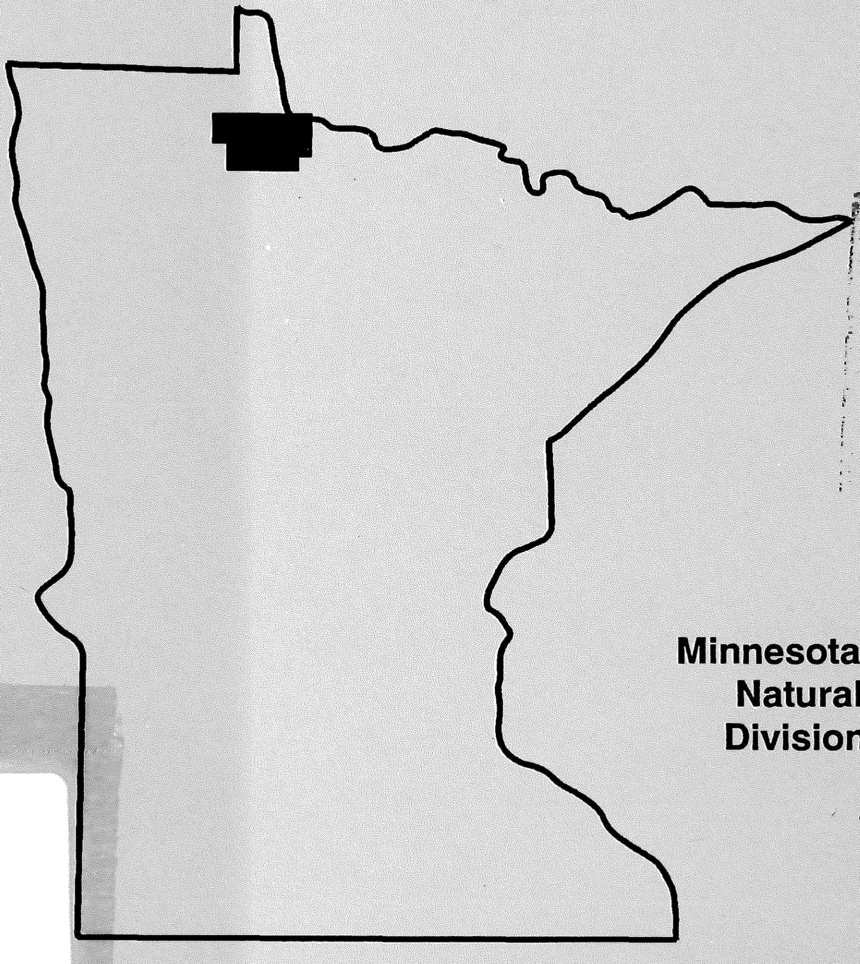
Report 280

Regional Survey of Buried Glacial Drift, Saprolite, and Precambrian Bedrock in Lake of the Woods County, Minnesota



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Regional Survey of Buried Glacial Drift, Saprolite, and Precambrian Bedrock in Lake of the Woods County, Minnesota

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A Minerals Diversification Project

1991

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Glossary

Attribute: Any physical or chemical property of a sample; especially refers to the quantitative measurements of sample fractions that are listed in the database.

Base of Quaternary Section: The contact, observed in drill core, between Quaternary glacial deposits and older materials. The older materials were commonly sound bedrock or saprolite, but in one case (OB-503) was Cretaceous marine marginal sands.

Dispersal Scale: "Dispersal can occur at a variety of scales ranging from **continental** (hundreds of kilometres), to **regional** (hundreds to tens of kilometres), to **local** (less than ten kilometres), to **small-scale** (final stages of mineral exploration in the hundreds to tens of metres) (Shilts 1984a). . . Other examples of major glacial dispersal patterns include those documented by (Coker & DiLabio, 1988, p. 337)

Dispersal Train: Debris excavated from a source unit by glacial movement is dispersed in a down-ice direction to produce a ribbon- or fan-shaped dispersal feature. Detectable dispersal trains in till have chemical, mineralogical, or other properties that stand out in contrast to nearby background levels. Shilts (1976) has demonstrated that the material being dispersed quickly becomes diluted to background levels, following essentially a negative exponential decay curve. The concentration of the dispersing material is highest near its source, declining rapidly (exponentially) in a down-ice direction. Gradients along the lateral edges of dispersal trains are often sharp, falling to background values much more quickly than in the down-ice direction. Tails of dispersal trains are typically much larger and more dilute than heads. It is often the tails that are first recognized during till sampling programs. Coker and DiLabio (1988) report that dispersal trains of debris related to mineralization (ore boulders, ore-related minerals, trace elements, and magnetic or radioactive components) may enhance the size of mineral exploration targets by several orders of magnitude (Fig. 1).

Geochemical Province: Bolviken and others (1990) describe geochemical provinces as regions (square kilometers to thousands of square kilometers) of abnormal spatial distribution of elements or combinations of elements. The use of regional geochemical surveys to resolve the distribution of chemical elements in relation to mineral deposits has been used successfully during recent exploration in Finland and other areas. A typical Archean gold geochemical province might be 75 square kilometers or larger in size. All nine existing ore deposits in Fennoscandia were found to lie within geochemical provinces (op. cit.). Since geochemical provinces can be identified earlier in an exploration program than metallogenic (metal mineralization) provinces, their importance in the early phases of exploration is becoming more often recognized (see also Averill, 1988).

Keewatin: Keewatin provenance glacial drift is named for the Keewatin sector of the late-Wisconsinan ice sheet, centered near Manitoba, Canada.

Labradorean: Labradorean provenance glacial drift is named for the Labradorean sector of the late-Wisconsinan ice sheet, centered near Labrador, Canada.

Mining camp: A cluster of gold deposits in the Superior province bedrock terrane of the Canadian Shield. This is described by Colvine and Stewart (1984), "Gold mineralization is not uniformly distributed along these zones, but is focused in individual mining camps up to tens of kilometers long and normally less than ten kilometers wide." Such a cluster of gold deposits, along with associated uneconomic occurrences, are proposed to provide sources of gold to the tills. The terms mining-camp scale or township-sized are used synonymously here to describe an area on the order of 100 square kilometers.

Pathfinder: In geochemical exploration, a relatively mobile element that occurs in close association with an element or commodity being sought, but can be more easily found because it forms a broader halo or can be detected more readily by analytical methods. A pathfinder serves to lead investigators to a deposit of a desired substance.

Till Composition: "The composition of a till sample may be the composite of many overlapping dispersal trains. The blending of trains derived from different up-ice sources produces the mixed lithology that is a normal feature of till. Most of the individual dispersal trains are not identifiable, however, because they are too small or are composed of rocks or minerals that are not distinctive." (Coker & DiLabio, 1988, p. 337)

Executive Summary

The Archean greenstone belts of northern Minnesota are a geologic setting that could contain world-class gold camps of >500 tonnes gold. In the Baudette area of northern Minnesota, where glacial overburden is often more than 30 m (100 ft) thick and composed of two or more glacial drift sequences, no surface sample media have yet been demonstrated to be effective for gold exploration. Buried tills are present in the area and could provide a prime sampling medium for detecting metal-bearing geochemical provinces[1], provided that the regional stratigraphic framework and regional-scale chemical-mineralogical background levels of the tills are established. The program goal is to establish such a framework and background levels in order to search for a township-size gold geochemical province.

In this project, we have used rotasonic overburden core drilling to collect twenty profiles of Baudette area glacial drift, saprolite, and bedrock; and have constructed a buried landscape model to explain and correlate the stratigraphic units found in the cores. We have also analyzed the buried tills in order to establish the regional background levels of gold grain content, heavy mineral mineralogy-chemistry, silt-clay chemistry, pebble lithology, matrix texture, and assorted physical properties. The glacial stratigraphy expertise of the Minnesota Geological Survey staff, and the bedrock and heavy mineral expertise of the United States Geological Survey staff have been of invaluable assistance.

The drilling results show that the Baudette area contains two distinctive landscapes. In the eastern portion, beneath the blanket of exotic Koochiching drift, a pervasive till sheet (Rainy till) exists in contact with saprolite or bedrock in most localities. An older Labradorean till[2] was found beneath the Rainy till in two paleo-topographic lows. Deep saprolite profiles exist in shear zones, and thinner saprolite sections are preserved on the protected flanks off bedrock topographic highs. Paleo-drainage is to the northeast toward a paleo-topographic low that contains an unlithified Cretaceous quartz-kaolin sedimentary deposit. The western portion of the Baudette area is generally more complex, containing older northwestern provenance (Keewatin) morainal sediments interbedded with the Labradorean drift. The till stratigraphy in the western portion is also complex, because the Labradorean tills begin to display some of the characteristics of the exotic Keewatin sediments they override. Paleo-drainage is to the west-northwest. Saprolite is less pervasive in the buried bedrock uplands in the western portion of the field area. Bedrock was recovered from eighteen of the twenty boreholes in the Baudette area. Metamorphosed mylonites, felsic-intermediate volcanics and intrusives, basalts and gabbros, graywackes, massive sulfide, and granitoids were recovered for use in U.S. Geological Survey CUSMAP mapping of the Roseau 1 x 2 degree map sheet.

Regional background levels for gold grains, pathfinder elements, and pathfinder mineral grains are very low compared to other areas of the state. Some of the regional background levels increase or decrease across the field area, reflecting addition of Keewatin sediments in the western portion of the Baudette area. Hg in the nonmagnetic heavy mineral fraction provides the highest contrast till provenance indicator, showing a ten-fold higher background level in Keewatin provenance sediments than in Labradorean provenance sediments. The source and mineralogy of the Hg in the Keewatin provenance sediments is not well understood. As, Ni, Sb, and Sr also show some provenance distinctions. K in the silt-clay fraction is partly able to discriminate Rainy till from older Labradorean tills. A plot of Hg versus K clearly resolves the three types of buried till, even to the point of being able to distinguish mixing of Keewatin sediments into overriding Labradorean tills in the western portion of the field area.

Low level enrichments of gold grains, galena, native copper, zinc spinel, scheelite, molybdenite, kyanite, and Au, Ag, Hg, Zn, W, Cu, Pb, Ba, Ce, Cs, Bi, Th, and Ni are present in the tills. Low level enrichments of gold grains, gold assays, and five pathfinder elements-minerals are observed in the Rainy till in the eastern portion of the field area, in the vicinity of the Baudette fault system (boreholes 502, 503, and 506) and nearby magnetic felsic intrusions. Other notes include low levels of gold and zinc spinel in the basal till sample of borehole 517, galena in the saprolite of boreholes 508 and 520, kyanite and bedrock massive sulfide in borehole 513, and a kaolin-quartz sand unit in borehole 503. The galena appears to have been

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[1] See glossary.

[2] See glossary.

associated with vein settings. The kyanite may represent an unusual or extreme bedrock alteration. The barren massive sulfide in the bedrock of borehole 513 is predominantly pyrrhotite. The kaolin-quartz sand unit (Cretaceous age) leads to speculative hypotheses about where the winnowed kaolin might have been deposited (see Mineral Potential Section).

A sufficient understanding of the regional stratigraphic framework and regional chemical-mineralogical background levels now exists to efficiently test the Baudette area for gold mining-camp-scale geochemical provinces. Follow up work should use rotasonic coring to test selected townships of the Baudette area to a sampling density of 25 sq. km (four samples per township). Gold grains, heavy minerals, and heavy mineral assays for gold and other pathfinder elements will provide the best indicators of buried mining-camp-scale mineralization. The heavy minerals provide unique tracers that can probably be followed across incomplete glacial stratigraphic sections. Silt-clay chemistry, texture, pebbles, and physical properties can provide additional in-depth information to solve local stratigraphic problems that arise.

Recommendations

Recommendations are directed at users of the data or methods and at future Minerals Division programs (Tables 1a and 1b).

To potential users of the data or methods, there is considerable information available at the Hibbing office regarding the geochemical database, samples, and customized design options. The complete dataset is available in an ASCII format on 3 1/2" or 5 1/4" disks. Core samples, heavy mineral fractions, or assay subsamples are available for observation, education, or assay purposes. The authors are available to discuss the many possible design options and methodology to use till samples at your choice of cost/risk analysis and applied to your target area(s) and scale.

Regarding future programs, the two categories of general program direction and specific methods are discussed. Regarding direction, infill drilling to complete the project goal in the Effie area is recommended over the Lake of the Woods area, due to a perceived higher gold potential there. Since nine case examples of ore deposits occurring within geochemical provinces have been cited by Bolviken and others (1991), the program goal for deep overburden regions in Minnesota should remain the search for such geochemical provinces (Fig. 2). Background values must be identified to define the contrast of a geochemical province, and appropriate sample density is also required. Thus, infill drilling is a necessity to fulfill the goal. The Effie infill drilling can be delimited by the new Koochibel MGS bedrock map showing the supracrustal rocks, appropriate ore deposit models and geological features, and the previous Effie area results (Martin and others, 1988).

Regarding specific methods, only the three most important are discussed. First, the drilling method should not grind up clasts to create a modified matrix composition and, hence, an artificial background value. Secondly, less expensive overburden core drilling methods should continue to be tested. Since development seems to be happening at levels from the individual driller to manufacturing suppliers on such drill methods and equipment, an organized focus group should be considered. Thirdly, advanced mineral and chemical analysis methods need to be tested, for example, on mid-density heavy minerals and for very fine-grained gold. The mid-density heavy mineral fractions are available as a by-product from the ODM Lab separation method, and perhaps contain cheap, useful tracers as ore minerals or pathfinders. The background value for gold in the fine fraction of till has not worked well for application to a geochemical province for two reasons--the nugget effect and an inadequate detection limit. Research in Finland (Kontas, 1991) permits a new hypothesis and subsequent methodology to resolve this problem. Gold grains are abraded by quartz grains during glacial erosion, transport, deposition, and sample screening resulting in a very large population of quartz grains having an "abraded or atomic" gold coating (op. cit.). Such gold is readily extractable by a partial leach (Heikki Niskanen, pers. communication) that excludes gold grains or nuggets. Such a method should be tested to identify a gold geochemical province.

Acknowledgements

Numerous individuals have contributed their talents during the course of this project. The management structure at DNR has contributed considerably by allowing the authors to approach the project with much flexibility and freedom. This has been of substantial help.

Doug Rosneau, Alan Dzuck, Mike Ellett, Darold Riihiluoma, Mike Lubotina, and Pat Geiselman handled and archived a proverbial mountain of core samples and subcomponent splits. Pat Geiselman, in particular, contributed many energetic and diligent hours during the drilling, sampling, and shipping phases of the project. Earl Mailhot, Greg Walsh, Pat Geiselman, Darold Riihiluoma, and Joe Fink contributed their drafting services. Rick Ruhanen and Jacki Jiran competently addressed the thankless but essential task of keeping our computer resources up and running.

Jean Drotts and Al Klaysmat of the DNR, Tim Elliot of Bondar-Clegg, and Remy Humealt of Overburden Drilling Management managed to wade through the barrage of samples sent their way. Gene Miller and Karl Keihn provided opinions on land ownership, and Gene Karel, Agnes Bates, and Phil Pippo expedited much of the contract and administrative work. Diane Melchert, Coleen Keppel, Sue Saban, Helen Koslucher, and Dorothy Cencich contributed word-processing and data entry skills.

Steve Sutley, Paul Theobald, and Dick Tripp of the U.S. Geological Survey in Denver provided indispensable instruction and guidance on heavy mineral processing and identification. Terry Klein, also of the U.S. Geological Survey, in Reston, Virginia, provided valuable observations of the petrography of the bedrock core.

Ken Harris, Howard Mooers, and Val Chandler of the Minnesota Geological Survey, and Barry Frey, Tom Lawler, and J.D. Lehr of the DNR all contributed to discussions of the buried rocks in Lake of the Woods County. Finally, comments made by three reviewers improved the initial manuscript significantly.

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Introduction

Background

This survey of part of Lake of the Woods County (the Baudette area) in northern Minnesota represents a westward expansion of the deep-overburden characterization (glacial till sampling) program begun by the Department of Natural Resources in 1985. The goals of the program are to detect regional-scale anomalies of gold and other metals in the glacial overburden, and to develop the stratigraphic framework for understanding those anomalies. The Baudette area, near Lake of the Woods on the Canadian border, is covered by deep glacial overburden (>100 feet), and is underlain by an attractive, but relatively unexplored, gold terrane made up of structurally-deformed, volcanic-associated rocks of the Wabigoon granite-greenstone belt. The deep overburden hides the bedrock and hinders mineral potential evaluation of state lands.

Problem Statement

The granite-greenstone terrane in the Baudette area is concealed by deep, unmapped overburden which masks the Precambrian bedrock and hinders assessment for areas of bedrock mineralization.

Significance of the Problem

The State of Minnesota is in global competition to attract the private assets used to explore for, identify, and develop mineral resources. Overburden is considered a hindrance to exploration and resource assessment by most exploration companies. The State, through legislative action, is making a commitment to help Minnesota's mineral economy diversify and compete on this worldwide basis. Overburden investigations are a part of this work. The legislature is encouraging regional-scale investigations to delineate the geologic framework and mineral potential of the state, and is sponsoring characterization studies of industrial mineral commodities, and encouraging cooperative and supporting research to enhance the value of Minnesota iron ore products. The geologic framework investigations sponsored by the state are designed to detect mining-camp-scale[3] areas for exploration investment and to delineate geologic features amenable to mineralization. The deep-overburden program provides a means for detecting areas within the state that contain regionally anomalous concentrations of gold or other metals.

While it is true that the overburden in Minnesota hides the granite-greenstone terrane and does hinder traditional drilling exploration programs, it can also provide an exploration media for detecting and tracing buried mineralized bedrock, if it is properly utilized. In many instances, the glacial overburden that hides the bedrock terrane also preserves mineralized rock fragments that have been excavated and redeposited by glacial activity. The excavated fragments, or "dispersal trains"[4], can exist as property features (less than ten square kilometers), township features (up to a hundred square kilometers), regional features (up to hundreds or thousands of square kilometers), or even continental features (tens or hundreds of thousands of square kilometers). Dispersal trains are generally much larger than the bedrock source they are dispersed from, and can leave chemical, mineral, textural, electromagnetic, or radiometric signatures in the overburden. If elevated background levels associated with a mining-camp can be detected, then the overburden becomes an effective tool for reconnaissance evaluation of mineral potential.

The Department of Natural Resources pursues this work of sorting out favorable from unfavorable mineral lands because it is charged with managing "for the benefit and pleasure of present and future generations" the public acreage which includes extensive, potentially mineral-rich lands in the northern part of the state. Fifty-nine percent of the land surface in Lake of the Woods County is publicly owned, and the State holds in public trust 438,600 acres (1983 data). Governmental activities in Canada and Minnesota, and the new tectonic model for the origin of Canadian shield crust segments (Percival and Williams, 1989; Williams, 1990; Davis and others, 1989) indicate that the mineral potential of the Wabigoon belt in Lake of the Woods County might be worth a closer look.

Project Scope and Progress

The objectives of the Baudette area project are to establish the regional-scale stratigraphic framework and chemical-mineralogical background

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[3] See glossary.

[4] See glossary.

levels of the glacial overburden in the twenty-one townships that encompasses most of the Wabigoon belt within Lake of the Woods County. The steps that must be taken to accomplish these objectives are:

1. Obtain representative samples of glacial overburden, saprolite, and solid bedrock from the subsurface of the Baudette area. (Objective completed November, 1989.)
2. Describe, measure, and log stratigraphic units within the glacial overburden and saprolite cores. (Objective completed January, 1990.)
3. Establish a regional-scale stratigraphy for the glacial overburden in the Baudette area, based on the cored materials. (Objective completed February, 1991.)
4. Identify chemical, mineralogical, textural, and physical properties of the glacial overburden, saprolite, and bedrock that may have use in resolving the framework stratigraphy and bedrock mineralization potential of the Baudette area. (Objective completed April, 1991.)
5. Summarize any anomalous values that have been detected to this point. (Objective completed April, 1991.)
6. Disseminate this information. (Objective completed June, 1991.)

Completion of the project should provide the information needed to conduct infill drilling.

Location, Geological Setting, and Exploration History

Location

The Baudette area encompasses 21 townships (2100 sq. km) west and south of Baudette in the southern half of Lake of the Woods County (Map 1). Highway 71, running south from Baudette, forms the eastern edge of the field area. Major drainages flow to the northeast, parallel to raised-beach strandlines of former glacial Lake Agassiz or along the periphery of the buried Vermilion Moraine (otherwise known as Beltrami Island). These drainage systems join with the Rainy River at the northeastern edge of the field area. Roseau flowage, on the western edge of the field area, is an exception, and flows northwesterly to join the Red River of the North.

Vegetative cover and land utilization reflect the permeability and topography of features reworked by glacial Lake Agassiz (Map 2). Lowlands are occupied by poorly-drained organic peatlands and black spruce forests. The sandy, narrow, laterally continuous raised-beaches contain upland conifers and deciduous varieties like aspen and birch. Better-drained surfaces in the northern part of the field area are utilized for large-scale agricultural activities. There are four peatlands of ecologic significance that occur within the Baudette field area. Drilling access in the summertime is limited by poor drainage and the sparse road network, which is confined mostly to the better-drained lands.

Geological Setting

A few gross aspects of subsurface geology are reflected in surficial landforms, but little is directly known of the composition and history of the sediments and bedrock buried beneath the most recent of the glacial deposits. A partial framework can be sketched based on data from the surrounding region. The Baudette area is thought to primarily contain Pleistocene drift and Precambrian (Archean) basement rocks. Marine and marine marginal strata of Mesozoic and Paleozoic age have been identified west and northwest of the field area but have not been detected in the Baudette area. Four glacial sequences have been identified in the region. Beneath the glacial drift are volcanics, sediments, and igneous intrusions that record at least one episode of regional metamorphism and shearing during the Precambrian. The unconformity between the Precambrian and Pleistocene units is known to have undergone significant weathering at one or more times since the early Proterozoic. Figure 3 summarizes the known events that may have helped to concentrate or redistribute gold and other metals in the Baudette area.

The Baudette area is underlain by a portion of the Wabigoon subprovince of the Superior province. The Quetico metasedimentary subprovince is present at the southern edge of the field area, on the south side of the Vermilion fault. Bedrock is not exposed anywhere in the Baudette area.

Day and Klein (1990) and Frey and Venzke (1991) describe the structural-stratigraphic fabric of the Baudette area as northeast-southwest. Major fault systems include the Vermilion, Quetico, Baudette, Border, and Fourtown.

Where exposed in other areas, the Wabigoon belt is a typical granite-greenstone terrane made up of variably deformed and metamorphosed volcanic and sedimentary supracrustals intruded by mafic to felsic intrusions (Frey and Venzke, 1991). Mafic to felsic cycles of bimodal volcanism and associated volcanogenic massive sulfide deposits have been recognized in other portions of the Wabigoon belt (op. cit.). Metamorphism is generally upper greenschist to lower amphibolite facies (op. cit.).

The subsurface portion of the Baudette area is penetrated by thirty recorded water wells, by eleven scattered scientific drill holes, by twenty deep overburden boreholes (present project) and forty-three bedrock drill holes drilled in search of base metals along a laterally extensive conductor, for gold near zones of regional structural shear, and for gold perhaps associated with chemical sediments. Each of the trends follows aeromagnetic anomalies identified in the 1960's. Maps 3, 4 and 5a-d summarize available geologic information for the area.

Exploration History

More geological information has become available about the character of the Wabigoon greenstone belt underlying Lake of the Woods County in the past four years than in perhaps the previous twenty. The United States Geological Survey (USGS), the Minnesota Geological Survey (MGS), the Minnesota Department of Natural Resources (MnDNR), and the United States Soil Conservation Service (SCS) have all been active in the area recently, and just across the border the Ontario Geological Survey (OGS) has been conducting regional-scale geologic mapping and geochemical sampling programs. Eight exploration leases are currently held in Lake of the Woods County, four within the Baudette area. Figure 3 provides a synopsis of available geologic coverage.

Historical records indicate that Precambrian bedrock exposed along the Rainy River and the shores of Lake of the Woods received early reconnaissance attention for gold (Winchel, 1899) and for uranium (Grout, 1927). Significant quantities of neither were located. In the early 1950's, the area around and east of Baudette was reviewed for potential wildcat iron ore occurrences. Exploration drilling along aeromagnetic anomalies reached as far as western Koochiching County (just east of the Baudette area), tracing an iron formation striking southwesterly out of Emo, Ontario, but no holes were spud in Lake of the Woods County. In the 1960's, aerogeophysical surveys were being used to detect base metal occurrences in Canada and the U.S., but it was 1969 before the first exploration drill hole was put down on a geophysical anomaly in the Baudette area. Between 1969 and 1986, three geophysical exploration plays served to generate a total of forty-three exploration drill holes that in places penetrated pyrrhotite, graphite, and iron formation, but identified no subeconomic or economic deposits of base or precious metals. Governmental work up through 1986 produced low resolution aeromagnetic, gravity, and interpretive bedrock maps (Meuschke and others, 1957; McGinnis and others, 1973; Sims and Ojakangas, 1973) and geologic maps of surface-subsurface features in Lake of the Woods and Koochiching counties (Helgesen and others, 1975; Ojakangas and others, 1977; Eng, 1979; Eng, unpublished maps; Meyer, unpublished maps).

Recent activities (since 1986) in the Baudette area have been primarily by governmental agencies. The U.S. Geological Survey is completing a substantial reconnaissance project over a larger region that includes the Baudette area, under the Conterminous United States Mineral Resource Assessment Program (CUSMAP). Aeromagnetic surveying and scientific drilling form the basis for this work (Braken & Godson, 1988; Klein and Day, 1989; Bracken and others, 1991). The USGS has also completed a reconnaissance-level geochemical survey of B-horizon soils survey in parts of Lake of the Woods and Koochiching counties (Clark and others, 1990). The B-horizon soil survey detected patterns indicative of quartz/chlorite/carbonate shear zones were detected south of Baudette.

The Minnesota Geological Survey has completed a scientific drilling program (Mills and others, 1987) placing eleven bedrock control points in the Baudette area and giving some indication of overburden composition. The scientific drilling in Lake of the Woods County was conducted to support CUSMAP efforts by the USGS. Horton and Chandler (1988) have recently assembled an update for the gravity data of McGinnis and others (1973).

The Minnesota Department of Natural Resources is completing two projects, in addition to this survey, that are directed at better resolving the metallic mineral potential of the Precambrian bedrock in the Baudette area (Frey and Venzke, 1991; Lawler and Venzke, 1991). Results from two previous overburden characterization surveys are also available for comparing and evaluating Baudette area results. These reports cover the Effie and Orr-Littlefork areas located east and south of the Baudette area (Martin and others, 1988; Martin and others, 1989).

In other developments, the Ontario Geological Survey recently completed a mapping and sampling program of overburden overlying a portion of the Wabigoon belt just across the Rainy River to the north and east of the Baudette area (Bajc and others, 1990). Four private mineral exploration developments are in progress as a result of that work. Subsurface glacial drift investigations have also been completed in southeastern Manitoba (Teller and Fenton, 1980). Meanwhile, the United States Soil Conservation Service is currently working on soil survey maps for Lake of the Woods County. Unpublished maps are available from the Soil Conservation Service[5]. Finally, eight exploration leases are currently held in Lake of the Woods County, four within the Baudette field area.

Project Design and Methods

Nine factors influence the design and outcome of a deep-overburden survey: drilling pattern, borehole density, drilling method, constraints on the placement of drill sites, sampling strategy, subsampling strategy, analytical methods, strategy for data handling (Table 3), and interpretive approach.

Drilling patterns are generally designed as grid-based or feature-based arrangements. Grid-based patterns are used to provide unbiased, model unspecific information about subsurface geology. Grid patterns work well to eliminate bias, but tend to waste important organizational resources because most of the critical geology in an area occupies 10% or less of the field area. Feature-based drilling, on the other hand, can provide a wealth of information about specific geologic features. Feature-based patterns work well for elucidating the geology of features already detected or hypothesized, but they do a poor job of resolving geologic features that are undetected or unhypothesized in an area. Feature-based drilling patterns to a large extent eliminate the opportunity for chance discovery. Chance discovery, or serendipity, is too often discounted during the design phase of projects, the end result being that project work serves merely to retrench existing ideas rather than shed light on very imperfectly resolved subsurface geology.

Since Baudette area overburden is largely unknown, and the underlying bedrock geology is very poorly constrained, a grid base is needed to ensure regional, relatively unbiased coverage, and to provide maximum opportunity for the chance discovery of geologic features not encompassed by current models or ideas. However, in order to best optimize the overall return of geologic information from each drill hole, some component of feature-based drilling also needs to be incorporated in the design so that a few of the geophysically detected, untested bedrock features present in the area can be evaluated.

The Baudette area drilling pattern is based on a grid of township-sized cells in which individual drill holes are constrained within cell boundaries, but are sited to test geophysically detected bedrock features. This ensures that the regional-scale overburden survey design is retained, and that a significant number of high quality bedrock control points can be placed to assist bedrock mapping projects being conducted in the area. Drill sites 501, 502, 505, 514, 515, 518, 519 and 520 were placed to test geophysical bedrock features outlined by CUSMAP efforts.

Borehole density in the Baudette area, like that of preceding deep-overburden survey projects in Minnesota, is designed as four boreholes per township (one borehole per 25 square kilometers), dense enough to detect and confirm the presence or absence of Archean gold geochemical province sized anomalies. The drilling density in the present project, which is reconnaissance work for the actual survey, is one borehole per 100 square kilometers, dense enough to establish the regional-scale stratigraphic framework and background levels in the area and dense enough to identify prospective till sheets, but not dense enough to determine the presence or absence of township-sized gold (or other metal) anomalies.

The rotasonic coring technique was selected for its ability to penetrate boulders and solid bedrock, to deliver large diameter undisturbed core of unlithified sediments, and to deliver uncontaminated samples of till, saprolite, and other overburden materials. These advantages increase the quality of the sampled materials and lend a

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[5] P.O. Box 217, Baudette, MN 56623

greater degree of confidence to the results.

Geological and non-geological criteria constrain the placement of borehole sites. Geological criteria were: drill sites should be located "down ice" from known and inferred zones of structural deformation or geologic contact so that "down ice" dispersals from these occurrences can be intersected, but drill sites should not be located where depth to sound bedrock exceeds 300 feet as indicated by available drill hole and geophysical data (300 feet is the practical depth limit for the rotasonic technique). If possible, sites should be located to support existing bedrock mapping projects. Drill sites should be located to maximize the likelyhood that till units will be encountered, avoiding, if possible, terminal moraines, eskers, and major fluvial/glacio-fluvial deposits. Non-geological constraints that influenced drill site placement were: first, a limit of one continuous core rotasonic drill hole per township with location restricted to land parcels containing state-owned surface and mineral rights. Drilling sites need summer access and, if possible, a minimum of trail/site preparation. Logging trail margins, log landings, and natural clearings were preferred drilling sites. For safety reasons, drill sites should not be placed within 100 feet of road right-of-ways, power lines, buried cables, and pipelines. Drilling sites should also be located outside the exclusion areas of designated peatlands. Finally, drill sites should be located in context of any applicable exploratory boring regulations and with approvals of local wildlife managers.

Detailed descriptions of the cored materials were used to select intervals of till and saprolite for analysis. Since the rotasonic technique yields large diameter core (3.7 inches), a high-precision sampling strategy can be employed. Ten kilogram samples can be collected from intervals as short as five feet, still leaving enough core intact for future stratigraphic reference. Ten foot samples are ideal. Appendix 280-C lists details of the procedures used to sample Baudette area core. The sub-sampling strategy for Baudette area core samples was to start with the analysis of the most direct indicators of gold mineralization (gold grain counts and gold assays) and work progressively toward more indirect mineralization indicators as time permitted. Subsampled fractions include gold grains, heavy mineral concentrates (mineralogy of the nonmagnetic sub-fraction and chemistry of magnetic and non-magnetic sub-fractions), silt-clay matrix (chemistry), pebbles (lithology), matrix texture (sand, silt, and clay), then physical properties (magnetic susceptibility, bulk density, pH, etc.) (Fig. 4).

The measurements on Baudette area cores help to elucidate either the regional background levels of mineralization pathfinders or the provenance attributes of glacial stratigraphic units. Appendix 280-C lists the chemical, mineral, textural, and physical properties made on the core samples.

The strategy for evaluating the approximately two-hundred chemical, mineralogical and other properties in the data set (Table 3) is to plot all of the attributes showing precision better than 15%, and display the data by location and depth, keyed to preliminary stratigraphic assignments. The data are evaluated for regional-baseline changes either within stratigraphic units or independent of stratigraphic units, and are checked for data spikes (anomalies). The surviving attributes are then used to re-evaluate stratigraphic assignments and make preliminary statements about regional glacial stratigraphy and background levels of measured attributes.

Baudette Area Survey Results

Project work took place during the period July 1, 1989 to June 30, 1991. Appropriations totaled $196,000, including $134,000 for drill coring and sample collection, $32,000 for sample preparation and analysis, and $30,000 for field crew expense, data analysis, report preparation, technique development, and information dissemination. Drilling sites were selected and checked in the summer of 1989. Coring work commenced in the fall of 1989 and was completed before first snowfall. Detailed logging and sampling of core was completed by spring of 1990, and data collection-compilation-analysis were wrapped up by spring of 1991. The data synthesis and report writing portions of the project were completed by early summer, 1991.

Twenty of the twenty-one sites selected for continuous coring were drilled during the fall of 1989. The remaining, lowest priority drill site, which sits atop the Quetico metasedimentary Subprovince (drill site 504), was eliminated from the drilling schedule after total budgeted drilling footage was reached at the twentieth drill site. Drilled depths ranged from 61 feet to 329 feet. Each of the drill holes penetrated the entire glacial overburden package, which ranged from 54 to 299 feet thick. Seventeen drill holes penetrated far enough to recover solid bedrock. Overall, core recovery was

92%.

Drilling operations intersected glacial till, layers of sand and gravel, silt-clay lacustrine sediments, saprolite, and solid bedrock. Bedrock lithologies recovered include metamorphosed Precambrian volcanic, sedimentary, and intrusive units. Silt-clay beds were frequently encountered between till units in the eastern portion of the field area, but sand and gravel were the dominant inter-till units in the western portion of the field area. Paleozoic strata (dolomite-limestone-chert bedrock) were not intersected in any of the 20 boreholes, but an unpredicted Cretaceous sedimentary unit was penetrated in a paleo-topographic low in the northeastern corner of the field area. Saprolite was encountered in 14 boreholes. Eleven of the saprolite profiles were more than ten feet thick.

4,247 feet of continuous core were drilled, broken to four-foot lengths, boxed, numbered, and loaded for transport, logging, and sampling as a result of the drilling operations. At the drill core library facilities in Hibbing, Mn, cores were measured, described, sampled, and archived for future reference. Appendix 280-A summarizes drill site locations, elevations, drift thickness, saprolite thickness, number of feet of solid bedrock drilled, total depth drilled, and overall recovery percentage. Appendix 280-A also summarizes the number of till, non-till, and solid bedrock samples taken from each drill core. Descriptions of core (and other measured parameters discussed later) are collected in Appendix 280-B.

Stratigraphy and Buried Landscape

In overview, there are four different glacial units named here, with the name only implying relative age and continental-scale provenance. Map 6 summarizes the distribution of glacial drift and weathered bedrock encountered in the Baudette area, and Map 5a shows the elevation of sound bedrock and basal Quaternary contacts. Summary maps of the four glacial stratigraphic packages are shown in Maps 7 through 10. Starting from the surface or youngest, the late-Wisconsinan Koochiching lobe deposits overlie the Rainy lobe deposits. Beneath them are the pre-late Wisconsinan (older) deposits of the Winnipeg lobe and the Old Rainy lobe. The pair of Koochiching lobe and Rainy lobe ice advances were both associated with the late Wisconsinan Laurentide ice sheet. The older tills have many similarities to this pair of younger tills; hence, the inference of repetitions of such pairing for the older till strata. However, no means of correlating such older till pairs was found. Note the preservation of six older tills identified by descriptive logging (Fig. 5). The six older tills are not present in any single borehole, but evidence from outside the area supports such multiple older events. In this regional survey, the older till samples of Keewatin provenance are hereafter classified as Winnipeg lobe tills--not Upper, Middle, or Lower Winnipeg--since so few samples of each exist. The same is true for Old Rainy lobe till samples.

A description of each unit and observations on variability are presented in the following sections. The variability is affected by the pre-glacial landscape and the spatial distribution of each subsequent glacial unit.

At least three factors of the pre-glacial landscape; the topography, saprolite thickness and composition, and bedrock lithology are major controls on subsequent till compositions. These factors make up the buried landscape, which can be reconstructed at a regional scale, primarily from the elevation data of preserved pre-glacial materials (Fig. 9 and Map 5a and 7-11). Summarizing the pre-glacial topography, the sound bedrock surface has a regional slope down of >100 feet from the central portion towards Baudette in the northeast. Diagonally crossing this and apparently following a major bedrock structure is a regional bedrock high that appears to be the major control upon glacial drift processes. The regional surface topography does not directly mimic the bedrock topography here. Moving up the stratigraphic column, saprolite appears to be regionally preserved off the bedrock topographic highs (>100 ft. drift) and where protected from the subsequent erosive Labradorean ice advances. Continuing up the column, the total glacial drift thickness is similar east to west, but the stratigraphy is not (Fig. 5). The late-Wisconsin events dominate the column in the eastern portion, whereas, both late-Wisconsin and older events are preserved in the western portion. This has a significant effect upon the till matrix compositions, discussed later. The other two factors regarding saprolite and bedrock are also described in later sections and presented on maps (Maps 6 & 5a).

Koochiching Lobe Deposits

Both inside and outside the Baudette area, where Koochiching drift makes up the surficial deposits in all or part of Koochiching, Lake of the

Woods, Beltrami and Itasca counties, it displays some common characteristics. The clasts and matrix are rich in Paleozoic limestone, dolostone, chert, and Cretaceous Pierre shale, clearly of a southeastern Manitoba-northwestern North Dakota provenance. The matrix becomes progressively more silty and clayey to the east, as the till overrode its own proglacial lake sediment. Glacial striae and clast fabric orientations measured at nearby Pinewood, Ontario, yield a flow direction of nearly due east.

The surficial deposits of glacial drift in the Baudette area are all made up of Koochiching lobe drift (Map 3, Surficial Geology) and Fig. 5; see also Martin and others, 1988). These deposits are described in terms of distribution, flow path direction, physical character, internal stratigraphic features, and variation in till composition across the region. The Koochiching tills have been described elsewhere as poor sample media for geochemical prospecting (Martin and others, 1988). Because of that and since these deposits are vertically farthest removed from bedrock, very few Koochiching till samples were analyzed.

The Koochiching tills were found in 19 of 20 boreholes, and the till thickness ranged from 11 to 102 feet. The deposits contain up to three separate till beds. The eastern portion of the area has consistently thicker Koochiching deposits, 76 to 166 ft.

The Koochiching lobe deposits have a complex internal stratigraphy. Evidence for three distinct phases of the Koochiching lobe are present across the northern portion of the study area. The first two phases correlate with two Koochiching tills separated by lake sediment noted to the east (Martin and others, 1988) and southeast (Martin and others, 1989). The upper till across northern Lake of the Woods County was laid down by the last readvance of the Koochiching lobe which apparently did not extend much further east. All three phases of the lobe were fronted by a large glacial lake during both advance and retreat across the county. Sediment deposited in the lake here is generally coarser than to the east where clay dominates the lacustrine sections. Likewise, subglacial Koochiching till where composed largely of reworked lake sediment in the Lake of the Woods area is rich in silt and fine sand, as opposed to the very clayey tills found to the east in Koochiching County.

Incorporation of underlying till and lake sediment accounts for the large textural variation of the Koochiching tills, particularly the till of the first phase, which plucked up both lake clay and sandy till of the Rainy lobe. Extensive incorporation of Rainy lobe sediment by the first advance of the Koochiching lobe is thought to account for the general lack of Cretaceous shale indicator clasts and the lower carbonate content of the lower Koochiching till, which was also noted in the Effie area (Martin and others, 1989, p. 22). Common to abundant shale clasts in till of the second Koochiching advance indicate a significant change in flow direction from the first; while reduced shale and more abundant carbonate in the uppermost till indicate a shift back to a more north-of-west source for the final advance of the Koochiching lobe. The upper Koochiching till probably correlates with the Falconer Formation of northwestern Minnesota (Harris and others, 1974), and the Whitemouth Lake Formation of southeastern Manitoba (Teller and Fenton, 1980). The lower two tills of the Koochiching lobe probably correlate with the upper and lower Red Lake Falls Formation (Minnesota) and the Roseau Formation (Manitoba), and the Rainy lobe till correlates with the Marcoux (Minnesota) and the Senkiw and Whiteshell formations (Manitoba). The first and third Koochiching lobe advances across Lake of the Woods County probably flowed about sixty to seventy degrees east of south (with reference to the bedrock of southeastern Manitoba; McRitchie, 1980); whereas, the second advance flowed almost due east. The increasing percentage of quartz and pisoliths in the very coarse sand fraction from the upper to lower Koochiching tills indicates progressively more local rock (Precambrian versus Paleozoic) down section, which in turn indicates progressively more incorporation of Rainy lobe sediment. In fact, the bulk of Precambrian clasts within Koochiching till in the study area was probably derived from Rainy lobe sediment. Thus, although usually not the till immediately above bedrock, the lower Koochiching till, particularly in areas of thin Rainy till over bedrock, should still be considered for prospecting purposes.

Rainy lobe Deposits

Rainy lobe deposits are very different from those of the Koochiching lobe in terms of distribution, flow path direction, physical character, variation in till composition across the region, and bedded sediment features. The Rainy lobe tills have been described elsewhere as good sample media for geochemical prospecting (Martin and others, 1988), and also appear to be in the eastern portion of the Baudette area.

Rainy drift was found in 18 of the 20 boreholes, but its till is commonly thin, 3 to 42 feet thick, averaging 17 ft. (Map 8 isopach). Thick sequences of Rainy drift are associated with the inferred, buried Vermilion moraine that crosses this region (Fig. 7), and associated proglacial lake deposits. The lack of Rainy till in OB-512 and 516 appears to be related to the regional bedrock high.

Glacial striae north and east of the study area (Bajc and Gray, 1987; Fig. 7) indicate a south-southwesterly (roughly 210° near Pinewood, Ontario, op. cit.) flow path for the late Wisconsinan Rainy lobe. Variations in striae direction from almost due south to seventy degrees west of south may be due to local variations in the sub-ice topography, or possibly they represent different phases in the ice advance. The flow path of the Rainy lobe may have been nearly due south as the ice stood at the Vermilion moraine, for example, across central Lake of the Woods County (Fig. 7); whereas earlier, the flowpath would have been more southwesterly across the southern part of the county. Not only does the underlying bedrock topography control the path of flow, it also helps to determine transport distance of entrained debris (Clark, 1987). In general, subglacial transport carries sediment toward topographic lows, and transport distances through valleys or bedrock lows are longer than across intervening highs. Flowpaths of earlier advances of the Rainy lobe can be expected to have been similarly altered by the bedrock high in central Lake of the Woods County.

The physical character of the Rainy lobe drift is dominated by an abundant assemblage of Precambrian rock clasts incorporated during the lobes advance across the Canadian Shield. Rainy lobe till is gray to greenish gray in its typically unoxidized state. The matrix is usually a sandy loam with very low carbonate content and low total matrix solubility (Appendix J). The matrix heavy minerals commonly contain pyrite. The magnetic susceptibility seems generally higher for Rainy tills than others, probably reflecting the higher content of unweathered magnetic pebbles. The true or proto-till character is difficult to assign, due to variability discussed below.

The variation in Rainy till composition displays regional, local?>, and property-scale trends due to at least the two factors of underlying material character (see Figs. 8 & 6) and bedrock topography. The regional trend is best displayed by increased carbonate content in the western portion, where the Rainy lobe advanced over Winnipeg lobe deposits. The local scale variation is best displayed by the increased sound Precambrian bedrock content over a local bedrock high (OB-509) or conversely increased saprolite content over a local bedrock low (OB-506). The property-scale variation is the most common type, often occurring at the bottom of the till, nearest underlying material, as in OB-501. The most significant variation is the regional change that affects both the Rainy till clasts and matrix composition.

The Rainy lobe bedded sediment contains two widespread features--a marker zone of brown clay and thick sequences related to the Vermilion moraine. A marker zone of brown to reddish-brown clay laminae, noted in previous drilling across southern Koochiching County and into St. Louis County (Martin and others, 1988, 1989), was encountered in holes OB-501, OB-502, OB-505, and OB-506 in the eastern part of the study area. Reddish-brown clay incorporated in basal Koochiching lobe till in hole OB-509 was derived from this marker bed. These occurrences further extend the known boundaries of the proglacial lake that fronted the Rainy lobe during its standstill at the Vermilion moraine (Fig. 7). The reddish clay originated either from a large glacial lake dammed by the Superior lobe south of the Mesabi Range, or from meltwater issuing from ice at the Highland moraine in Lake County (Hobbs and Goebel, 1982). Interbedded calcareous sediments indicate greater proximity to the Koochiching lobe in the Lake of the Woods end of the lake. Thick sequences of bedded sediment present in holes OB-508, OB-515, OB-518, and OB-519 were laid down as the Rainy lobe retreated to the position of the Vermilion moraine. The Rainy till bed within lake sediment in hole OB-508 represents a local readvance of the Rainy, and it may correlate with a similar sequence found in southwestern Koochiching County (Martin and others, 1989, p. 22).

The surface expression--and possibly the deposits--of the Vermilion moraine was obliterated by the Koochiching lobe and its proglacial lakes across Lake of the Woods and northwestern Koochiching counties. However, the position of the moraine across this area can be approximated (Fig. 7) by reference to the trend of the moraine in St. Louis County and the trend of strings of Rainy lobe kames at the surface across northern Koochiching

(Horton and others, 1989) and eastern Roseau counties, southwestern Ontario (Bajc and Gray, 1987), and southeastern Manitoba (Nielsen and others, 1981). The north thirty degrees west trend of the moraine appears to continue from the point of burial west of Orr to central Lake of the Woods County, where it is thought to bend to the west, and then in Roseau County back to the north. The bend in Lake of the Woods County is believed analogous to that noted in the Effie moraine (Martin and others, 1989, p. 23), which was caused by a bedrock high in the Deer Lake area. A similar bedrock high (Map 5a) is present in Lake of the Woods County. During retreat of the Rainy lobe, the ice over the bedrock high would have been thinner and thus melted back faster. Any readvances would also be obstructed by the bedrock high. The Effie moraine may coalesce with the Vermilion in western Lake of the Woods County, forming the western end of the lake bounded by the two moraines.

To summarize, the Rainy lobe tills appear to have a major component of sound Precambrian bedrock, which is modified by regional ± local ± property - scale components. In general, the chemistry data strongly supports this observation (Fig. 8).

Winnipeg Lobe Deposits

Winnipeg lobe deposits are similar to the Koochiching in terms of continental provenance, but are older. The Winnipeg lobe will also be described in terms of distribution, internal stratigraphy, flow path direction, physical character, variation in composition for comparison to the other units. These tills vary in usefulness for prospecting from a completely exotic composition (518-05) to a useful, property-scale composition (518-08).

Outside the Baudette area, buried Winnipeg lobe deposits were identified from cores in southern Koochiching and northern Itasca counties (Martin and others, 1989). A clayey, carbonate-poor till of Keewatin provenance has been recognized in northwestern Wisconsin (Johnson, 1986), far down ice but along a reasonable flow path from Lake of the Woods (see carbonate-poor till below).

The internal stratigraphy of the Winnipeg lobe deposits is complex. Glacial sediment from three separate advances of the Winnipeg lobe are recognized in the Baudette area (Fig. 5). Till of the upper and lower advances, unlike the middle advance or Winnipeg till studied elsewhere in Minnesota (Martin and others, 1989; Meyer, 1986), has only moderate amounts of carbonate. The high clay content of Winnipeg lobe till is believed due to the incorporation of Cretaceous marine and nonmarine (reworked saprolite) sediment as the ice moved across southeastern Manitoba. Charcoal from a sandy silt bed between the upper and middle Winnipeg tills yielded a radiocarbon date of greater than 40,400 years B.P. No direct proof was available to indicate a pre-late Wisconsinan age for the upper Winnipeg till; it was simply noted to be stratigraphically below sediment from the last Rainy lobe advance.

Till-clast lithology must be used to estimate the flow paths for Winnipeg hole advances, because related landforms and glacial striae have been buried or obliterated. The first and third carbonate-poor Winnipeg advances probably had a flow path twenty to thirty degrees east of south, whereas the second and carbonate-rich advance probably flowed about due southeast.

The physical character of these deposits is dominated by the abundant limestone and dolostone. Winnipeg lobe till is typically gray to dark gray in contrast to the greenish-gray color of Rainy lobe till. The lower Winnipeg till in the study area is oxidized grayish brown in all five holes in which it was encountered; this serves as a useful marker bed in the subsurface. The matrix is usually a silt loam, with much more clay than the Rainy or Old Rainy, and with very high matrix solubility (Appendix J). The matrix heavy mineral weight is significantly lower than the Rainy or Old Rainy. Limonite pisoliths are common in the heavy mineral fraction of these tills and uncommon in the others. Paleozoic pebbles dominate the clasts. There are clear trends in the matrix chemistry for this stratigraphic unit, such as for Hg, K, Cu, B, & As (see Results Chemistry).

There are definite variations in Winnipeg deposits, inferred to be from mixing of underlying materials (Fig. 8). This is particularly true for the oxidized, lower till. In four of the five holes, this till lies directly over saprolite or bedrock, clasts of which were clearly incorporated by Winnipeg lobe ice. Visual evidence was verified by pebble and sand counts (Table 4 & App. M). Similar dilution occurs in the middle till in a few cases where it is very low in the Quaternary section.

In summary, the Winnipeg lobe deposits are very different from the Rainy or Old Rainy tills.

They are useful as a prospecting media only where they occur at the base of the Quaternary section, but even then retain an identifiable Winnipeg fingerprint.

Old Rainy Lobe Deposits

The Old Rainy lobe deposits will also be presented in terms of distribution. The Old Rainy lobe deposits distribution is unusual in terms of its elevation and thickness across six boreholes where it is preserved (see Map 10). Regarding elevation, it occurs in two boreholes in the eastern portion, only in topographic lows where the top is below 990 feet elevation. In contrast, in two boreholes in the western portion, it creates a topographic high where the top is 1145 feet elevation (OB-520). Moreover, it is thicker in the western portion, up to 193 feet thick in OB-520. In all of these cases, it is the stratigraphically lowest till in the Quaternary section. Note that in OB-521, sediment from two Old Rainy advances is separated by Winnipeg lobe deposits.

The physical character of the Old Rainy tills is dominated by relatively more saprolite, an abundance of Precambrian rock clasts, and variable Paleozoic carbonate content. Even where rich in carbonates, it is distinguished from Winnipeg lobe till by its sandy texture, greenish color, and low clay mineral content (Table 5, Table 4, App. K & App. J). In OB-507, where Rainy lobe till rests on Old Rainy till, the Older till is oxidized pale brown in color. Without the oxidized zone, the contrast of greater compactness, somewhat higher clay content, and higher matrix carbonate distinguishes the Older till. Many distinctions in element composition, such as K, Ti, Na, B, and Hg also are recognized. The Old Rainy tills also contain a higher siderite weight in the matrix heavy mineral fraction.

The continental-scale flow paths of Old Rainy lobe advances cannot be defined yet by direct indicators, so must be inferred on the basis of till composition. Based upon gross composition, the continental flow paths of the Old Rainy are similar to Rainy lobe advances. One difference is the higher matrix carbonate content and it suggests two hypotheses. One is incorporation of older Keewatin tills, the other is a Hudson Bay lowland carbonate source for the Old Rainy tills (see Dredge and Cowan, 1989).

To compare the Old Rainy deposits to those outside the Baudette area is difficult, since the subsurface record is fragmentary. Correlation between holes within this area is not clear-cut, and correlation with the two advances recognized in the Effie area to the southeast (Martin and others, 1989) is not attempted. Old Rainy till sampled in the Effie area averaged more silt, less sand, and a little less clay than Old Rainy till sampled in Lake of the Woods County (App. J). Assuming much of the silt content in Rainy till is rock flour from glacial abrasion of crystalline rocks, till from the Lake of the Woods area may be derived from a rock source slightly more saprolitic than fresh, as compared to Old Rainy till in the Effie area.

In summary with regard to prospecting, the Old Rainy lobe till compositions suggest that local and property-scale incorporation of underlying saprolite and bedrock commonly occurs. Moreover, the generally depleted values of many elements in saprolite offers good geochemical contrast.

Saprolite Deposits

Saprolite deposits are very different from glacial drift deposits in terms of distribution, physical character and variation. Because of its wide distribution in the Baudette area and the pathfinder element accumulations, it has good potential as a prospecting media (DaCosta and others, 1991).

Fourteen holes in the Baudette area contained saprolite, with the thickest section of 124 ft in drill hole 508, and the thinnest section in drill hole 512 containing 2 ft. A few holes contained 1-2 ft. sections of reworked saprolite and a thicker section of Cretaceous sand in drill hole 503 at the saprolite/drift interface. Kaolinitic saprolite was encountered in six drill holes: 501, 503, 506, 507, 508, and 520. Most drill holes contained varying thicknesses of chloritic saprolite except for drill hole 519 which contained only grus. Drill holes 505 and 511 contained grus directly above bedrock.

A hypothetical weathering profile is made up of lateritic duracrust, reworked saprolite, kaolinitic saprolite, and chloritic saprolite (Smith, 1987; Parham, 1970) (see Fig. 9). In the Baudette area, the lateritic duracrust was not encountered in our boreholes. Reworked saprolite typically occurs in the first few feet of the saprolite, it is characterized by disturbed structures and the presence of foreign rounded pebbles and sand. In drill hole 503, there is a 58 foot section of Cretaceous sand (reworked saprolite). This sand is 99% angular quartz grains that range from fine to coarse grained. This unit is also reported by the OGS across the border in Ontario (Bajc, 1989). Kaolinitic saprolite is characterized by light greenish gray to white color, high kaolinite content and has a low bulk density. Chloritic saprolite is characterized by a darker greenish gray color, high chlorite content and a higher bulk density than kaolinitic saprolite. Grus is less weathered and more dense than saprolite; it is characterized by grainy texture caused by the breakdown of bonds between individual mineral grains (Appendices 280-B&K). All saprolite samples measured have high pH values (Appendix 280-K).

Bedrock type has some control over saprolite variation. It appears that the ferromagnesian mineral content of the protolith controls the kaolinite:smectite ratio, with more kaolin over feldspar rich protoliths (Appendix 280-0).

Gold Grain Counts

The median gold grain count for Baudette area tills is zero gold grains per 10 kg sample. Five boreholes in the eastern portion of the field area show elevated gold grain values in the Rainy till. In three of these boreholes the gold grain counts are anomalous compared to the regional median value (Table 5). The gold grain values fall off to background levels beyond drill hole 502 (see map in Appendix 280-E). With the regional-scale drilling density used in the current project, the data are inadequate to isolate a unique township source, but they are adequate to determine a regional trend for the gold grain dispersal, pointing to a regional source area in the vicinity of the newly recognized Baudette fault system, or in the vicinity of the magnetic felsic intrusions (magnetite tonalites? based on pebbles) located near the Baudette fault system. Till in drill holes 517 and 520 also display weak gold grain anomalies. Saprolite in the Baudette area does not display elevated gold grain counts for any of the samples analyzed.

The gold grain counts for all of the Baudette area samples are listed by sample number in Appendix 280-F, and are listed with gold assay information in Appendix 280-P.

Heavy Mineral Mineralogy

Heavy minerals provide a second means of detecting and tracing glacial dispersal of gold and other metals. Fifty-seven of the 103 Baudette area till samples were selected for intensive mineralogical examination. The samples selected exhibited anomalous or unusual assay results that suggest the presence of distinctive heavy mineral varieties. All of the 103 heavy mineral samples were eventually checked for siderite and limonite pisolith content in order to test the stratigraphic utility of those minerals.

Before making the mineralogy examinations, the nonmagnetic fraction of the Heavy Mineral Concentrates (nmHMC) obtained from the processing laboratory (the 1/4 split not sent for assay) was further refined at the heavy mineral facilities of the U.S. Geological Survey in Denver, Colorado. The further processing yielded nmHMC-C3 (very nonmagnetic) and nmHMC-C2 (paramagnetic) sub-fractions. The intensive grain mineralogy work was done on the C3 sub-fraction. Siderite and limonite pisolith contents were visually estimated in the C2 sub-fraction (Fig. 10).

Gold, galena, molybdenite, native copper, scheelite, corundum, kyanite, and gahnite (zinc spinel) appear to be distinctive mineral varieties in the C3 fraction of Baudette area tills. The limonite pisoliths appear to be prevalent in Keewatin provenance deposits (Winnipeg tills). The siderite content is not stratigraphically controlled, but appears to correlate with saprolite incorporation into the tills.

Some of the more interesting pathfinder mineral varieties identified during examination include blue-gray scaly and/or hexagonal flakes of molybdenite (boreholes 512 and 505), native copper (seven boreholes in the eastern half of the field area, and in one large clear quartz cobble in borehole 503), and chalcopyrite (boreholes 502 and 520). Scheelite is present in many of the boreholes, with zero to five grains noted per borehole. Light blue corundum was noted in boreholes 507, 509, 517, and 521. Specimens of the corundum are being evaluated to test for possible gem quality. Gahnite, the zinc spinel, was identified in the basal (Old Rainy) till sample in borehole 517. The gahnite occurrence is coincident with the weak gold grain and scheelite anomaly also present in the basal till in 517 (Todd, 1991). SEM-EDS analysis of individual grains by Hanna Research Labs confirmed the identities of galena, chalcopyrite, corundum, arsenopyrite, and gahnite.

Heavy mineral examination results are summarized by sample number in Appendix 280-L.

Remarks from the initial heavy mineral examinations at the processing laboratory are listed in Appendix 280-P.

Heavy Mineral Chemistry

Assay results for the nonmagnetic (nmHMC) and magnetic (magHMC) fractions of heavy mineral concentrates (>3.3 specific gravity) exhibit four types of variation: some display invariant (unresolvable?) regional baselines, some exhibit sloping regional baselines, some display distinct stratigraphic signatures superposed on either invariant or sloping regional baselines, and some assayed elements show distinct enrichments or anomalous values in particular samples. Figs. 11 and 12 illustrate how these types of variation appear on graphic plots. By way of example, mercury (Fig. 11c) exhibits a sloping regional baseline that is independent of stratigraphy, displays a diagnostic stratigraphic signature, and shows some anomalous values.

Eleven nmHMC assayed elements show regional baseline changes that are independent of stratigraphy. Eight of these elements show regional increase to the west-northwest. They are: Ag,* As, Cr, Hg, Lu*, Zr, Fe, and Mn. The other three elements show a regional decrease to the west-northwest. They are: Sr, Ca, and P. The regional baseline for one magHMC element, Pb, decreases to the west-northwest.

Mercury is the most diagnostic stratigraphic tracer in the nmHMC dataset. It displays up to a ten-fold higher concentration in the northwestern provenance Winnipeg tills than in the northeastern provenance Rainy and Old Rainy tills. The contrast is sufficient to resolve till contamination of the Rainy and Old Rainy tills where they have overridden Winnipeg sediments. As, Ni, Sb*, and Sr also exhibit some stratigraphic distinction, but with less resolution. Regional baselines and stratigraphic variations found in the heavy mineral assay results are summarized in Table 2.

Samples that show distinct enrichment or anomalous values are scattered throughout the analytical results. Rainy till, Old Rainy till, and saprolite display coincident subregional-scale enrichments and anomalies. Rainy till in boreholes 503 and 514 shows coincident enrichment. Borehole 503 shows enrichment or anomaly in Au*, Ba, and Sr, and high Hg in the Cretaceous sediment. Borehole 514 shows enrichment or anomaly in Bi, Cu, Hg, Rb*, and Th compared to regional background levels. The elevated Cu assays in the Rainy Till correlate well with native copper observations in the heavy minerals, but the elevated Cu values in borehole 521 do not match any observed native copper grains. Borehole 502 shows elevated Ag and Pb values in the magHMC fraction. Borehole 509 shows a W anomaly (244 ppm) in the nmHMC of Rainy till. The saprolite overlying the massive sulfide in borehole 513 shows enriched values for Co, Cu, Mn, Ni, Ti and Zn*. Siderite content (up to 95%) in the samples probably dilutes the actual concentrations of many of the nmHMC assay results, making them only enriched, rather than anomalous.

Gold assays match predicted gold assay values that were based on the observed gold grains. Only four samples are discrepant: 501, 503, 515, and 520 Rainy or Old Rainy tills. Saprolite in 507 and 508 shows higher gold assay than the gold grain counts predicted. These samples likely contain gold in a very fine-grained form.

The most pronounced enrichment of multiple elements occurs in the basal fifty feet of Old Rainy sand/till in borehole 520 and in the underlying saprolite in 520. The till and saprolite each show multiple enrichments, some up to 20x above regional till baselines, but the elements enriched differ. The nmHMC mineralogy shows fairly abundant (30 grains) galena in the saprolite in 520. Distinctly elevated trace element values in the saprolite include Ag*, Ba, Bi, Ce, Cu, Eu*, Ga*, La, Pb, Sm, Tb*, and Y. Elevated element levels in the till and sand of 520 include: Ce, Cr, Cs*, Ga*, Hf*, La, Rb*, Sn, Ta*, Tb*, Th, U, and Yb. Only Ga, La, and Tb are enriched or anomalous in both the till and the saprolite.

Tables 6 & 7 summarizes the distribution of detected enrichments or anomalies in the heavy mineral assays. Appendix 280-G and Appendix 280-H list samples and assay results for the nonmagnetic and magnetic heavy mineral concentrate fractions. Regional median values, calculated for each stratigraphic unit and further divided by eastern portion versus western portion, are shown in Table 8.

Silt-Clay Chemistry

The silt and clay fractions of drift samples can

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* Precision for this element exceeds 20%.

also be used to detect and trace glacial dispersal of gold and other metals, particularly the less-resistant mineral species, metals adsorbed onto clays during oxidation or weathering activity, and very fine-grained fragments of mineralized rock. The silt-clay assay results for Baudette area samples display many of the same patterns exhibited by the nmHMC and magHMC.

Twelve elements in the silt-clay fraction show regional baseline variation. As, Sb*, Zr*, and Ca increase in amount in the western portion of the field area. Cr, Cu, V, Al, Fe, K, Na, and P decrease in abundance in the western portion of the field area. Six of the twelve elements are rock-forming major elements. Aluminum, potassium, and sodium show regional baseline changes in the silt-clay assays that are not reflected in the heavy mineral assay data. K and Ti display some stratigraphic variation, discriminating between Rainy and Old Rainy tills, probably reflecting a larger saprolite content incorporated into the Old Rainy till.

Several silt-clay fraction samples show enriched or anomalous values. Many of the silt-clay enriched values are coincident with nmHMC enriched values. The Labradorean tills in borehole 507, both the Rainy and the Old Rainy, are enriched in Ag*. High Au values in the silt-clay fraction are confined entirely to the Rainy till, with Au data spikes showing up in boreholes 503, 506, 509, 514, and 515. Saprolite in borehole 520 contains elevated assay values for many of the same elements that were enriched in the nmHMC fraction: Ag*, As, Be, Ce, Co, Ga, La, Nb, Pb, Sb*, W, and Y. Some of the elevated values are enriched more than 10x over the regional background. Saprolite sections in boreholes 505 and 506 are also enriched in a number of elements, including Sr, Sc, Rb, Ni, Ga, Au, Y, and Zn. The enrichment in Zn in the silt-clay fraction is much less prominent than in the nmHMC fraction.

Table 2 summarizes the characteristics assayed in the silt-clay fraction and displays the regional baseline changes or stratigraphic differences found. Table 6 lists silt-clay fraction assay results that have anomalous values compared to regional baselines. Silt-clay fraction assay results are listed in Appendix 280-G, along with the nmHMC assay results. Regional median values, listed by stratigraphic unit and further divided into eastern portion versus western portion are shown in Table 8.

Pebbles

The lithologies of pebble clasts in tills give some opportunity to trace regional bedrock lithologies and provide some correlation of elevated chemical baseline levels to regional bedrock sources. In the 9.4 cm diameter rotasonic core, the larger pebble clasts are difficult to evaluate because they undergo mechanical abrasion and fracturing during the coring operation and are more likely to display sampling errors due to till heterogeneity. Smaller clasts provide more consistent indications of regional trends. The largest pebble class in the rotasonic core to yield reliable results is the 1/4 - 3/8" (0.64 - 0.95 cm) size class. Appendix 280-M shows how limestone-dolomite-chert, coarse grained granitoid, and supracrustal pebble clasts are distributed by size in the 103 Baudette area till samples.

Limestone-dolomite-chert is present in the western portion of the field area, and displays a regional baseline pattern of increasing carbonate-chert toward the northwestern edge of the field area (Fig. 13). The carbonate-chert appears to be exotic since no drilling in the Baudette area has penetrated carbonate-chert strata. In the eastern portion of the field area, little or no carbonate-chert is present in the tills. In the western portion of the field area all of the tills contain some carbonate-chert. The regional increase in limestone-dolomite-chert in the western tills (up to 45% in Rainy/Old Rainy tills) reflects both the transport of carbonate-chert into the Baudette area (in the case of the Winnipeg tills), and the incorporation of Winnipeg provenance glacial sediments into the overriding Rainy and Old Rainy tills (Dahl and Cartwright, 1990). Granitoid content in the pebble samples mimics the carbonate-chert pattern, but is difficult to resolve because of dilution effects caused by granitoid content in the Labradorean tills.

Pebble counts of the 1/4 - 3/8" supracrustal pebbles (Appendix 280-N) show that graywacke displays regional variation similar to the carbonate-chert and granitoid of the Winnipeg tills, increasing in abundance to the northwest. Amphibolitic pebbles in the Rainy till decrease to the west. Sub-regional elevated values include mafic plutonic and magnetic pebbles (50%) in the basal till sample of borehole 515, felsic-intermediate hypabyssal pebbles in the basal till sample of borehole 513, sulfide the basal till sample of borehole 511, fine-grained

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* Precision for this element exceeds 20%.

grains in metasediments in the Old Rainy till in boreholes 517 and 520. The supracrustal pebbles do not show distinct associations with underlying bedrock.

Magnetic tonalite clasts noted in boreholes 502, 505, 506, and 508 correlate well with the gold grain dispersal trend and the magnetic susceptibility of Rainy till. That clast type may be useful as a subregional lithologic tracer.

Physical Properties

Bulk density increases downhole in most of the saprolite and bedrock profiles. Bulk density readings for 9 of the 13 boreholes measured show an increase in density down the hole. Six selected till samples range from 1.5 to 2.3 g/cm3. Forty saprolite samples range from 1.5 to 2.3 g/cm3, and six bedrock and weathered bedrock samples range from 2.0 to 2.8 g/cm3. Appendix 280-K lists results for individual samples.

Forty-eight saprolite samples from 14 boreholes were measured for pH. All of the boreholes had high pH readings. pH measurements ranged from 5.7 to 9.8. Results for individual samples are listed in Appendix 280-K.

Mean magnetic susceptibility of sampled intervals shows an area of Rainy till with elevated magnetic susceptibility levels. These elevated levels are five to ten times higher than the magnetic susceptibilities of Rainy till in other parts of the field area. The elevated Rainy till values are found in boreholes 502, 505, 506, and 508.

Till compactness, in the recovered rotasonic core, does not appear to be diagnostic of stratigraphic types. Most of the till samples are moderately compact to compact. A few of the Old Rainy and Winnipeg tills are very compact.

Maxtrix Texture

On average, Winnipeg tills are less sandy than Old Rainy and Rainy tills. Old Rainy is slightly more silty than Rainy till in selected boreholes. The difference is not diagnostic for Winnipeg, Rainy, and Old Rainy tills because the ranges overlap significantly. Borehole 517 shows the best resolution of stratigraphy, separating Keewatin provenance from Labradorean provenance units.

Bedrock and Saprolite Results

Bedrock profiles recovered during coring operations were described petrologically and petrographically by T. Klein of the U.S. Geological Survey in Reston, Virginia (Klein, 1991). Fifteen bedrock samples selected from 14 boreholes were analyzed for major elements, and ten saprolite and bedrock samples were analyzed for trace elements. Frey and Venzske, 1991 describe in detail the analytical results for a great many more bedrock samples. These results can be compared to the analysis results listed in Appendix 280-I. Descriptions of the bedrock profiles are listed by borehole in Appendix 280-B. These analyses provide some basis for evaluating the regional influence of major rock types (see for instance the semi-massive sulfide and overlying saprolite in borehole 513; mylonites in boreholes 503, 506, 517, 521); graywacke in boreholes 512; gabbro in borehole 509; basalt in borehole 514; and syenite in borehole 502).

Seven boreholes contain bedrock analyses worthy of review. The highest bedrock gold assay, 30 ppb, occurs in association with Bi, 11 ppm, in a barren semi-massive sulfide (17.9% S) in OB-513. Borehole OB-503, a mylonite near the Baudette fault, contains the highest B, 222 ppm, and Hg, 18 ppb, and calcite metasomatism. Borehole 517, a mafic mylonite, contains 11.5% MgO, 239 ppm Ni, and 567 ppm Cr and could have been a komatiitic basalt protolith. Borehole 521, a mylonite with locally present mafic volcanic breccia clasts, appears to be enriched in K_2O, 5.55%, and depleted in NA_2O, 0.43%. Borehole 501, a weathered quartz monzonite contains the highest Zn, 989 ppm. Borehole 519, a hornblende tonalite, contains the highest Cu, 447 ppm. Three of the above observations are corroborated by other drill core from this area (see Frey and Venzke, 1991): 1) an apparent Au with Bi association; 2) the presence of komatiites is confirmed in the western portion of the area; and 3) elevated Cu and Zn values in tonalite-monzonite intrusives.

Significant new data on saprolite composition has been obtained for the Baudette area. In addition to the ten saprolite samples analyzed on a bulk sample basis, 15 other saprolite intervals were analyzed using the same geochemical fractions as for the till samples. A summary of those results follows.

In the Baudette area, the common minerals found in the saprolite include: quartz, kaolinite, muscovite, siderite, and varying amounts of illite and smectite. Saprolite mineralogy is generally characterized by quartz, kaolinite, muscovite, and chlorite (Davy and El-Ansary, 1986). Oriented clay XRD results show relative amounts of kaolinite, chlorite, illite, and smectite from six selected Baudette area saprolite samples (Appendix 280-O).

Saprolite samples contain a surprising range of weight, 8 g/10kg to 410 g/10kg, of heavy minerals. Native copper, galena, zircon, corundum, siderite, rutile, ilmenite, garnet, and quartz seem to be fairly resistant to weathering processes. They remain in considerable numbers in saprolite heavy mineral samples. Siderite, which is ubiquitous in the saprolite, contributes very high weights to some heavy mineral concentrates. Pyrite, scheelite, epidote, pyroxene, and amphibole are moderately resistant, and chalcopyrite and sphene are fairly nonresistant to weathering processes.

Five drill holes contain pathfinder minerals in the saprolite including: galena, gold, corundum, native copper, and scheelite. Drill holes 508 and 520 contain considerable amounts of galena. Thirty grains were counted in drill hole 520 and ten grains were counted in drill hole 508. Galena grains are in cube and cube-like forms and range from <.1 mm to 1 mm. Drill holes 503 and 507 each contain one gold grain in the saprolite. Corundum is identified (SEM/EDS) in the saprolite in drill hole 501. Four grains of corundum are also found in the saprolite in drill hole 507. One grain of native copper is found in the saprolite in drill hole 508, and scheelite is identified in the saprolite in drill holes 501 and 503.

Magnetite is destroyed during the weathering process that forms saprolite. Both the low magnetic susceptibility readings (see App. B) and low weight recovery of magnetic fraction (see App. J) verify this. However, before complete destruction of a magnetic grain occurs, the outer rim of hydrous iron oxides accumulates available Cu, Pb, Zn, Co, MgO, V, MgO, V, Mn, Cr, or TiO2. Thus, the weathering process has an effect on concentration and depletion of elements even in the magnetic fraction.

Saprolite samples contain elevated MgO (3x median), Co (9x median), Cr (3x median), Cu (17x median), Pb (3x median), and Zn (6x median) in this fraction (see Table 7). Note the high Cu in drill hole 520 and the high Zn in drill hole 507. The saprolite samples contain a very small weight of magnetic fraction material, but that fraction can scavenge available metals cations.

Nonmagnetic heavy mineral concentrate and silt/clay analysis for saprolite samples are listed in Appendix 280-G and show significant enrichment in certain elements. Elements which are enriched by ≥ 3x median in the nmHMC fraction of the saprolite over bedrock include: Ba, Ce, Co, Cu, K, Mn, Ni, Pb, Ti, V, W, Y, and Zn. Elements enriched by ≥ 3x median in the -2 um fraction of the saprolite include: Ag, Ce, Co, Mn, Nb, Pb, V, Y, and Zn.

In summary, this new saprolite composition data combined with the saprolite stratigraphy results (see Stratigraphy and Buried Landscape) will permit more confident evaluation of this ample media in future geochemical prospecting.

Summary of Results

In sum, many patterns are evident in the observations regarding the stratigraphic units and regional variation (Table 10). Superimposed upon these patterns are the proposed anomalous values that could relate to mineralization.

Within the stratigraphic units, four factors related to till composition are observed. The factors include: 1) the presence of tills deposited by subglacial vs. supraglacial processes; 2) the presence of head vs. tail of dispersal trains; 3) the incorporation of underlying material into till; and 4) the characteristic content of certain elements (Hg, K, B, As, Ca, Na, or P) in each stratigraphic unit. Regarding regional variation, basically a regional slope east to west, three factors are noted. They include high exotic carbonate clast content and high matrix carbonate content in the west, and variation in 11 elements in the matrix clay fraction. Of those 11 elements, only Ca is higher in the west.

Numerous anomalous geochemical (3x median) values have been pointed out within the separate sample fractions of tills. They are listed in Table 9 and on map in App. E. Briefly summarizing prior to interpretation:

1) low, but anomalous, levels of gold with pathfinders are found in OB-503, 506, 509, 514, and 517;
2) potential pathfinders are found in OB-505 (molybdenite, Zn, Ni), 512 (molybdenite), and 513 (kyanite);
3) low, but anomalous, levels of gold without pathfinders are found in OB-502, 515, 518, 519, 520, and 521; and
4) anomalous native copper grain counts are

reported for OB-508, 514, and 511.

Moreover, a few pathfinder mineral occurrences were found in place in saprolite or bedrock:

5) low level Au and Bi occur in OB-513; and
6) potential pathfinders occur in OB-501 (Zn), 503 (scheelite, Hg, & B), 508 (galena and native copper), and 520 (galena and Cu).

Discussion

Geochemical Province

The model most significant to this project involves a geochemical province[6]. The geochemical province concept is fundamental to the design of this survey. The total dispersal could create a geochemical province in the overburden if the country rock contains abnormal abundances of gold along one large source zone or many small dispersed zones. It is appropriate here to note the conclusions of Bolviken and others (1990) (Fig. 2). "At this stage, three empirical facts appear to be established:

1) Geochemical provinces can be disclosed not only through analysis of certain grain-size fractions of overburden material, but also through analysis of water (Bolviken and others, 1990b), heavy mineral fractions and organic samples.
2) Both ore and non-ore elements produce geochemical provinces that possibly are associated with ore mineralization.
3) The determination of total contents of elements is not always the best procedure for outlining an interesting geochemical province. Acid-extractable elements are often more indicative."

It is suggested here that a gold geochemical province of roughly 75 square kilometers has been identified about 40 kilometers east of Baudette by an Ontario Geological Survey glacial drift geochemistry project (Bajc, 1988). Two additional gold geochemical provinces appear in Thorleifson and Kristjansson, 1988, in the Beardmore-Geraldton, Ontario, area. These above three interpretations are based upon gold grain counts and assays from tills. Two gold(?) geochemical provinces of 89 km^2 and 77 km^2 have recently been reported in northeastern Minnesota (Alminas and others, 1991). These gold enrichments are reported from A-horizon soils developed on glacial deposits. All of these occurrences are in Archean Superior Province bedrock terrane, similar to Baudette area bedrock. Examples of other probable geochemical provinces across the Canadian shield, as defined by gold grain counts in till, are presented by Averill (1988).

Using these gold geochemical provinces as a model for similar Archean terranes in Minnesota, a minimum sample pattern for recognition of a gold geochemical province can be established. A gold province is likely to be 75 km^2 in area or larger, and associated with a major structure, hydrothermal system, or stratigraphy. This size province could be identified by a borehole density of 1 per 25 km^2. Coincident pathfinder anomalies in multiple forms, in elements, sample fractions, samples, or stratigraphic units would increase the significance of the occurrence. Furthermore, anomalies in either a dispersal train head (threshold of 10x median or 10 gold grains) or a tail (threshold of 3x median or 3 gold grains here) should be considered. A successful identification of a gold province is unlikely at a drilling density of greater than 25 km^2, that is, prior to the infill drilling.

Saprolite, Glacial Stratigraphy, and Buried Landscape

Before this survey, little was known about the saprolite in the Baudette area. Descriptive logging, heavy mineral mineralogy, clay mineralogy, and chemistry are providing a better understanding.

Fig. 9 shows the generalized stratigraphy within the saprolite in the Baudette area. Reworked saprolite, kaolinitic saprolite, chloritic saprolite, and grus are present, though not in every drill hole. In most profiles, the upper portion of the saprolite section has been removed probably by glacial erosion. In other cases, the entire saprolite profile has been removed.

The Cretaceous sand (reworked saprolite) found in drill hole 503 is unlike other sediments found in the Baudette area. This 54 foot section of unlithified, angular quartz sand and kaolin has not been reported in Minnesota before. It may be an important aquifer near Baudette. The same kind of unit is reported by the Ontario Geological Survey in a borehole sited about five kilometers to the northeast of Baudette. Palynology results on their samples give a Cretaceous age (Zippi and Bajc,

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[6] See glossary

1990).

Grus is present in three drill holes in the Baudette area, 505, 511, and 519. Grus is slightly weathered granitic rock. Only the bonds between individual mineral grains in a granite have broken down, thus leaving a disintegrated rock (see App. 280-B).

Resistant and secondary economic minerals are present in the saprolite. Galena, gold, corundum, and native copper are all found in the saprolite in the Baudette area (see App. 280-L). These can be useful tracers to bedrock mineralization. Botryodal siderite in saprolite is also useful. This same siderite is found in the tills above the saprolite, providing a measure of the amount of incorporation of saprolite into till (see App. 280-J).

Bedrock type seems to control clay mineral content in the overlying saprolite. Granitoids produce saprolite with high kaolinite content. Ferromagnesian-rich bedrock units produce saprolite with high chlorite content (see App. 280-O & B).

The magnetic and nonmagnetic HMC fractions of the saprolite are enriched in certain elements. Assemblages of these enriched elements may permit the tracing of till sources and may be useful for prospecting directly in the saprolite.

Identification of stratigraphic units from core samples is best done by an experienced glacial geologist using key matrix chemistry data. The most important stratigraphic assignment of Keewatin vs. Labradorean provenance can be confidently defined using matrix chemistry data. Even with such data, the stratigraphy in OB-521, which provides the only evidence for the 5th and 6th older till units here, is ambiguous due to conflicting data in one or two samples. Mixing has been demonstrated, at both the regional- and small-scale, to alter the typical stratigraphic composition of tills. Such mixing may be the cause of the problem in OB-521. A less important distinction, that of younger vs. Older Labradorean tills, can also usually be resolved by matrix chemistry.

Critical review of this new body of information on stratigraphy should be encouraged. Additional or alternative inexpensive stratigraphic identification tools (see Table 10) should be sought. The descriptive logs supported by the matrix chemistry and pebble counts yield strong characterizations, however, the interpretation of the causative glacial processes needs additional work.

On a more detailed note, there are perhaps three Winnipeg lobe ice advances represented within the stratigraphy here[7]. Limonite pisolites are present in most, but not all, Winnipeg till samples. Unusual element variation, such as in OB-517 for Ce, Zn, and Zr (see App. G), are observed within the Winnipeg tills. Such fingerprints may be useful enough to correlate internal Winnipeg till units and the link between the pisoliths and composition might be better resolved.

Accurate knowledge of glacial stratigraphy improves the ability to trace bedrock sources within a geochemical province, and also improves the effectiveness of geophysical conductivity surveys. A brief digression from our regional survey discussion is appropriate here. Most important to prospecting is the ability to find a buried geochemical anomaly and to be able to trace it. This requires a pathfinder, a unique tracer, an estimate of flow path direction and transport distance. Property-scale flow paths can be readily measured in the future under two conditions: 1) first a tracer element, mineral, or pebble is identified and 2) closely-spaced drilling. Examples from outside this area suggest that property-scale flow paths will vary significantly across the region. Pertinent examples of transport distance should be sought from the Labradorean till data of Bajc (1988) from 40 kilometers to the east. Since we cannot reliably predict a specific flow path direction at a site, or the presence of the best till overlying bedrock, we present tools and methods to use the available samples to the maximum extent possible. Some geophysical surveys are degraded by the presence of conductive clays. The bedded sediments, including clays, described in the logs (App. B) and summarized in Maps 7-11, should be considered for this problem, as well as the clays present in the saprolite.

Based upon the till geochemical patterns described in the summary of results, a working hypothesis for "unmixing" the till compositions was developed. The hypothesis, presented in Table 11, is that each stratigraphic unit has a fundamental composition, that can be modified by one or more

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[7] A designation of upper, middle, or lower is listed for every Winnipeg till sample, as interpreted by Gary Meyer, and is available from the DNR project file.

factors. When modified, the composition may be significantly different. The three first-order modifying factors are basal ice mechanics and velocity, buried topography, and underlying materials. The presence of exotic carbonate, Winnipeg lobe deposits, as the underlying materials in the western portion of the Baudette area is suggested to cause the dramatic regional variation of 11 elements in the Labradorean tills. Such a hypothesis ties together the observations from the individual datasets, and explains the x-y plots by stratigraphic units. Such x-y plots have a cluster or central tendency with outliers when modified by the above factors (Figs. 12a-c).

In summary, it is suggested that glacial till composition on a regional scale has been defined by many attributes, resulting in a Western vs. Eastern portion. The buried landscape and underlying materials were major controls. The dilution effect caused by the incorporation of exotic carbonate materials of Keewatin provenance is proposed to create the observed dramatic regional variation. In a broader perspective, the interpretation of the anomalous values in this dataset would be improved by better recognition of two factors. One is the recognition of the head vs. tail of a dispersal train. The second is the mixing caused by different dispersal scales[8]. The effect of both factors is to change the appropriate background value to apply an anomaly threshold value.

The reconstruction of the Baudette area buried landscape is appropriate to understanding the total geochemical dispersal here. That total dispersal is proposed to be the sum of glacial processes plus laterite processes. The observed regional till variations of Western vs. Eastern portion, and smaller scale variations, are attributed to the influence of the buried landscape. These topics are briefly summarized and a proposed landscape description is presented.

First, the laterite concentration of supergene enrichment is inferred to create short transport, tens to a thousand meters (DaCosta and others, 1991). Different profiles develop under various elevation and slope conditions (Smith, 1987). Preservation of the saprolite is probably a complex function of protection from erosive Labradorean ice advances. In summary, the possible supergene enrichment due to laterite processes is attractive in terms of both a higher grader ore, such as at Ladysmith, Wisconsin, and a larger target.

Secondly, glacial dispersal is regionally affected by the bedrock topography in the central part of the area, judging by the distribution of Winnipeg tills (Western portion) and the Rainy lobe post-glacial lake sediments (southeastern portion). The result is a major landscape boundary, as evidenced by till compositions. Thus, the two major compositional controls on till are the substrate and the buried topography in the up-ice direction, which in combination are referred to simply as the buried landscape.

Regarding glacial dispersal on smaller scales, it is inferred to be hundreds to thousands of meters in the head and kilometers in the tail of specific dispersal trains in this area. That conclusion is based upon the many different single-lithology dominated, or head of dispersal trains observed at the base of our boreholes spaced six miles apart. The third dimension, height above the Quaternary base, offers for a regional survey useful samples of mixed lithologies, or tails of dispersal trains, probably with transport of a mile or more. For example, seven of the samples on the summary pathfinder map are not the bottom till samples, vs. three that are. Two additional cases, which do not contain pathfinders, should be noted here. In sample 515-01, the very high siderite content (App. F) suggests that much saprolite has been incorporate into this till which is 70 ft. above the base of the Quaternary. They serve to point with caution to the use of pebble counts as a means to characterize a till sample in an area with saprolite. That is, the saprolite may dominate the matrix composition, yet not be reflected in the pebble counts.

Regarding the multiple glacial advances, each could erode and incorporate more of an ore-bearing source and/or the previous dispersal train deposits. In the latter case, the younger till deposits could have an unusual mixed lithology composition and a dispersed, diluted anomaly. The multiple glacial dispersal increases the chances of success for this regional survey by broadening and homogenizing the geochemical province.

The buried landscape can be described using data from various sources, such as previous drilling data, structures inferred from aeromagnetic data, and nearby terranes not deeply buried (e.g. Echo Lake Quadrangle, St. Louis County). The results are presented in a regional scale (Fig. 6, schematic, and Map 5a, elevation map), and a local scale can

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[8] See glossary

be hypothesized. The bedrock surface may be described as gently-sloped, low relief tablelands, cut sharply by high relief, angular valleys controlled by bedrock structural or lithological features. In T157N-R34W, near the Vermilion fault system, occurs the greatest known (200 ft.) bedrock relief in the Baudette area, in contrast to the 100 ft. of relief associated with the local-scale topographic highs. The paleo drainage was probably controlled by bedrock features. The saprolite is much thicker in the valleys, due to both deeper weathering and better preservation. The buried landscape probably has the most readily observed impact upon property-scale dispersal.

Concluding on a practical level, the regional buried landscape also affects drilling depth, hence cost, and sample type (preferred tills--Labradorean rather than Keewatin) for the bottom of the Quaternary section and till composition.

The interpretation of this data remains a subjective and evolving process. The goal of this section has been to highlight significant observed factors and provide a springboard for further progress. This dataset is of a three-dimensional nature, and steps need to be attempted to handle and present the data in 3D. The ability to generate specific computerized maps, such as for stratigraphic unit distribution and geochemical values as proportional dot sizes, would be an improvement.

Mineral Potential

The design criteria for identifying a geochemical gold province (see Geochemical Province) suggest infill drilling is required to define one. However, it is possible at this time to review the observed pathfinders (map in Appen. E), especially the combinations, and within the new regional bedrock setting, discuss speculative resources here, plausible geochemical provinces, and also small-scale features.

The combination of pathfinders in boreholes 502, 503, 506, and 507, combined with the inferred bedrock setting, suggest that a gold province be sought here. The Baudette fault deforms the lithologies in 503 and 506 (Maps 12a & 12b). The magnetic pebbles in till overlying the syenite in 502, 60 ft. of glacial deposits with high magnetic susceptibility and the shape of the aeromagnetic feature, suggest an intrusive tonalite body. Such an intrusive may fit the description of an oxidized felsic magma (Hattori, 1987) for a source of gold-bearing fluids. The magnetite has an unusual Pb + Ag content, perhaps analogous to the Ag-bearing magnetite found at Kirkland Lake, Ontario (Lee, 1963). In OB-503, the combination of the small individual values of gold grains, fine fraction gold assay, scheelite, Ba, Hg, Mo, and Se raises the rating. Borehole OB-506 contains the best combined gold values of all holes, with five gold grains and an anomalous fine-grained gold assay (see columnar log, sample 506-01) only 5 feet above a saprolite that had an anomalous fine-grained gold assay and high copper. The bedrock in OB-506 also has quartz + calcite veins, but the whole rock assay was only 10 ppb gold. The saprolite in OB-507 contains gold in the nmHMC and a till sample has anomalous (4) gold grains. This site is located on a proposed fault, which intersects the Baudette fault (see Spector in Lawler and Venzke, 1991). In conclusion, none of these four sites offers a direct target, but in combination they offer an appropriate setting for gold. Moreover, previous work by the U.S.G.S. (Clarke, 1990) points to anomalous soils geochemistry in this vicinity.

A geochemical copper province should be considered in future evaluations. The observed native copper grains (App. O) do not seem to be in a pattern, but they are suggested to be secondary weathering products and create a nugget problem. Other data (Frey and Venzke, 1991) from bedrock cores here support the suggestion of elevated copper values in this area.

The multi-element pathfinders in borehole OB-514 and a location near the Quetico fault are evidence for gold potential there. The coincident anomalies of fine fraction Au with Hg and Cu and depleted B in 514-02 are attractive, since this sample is interpreted as the tail of a dispersal train. That conclusion, supporting a source to the NE in the granitoids, is based upon the high granitoid pebble content, relatively high Th value, lack of saprolite component indicators in this till, and a large difference in composition from underlying basaltic saprolite.

Galena was found in the heavy minerals from saprolite in OB-520 and OB-508. In OB-520, it occurs with elevated copper, silver, cerium, europium, gallium, lanthanum, and depleted arsenic, thorium, and titanium in our deepest borehole at 310-320 ft. The elevated values in till are not the same elements as found in the underlying saprolite. No sound bedrock was reached in this hole, so the protolith is uncertain. In OB-508, the galena was found in the heavy minerals from saprolite and associated with native copper, anomalous silver, minor gold, bismuth, and manganese and depleted thorium, titanium, and uranium. A very thick saprolite, 128 ft., overlies a metagraywacke here. The site is near a splay of the Vermilion fault, and centimeter scale mylonitized shear bands are observed in the bedrock. Neither of these two occurrences seem related to chemical sediments. The possibility of galena forming from a secondary process is possible, yet the other anomalous elements support these as real occurrences. Lead and silver are reported from two occurrences in the Kenora district (Blackburn and others, 1989) and should be reviewed.

Kyanite is noted in significant amounts (App. L) from Rainy till in OB-513, which contains a barren, semi-massive sulfide. Only a trace of kyanite was noted from the saprolite in this hole. Perhaps an unusual alteration-metamorphism has occurred nearby, basically in the middle of the supracrustal belt. This mineral should provide a good tracer for backtracking.

Gahnite, a zinc spinel, is noted in the lowest till overlying a brecciated mafic mylonite in OB-571, near the Border fault. There were also four gold grains, two scheelite grains, and distinctive, very large, 1-2 mm, pyrite grains in this heavy mineral sample. Gahnite probably represents a metamorphosed form of sphalerite (Todd, 1991). Note the bedrock core here has the composition indicative of a komatiitic basalt.

In OB-505, the highest zinc values from this survey occur in an iron-rich saprolite associated with anomalous copper, lead, and nickel. The underlying bedrock here is a biotite quartz monzonite and inferred to be very near the contact with supracrustal rocks. Two molybdenite grains were found in a till 95 ft. above the saprolite and are interpreted to be from a difference source.

Corundum has been identified in saprolite in borehole from OB-501 and OB-507. It will be further evaluated regarding gem quality.

The occurrence of native copper grains in tills, and especially saprolite in this region, needs further consideration as a copper geochemical province.

Kaolin is a speculative resource in the vicinity of OB-503, where 50' of Cretaceous kaolin-bearing quartz sands are preserved in a major topographic low overlying thick saprolite. The nearby granitoid source rocks may have contributed kaolin sediments to a secondary deposit in this setting.

This database includes some physical property information that may be helpful for geophysical surveys in the region. Conductive overburden may result from the clay-rich glacial sediments listed in logs such as OB-501, OB-505, OB-511 (see Maps 7 through 11) or from a thick saprolite blanket such as OB-508. The magnetic susceptibility of all core--glacial, saprolite, and bedrock--was measured. Finally, rather crude bulk density measurements of many samples were taken (Appendix K).

In summary, the powerful tool of mineralogy has helped locate pathfinders and unique tracers in this saprolite-blanketed area. The preserved saprolite offers attractive supergene-enrichment targets. The best sub-area for gold potential appears to be in the northeast near the Baudette fault system.

Environmental Geology

There are potentially broad applications of this database to environmental geology. The two subjects perhaps most relevant are the types of deposits and the matrix composition of the overburden.

The various types of buried glacial deposits and pre-glacial deposits affect groundwater availability and flow. Significant aquifers may exist in glacial sands and gravels, such as the 200 ft. thickness in OB-521, or the pre-glacial sand, such as in OB-503. The buried regional bedrock topography probably affects the groundwater flow paths (see Map 5a and Maps 6-11). The saprolite itself probably has a low permeability.

The overburden matrix composition affects groundwater quality. The Koochiching and Winnipeg tills contain high amounts of carbonate in the matrix. The Winnipeg tills contain higher mercury and arsenic contents, which appear to be leachable during oxidation, such as inferred interglacial weathering (see OB-512 or -513).The Rainy lobe tills in OB-502 contain high phosphorus, with 2% P in the clay fraction. The saprolite may contain high iron and a high pH. More specific information on 23 elements can be found in the appendices.

Planning for specific activities that exploit the groundwater or mineral resources, involve waste disposal facilities, or deep excavations, should find the regional information here to be invaluable.

Subsample Fractions and Physical Properties

The methodologies, new applications, and implications of each subsample fraction are briefly discussed.

Characterization of the heavy mineral fraction provides the most effective way to identify the specific bedrock source of a dispersal train, and a new system is applied here to ease the mineral identification task. The mineral characterization of color, size, abrasion, morphology, composition, zoning, and other features, when combined with associated minerals, can define with very high confidence a specific bedrock source.

The new system is to combine a standard till heavy mineral concentration process to obtain gold grain counts with a modification of the U.S.G.S. heavy mineral separation method (see App. C). The result is that most of the important pathfinder minerals end up in one fraction where easily identified from the only four common accessory minerals present. Any reasonable heavy mineral concentration process, from simple panning to the Knelson concentrator, could be considered on the front end. This new system is not cheap, but it is very effective.

A specific technique within the new system, during the visual estimation of the percentage of common accessory minerals, is recommended here. The technique, used by Steve Sutley at the U.S.G.S., takes into account the total volume of each mineral phase by scanning the total sample. The problems of different grain sizes and of uneven distribution of minerals are better addressed by this technique than by counting 100 grains.

For this report, the nonmagnetic, +3.3 S.G. fraction was examined in detail. There are two specific other fractions that are available, and since they contain minerals like garnet, tourmaline, and apatite, those fractions could be useful to a specific investigation.

Silt/clay chemistry can help to resolve the contribution of weathered bedrock into till and can qualitatively help to resolve older Labradorean tills from younger Labradorean tills. Moreover, a summary report from Finland (Lehmuspelto, 1987) clearly states that the majority of dispersal trains defined there by the fine-fraction chemistry of till are only a few hundred meters long. Thus, if anomalies are found in the fine fraction, then the bedrock source may be very nearby.

Regarding the heavy mineral concentrates, since gold can occur in many mineral species, it is prudent to assay the nmHMC in addition to performing native gold grain counts. Further, during interpretation and ranking of the nmHMC anomalies, the total mass of an element should be calculated, since very high siderite contents may dilute the reported assay value.

Magnetic fraction analysis was performed to provide additional pathfinder information to mineralization (e.g. sulfidation; see also Overstreet and Gordon, 1985)) and to pursue unique tracers to identify dispersal trains within tills. The observed geochemical anomalies and unique compositions have the potential to show up when there is nothing evident in the other fractions. Costs are similar to other types of analysis, however, magnetic separation could be done cheaply without doing complete heavy mineral separation.

Pebble counts of +1/4" - 3/8" pebbles from core samples can be done quickly if a binocular microscope is available for use and a good quality light source is available to illuminate wetted pebbles. Larger clasts may be peculiarly interesting, but do not generate usable between sample comparisons on stone lithology distributions. Clasts smaller than 1/4" are more difficult to handle and display much less textural and fabric information than +1/4" clasts. If non-resistant lithologies are being counted, then inspection of unprocessed core may provide the best technique, since processing tends to disaggregate non-resistant clasts.

The objective of the bulk density measurements is to evaluate an economical way to characterize the degree of weathering of the saprolite. Although taking density readings from bedrock drill core is fairly accurate, density readings from materials like saprolite and till can be misleading. These materials can become compacted by the drill, increasing their density because of the exotic carbonates in the till and the siderite in the saprolite. Bulk density is still a more effective way to measure the degree of weathering than L.O.I., a simple chemical alteration index, matrix solubility, or pH. Although there are slight differences in pH, zones in the saprolite cannot be differentiated with pH alone.

Design

The design of this phase of the project has permitted significant progress toward attainment of the project goals and objectives. For example, new characterizations of the glacial drift stratigraphy, saprolite distribution, bedrock lithologies for mapping, and the buried landscape were only possible by the widely-spaced pattern of the 20 boreholes. Moreover, it has been demonstrated that glacial drift compositions, hence background values, should be viewed in the context of regional, local, and small-scale perspective. In summary, all the above characterizations affect the geochemistry and needed to be addressed by the design. One important limitation is that detailed, small-scale till transport distance evaluation, which is important to any follow-up work, was not possible. Brief recommendations on infill drilling, some of which reflect design, are presented in Table 1b.

Conclusion

A tool kit of specific methods, strategies, applications, case examples, and new hypotheses have been presented in this regional survey. Further, a stratigraphic and geochemical framework has been presented, providing an opportunity for improvements through future investigations. A large database, founded upon the quantification of many physical and chemical parameters, has been compiled that should enable more efficient future exploration here within a regional context.

Few exploration techniques of geophysics, geochemistry, and lithochemistry are useful in this deep overburden terrane. The character of the overburden directly affects two--geophysics and geochemistry--and indirectly affects the cost of all of them. The view that the overburden is a material that should be used productively in exploration has been expressed here. And the strategy has been to find tools (attributes) to obtain the most information from whatever case of stratigraphy is found at a given site. Significant progress toward that end has been made.

Finalization of the goal of evaluation for a gold geochemical province must await future infill drilling. In contrast, the opportunity to make a positive contribution through the citing of nine boreholes to the new U.S.G.S. bedrock map (Day and Klein, 1991) has been a gratifying, cooperative effort.

Simultaneous work covering bedrock mapping, geophysical interpretation, and bedrock core logging and lithochemistry (see Previous Work) should be reviewed in conjunction with this report. For example, the bedrock in OB-520 is very deformed, but since no offset pattern is observed in the aeromagnetic map, the bedrock structure there remains ambiguous. In addition, komatiitic rocks were recently identified in available cores (Frey and Venzke, 1991) in this western belt, so perhaps the lower iron content is masking the magnetics and/or conductors. In conclusion, the time is appropriate to take a fresh look at this Baudette area.

A deep overburden drill program such as this is unlike typical geochemical surveys, since the drill samples are very costly. Thus, a broad spectrum of evaluation was done to the samples, and the results of this report include a comprehensive compilation of information for this area that is intended to foster many phases of future exploration.

References

Aluminas, H. V., McHugh, J. B., and Perry, E. C., Jr., 1991, Geochemical evidence for near-surface precious- and base- metal disseminated and vein deposits in the west-central Vermilion district, northeastern Minnesota. In: E. E. Good, J. F. Slack, and R. K. Kotra (Editors), 1991 Program and Abstracts of the Seventh Annual V. E. McKelvey Forum on Mineral and Energy Resources, Reno, Nevada, U.S.G.S. Circular 1062.

Averill, S. A., 1988, Regional variations in the gold content of till in Canada. In: D. R. MacDonald and K. A. Mills (Editors), Prospecting in Areas of Glaciated Terrain 1988. Canadian Institute of Mining and Metallurgy, p. 271-284.

Bajc, A. F., 1988, Gold grains in rotasonic drill core and surface samples (1987-1988). Ontario Geological Survey, Map P. 3140, scale 1:100,000.

Bajc, A. F. and Gray, P. A., 1987, Quaternary geology of the Rainy River area, District of Rainy River; Ontario Geological Survey, Preliminary Map P. 3065, scale 1:50,000.

Bajc, A. F., White, T. N. and Gray, P. A., 1990, Quaternary geology, Northwest Bay area. Ontario Geological Survey, Preliminary Map P. 3138, scale 1:50,000.

Beck, Warren and Murphy, V. R., 1982, Rb-Sr and Sm-Nd studies of Proterozoic mafic dikes in northeastern Minnesota [abs.]: Proceedings, 28th Institute on Lake Superior Geology, International Falls, Mn, p. 5.

Blackburn, C. E., Hailstone, M. R., Delisle, P. C., and Storey, C. C., 1989, Annual report for the Kenora resident geologist's district, reprinted in Ontario Geological Survey Miscellaneous Paper 147, 40 pp.

Bolviken, B., Kullerud, G., and Loucks, R. R., 1990, Geochemical and metallogenic provinces: A discussion initiated by results from geochemical mapping across north Fennoscandia. Journal of Geochemical Exploration, vol. 39, no. 1/2, p. 49-90.

Bracken, R. E. and Godson, R. H., 1988, Aeromagnetic map of the northwestern part of the Hibbing 1° x 2° quadrangle, Minnesota. U. S. Geological Survey, Open-File Report 88-8, scale 1:62,500.

Bracken, R. E., Horton, R. J., Rohret, D. H., Krizman, R. W., Thompson, C. R., Sneddon, R. A., Pierce, H. A. and Mitchell, C. M., 1991, Aeromagnetic map of the Roseau 1° x 2° quadrangle, Minnesota and Ontario, United States Geological Survey, Open File Report 89-452.

Chandler, V. W. and Southwick, D., 1989, Shaded-relief aeromagnetic map of Minnesota. Minnesota Geological Survey and The Legislative Commission on Minnesota Resources, scale 1:2,534,400.

Clark, P. U., 1987, Subglacial sediment dispersal and till composition. Journal of Geology, vol. 95, no. 4, p. 587-541.

Clarke, J. R., Day, W. C., and Klein, T. L., 1990, Geochemical and geological evidence for potential lode-gold deposits near Baudette, Lake of the Woods and Koochiching counties, Minnesota: U. S. Geological Survey, Executive Announcement.

Coker, W. B., Bird, D., Snow, R. J., Downes, M. J., and DiLabio, R. N. W., 1984, Quaternary stratigraphy and geochemistry at the Owl Creek gold mine, Timmins, Ontario. In: Till Tomorrow '84, The Canadian Institute of Mining and Metallurgy - Ontario Geological Survey, Paper 12.

Coker, W. B. and DiLabio, R. N. W., 1988, Geochemical exploration in glaciated terrain: geochemical responses. In: Exploration '87 Proceedings, p. 336-383.

Colvine, A. C. and Stewart, J. W., 1984, Precambrian shield gold exploration trends detailed. Mining Engineering, p. 1642-1645.

Corfu, F. and Stott, G. M., 1986, U-Pb ages for late magmatism and regional deformation in the Shebandowan Belt, Superior Province, Canada. Canadian Journal of Earth Sciences, vol. 23, no. 8, p. 1075-1082.

Corfu, F. and Wood, J., 1986, U-Pb Zircon ages in supracrustal and plutonic rocks, North Spirit Lake area, northwestern Ontario. Canadian Journal of Earth Sciences, vol. 23, no. 7, p. 967-977.

DaCosta, M. L., Fonseca, L. R., and Costa, J. V., 1991, Pattern curves for gold contents distribution in lateritic profiles: application for geochemical exploration in tropical environments. International Geochemical Exploration Symposium Abstracts, Reno, Nevada, 70 pp.

Dahl, D. A. and Cartwright, D. F., 1990, Carbonate in till units of Lake of the Woods County, Minnesota. In: Institute on Lake Superior Geology Proceedings, vol. 36, part 1, p. 16.

Davey, R. and El-Ansary, M., 1986, Geochemical patterns in the laterite profile at the Boddington Gold Deposit, Western Australia, Journal of Geochemical Exploration, 26, p. 119-144.

Davis, D. W., Blackburn, C. E., and Krogh, T. E., 1982, Zircon U-Pb ages from the Wabigoon-Manitou Lakes region, Wabigoon Subprovince, northwest Ontario, Canadian Journal of Earth Sciences, vol. 19, p. 254-266.

Davis, D. W. and Edwards, G. R., 1986, Crustal evolution of Archean rocks in the Kakagi Lake area, Wabigoon subprovince, Ontario, as interpreted from high-precision U-Pb geochronology. Canadian Journal of Earth Sciences, vol. 23, p. 182-192.

Davis, D. W., Poulsen, K. H., and Kamo, S. L., 1989, New insights into Archean crustal development from geochronology in the Rainy Lake area, Superior Province, Canada. Journal of Geology, vol. 97, p. 379-398.

Day, W. C., Klein, T. L., and Schulz, K. J., 1991, Bedrock geologic map of the Roseau 1° by 2° quadrangle, Minnesota and Ontario, Canada: open-file map series, U. S. Geological Survey, Denver, Colorado.

Dredge, L. A. and Cowan, W. R., 1989, Quaternary geology of the southwestern Canadian Shield. In: Fulton, R. J. (Editor), Quaternary Geology of Canada and Greenland. Geological Survey of Canada, p. 214-235.

Eng, M. T., 1979, An Evaluation of the surficial geology and bog patterns of the Red Lake bog, Beltrami and Lake of the Woods counties. Minnesota Department of Natural Resources, Minerals Division, scale 1:126,720.

Frey, B. A., Venzke, E. A., and Walker, J. S., 1991, 1990-1991 Archean drill core description and assay, Lake of the Woods County, Minnesota. Report 278, Minnesota Department of Natural Resources, Division of Minerals.

Grout, F. F., 1927, Field note book number 150: Minnesota Geological Survey, 47 pp.

Harris, K. L., Moran, S. R., and Clayton, L., 1974, Late Quaternary stratigraphic nomenclature, Red River Valley, North Dakota and Minnesota. North Dakota Geological Survey, Miscellaneous Series, no. 52, 47 pp.

Hattori, K., 1987, Magnetic felsic intrusions associated with Canadian Archean gold deposits. Geology, vol. 15, no. 12, p. 1107-1111.

Helgesen, J. O., Lindholm, G. F., and Ericson, D. W., 1975, Water resources of the Lake of the Woods watershed, north central Minnesota. U. S. Geological Survey, Hydrologic Investigations Atlas, HA-544, scale 1:500,000, 2 sheets.

Hobbs, H. C. and Goebel, J. E., 1982, Geologic map of Minnesota, Quaternary geology. Minnesota Geological Survey, State Map Series, S-1, scale 1:500,000.

Horton, R. J. and Chandler, V. W., 1988, Complete Bouguer gravity anomaly map of the Roseau 10 x 20 quadrangle, Minnesota and Ontario: U. S. Geological Survey Open-File Report 88-531.

Horton, R. J., Meyer, G. N., and Bajc, A. J., 1989, Reconnaissance Quaternary geology map of the International Falls 1° x 2° quadrangle. U. S. Geological Survey, Open-File Report 89-654, scale 1:250,000.

Johnson, M. D., 1986, Pleistocene geology of Barron County, Wisconsin. Wisconsin Geological and Natural History Survey, Information Circular, no. 55, 42 pp.

Klein, T. L., 1991, Lithologic descriptions of bedrock core from the Roseau 1° x 2° quadrangle, northern Minnesota, United States Geological Survey, Open-file Report 91-35, 11 pp.

Klein, T. L., and Day, W. C., 1989, Tabular summary of lithologic logs and geologic characteristics from diamond drill holes in the western International Falls and the Roseau 1° by 2° quadrangles, northern Minnesota: Open-File Report 89-346, United States Geological Survey, Reston, Virginia.

Kokkola, M. and Pehkonen, E., 1976, Kangaskyla: gold in till. Journal of Geochemical Exploration, vol. 5, no. 3, p. 209-211.

Kontas, E., 1991, Gold contamination of the fine fraction of till during sampling and sample preparation. Journal of Geochemical Exploration, vol. 39, p. 289-294.

Lawler, T. L. and Venzke, E. A., 1991, Aeromagnetic interpretation pseudo-geologic maps, with evaluation, in Lake of the Woods and Lake counties, Minnesota. Report 290, Minnesota Department of Natural Resources, Division of Minerals.

Lee, H. A., 1963, Glacial fans in till from the Kirkland Lake Fault: a method of gold exploration. Ottawa: Geological Survey of Canada, 36 pp.

Lehmuspelto, P., 1987, Some case histories of the till transport distances recognized in geochemical studies in northern Finland. Geological Survey of Finland, Special Paper 3, p. 163-168.

Martin, D. P., Meyer, G., Cartwright, D. F., Lawler, T. L., Pastika, T., Jirsa, M. A., Boerboom, T. J. and Streitz, A. R., 1989, Regional geochemical survey of glacial drift drill samples over Archean granite-greenstone terrane in the Effie area, northern Minnesota. Report 263, Minnesota Department of Natural Resources, Division of Minerals.

Martin, D. P., Meyer, G., Lawler, T. L., Chandler, V. W., and Malmquist, K. L., 1988, Regional survey of buried glacial drift geochemistry over Archean terrane in northern Minnesota. Legislative Commission on Minnesota Resources Project, Report 252, Minnesota Department of Natural Resources, Division of Minerals.

Mathes, S. A., Farrell, R. F., and Mackie, A. J., 1983, A microwave system for the acid dissolution of metal and mineral samples. Bureau of Mines Technical Progress Report, Report 120, 9 pp.

McGinnis, L., Durfee, G., and Ikola, R. J., 1973, Simple Bouguer gravity map of Minnesota Roseau sheet: Minnesota Geological Survey, Miscellaneous Map Series, Map M-12, 1:250,000.

McRitchie, W. D., 1980, Mineral map of Manitoba. Manitoba Department of Energy and Mines, Mineral Resources Division, Map, No. 80-1, scale 1:1,000,000.

Meuschke, J. L., Books, K. G., Henderson, J. R. Jr. and Schwartz, G. M., 1957, Aeromagnetic and geologic map of northern Lake of the Woods and northeastern Roseau counties, Minnesota, United States Geological Survey, Geophysical Investigations Map GP 128, scale 1:63,360.

Meuschke, J. L., Books, K. G., Henderson, J. R. Jr. and Schwartz, G. M., 1957, Aeromagnetic and geologic map of northern Beltrami and southern Lake of the Woods counties, Minnesota, United States Geological Survey, Geophysical Investigations Map GP 129, scale 1:63,360.

Meyer, G. N., 1986, Subsurface till stratigraphy of the Todd County area, central Minnesota. MGS, RI 34, 40 pp.

Mills, S. J., Southwick, D. L., and Meyer, G. N., 1987, Scientific core drilling in north-central Minnesota: Summary of 1986 lithologic and geochemical results. Minnesota Geological Survey, Information Circular 24, University of Minnesota, p. 19-40.

Mutschler, F. E. and Radtke, A. S., 1991, Word-class gold deposits--the model success story--where is the next olympic dam? International Geochemical Exploration Symposium, Reno, Nevada, Abstracts, 70 pp.

Nielsen, E., Ringrose, S. M., Matile, G. L. D., Groom, H. D., Mihychuk, M. A., and Conley, G. G., 1981, Surficial geological map of Manitoba. Manitoba Department of Energy and Mines, Mineral Resources Division, Map 81-1, scale 1:1,000,000.

Ojakangas, R. W., Meineke, D. G. and Listerud, W. H., 1977, Geology, sulfide mineralization and geochemistry of the Birchdale - Indus area, Koochiching County, Minnesota. Minnesota Geological Survey, Report of Investigation 17, 78 pp.

Overstreet, W. C. and Gordon, W. D., 1985, Review of the use of magnetic concentrates in geochemical exploration. Technical record, USGS-TR-05-4, p. 1-38.

Parham, W. E., 1970, Clay mineralogy and geology of Minnesota kaolin clays. Minnesota Geological Survey, Spec. Pap. Ser., SP-10, 142 pp.

Pavich, M. J., Leo, G. W., Obermeier, S. F., and Estabrook, J. R., 1989, Investigations of the characteristics, origin, and residence time of the upland residual mantle of the Piedmont of Fairfax County, Virginia, U. S. Geological Survey Professional Paper 1352, 58 pp.

Percival, J. A. and Williams, H. R., 1989, Late Archean Quetico accretionary complex, Superior Province, Canada. Geology, vol. 17, p. 23-35.

Roberts, R. G., 1988, Ore deposit models. Geological Association of Canada, 1988 vol., 194 pp.

Schiffelbein, P., 1987, Calculation of confidence limits for geologic measurements. In: Use and Abuse of Statistical Methods in the Earth Sciences. International Association for Mathematical Geology Studies in Mathematical Geology, p. 21-32.

Shilts, W. W., 1976, Mineral exploration and till. In: R. F. Legget (Editor) Glacial Till. Royal Society of Canada, Special Publication 12, p. 205-224.

Sims, P. K. and Ojakangas, R. W., 1973, Precambrian geology of the Roseau sheet, Minnesota, Minnesota Geological Survey, Open-File Map, scale 1:250,000.

Size, W. B., 1987, Use of representative samples and sampling plans in describing geologic variability and trends. In: Use and Abuse of Statistical Methods in the Earth Sciences. International Association for Mathematical Geology Studies in Mathematical Geology, p. 3-20.

Smith, R. E., 1987, Some conceptual models for geochemistry in areas of preglacial deep weathering. Geochemical Exploration, p. 337-352.

Szabo, N. L., Govett, G. J. S., and Lajtai, E. Z., 1975, Dispersion trends of elements and indicator pebbles in glacial till around Mt. Pleasant, New Brunswick, Canada, Canadian Journal of Earth Sciences, vol. 12, p. 1534-1556.

Teller, J. T. and Fenton, M. M., 1980, Late Wisconsinan glacial stratigraphy and history of southeastern Manitoba. Canadian Journal of Earth Sciences, vol. 17, p. 19-35.

Thorleifson, L. H. and Kristjansson, F. J., 1988, Visible gold content and lithology of till from overburden drillholes, Beardmore-Geraldton area, district of Thunder Bay, northern Ontario. Geological Survey of Canada, Open File Report 1756, 21 pp.

Todd, R. G., 1991, Characteristics of a stratabound gold/base metal deposit in an amphibolite terrane. Geological Association of Canada/Mineralogical Association of Canada, Abstracts.

Williams, H. R., 1990, Subprovince accretion tectonics in the south-central Superior Province. Canadian Journal of Earth Sciences, vol. 27, p. 570-581.

Winchel, N. H., 1899, The geology of Lake of the Woods County: Geology of Minnesota, 1896-1898: The Geological and Natural History Survey of Minnesota, vol. 4, p. 155.

Zippi, P. A. and Bajc, A. F., 1990, Recognition of a Cretaceous outlier in northwestern Ontario. Canadian Journal of Earth Science, vol. 27, p. 306-311.

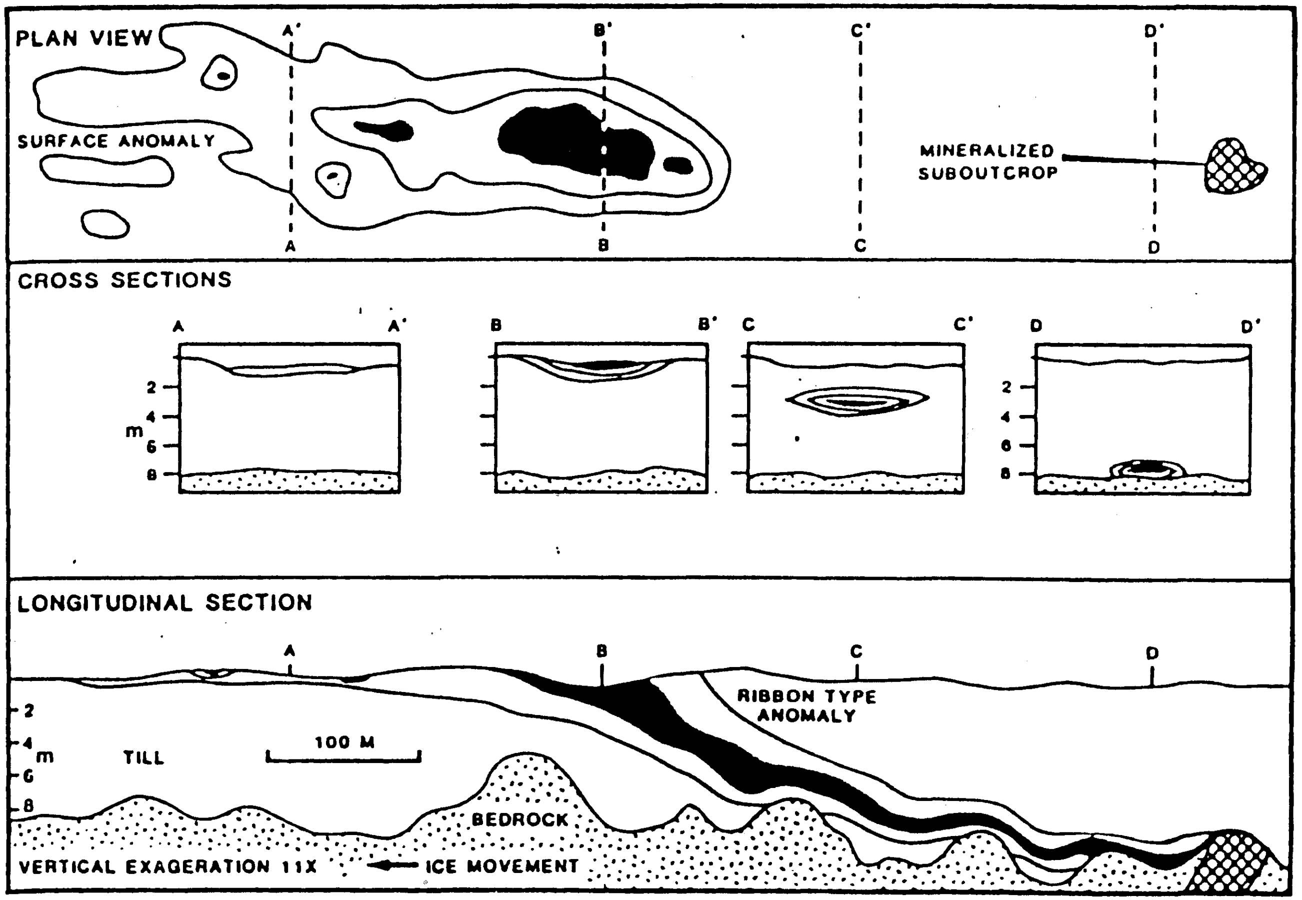


Figure 1. Idealized glacial dispersal model [modified from (Miller 1984) in (Coker and Dilabio, 1988)].

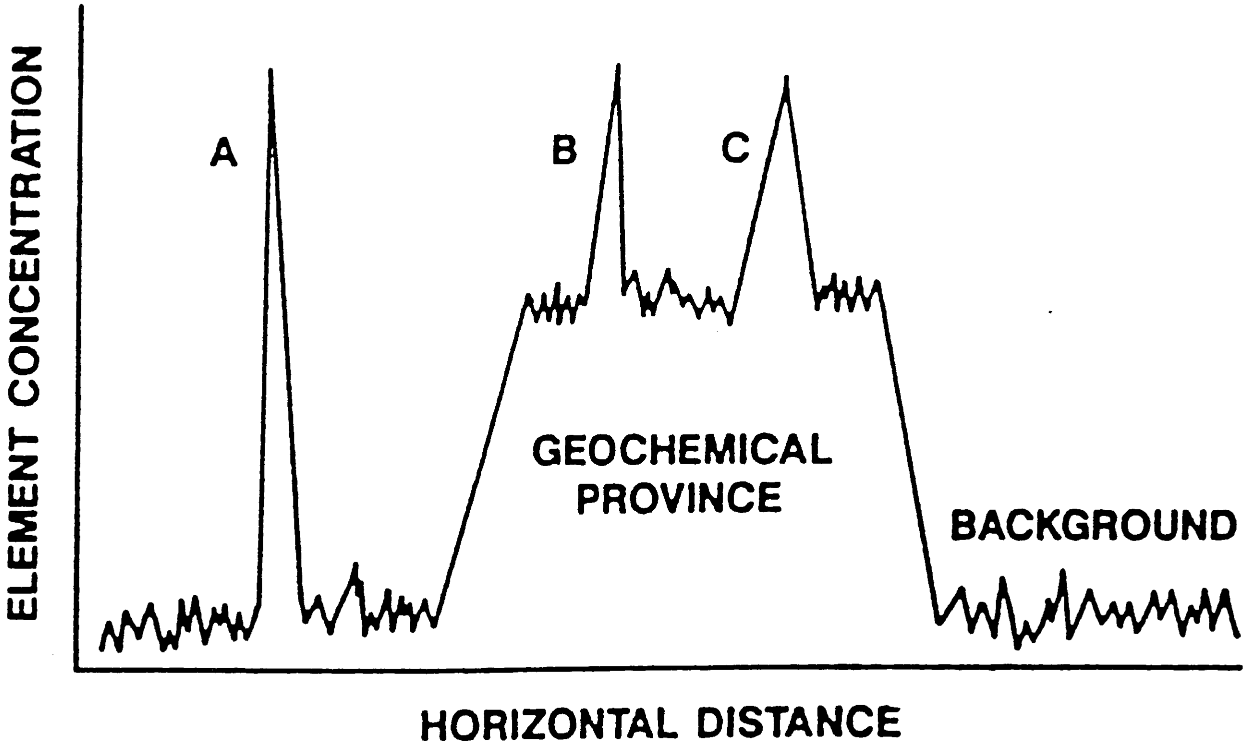
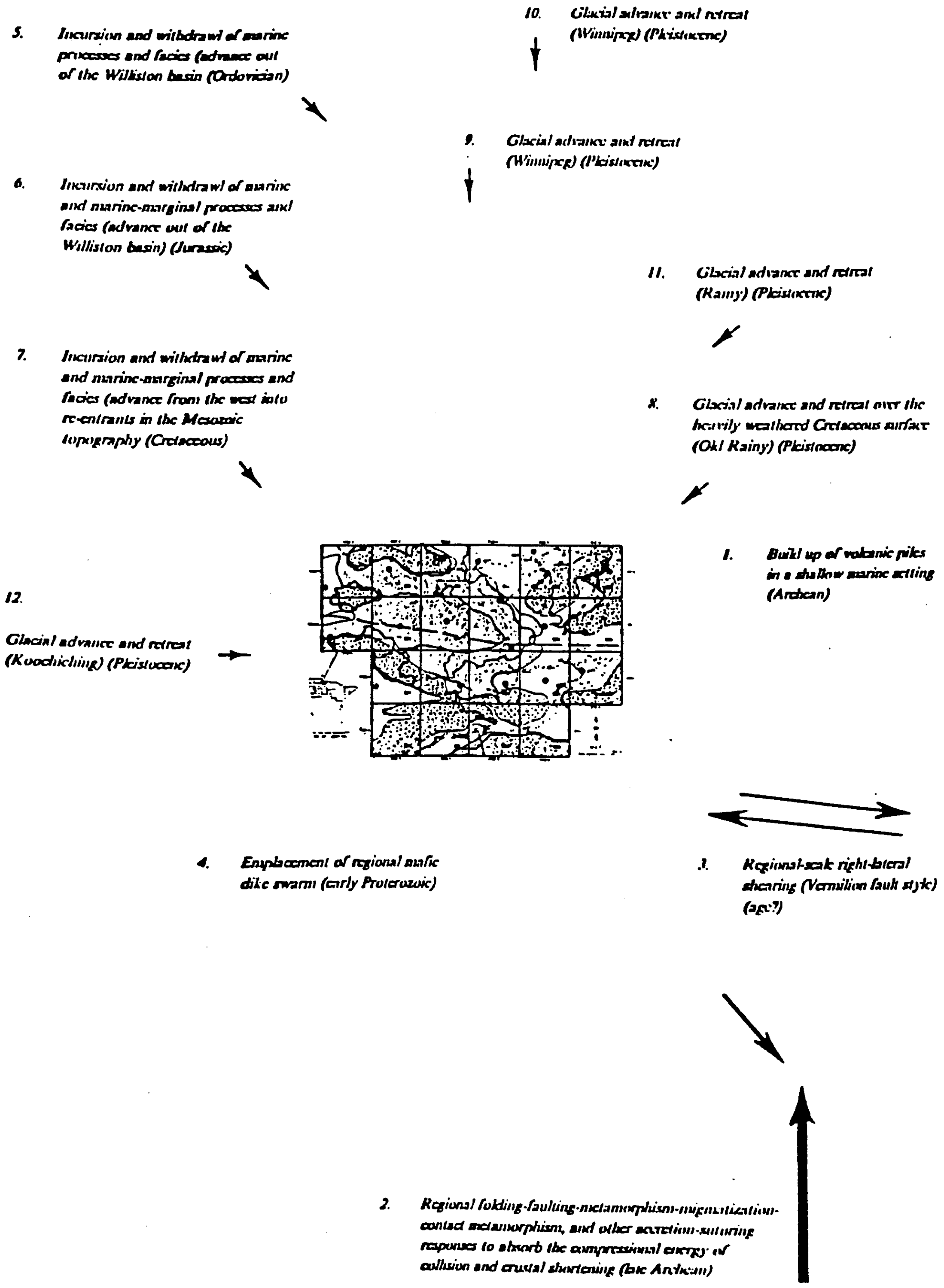


Figure 2. Sketch showing a profile with a geochemical province and three geochemical anomalies caused by ore deposits of which one (A) is outside the geochemical province and two (B and C) are inside. The horizontal distance is any where from the order of kilometers and upward. Most mineral deposits of economic interest are assumed to belong to types B and C (Bolviken and others, 1990).

Figure 3. Schematic summary of the geologic history.



1. Build up of volcanic piles in a shallow marine setting (Archean)

2. Regional folding-faulting-metamorphism-migmatization-contact metamorphism, and other accretion-suturing responses to absorb the compressional energy of collision and crustal shortening (late Archean)

3. Regional-scale right-lateral shearing (Vermilion fault style) (age?)

4. Emplacement of regional mafic dike swarm (early Proterozoic)

5. Incursion and withdrawl of marine processes and facies (advance out of the Williston basin (Ordovician)

6. Incursion and withdrawl of marine and marine-marginal processes and facies (advance out of the Williston basin) (Jurassic)

7. Incursion and withdrawl of marine and marine-marginal processes and facies (advance from the west into re-entrants in the Mesozoic topography (Cretaceous)

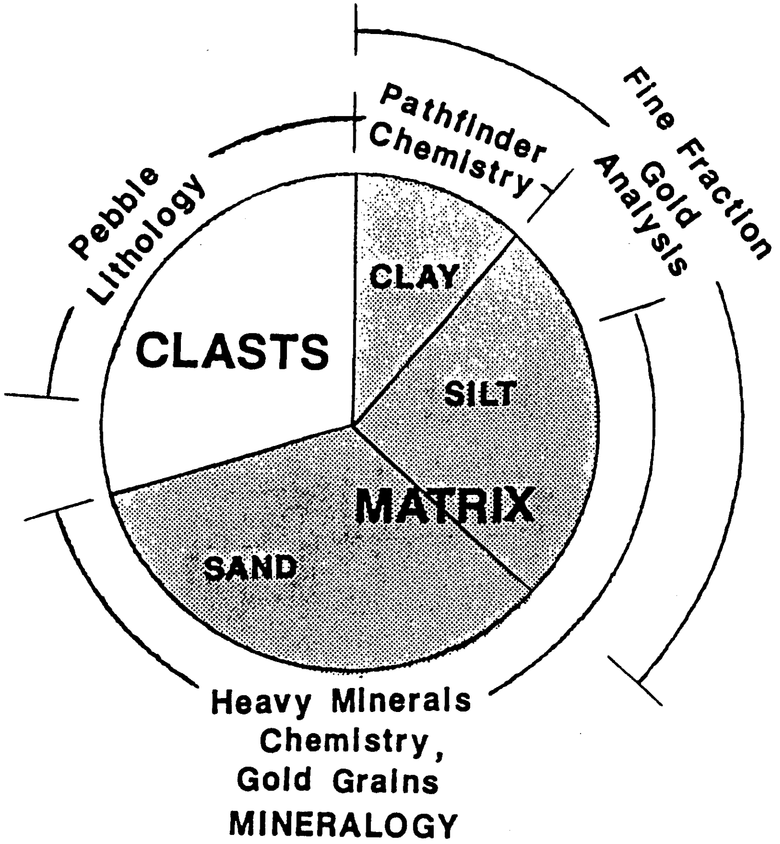
8. Glacial advance and retreat over the heavily weathered Cretaceous surface (Old Rainy) (Pleistocene)

9. Glacial advance and retreat (Winnipeg) (Pleistocene)

10. Glacial advance and retreat (Winnipeg) (Pleistocene)

11. Glacial advance and retreat (Rainy) (Pleistocene)

12. Glacial advance and retreat (Koochiching) (Pleistocene)



- I. Matrix
  - 1. Chemistry
    - a. -2 um fraction (clay sized, 23 pathfinder elements)
    - b. -63 um fraction (Au + Ag)
    - c. -1700 um fraction, heavy minerals (+3.3 s.g.)
      - 1. Nonmagnetic (gold + 23 pathfinder elements)
      - 2. Magnetic (10 pathfinder elements)
    - d. Matrix solubility (Ca, Mg, Fe, total wt% soluble)
  - 2. Mineralogy
    - a. -1700 um fraction nonmagnetic heavy minerals (+3.3 s.g.)
    - b. 14 selected samples: clay identification
- II. Clasts
  - 1. Pebble counts by lithology and size
- III. Bulk Sample
  - 1. Magnetic susceptibility (all 4325 feet)
  - 2. Oxidation state (all 4325 feet)
  - 3. Color (all 4325 feet)
  - 4. pH (48 selected samples)
  - 5. Bulk density (52 selected samples)

Figure 4. Sample fractions analyzed. The total composition was subdivided into two major parts, matrix vs. clasts, for quantitative analysis. The attributes measured are outlined here.

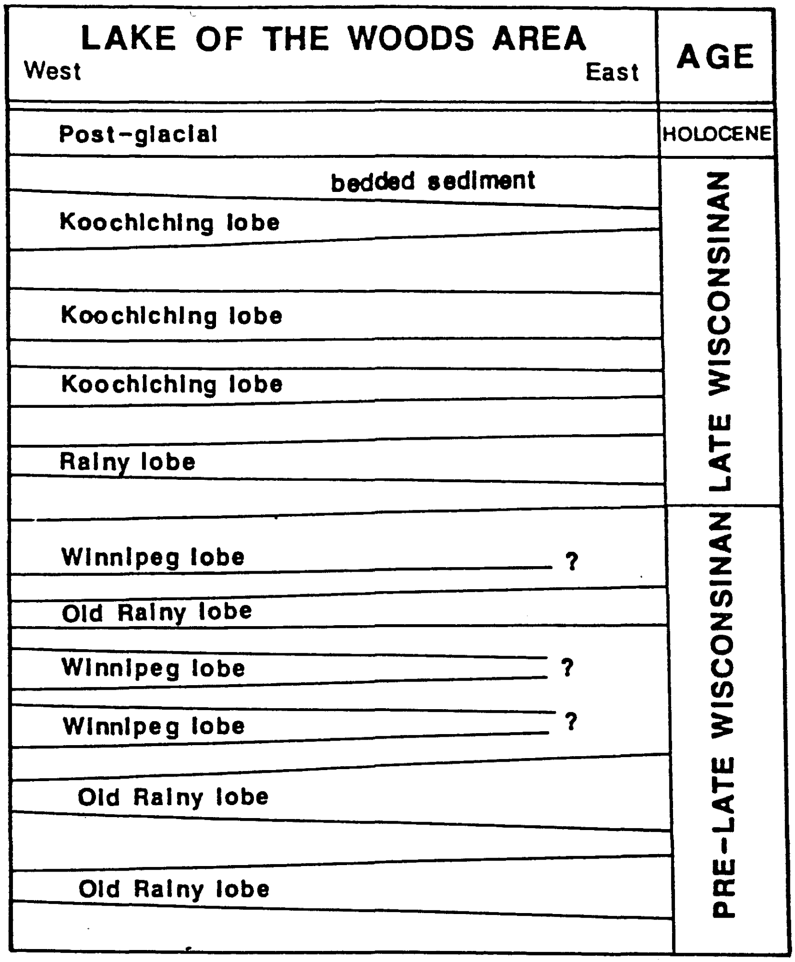
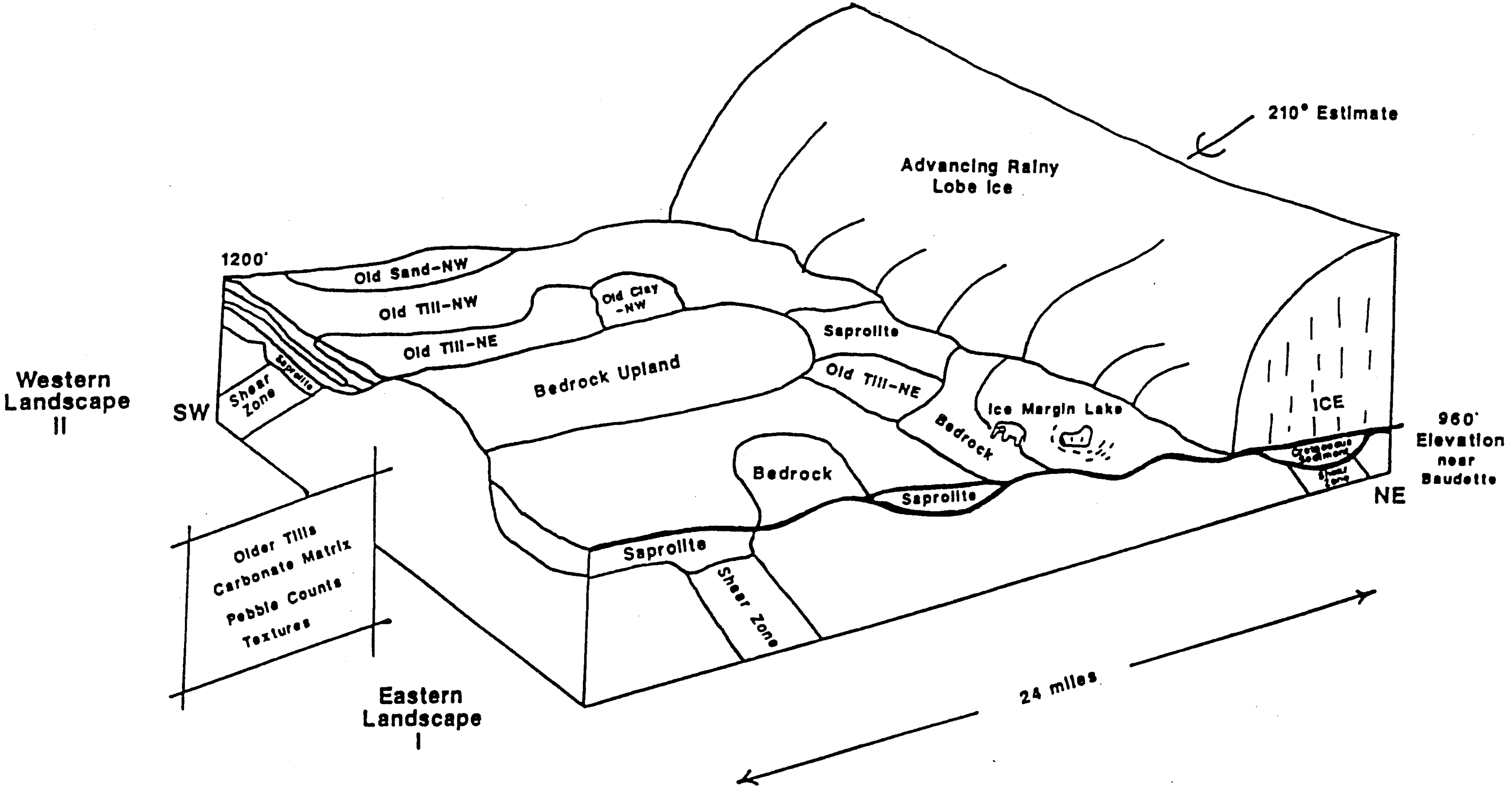


Figure 5. Time-distance diagram showing relative timing and extent of glacial events in the Baudette Area.

Provenance of glacial drift units.

Name	Continental Provenance
Koochiching lobe deposits	Keewatin
Rainy lobe deposits	Labradorean
Winnipeg lobe deposits	Keewatin
Old Rainy lobe deposits	Labradorean

Figure 6. Landscape near Baudette, Minnesota, at the time of Rainy lobe ice advance. Sediment cover varies on a much smaller scale than depicted. This reconstruction is based on all available drillhole data.



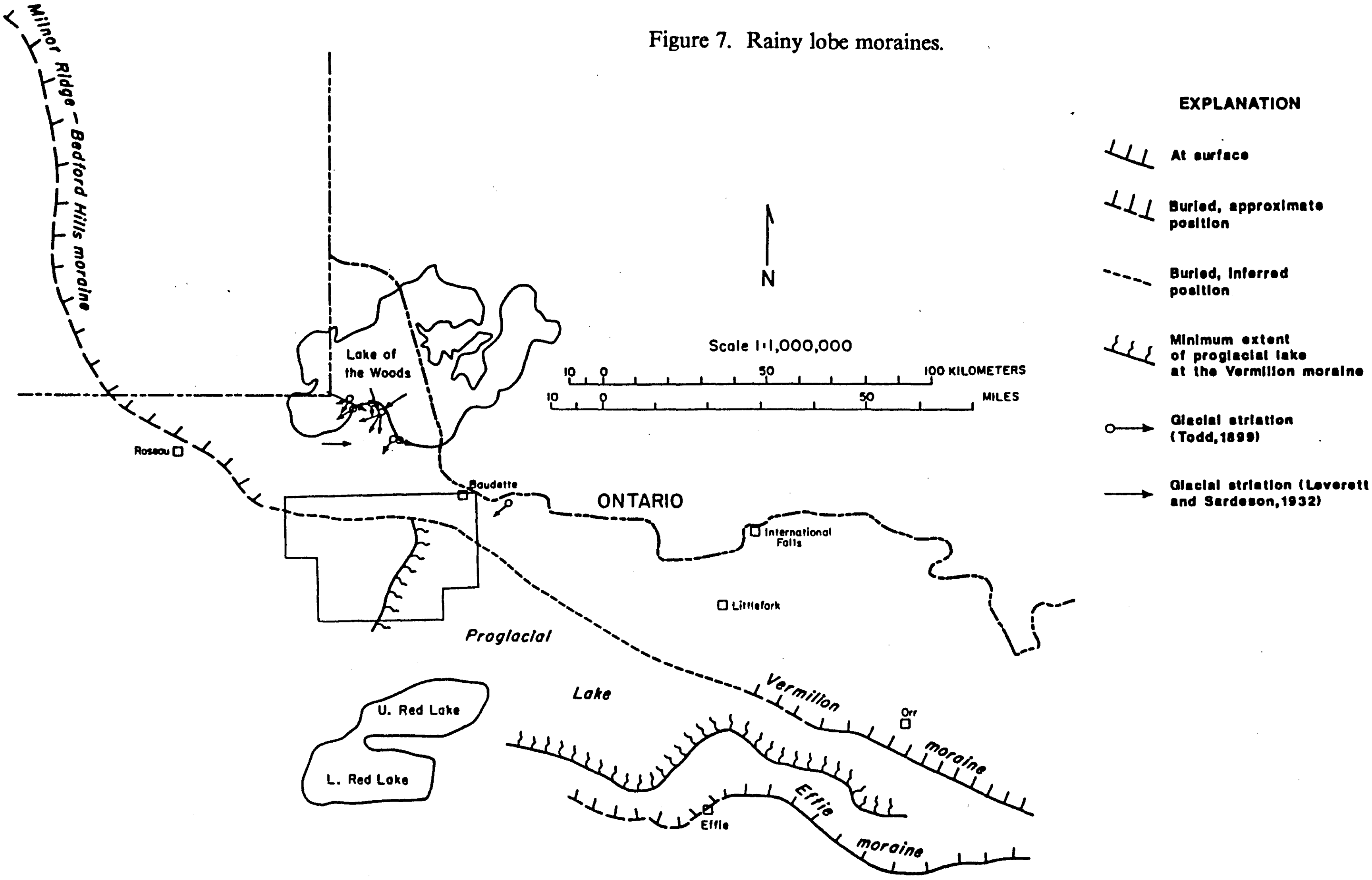
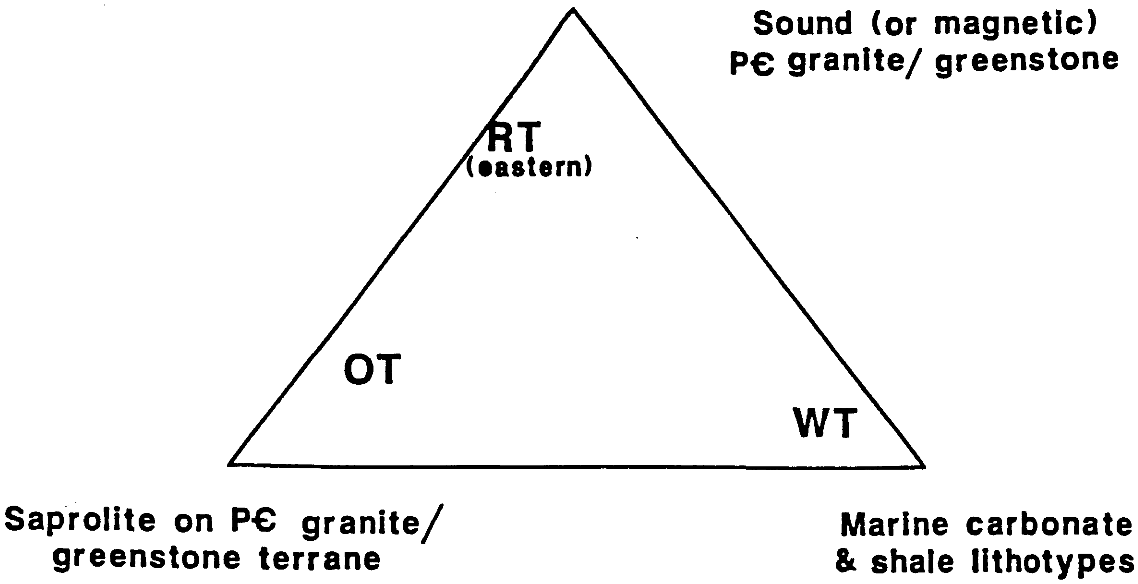


Figure 7. Rainy lobe moraines.

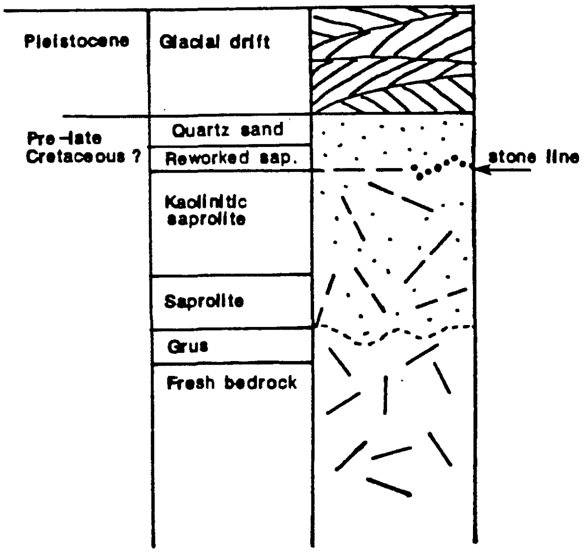
Figure 8. Proposed model summarizing the regional stratigraphic composition and case examples of mixing that change the composition. Mixing is inferred to occur at all scales, based upon the examples, primarily by incorporation of available underlying materials.



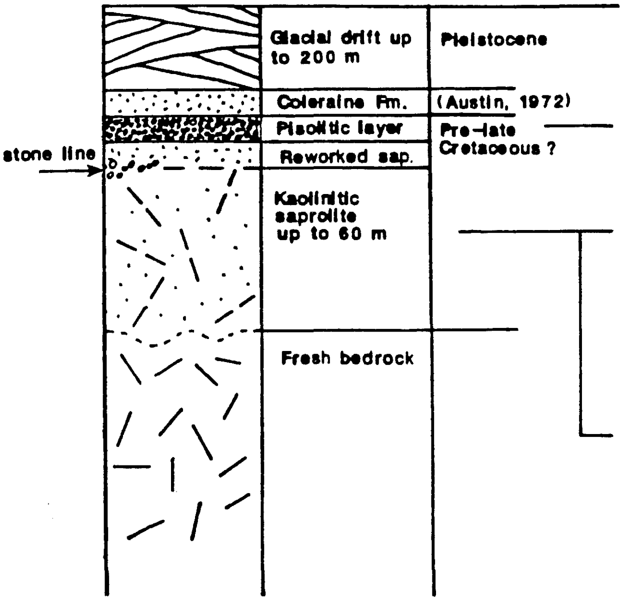
Examples of processes that cause mixing:	Boreholes
Case 1: RT overrides SAP → more SAP in RT	501
Case 2: RT overrides WT → more carb. in RT	517-521
Case 3: RT overrides OT → intermed. SAP + carb. in RT	507
Case 4: RT overrides outcrop → more sound PC in RT	509
Case 5: WT overrides SAP → more SAP in WT	511
Case 6: WT overrides OT → less carb. in WT	517
Case 7: WT overrides outcrop → more sound PE in WT	513 512?
Case 8: OT overrides WT → more carb. in OT	521?
Case 9: OT overrides outcrop → more sound PE in OT	515
Case 10: OT overrides SAP → more SAP in OT	505

Figure 9. Generalized stratigraphy within saprolite in the Baudette Area.

A. Baudette Area - Minnesota - units found in Rotasonic core (modified from Smith, 1987).



B. Northern Minnesota - Generalized - from the literature (Parham, 1970, as cited in Smith, 1987).



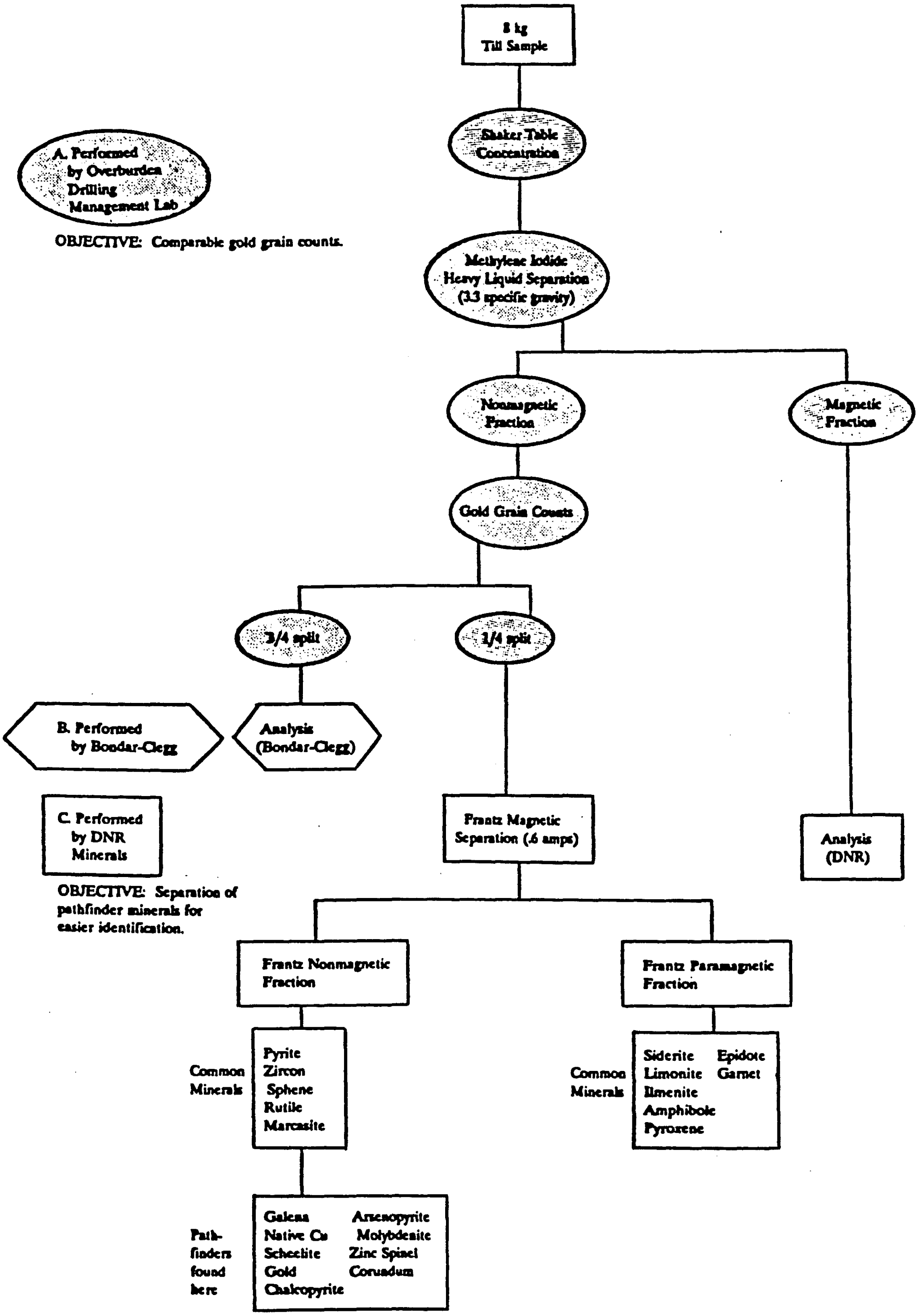
Examples of Trace Element Distribution in Laterite from Literature Examples

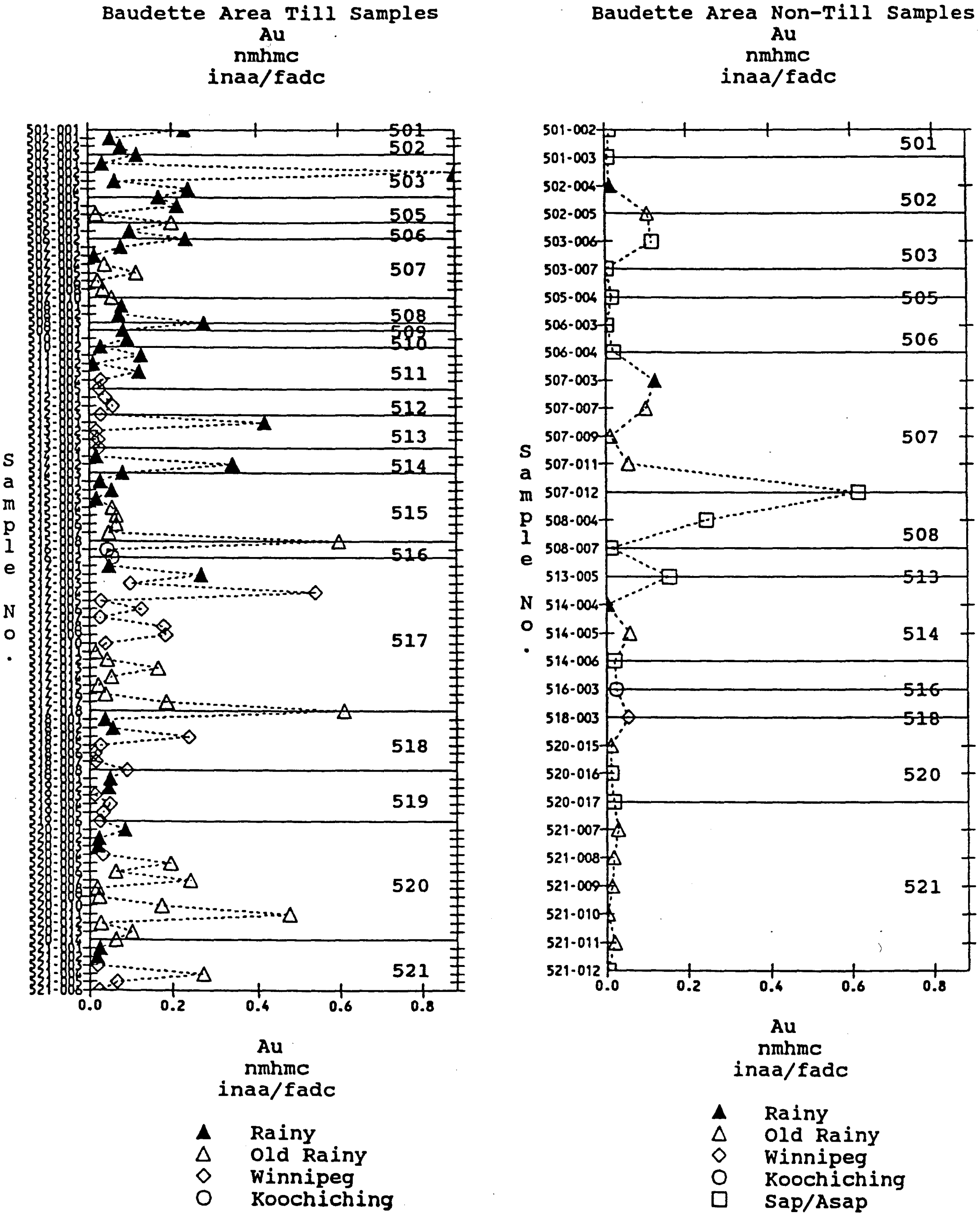
For Duricrust anomalies over massive sulfide occurrences in Australia (Smith & Perdrix, 1983) Bi-Sn-Sb-As-Mo-In-Cu-Au enrichment.

For Boddington Gold Deposit, Australia (Davy & El-Ansary, 1986) Generalization of: Elements Leached: Ba, Co, La, Mn, Ni, Rb, Sr, Ta, Zn, Y, CaO, K_2O, MgO, Na_2O; Elements Reprecipitated: Au, Ce, Cr, Cu, Mo, Fe_2O_3; Elements Residual: Sn, Nb, Th, V, W, Zr, Al_2O_3, TiO_2.

Saprolite Accumulations: Fe, Mn, Ni, Co, Si, CO_3 (relating to nickel sulfide exploration in Australia; Smith, B.H., 1984).

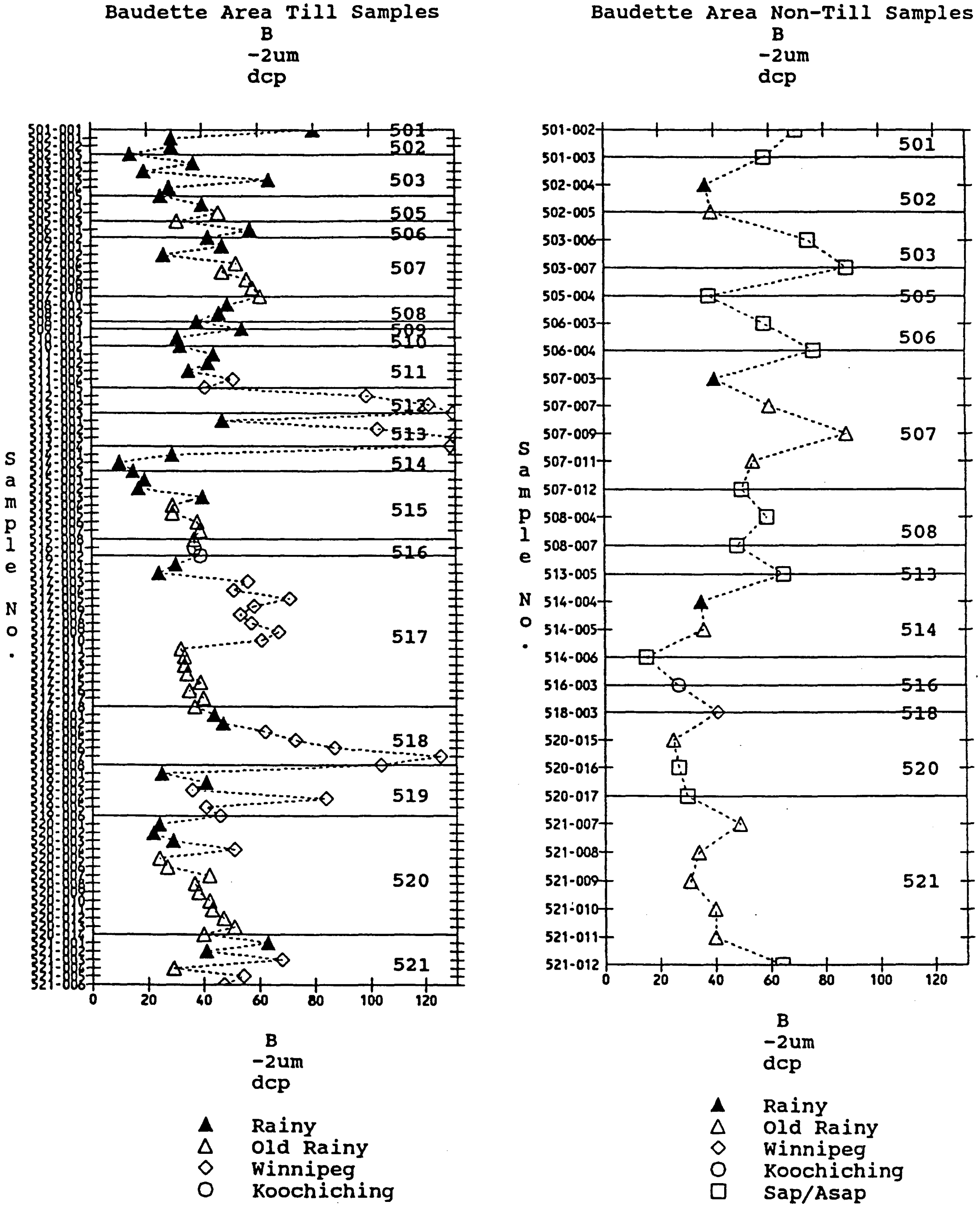
Figure 10. Sample prep flow sheet.





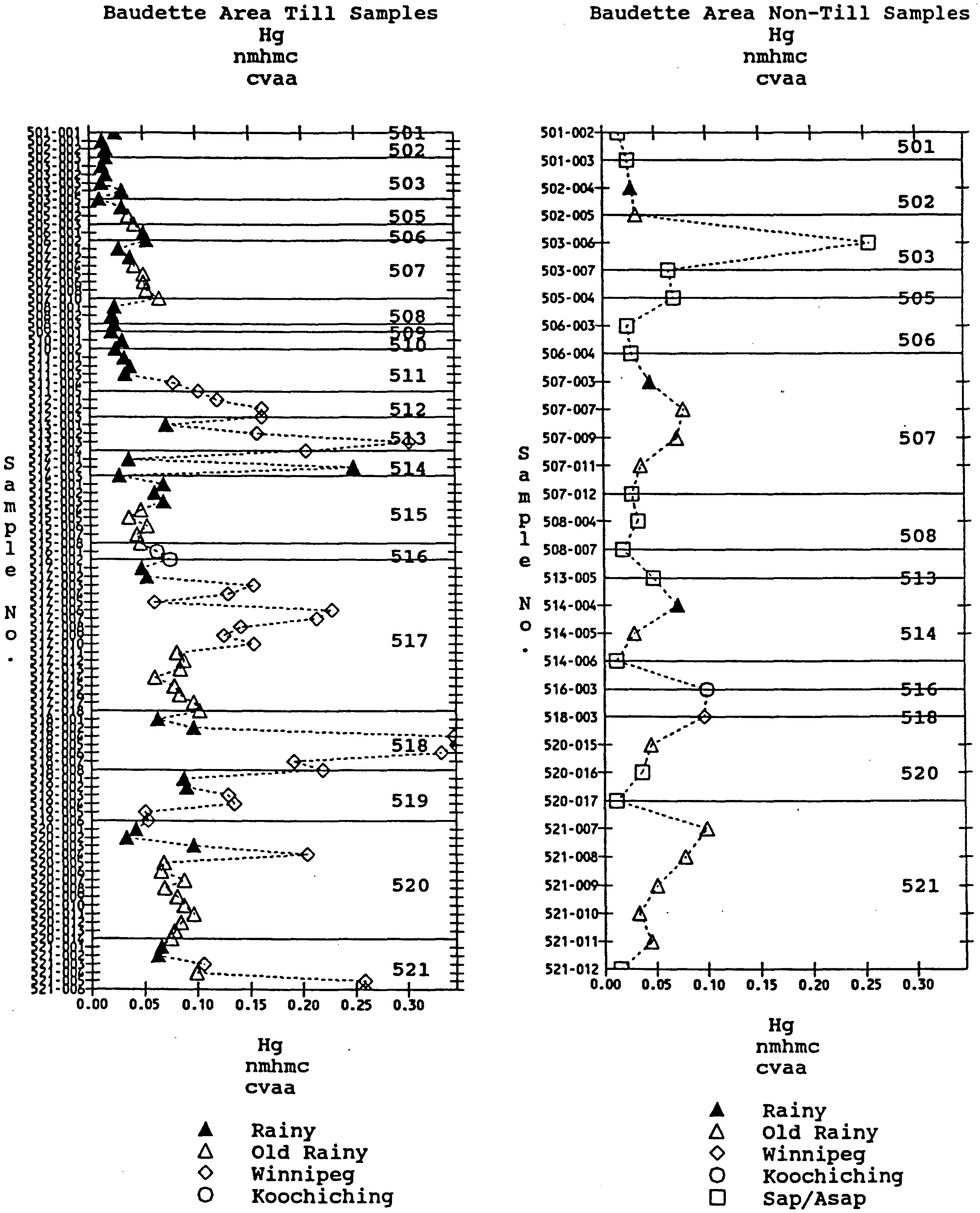
Note: Units are in ppm

Figure 11a. Plot of gold assays in the nmHMC fraction of till and nontill samples in the Baudette Area.



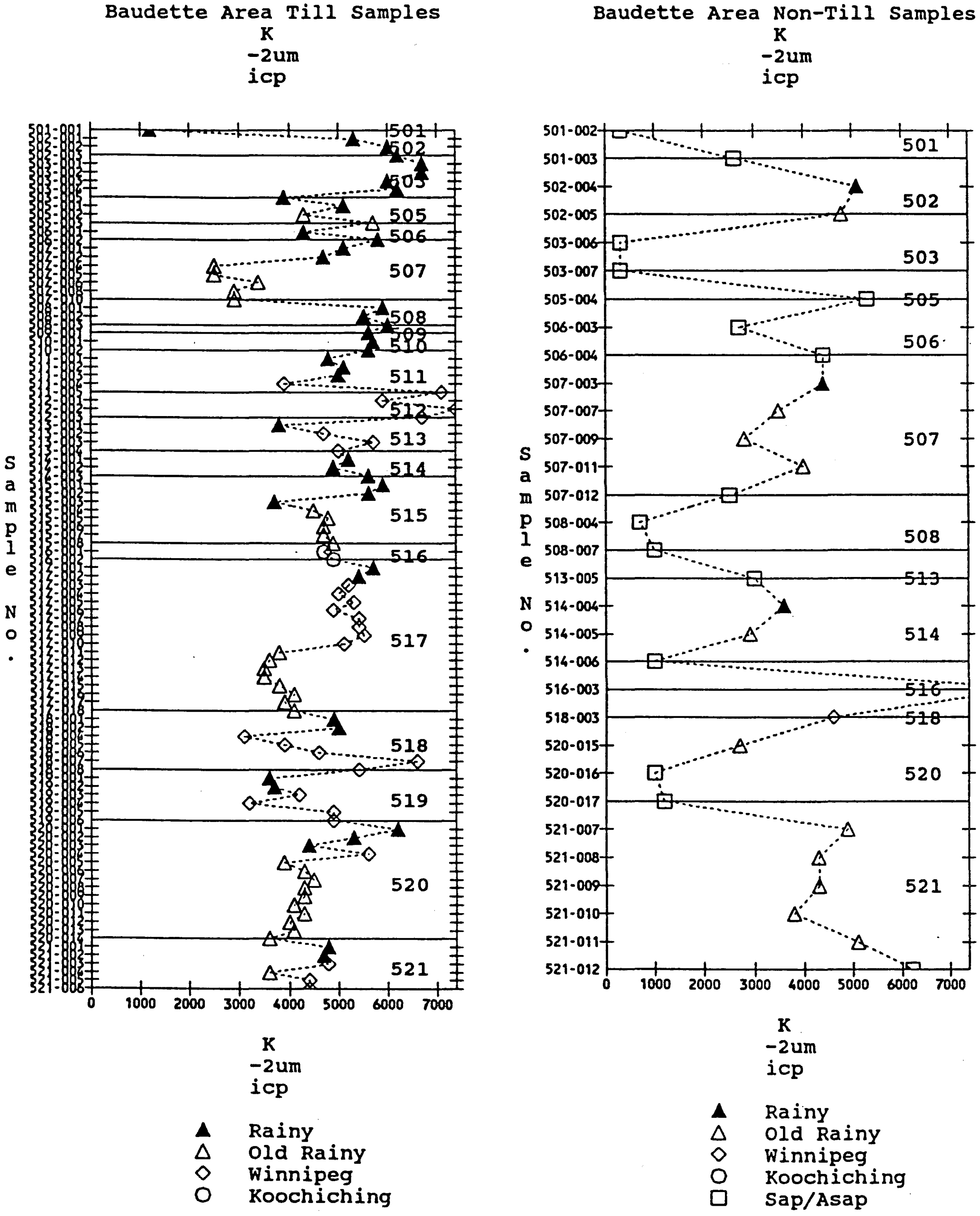
Note: Units are in ppm

Figure 11b. Plot of boron sassays in the -2um fraction of till and nontill samples in the Baudette Area.



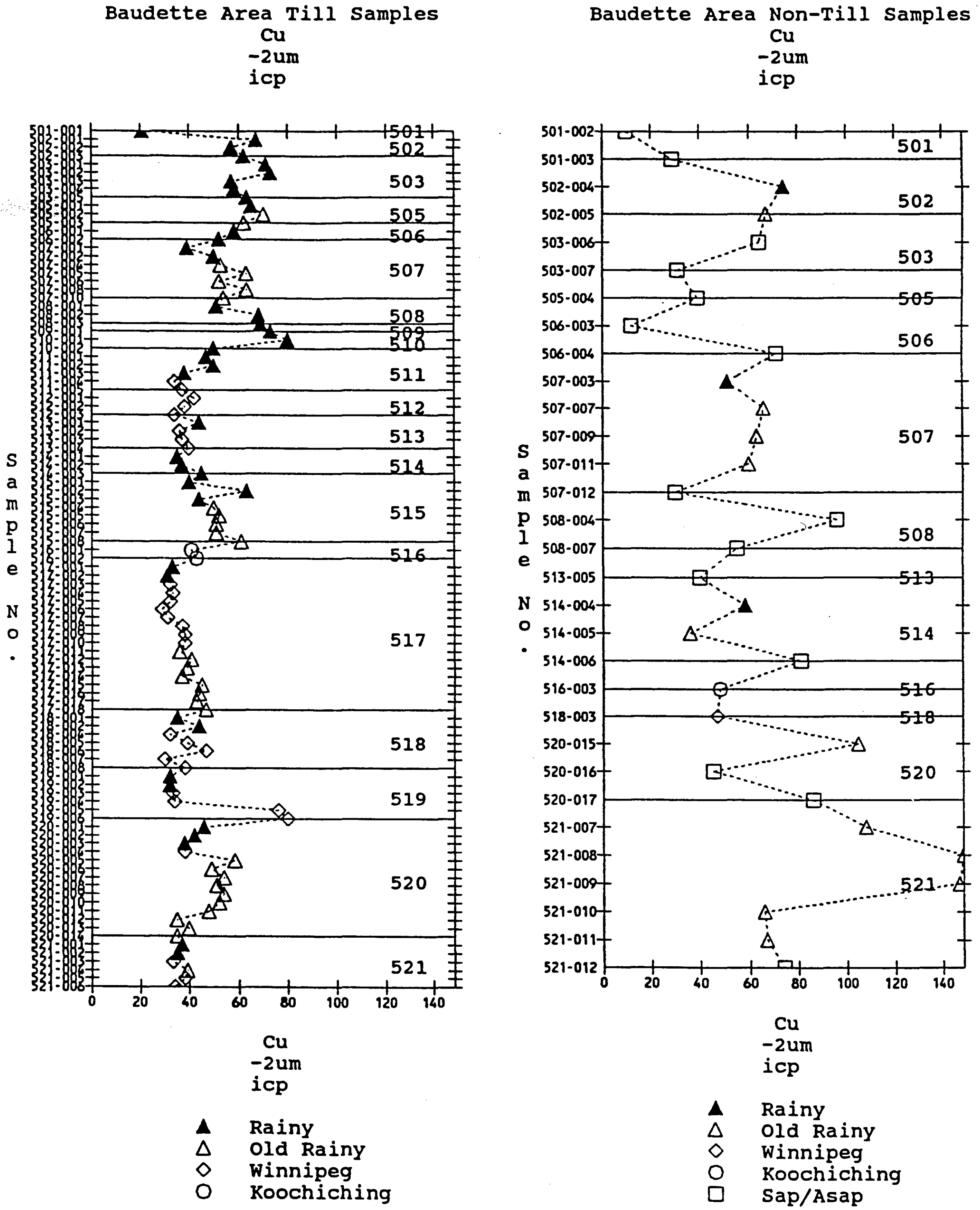
Note: Units are in ppm

Figure 11c. Plot of mercury assays in the nmHMC fraction of till and nontill samples in the Baudette Area.



Note: Units are in ppm

Figure 11d. Plot of potassium assays in the -2um fraction of till and nontill samples in the Baudette Area.



Baudette Area Till Samples
Cu
-2um
icp

Baudette Area Non-Till Samples
Cu
-2um
icp

Note: Units are in ppm

Figure 11e. Plot of copper assays in the -2um fraction of till and nontill samples in the Baudette Area.

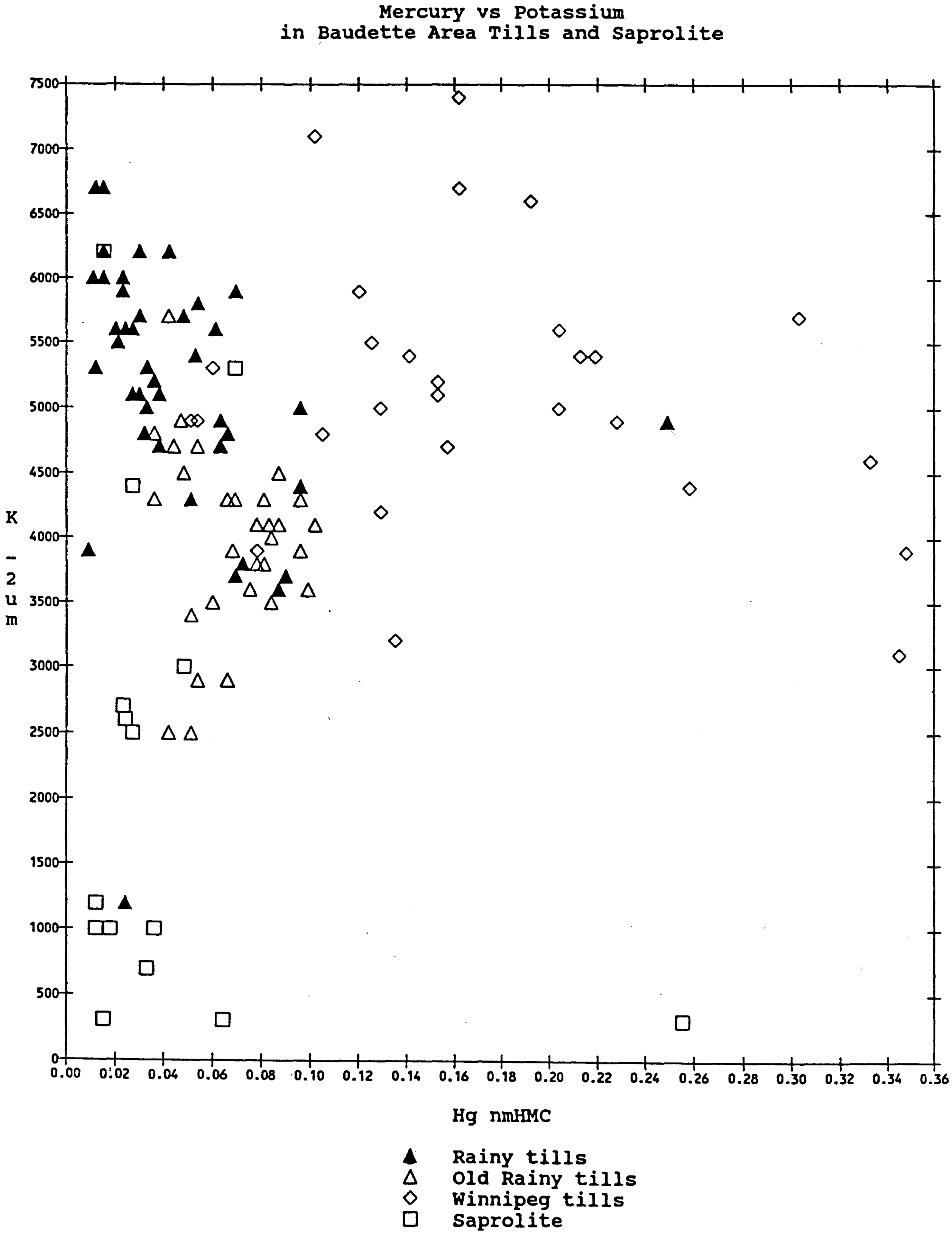
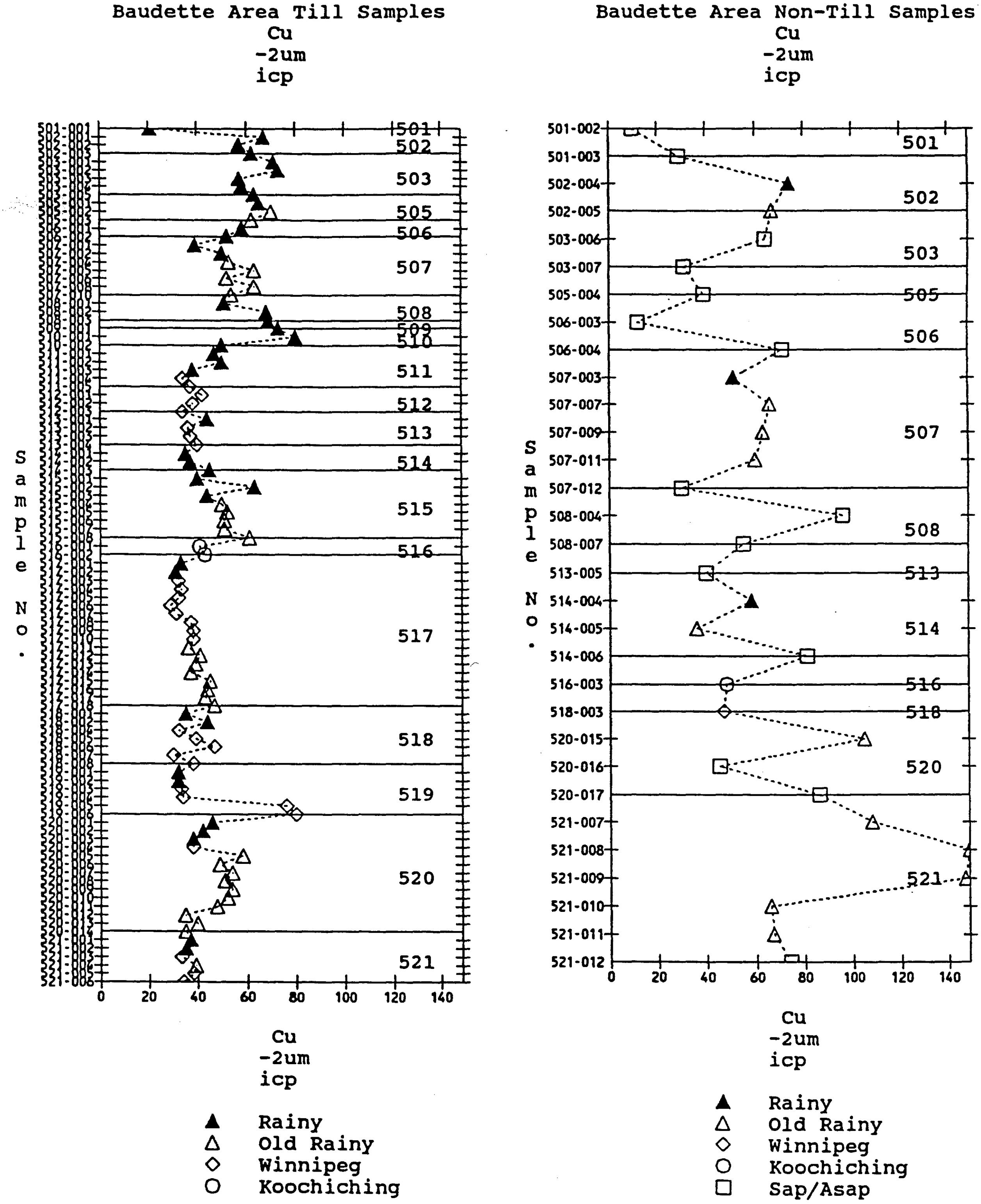


Figure 12a. Plot of mercury vs. potassium assays in Baudette Area tills and saprolite.



Baudette Area Till Samples
Cu
-2um
icp

Baudette Area Non-Till Samples
Cu
-2um
icp

Note: Units are in ppm

Figure 11e. Plot of copper assays in the -2um fraction of till and nontill samples in the Baudette Area.

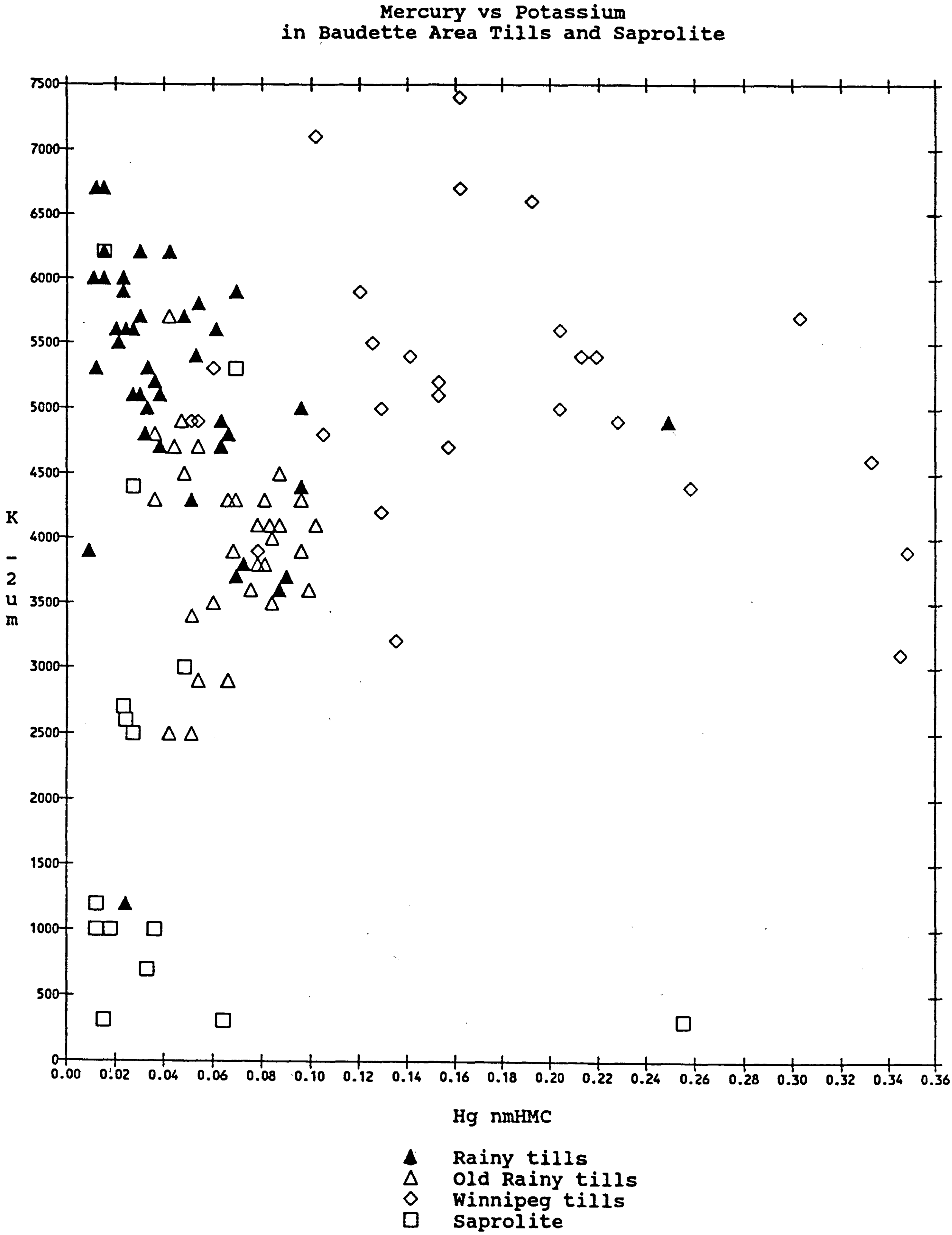


Figure 12a. Plot of mercury vs. potassium assays in Baudette Area tills and saprolite.

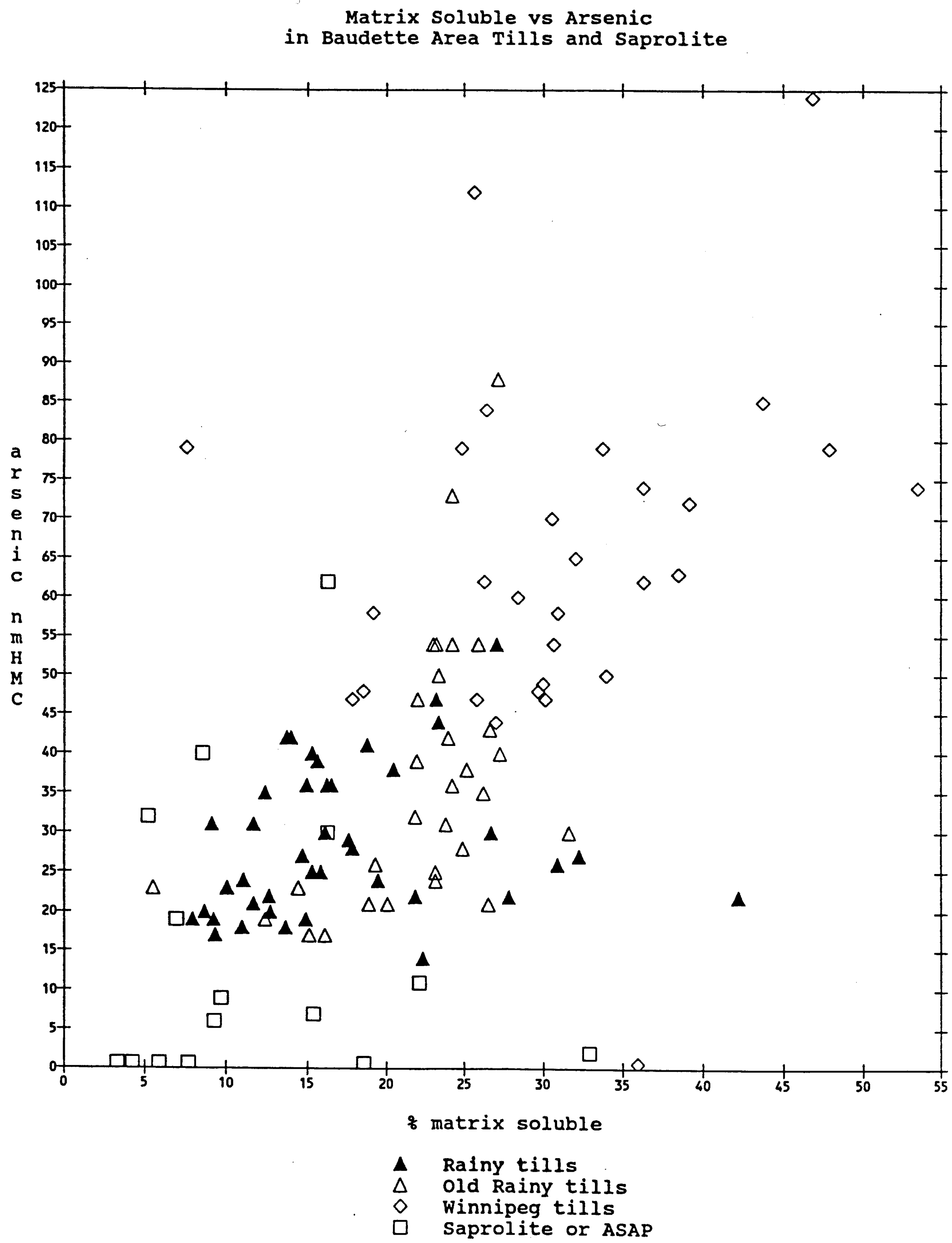


Figure 12b. Plot of matrix soluble vs. arsenic assays in Baudette Area tills and saprolite.

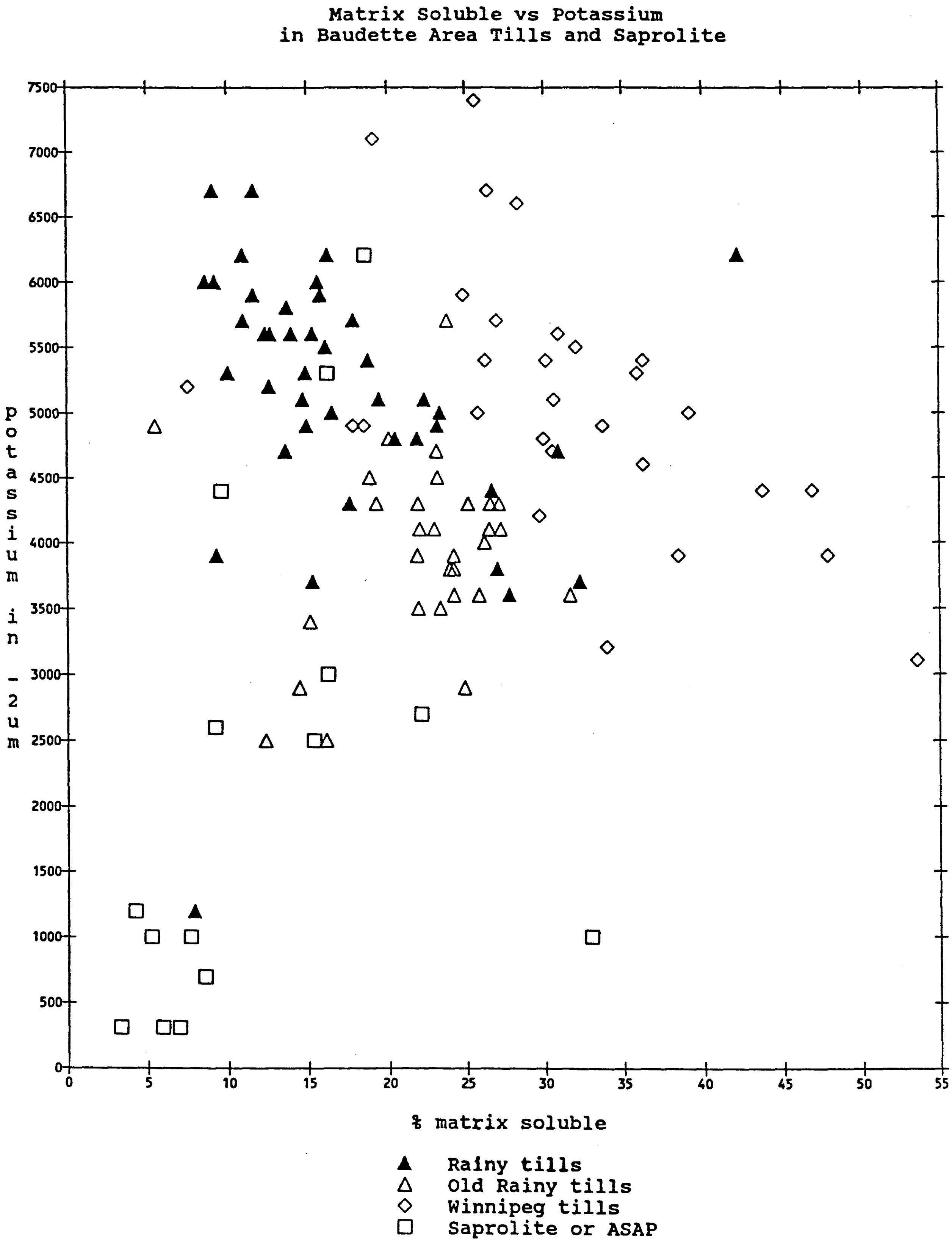
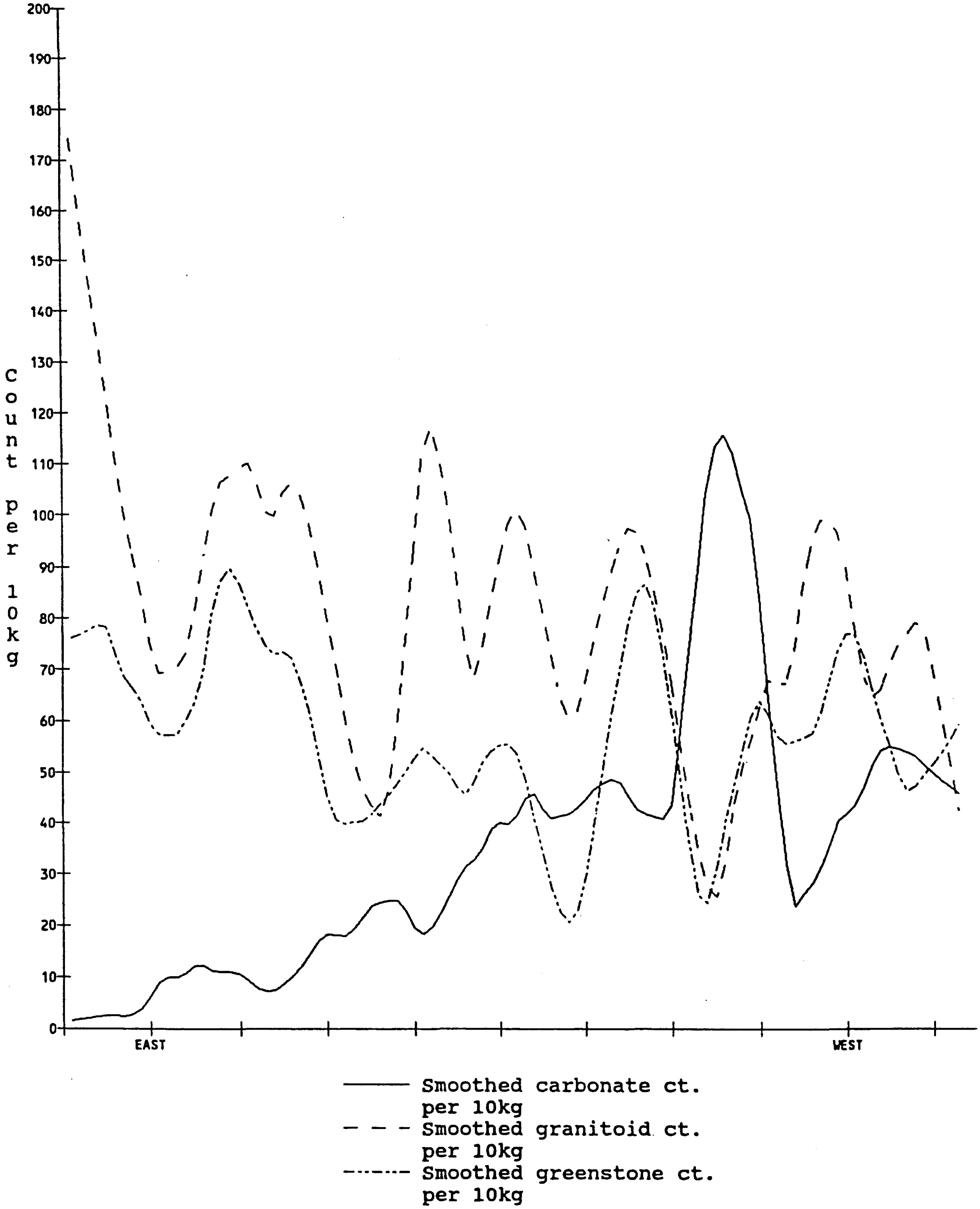


Figure 12c. Plot of matrix soluble vs. potassium assays in Baudette Area tills and saprolite.

Figure 13. Regional variations in pebble content of tills in the Baudette Area.



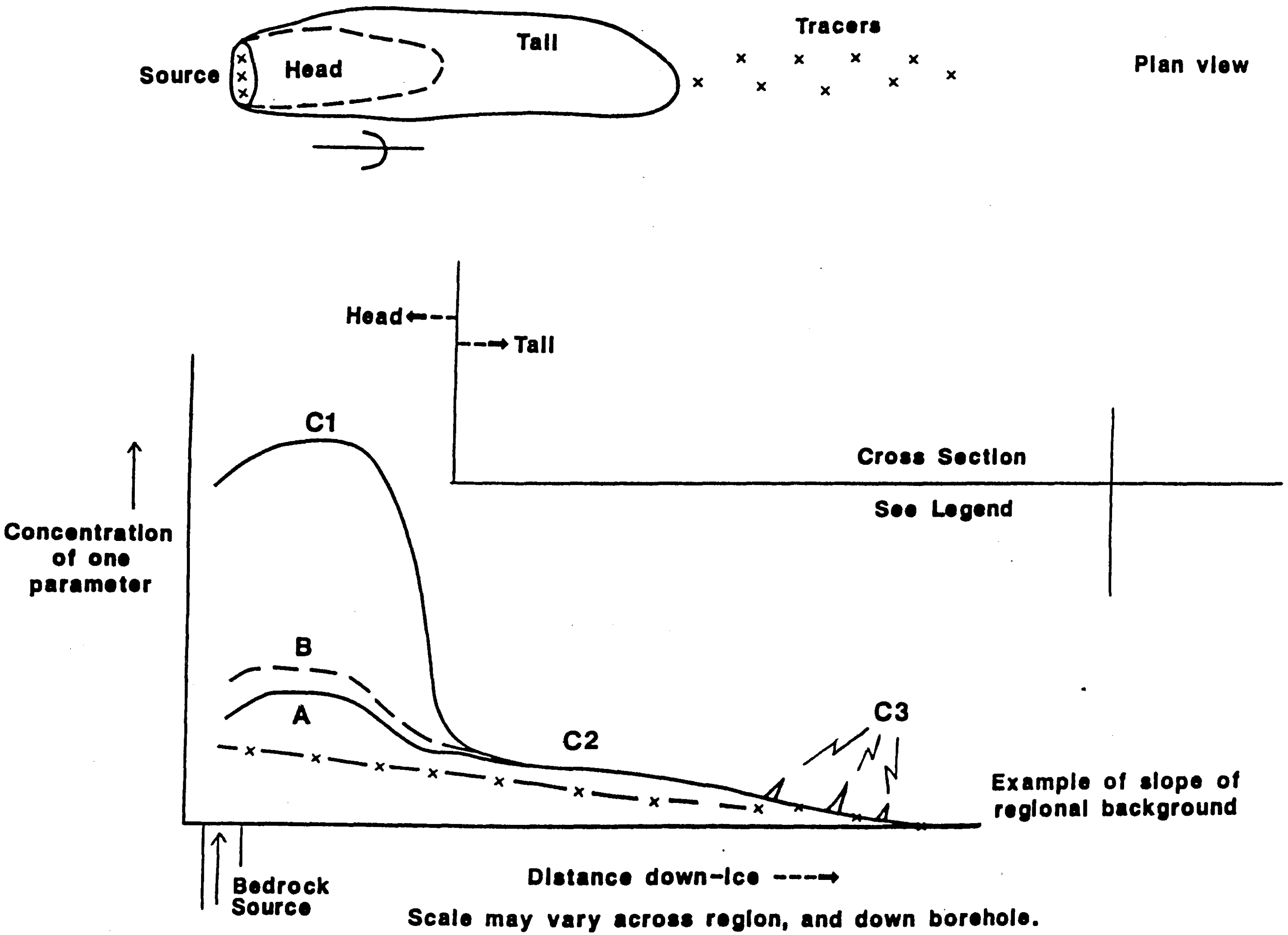


Figure 14a. Dispersal train model used for interpretation of two geochemical patterns--a recognizable, contrasting, single-lithology dominated composition (traceable head lithology) vs. anomalous pathfinder values. Scale of both axes varies.

Figure 14b. Legend.

Legend

A = Lithotype A, such as Mg(%) from a granite bedrock source, present in the head of dispersal train dominated by this source rock composition. Major element contrast to regional background is usually much less than some minor elements contrast.

B = Lithotype B, such as Mg(%) from an ultramafic bedrock source present in the head of dispersal train dominated by this source rock composition.

C1 = Lithotype C, such as Au (ppb) from a gold ore zone. Contrast in the head is usually very high, so a true anomaly is proposed 10x median.

Conclusion: Since till regional backgrounds are very low, contrast in head is a function of lithotype composition and mineralogy of subsample fraction analyzed (clay size fraction vs. heavy minerals).

Dilution is the dominant process affecting till composition and it occurs at a log normal rate of decay. The tail is that volume where the lithotype is still recognizable within the regional mixture, usually by accessory minerals.

C2 = Lithotype C, such as gold (ppb) from a gold ore zone, even diluted, still recognizable from the background, such as 3x regional-stratigraphic median value. Contrast varies greatly by element here.

C3 = Lithotype C, represented by resistant, sparse, gold grains (analogous to surface boulder train where only one is required to continue). In cases where background is near zero, such as for gold or Zn-spinel, the unique minerals become effective tracers.

Table 1a. Options of methodology and strategy applied to site-specific investigations.

1. Drilling method options

	Drilling Method	Estimated 1989 costs	Remarks
	Reverse circulation	$15/ft.	Till is pulverized and disaggregated, lower quality.
*	Rotasonic	$21-$31/ft.	Core for stratigraphic logs and sample selection, higher quality.

2. Site selection options: geophysical, geochemical, and geological targets.

3. * Sample selection options: 5 ft. to 10 ft. composite of any Labradorean till within 70 ft. of base of Quaternary or Keewatin till within 30 ft. Sample saprolite above and below the Kaolin-rich (or otherwise most-leached section). Sample bedrock.

4. Sample fraction and processing options.

   * a. Bulk sample for heavy mineral concentrate, and process via Knelson concentrator, or shaking table plus heavy liquid, or similar reproducible method. Save magnetic fraction.

   b. Fine fraction options are -63um for gold transported a short distance (silt/clay) or -2um (clay) for pathfinders.

5. Sample analysis options

   * a. INAA on split of nmHMC for gold and pathfinder elements. Analyze Hg.

   b. Numerous analysis packages available for fine fraction. Use only 1 gram for gold subsample.

   *** = Suggested approach for gold that should be the most effective, at a reasonable risk level. The use of drill equipment that grinds up pebbles during drilling will change the matrix composition, probably toward a Rainy till end member. That will make stratigraphic logging more difficult, in many ways. Do not core the Koochiching tills, which requires on-the-rig observations of stratigraphy. Search for unusual compositions or patterns in the HMC first, and only. Follow up with fine fraction and magnetic fraction analysis on subsequent interesting results of mineralogy. Focus sampling upon single-component lithology units for nearby sources.**

Projected cost of 100 ft. borehole with 3 till samples, 1 saprolite, and 1 bedrock sample at preferred method:

Procedure	Number of Samples	Cost per Sample	Total Cost
Rotasonic drilling	-	-	$2500.00
HMC via Knelson concentration	4	$15.00	$60.00
Analysis, chemical	5	$30.00	$150.00
Frantz nmHMC separation	4	$10.00	$40.00
Analysis, mineralogy (4 hours labor) including gold grain count (done in house)	-	-	$80.00
			$2830.00

Table 1b. Recommendations for Minerals Division infill drilling.

1. Drill Pattern
   a) One borehole per 25 km^2 across the supracrustal belt.
   b) Use the new pseudo-geologic maps to site down-ice from appropriate features.

2. Drill Method
   a) Rotasonic coring. Other drill methods grind up clasts, creating an artificial matrix. Correct background values, which are a major objective, and confident stratigraphic logging cannot be attained with such an artificial matrix.
   b) Drill through the Koochiching lobe deposits without coring, at an estimated cost savings of 30%(?). Koochiching deposits made up 50% of our 20 boreholes, in terms of footage.
   c) Wintertime drilling will likely be required to obtain access to selected features.

3. Sample Selection
   a) From the sub-Koochiching core samples, select analytical samples from the lowest 70 ft. of glacial deposits, primarily emphasizing tills. No observed pathfinders, significant saprolite incorporation, or heads of dispersal trains were noted above 70 feet from the Quaternary base.
   b) Select appropriate saprolite samples.

4. Analytical Fractions and Methods

   The heavy mineral fraction subsample offers the most information, and comparable gold grain counts should be done. A less costly concentration method, using the Knelson concentrator, should be evaluated. Options exist to limit the fine fraction analysis, but it offers convincing evidence in regard to the veracity of stratigraphic logging. Criteria for selecting such samples on a follow-up basis could be established. Further, a total matrix (-1 mm?) fraction should be evaluated in cases where the head of a dispersal train carries pathfinders.

   The analytical methods should be modified based on three criteria:
   1) delete elements of no demonstrated value;
   2) add elements shown in the Nordkallot project to be applicable to geochemical province recognition (Bolviken and others, 1991); and
   3) obtain lower detection limits on a few elements of real demonstrated value.

Table 2. Analytical measurements showing regional baseline changes in the Baudette area.

Measured attribute	Regional variation	Remarks
Ag nmHMC	increases NW	Affects Rainy till
As nmHMC	increases NW	Affects Labradorean tills
Cr nmHMC	increases NW	Affects all tills
Fe nmHMC	increases NW	Affects Rainy till
Hg nmHMC	increases NW	Affects all tills
Lu* nmHMC	increases NW	Affects all tills
Mn nmHMC	increases NW	Affects Labradorean tills
Zr nmHMC	increases NW	Affects all tills
Ca nmHMC	decreases NW	Affects all tills
P nmHMC	decreases NW	Affects all tills
Sr nmHMC	decreases NW	Affects Rainy till
Pb magHMC	increases NW	Affects all tills
As -2um	increases NW	Affects all tills
Ca -2um	increases NW	Affects all tills
Sb* -2um	increases NW	Affects all tills
Zr* -2um	increases NW	Affects all tills
Al -2um	decreases NW	Affects all tills
Cr -2um	decreases NW	Affects Labradorean tills
Cu -2um	decreases NW	Affects all tills
Fe -2um	decreases NW	Affects all tills
K -2um	decreases NW	Affects all tills
Na -2um	decreases NW	Affects all tills
P -2um	decreases NW	Affects all tills
V -2um	decreases NW	Affects Labradorean tills
ct P-M 1/4"	increases NW	Affects all tills
% P-M 1/4"	increases NW	Affects all tills
% P-M 4mesh	increases NW	Affects all tills
ct P-M 4mesh	increases NW	Affects all tills
% Sol in matrix	increases NW	Affects Labradorean tills
% Ca in matrix	increases NW	Affects Labradorean tills
% Mg in matrix	increases NW	Affects Labradorean tills

*This measurement exceeds 20% precision.

Table 3. Data manipulation and interpretation flow chart.

1. From logging, assign each till to a stratigraphic unit.

2. Calculate precision for each element or parameter. If >15%, do not use for stratigraphic correlation or regional background changes.

3. For each element or parameter, calculate basic statistics by stratigraphic unit.

4. Establish distinct end member populations for key parameters for each stratigraphic unit. Use x-y graphs. Look at case examples of mixing (Fig. 8).

5. Review descriptive log stratigraphic correlation based on analytical data. We made revisions on 6% of till samples.

6. Search for regional background variation, one parameter at a time.

7. Review all data for one sample, creating a total picture of all fractions recombined. Contrast all samples in a borehole this way. Interpret mixing case for each stratigraphic unit (Fig. 8), considering changes in dispersal scale moving up the borehole. Result: interpret proportions of saprolite vs. sound bedrock vs. exotic materials by sample.

8. Select ore and pathfinder element anomalies, such as 3x median value, plus pathfinder mineral information for review. Interpret the nature of the anomaly. Review associated data for lesser trends.

9. Interpret the dispersal scale of the anomaly. Try to find at least three parameters of the sample to determine first if underlying (property scale) dispersal is evident. Is there a tracer mineral present (Table 4) or unusual alteration of pebbles or unusual element concentration? Second, estimate the local and regional dispersal component. Use tools such as distance above Quaternary base, regional topography and isopachs, pebble counts, matrix solubility, siderite content, and review anomalous sample on regional stratigraphic x-y plots. That is, look for divergence from the population cluster and infer type of mixing.

Table 4. Analytical measurements useful for resolving regional till stratigraphic questions.

Measured Attribute	Resolves	Remarks
As nmHMC	WT vs RT, OT	high in unox. WT
B* -2um	WT vs RT, OT	high in unox. WT
Ca -2um	WT vs RT, OT	low in WT
Hg nmHMC	WT vs RT, OT	high in unox. WT
K -2um	RT vs OT	lower in OT
Na -2um	WT vs RT, OT	lower in WT
P -2um	WT vs RT, OT	lower in WT
Ti -2um	RT vs OT	lower in OT
Limonite	WT vs RT, OT	higher in WT
FI 1/4"	WT vs RT, OT	lower in WT
FI 4mesh	WT vs RT, OT	lower in WT
% Clay	WT vs RT, OT	higher in WT
% Sand	WT vs RT, OT	lower in WT
% Ca matrix	WT vs RT, OT	higher in unox. WT

*This measurement exceeds 20% precision.

Table 5. An interpretation of the type of glacial dispersal for the samples bearing significant pathfinders.

Pathfinders	Sample	Height (ft.) above Quaternary Base	Useful Parameters	Dispersal Train Interpretation
Pb & Ag in magnetic fraction Au: 4 grains	502-01	51	B vs. Na(F) plot; high P content; Ba vs. Ti(F) plot; till mag. susceptibility v. high; high sphene content	high component of one unusual lithology of sound bedrock; head, <3 miles transport
Au, Hg, Cu	514-02	41	70% granite pebbles, B vs. Na(F) plot; Ba vs. Ti(F) plot; siderite content; Cu vs. Cu; h. HMC wt.	mixed component till; tail, from granitoids
Au: 5 gold grains & anom. fine fraction gold assay	506-01	8	siderite content high; plot B vs. Na(F); Ba vs. Ti(F) plot; plot Ti vs. V(F) pyrite/zircon ratio; plot Ni(H) vs. Mg(F)	high component of saprolite of unusual composition in till; head, very short transport
Au: 1 large grain; 1 scheelite; 1 arsenopyrite	503-02	30	very low siderite content; Ba vs. Ti(F) plots in unique field; high K content; elevated Sr, Th, & U	more of a sound bedrock component; tail, distance?
Au: anom. fine fraction & some in nmHMC; Hg	503-04	10	very high matrix soluble assay; high magnetic frac. wt.; 91% of sample is matrix	more incorporation of underlying Cretaceous sand; head, short transport?
Au: 2 grains & anom. fine fraction; 2 Cu grains; 2 scheelite grains	509-01	5	median siderite content vs. no saprolite in borehole; Ba vs. Ti plots in unique field; relatively low Ni, Cr, Mg for gabbro; high magnetic frac. wt.; mafic (plutonic?) pebbles common	uncertain
Cu, Ni, Zn; 1 grain Au; Fe	505-03	3	high siderite content; incorp. of Cu, Ni, Zn from underlying saprolite; high Fe; unusual Ce & Ga content; plot Ba vs. Ti(F); 90% of sample is matrix; high matrix sol. Fe	much incorporation of saprolite similar to that in borehole; head, very short transport
Kyanite 10% of HMC subsample; Au: 1 grain	513-01	20	mixture of pebble types; 22% P-M pebbles; matrix sol. vs. As(H); B vs. Na(F); elevated Cr(H), Co(H), Ni(H), Cu(H); zircon	mixing with underlying WT; kyanite-bearing till is not one lithology; tail
Molydenite: 4 grains; Scheelite: 2 grains	512-01	14	pebbles high SC content, low PM for WT; 9% graywacke in SC; Mo increases down borehole; mag HMC assays; As(H); B vs. Na(F); Ti vs. V(F); K vs. Hg	WT mixing with local sound bedrock on high; tail, transport from SW of Vermilion fault?
2 gahnite; 2 scheelites; Au: 4 grains	517-18	9	1-2 mm pyrite grains distinctive; As hmc elevated	this till sample rests upon bedrock; no dominant lithology observed; tail ? short distance

(F) = fine fraction
(H) = nmHMC

Table 6. A list of till samples which exceed the regional-stratigraphic median by >3x for the seven selected elements of Au, As, Cu, Pb, Zn, Ni, Hg.

Element/Fraction	Sample	Value	Appropriate Median x3	Unit/Region
Au, nmHMC (grains/10 kg	502-01	4	3	
	506-01	5	3	
	517-018	4	3	
	520-03	4	3	
Au, -63 um assay (ppb)	503-04	23	6	RT-E
	506-01	34	6	RT-E
	509-01	15	6	RT-E
	514-02	14	3	RT-W
	515-03	10	6	RT-W
	517-15	5	3	OT-W
	517-16	6	3	OT-W
	518-02	6	3	RT-W
	519-06	4	3	WT-W
	521-02	5	3	RT-W
Cu, nmHMC (ppm) (see also Native Copper App. F & L)	508-02	369	266	RT-E
	508-03	461	266	RT-E
	511-02	386	210	RT-W
	505-02	220	210	OT-E
	505-03	700	210	OT-E
	514-01	260	210	RT-W
	514-02	271	210	RT-W
Cu, nmHMC (ppm)	521-05	263	225	OT-W
	517-06	400	381	WT-W
Zn, nmHMC (ppm)	505-03	272	264	OT-E
Ni, nmHMC (ppm)	505-03	665	168	OT-E
Hg, nmHMC (ppb)	514-02	249	189	RT-W

Pb, nmHMC none
Pb, -2 um none
As, nmHMC none
As, -2 um none
Cu, -2 um none
Zn, -2 um none
Ni, -2 um none

Table 7. A list of magnetic fraction till and saprolite samples that exceed the regional-stratigraphic median by ≥ 3x the median for elements listed.

Element	Sample	Value	Appropriate Median x3	Unit/Region
MgO	501-003	3.7	3.75	SAP-E
TiO2	503-006	27.4	22.5	ASAP-E
	515-001	22.9	22.5	RT-W
	515-008	26.4	22.5	OT-W
Ag	502-001	8	6.6	RT-E
	502-002	8	6.6	RT-E
Co	501-002	1772	579	SAP-E
Cr	501-001	2660	2160	RT-E
	507-004	2500	2160	OT-E
	507-012	2616	2160	SAP-E
	512-002	3080	2160	WT-W
	512-003	2580	2160	WT-W
	513-003	3140	2160	WT-W
	513-004	3120	2160	WT-W
Cu	507-012	178	174	SAP-E
	514-006	241	174	SAP-W
	520-016	1006	174	SAP-W
Ni	512-002	538	492	WT-W
	518-006	596	492	WT-W
Pb	507-012	182	141	SAP-E
Zn	507-012	2938	1275	SAP-E

Table 8. Regional-stratigraphic till median values (ppm).

Element- Fraction	Rainy Till Median East (n=20)	Rainy Till Median West (n=21)	Winnipeg Till Median West (n=29)	Old Rainy Till Median East (n=7)	Old Rainy Till Median West (n=24)	Saprolite Median (n=14)
Ag - nmHMC	1.9	2.5	3.0	2.7	2.2	3.1
Ag - -2um	0.90	0.80	0.70	0.80	0.95	0.50
As - nmHMC	24	30	62	23	39	6.5
As - -2um	1	1.5	2.5	1.5	2	0.312
Au - nmHMC	0.088	0.047	0.028	0.038	0.065	0.013
Au - -2um	0.002	0.001	0.001	0.001	0.001	0.002
B	37.5	30	62	52	37	58
Ba - nmHMC	62.5	62.5	62.5	120	62.5	96.25
Ba - -2um	155.5	126	118	97	123	52
Ca - nmHMC	17500	16400	14800	17200	14500	15950
Ca - -2um	21950	55500	41300	10100	68150	1100
Cr - nmHMC	395.00	510.00	410.00	210.00	520.000	31.250
Cr - -2um	122	75	60	95	84	21
Cu - nmHMC	88.5	70	127	70	74.5	190.5
Cu - -2um	60	38	37	62	47.5	42.5
Fe - nmHMC	220000	240000	310000	300000	270000	300000
Fe tot - -2um	41450	32500	27300	36700	36550	42400
Hg	0.023	0.063	0.157	0.051	0.079	0.025
K - nmHMC	312.5	312.5	312.5	312.5	312.5	506.25
K - -2um	5650	5000	5000	2900	4100	1850
Li - nmHMC	4	3	4	4	3	5
Li - -2um	34	33	33	29	29	14
Mg - nmHMC	6150	7200	7500	10900	7600	12700
Mg - -2um	15600	16700	15500	8600	15400	4800
Mn - nmHMC	2700	3500	4100	4100	4750	8250
Mn - -2um	605	636	600	418	712.5	86.5
Mo - nmHMC	1.25	1.25	1.25	1.25	1.25	1.25
Mo - -2um	0.625	3.000	4.000	1.000	4.500	0.625
Ni - nmHMC	42.5	36	84	56	47.5	52.5
Ni - -2um	65.5	48	46	63	53	49
P - nmHMC	1170	1280	1300	1060	1065	1115
P - -2um	7445	7790	4430	7670	6195	5985
Pb - nmHMC	34	39	59	35	39	47.5
Pb - -2um	13	11	12	15	12	19
Sc - nmHMC	68.0	72.2	44.0	48.0	68.05	40.5
Sc - -2um	9.0	7.0	6.0	9.0	8.0	11.5
Th	127.0	176.0	158.5	46.0	161.5	20.0
Ti - nmHMC	8360	7320	4840	4210	5760	1090
Ti - -2um	1290	1090	790	780	985	312.5
U	15.0	18.0	17.0	6.1	15.0	3.95
V - nmHMC	160.0	136.0	142.0	195.0	144.5	129.5
V - -2um	79.0	59.0	52.0	71.0	62.5	86.0
W - nmHMC	5.000	3.125	3.125	7.000	3.125	3.125
W - -2um	6.25	6.25	6.25	6.25	6.25	6.25
Zn - nmHMC	66.5	72	121	88	77.5	181.5
Zn - -2um	93	81	75	82	79.5	89
Zr - nmHMC	6150	6700	7400	2800	6150	312.5
Zr - -2um	4	3	5	4	4	2.5
% Matrix sol.	13	19	31	16	24	9
% Matrix sol. Ca	1	4	7	2	5	0
nmHMC wt. (g)	11.3	11.9	8.4	11.8	10.3	9.4

Table 9. Observed attributes or available tools that are probably usable tracers to specific sources in the Baudette Area since the regional background in till is so low.

I. Matrix
  A. Mineralogy
    1. scheelite
    2. gahnite
    4. corundum
    5. limonite pisolith
    6. native copper
    7. galena
    8. native gold
    9. molybdenite
    10. kyanite

  B. Chemistry
    1. Au
    2. Hg
    3. Ba
    4. Zn
    5. Ag & Pb bearing magnetite
    6. Pb
    7. Ni
    8. W

II. Clasts
  1. komatiites?
  2. tourmalinites
  3. magnetic tonalites
  4. magnetic coarse grained mafic intrusives

III. Whole Core
  1. high magnetic susceptibility of till unit

IV. Additional plausible tracers not identified in this survey.
  1. tourmaline
  2. apatite
  3. monazite
  4. diamond
  5. ilmenite
  6. diopside

Remarks

1. Siderite content is an excellent guide to the saprolite incorporation in till.

2. The list of potential mineral tracers to ore deposits for this area is very long, especially if microprobe final analysis is used (e.g. olivine, diopside, ilmenite and garnet for diamond-bearing kimberlites).

Table 10. A synthesis of the observations and conclusions regarding till composition and variability.

A. Summary of results.

1. Stratigraphic units with:
    a. various till types, subglacial vs. supraglacial;
    b. heads and tails of dispersal trains;
    c. incorporation of underlying material (mixing cases); and
    d. characteristic content of certain elements--Hg, K, As, B, Ca, Na, P, Cu.

2. Regional variation, E vs. W, in:
    a. exotic carbonate clast content;
    b. exotic carbonate matrix content; and
    c. ten elements in matrix clay fraction express the variation.

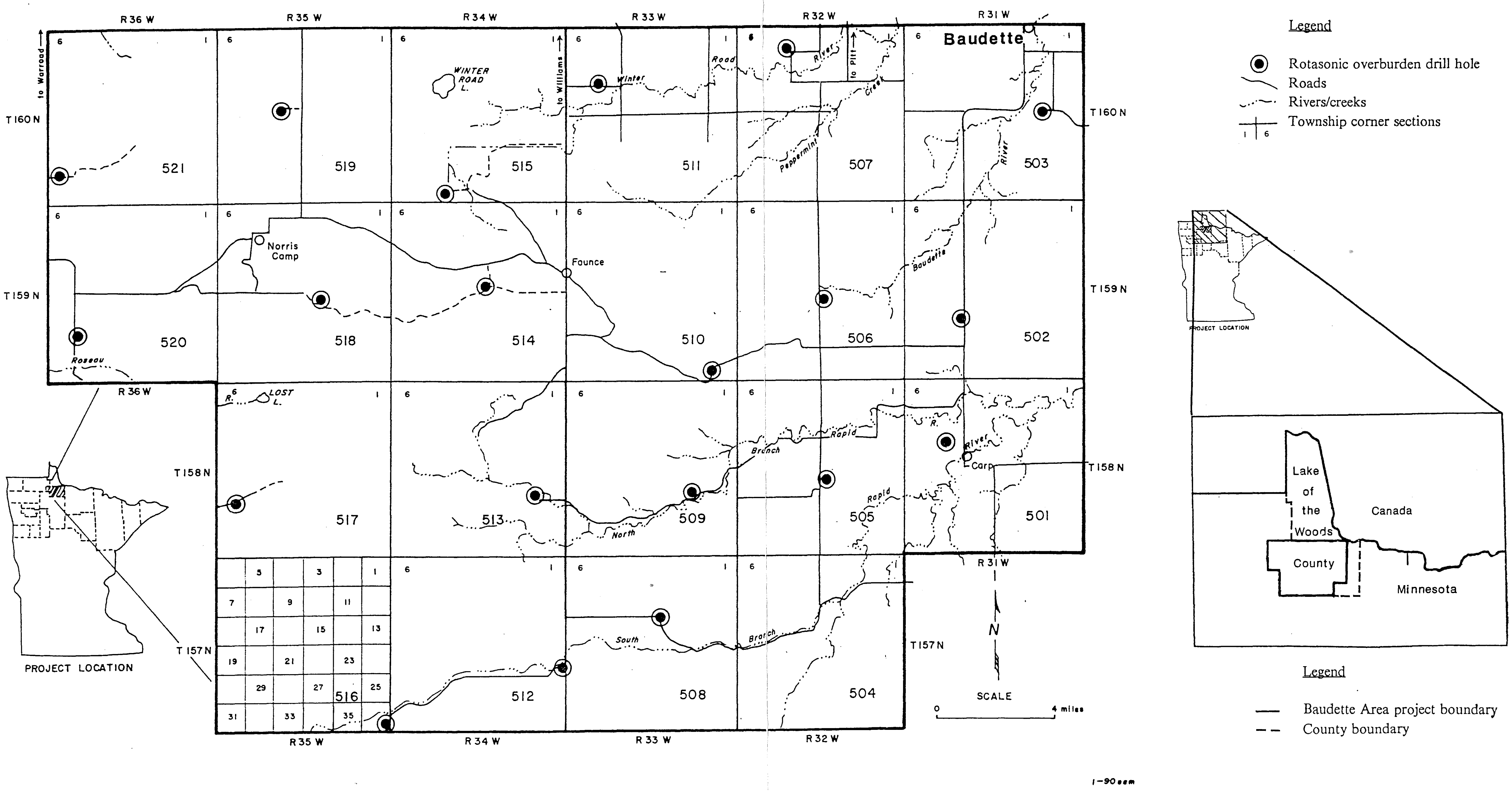
B. A working hypothesis to explain the observations.

1. Each stratigraphic package contains a basic composition, created by continental + regional provenance and flow path (e.g. Rainy lobe deposits contain a crystalline granite-greenstone composition).

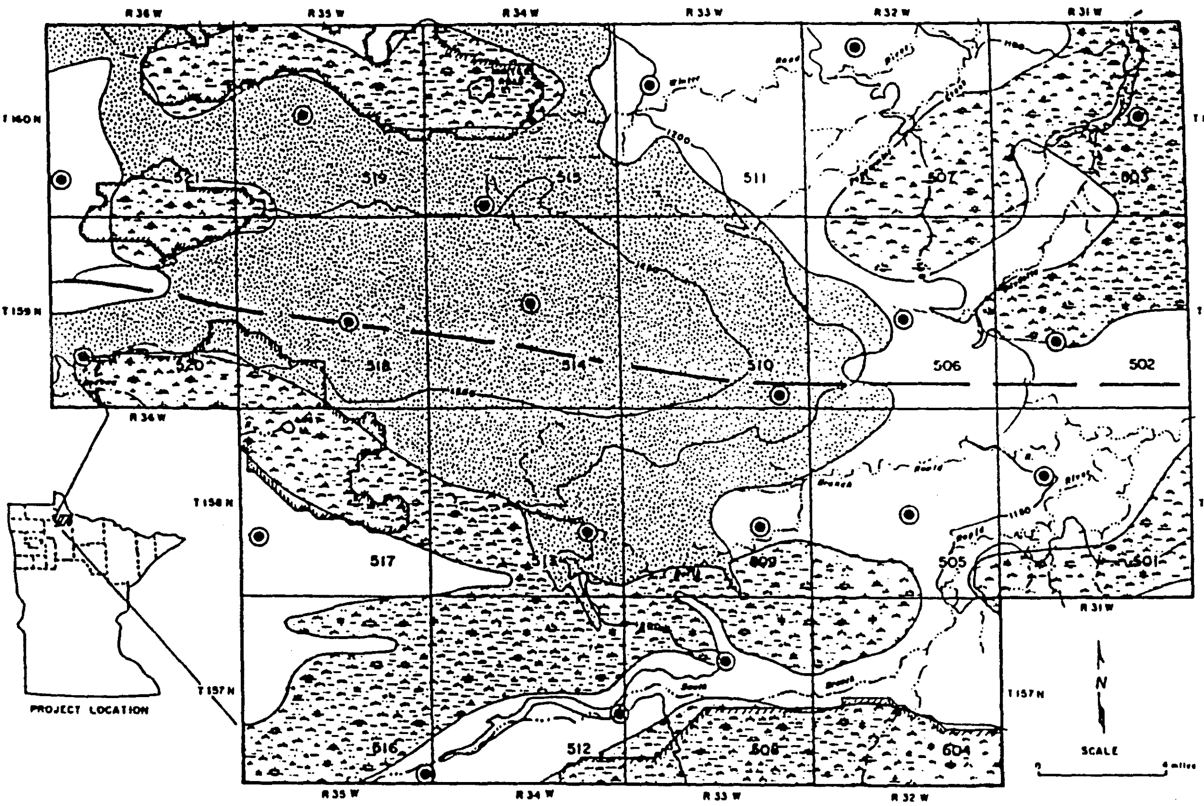
2. That composition, or central tendency of population on an X-Y plot, is modified by glacial processes.
    a. Erosion + Entrainment + Transport + Deposition; probably dominated by:
        1) basal ice mechanics and flow velocity;
        2) the buried landscape topography, especially the topographic relief at the local- and property-scales; and
        3) the underlying materials; three types are available for incorporation to create the nine mixing models observed in Figure 8.
    b. Result is expressed by two general groups of deposits:
        1) supraglacial tills; and
        2) subglacial tills whose deposition and composition are affected by the buried landscape.

3. The result of regional variation of twelve elements in the matrix clay fraction is ascribed to incorporation of the Winnipeg lobe deposits.
    a. Dilution of the matrix by carbonate-rich matrix.
    b. The variation fits the distribution pattern of the Winnipeg lobe deposits.

4. After deposition, subsequent inter-glacial weathering causes observed oxidation. Hydromorphic dispersion may occur, but has not been identified.



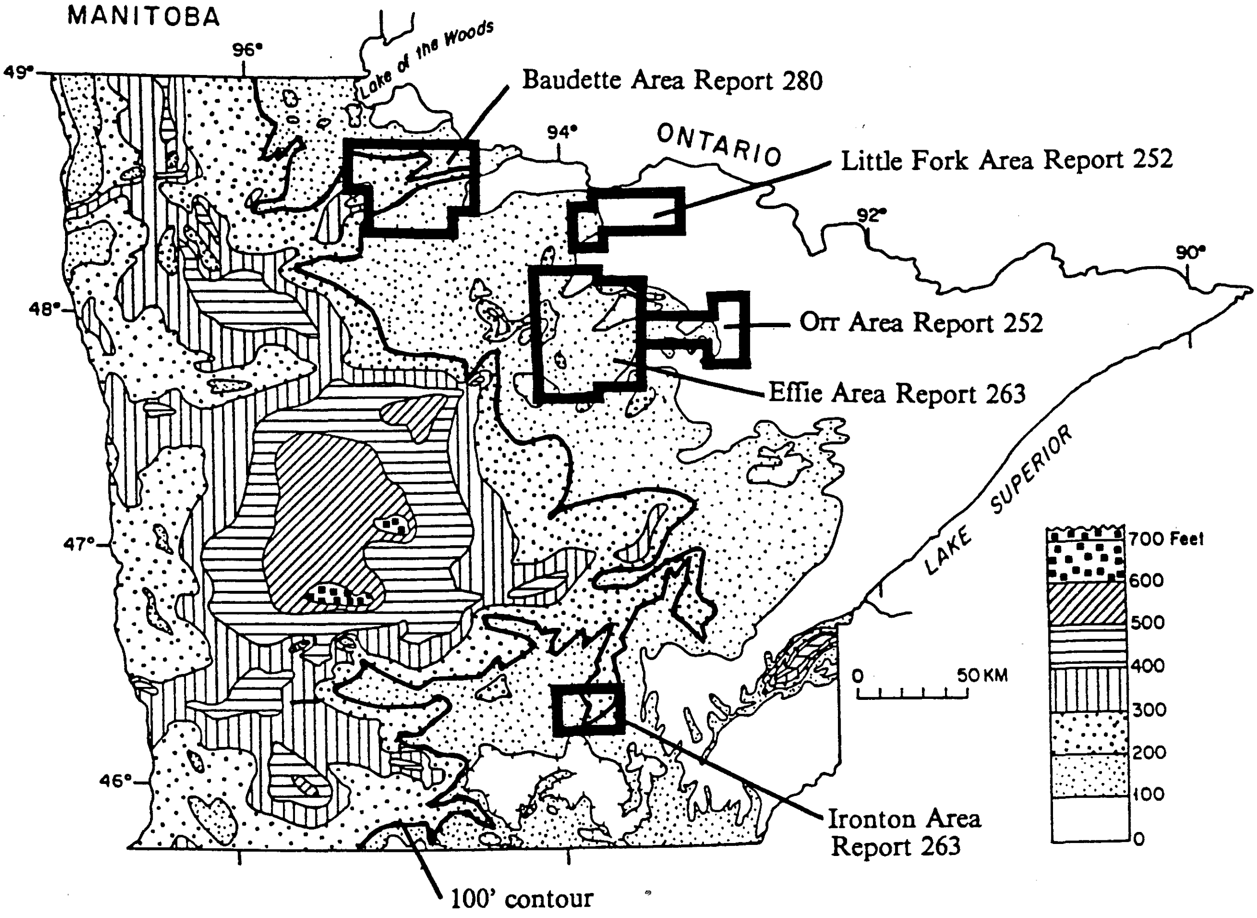
Map 1. Location of the Baudette Area in Lake of the Woods County, Minnesota.



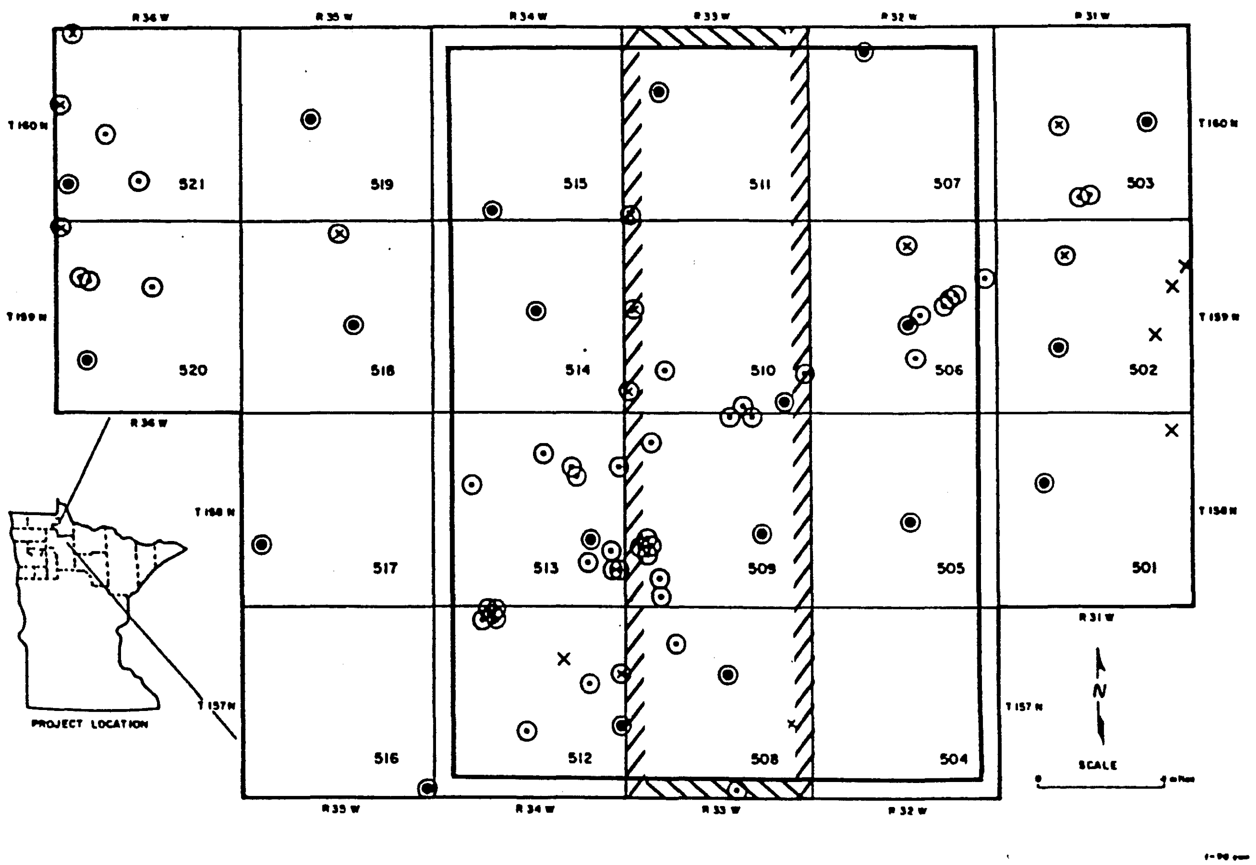
Legend

◉ 517	Rotasonic overburden drill hole
▨	Predominantly peatlands
	Boundary of designated peatland exclusion area
▒	Predominantly Agassiz sand-silt
☐	Predominantly ground moraine (Koochiching Lobe)
—1200—	Contour line elevation (msl), contour interval 50 ft.
— —	Axis of topographic high
	River or stream

Map 2. Surficial features and general topography of the Baudette Area (after Eng, 1982; and Eng, unpublished data). East-west dashed line is inferred buried Vermilion moraine.



Map 3. Past and present overburden drilling projects in relation to regional glacial drift thickness (modified from Figure 2, MGS Information Circular 30, 1989, Ed. by G.B. Morey).



Legend

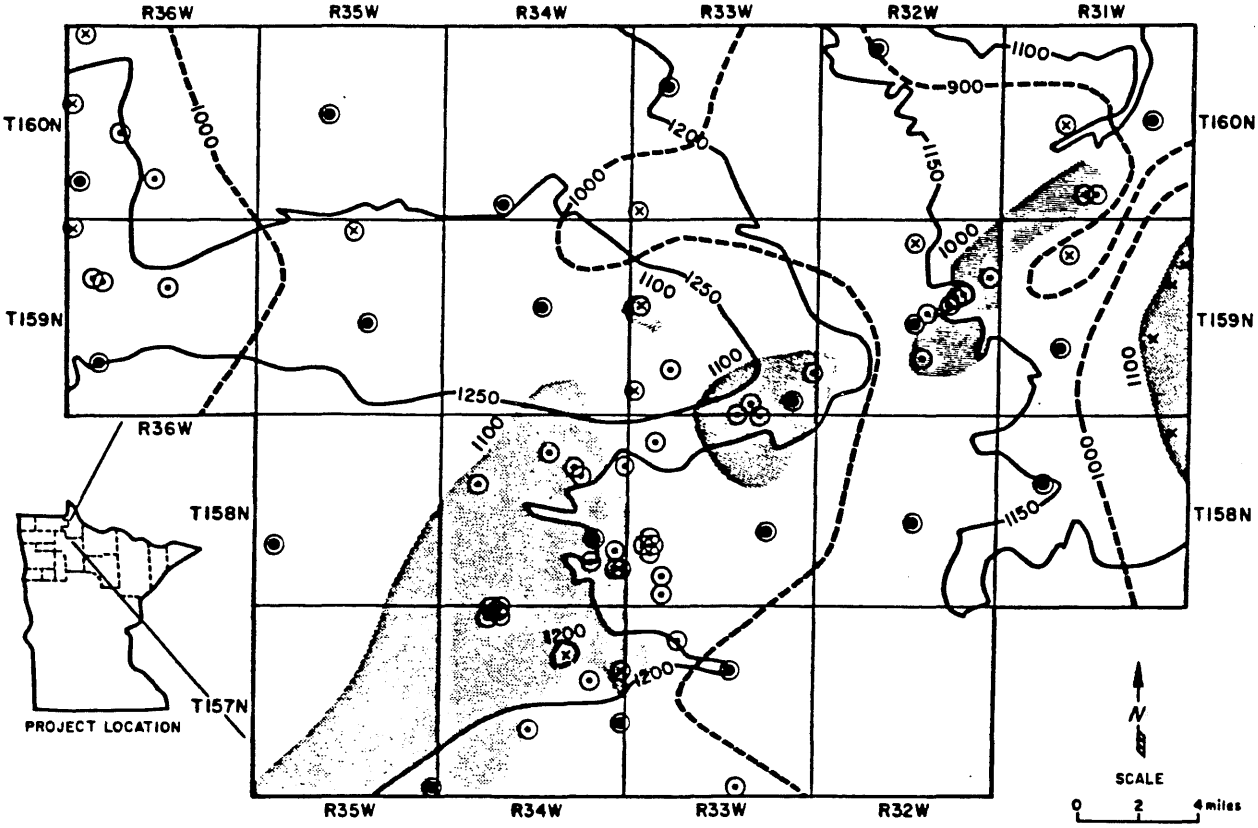
◉ Rotasonic overburden drill hole

⊗ MGS scientific drill hole-bedrock
test with stratigraphic log of overburden

⊙ Industry exploration bedrock drill hole
× Bedrock outcrop
⟍⟍ 1989, Aeromagnetic interpretation Baudette
area, Spector, A., 1:62,500

= 1991, Aeromagnetic interpretation Baudette
area extension, Spector, A., 1:62,500

Map 4. Sources of subsurface geological information for the Baudette Area. CUSMAP aeromagnetics, Bouger gravity, and CUSMAP reconnaissance cover the entire area.

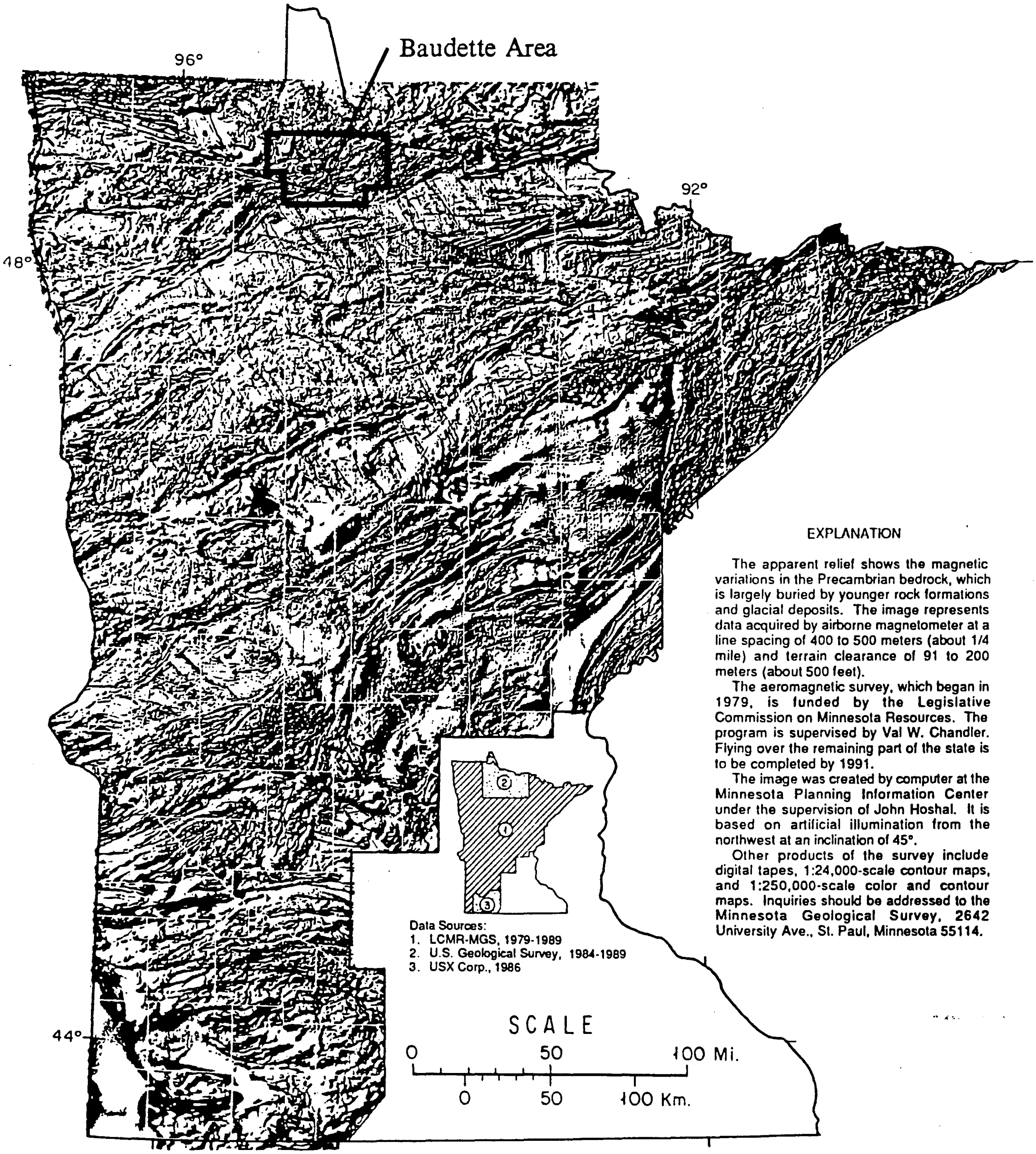


Legend

—	Surface elevation; contour 50 ft. interval
--	Sound bedrock elevation; contour 100 ft. interval
1100☐	Relative bedrock high (1)
◉	Rotasonic overburden drill hole
⊗	MGS scientific drill hole-bedrock test with stratigraphic log of overburden
⊙	Industry exploration bedrock drill hole
×	Bedrock outcrop

(1) defined as >100 ft. above local bedrock surface; elevation of high is given; interpretation based upon evaluation of all borehole data.

Map 5a. A regional contour map of both bedrock and surface elevation. Local-scale features, inferred to be relative bedrock highs, are shown by gray tone.



EXPLANATION

The apparent relief shows the magnetic variations in the Precambrian bedrock, which is largely buried by younger rock formations and glacial deposits. The image represents data acquired by airborne magnetometer at a line spacing of 400 to 500 meters (about 1/4 mile) and terrain clearance of 91 to 200 meters (about 500 feet).

The aeromagnetic survey, which began in 1979, is funded by the Legislative Commission on Minnesota Resources. The program is supervised by Val W. Chandler. Flying over the remaining part of the state is to be completed by 1991.

The image was created by computer at the Minnesota Planning Information Center under the supervision of John Hoshal. It is based on artificial illumination from the northwest at an inclination of 45°.

Other products of the survey include digital tapes, 1:24,000-scale contour maps, and 1:250,000-scale color and contour maps. Inquiries should be addressed to the Minnesota Geological Survey, 2642 University Ave., St. Paul, Minnesota 55114.

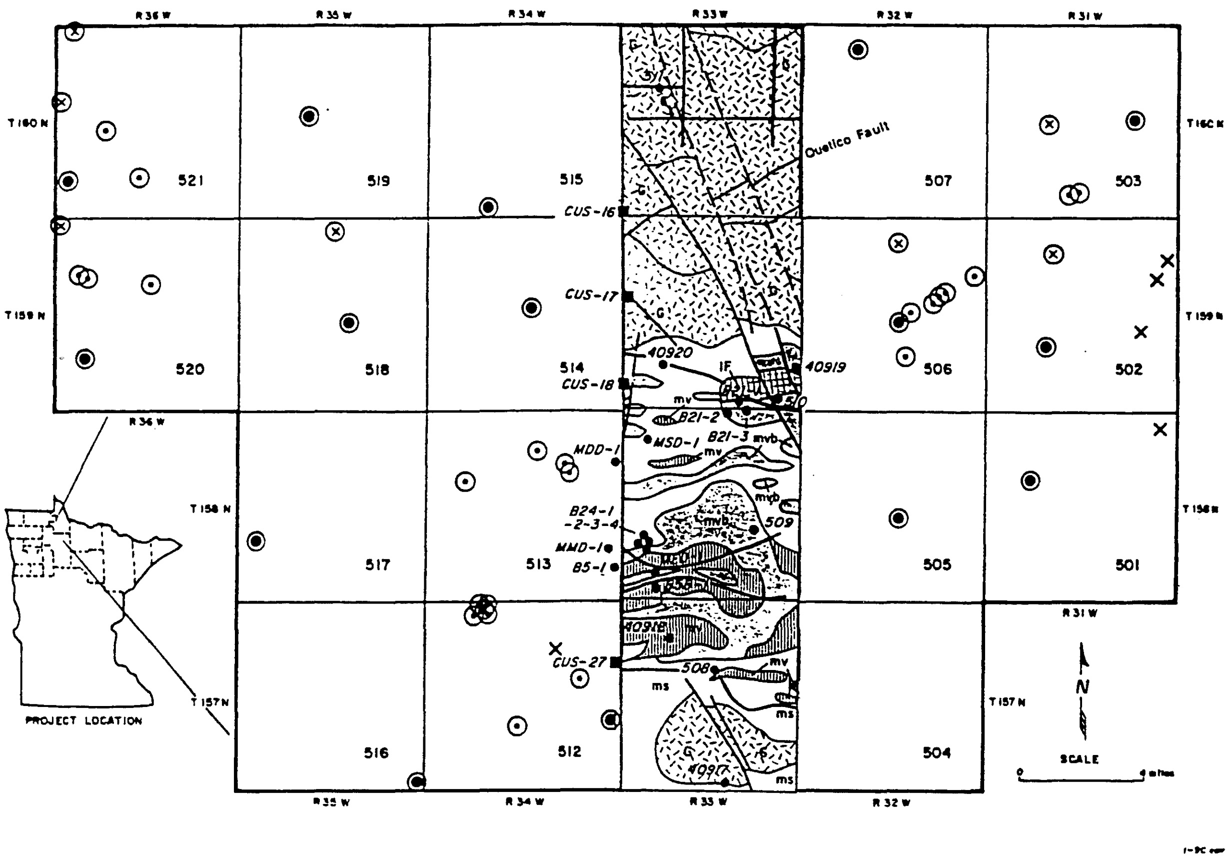
Data Sources:
1. LCMR-MGS, 1979-1989
2. U.S. Geological Survey, 1984-1989
3. USX Corp., 1986

SHADED-RELIEF AEROMAGNETIC MAP OF MINNESOTA

Minnesota Geological Survey and
The Legislative Commission on Minnesota Resources

1989

Map 5b. Aeromagnetic shaded relief map in the Baudette Area (Chandler and Southwick, 1989).



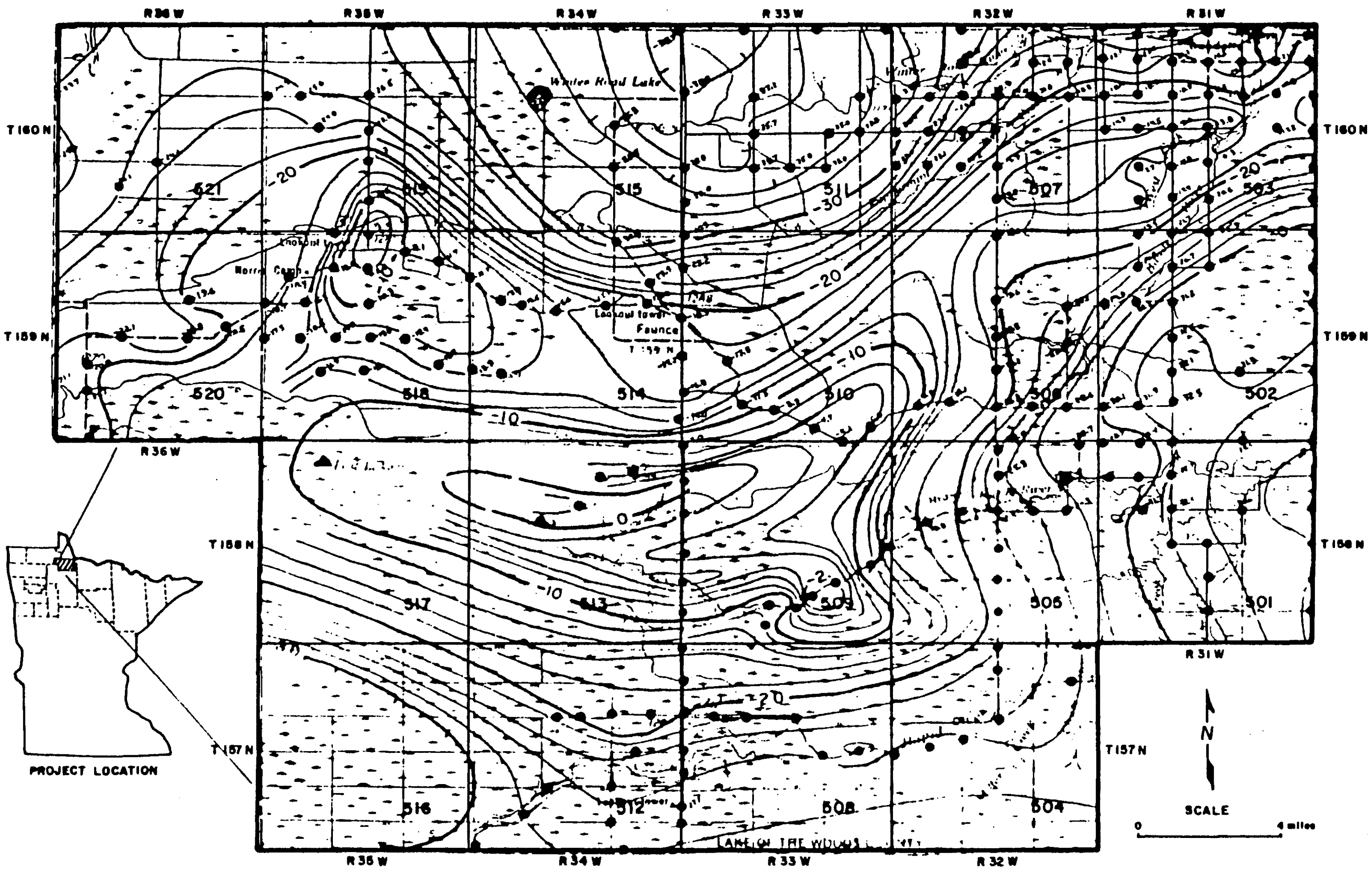
Legend-Pseudomap R33W Strip

- G Granitic rocks
- mv Metavolcanics
- mvb Basic metavolcanics
- IF Iron formation
- ms Metasedimentary rocks
- — Interpreted fault
- — Road
- • Drill hole
- ▪ Drill data available to Dr. Spector

Legend

- ◉ Rotasonic overburden drill hole
- ⊗ MGS scientific drill hole-bedrock test with stratigraphic log of overburden
- ⊙ Industry exploration bedrock drill hole
- x Bedrock outcrop

Map 5c. Aeromagnetic interpreted pseudomap (Spector in Lawler and Venske, 1991).



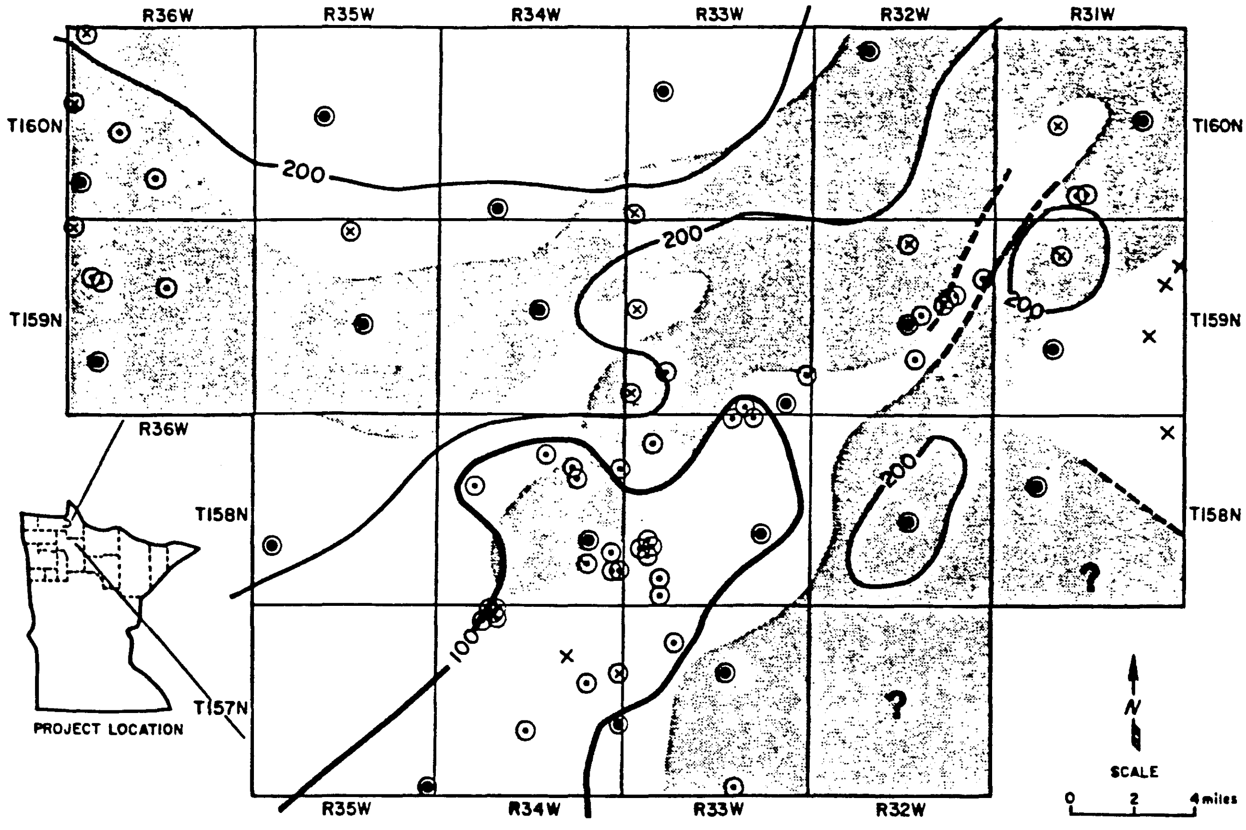
Legend

——— Gravity contours
Contour interval at 2/milligals.
Assumed density is 2.67 grams per cubic centimeter

40 Gravity contours enclosing area of low gravity

● Gravity station

Map 5d. Simple Bouguer gravity map of the Baudette Area (after McGinnis, and others, 1973).



Legend

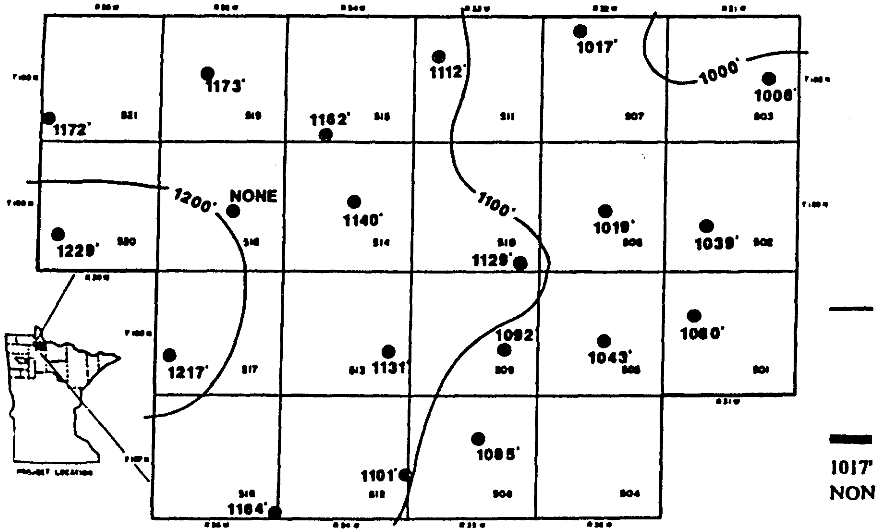
— 100 ft. contour - drift thickness
— 200 ft. contour - drift thickness
☐ Areas where preserved saprolite is greater than 10 ft. thick (1)
-- Inferred area
◉ Rotasonic overburden drill hole
⊗ MGS scientific drill hole-bedrock test with stratigraphic log of overburden
⊙ Industry exploration bedrock drill hole
× bedrock outcrop

(1) interpreted from all available data and assumption of saprolite preservation in bedrock topographic lows

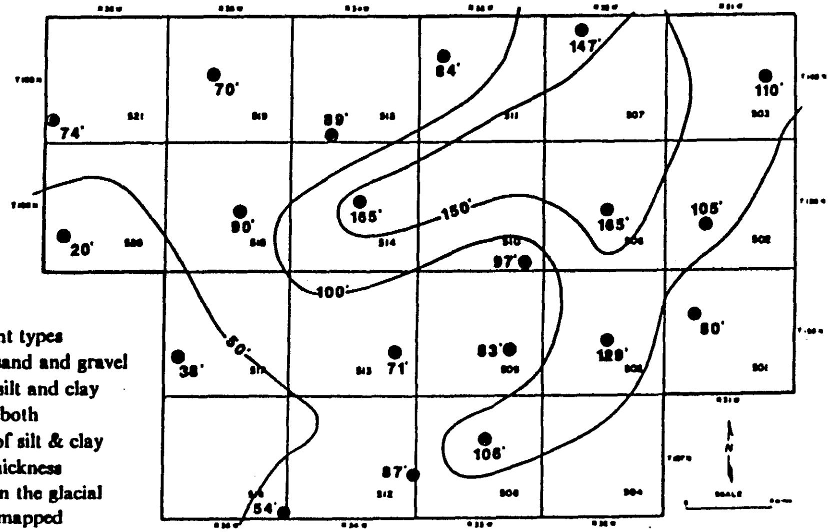
Map 6. A regional contour map of both glacial drift and saprolite thickness.

Map 7. Isopachs of Koochiching lobe sediment from 20 boreholes of this project.

REGIONAL TRENDS OF ELEVATION AT THE BASE OF THE KOOCHICHING LOBE SEDIMENT



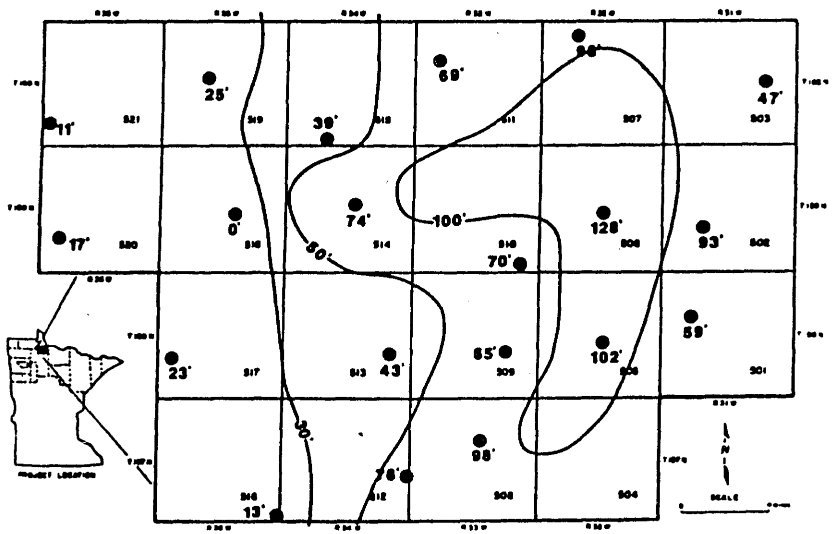
REGIONAL TRENDS OF KOOCHICHING LOBE SEDIMENT THICKNESS



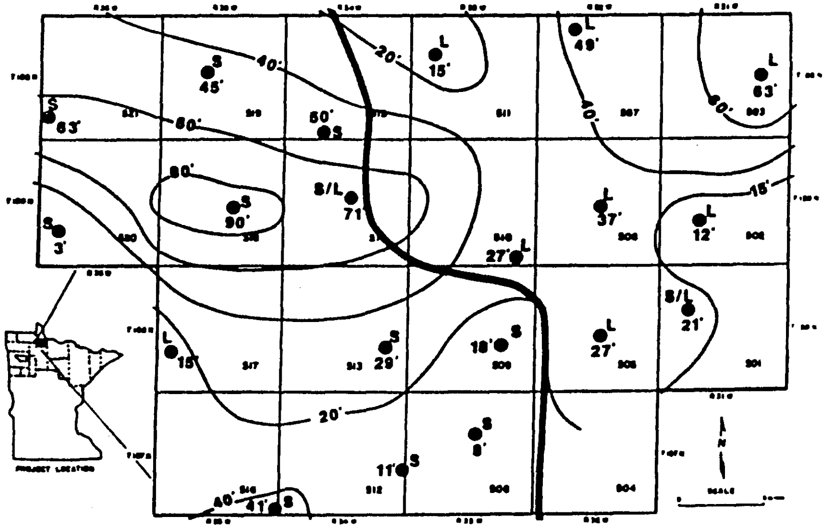
Legend
— Contour line
Nontill sediment types
S = sand and gravel
L = silt and clay
S/L = both
▬ Western limit of silt & clay
1017' Elevation or thickness
NONE Did not contain the glacial lobe sediment mapped

0' Contained the glacial lobe sediment, but not the particular unit mapped

REGIONAL TRENDS OF KOOCHICHING TILL THICKNESS

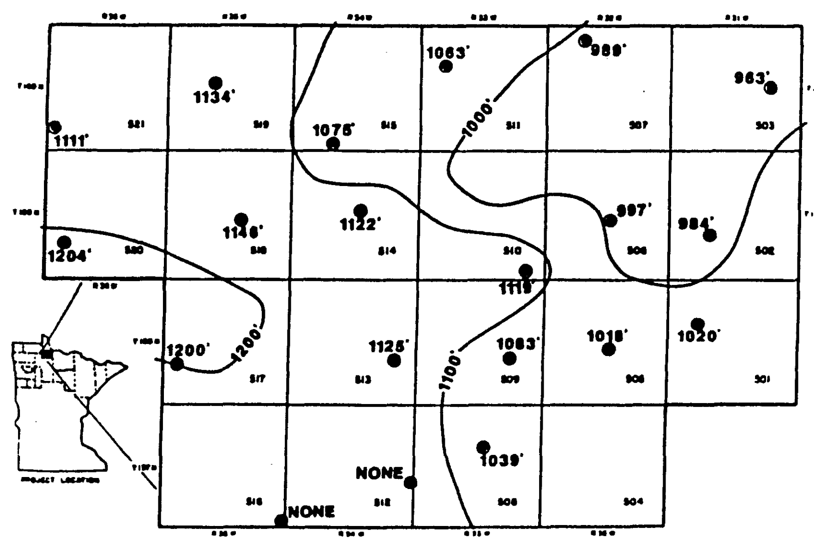


REGIONAL TRENDS OF KOOCHICHING NON-TILL THICKNESS

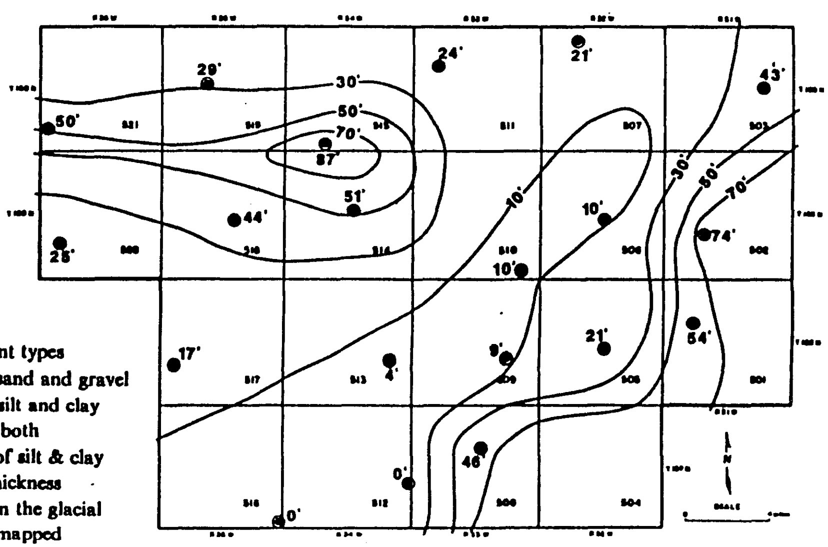


Map 8. Isopachs of Rainy lobe sediment from 20 boreholes of this project.

REGIONAL TRENDS OF ELEVATION AT THE BASE OF THE RAINY LOBE SEDIMENT



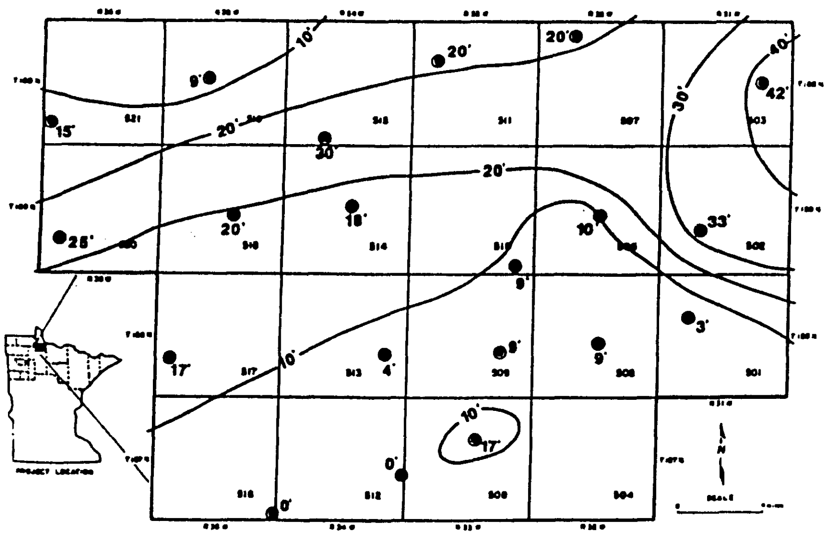
REGIONAL TRENDS OF RAINY LOBE SEDIMENT THICKNESS



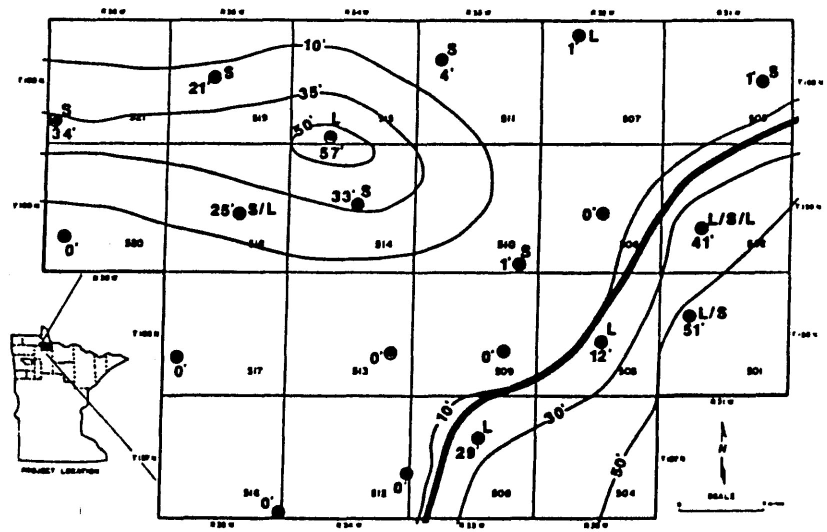
Legend
— Contour line
Nontill sediment types
S = sand and gravel
L = silt and clay
S/L = both
▬ Western limit of silt & clay
1017' Elevation or thickness
NONE Did not contain the glacial lobe sediment mapped

0' Contained the glacial lobe sediment, but not the particular unit mapped

REGIONAL TRENDS OF RAINY TILL THICKNESS

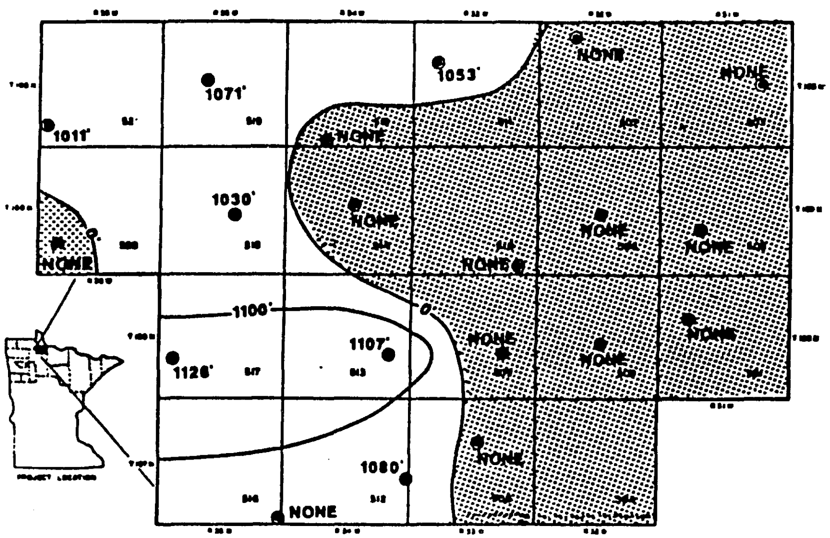


REGIONAL TRENDS OF RAINY NON-TILL THICKNESS

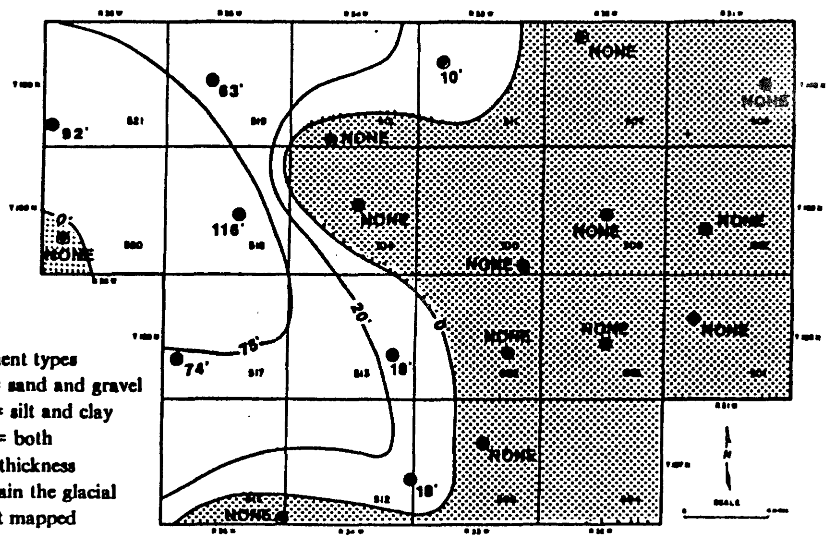


Map 9. Isopachs of Winnipeg lobe sediment from 20 boreholes of this project.

REGIONAL TRENDS OF ELEVATION AT THE BASE OF THE WINNIPEG LOBE SEDIMENT



REGIONAL TRENDS OF WINNIPEG LOBE SEDIMENT THICKNESS



Legend

— Contour line

Nontill sediment types

S = sand and gravel

L = silt and clay

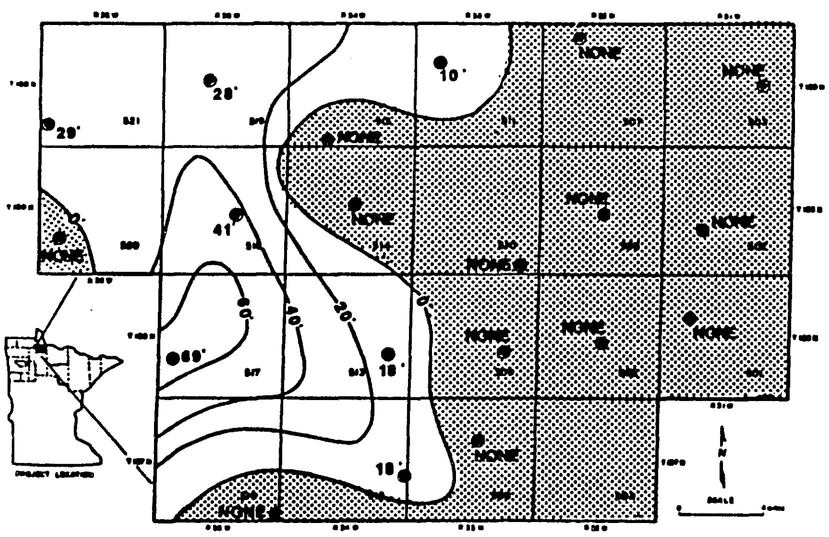
S/L = both

1017' Elevation or thickness

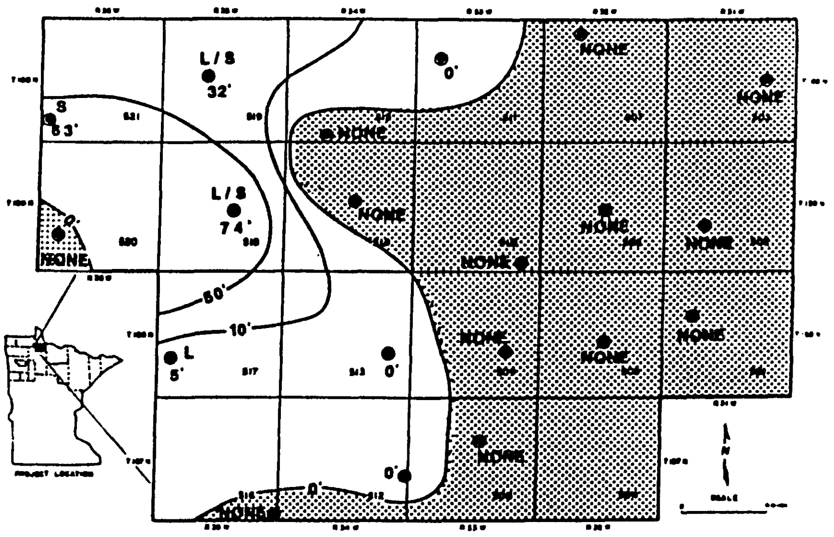
NONE Did not contain the glacial lobe sediment mapped

0' Contained the glacial lobe sediment, but not the particular unit mapped

REGIONAL TRENDS OF WINNIPEG TILL THICKNESS

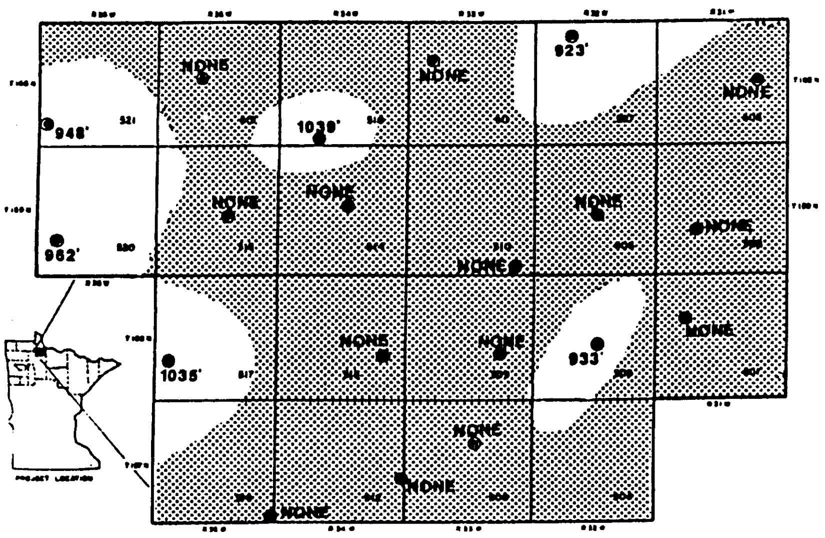


REGIONAL TRENDS OF WINNIPEG NON-TILL THICKNESS

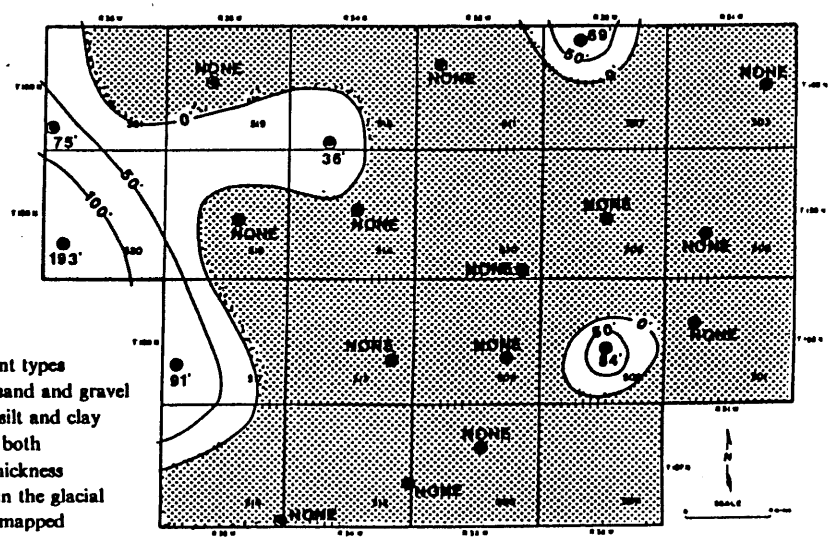


Map 10. Isopachs of Old Rainy lobe sediment from 20 boreholes of this project.

REGIONAL TRENDS OF ELEVATION AT THE BASE OF THE OLD RAINY LOBE SEDIMENT



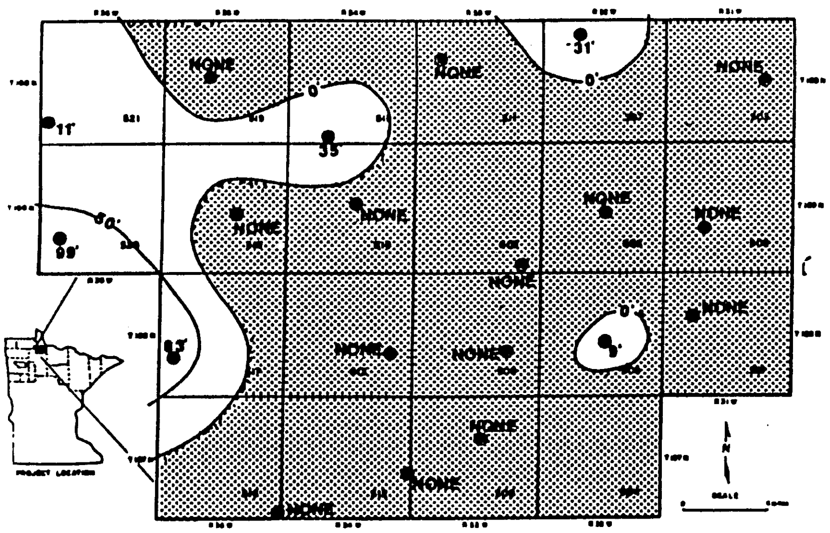
REGIONAL TRENDS OF OLD RAINY LOBE SEDIMENT THICKNESS



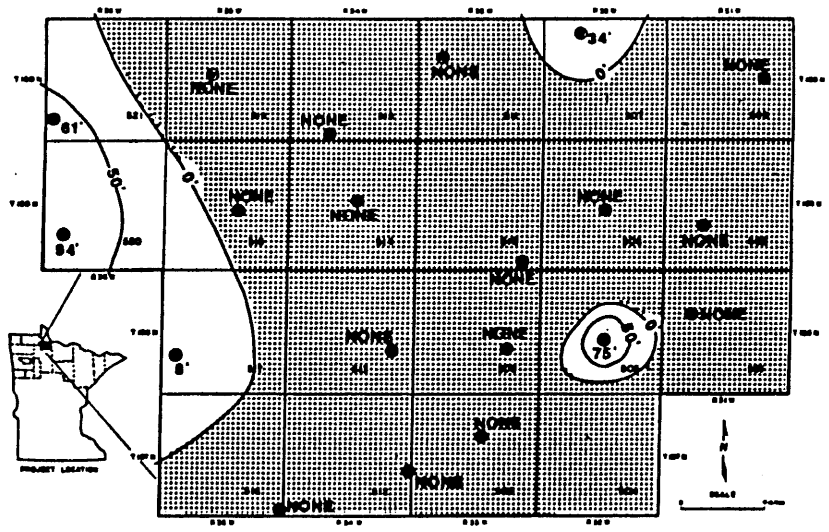
Legend
Contour line
Nontill sediment types
S = sand and gravel
L = silt and clay
S/L = both
1017' Elevation or thickness
NONE Did not contain the glacial lobe sediment mapped

0' Contained the glacial lobe sediment, but not the particular unit mapped

REGIONAL TRENDS OF OLD RAINY TILL THICKNESS

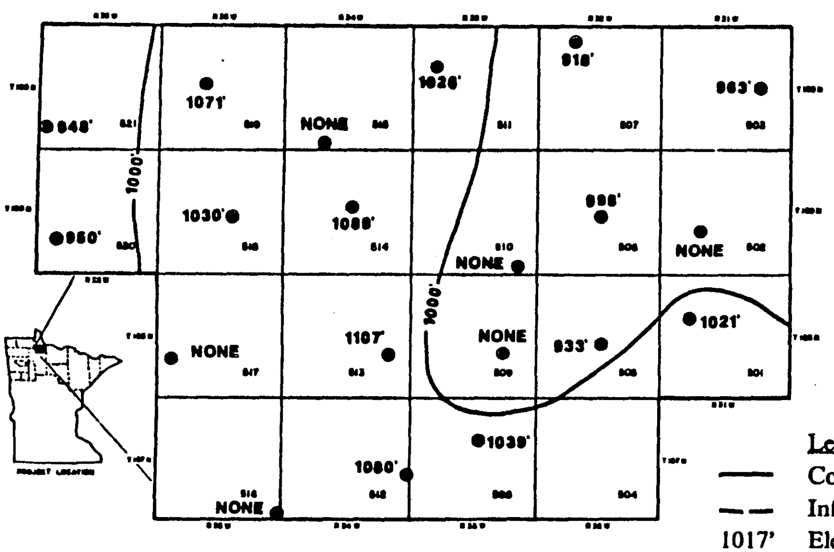


REGIONAL TRENDS OF OLD RAINY NON-TILL THICKNESS

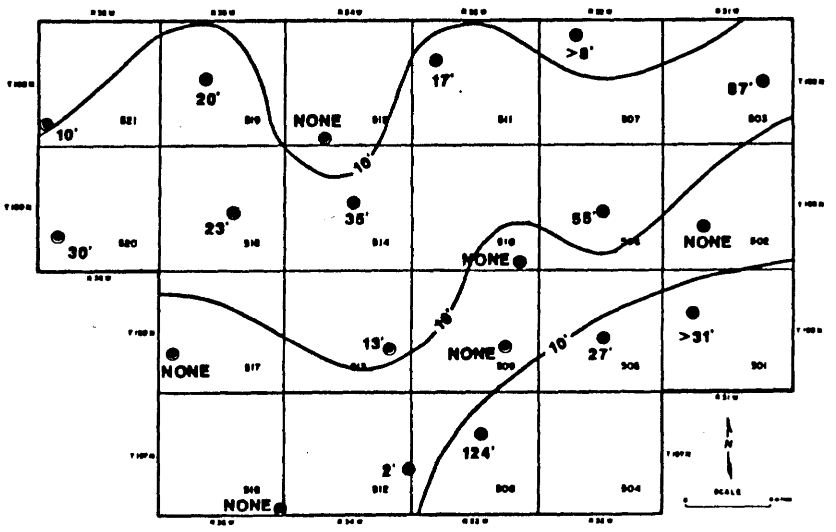


Map 11. Isopachs of saprolite from 20 boreholes of this project.

REGIONAL TRENDS OF ELEVATION AT THE TOP OF THE SAPROLITE OR GRUS

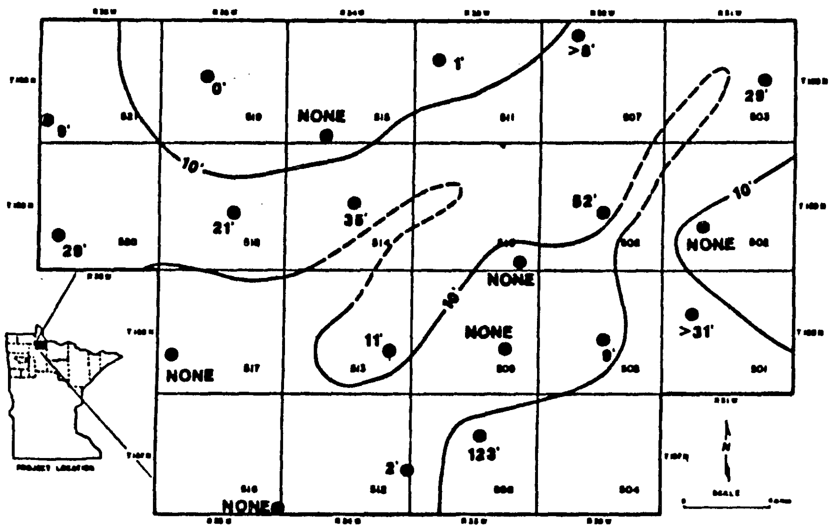


REGIONAL TRENDS OF TOTAL SAPROLITE THICKNESS
(INCLUDING GRUS, REWORKED SAPROLITE, AND CRETACEOUS SAND-DRILL HOLE 503)

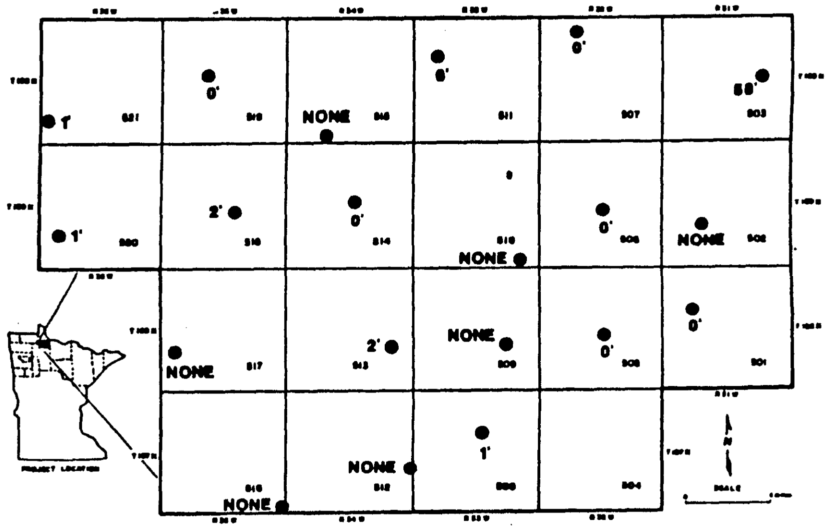


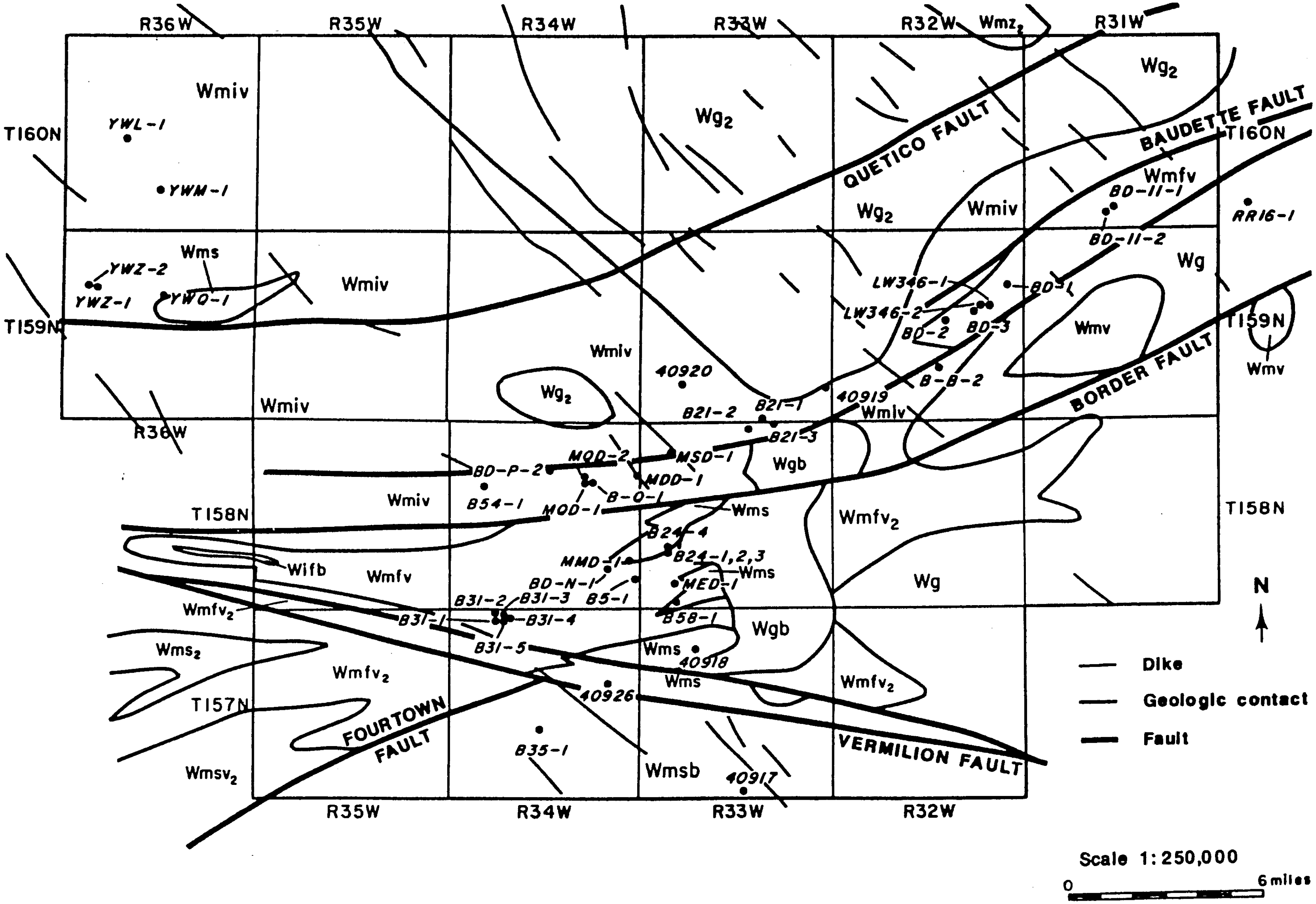
Legend
Contour line
Inferred area
1017' Elevation or thickness
NONE Did not contain saprolite/grus
0' Contained saprolite/grus, but not the particular unit mapped

REGIONAL TRENDS OF KAOLINITIC + CHLORITIC SAPROLITE THICKNESS



REGIONAL TRENDS OF THICKNESS
OF REWORKED SAPROLITE AND CRETACEOUS SAND (DRILL HOLE 503)





Map 12a. Bedrock geology map (modified from 1:250,000 scale Roseau 2° sheet by Day, and others, 1991).

MAP UNIT DESCRIPTION

Phanerozoic Rocks

K	Cretaceous rocks, undivided

Early Proterozoic Rocks

Xd	Diabase, gabbro and diorite

Late Archean Units of the Wabigoon Subprovince

Post-tectonic intrusive rocks (younger than about 2,700 Ma)

Wgmz	Granodiorite, quartz monzonite, and granite
Wmz	Hornblende monzonite
Wgn	Granodiorite gneiss

Pre- and syn-tectonic intrusive rocks (about 2,700 to 2,736 Ma)

Wg	Granitoid rocks
Wgb	Mafic intrusive rocks
Wui	Ultramafic to mafic intrusive rocks

Supracrustal rocks

Wms	Metasedimentary rocks, undivided
Wif	Iron-formation
Wifb	Chert-rich iron-formation
Wmsv	Metasedimentary and metavolcanic rocks
Wfvs	Felsic metavolcanic and volcaniclastic metasedimentary rocks
Wfv	Felsic metavolcanic rocks
Wmfv	Mafic and felsic Metavolcanic rocks
Wiv	Intermediate metavolcanic rocks
Wmiv	Mafic to intermediate metavolcanic rocks
Wmv	Mafic metavolcanic rocks
Wvs	Metavolcanic and metasedimentary rocks

Late Archean Units of the Quetico Subprovince

Intrusive and migmatitic rocks

Whm	Hornblende monzonite
Wvsm	Schist-rich migmatite
Wmsb	Metasedimentary rocks

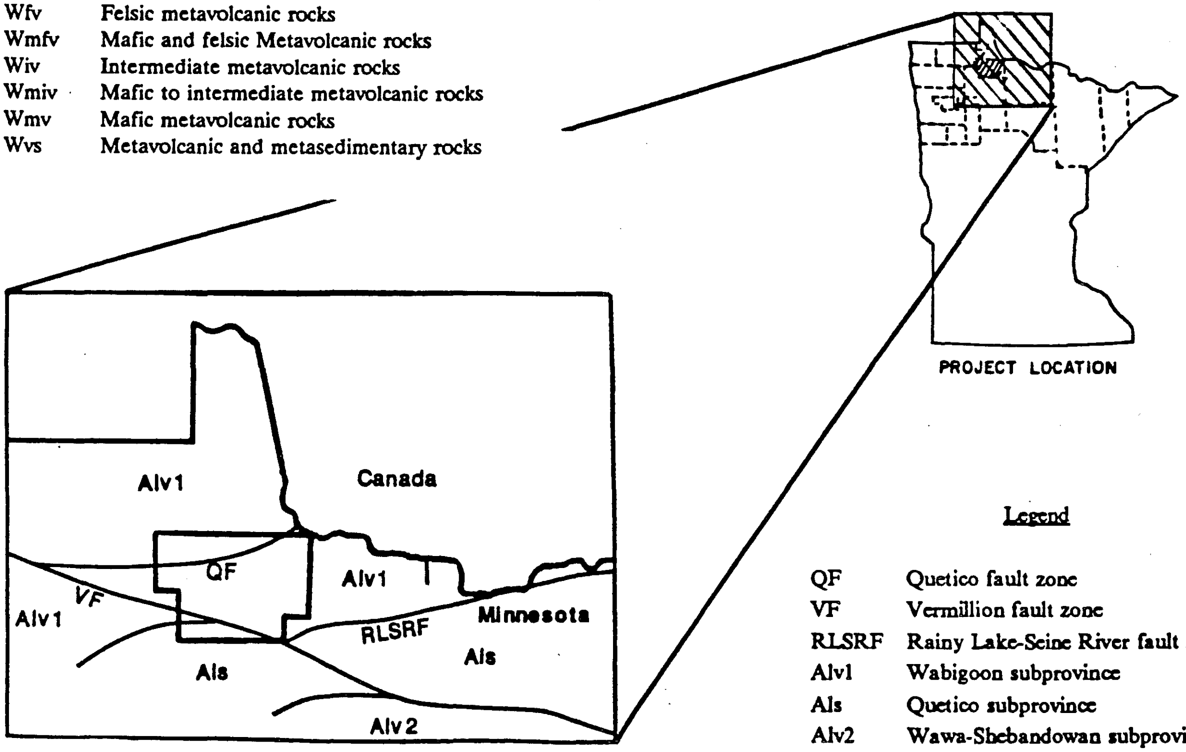
Late Archean Units of the Wawa-Shebandowan Subprovince

Intrusive rocks

Wgd	Granodiorite, quartz diorite, and tonalite

Supracrustal rocks

Wlvs	Layered volcanic-sedimentary rocks
Wmmv	Metavolcanic rocks, undivided



Legend

QF	Quetico fault zone
VF	Vermillion fault zone
RLSRF	Rainy Lake-Seine River fault zone
Alv1	Wabigoon subprovince
Als	Quetico subprovince
Alv2	Wawa-Shebandowan subprovince

Map 12b. Bedrock geology map description and location.

APPENDICES

Appendix 280-A.	Synopsis of Baudette area drill information. Map scales are 1:24,000.
Appendix 280-B.	Descriptive logs of Baudette area drill core.
Appendix 280-C.	Sampling and analytical methods.
Appendix 280-D.	Precision and accuracy of assay methods.
Appendix 280-E.	Variation maps for the Baudette area.
Appendix 280-F.	Master index for Baudette area samples.
Appendix 280-G.	Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.
Appendix 280-H.	Baudette area assays. Magnetic heavy mineral concentrate samples from tills and saprolite.
Appendix 280-I.	Baudette area bedrock and saprolite samples analyzed as bedrock. Trace element and oxide assays.
Appendix 280-J.	Baudette area sample component weights and percents reported by contract laboratory.
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Appendix 280-L.	Mineralogy of nonmagnetic heavy mineral concentrate fraction from till and saprolite samples in the Baudette area.
Appendix 280-M.	Baudette area pebble counts. Super-category counts per 10 kg sample by size fraction.
Appendix 280-N.	Baudette area pebble counts +1/4" - 3/8" pebbles.
Appendix 280-O.	X-ray diffraction results for 14 selected Baudette area till and saprolite samples.
Appendix 280-P.	Baudette area gold data summary.

Appendix 280-A. Synopsis of Baudette area drill site information.

Column abbreviations and data key

Twp =township
Rng =range
Sec =section
min. =minute
dia. =diameter
Inclin. =inclination
Surf. =surface
elev. =elevation
Quat. =Quaternary
Pct. =percent
No. =number
< =less than
> =greater than
n/a =not applicable

Appendix 280-A. Synopsis of Baudette area drill site information. Map scales are 1:24,000.

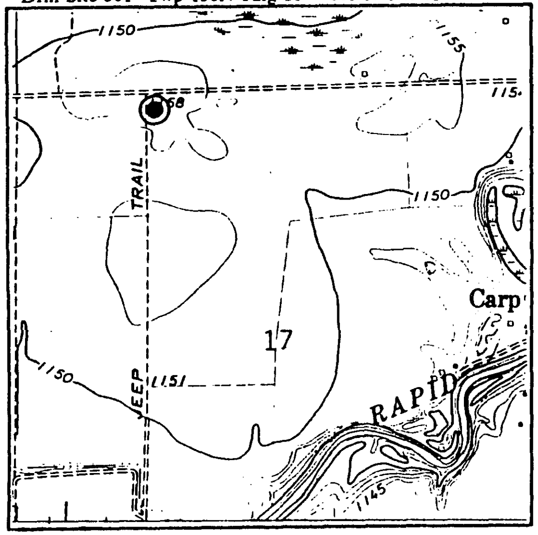
Drill Site	Twp	Rng	Sec	40acre	County	Quadrangle 7.5 min.	Regional survey	UTM East coordinate	UTM North coordinate	Latitude	Longitude	Drilling method	Drilling company	Core dia.	Azimuth	Inclin. angle
501	158N	31W	17	NE of NW	Lake of Woods	Baudette SW	Baudette	377 200	5374 280	48 30 39	94 39 46	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
502	159N	31W	20	SE of SE	Lake of Woods	Baudette SW	Baudette	378 360	5381 120	48 34 21	94 38 57	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
503	160N	31W	14	SW of SE	Lake of Woods	Baudette	Baudette	382 830	5392 060	48 40 18	94 35 32	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
504	157N	32W	1	SE of SE	Lake of Woods	Chase Brook	Baudette	374 600	5366 380	n/a	n/a	n/a	n/a	n/a	n/a	n/a
505	158N	32W	22	SW of NW	Lake of Woods	Oaks Corner NE	Baudette	370 320	5372 150	48 29 26	94 45 14	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
506	159N	32W	22	NW of NW	Lake of Woods	Graceton SE	Baudette	370 420	5382 350	48 34 55	94 45 22	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
507	160N	32W	5	SE of SE	Lake of Woods	Graceton	Baudette	368 920	5395 550	48 42 03	94 46 56	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
508	157N	33W	15	NW of NW	Lake of Woods	Oaks Corner	Baudette	360 880	5364 940	48 25 22	94 52 53	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
509	158N	33W	23	SE of SW	Lake of Woods	Oaks Corner NE	Baudette	363 870	5371 560	48 29 02	94 51 21	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
510	159N	33W	36	NW of SW	Lake of Woods	Graceton SE	Baudette	364 340	5378 400	48 32 38	94 50 20	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
511	160N	33W	8	SW of SW	Lake of Woods	Graceton NW	Baudette	358 310	5394 010	48 41 04	94 55 31	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
512	157N	34W	24	NE of SE	Lake of Woods	Oaks Corner	Baudette	355 630	5362 550	48 24 01	94 57 02	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
513	158N	34W	23	SE of SE	Lake of Woods	Oaks Corner	Baudette	354 160	5371 590	48 28 55	94 58 27	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
514	159N	34W	15	SE of SW	Lake of Woods	Winter Road Lake	Baudette	351 720	5383 260	48 35 10	95 00 42	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
515	160N	34W	32	NE of SE	Lake of Woods	Winter Road Lake	Baudette	349 650	5388 480	48 37 56	95 02 24	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
516	157N	35W	36	NE of SE	Lake of Woods	Shilling Dam	Baudette	345 920	5359 340	48 22 14	95 04 55	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
517	158N	35W	30	NW of NE	Lake of Woods	Shilling Dam NW	Baudette	337 790	5371 930	48 28 51	95 11 48	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
518	159N	35W	22	SW of NE	Lake of Woods	Winter Road Lake	Baudette	342 810	5382 690	48 34 44	95 07 55	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
519	160N	35W	16	SE of NW	Lake of Woods	Winter Road Lake	Baudette	340 692	5393 260	48 40 23	95 09 40	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
520	159N	36W	29	SW of NW	Lake of Woods	Mulligan Lake	Baudette	329 010	5381 190	48 32 48	95 19 08	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90
521	160N	36W	30	SE of SW	Lake of Woods	Mulligan Lake NE	Baudette	328 020	5390 060	48 38 28	95 20 04	rotasonic	J.R. Drilling, Ltd	3.7 inch	0	-90

Appendix 280-A (continued).

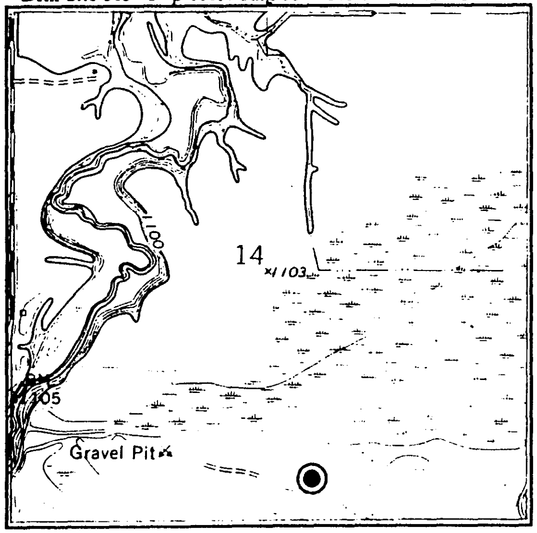
Drill Site	Surf. elev.	Base Quat. elev.	Sound bedrock elev.	Quat. thick ness	Reworked saprolite thickness	Saprolite thickness	Sound bedrock thickness	Total depth	Cored interval	Pct. recovery	No. of till samples	No. of other drift samples	No. of non-drift samples	Total samples
501	1156	1021	<942	135	0	>79	0	214	0-214	76	1	0	3	4
502	1137	958	958	179	0	0	8	187	0-187	96	3	2	1	6
503	1116	963	857	153	58	48	8	267	0-267	96	5	0	4	9
504	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
505	1167	933	906	234	0	27	6	267	0-267	96	3	0	2	5
506	1174	998	943	176	3	52	15	246	0-246	96	2	0	3	5
507	1157	918	<910	239	0	>8	0	247	0-247	98	7	4	2	13
508	1191	1039	911	152	1	127	5	285	0-285	90	3	0	6	9
509	1175	1083	1083	92	0	0	8	100	0-100	100	1	0	1	2
510	1226	1119	1119	107	0	0	5	112	0-112	90	2	0	1	3
511	1196	1053	1026	143	0	27	15	185	0-185	85	5	0	1	6
512	1185	1080	1078	105	0	2	10	117	0-117	100	3	0	1	4
513	1200	1107	1093	93	2	12	8	115	0-115	93	4	0	2	6
514	1305	1089	1048	216	0	41	5	262	0-262	87	3	2	2	7
515	1251	1039	1039	212	0	0	11	223	0-223	94	8	0	1	9
516	1211	1157	1157	54	0	0	7	61	0-061	95	2	1	1	4
517	1255	1035	1035	220	0	0	9	229	0-229	90	18	0	1	19
518	1280	1030	1023	250	2	5	16	273	0-273	91	7	1	1	9
519	1233	1071	1048	162	0	23	23	208	0-208	95	6	0	1	7
520	1249	950	<920	299	1	>29	0	329	0-329	91	14	1	2	17
521	1235	948	938	287	1	9	23	320	0-320	90	6	5	4	15

Appendix 280-A. Synopsis of Baudette area drill site information. Map scales are 1:24,000.

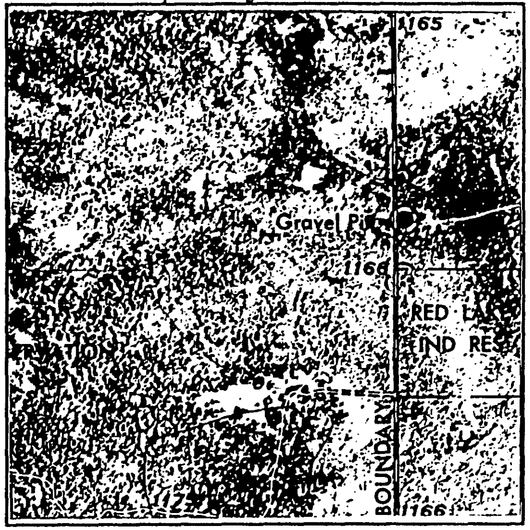
Drill Site 501 Twp 158N Rng 31W Sec 17 NE of NW



Drill Site 503 Twp 160N Rng 31W Sec 14 SW of SE



Drill Site 505 Twp 158 Rng 32W Sec 22 SW of NW



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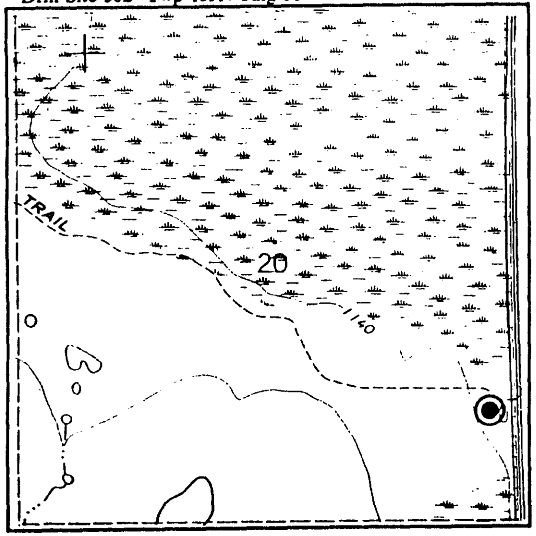

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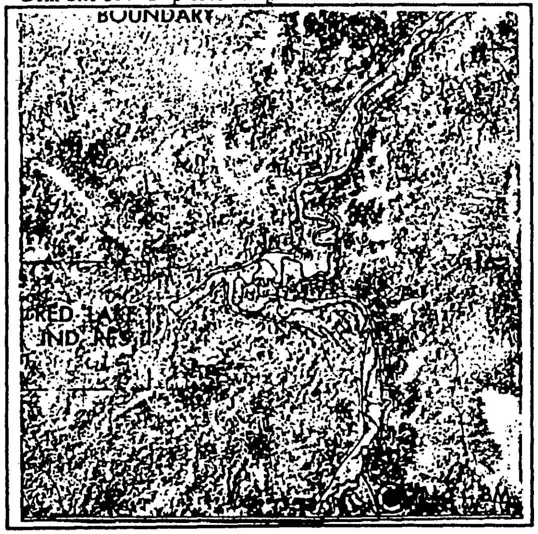

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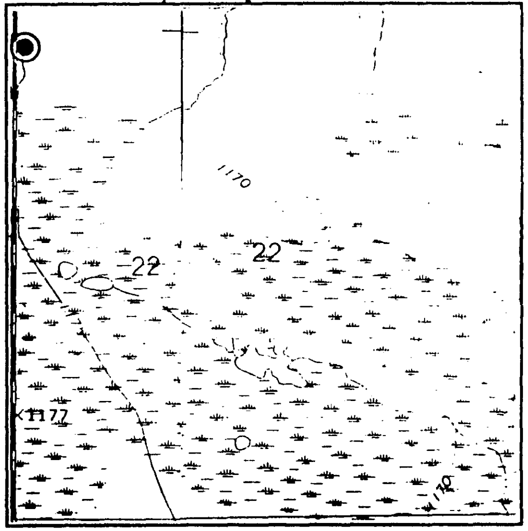
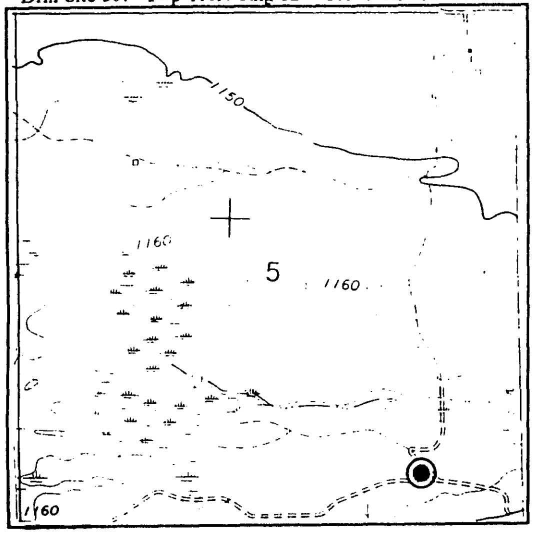


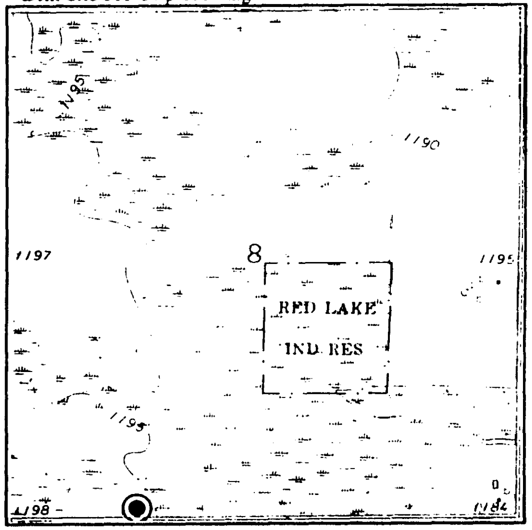
Appendix 280-A. Synopsis of Baudette area drill site information. Map scales are 1:24,000.

Drill Site 507 Twp 160N Rng 32W Sec 5 SE of SE



Drill Site 509 Twp 158N Rng 33W Sec 23 SE of SW

Drill Site 511 Twp 160 Rng 33W Sec 8 SW of SW



Drill Site 508 Twp 157N Rng 33W Sec 15 NW of NW

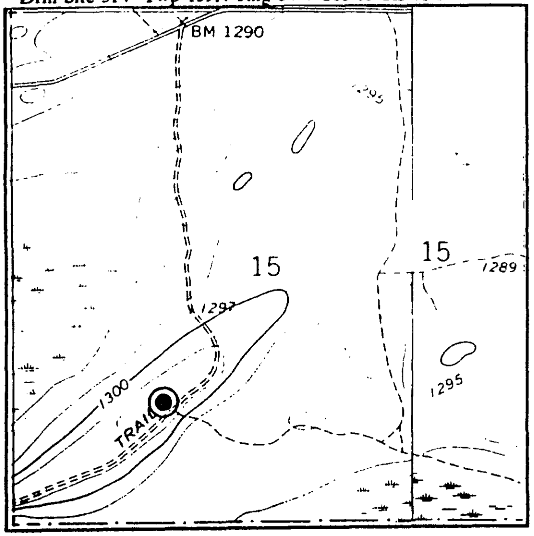
Drill Site 510 Twp 159N Rng 33W Sec 36 NW of SW

Drill Site 512 Twp 157 Rng 34W Sec 24 NE of SE

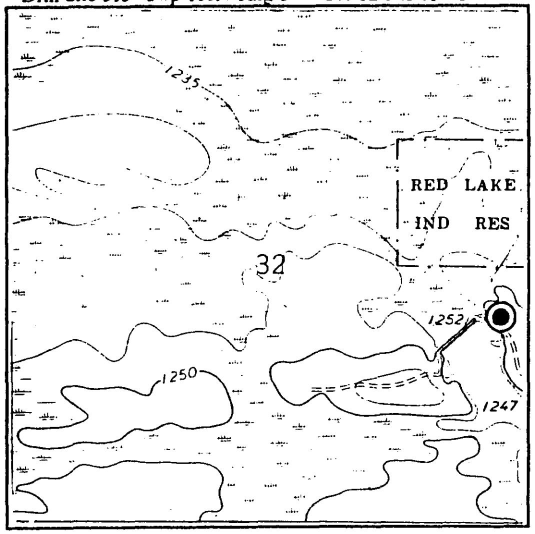
Appendix 280-A. Synopsis of Baudette area drill site information. Map scales are 1:24,000.

Drill Site 513 Twp 158N Rng 34W Sec 23 SE of SE

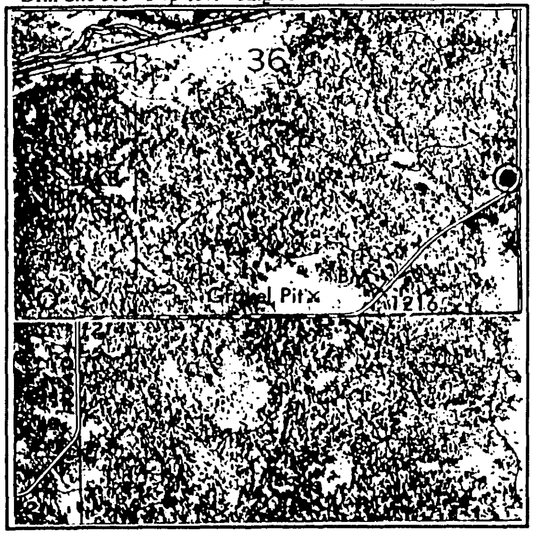
Drill Site 514 Twp 159N Rng 34W Sec 15 SE of SW



Drill Site 515 Twp 160N Rng 34W Sec 32 NE of SE

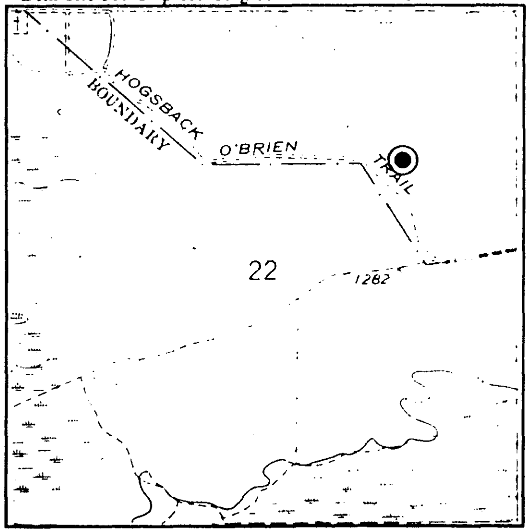


Drill Site 516 Twp 157N Rng 35W Sec 36 NE of SE



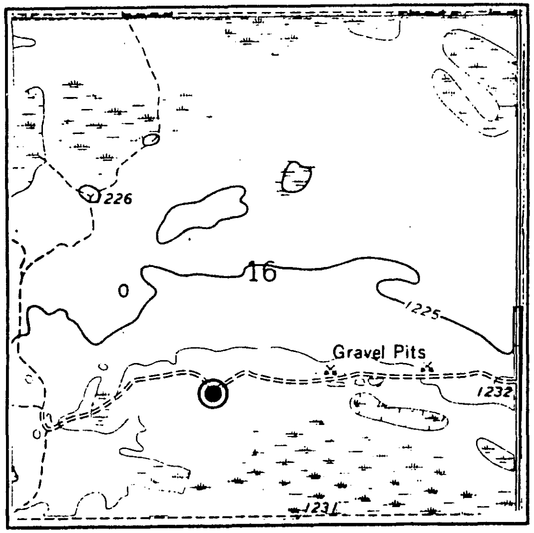
Drill Site 517 Twp 158 Rng 35W Sec 30 NW of NE

Drill Site 518 Twp 159 Rng 35W Sec 22 SW of NE

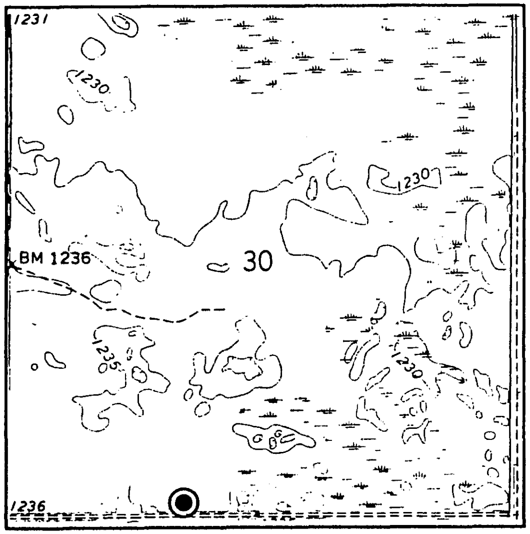


Appendix 280-A. Synopsis of Baudette area drill site information. Map scales are 1:24,000.

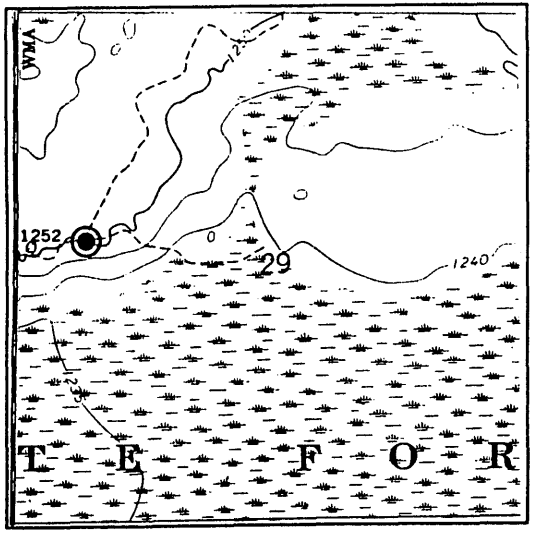
Drill Site 519 Twp 160N Rng 35W Sec 16 SE



Drill Site 521 Twp 160N Rng 36W Sec 30 SE



Drill Site 520 Twp 159N Rng 36W Sec 29 SW



Appendix 280-B. Descriptive logs of Baudette area drill core.

Column abbreviations, data key, and other notation

Descriptive Log Abbreviations

apar =apparently
calc =calcareous
carb =carbonate
cgr =coarse-grained
cob =cobbles
ft =feet
fgr =fine-grained
gnl =granules
gvl =gravel
grn =green
incl =including
lam =laminae
lith =lithology
mgr =medium-grained
mod =moderately
noncalc =non-calcareous
occ =occassional
ox =oxidized
pebs =pebbles
sed =sediment
sev =several
sh =shale
sl =slightly
sm =small
unox =unoxidized
v =very
w/ =with

Stratigraphic Picks

K =Koochiching
R =Rainy
W =Wnnipeg
O =Old Rainy
S =Saprolite
B =Bedrock

Other Notes

Glacial Drift descriptive logs by G. Meyer (MGS) Saprolite descriptive logs by D. Cartwright (MnDNR) Bedrock descriptive logs by T. Klein (USGS)

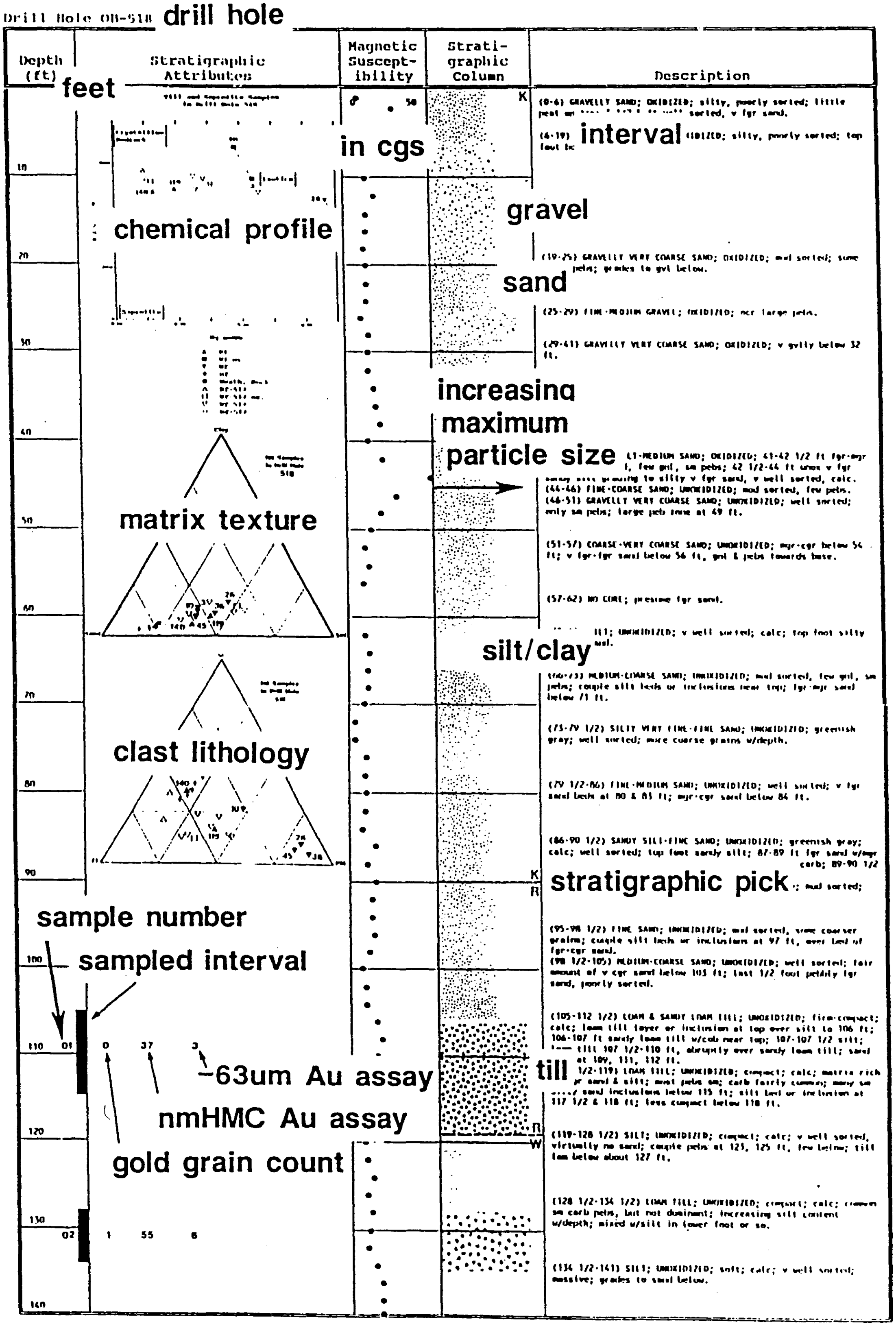
For clast lithologies, PM =Paleozoic-Mesozoic FI =felsic-intermediate intrusives SC =supracrustals

Numbers next to samples in graphic plots are height in feet above the basal Quaternary contact

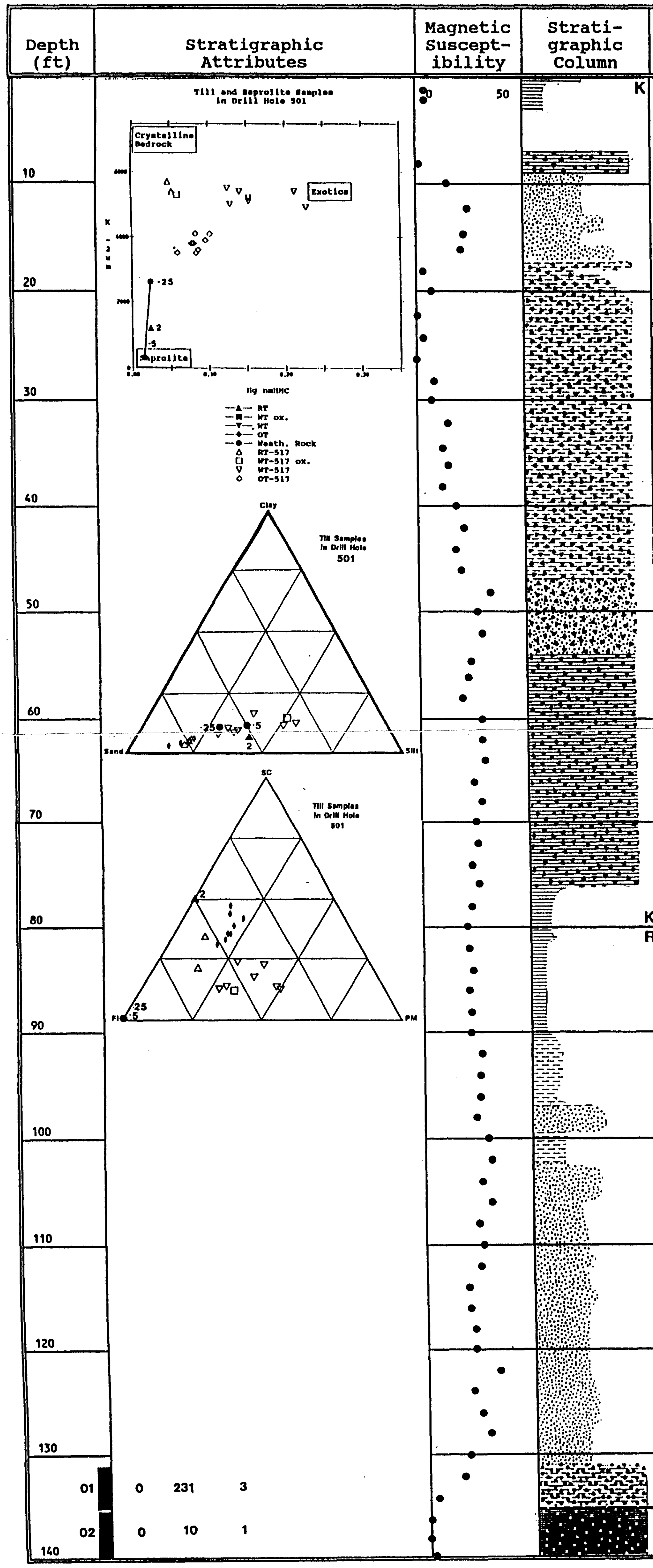
The data from drill hole 517 have been plotted as type samples for the other drill holes

Gold (Au) assay data is in parts per billion (ppb).

Explanation of data contained on descriptive logs.



Drill Hole OB-501



Description

(0-3) SILTY CLAY; OXIDIZED; leached; top foot fgr sand; peb line at base over silty till.
(3-7) NO CORE.

(7-9) SILTY CLAY TILL; OXIDIZED; mod calc, carb pebs; v silty sand at top interbeds & grades to till.
(9-13 1/2) SILTY VERY FINE SAND; OXIDIZED; inclined upper contact; fgr peb lines in last foot.

(13 1/2-17) GRAVELLY SAND; OXIDIZED; unox at 14 1/2 ft; abrupt upper contact; mostly fgr sand 14 1/2-15 1/2 ft, mostly fgr gvl from 15 1/2 ft; abundant carb; abrupt lower contact.

(17-28) SILT LOAM TILL; UNOXIDIZED; firm; calc, carb pebs common, occ sh pebs; silt bed at 18 ft; coarsening upward gvl bed 19 1/2-21 ft; fine sandy loam till 21-22 1/2 ft, silt bed w/gvl at base 22 1/2-23 ft.

(28-47) LOAM TILL; UNOXIDIZED; as above, but massive; sm to m pebs fairly common, sm cob at 31 1/2 ft;
darker gray w/depth; last foot more silty & obscurely laminated.

(47-54) FINE SANDY LOAM TILL; UNOXIDIZED; as above, massive; mostly only sm pebs, carb dominant; sev medium pebs near base.

(54-72) CLAY TILL; UNOXIDIZED; massive, softer than above, abrupt upper contact; mod calc, calc by 58 ft; less pebs than above, carb pebs common, but fewer than above, most large pebs Precambrian; compact by 58 ft; sm cob at 58 ft; gradational lower contact.

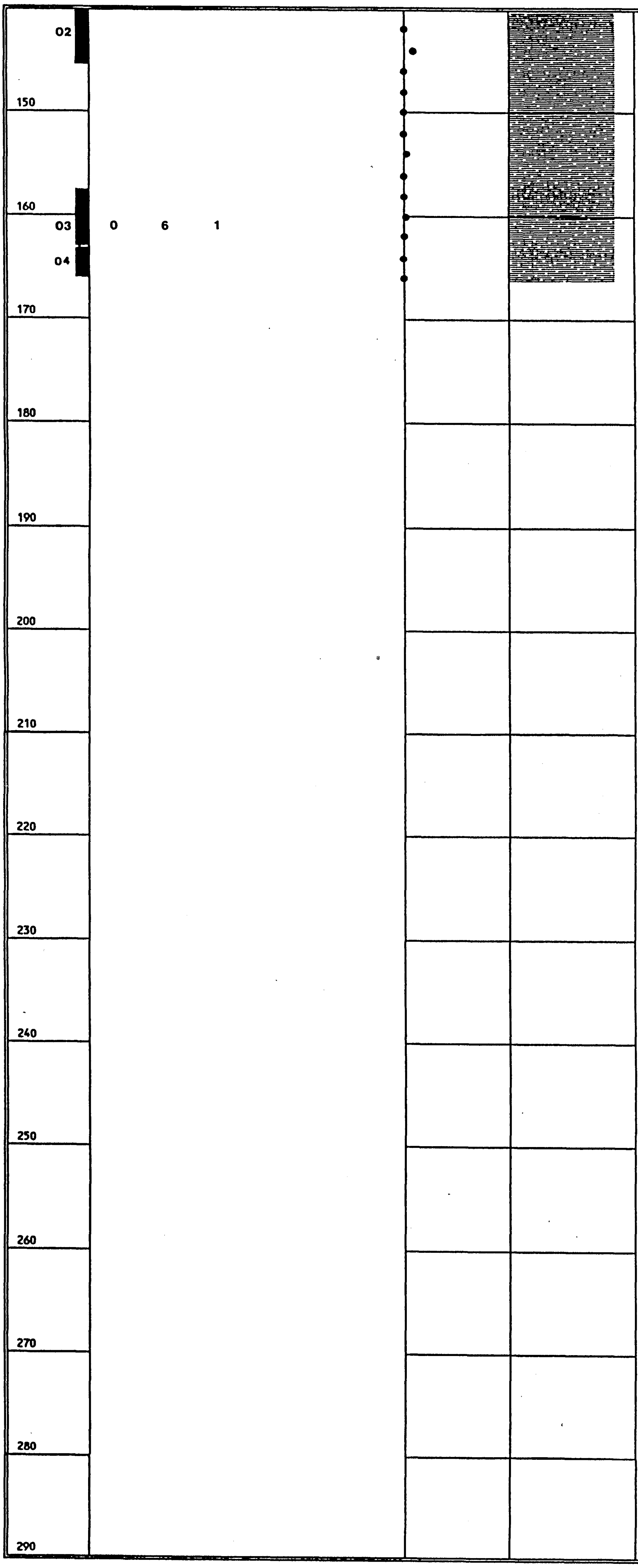
(72-76 1/2) SILT LOAM-SILTY CLAY TILL; UNOXIDIZED; as above, but variable texture; mostly silty clay till by 74 ft; many clay & silt inclusions below 74 1/2 ft; abrupt lower contact.
(76 1/2-80) SILTY CLAY, CLAY & CLAYEY SILT; UNOXIDIZED; laminated, firm; mod calc (clay) to v calc (silt).

(80-91) SILTY CLAY; UNOXIDIZED; sl calc-noncalc; reddish brown lam to 82 1/2 ft, could be oxidation phenomena as encompassing clay is greenish gray; poorly sorted fgr sandy silt bed at 81 1/2 ft; fgr sand scattered throughout silty clay, no pebs; vaguely laminated w/clay & clayey silt below 82 1/2 ft; more silt w/depth, grades to silt from 89 ft.

(91-97) SILT; UNOXIDIZED; greenish gray sl calc; fgr mica flakes; reddish brown silty clay laminated below 92 1/2 ft; mostly greenish silty clay below 95 1/2 ft, over clayey silt at 96 ft; fairly abrupt lower contact.
(97-99 1/2) SILTY GRAVELLY SAND; UNOXIDIZED; pebbly v cgr sand grading upward to mgr sand, mod sorted; interbedded w/clayey silt; rare carb.
(99 1/2-102) CLAYEY SILT; UNOXIDIZED; greenish gray; sl calc; mod. sorted; sev v large pebs near top, cob at base.
(102-106 1/2) MEDIUM-COARSE SAND; UNOXIDIZED; well sorted, rare cob.
(106 1/2-112 1/2) FINE-MEDIUM SAND; UNOXIDIZED; silty zone w/silt bed near top; varies to mgr sand; sm pebs at base.

(112 1/2-127) FINE SAND; UNOXIDIZED; fairly abrupt upper contact; fgr to mgr from 114-115 1/2 ft w/coarse grains; v fgr-fgr below 116 1/2 ft; fgr to mgr below 123 ft.

(127-131 1/2) VERY FINE SAND; UNOXIDIZED; clay layer at 128 1/2 ft, sand silty below; inclined & abrupt contact over greenish gray fgr sandy silt at 130 ft; apar some saprolite-derived sed; grades to till.
(131 1/2-135) LOAM TILL; UNOXIDIZED; light greenish gray; compact; sl calc-noncalc; only rare, mostly sm pebs; much incorporated saprolite; sandy zone at 134 ft, cob & large peb at 134 1/2 ft; abrupt basal contact.



(135-145) SAPROLITE; KAOLINITIC; greenish gray, powdery, soft. Fine to medium-grained equigranular rock texture evident. Sharp contact with Rainy till above. Iron oxide staining around some grains. Also sparse 2-4 cm globular siderite nodules. Nodules are pale brown with agglomerated quartz grains. No rock fragments, fairly uniformly weathered with abundant 0.5 mm angular quartz grains and small black flecks. Subangular pebbles ranging up to 3 cm at 138 ft. Slightly calcareous to noncalcareous.
(145-157) SAPROLITE; KAOLINITIC; similar to above with preserved rock texture less pronounced.
(157-163) SAPROLITE; CHLORITIC; similar to above but no siderite nodules. 0.5-1 mm magnetite and feldspar grains. Texture changes to schist-like and then fades to massive at 160 ft. Slightly calcareous.

(163-166) SAPROLITE; KAOLINITIC; dusky yellow-green saprolite. Less weathered than above with fine to medium-grained texture. Sharp color change at 163 ft. Abundant micas and chlorite. Large 2 cm feldspar crystals at 163-164 ft. Noncalcareous to slightly calcareous.

(136-214) SAPROLITE; developed from fine-grained, equigranular quartz monzonite. Fine-grained (1-2 mm) quartz and weathered feldspars in a light gray to tan clay-rich matrix. Five to seven centimeter thick medium-grained granite dikes intruded the quartz monzonite at 162 and 164 feet. A very fine-grained, six inch intercept of biotite-rich xenolith with relict diabasic texture (mafic volcanic or hypabbysal intrusive) is present from 163 to 166 feet. Biotite is altered to chlorite and plagioclase to epidote. All the bedrock has a moderately to strongly developed S_1 fabric.

TD = 214'

Drill Hole OB-502

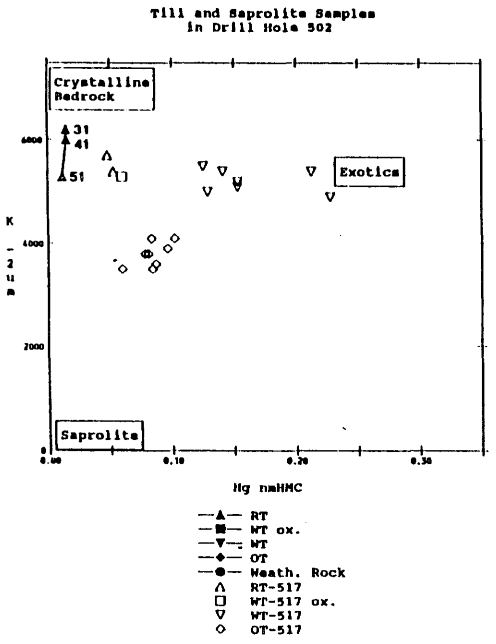
Depth (ft)

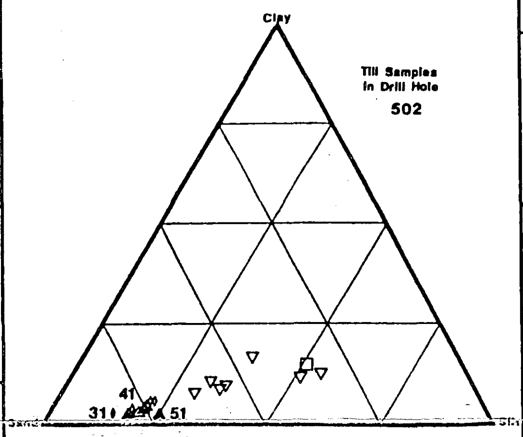
Stratigraphic Attributes

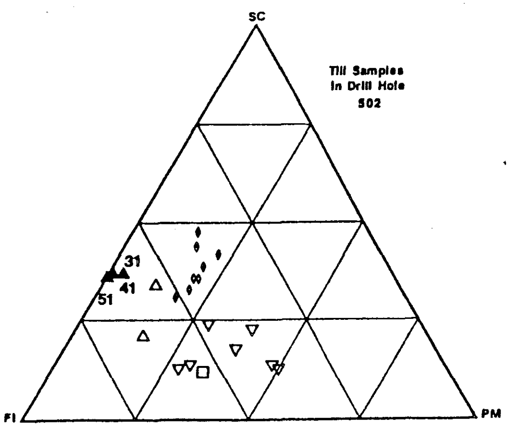
Magnetic Susceptibility

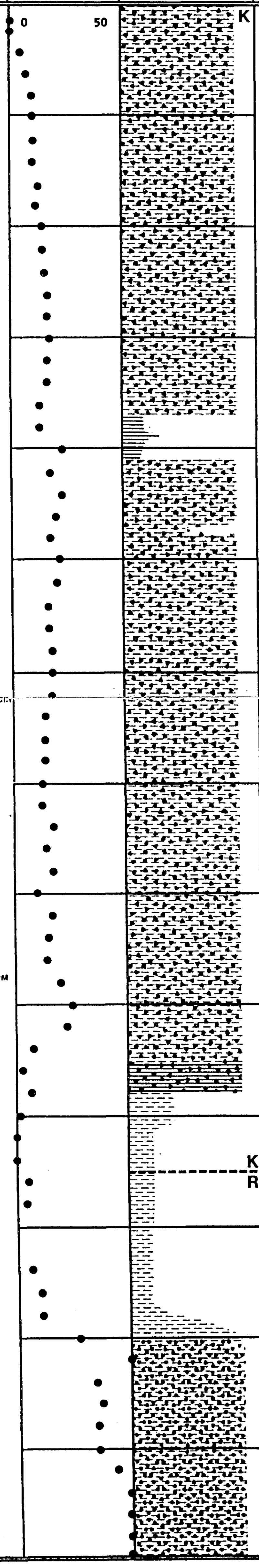
Stratigraphic Column

Description









01	4	53	2
02	2	79	5

(0-4) SILT LOAM TILL; OXIDIZED; firm; calc; top foot peaty, silty, clay loam; not many pebs; mottled in lower 2 ft.
(4-14 1/2) LOAM TILL; OXIDIZED; as above but more pebs; carb common.

(14 1/2-34 1/2) LOAM TILL; UNOXIDIZED; as above; most pebs sm; carb abundant, v rare sh.

(34 1/2-37) CLAY LOAM TILL; UNOXIDIZED; couple thin beds of silty cgr sand in upper 1/2 ft; silt & clay lam below 36 ft.

(37-41 1/2) CLAY; UNOXIDIZED; calc; firm; mostly silt in upper 1 1/2 ft; occ sm pebs, clustered; silt bed at 41 ft; abrupt lower contact.

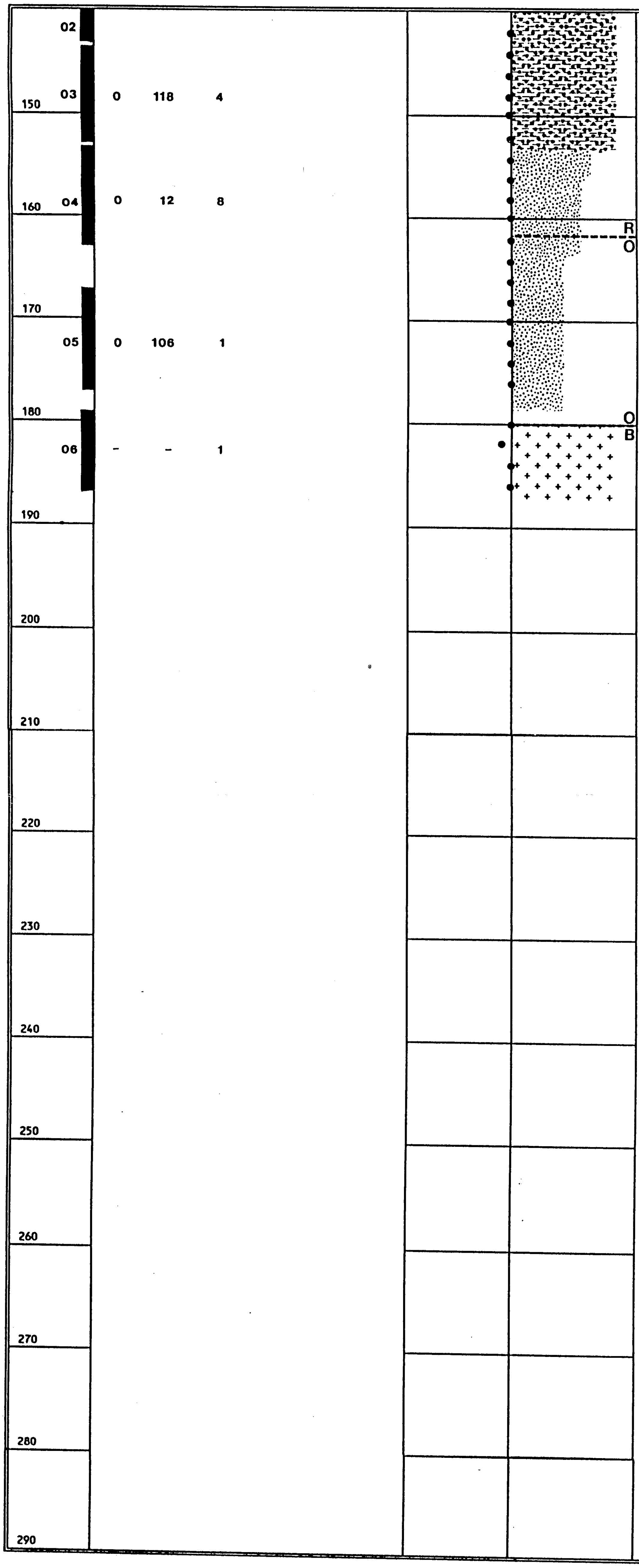
(41 1/2-47) LOAM TILL; UNOXIDIZED; soft; calc; common carb; clay poor; sm cob, large pebs towards top; thin silty sand beds throughout; lower foot silty fgr-mgr sand, sm pebs at base.

(47-79) LOAM TILL; UNOXIDIZED; massive; firm; calc; clay poor to about 52 ft.; common carb, fairly common sh; occ large pebs but not v pebbly; clay loam till below 73 ft, silty clay till below 77 ft.

(79-95 1/2) LOAM TILL;UNOXIDIZED; almost loose consistency, then quite firm by 82 ft; matrix high in silt & fgr sand, not many pebs; lighter gray than above till, also no sh noted; compact by 91 ft.

(95 1/2-98) CLAY TILL; UNOXIDIZED; massive; calc; only scattered pebs; abrupt upper & lower contacts but clay & silt lam near base.
(98-105) SILT; UNOXIDIZED; calc; mod calc, irregularly spaced clay lam; scattered sand grains, sm pebs; mostly clay & silty clay below 101 ft, w/silt lam; thin greenish bed at 103 ft, mostly silty clay below w/fair amount of fine sand; thin clay bed at 104 ft, lam below.
(105-120) SILT & CLAY; UNOXIDIZED; sl calc-noncalc; more greenish, better laminated than above, v few sand grains, no pebs; sev dark brown lam at 107 ft; 107-108 ft less distinctly laminated, sl calc-calc, more sand grains, apar interbedded Koochiching source sed; 108-112 ft disturbed section w/some core loss, apar lake sed as above; 112-113 ft sl-mod calc, only sl calc below; rare sand grains; transitional to till below 117 1/2 ft, silty clay-clayey silt w/variable amounts of sand, occ sm pebs.

(120-153 1/2) SANDY LOAM TILL; UNOXIDIZED; greenish gray; loose to firm; sl calc, v rare carb; occ cobs, large pebs fairly common; gvlly sand seam at 120 1/2 ft; v sandy below 125 ft; could be poorly sorted in places; firm sandy loam till below 129 ft; v sandy & apar poorly sorted in places below 136 ft, some poorly sorted gvlly sand beds; mod sorted fgr-mgr sand bed at 152 1/2 ft, more could have been lost from core.



(153 1/2-156) GRAVELLY SAND; UNOXIDIZED; silty, cgr, poorly sorted w/common large pebs, sm cob at 154 ft; carb pebs rare; silt clast at base, abrupt lower contact.

(156-163 1/2) COARSE SAND; UNOXIDIZED; v well sorted; cgr -v cgr w/few gnl by 158 ft; sm clast of gray, mod calc sandy till at 159 1/2 ft; last 2 ft not as well sorted, mostly mgr, w/some gnl at 162 ft; abrupt lower contact.

(163 1/2-178 1/2) SILTY VERY FINE SAND; UNOXIDIZED; greenish gray; abundant dark mica flakes; v fgr-fgr below 164 1/2 ft, silty in spots; mostly silty below 172 ft; no core 177-178 1/2 ft.

(178 1/2-180) NO CORE.

(180-187) BEDROCK; pink to tan, medium-coarse grained biotite-bearing syenite. The biotite is ragged, mostly altered to chlorite, and forms a variably present, moderately well developed foliation at 45° to core axis. The original coarse-grained feldspars have recrystallized to anhedral patches comprised of very fine-grained, sausseritized feldspars separated by intergranular micas.

Thin section description: sample at 181 feet.

Mineralogy: microcline (44%), plagioclase (48%), biotite (4%), epidote (4%), accessory minerals (garnet, opaque).

Texture: hypidiomorphic-granular, with 0.5 to 0.8 mm diameter, generally equigranular, feldspars. Light brown, slightly pleochroic biotite is present in glomeroporphyritic megacrysts 0.9 mm in diameter.

Lithology: syenite.

TD = 187'

Drill Hole OB-503

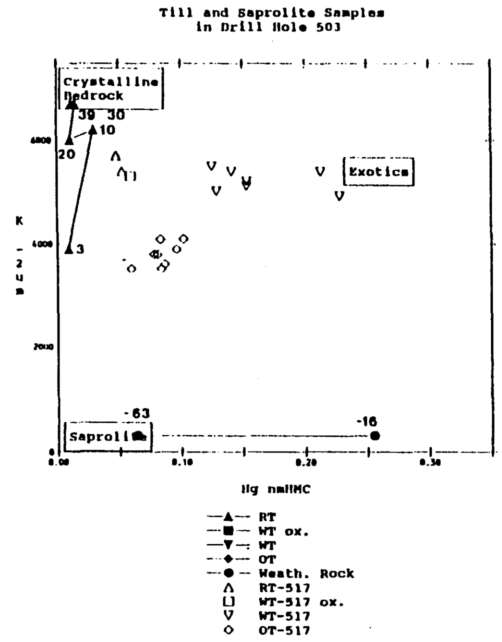
Depth (ft)

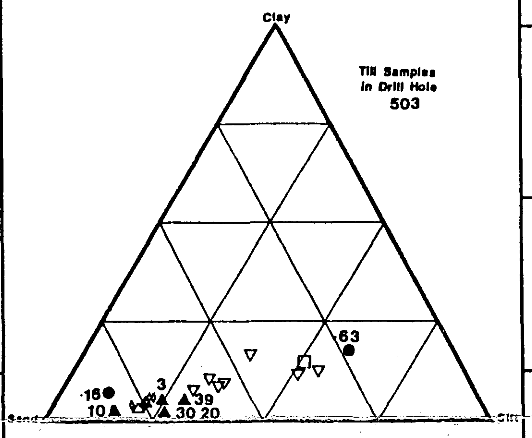
Stratigraphic Attributes

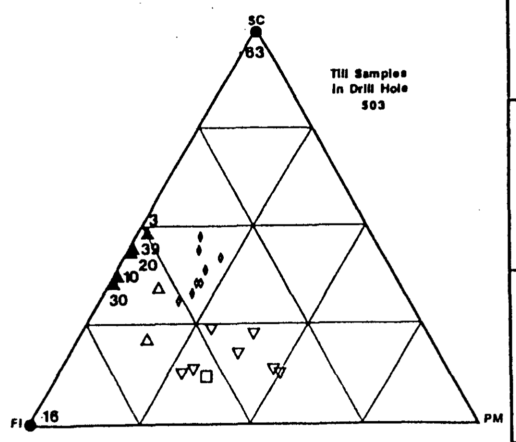
Magnetic Susceptibility

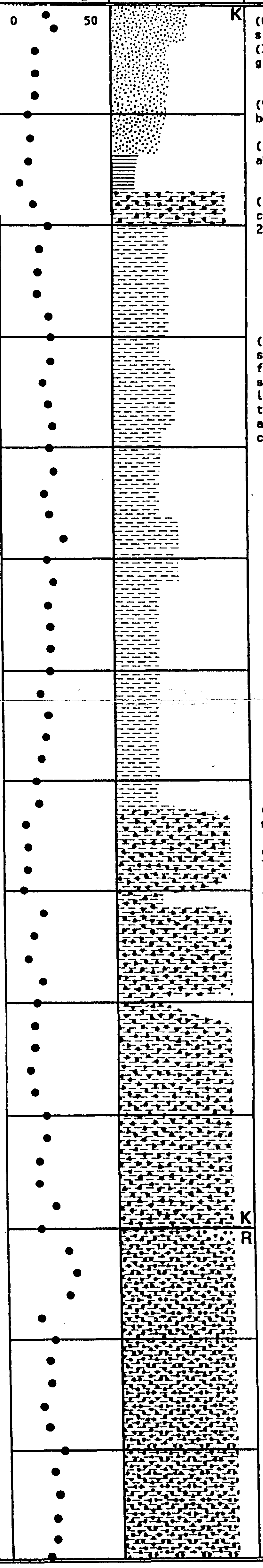
Stratigraphic Column

Description









	01	0	34	2
	02	1	887	1
	03	0	64	2
140	04	0	240	23

(0-3) GRAVELLY SAND; OXIDIZED; reddish brown; sand mod sorted, silty & fgr; last foot poorly sorted fgr gvl.
(3-9) SILTY FINE SAND; OXIDIZED; mod sorted; some coarser grains.

(9-13 1/2) VERY FINE SAND; UNOXIDIZED; sm pebs, little organics below 11 ft; v fgr sandy silt below 12 ft.

(13 1/2-17) CLAY & SILTY CLAY; UNOXIDIZED; vaguely laminated; abrupt lower contact.

(17-30) LOAM TILL; UNOXIDIZED; soft; common sm carb pebs; clayey w/clay lam in upper foot or so; firm & more pebbly below 27 ft; last foot mostly silt.

(30-73) VERY FINE SANDY SILT & SILTY SAND; UNOXIDIZED; v well sorted; 30-32 ft v fgr sandy silt w/silt lam near base; 32-38 ft silty v fgr sand; 38-46 ft silt-v fgr sandy silt; 46-52 ft silty v fgr sand; 52-62 ft v fgr sandy silt; 62-63 1/2 ft clay loam till mixed w/silt; 63 1/2-65 ft silt w/pebbly clay lam towards base; 65-73 ft v fgr sandy silt, clay loam till layer at 68 1/2 ft; carb pebs in last foot, gradational lower contact.

(73-76 1/2) SILTY CLAY LOAM TILL; UNOXIDIZED; grades to silt w/thin clay loam till lam 75-76 1/2 ft; abrupt lower contact.

(76 1/2 -80) CLAY LOAM TILL; UNOXIDIZED; compact; silt bed at 77 1/2 ft, silt lam below 78 1/2 ft, gradational lower contact.

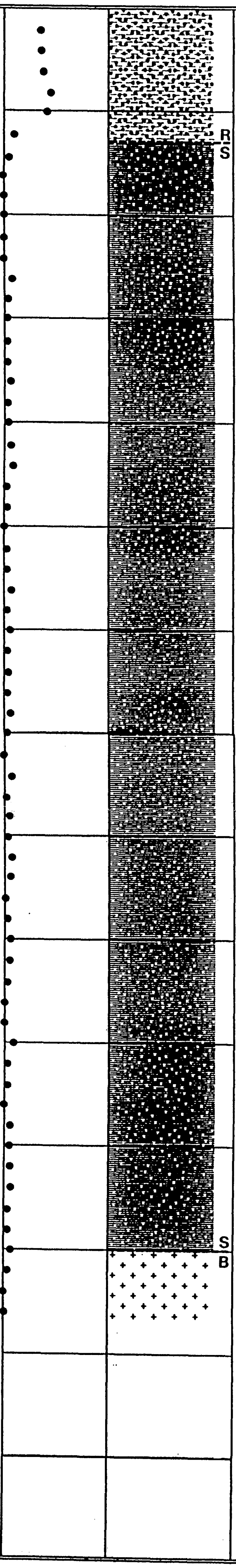
(80-82 1/2) SILT - VERY FINE SANDY SILT; UNOXIDIZED; clay loam till layers below 81 ft.
(82 1/2-89) CLAY LOAM TILL; UNOXIDIZED; firm; silt lam in upper foot or so; sm carb & sh pebs common; fine loamy texture by 85 ft; cob at 88 ft.

(89-92) SILT; UNOXIDIZED; scattered sand grains; peb cluster at 90 ft, few below; grades to till below.

(92-110) LOAM TILL; UNOXIDIZED; mostly only sm pebs; clay bed at 95 ft, silty clay loam texture below; uncommon carb; compact by 104 ft, also clay texture w/few pebs.

(110-153) SANDY LOAM TILL; UNOXIDIZED; greenish gray; firm; sl calc; foot or so of mgr-cgr sand at top; till cobbly at top, occ large pebs below; v rare carb; loose in places, v sandy from about 123-131 ft; cobs at 127, 131, 134 1/2, 146, 149 ft & at base; much quartz sand from below mixed into lower couple ft of till.

	04			
150	05	1	170	1
160				
170	06	1	116	2
180				
190				
200				
210				
	07	0	3	2
220				
230				
240				
	08	-	3	-
250				
	09	-	-	5
260				
270				
280				
290				



(153-155) SAPROLITE; REWORKED; pale yellowish brown to grayish orange medium-grained, angular to subrounded quartz sand. Sand is very yellowish for the first 6 inches and then turns gray. Contains a few small 1 mm concretions of quartz sand and globular siderite nodules. Sand is made up of quartz grains coated with clay minerals. Grains range up to 1 cm. Slightly calcareous to noncalcareous.
(155-158) SAPROLITE; REWORKED; similar to above but more oxidized (light brown).
(158-164) SAPROLITE; REWORKED; similar to above but more yellowish gray to very light gray.
(164-166) SAPROLITE; REWORKED; similar to above but more medium light gray.
(166-174) SAPROLITE; REWORKED; similar to above but slightly oxidized. Fine-grained sand almost silt size with mica flakes.

(174-211) SAPROLITE; REWORKED; very light gray fine to very fine-grained sand. Grains angular to subrounded and coated with clay minerals. Siderite nodules change to a reddish brown color. Similar to 158-164 ft. except much finer-grained. Small flakes of mica. Sandy, clayey silt from 193-194 ft. Boulder at 185 ft. Slightly calcareous to noncalcareous.

(211-226) SAPROLITE; KAOLINITIC; light greenish gray. Powdery, soft and massive. Oxidation occurs around some of the nodules. Abundant 0.1 mm - 3 cm siderite nodules. Line of 4 cm subrounded quartz pebbles 6 inches from contact with reworked saprolite. Noncalcareous.

(226-234) SAPROLITE; CHLORITIC; greenish gray. Preserved mylonitic texture less weathered and harder than above. Relict veining and sparse hairline oxidized quartz veins from 230-234 ft. Siderite nodules are fewer and smaller. More chorite-rich than above. Noncalcareous.
(234-240) SAPROLITE; CHLORITIC; similar to 230-234 except visible calcite rich zones and veins throughout. Core is more oxidized than above. Moderately calcareous to highly calcareous.

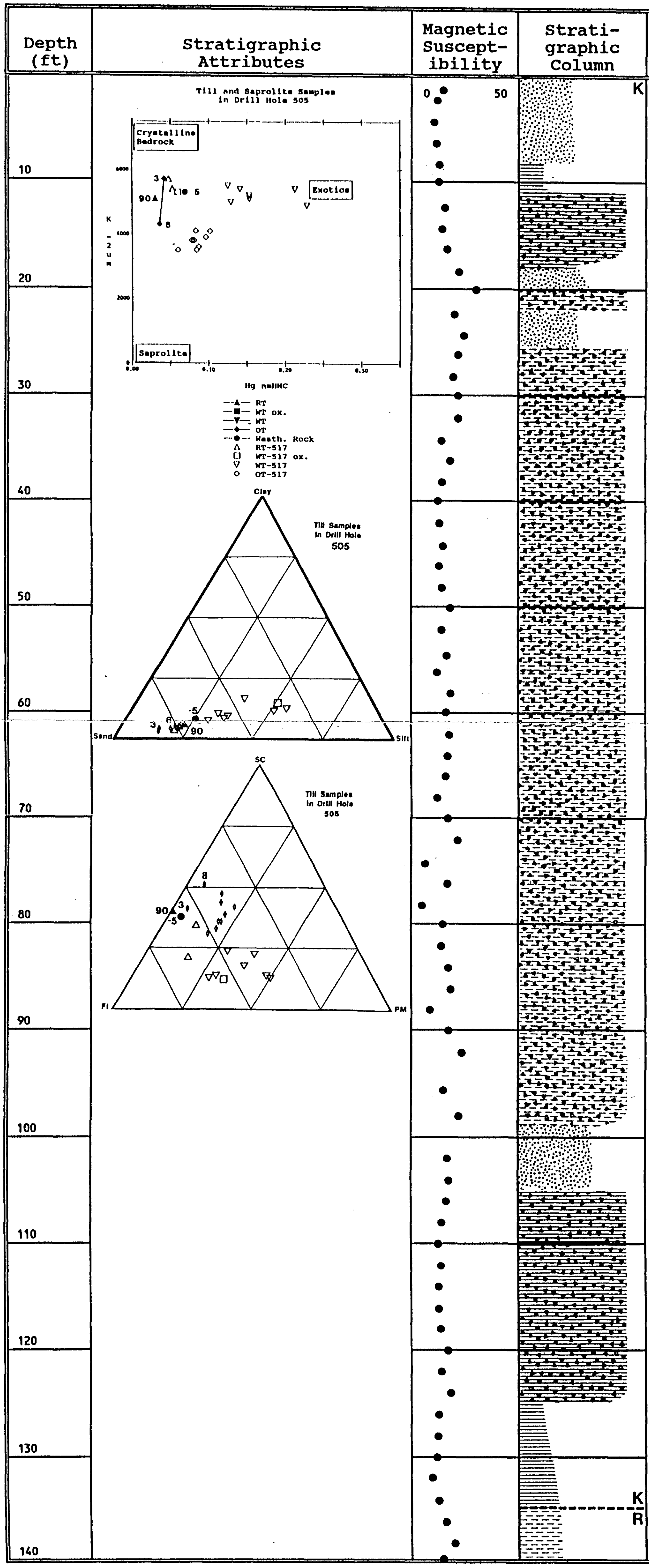
(240-260) WEATHERED BEDROCK; mylonite.
(260-267) BEDROCK; light yellow-tan, fine-grained rock with very fine-grained biotite-rich augen 1 x 5 mm comprise 5 to 10% of the rock. Augen are not folded but some are rounded. Light green, altered plagioclase(?) clasts (3 mm) show rotation of up to 30°. Two foliations are present with a strongly developed S_1 parallel to CA and weak S_2 at 30° to CA. A composite, 0.5-2 cm thick quartz vein composed of light gray translucent quartz with numerous chloritite wall rock inclusions is nearly continuous over the length of the core. White quartz with a well developed fibrous texture is found along the boundaries of the gray, crack-seal quartz veins. Fibers are oriented perpendicular to the vein walls. Iron oxide pseudomorphs after pyrite are present in trace amounts within the veins. Calcite replacement of the wallrock is apparent in the deepest core samples where it has not been removed by weathering.

Thin section description: samples at 250 and 256 feet.

> Mineralogy: plagioclase (40%), blue-green biotite (40%), quartz (10%), epidote (5%), fine-grained white mica (3%), apatite (trace.), calcite (in vein).
>
> Texture: Porphyroclasts of plagioclase and quartz are commonly 0.05 to 0.08 mm long (with up to 5:1 flattening in quartz). Broken plagioclase is rotated from 1/3 to 1/2 and quartz contains many biotite inclusions. Biotite is commonly intergranular with some growth in pressure shadows adjacent to plagioclase. Well developed cataclastic foliation. Calcite, in a late vein, incorporates previously-deformed host rock.
>
> Lithology: mylonite (protolith may have been a quartz-bearing plutonic rock).

TD = 267'

Drill Hole OB-505



Description

(0-8) FINE SAND; OXIDIZED; mod sorted, few sm pebs in upper part; thin silty cgr sand bed w/sm carb pebs at base; abrupt lower contact.

(8-11 1/2) CLAY & SILTY CLAY; UNOXIDIZED; mod calc; generally rare & v thin calc silt lam; few sm pebs & silt lam 10-11 ft.

(11 1/2-18) CLAY TILL; UNOXIDIZED; massive, firm; mod calc-calc; few sm pebs; gradational upper contact; silty clay till below 14 ft; more pebs, some large by 16 ft; last foot silty clay w/interbeds of clay, soft, mod calc, v rare clasts.

(18-20) MEDIUM SAND; UNOXIDIZED; gvl at base grading up to silty v fgr sand.
(20-22) LOAM TILL; UNOXIDIZED; mod calc; high in v fgr sand & silt, pebbly; abrupt contacts.
(22-25 1/2) SILTY VERY FINE SAND; UNOXIDIZED; well sorted, few coarse grains; gnl at 24 1/2 ft, v silty below; medium peb bed at base.
(25 1/2-68 1/2) LOAM TILL; UNOXIDIZED; firm; calc; carb common, sh uncommon; fgr sand inclusion at 27 1/2 ft, well sorted fgr sand bed 28-28 1/2 ft; more silty 44-48 ft w/silt inclusion at 46 ft; more compact w/depth; carb cob at 65 ft.

(68 1/2-75 1/2) CLAY LOAM TILL; UNOXIDIZED; compact; calc; broadly gradational upper contact; sh more common than above; lignite peb at 71 ft; more silty below 73 ft; laminated silty clay & clay, calc, w/few clasts, below 74 ft.

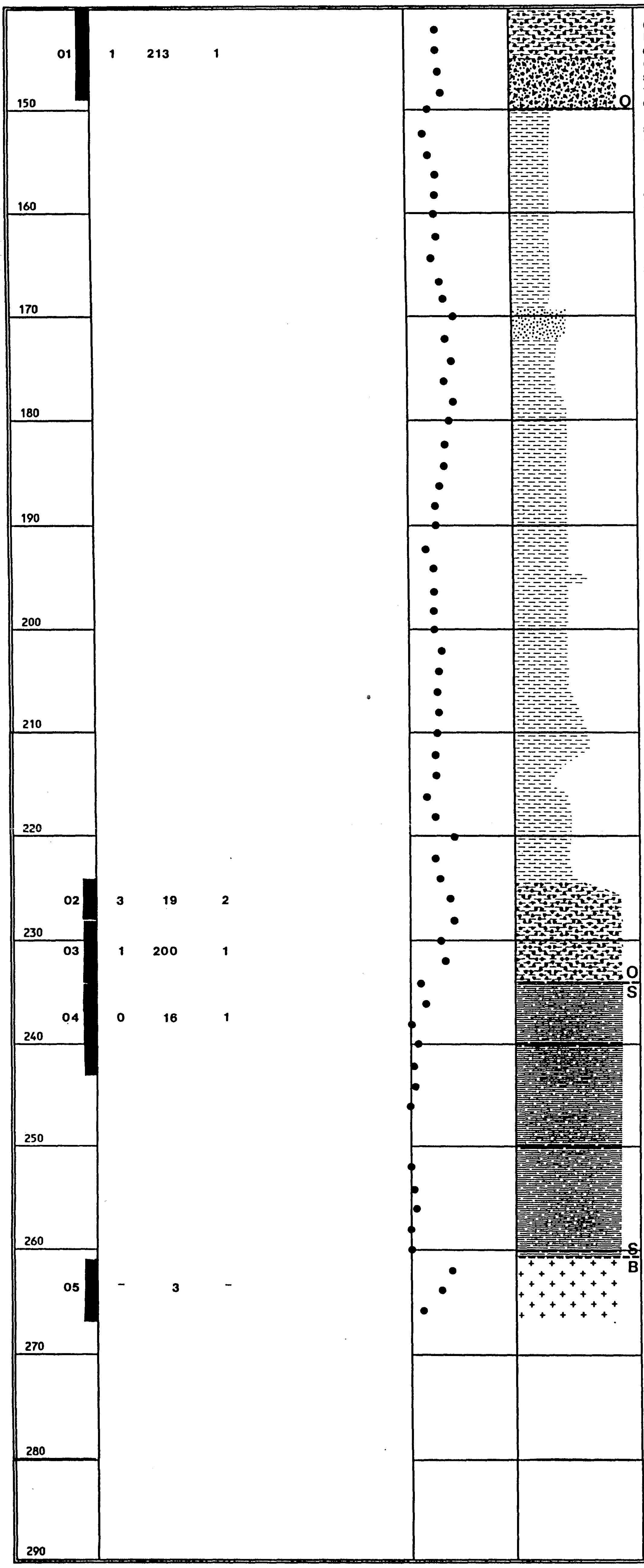
(75 1/2-87) LOAM TILL; UNOXIDIZED; soft; calc; common carb & sh pebs; fairly abrupt upper contact; fine sandy loam till below about 80 ft; mostly sm pebs; cob at 86 1/2 ft.

(87-89) BOULDER.
(89-99 1/2) CLAY LOAM TILL; UNOXIDIZED; compact; common carb & sh; minor silt & fgr sand inclusions; silty in upper couple ft, more clayey in places; darker & more massive w/no inclusions below 95 ft.

(99 1/2-105 1/2) GRAVELLY SAND; UNOXIDIZED; silty, poorly sorted; common to abundant carb pebs, sm carb cob at 100 ft; till bed at 101 ft, sandy to clayey till from 101 1/2-102 1/2 ft, mostly till w/mgr sand interbeds 104-105 1/2 ft.
(105 1/2-124 1/2) CLAY TILL; UNOXIDIZED; compact; calc; clay loam texture above 108 ft, large carb cob at 107 ft; silt inclusions 108-112 ft; mostly silty clay w/scattered pebs; not quite as clayey below about 122 ft.

(124 1/2-129) SILTY CLAY & CLAY; UNOXIDIZED; laminated; mod calc-calc; v well sorted, no sand grains; greenish gray, dark gray & gray; greenish silt bed towards base.

(129-135 1/2) SILT & CLAY; UNOXIDIZED; laminated; sl-mod calc; greenish gray silt & light brownish gray clay, w/reddish brown clay beds at 129 1/2 ft; below 129 1/2 ft massive gray silty clay w/sand grains, red bed at 130 ft; below 130 ft laminated silt, calc silty clay & few reddish brown lam; few sand grains below 130 1/2 ft; sev red beds at 132 1/2 ft; well developed rhythmites at 134 ft.
(135 1/2-137 1/2) FINE SANDY SILT; UNOXIDIZED; greenish gray; massive, not as well sorted as above; no pebs; mod calc.



(137 1/2-140) SILT; UNOXIDIZED; greenish gray w/gray silty clay lam; scattered fine sand grains, sm pebs at 140 ft; sl- mod calc.
(140-145) SILT LOAM TILL; UNOXIDIZED; greenish gray; soft; sl-mod calc; only sm pebs; gray silty clay layers at 143 1/2 ft, large pebs below; large peb & sm cob at base; abrupt lower contact.
(145-150 1/2) LOAMY SAND TILL; UNOXIDIZED; greenish gray; firm; sl calc; silty pebbly sand from 145 1/2-146 1/2 ft; large pebs fairly common; dark greenish gray cgr silt & gray silty clay 149-149 1/2 ft; gray v silty cgr sand, poorly sorted 149 1/2-150 1/2 ft.
(150 1/2-169 1/2) SILT; UNOXIDIZED; dark greenish gray cgr silt & gray silt; mod calc; laminated; abundant dark mica flakes in cgr silt; no gray silt below 156 ft; v fgr sand lam at 161 ft; laminated greenish gray silt & grayish brown clay zone at 162 1/2 ft; brownish colors at joints; no pebs; 168-169 ft silt w/clay lam at top.

(169 1/2-172) VERY FINE-FINE SAND; UNOXIDIZED; v silty & interbedded w/fgr sandy silt.
(172-177) COARSE SILT; UNOXIDIZED; dark greenish gray; occ brownish clay lam; v fgr sandy silt lam at 174 1/2 ft.

(177-224 1/2) SILTY VERY FINE & FINE SAND & SANDY SILT; UNOXIDIZED; sl calc; dark greenish gray, high mafic content; fgr-mgr sand lam at 181 ft; mostly v fgr sandy silt 188-194 ft; rare carb; silty cgr sand pocket at 192 ft; few gnl below to 194 ft; cgr-v cgr sand bed at 195 ft; 205-206 ft silty v fgr-fgr sand grades down to cgr sand; cgr silt 210-211 ft, brownish clay lam in silt bed below; mostly cgr silt 213 1/2 ft-215 ft; 215-217 ft silty v fgr-mgr sand, mod sorted, w/v fgr sandy silt beds.

(224 1/2-234) LOAM TILL; UNOXIDIZED; greenish gray; loose; sl calc; 225-228 ft many rounded to subangular cobs & large pebs, v large cob at base; no pebs or cobs 228-232 ft, more a v poorly sorted sandy silt; 232-234 ft v poorly sorted sandy clay w/few pebs incl 2 large pebs at top, also large saprolite inclusion different from saprolite below; peb lines at base in reworked saprolite.

(234-237) SAPROLITE; CHLORITIC; greenish gray, soft. Slight fine-grained equigranular rock texture. Coarse texture from 237-238 ft. Oxidized zones occur along fractures at 236 ft. Completely weathered to clay minerals except for sparse angular quartz and pink feldspars ranging up to 2 mm, and abundant flakes of muscovite. Slightly calcareous.
(237-240) SAPROLITE; CHLORITIC; dark greenish gray. Similar to above only texture is less pronounced. 2 cm rounded pebble at 240 ft (in place?). Slightly calcareous.
(240-243) SAPROLITE; CHLORITIC; similar to 234-237 ft.
(243-261) GRUS; dark greenish gray, fine grained. Core has a grainy-clumpy texture. Contains more quartz, some feldspars and abundant small muscovite flakes. Similar to above (234-237 ft) only less weathered. Slightly calcareous to moderately calcareous.

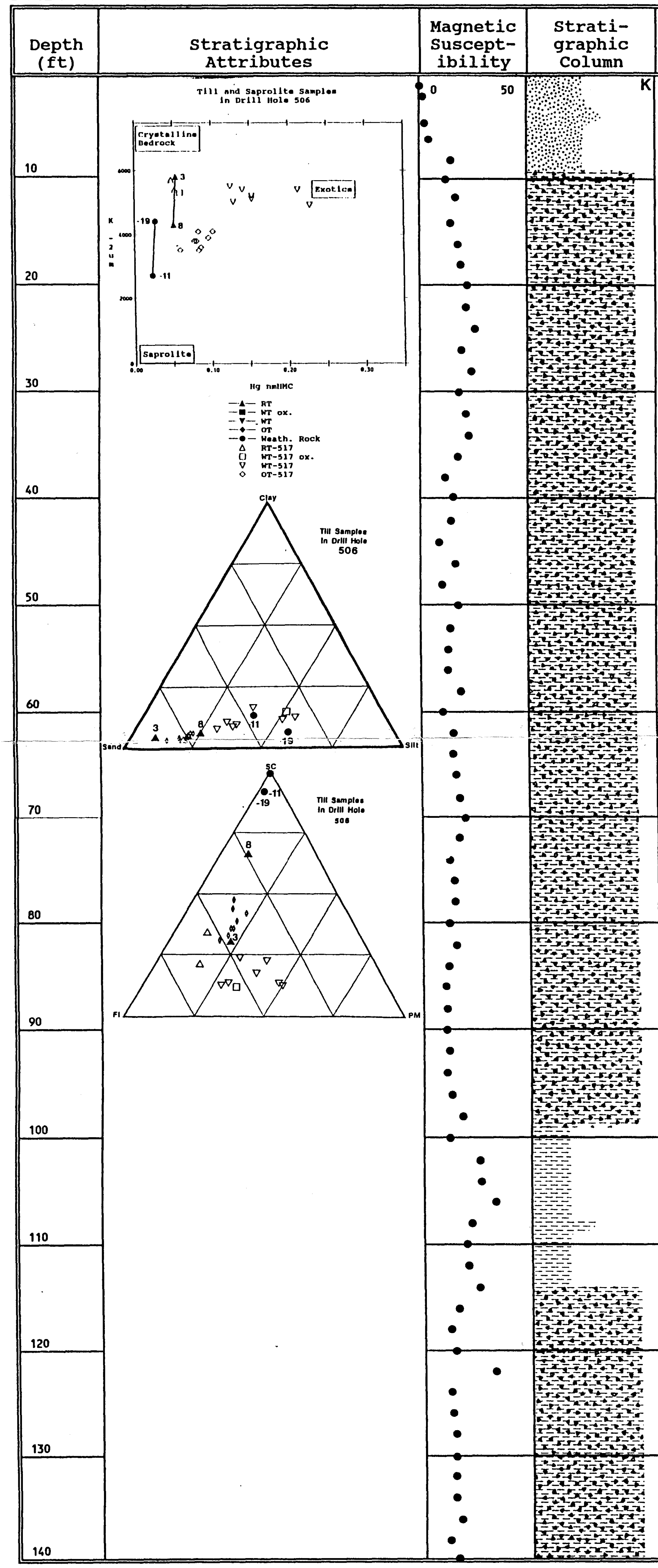
(261-267) BEDROCK; light gray, equigranular, biotite quartz monzonite composed of 1 to 2 mm subhedral plagioclase, 5% quartz and 5% biotite. Moderately well-developed S_1 foliation is at 45° to the CA.

Thin section description: sample at 262 feet.

> Mineralogy: plagioclase (33%), microcline (25%), quartz (21%), dark green biotite (20%), apatite (trace).
>
> Texture: Hypidiomorphic-granular with zoned, subhedral plagioclase (0.5-3 mm long) and recrystallized anhedral microcline and quartz (0.2-0.7 mm diameter). Biotite is subhedral usually 0.5 to 1.5 mm long with moderate chloritization and clay alteration (weathering). The cores of the zoned plagioclase are extensively altered
>
> Lithology: Weathered biotite quartz monzonite.

TD = 267'

Drill Hole OB-506



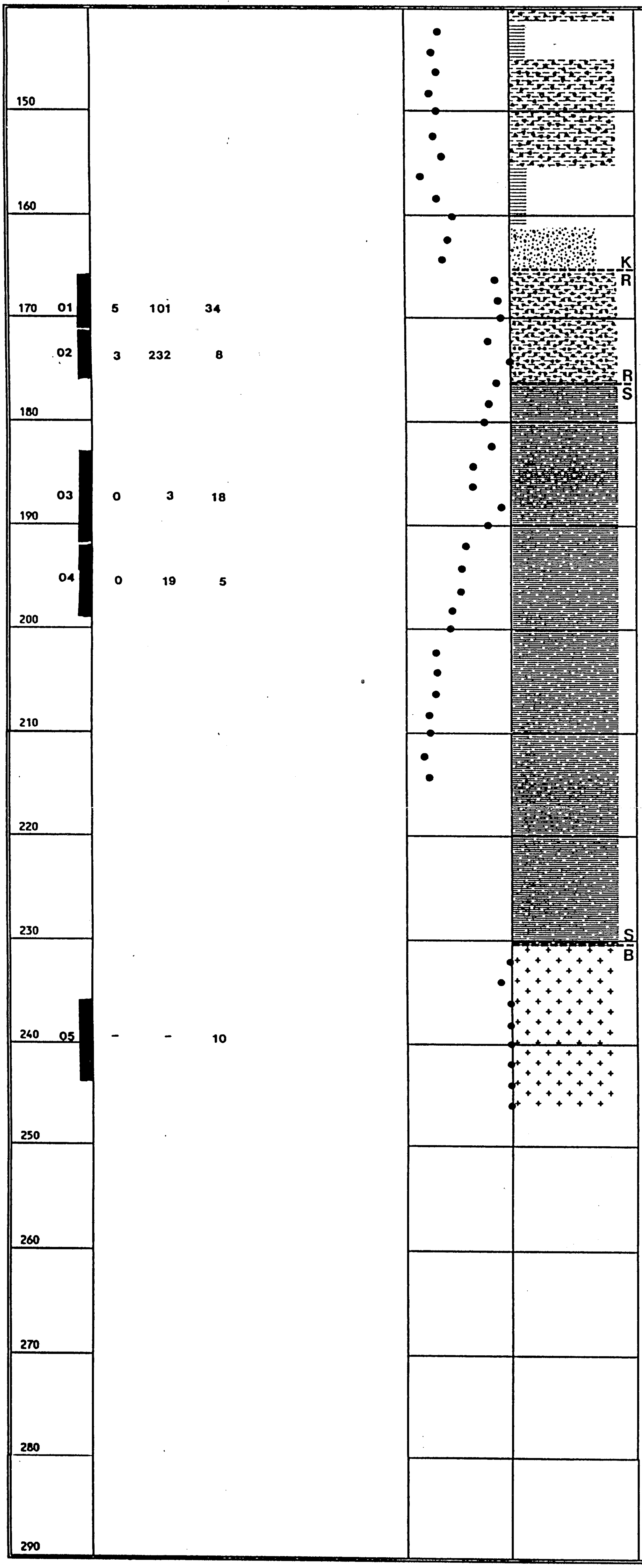
Description

(0-9 1/2) FINE SAND; OXIDIZED; mod sorted; 3-4 ft fgr-mgr sand w/coarse grains, grading down to well sorted v fgr sand below 4 ft; unox below 7 1/2 ft; calc till inclusion & large carb peb at 9 ft.

(9 1/2-58 1/2) LOAM TILL; UNOXIDIZED; firm; calc; mostly sm pebs, abundant carb, v rare sh; upper foot or so more clayey & soft, till less clayey w/depth; much fgr sand & silt in matrix below 20 ft; more clayey below 51 ft, clay loam till below 57 ft; gradational lower contact w/beds of laminated silty clay & clay near base.

(58 1/2-99 1/2) LOAM TILL; UNOXIDIZED; loose; calc; 58 1/2-60 ft clay vaguely laminated w/silty clay w/many pebs incl sh, grades to till below; common carb & sh; till matrix rich in fgr sand & silt to 67 ft, firm w/more clay below; clay loam till below 73 ft; occ large pebs; silt bed or inclusion at 85 1/2 ft, few silt streaks 91-92 1/2 ft & at 94 1/2 ft, crudely laminated w/silt below 95 1/2 ft.

(99 1/2-114 1/2) SILT; UNOXIDIZED; mod calc-calc; v well sorted, rare coarse sand grains; top foot calc silty clay w/clay lam, few sm pebs & sev large pebs at 100 1/2 ft; 108-109 1/2 ft fgr sand & silt-rich till gradational above & below w/silt; v fgr sandy silt lam below 109 1/2 ft, w/beds from 111-111 1/2 ft & last 1/2 ft; fairly abrupt lower contact.
(114 1/2-142) LOAM TILL; UNOXIDIZED; firm; calc; common carb, rare sh; mostly sm pebs; massive; rich in silt & clay, clay loam till below 127 ft, more clayey w/depth.



(142-144 1/2) CLAY; UNOXIDIZED; calc; interbedded w/clay till to about 143 ft, mostly silty clay & clay w/fairly common sm pebs below.

(144 1/2-155) SILTY CLAY LOAM TILL; UNOXIDIZED; v soft; calc; more silty & firm below 151 1/2 ft, also more pebs; silt & clay inclusions below 154 ft from underlying lake sed.

(155-161) SILT & CLAY; UNOXIDIZED; laminated greenish gray silt & dark gray clay, lam vary from sl calc-calc; well developed rhythmites in places, best least calc; few v thin brown clay lam towards top; mostly calc silt below 157 ft; sm pebs fairly common; clay lam below 160 ft, clay flow till at base.

(161-165) CLAYEY GRAVEL; UNOXIDIZED; mod calc, bimodal sorting; more silty clay than gvl in upper foot; common carb; mostly fgr-mgr gvl mixed w/silty clay.

(165-176) SANDY LOAM TILL; UNOXIDIZED; greenish gray; firm; sl calc; rare carb; less sandy below 168 ft; 169-170 ft loamy textured & softer; more compact below 172 1/2 ft, sl-mod calc w/few sm carb pebs; common large pebs; incorporated saprolite below 174 ft.

(176-179) SAPROLITE; REWORKED; mottled dark greenish gray. Contains numerous exotic carbonate and other rounded pebbles up to 4 mm and rock fragments up to 4 cm. Also contains large unweathered sections of rock. Calcareous.

(179-180) SAPROLITE; CHLORITIC; dark greenish gray weathered rock.

(180-183) SAPROLITE; CHLORITIC; dark greenish gray. The preserved rock texture is medium-grained and horizontally foliated. Thin oxidized zones at 182 ft (drilling or glacial artifact?). Contains up to 1 cm rock fragments and up to 1 mm angular quartz and feldspars. Calcareous.

(183-191) SAPROLITE; CHLORITIC; similar to above but oxidized. Dark to moderate reddish brown streaks and stains. Less oxidized from 183-184. Core is a dark greenish gray mottled with dark reddish brown and moderate olive brown. Contains fragments of up to 1 mm angular pink granitic fragments. Calcareous.

(191-208) SAPROLITE; KAOLINITIC; grayish green. Rock texture is much more pronounced than above or maybe just a finer texture. Contains 0.5 mm grains of quartz and feldspar. Weathered feldspars appear as sparse white specs. Alignment of chlorite 5° from vertical calcite veins at 202 ft, 204 ft, and 207 ft parallel to alignment of chlorite. Slightly calcareous to calcareous.

(208-215) SAPROLITE; CHLORITIC; dark greenish gray to dusky green. Similar to above. Contains thin layers of chlorite-rich material horizontally cross cutting the foliation of the majority of the saprolite. Slightly calcareous.

(215-231) SAPROLITE; CHLORITIC; [Note: Wet coring done. Usually fines are washed out.] 13 ft core lost. Dark greenish gray. Core looks like fine to medium-grained sand but was probably similar to above.

(231-246) BEDROCK; most of the cored interval is gray-green, fine-grained and strongly foliated with an undulating S_1 foliation parallel to CA with poorly defined by fine-grained biotite layers. Abundant quartz and quartz-feldspar veins generally show 5:1 flattening. Between 237 and 240 feet calcite replaces the groundmass surrounding a diffuse calcite vein which is perpendicular to the CA. In the same interval, the carbonate replaced wall rock is cut by 0.5 to 2 cm quartz and quartz-feldspar veins which show well developed boudinage. A crosscutting, gray quartz vein, containing trace amounts of fine-grained disseminated pyrite and chalcopyrite, fills the central part of the quartz-feldspar vein or surrounds the early quartz-feldspar veins. The late, gray quartz portion of vein is completely pulled apart at one location with the in-filling host rock showing the same foliation as the adjacent wall rocks. Between 240 and 245 brittle deformation caused by a closely spaced fracture cleavage at 45° to CA offsets earlier fine-grained, gray calcite veinlets which are parallel to CA. The protolith was probably a dark gray to black, strongly foliated and brecciated mafic rock with 3 mm diameter stumpy euhedral plagioclase porphyroclasts that have been highly deformed and variably replaced by sericite, calcite, and minor biotite.

Thin section description: samples at 240 and 241 feet.

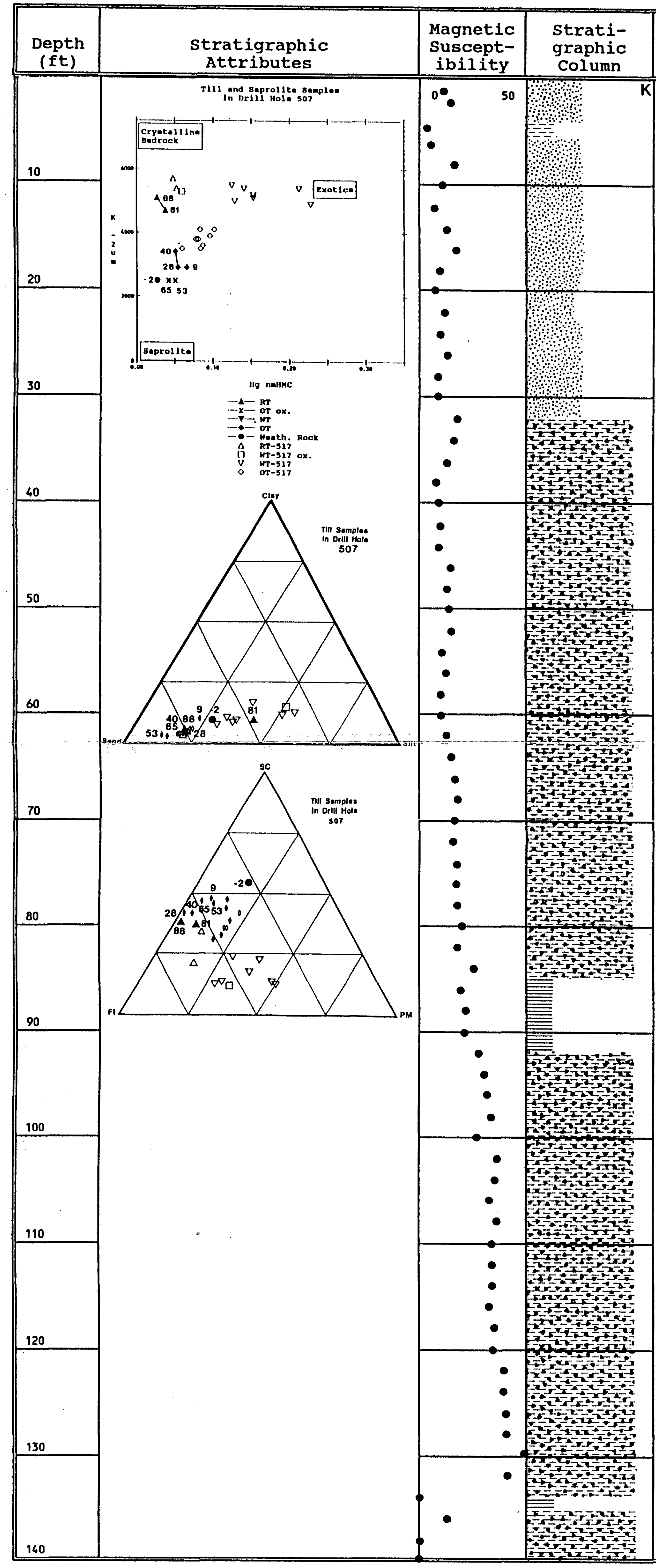
Mineralogy: porphyroclastic hornblende (30%), chlorite (20%), calcite (20%), epidote (15%), quartz (10%), plagioclase (2%), opaques [pyrite, chalcopyrite, iron or iron-titanium oxides] (2%).

Texture: Intensely deformed hornblende (dark green), porphyroclasts with rotation up to 1/2 commonly have chlorite and quartz pressure shadows. Chlorite and elongation of the hornblende porphyroclasts defines the foliation. Fine-grained plagioclase porphyroclasts are broken. Epidote is present as prismatic euhedral crystals or as irregular, anhedral patches. A 3 mm wide vein?? is composed of anhedral recrystallized, with fine-grained intergranular calcite replacing the host rock near the vein. A thin (0.3 mm) quartz vein is displaced along the prominent shear plane.
Subdomains within the thin section show rotation along the vein boundaries.

Lithology: protomylonite with quartz and calcite veins (protolith gabbro). (Subophitic gabbro is poorly preserved locally in the sample at 240 feet).

TD = 246'

Drill Hole OB-507



Description

(0-3 1/2) VERY FINE-FINE SAND; OXIDIZED; well sorted, few coarser grains.
(3 1/2-6) CLAY & SILT; OXIDIZED; leached to 5 1/2 ft; well developed lam; mostly silt w/few sand grains below 5 ft.
(6-32) VERY FINE SAND; OXIDIZED; v well sorted, silty & coarse grains in places; bed of silty clay w/sand grains at 9 ft, v fgr-fgr sand below; large carb peb at 10 1/2 ft, fgr sand w/few sm pebs below to 11 ft; unox below 11 ft; clayey till over clay bed at 11 ft over bed of v fgr sandy silt w/silt lam; clayey till lam at 12 ft; 13-14 ft clayey till w/carb & sh pebs, silt beds at 13 1/2 ft; laminated silt bed at 15 ft over v well sorted fgr sand w/beds of v fgr sand; at 21 ft silty v fgr sand grading to silt at 22 ft, calc, w/clay lam, some sand; v fgr sand below 23 ft, clayey till bed at 25 ft; thinly laminated silt beds at 27 1/2, 28 1/2 ft; fgr sand below 29 1/2 ft.

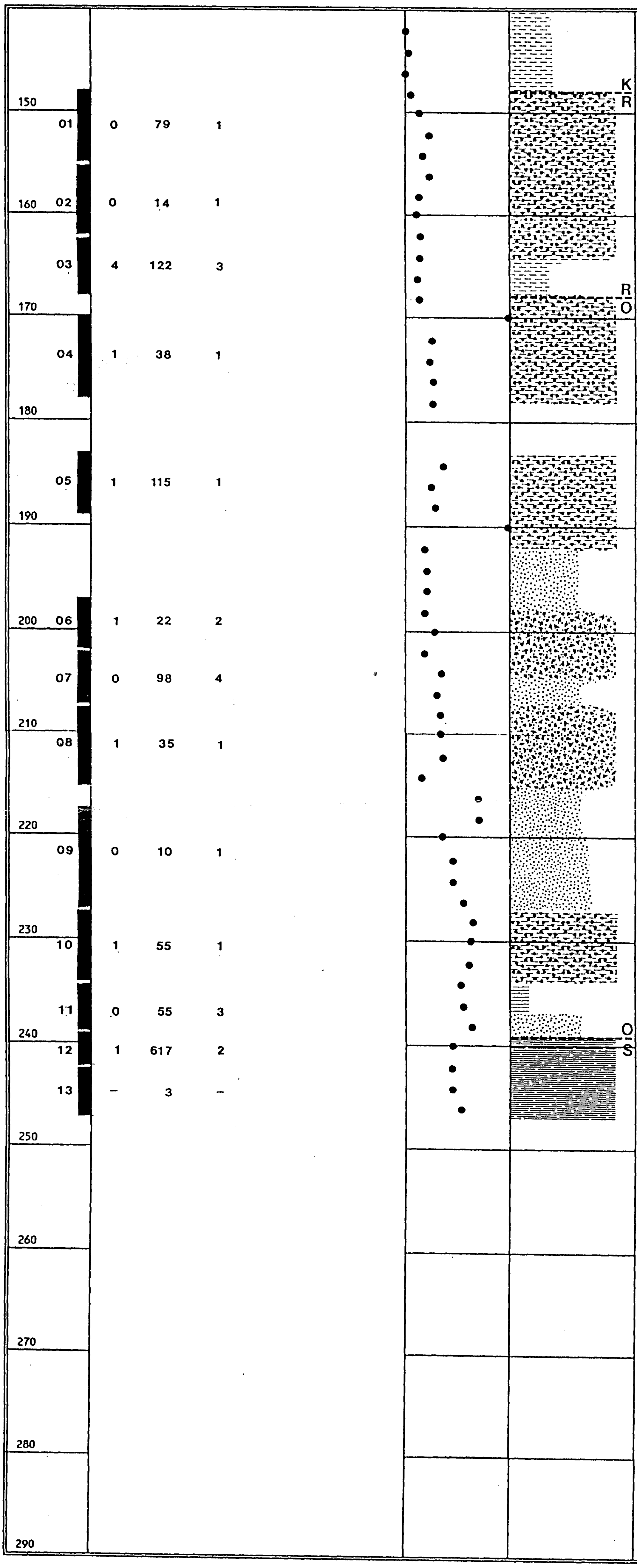
(32-85) LOAM TILL; UNOXIDIZED; firm; calc; abundant carb, v rare sh; abrupt upper contact; darker gray & compact below 36 ft; mostly sm & medium pebs, little more large pebs w/depth; gradational lower contact, clayey in last couple ft, interbedded w/clay at base.

(85-92) SILT & CLAY; UNOXIDIZED; clay to silty clay interbedded w/clayey till in upper foot, silt laminated w/clay below; few sm pebs; interbedded w/till below 90 ft.

(92-101 1/2) CLAY LOAM TILL; UNOXIDIZED; mud flow deposits; soft, pebbly silt 92 1/2-93 1/2 ft; mostly pebbly silt below 94 1/2 ft, laminated w/clay at about 97 1/2 ft; mostly clayey till below 98 1/2 ft, silt bed at 99 ft.

(101 1/2-134) CLAY LOAM TILL; UNOXIDIZED; firm; massive; common carb & sh; mostly only sm pebs; more silty w/depth; grades to laminated silt & clay at 119 ft, back to clayey till by 119 1/2 ft; sandy zone at 131 ft; dark gray in last 1/2 ft.

(134-136) SILT & CLAY; UNOXIDIZED; laminated; sm pebs in upper part, sandy bed at base.
(136-140 1/2) LOAM TILL; UNOXIDIZED; firm; calc; sm cob near top; interbedded w/sand below 138 1/2 ft, v fgr sand 139 1/2-140 ft.



(140 1/2-148) SILT; UNOXIDIZED; calc; some v fgr sandy silt above 142 ft; massive w/occ dropstones; 147-148 ft greenish gray silt, gray silty clay & dark gray clay, well laminated, sl-mod calc, abrupt upper contact.

(148-155) SANDY LOAM TILL; UNOXIDIZED; firm to loose; sl-mod calc; rare carb; cob & large peb at top, cob at 152 1/2 ft.

(155-164) CLAY LOAM TILL; UNOXIDIZED; firm; calc; uncommon carb; not many pebs; crudely stratified in places w/silt; only mod calc, more sandy in places; greenish gray below 156 ft; much interbedded silt below 162 ft; believe till mixed w/saprolite &/or lake sed.

(164-168 1/2) SILT; UNOXIDIZED; v pebbly below 165 ft; mod calc sandy loam till 166-167 ft; v pebbly towards base.

(168 1/2-178 1/2) SANDY LOAM TILL; OXIDIZED; pale brown; firm; sl calc; 168 1/2-170 boulder; disturbed core below 175 ft, probably boulder or cobs 177-178 1/2 ft.

(178 1/2-183) NO CORE.

(183-189) SANDY LOAM TILL; OXIDIZED; as above; uncommon carb; gray sl calc silt bed at 188 ft, till light brown below.

(189-192) BOULDER.

(192-197) MEDIUM-COARSE SAND; UNOXIDIZED; mod sorted, occ pebs; rare carb; cgr-v cgr below 194 ft; cob at or near base.

(197-204) LOAMY SAND TILL; UNOXIDIZED; sl calc; mostly pebbly sand in upper foot; 200-201 ft silty pebbly cgr sand, mod sorted, could be sluff; 202-203 ft compact, sl calc-calc silt to v silty till w/sm carb pebs; 203-204 ft boulder.
(204-207) GRAVELLY SAND; silty, cobbly, cgr; mod-poorly sorted; rare carb; grades to till below.

(207-215) LOAMY SAND TILL; UNOXIDIZED; loose; sl calc; firm sandy loam till below 211 ft, mod calc; rare carb; below 212 ft compact & mod calc-calc.

(215-218) VERY FINE SAND; UNOXIDIZED; v silty; coarsens downwards.
(218-227) MEDIUM-VERY COARSE SAND; UNOXIDIZED; silty mgr sand coarsening downwards to silty cgr sand below 220 1/2 ft; pebbly & silty layers; well sorted v cgr sand below 221 1/2 ft; cobs below 225 1/2 ft, w/large cob at base.

(227-234) SANDY LOAM TILL; UNOXIDIZED; compact; mod calc; cobs from 228 1/2-230 ft; large pebs fairly common; uncommon carb; sandy clay loam till in lower part.

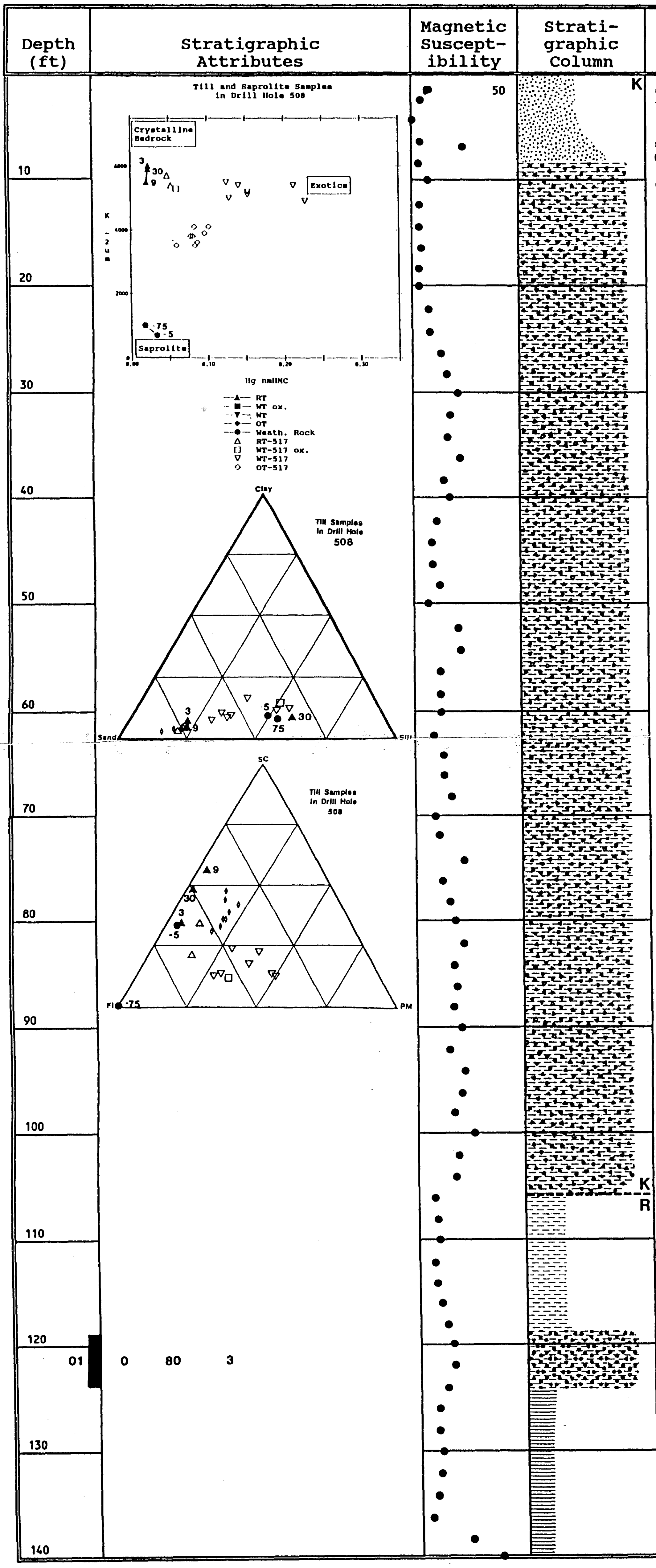
(234-237) SILT & CLAY; UNOXIDIZED; greenish gray silt, dark gray clay; interbedded; mod calc; abrupt upper contact; clay light brown below 236 ft, also noncalc to v sl calc; gradational lower contact.
(237-239) GRAVELLY SAND; mgr sand, silty, mod sorted; some large pebs.

(239-243) SAPROLITE; KAOLINITIC; grayish olive-green. Preserved rock texture of white specs (1-2 mm) in darker clay minerals with banding from 240-243 ft. Bands are horizontal, much lighter in color (very light gray), range in thickness from 0.2-3 cm. completely weathered to clay minerals. Moderately calcareous, but slightly calcareous in the lighter colored bands.
(243-247) SAPROLITE; CHLORITIC; grayish olive. Similar to above but strong yellow tint. The large light gray bands stop at 243, where thin white horizontal to subhorizontal streaks occur. Iron oxide staining along some streaks and as small 1 mm blebs sporadically. 3 cm strip of dark brown organic material at the bottom of the bag (contamination?). Moderately calcareous.

(239-247) SAPROLITE; derived from aplite dikes which intrude a black, biotite- and plagioclase-rich, porphyritic mafic plutonic rock. Aplite is white, fine-grained, with 1 to 2 mm quartz, plagioclase and muscovite phenocrysts. Mafic pluton is medium-grained and porphyritic with 3 to 4 mm parallel plagioclase laths, in a biotite-rich matrix, which are locally parallel in structural subdomains. From 243 to 246 feet a medium green-gray, clay-rich saprolite is highly deformed showing a strong foliation and brecciation with small-scale S-folds of tectonic breccia clasts (0.5-2 cm long, > 5:1 flattening). Many clasts are flattened and show pressure shadows. The mafic and felsic layers in this interval alternate frequently with contacts parallel to the prominent foliation. Mafic layers are warped into discontinuous, low-amplitude, open folds and are tectonically thinned by ductile-style deformation. Aplite layers show brittle deformation. A few percent calcite is disseminated throughout.

TD = 247'

Drill Hole OB-508



(0-6 1/2) FINE-MEDIUM SAND; OXIDIZED; sm pebs in upper couple ft.

(6 1/2-8 1/2) GRAVELLY COARSE SAND; UNOXIDIZED; poorly sorted, silty fgr gvl at top; sm pebs; only gnl 7 1/2-8 ft, fgr gvl, mod sorted below.

(8 1/2-21) CLAY LOAM TILL; UNOXIDIZED; firm; calc; abrupt upper contact; common carb & sh; mostly sm pebs; coarsens w/depth.

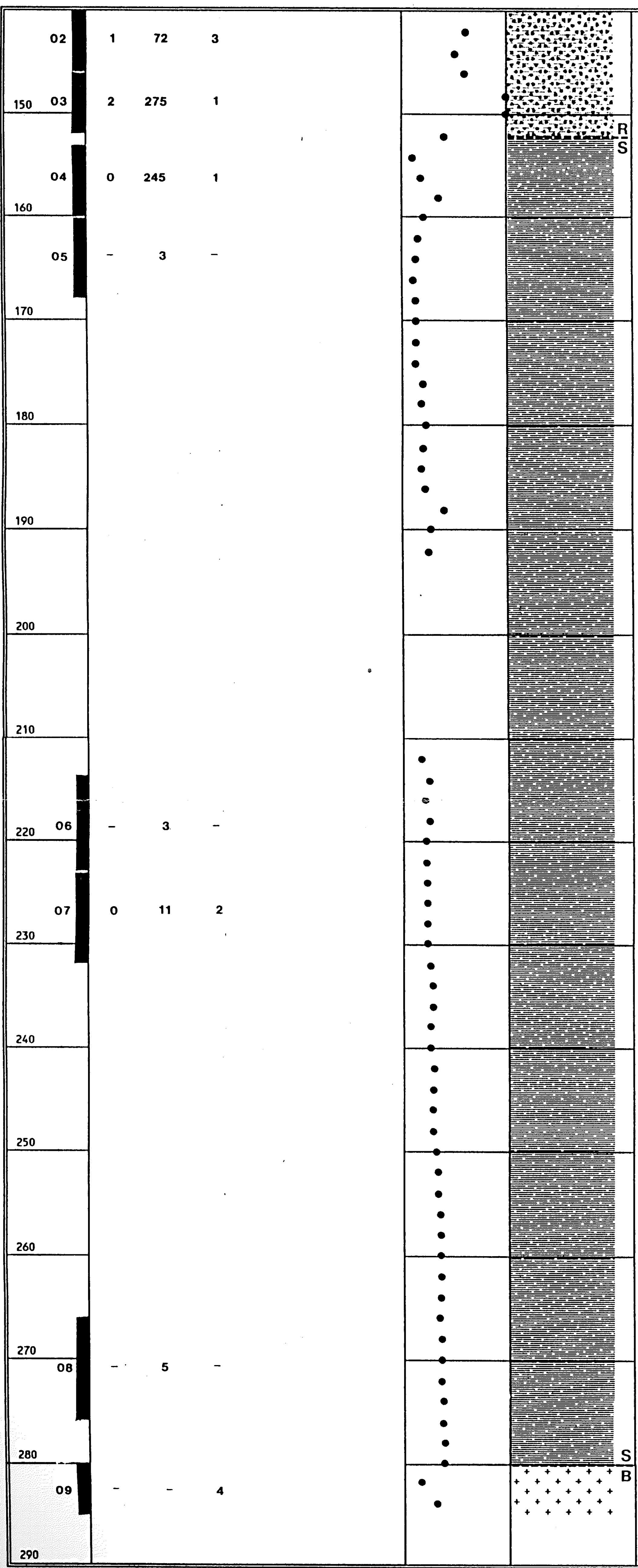
(21-106) LOAM TILL; UNOXIDIZED; as above, but lighter gray; compact below 36 ft; v fgr sand bed at 50 ft; v compact below 55 ft; till rich in v fgr sand & silt; sand lam at 84 1/2 ft; 105-105 1/2 ft cobbly gvl mixed w/clay & clay loam till, 105 1/2-106 ft greenish gray silty clay mixed w/clay loam till; less carb, no sh noted towards base.

(106-119) SILT, CLAY & VERY FINE SANDY SILT; UNOXIDIZED; greenish gray; sl-mod calc; pebs within sandy silt; mostly silt below 109 ft, w/rare sm pebs; some obsure lam of silty clay.

(119-124 1/2) LOAM TILL; UNOXIDIZED; greenish gray; firm; mod calc; rich in fgr sand & silt; large peb at top, gradational upper contact.

(124 1/2-134 1/2) SILTY CLAY; UNOXIDIZED; greenish gray; massive; mod calc.

(134 1/2-140) SILTY CLAY, CLAY & CLAYEY SILT; UNOXIDIZED; interbedded; mod calc; v rare sand grains; mostly silt in lower foot.



(140-153) SANDY LOAM TILL; UNOXIDIZED; greenish gray; firm, compact below 143 ft; mod calc; cob near top but not real rocky; more large pebs 146-150 ft; rare carb, common dark Precambrian pebs; some evidence of mixing w/saprolite below 150 ft; 152-153 ft reworked saprolite w/large peb at base.

(152-153) SAPROLITE; REWORKED; greenish gray and dark greenish gray, mottled. No apparent preserved texture, just a mottle of light and dark green clay minerals. Cobble at 152 ft. Contains many subrounded pebbles that range up to 3 cm. Slightly calcareous.
(153-160) SAPROLITE; KAOLINITIC; pale blue-green, massive. Where exposed to air it turns olive. Uniformly weathered, no mottles. Siderite nodules up to 1 mm and also some very small angular quartz grains. Highly calcareous zone at 155 ft. Quartz grains range up to 3 mm at 155 ft. Slightly calcareous.
(160-161) SAPROLITE; KAOLINITIC; light greenish gray, massive. Slightly oxidized in places. Line of subrounded pebbles and a thin layer of sand at 160-1/2 ft. Pebbles range up to 2 cm. Contains angular quartz grains and siderite nodules up to 1 cm. Slightly calcareous to noncalcareous.
(161-175) SAPROLITE; KAOLINITIC; similar to 156-160 ft. with slightly larger siderite nodules. Large 2 cm angular quartz fragments at 162 ft. Becomes almost fissile at 164-167 ft. 3 mm quartz fragments in a continuous line at 173 ft. (quartz vein?). Slightly calcareous.
(175-178) SAPROLITE; CHLORITIC; similar to above only slightly darker. Some areas are dark greenish gray. Variegated at 175-176 ft. 2 mm siderite nodules. Quartz cobble at 175 ft. 5 mm rock fragments. Slightly calcareous.
(178-185) SAPROLITE; CHLORITIC; pale blue-green to greenish gray, soft. Color turns to greenish gray when exposed to air. No apparent texture, just a soft mottling of colors. Many 1-2 mm siderite nodules with a few angular quartz grains. Powdery from 183-184 ft. Slightly calcareous.
(185-187) SAPROLITE; CHLORITIC; similar to 175-178 ft.
(187-232) SAPROLITE; CHLORITIC; similar to 178-185 ft. Siderite nodules slightly larger and variegation slightly stronger. Lost 192-212 ft. Large metagraywacke fragments at 212-214 ft. Abundant angular quartz fragments up to 2 cm with siderite nodules associated with the grains (relict? quartz veins?). Core harder, dryer, and variegation becomes coarser at 226 ft., slightly less weathered. Slightly calcareous to calcareous.

(232-240) SAPROLITE; CHLORITIC; grayish blue-green to grayish green, blockly, weathered metagraywacke in a matrix of grayish green saprolite. Blocks range up to 10 cm. Relict bedding structure may be present. 1-2 mm quartz fragments and siderite nodules. Powdery with less rock fragments from 237-240 ft. Slightly calcareous.
(240-245) SAPROLITE; CHLORITIC; similar to above, rock fragments absent. Abundant mica flakes in 6-inch zone at 240 ft.

(245-253) SAPROLITE; CHLORITIC; pale blue-green, soft. Similar to 178-185 ft. Massive but has horizontal alignment of grains. Lumpy appearance from the abundant quartz grains and siderite nodules. Massive pale blue-green clay from 248-251 ft. Slightly calcareous.

(253-276) SAPROLITE; CHLORITIC; grayish green variegated, soft. Quartz grains, siderite nodules, and occasional mica-rich zones or layers. Calcareous in areas from 266-268 ft., with mica-rich zones and angular quartz fragments. 4 cm quartz vein at 271 ft. Highly calcareous around quartz vein. Slightly calcareous to noncalcareous.
(276-280) WEATHERED BEDROCK; weathered metagraywacke.
(280-285) BEDROCK; gray-green, medium- to coarse-grained graywacke with subangular to subrounded feldspars in a green biotitic matrix. S_0 defined by contact with fine-grained well sorted laminated siltstone is locally parallel with S_1. At 282 feet mylonitic shear bands are present at a scale of 3 to 8 cm. Mylonite consists of quartz and sericite. S_0 and S_1 are parallel and folded (oriented at 30-60° to CA) at the top of the cored interval by D_2 which caused cataclasis near the bottom of the interval. S_2 is developed by closely spaced shear-bands oriented 30° to CA and discordant to S_0 and S_1. At 283 feet fish-hook folds terminate against a deformed quartz vein in a zone 4 cm wide.

Thin section description: samples at 282 and 284 feet.

Mineralogy: quartz (70%), plagioclase (20%), biotite (10%).

Texture: Strained and recrystallized, elongate quartz (0.1-0.5 mm) and plagioclase (0.1-0.3 mm) usually show interlocking boundaries. Brown biotite (0.05 mm) is lepidoblastic. Primary sedimentary layering (S_0) is nearly parallel to S_1. In the sample from 284 feet, feldspar is coarser (0.5-2.0 mm) and extensively altered to white mica.

Lithology: meta-graywacke.

TD = 285'

Drill Hole OB-509

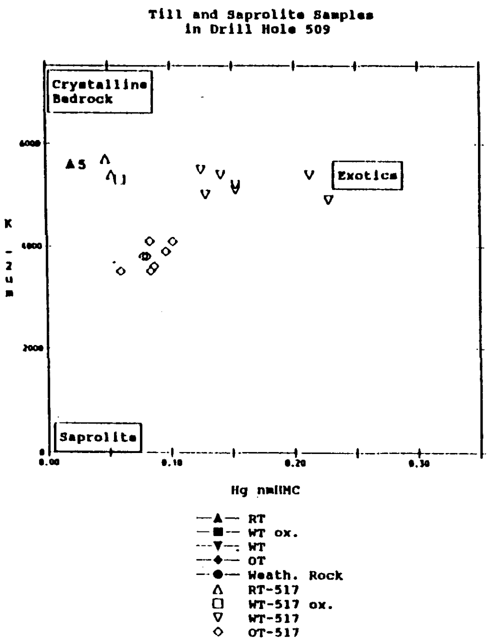
Depth (ft)

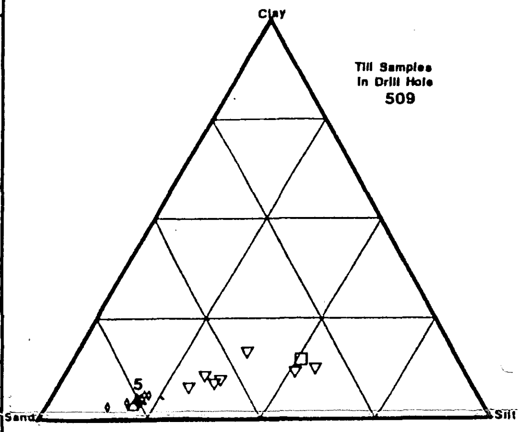
Stratigraphic Attributes

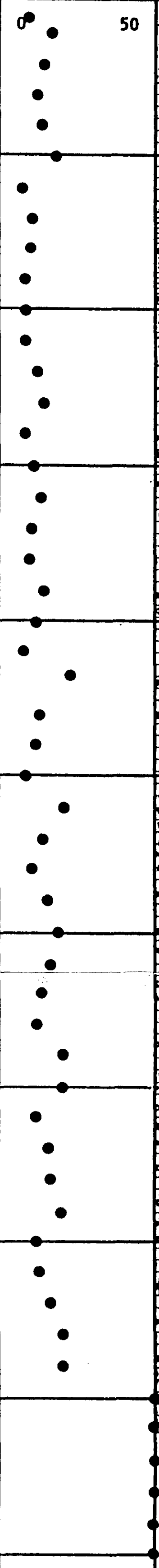
Magnetic Susceptibility

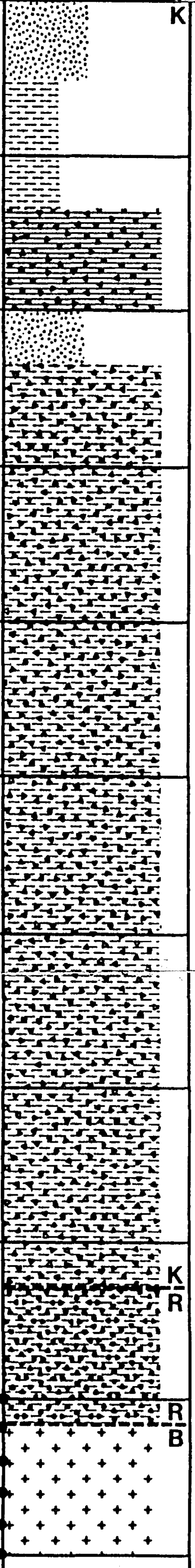
Strati-graphic Column

Description









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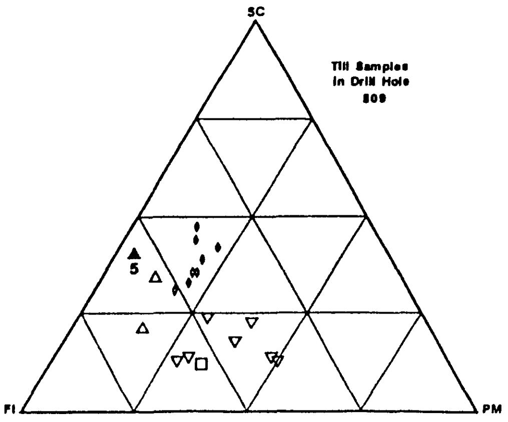


(0-5) SILTY VERY FINE SAND; OXIDIZED; v well sorted.

(5-13) VERY FINE SANDY SILT; OXIDIZED; poorly sorted w/pebbly cgr sand interbeds in upper foot, cob at 6 ft, v well sorted below; silt bed at 9 ft; coarse sand grains below 11 1/2 ft, also unox; silt lam at 12 1/2 ft; mod sorted, silty mgr-cgr sand w/sm pebs in last 1/2 ft.

(13-20 1/2) LOAMY SAND-SANDY CLAY TILL; UNOXIDIZED; crudely stratified; common carb & sh; mostly sm pebs; bed of pebbly mgr-cgr sand at 17 1/2 ft over mgr-cgr sand, well sorted w/few sm pebs to 18 1/2 ft; till rich in fgr sand & silt & loose below 18 1/2 ft; firm dark gray loam till below 20 ft.

(20 1/2-23) SILTY FINE SAND; UNOXIDIZED; mod sorted w/couple firm loam till layers to 22 ft, well sorted v fgr sand below.

(23-43) LOAM TILL; UNOXIDIZED; firm; texture on silty side of loam; silty fgr sand bed at 26 ft, grades to silty fgr-mgr pebbly sand w/till layers from 27-28 ft; common sm pebs; 36 1/2-40 1/2 ft v fgr sand-rich till, abrupt lower contact w/large pebs at base; 40 1/2-43 ft pebbly clayey silt, firm, calc, v poorly sorted, reworked lake sed.

(43-83) LOAM TILL; UNOXIDIZED; firm; calc; matrix high in silt & fgr sand; common carb, rare sh; mostly only sm pebs; clay loam till below 70 ft; large inclusion at 74 1/2 ft of clayey silt, silty clay & clay, greenish gray & gray w/reddish brown mottles, mod calc-calc; 77-83 ft mixed gray clay loam till & greenish gray sandy loam till.

(83-92) SANDY LOAM TILL; UNOXIDIZED; greenish gray; firm; sl calc; large pebs fairly common; uncommon carb.

(92-100) BEDROCK; medium to dark gray, coarse-grained gabbro, subophitic, with ferromagnesian megacrysts (0.5 cm) enclosed by 0.1 to 0.2 mm plagioclase and ferromagnesian minerals with a diabasic texture. Plagioclase is pink to tan color. Ferromagnesian minerals up to 60% usually enclose disseminated subhedral pyrite (1%). Magnetite disseminated in the ferromagnesian minerals. Some primary? biotite is present. No penetrative fabric is observed.

Thin section description: sample at 100 feet.

Mineralogy: Pyroxene and fibrous amphibole (51%), plagioclase (36%), biotite (9%), iron oxide and pyrite (4%), sphene (trace).

Texture: Subophitic, with large subhedral uralite-altered pyroxene porphyroclasts partly enclosing plagioclase (An 60) laths. Large subhedral brown biotite grains usually occupy intergranular areas whereas green biotite is altering from the fibrous amphibole. Plagioclase crystals are intergrown with amphibole where they are in contact. No penetrative fabric is present. The textures suggest an autometamorphic origin for the amphibole and some of the green biotite. Brown biotite may be a magmatic mineral.

Lithology: Gabbro (plagioclase-pyroxene cumulate).

TD = 100'

Drill Hole OB-510

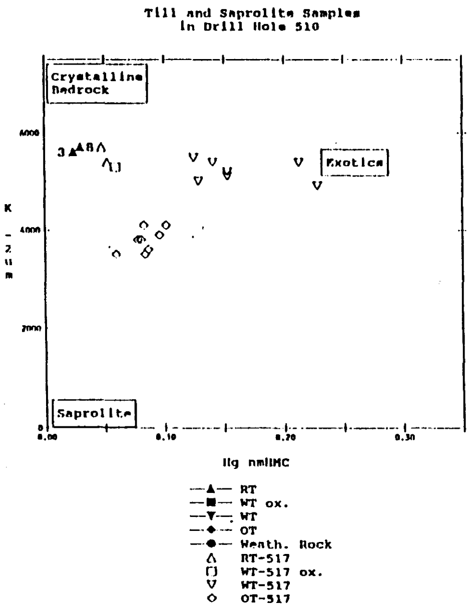
Depth (ft)

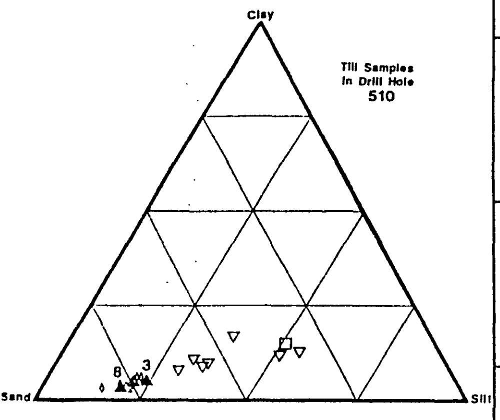
Stratigraphic Attributes

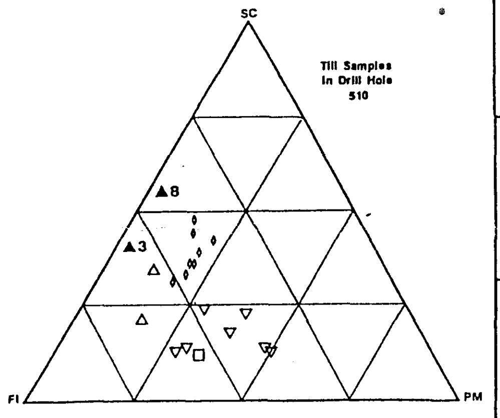
Magnetic Susceptibility

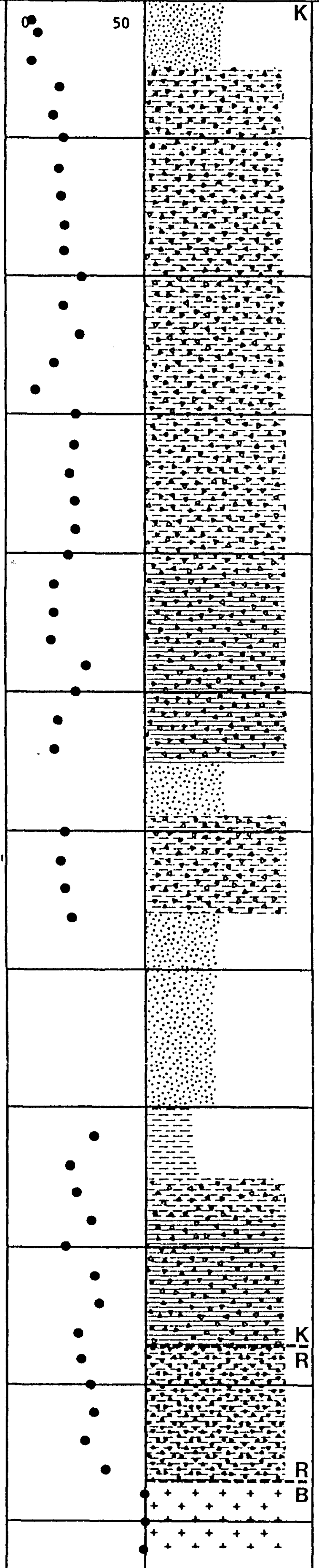
Stratigraphic Column

Description









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(0-5) SILTY FINE SAND; OXIDIZED; unox below 2 ft; v fgr sand bed at 2 ft, less silty below; 4-5 ft gvlly fgr sand w/large pebs, poorly sorted, abundant carb; abrupt basal contact.
(5-20 1/2) LOAM TILL; UNOXIDIZED; firm; abundant carb, no sh noted; large pebs fairly common; compact below 14 ft, not as pebbly; fairly abrupt lower contact.

(20 1/2-27) CLAY LOAM TILL; UNOXIDIZED; compact, as above; loamy texture 23-24 1/2 ft w/sm cob at base; sh peb at 25 ft.

(27-41) SANDY LOAM TILL; UNOXIDIZED; compact; rich in v fgr sand; v sandy below 30 ft, grading to v fgr sandy silt from 32-33 ft; pebs fairly common, carb common, occ sh noted; coarse loamy texture below 38 ft.

(41-55) CLAY TILL; UNOXIDIZED; compact; abundant carb, uncommon sh; abrupt upper contact; loamy textured 50-50 1/2 ft, clay loam till below.

(55-59) NO CORE; driller believes fgr sand.

(59-66) CLAY LOAM TILL; UNOXIDIZED; as above; grades to calc silt at 65 ft, few gnl, sand grains in lower part.

(66-80) NO CORE; driller believes fgr sand.

(80-85) VERY FINE SANDY SILT; UNOXIDIZED; well sorted but fair amount of sm pebs; calc; couple inches silty v fgr sand at top; 82-84 ft interbedded w/sandy loam till; clay pick-up clasts at 83 ft; v fgr sand bed at 84 1/2 ft; gradational lower contact.
(85-88 1/2) LOAM TILL; UNOXIDIZED; firm; calc; rich in silt & v fgr sand; v fgr sand bed near top; pebs uncommon; last foot mostly v fgr sandy silt.
(88 1/2-97) SILTY CLAY TILL; UNOXIDIZED; compact; calc; gradational upper contact; fine loamy texture below 92 ft; v compact clay loam till below 94 ft; below 96 ft greenish gray silt & clay mixed w/little clay loam till.

(97-107) SANDY LOAM TILL; UNOXIDIZED; greenish gray; firm; sl-mod calc; large pebs fairly common; uncommon carb, mod calc in lower part; last few inches calc & loamy in texture, could be mixed w/ another till.

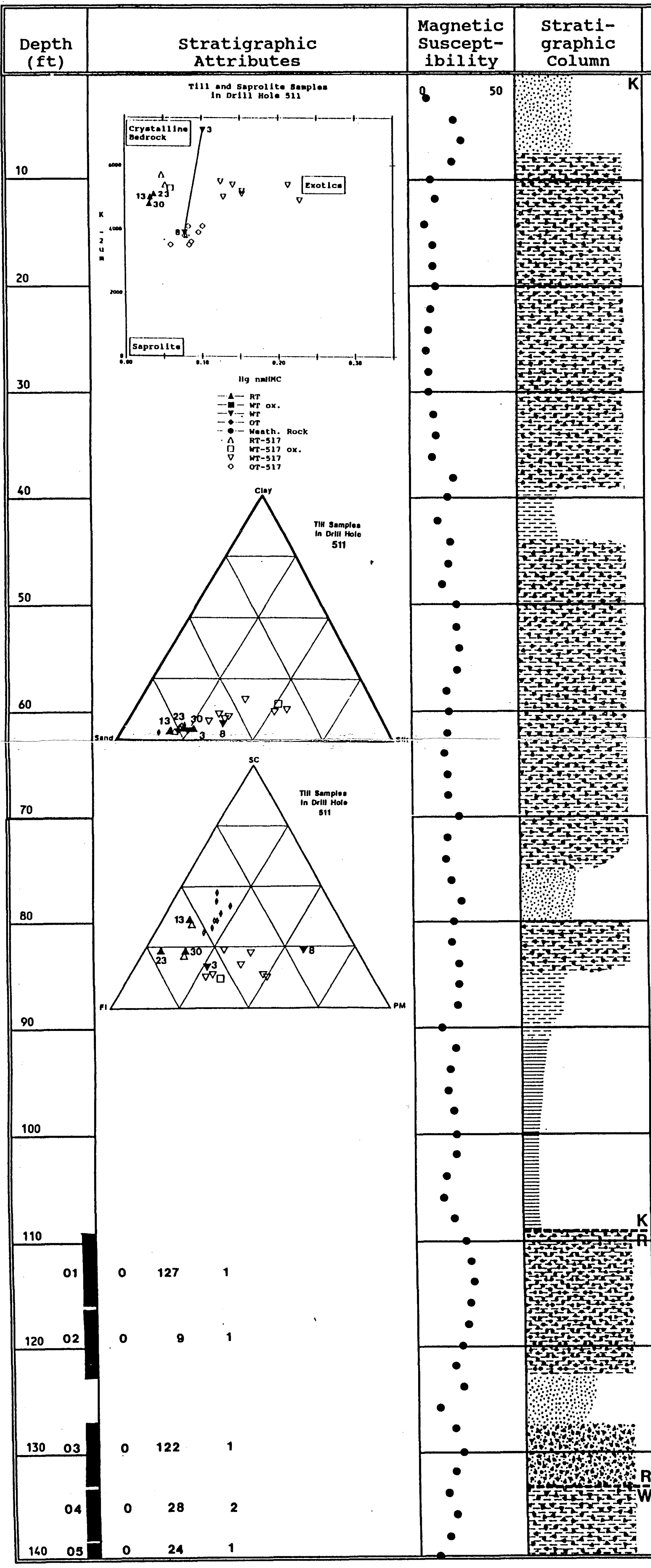
(107-112) BEDROCK; very dark gray, coarse-grained gabbro, subophitic pyroxenes (now chlorite) with sausseritized plagioclase from 0.5 to 1 cm long. Several pyrite veinlets (2-5 mm thick) and small amounts of disseminated pyrite are found in a metabasalt xenolith. One 4 wide magnetite-rich (0.1 mm diameter crystals) layer occurs at 107 feet. No penetrative fabric is observed.

Thin section description: samples at 108 and 109 feet.

> Mineralogy: plagioclase (67%), biotite (22%), augite (9%), iron and iron-titanium oxides (2%).
>
> Texture: Hypidiomorphic-granular with subhedral plagioclase (0.5-1 mm) laths enclosing intergranular anhedral augite (0.1-0.3 mm) now altered to fibrous amphibole whereas brown biotite occupies intergranular areas and may be a primary magmatic mineral. Plagioclase slightly altered to white mica. No penetrative fabric is observed.
>
> Lithology: plagioclase-cumulate rock.

TD = 112'

Drill Hole OB-511



Description

(0-7) FINE SAND; OXIDIZED; well sorted, some coarser grains; abrupt lower contact.

(7-10 1/2) LOAM TILL; OXIDIZED; common carb pebs; v silty 8-8 1/2 ft; 10-10 1/2 ft silty mgr sand over silty v fgr sand; v abrupt lower contact.
(10 1/2-39) LOAM TILL; UNOXIDIZED; compact; common carb pebs; clay loam till below 19 ft; 22-23 1/2 ft silt, gradational contacts; mostly sm pebs; uncommon sh; grades into silt below.

(39-44) SILT; UNOXIDIZED; calc; w/mostly thin till layers; massive silt below 40 1/2 ft, v rare pebs.

(44-75) SILT LOAM TILL; UNOXIDIZED; firm, compact below 47 ft; common carb & sh; silty zone at 53 ft; apar some core loss 52-57 ft, driller assumed was silt bed; coarse loamy texture w/dark pebs 67-70 1/2 ft; gradational lower contact.

(75-80) SILTY VERY FINE SAND; UNOXIDIZED; v well sorted; little silt at top; greenish gray w/depth; clay lam at 79 ft; v fgr sandy silt below 79 ft, grades into till below.

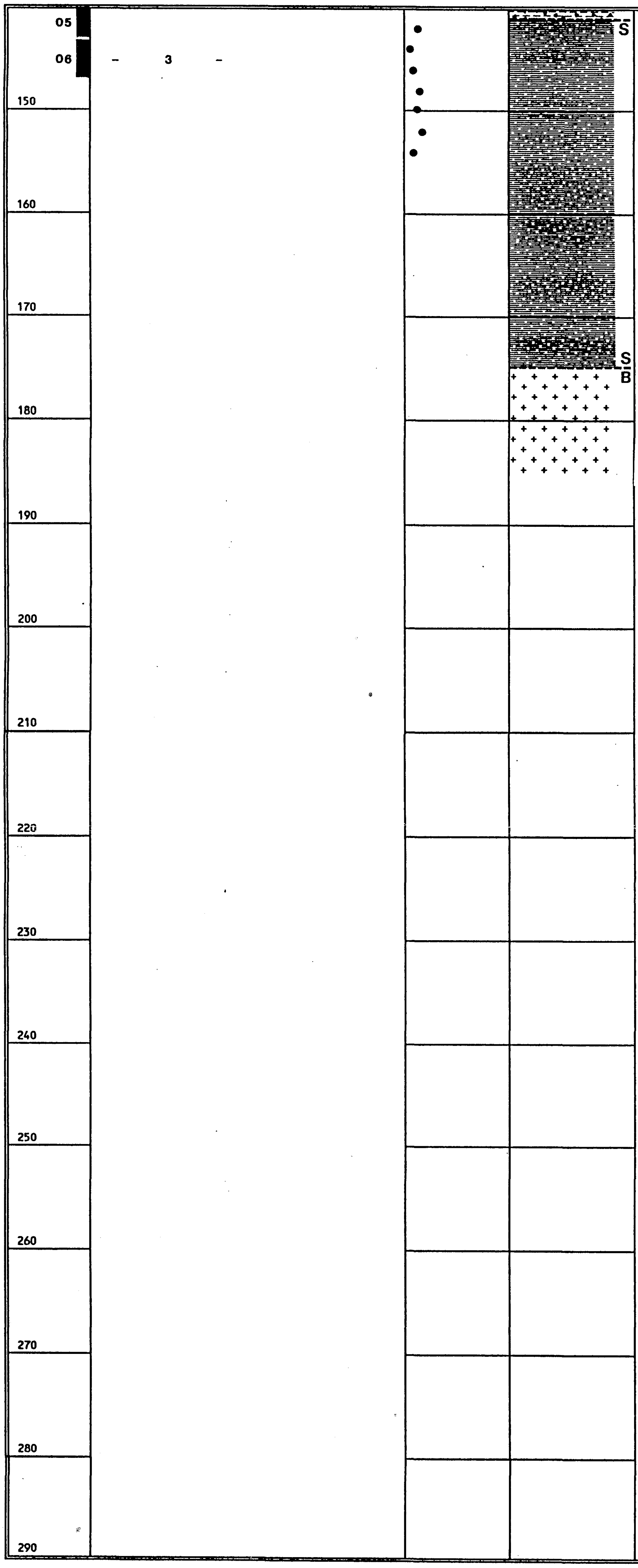
(80-84 1/2) SILTY CLAY LOAM TILL; UNOXIDIZED; compact; calc; mixed w/greenish gray silt to 81 1/2 ft; not many pebs; 82-83 1/2 ft silty v fgr sand, grading to v fgr sandy silt at base; till mixed w/silt towards base.
(84 1/2-89) VERY FINE SANDY SILT; UNOXIDIZED; massive; last foot silty v fgr sand.

(89-91) SILT; UNOXIDIZED; greenish gray.

(91-109) SILTY CLAY-CLAYEY SILT; UNOXIDIZED; calc; interbedded w/dark gray clay to 93 ft; massive silty clay to 94 ft; few pebs below 94 ft; clayey silt below 94 ft, vaguely laminated w/silty clay from 96-97 ft; clayey silt laminated w/silty clay below 102 ft, also silty v fgr sand lam below 104 1/2 ft; dark gray clay bed at 107 ft, great variety of interbeds.

(109-123) SANDY LOAM TILL; UNOXIDIZED; greenish gray to 111 ft; firm; mod calc-calc; rare carb; large pebs fairly common; sparse dark Precambrian pebs, most are granitic; mostly only sm pebs below 119 ft, cob at base.

(123-127) GRAVELLY SAND; UNOXIDIZED; well sorted fgr-mgr sand to 123 1/2 ft, grading to silty cgr sand; silty fgr gvl below 124 ft, apar w/clay layers or inclusions; poorly sorted, cob at 125 ft, gvlly fgr sand below, common large pebs; fairly abrupt lower contact.
(127-133 1/2) LOAMY SAND TILL; UNOXIDIZED; firm; mod calc; uncommon large pebs, carb; silty pebbly sand from 130-131 ft; calc & less sandy in last foot or so; sm cob at base.
(133 1/2-138 1/2) LOAM TILL; UNOXIDIZED; compact; calc; abundant carb; almost all pebs sm; gradational lower contact.
(138 1/2-143) SANDY LOAM TILL; UNOXIDIZED; firm to compact; varies from mod calc to calc; most clasts derived from underlying sandy saprolite; some carb pebs; intact chunks of punky rock saprolite towards base.



(141-142) Saprolite decribed from twinned hole. SAPROLITE; CHLORITIC; light olive gray laminated. Laminations of white and light olive gray range from 0.5-2 mm contains 0.5-1 mm angular quartz grains feldspar grains and biotite flakes. Also contains a few 2-4 mm rock fragments similar to the grus and bedrock below. Highly calcareous.
(142-158) GRUS; light gray to light olive gray. Rock is medium grained equigranular. Contains white and pink feldspars, quartz, biotite and muscovite with some chlorite. White feldspars altered, some to clay minerals. Calcareous to slightly calcareous.

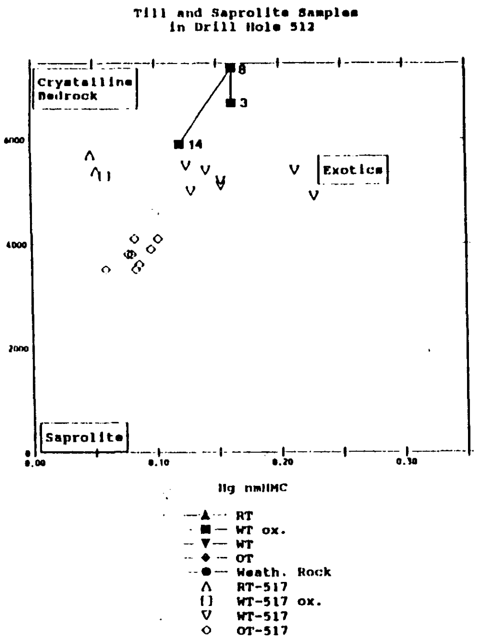
(158-175) Weathered bedrock.

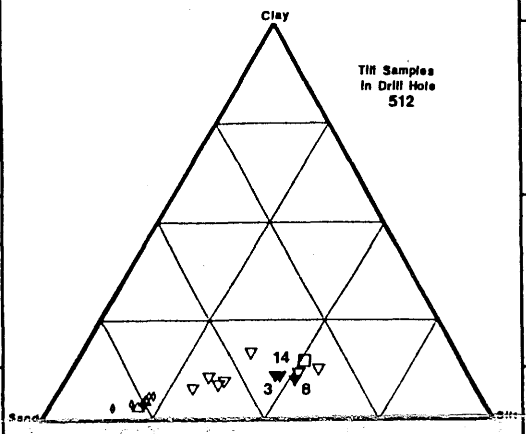
(175-185) Bedrock. Moderately weathered, light gray, coarse-grained, biotite quartz monzonite. Biotite is mostly altered to chlorite and forms a moderately well-developed foliation at 60 degrees to CA. Recrystallized plagioclase is altered to muscovite.

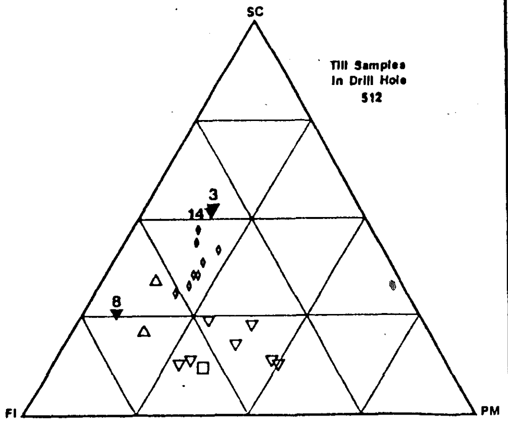
TD = 185'

Drill Hole OB-512

Depth (ft) | Stratigraphic Attributes | Magnetic Susceptibility | Stratigraphic Column | Description







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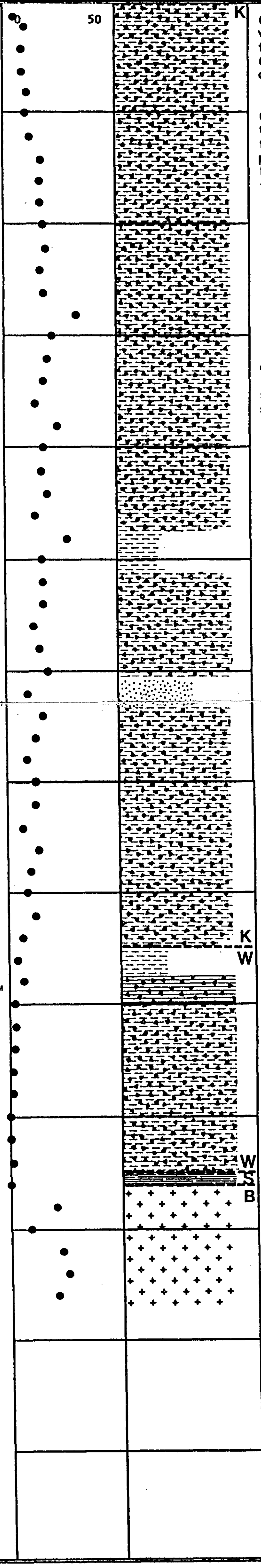
03	0	27	1
04	- ·	-	3



(0-3) CLAY LOAM TILL; OXIDIZED; firm; calc; few inches of silty v fgr sand on top; common carb & sh; sandy & soft in last 1/2 ft.

(3-10 1/2) LOAM TILL; OXIDIZED; unox below 5 ft; compact; calc; common carb & sh; abrupt lower contact.

(10 1/2-31) LOAM TILL; UNOXIDIZED; compact; calc; coarser textured than above, also sh not as common; v compact below 20 ft; cobs at 24, 26 1/2, 27 ft; soft sandy zone at 28 ft; less pebbly below 27 ft; 30-31 ft silty fgr-mgr sand, pebbly in lower part, interbedded w/clayey silt to silty clay, grades into till below.

(31-47 1/2) CLAY LOAM TILL; UNOXIDIZED; greenish gray; compact; calc; carb common but not dominant; 34-35 ft clayey silt; sandy zone at 35 1/2 ft, more below 37 1/2 ft w/inclusions of silt & sand; pebs mostly sm; v thin silt lam below 43 ft, v fgr sandy silt inclusion at 47 ft; fairly abrupt lower contact.

(47 1/2-51) VERY FINE SANDY SILT; UNOXIDIZED; v well sorted, few dropstones.

(51-61) CLAY LOAM TILL; UNOXIDIZED; as above, compact, calc, mostly sm pebs; 58 1/2-59 1/2 ft interbedded fgr-mgr sand & clayey silt, pebbly in lower part, cob at base; 59 1/2-61 ft, greenish gray sandy loam till, compact, mod calc, common dark pebs, probably inclusion of another till; abrupt lower contact.

(61-63) COARSE SAND; UNOXIDIZED; mod sorted, occ large pebs; common carb, but Precambrian dominant.

(63-84 1/2) SANDY LOAM TILL; UNOXIDIZED; compact; mod calc-calc; dark pebs out number carb; sand lam 64-65 ft; calc below 65 ft; more clayey 65-66 ft; fair amount of large pebs; texture ranges to sandy clay loam; probably mixed w/Rainy lobe till; no sh noted; boulder 76 1/2-77 1/2 ft; wood chip at 83 ft, more clayey, little more carb below.

(84 1/2-87) SANDY SILT; REDUCED; mottled; well sorted, virtually no pebs.

(87-90 1/2) CLAY TILL; REDUCED; ox grayish brown below 89 1/2 ft; v compact; calc; carb uncommon; vague v thin clay lam; sm fgr sand inclusion at 89 1/2 ft; abrupt lower contact.

(90 1/2-104 1/2) CLAY LOAM TILL; OXIDIZED; light brownish gray; compact; calc; carb uncommon; soft sandy silt bed at top; mostly sm pebs; much local rock (schist) incorporated in till; silt lam & pebbly sand beds at 102 ft, silty fgr-mgr sand bed near base; unox in lower few feet; v abrupt lower contact, no evidence of mixing w/saprolite.

(105-107) SAPROLITE; CHLORITIC; light greenish gray, soft, dry, micaceous. Fine to medium-grained relict texture. Quartz calcite zones throughout. Angular quartz grains, feldspar, muscovite and rock fragments to 5 mm. 1 cm quartz/calcite vein at 105 ft. Last few inches of core is greenish gray and muscovite content decreases. Calcareous.

(107-117) BEDROCK; light gray, medium-grained, equigranular meta-graywacke with a moderately well developed S_1. The rock contains 0.5% light pink garnet (1 mm), 10% biotite, 5% muscovite, and 0.5% disseminated pyrite (0.5 mm). Two 0.5 cm vertical light gray, translucent quartz veins are associated with locally coarse-grained biotite and contain no apparent sulfide mineralization.

Thin section description: sample at 116.

Mineralogy: plagioclase (55%), quartz (18%), biotite (16%), muscovite (8%), garnet (1%), opaque minerals (trace).

Texture: Red-brown biotite and muscovite are lepidoblastic (0.1-1.4 mm long) and define a moderately well-developed fabric. Quartz and plagioclase (both 0.1-0.3 mm) are xenoblastic. Quartz is strained and recrystallized. Syntectonic garnets range in size from 0.7 to 1.0 mm.

Lithology: meta-graywacke.

TD = 117'

Drill Hole OB-513

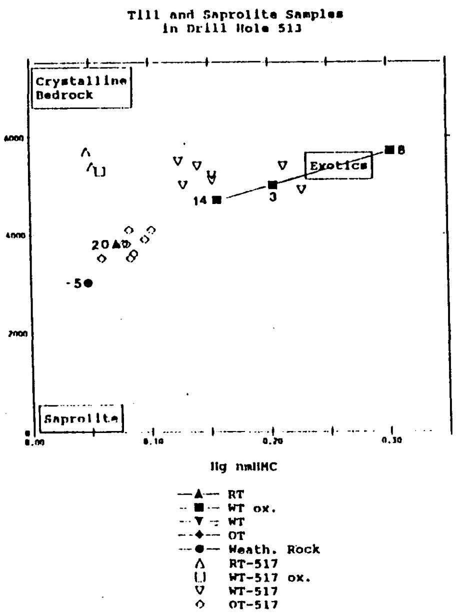
Depth (ft)

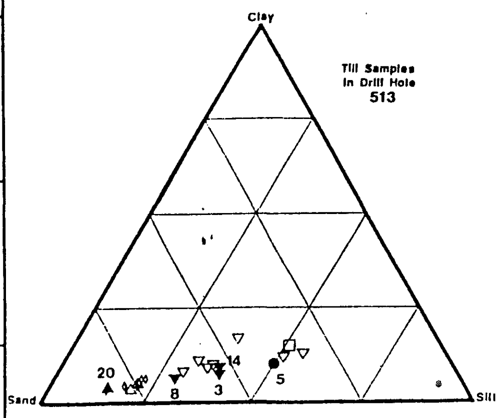
Stratigraphic Attributes

Magnetic Susceptibility

Stratigraphic Column

Description





Depth (ft)	Stratigraphic Attributes			
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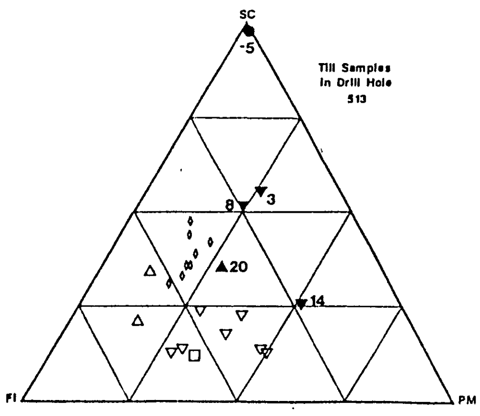
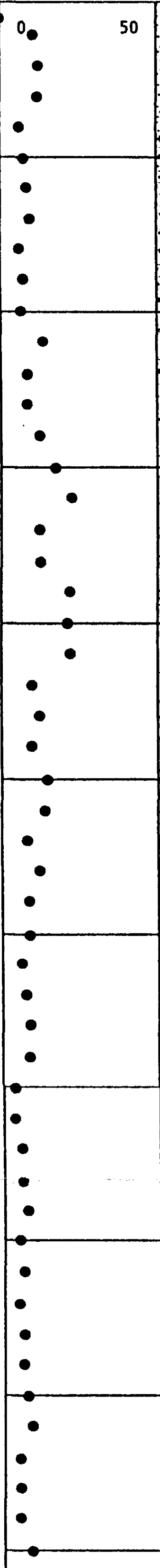
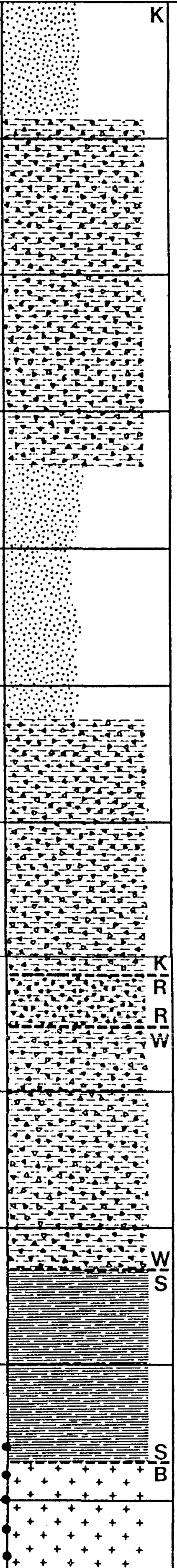
20				
30				
40				
50				
60				
70				
	01	1	418	3
80	02	0	17	1
	03	0	21	3
90	04	0	23	2
	05	0	156	3
100				
110	06	-	-	30
120				
130				
140				







(0-8) SILTY VERY FINE SAND; OXIDIZED; well sorted; gnl lam at base; abrupt lower contact.

(8-12 1/2) CLAY LOAM TILL; UNOXIDIZED; firm; calc; common carb & sh; grades to v fgr-fgr sand w/few pebs at 11 1/2 ft.

(12 1/2-27) LOAM TILL; UNOXIDIZED; firm; calc; sandy loam till above 14 ft, fining & compact below; abundant carb, some sh; more clayey w/depth to 19 ft; gvlly zone at 19 ft; v fgr sand lam at 21, 24 & 25 ft; dark gray clay loam till below 25 ft; abrupt lower contact.

(27-34) FINE SANDY LOAM TILL; UNOXIDIZED; loose; common carb.

(34-52 1/2) VERY FINE SAND; UNOXIDIZED; v well sorted; fgr in upper foot; grades to v fgr sandy silt below 41 ft; number of carb pebs from 43-44 ft, could be "flow till"; 44-45 ft v fgr sand, 45-46 ft greenish gray, mod calc silt; 46-47 ft fgr sand; 47-48 ft v fgr sand w/silt bed at base w/silty clay lam, mod calc; pebbly mgr sand below to 48 1/2 ft, abrupt lower contact; 48 1/2-50 greenish gray loam till, compact, mod calc-calc, not much carb; 50-51 ft well sorted mgr sand, few pebs, cob at base; 51-52 1/2 v fgr sandy silt w/few pebs; cob at base.

(52 1/2-58 1/2) SANDY LOAM TILL; UNOXIDIZED; greenish gray; firm; calc; carb fairly common; cob near top; 57-58 1/2 ft grayish brown loam till, calc, compact, gradational upper contact, abrupt lower contact, probably inclusion of another till.
(58 1/2-71 1/2) LOAM TILL; UNOXIDIZED; compact; calc; carb fairly common; cobs at 60 1/2 & 65 ft; inclusion of greenish gray sandy loam till at 62 1/2 ft; sandy loam till w/uncommon carb in lower few ft; 70-71 1/2 ft v fgr sandy silt w/few pebs, mgr sand bed at 71 ft.

(71 1/2-75) SANDY LOAM TILL; UNOXIDIZED; compact; calc, carb fairly common, probably derived from till below; cob at 73 ft; last 1/2 ft or so mixed w/till below.
(75-79 1/2) CLAY LOAM TILL; OXIDIZED; grayish brown; v compact; v calc, abundant carb; unox, less compact below 76 ft; mostly sm pebs; grayish brown inclusion at 77 1/2 ft; clay bed at 79 ft; gradational lower contact.
(79 1/2-93) CLAY LOAM TILL; OXIDIZED; grayish brown; v calc but less carb than above, more greenish pebs, probably contains fair amount of local rock & saprolite; cob at 92 ft.

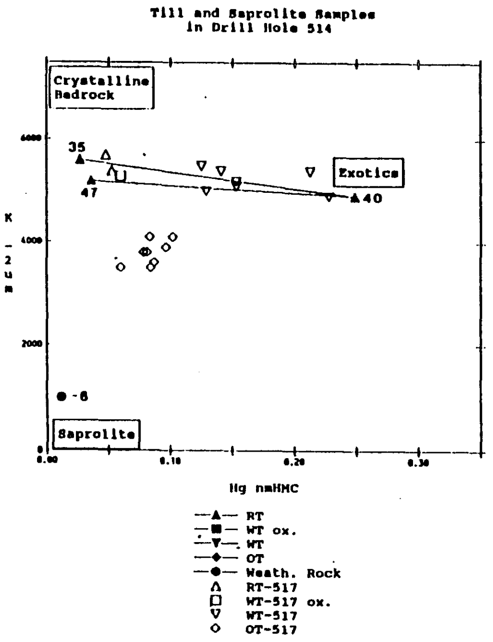
(93-95) SAPROLITE; REWORKED; large pebs of local rock, not same as underlying bedrock; some indication that saprolite below could be reworked to bedrock.
(93-95) SAPROLITE; REWORKED; olive-gray, blocky. Winnipeg till mixed with it 93-94 ft. Pyrite crystals up to 2 mm. Angular rock fragments up to 5 cm. Highly calcareous.
(95-101) SAPROLITE; CHLORITIC; greenish gray, massive. No sulfides.. Rock fragments up to 4 cm at 96 ft. Pebble line at 101 ft. (contamination?). Highly calcareous.
(101-107) NO CORE.

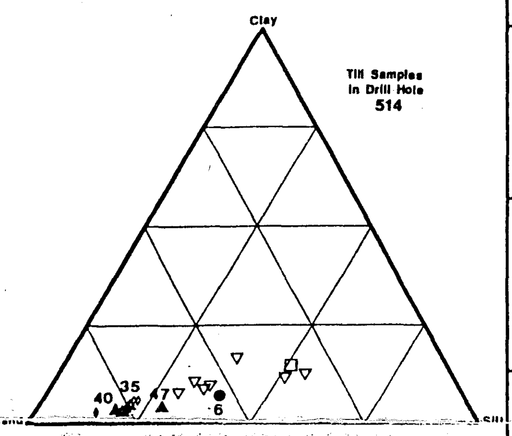
(107-115) BEDROCK; pyrrhotitic massive sulfide with minor amounts of pyrite. Intercepts of swirling, highly-deformed, banding alternate with intervals of wispy banding. A one foot interval (at 111) feet of a deformed pyrrhotite-cemented breccia with some light gray, chlorite-rich, fragments showing a seriate texture which developed before sulfide replacement of the groundmass. Subhedral to euhedral pyrite crystals are present in aggregates ranging from 0.3 to 1 cm in diameter. Pyrrhotite sometimes fills fractures in crosscutting, highly silicified, medium gray quartz-feldspar porphyry dikes. Blue, waxy, quartz? veins and patches may be related to the silicification of the porphyry dikes. All lithologies show a moderate to strongly developed S_1 to 10° to CA.

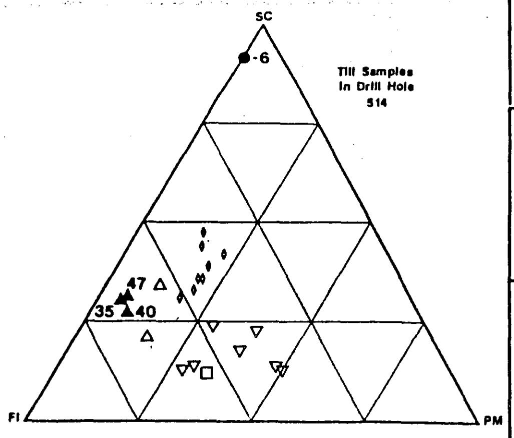
TD = 115'

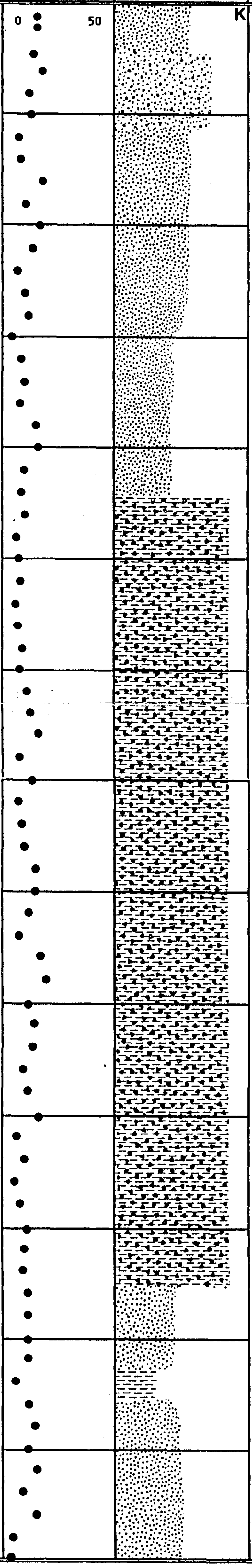
Drill Hole OB-514

Depth (ft)	Stratigraphic Attributes	Magnetic Suscept- ibility	Strati- graphic Column	Description









(0-4) GRAVELLY COARSE SAND; OXIDIZED; mod sorted; little peat on top.

(4-11) FINE-MEDIUM GRAVEL; OXIDIZED; silty, mod sorted; common carb; well sorted gvlly v cgr sand 8-9 1/2 ft.

(11-25) GRAVELLY COARSE SAND; OXIDIZED; mod sorted; some large pebs; large pebbly bed at 15 ft; well sorted w/only few pebs below 19 ft.

(25-27) COARSE SAND; OXIDIZED.

(27-29) MEDIUM SAND; OXIDIZED; well sorted.

(29-35) FINE SAND; OXIDIZED; well sorted.

(35-44) SILTY VERY FINE-FINE SAND; OXIDIZED; mod sorted, some coarser grains & sm pebs; well sorted, not silty below 37 ft; v well sorted v fgr sand below 39 ft; unox below 41 ft; sh-rich bed at base.

(44-48) CLAY LOAM TILL; UNOXIDIZED; firm; calc; compact layer 46 1/2-47 1/2 ft; abundant carb, uncommon sh.

(48-63) LOAM TILL; UNOXIDIZED; compact; lith as above; lighter gray below 57 ft; pebbly zone 60-61 ft; abrupt lower contact.

(63-68) SILT LOAM TILL; UNOXIDIZED; firm; calc; v fgr sand beds in upper foot or so; only sm pebs.

(68-84 1/2) LOAM TILL; UNOXIDIZED; compact; common carb, uncommon sh; more pebs then above; carb cob at base.

(84 1/2-89) LOAM TILL; UNOXIDIZED; firm; calc, common carb; matrix rich in silt & fgr sand; mostly sm pebs; gradational lower contact.

(89-110) LOAM TILL; UNOXIDIZED; firm-compact; lith as above, uncommon sh.

(110-116) CLAY LOAM TILL; UNOXIDIZED; firm; lith as above; few pebs; silt-rich below 111 1/2 ft; mixed w/silt below 114 ft, mostly silt below 115 ft.

(116-123) SILTY VERY FINE SAND; UNOXIDIZED; v well sorted; calc; v fgr sandy silt in top 1/2 ft.

(123-126) VERY FINE SANDY SILT-SILT; UNOXIDIZED; v well sorted, abrupt upper contact.

(126-143) SILTY VERY FINE SAND; UNOXIDIZED; v well sorted; only 7 ft of core recovered from 127-143 ft, lower couple ft had scattered coarser grains.

150				
160				
170	01	0	17	2
	02	1	341	14
180	03	0	81	3
190				
	04	0	3	1
200				
	05	1	57	1
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250				
260	07	-	-	1
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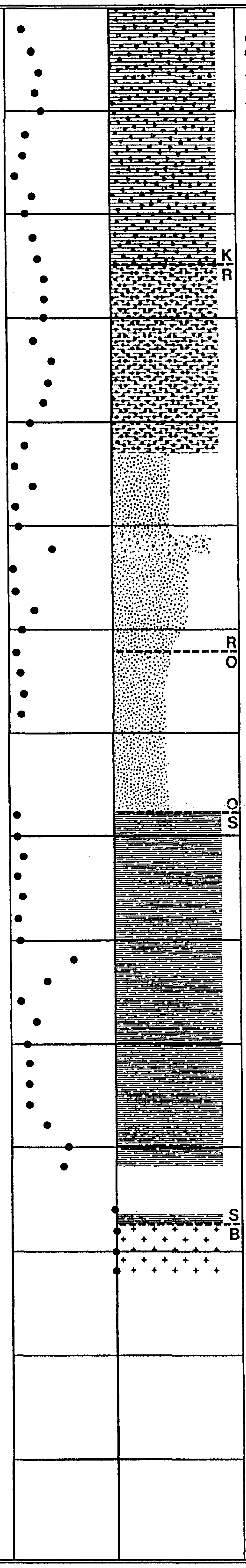
290				



(143-165) SILTY CLAY TILL; UNOXIDIZED; firm; calc; mostly only sm pebs; sm cob at 146 1/2 ft; carb fairly common, no sh noted; interbedded w/silt 148-150 ft; silt lam at 151 ft; silt beds 152, 154 & 155 ft, silt inclusions & bed at 156 ft, silt inclusions at 161 ft; mixed w/underlying sandy till in lower foot.

(165-183) SANDY LOAM TILL; UNOXIDIZED; compact; mod calc; uncommon carb; fairly common large pebs; boulder 169-170 ft; sl-mod calc w/depth; v sandy below 174 ft, w/few thin pebbly sand beds; cob at 181 ft, more loamy texture below, also mod calc.

(183-188) NO CORE; probably mostly sand.

(188-191) GRAVELLY COARSE SAND; UNOXIDIZED; mod sorted; uncommon carb; cob at 190 ft, more gvlly & not as well sorted below.
(191-193 1/2) COARSE GRAVEL; UNOXIDIZED; v silty, v poorly sorted; couple cobs at base.
(193 1/2-202 1/2) GRAVELLY VERY COARSE SAND; UNOXIDIZED; mod sorted at best; upper foot silty cgr sand; possible inclusion of sandy till at 195 ft; cob at 199 ft; poorly sorted below 200 ft, carb fairly common.

(202 1/2-208) VERY FINE SAND; UNOXIDIZED; v well sorted; interbedded w/fgr sand above 204 ft, & w/sandy silt & silt below; apar fair amount of saprolite-derived sed.

(208-217) NO CORE; based on drilling, probably above unit to 216 ft, over saprolite; top couple feet of saprolite may be reworked.

(217-252) Dusky yellow-green to dusky green saprolite. 6-inch boulder at 217 ft. Clumpy. Weathered rock and rock fragments ranging up to boulder size. Mica flakes from 218-222 ft., quartz/calcite veins and blebs from 223-224 ft., and quartz grains throughout. 4-inch boulder at 233 ft. darker core from 226-232 ft. Slightly calcareous to calcareous.

(252-256) NO CORE.

(256-257) WEATHERED BEDROCK; weathered volcanic.

(257-262) BEDROCK; light gray-green, massive, very fine-grained mafic volcanic rock. Very distinctive disseminated 0.3 mm magnetite phenocrysts. Moderately well-developed, vertical S_1 from alignment of chlorite.

Thin section description: sample at 260 feet.

Mineralogy: chlorite (0.03-0.07 mm), epidote (0.05-0.1 mm), plagioclase, quartz, magnetite (0.1-0.3 mm), pyrite (trace).

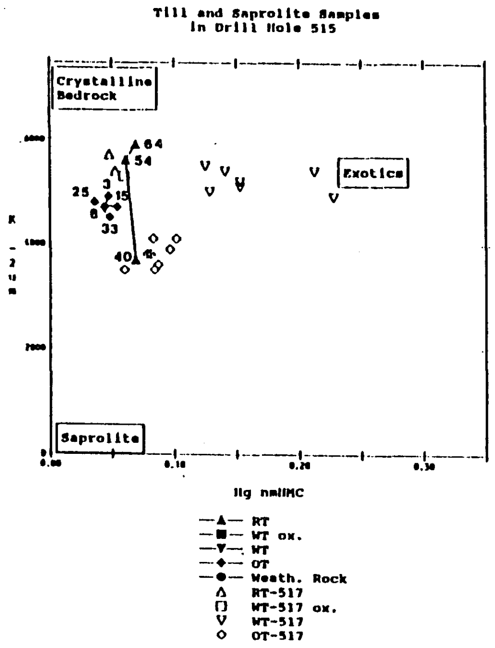
Texture: Very fine-grained non-pleochroic chlorite is lepidoblastic with anhedral masses of epidote (after plagioclase) disseminated throughout. Magnetite octahedra show quartz-filled pressure shadows. The original plagioclase is very poorly preserved.

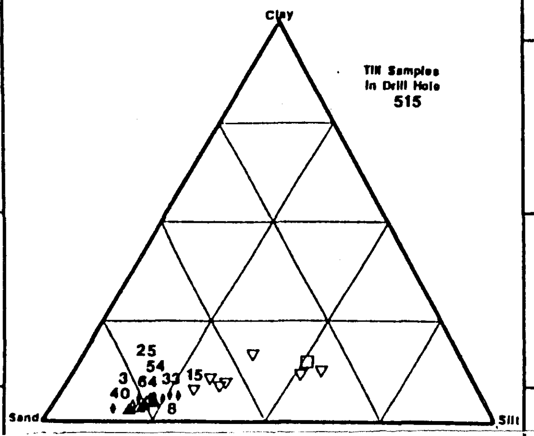
Lithology: metabasalt.

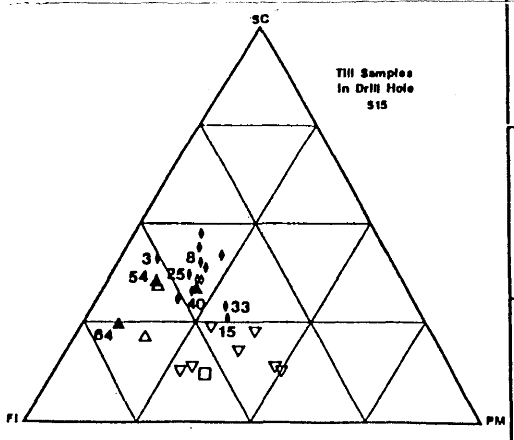
TD = 262'

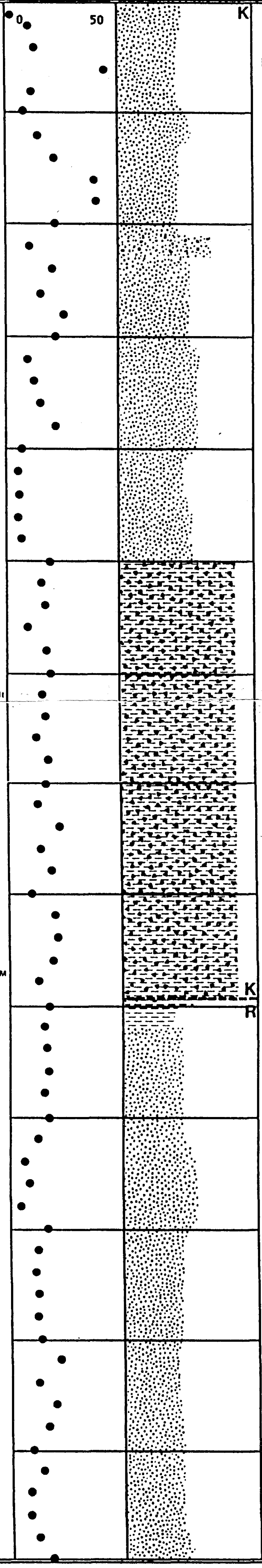
Drill Hole OB-515

Depth (ft)	Stratigraphic Attributes	Magnetic Susceptibility	Stratigraphic Column	Description









(0-2) FINE SAND; OXIDIZED; well sorted; some coarse sand grains.
(2-9) VERY FINE SAND; OXIDIZED; v well sorted; coarse grains below 7 1/2 ft.

(9-12) MEDIUM-COARSE SAND; UNOXIDIZED; well sorted, few gnl; top 1/2 ft pebbly cgr sand, cob near top; abundant carb.
(12-21) VERY FINE-FINE SAND; UNOXIDIZED; v well sorted; fairly abrupt upper contact; v fgr sand in upper foot; much v coarse sand grains below 19 ft, bimodal sorting; abrupt lower contact.

(21-23) GRANULE GRAVEL; UNOXIDIZED; well sorted; abundant carb.
(23-29) COARSE-VERY COARSE SAND; UNOXIDIZED; well sorted; upper foot v fgr sand w/coarser grains; abrupt lower contact.

(29-31) FINE-MEDIUM SAND; UNOXIDIZED; well sorted.

(31-35 1/2) COARSE-VERY COARSE SAND; UNOXIDIZED; well sorted; few sm pebs; more pebbly below 33 ft.

(35 1/2-41) MEDIUM-COARSE SAND; UNOXIDIZED; well sorted; fgr sand bed on top; few gnl in places.

(41-45) VERY FINE-FINE SAND; UNOXIDIZED; v well sorted; coarsens w/depth.

(45-48) MEDIUM SAND; UNOXIDIZED.

(48-50) MEDIUM-COARSE SAND; UNOXIDIZED; well sorted; few pebs, especially towards base; fgr-mgr sand bed at base; abrupt lower contact.
(50-80) LOAM TILL; UNOXIDIZED; compact; calc; uncommon carb, no sh noted; mostly sm pebs; sm cobs at 51, 52 ft; silt inclusions at 57 ft; 60-62 ft mostly reworked lake silt; silt inclusion, 2 sm cobs at 67 ft; v silty below 70 ft; sm cob at base.

(80-89 1/2) LOAM-SILT LOAM TILL; UNOXIDIZED; greenish gray; v loose; apar interbedded silty till & silt; lith as above; mod calc below 85 ft, apar mostly reworked lake sed; gray clayey till inclusion at base.

(89 1/2-92 1/2) VERY FINE SANDY SILT; UNOXIDIZED; greenish gray; v well sorted; mod calc.
(92 1/2-101) VERY FINE-FINE SAND; UNOXIDIZED; greenish gray; v well sorted; rare coarser grains; mostly silty v fgr sand below 96 ft; v fgr sandy silt towards base; abrupt lower contact.

(101-108 1/2) MEDIUM-COARSE SAND; UNOXIDIZED; v well sorted; rare carb.

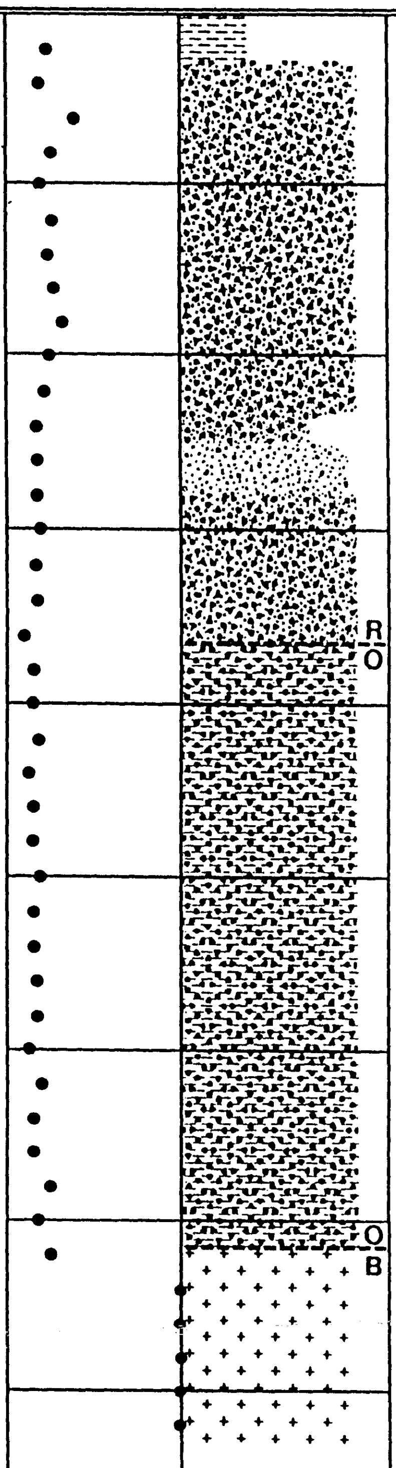
(108 1/2-112 1/2) VERY FINE-FINE SAND; UNOXIDIZED; well sorted; fgr-mgr sand 110-111 1/2 ft, v well sorted below.

(112 1/2-117) VERY FINE SAND; UNOXIDIZED; v well sorted; fgr sand bed at base.

(117-135) VERY FINE SANDY SILT-SILTY VERY FINE SAND; UNOXIDIZED; v well sorted; sl calc; v fgr sand bed w/mica-rich layers 129 1/2-131 1/2 ft, v fgr sandy silt below; 133-133 1/2 ft silt; somewhat gradational lower contact.

(135-139) FINE SAND; UNOXIDIZED; v well sorted; v fgr-fgr below 136 1/2 ft; v fgr sandy silt in last 1/2 ft.
(139-141) LOAMY SAND TILL; UNOXIDIZED; firm; sl calc; large pebs.

150	01	0	26	2
160	02	0	53	1
170				
	03	0	17	10
180	04	0	54	2
190	05	0	66	1
200	06	0	66	1
	07	1	46	1
210	08	0	597	1
220	09	-	-	2
230				
240				
250				
260				
270				
280				
290				



(141-143 1/2) VERY FINE SANDY SILT; UNOXIDIZED; greenish gray; grades into till below.
(143 1/2-163) LOAMY SAND TILL; UNOXIDIZED; sl-mod calc; uncommon carb; sandy loam till below about 147 ft, also mod calc-calc; cob at 157 ft; calc & compact below 159 ft, carb fairly common; cob near base.

(163-165) GRAVELLY COARSE-VERY COARSE SAND; mod sorted; uncommon carb.
(165-168) COBBLY GRAVEL; boulder at top; little sandy till at 167 ft, silty mgr-cgr sand w/pebs below; gradational lower contact.
(168-176) LOAMY SAND TILL; UNOXIDIZED; as above till; silty fgr sand 169-169 1/2 ft; cob at 170 ft; loamy bed at 172 ft; pebs uncommon; loam till inclusion at 175 ft; fairly abrupt lower contact.

(176-191) SANDY LOAM TILL; UNOXIDIZED; firm-compact; calc; fairly common carb; iron stains below 181 ft; more compact w/depth; large pebs fairly common.

(191-212 1/2) SANDY LOAM TILL; UNOXIDIZED; greenish gray; compact; calc, fairly common carb; somewhat gradational upper contact; sand content of matrix varies somewhat w/depth; fgr sand lam at 197, 197 1/2, 200 1/2 ft; cob at 205 1/2 ft; sand inclusion at 206 ft; loamy bed near base.

(212-223) BEDROCK; black, fine-grained, massive, metabasalt with a locally poorly-preserved diabasic texture is metamorphosed to the biotite-facies and exhibits a poorly developed tectonic fabric. Several very thin veinlets and crushed zones containing epidote and trace amounts of pyrite. A 15 cm intercept of an aplite dike at 222 feet is cut by a vertical 2 cm-thick white quartz vein.

Thin section description: sample at 214 feet.

Mineralogy: hornblende (0.2-0.6 mm), plagioclase (0.1-0.2 mm), epidote, sphene, chlorite.

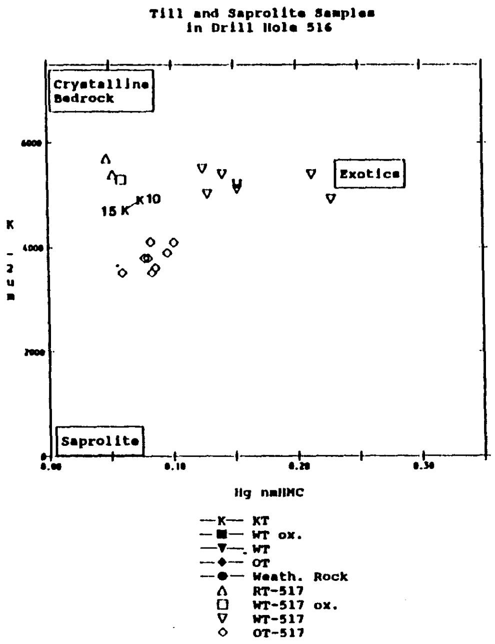
Texture: Blastosubophitic hornblende preserves the texture of the original pyroxene mineral. Plagioclase is recrystallized and extensively altered to epidote. Sphene occurs in irregular patches.

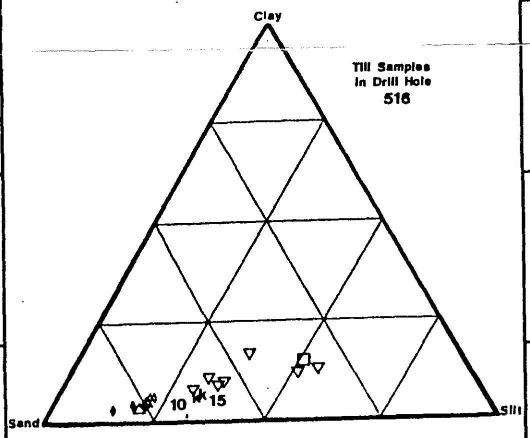
Lithology: metabasalt.

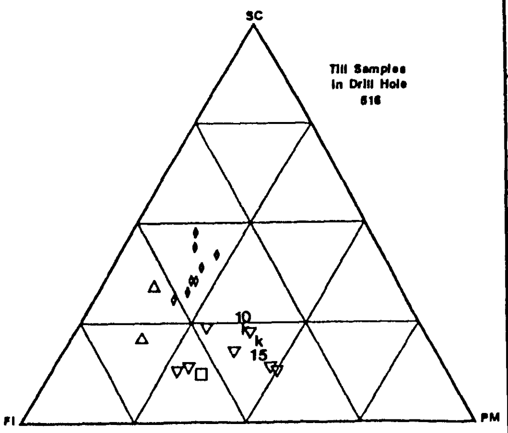
TD = 223'

Drill Hole OB-516

Depth (ft)		Stratigraphic Attributes		
40	01	0	42	1
	02	0	54	1
50	03	1	23	1
60	04	–	–	1

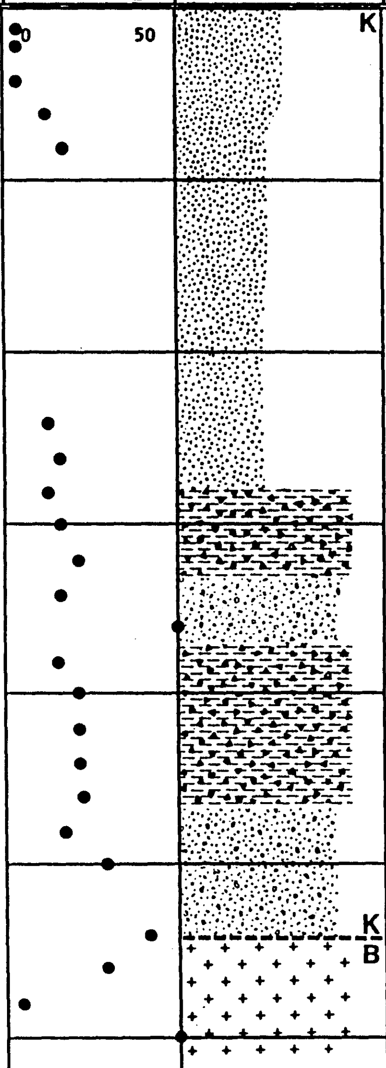






Magnetic Suscept- ibility

Strati- graphic Column



Description

(0-6) FINE-MEDIUM SAND; OXIDIZED; well sorted; few coarser grains, rare pebs.

(6-28) VERY FINE-FINE SAND; UNOXIDIZED; mod sorted, some coarser grains; much loss out of core barrel; few carb gnl; large peb apar near bottom; beds of fine pebbly sand in last foot.

(28-31) CLAY LOAM TILL; UNOXIDIZED; firm; common carb & sh; upper foot laminated clay, silty clay & clayey till.

(31-33) SILT; UNOXIDIZED; well sorted; calc; few pebs; clayey till lam near top, inclusion near base; cobs at base.
(33-37) COBBLES; upper foot v silty, apar silt filled interstices of wave-washed cob gvl; 34-35 ft unox mgr sand, well sorted; boulder at 35 ft over cobs.
(37-47) SANDY LOAM TILL; UNOXIDIZED; compact; calc, common carb; no sh noted; occ large pebs; sm cob at 42 ft.

(47-54) COBBLY GRAVEL; mod-poorly sorted; common carb; last 1/2 foot reworked saprolite, pebbly clay w/carb pebs.

(54-61) BEDROCK; gray green, medium-grained, massive graywacke is moderately well-sorted with a gradual decrease in grain size downward with 1% disseminated pyrite. Pyrite is present in a 2 cm-thick quartz vein as stringers and disseminated (1%) in the host rock. S_0 50° to CA is cut by a nearly vertical, poorly developed S_1 defined by the alignment of amphibole.

Thin section description: sample at 60 feet.

Mineralogy: quartz (37%), plagioclase (33%), biotite (24%), garnet (5%), iron oxides (trace).

Texture: Poorly sorted and massive with

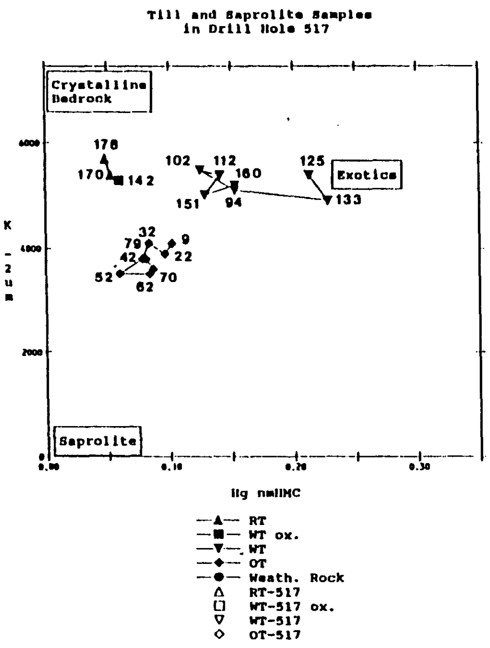
porphyroblastic garnet (0.5-0.7 mm) and red-brown biotite (0.1-1.2 mm). Penetrative fabric is poorly developed by the alignment of biotite.

Lithology: meta-graywacke.

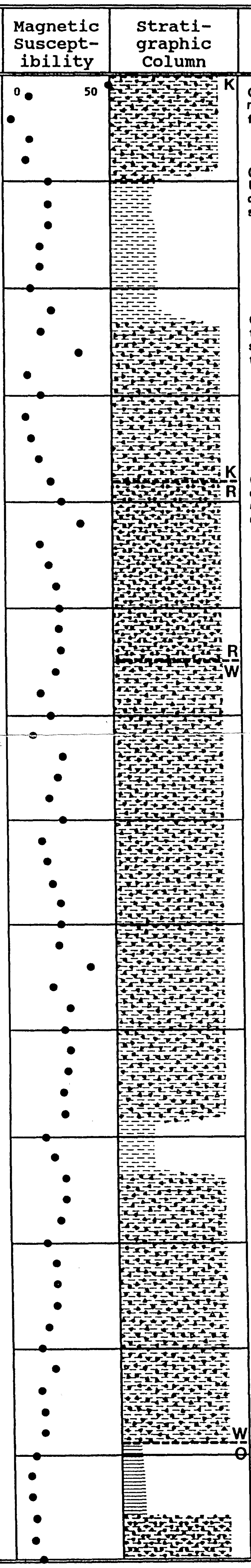
TD = 61'

10
20
30
70
80
90
100
110
120
130
140

Drill Hole OB-517



Depth (ft)	Stratigraphic Attributes		
01	0	47	1
02	1	268	2
03	0	100	1
04	1	538	1
05	0	28	1
06	0	127	1
07	1	25	1
08	1	178	1
09	0	182	2
10	0	38	2
11	0	16	2



Description

(0-9) LOAM TILL; OXIDIZED; compact by 4 ft; calc; carb common, noted sh; 0-1 ft v silty fgr sand w/pebs, 1-1 1/2 ft cob; silty fgr sand bed at 3 ft.

(9-23) SILT; UNOXIDIZED; well sorted; few sand grains, sm pebs; laminated w/v fgr sandy silt below 13 ft; pebbly from 17-19 ft, could be "flow till"; silty clay lam below 22 ft; lower contact somewhat gradational.

(23-38) CLAY-CLAY LOAM TILL; UNOXIDIZED; firm-compact; calc; fairly common carb; apar has partings, could be flow till; softer & lighter gray below 28 ft, loam till below 29 ft; sandy till zones below 32 ft; thin fgr sand bed at 37 1/2 ft.

(38-55) SANDY LOAM TILL; UNOXIDIZED; loose-firm; calc; fairly common carb, but Precambrian pebs dominant; loamy sand texture above 42 ft; cobs at 41, 51, 54 ft; fairly abrupt lower contact.

(55-74 1/2) CLAY LOAM TILL; UNOXIDIZED; compact; calc; common-abundant carb; loam texture above 59 ft, v compact below 59 ft; somewhat less compact below 73 ft; sm cob at base.

(74 1/2-98) CLAY LOAM TILL; OXIDIZED; dark grayish brown; compact; v calc; carb common but not dominant; greenish gray color to 79 ft; silt 80-81 ft; 87-88 ft pebbly, loamy texture w/sand inclusions; short gradational zone at base.

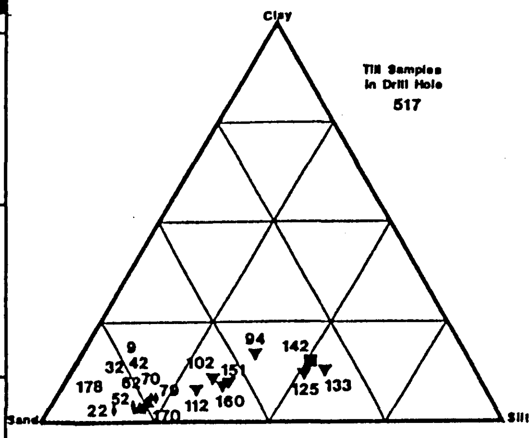
(98-103) CLAYEY SILT; OXIDIZED; grayish brown, laminated w/dark gray clay below 99 ft; v fgr sandy silt in lower foot or so.

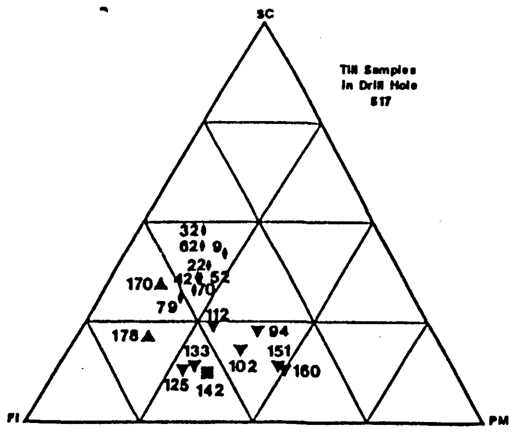
(103-121) LOAM TILL; UNOXIDIZED; olive gray; firm; v calc; common carb; coarse side of loam texture, less so & compact below 107 ft; couple sm cobs at 116 1/2 ft; v compact below 115 ft; clay loam till, dark gray, & less compact below 117 ft; large carb peb at base, fairly abrupt contact.

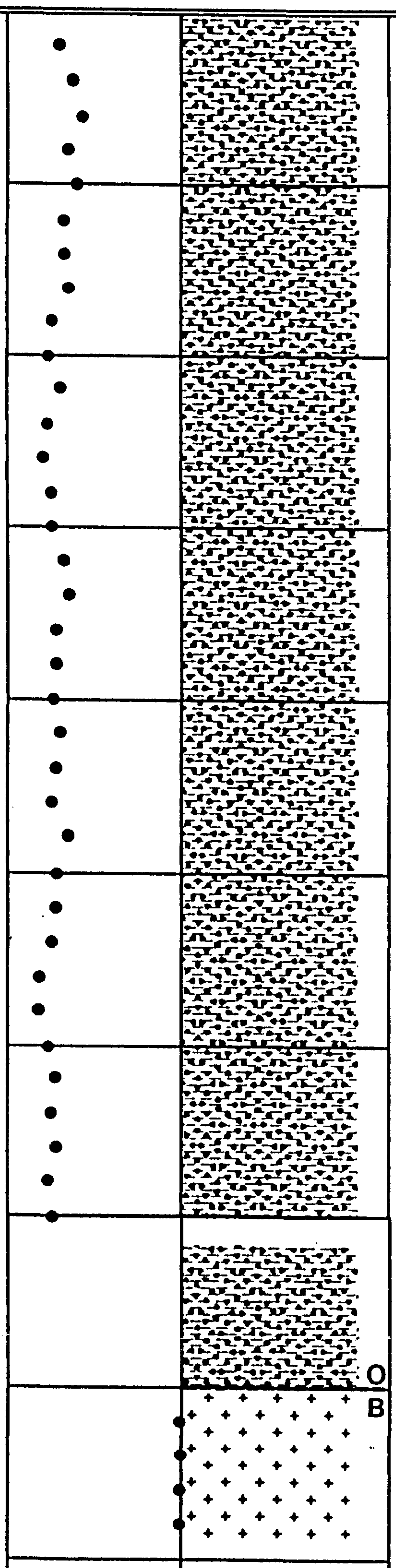
(121-129) CLAY LOAM TILL; UNOXIDIZED; soft; calc; common carb; v compact below 125 ft, & dark gray; silt inclusion at 126 ft; silt lam towards base, grades to lake sed in last few inches.

(129-136 1/2) SILTY CLAY; UNOXIDIZED; obsurely laminated w/clayey silt; calc; possible thin flow till in few spots; interbedded w/underlying till.

	11			
150	12	0	42	2
160	13	3	166	1
170	14	0	52	3
180	15	0	21	5
190	16	0	39	6
200	17	0	185	3
210				
	18	4	609	1
220				
	19	-	-	3
230				
240				
250				
260				
270				
280				
290				







(136 1/2-210) SANDY LOAM TILL; UNOXIDIZED; loose-firm; calc; carb fairly common, but Precambrian pebs dominant; large pebs fairly common; silty gvl bed at 146 ft; compact in places below 150 ft; cob at 154 1/2 ft; v sandy below 159 ft; 163-165 ft interbedded w/sand; 165-166 ft well sorted cgr sand w/cob at base; less sandy below 167 ft; sand beds at 167, 170 ft; carb cob at 167 ft, compact below; cobs at 179, 180, 184 ft; six cobs from 185-189 ft; boulder 196-197 ft; cobs at 200, 209 1/2 ft.

(210-212) NO CORE.
(212-220) SANDY LOAM TILL; UNOXIDIZED; same as above, poor recovery.

(220-229) BEDROCK; dark gray fragmental rock is comprised of 1-3 mm long dark gray angular rock fragments and some equant plagioclase clasts in a fine-grained chloritic matrix. The breccia alternates with intervals of fine-grained, medium gray chloritic rock which contains 3% light red fragments that show more than 10:1 flattening (0.5 x 5 cm). Moderately to strongly developed S_1, that sometime warps around the rock fragments, is parallel to S_0 at 30° to CA.

Thin section description: samples at 224 and 226 feet.

Mineralogy: chlorite, amphibole (0.1-1.4 mm long, after pyroxene ?), plagioclase (0.2-0.7 mm), epidote (after plagioclase), magnetite.

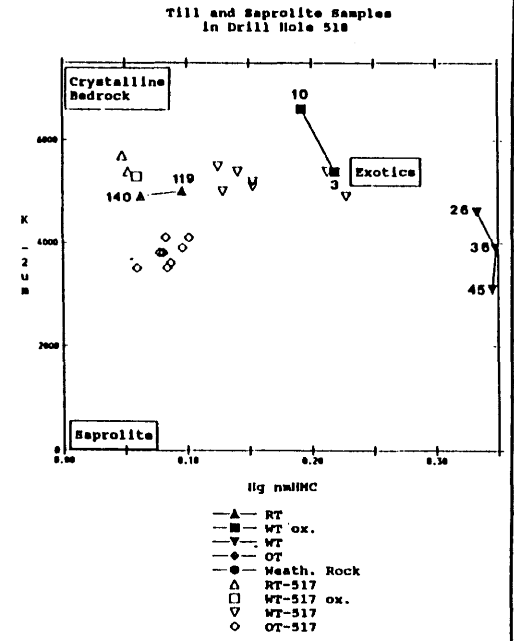
Texture: A highly foliated, chlorite and epidote-rich groundmass flows around porphyroblasts of amphibole (after pyroxene?) and plagioclase. Pressure shadows of chlorite are adjacent to some of the larger porphyroblasts which show slight rotation. Some of the rock fragments are extremely fine-grained altered porphyritic basalt.

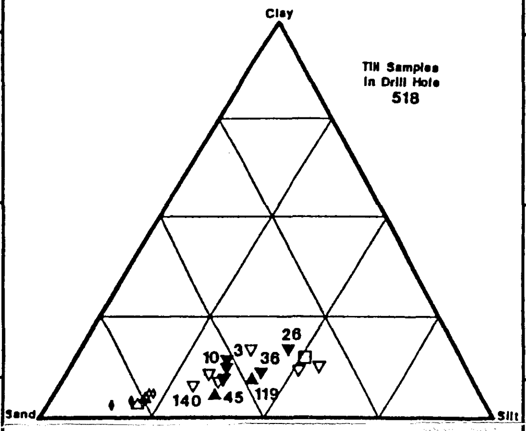
Lithology: mafic mylonite.

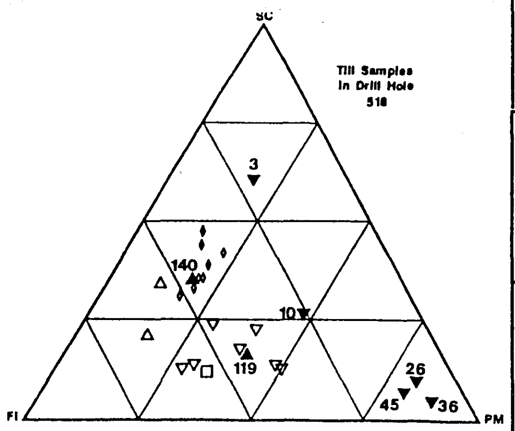
TD = 229'

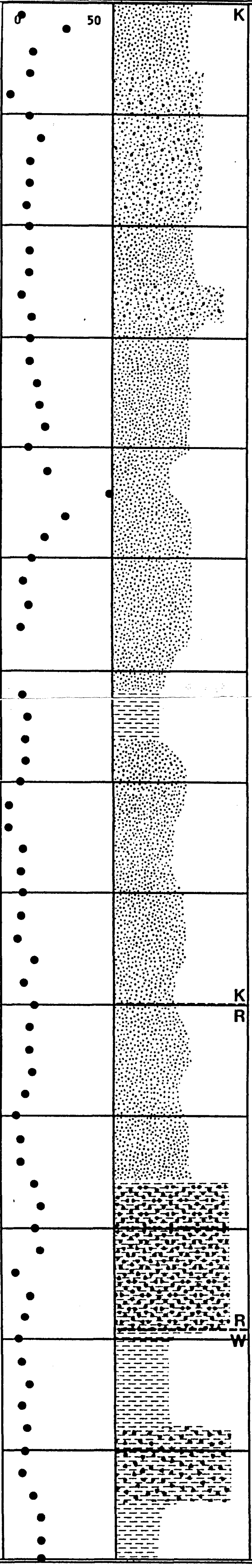
Drill Hole OB-518

Depth (ft)	Stratigraphic Attributes	Magnetic Susceptibility	Strati-graphic Column	Description









10				
20				
30				
40				
50				
60				
70				
80				
90				
100				
110	01	0	37	3
120				
130				
	02	1	55	6
140				

(0-6) GRAVELLY SAND; OXIDIZED; silty, poorly sorted; little peat on top; 3 1/2-5 ft well sorted, v fgr sand.

(6-19) FINE-MEDIUM GRAVEL; OXIDIZED; silty, poorly sorted; top foot boulder; carb-rich.

(19-25) GRAVELLY VERY COARSE SAND; OXIDIZED; mod sorted; some large pebs; grades to gvl below.

(25-29) FINE-MEDIUM GRAVEL; OXIDIZED; occ large pebs.

(29-41) GRAVELLY VERY COARSE SAND; OXIDIZED; v gvlly below 32 ft.

(41-44) SANDY SILT-MEDIUM SAND; OXIDIZED; 41-42 1/2 ft fgr-mgr sand, mod sorted, few gnl, sm pebs; 42 1/2-44 ft unox v fgr sandy silt grading to silty v fgr sand, v well sorted, calc.
(44-46) FINE-COARSE SAND; UNOXIDIZED; mod sorted, few pebs.
(46-51) GRAVELLY VERY COARSE SAND; UNOXIDIZED; well sorted; only sm pebs; large peb zone at 49 ft.

(51-57) COARSE-VERY COARSE SAND; UNOXIDIZED; mgr-cgr below 54 ft; v fgr-fgr sand below 56 ft, gnl & pebs towards base.

(57-62) NO CORE; presume fgr sand.

(62-66) SILT; UNOXIDIZED; v well sorted; calc; top foot silty fgr-mgr sand.

(66-73) MEDIUM-COARSE SAND; UNOXIDIZED; mod sorted, few gnl, sm pebs; couple silt beds or inclusions near top; fgr-mgr sand below 71 ft.

(73-79 1/2) SILTY VERY FINE-FINE SAND; UNOXIDIZED; greenish gray; well sorted; more coarse grains w/depth.

(79 1/2-86) FINE-MEDIUM SAND; UNOXIDIZED; well sorted; v fgr sand beds at 80 & 83 ft; mgr-cgr sand below 84 ft.

(86-90 1/2) SANDY SILT-FINE SAND; UNOXIDIZED; greenish gray; calc; well sorted; top foot sandy silt; 87-89 ft fgr sand w/mgr bed near top, pebbly cgr sand bed at base, some carb; 89-90 1/2 ft v fgr sandy silt.
(90 1/2-95) MEDIUM-VERY COARSE SAND; UNOXIDIZED; mod sorted; occ sm peb; not much carb.

(95-98 1/2) FINE SAND; UNOXIDIZED; mod sorted, some coarser grains; couple silt beds or inclusions at 97 ft, over bed of fgr-cgr sand.
(98 1/2-105) MEDIUM-COARSE SAND; UNOXIDIZED; well sorted; fair amount of v cgr sand below 103 ft; last 1/2 foot pebbly fgr sand, poorly sorted.

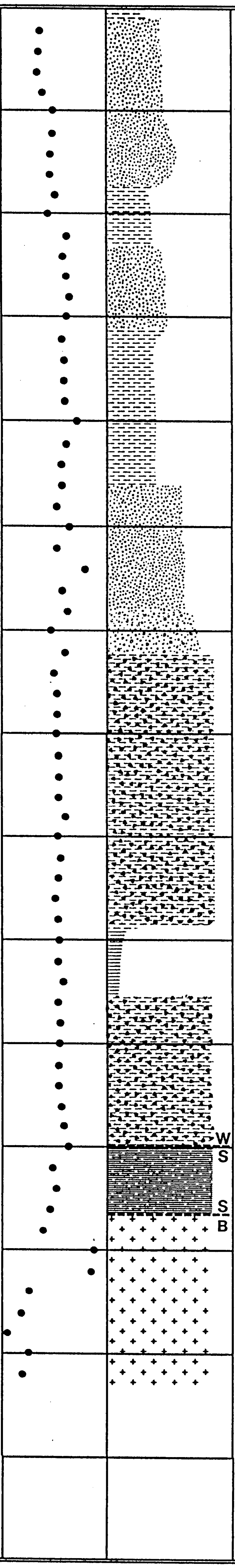
(105-112 1/2) LOAM & SANDY LOAM TILL; UNOXIDIZED; firm-compact; calc; loam till layer or inclusion at top over silt to 106 ft; 106-107 ft sandy loam till w/cob near top; 107-107 1/2 silt; loam till 107 1/2-110 ft, abruptly over sandy loam till; sand beds at 109, 111, 112 ft.
(112 1/2-119) LOAM TILL; UNOXIDIZED; compact; calc; matrix rich in fgr sand & silt; most pebs sm; carb fairly common; many sm silty sand inclusions below 115 ft; silt bed or inclusion at 117 1/2 & 118 ft; less compact below 118 ft.

(119-128 1/2) SILT; UNOXIDIZED; compact; calc; v well sorted, virtually no sand; couple pebs at 123, 125 ft, few below; till lam below about 127 ft.

(128 1/2-134 1/2) LOAM TILL; UNOXIDIZED; compact; calc; common sm carb pebs, but not dominant; increasing silt content w/depth; mixed w/silt in lower foot or so.

(134 1/2-141) SILT; UNOXIDIZED; soft; calc; v well sorted; massive; grades to sand below.

150				
160				
170				
	03	0	52	22
180				
190				
200				
	04	1	237	1
210				
	05	0	25	1
220				
	06	0	13	1
230				
240	07	0	16	2
	08	1	91	1
250				
260				
	09	–	3	–
270				
280				
290				



(141-157) SILTY VERY FINE SAND; UNOXIDIZED; well sorted; v fgr sandy silt 145-146 ft; some coarser grains below 146 ft; less silty below 150 ft; v fgr sandy silt below 155 ft.

(157-163) SILT; UNOXIDIZED; well sorted; dark greenish gray calc clay bed at 158 ft; silty till mixed w/silt 159-161 ft, coarse sand grains in silt below.

(163-171) SILTY VERY FINE SAND; UNOXIDIZED; v fgr sandy silt 168-169 ft, over bed of fgr-mgr sand, which grades back to silty v fgr sand.

(171-186) VERY FINE SANDY SILT; UNOXIDIZED; beds of silty v fgr sand, occ lenses of silty clay-clay; little charcoal below 175 ft, layer at 177 ft w/little wood, dated greater than 40,400 radiocarbon years; peb at 182 ft; silty v fgr sand in last foot or so; abrupt lower contact.

(186-188) GRAVELLY FINE-COARSE SAND; UNOXIDIZED; silty, v poorly sorted, many v large pebs; lower foot cobs.
(188-198) GRAVELLY COARSE-VERY COARSE SAND; UNOXIDIZED; mod sorted; silty; common carb; occ large pebs; poorly sorted below 196 ft; some v large pebs below 197 ft.

(198-202) SILTY FINE-MEDIUM GRAVEL; UNOXIDIZED; some large pebs; 199 1/2-200 1/2 ft v dark gray clay loam till; gvlly v cgr sand to 201 ft, silty gvl below.
(202-229 1/2) CLAY LOAM TILL; UNOXIDIZED; v dark olive gray; compact; abundant carb, rare sh; top foot soft, gray, loam till (mud flow) w/ball of dark gray till at 202 1/2 ft; indurated (cemented?) 207-209 1/2 ft; less compact below 211 ft; v compact below 217 ft; v dark gray below 220 ft.

(229 1/2-235 1/2) CLAY; UNOXIDIZED; v dark gray; v thin, v fgr sandy silt lam; abrupt lower contact.

(235 1/2-249 1/2) CLAY LOAM TILL; OXIDIZED; compact; calc; little less clay, less pebs than above till; carb common but not dominant; gray in upper foot (reduced?); mixed w/saprolite below 248 ft.

(249 1/2-251 1/2) SAPROLITE & TILL; mostly saprolite, mixed w/little till as above.

(250-252) SAPROLITE; REWORKED; grayish yellow-green to greenish gray. Looks "brecciated" with a mottled pale brown tint. Medium to coarse-grained sand in a matrix of clay minerals. Some small weathered rock fragments. Highly calcareous.
(252-258) SAPROLITE; CHLORITIC; greenish gray, blocky. Hard with angular weathered rock fragments up to 3 cm. 5 mm oxidized vein from 253-256 ft. (10 R 4/6). Vein is less calcareous than the rest of core. Highly calcareous.
(258-259) WEATHERED BEDROCK; weathered metavolcanic.
(259-273) SAPROLITE; CHLORITIC; same as 252-258, calcareous to highly calcareous.

(257-273) BEDROCK; a medium gray-green, well-foliated, intermediate volcaniclastic rock contains 5% 3-4 mm rounded, dark, soft, pretectonic crystals that have an occasionally well-preserved prismatic habit. Sericitically-altered, stumpy plagioclase occur at 268 feet. Anastomosing S_1? cleavage is parallel to CA.

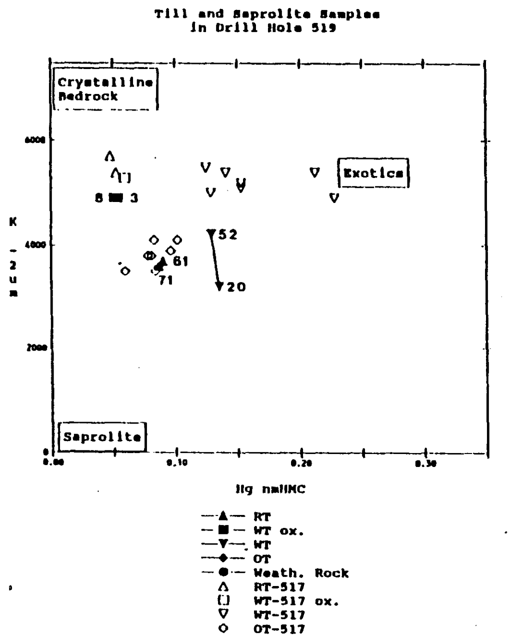
Thin section description: sample at 262 feet.

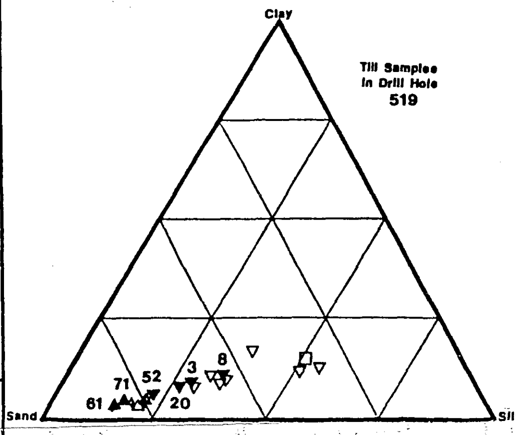
> Mineralogy: chlorite, plagioclase, quartz, epidote, white mica.
>
> Texture: Blastoporphyritic, pretectonic euhedral to anhedral, commonly broken, lath-like, plagioclase crystals (An 10?, most 0.3-0.5 mm, some >5 mm long) are aligned and accompanied by quartz and green, pleochroic, chlorite filling pressure shadows. The matrix is well foliated chlorite and lenses of recrystallized quartz transected by a widely-spaced chlorite-rich shear bands. Epidote and white mica are alteration products of plagioclase.
>
> Lithology: protomylonite.

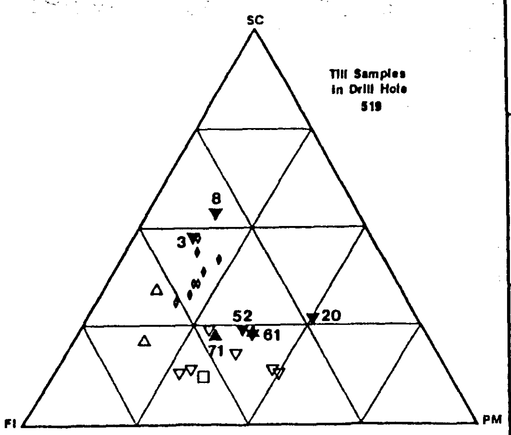
TD = 273'

Drill Hole OB-519

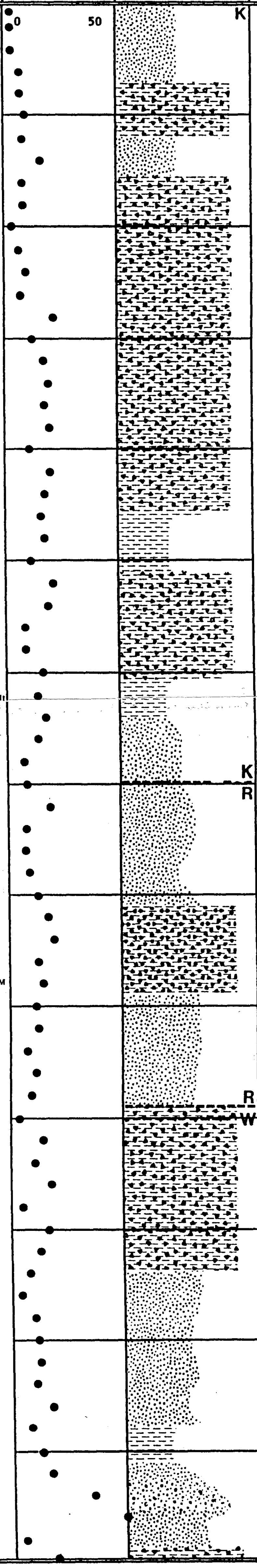
Depth (ft) | Stratigraphic Attributes | Magnetic Susceptibility | Stratigraphic Column | Description







01	0	49	1
02	2	46	1
03	1	14	2



(0-7) VERY FINE SAND; OXIDIZED; well sorted; little peat on top; pebbly below 4 ft, not as well sorted; abrupt lower contact.

(7-12) LOAM TILL; OXIDIZED; grayish brown; firm; calc, abundant carb; silt inclusion at 10 & 12 ft.

(12-15 1/2) SILTY VERY FINE SAND; OXIDIZED; mod sorted, w/coarse grains; pocket of pebbly fgr sand at 13 1/2 ft; pebbly v fgr sandy silt below 14 ft.
(15 1/2-27) LOAM TILL; OXIDIZED; dark grayish brown; compact; abundant carb; 15 1/2-16 1/2 ft 'flow' till, 16 1/2-17 ft silty fgr-mgr gvl, poorly sorted; v fgr sandy silt inclusion at 22 ft; large cob at 27 ft.

(27-45 1/2) LOAM TILL; UNOXIDIZED; matrix rich in v fgr sand & silt; interbedded w/silty v fgr sand; massive below 35 ft; common carb, fairly common sh.

(45 1/2-51) VERY FINE SANDY SILT; UNOXIDIZED; silt bed on top; few pebs; clay lam at 47 ft, more pebs below.

(51-54) LOAM TILL; UNOXIDIZED; approaches sandy loam texture, rich in v fgr sand & silt as above till.
(54-60 1/2) LOAM TILL; UNOXIDIZED; firm; calc; carb fairly common, no sh noted; matrix high in silt & v fgr sand; silty bed at 60 1/2 ft.

(60 1/2-64 1/2) SILT; UNOXIDIZED; v well sorted; massive.

(64 1/2-70) SILTY VERY FINE SAND; UNOXIDIZED; v well sorted; laminated silt bed at 68 1/2 ft, well sorted v fgr-fgr sand below, w/some coarser grains.

(70-76) FINE-VERY COARSE SAND; UNOXIDIZED; poorly sorted, w/pebs up to large; uncommon carb.

(76-79) SILTY VERY FINE SAND; UNOXIDIZED; v well sorted.

(79-81) GRAVELLY COARSE-VERY COARSE SAND; UNOXIDIZED; well sorted.
(81-89 1/2) SANDY LOAM TILL; UNOXIDIZED; firm; mod calc; calc below 85 ft w/common carb; cob at 83 1/2, 87 ft; v silty gvl 87 1/2-88 1/2 ft.

(89 1/2-93 1/2) GRAVELLY VERY COARSE SAND; UNOXIDIZED; silty, poorly sorted; common carb, more than in gvl above till; 92-93 1/2 ft sandy loam till, firm-compact, calc, common carb, less sandy than above till.
(93 1/2-99) GRAVELLY MEDIUM-COARSE SAND; UNOXIDIZED; silty, poorly sorted; finer grained towards base.

(99-111) LOAM TILL; UNOXIDIZED; compact; calc; common carb; large pebs fairly common.

(111-114 1/2) SANDY LOAM TILL; UNOXIDIZED; firm to loose; lith similar to above; loamy bed at 112 ft.
(114 1/2-116 1/2) GRAVELLY COARSE SAND; UNOXIDIZED; poorly sorted, many large pebs; lower foot mod sorted mgr-cgr sand w/occ large pebs.
(116 1/2-120) SILTY VERY FINE SAND; UNOXIDIZED; well sorted.

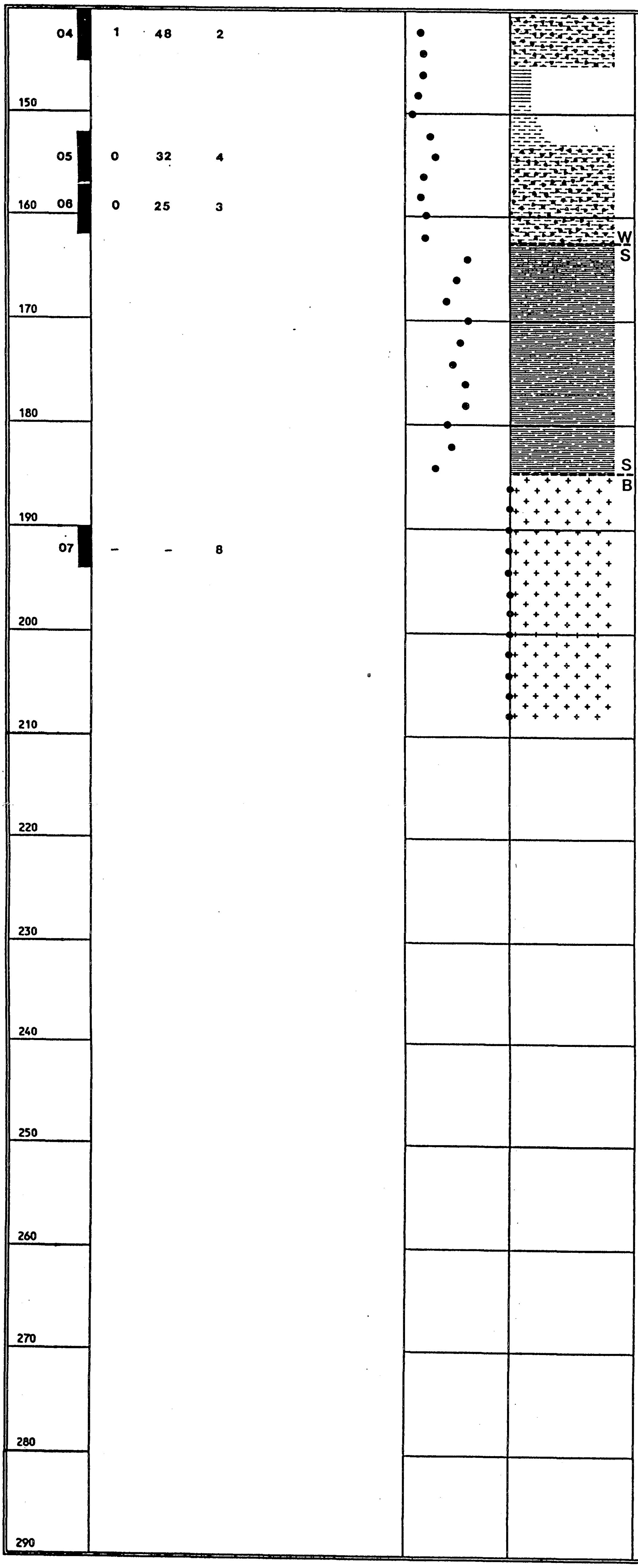
(120-123) FINE-MEDIUM SAND; UNOXIDIZED; mod sorted.

(123-126) FINE-VERY FINE SAND; UNOXIDIZED.

(126-128) FINE-MEDIUM SAND; UNOXIDIZED.
(128-131) VERY FINE SANDY SILT; UNOXIDIZED; well sorted.

(131-133) COBBLY SILTY SAND; UNOXIDIZED.
(133-136 1/2) COBBLES; boulder from 134 1/2-136 ft.

(136 1/2-139) GRAVELLY VERY COARSE SAND; UNOXIDIZED; poorly sorted; carb v common.



(139-145) SANDY CLAY LOAM TILL; UNOXIDIZED; v dark gray; v compact; calc, carb fairly common, lith indicates extensive mixing w/saprolite; top foot loose, gvlly till w/common large carb pebs.
(145-149) SILTY CLAY; UNOXIDIZED; olive gray; calc; top 1/2 ft silt; gradational upper contact w/pebs; 145 1/2-146 1/2 ft clayey silt grading to silty clay; looks more like till w/depth.
(149-152 1/2) VERY FINE SANDY SILT; UNOXIDIZED; laminated w/dark gray loam till below 150 1/2 ft.
(152 1/2-162) SANDY CLAY LOAM TILL; OXIDIZED; dark grayish brown to dark brown; compact; calc; carb pebs subordinate to greenish crystalline pebs; noted sh peb at 157 ft, sev more below; abrupt lower contact.

(162-165) WEATHERED BEDROCK; weathered tonalite, also contains some relatively unweathered sections.
(165-185) GRUS; light olive-gray. Resembles sand when crushed. Majority of minerals are recognizable; quartz, feldspar, biotite. Feldspars are altered. Boulder at 185 ft. Calcareous.

(185-208) Medium gray, coarse-grained, slightly porphyritic biotite tonalite contains both subhedral and anhedral biotite with ragged terminations. Most of the plagioclase is subhedral (4 mm to 1 cm diameter) with some intervals containing 1 cm tabular plagioclase megacrysts. Up to 1% disseminated, 1 mm diameter, pyrite is present. Numerous 1 to 2 cm aplite and pegmatite veins intrude the tonalite. No penetrative fabric was observed.

Thin section description: sample at 187 feet.

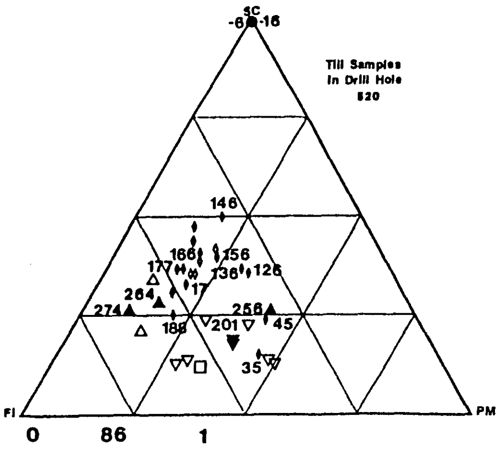
Mineralogy: plagioclase (56%), hornblende (16%), quartz (12%), biotite (10%), potash feldspar (6%).

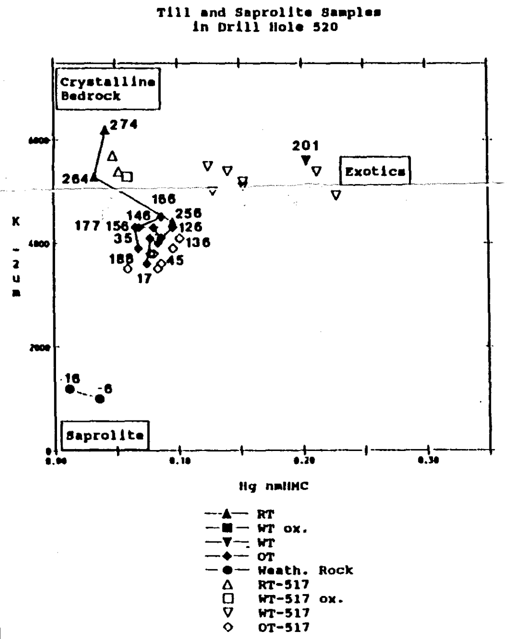
Texture: Hypidiomorphic-granular texture is developed with subhedral plagioclase (1-4 mm) and intergranular subhedral hornblende (1-3 mm), anhedral quartz (0.5-0.7 mm) and potash feldspar (0.7 mm). Plagioclase is altered to white mica along widely-spaced fractures and exhibits some myrmekitic intergrowth. Biotite is formed from the alteration of hornblende. No penetrative fabric is apparent.

Lithology: hornblende tonalite.

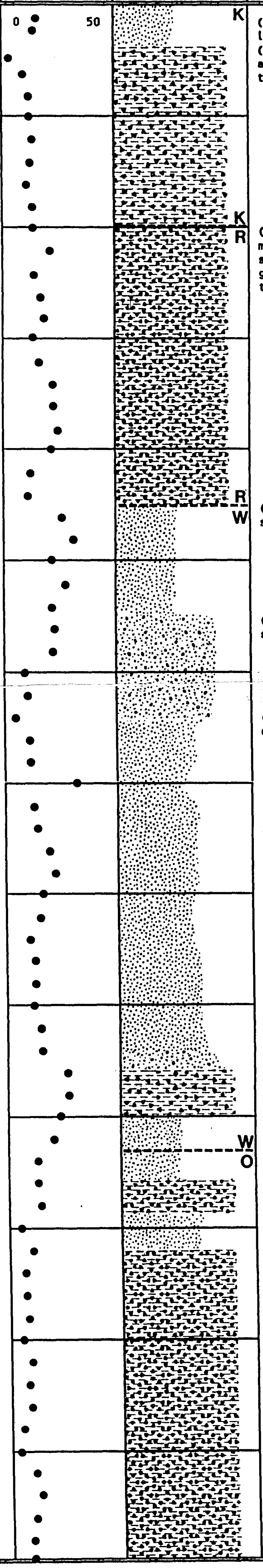
TD = 208'

Drill Hole OB-520





Depth (ft)	Stratigraphic Attributes		
01	0	86	1
02	3	23	1
03	4	21	1
04	0	31	1
05	1	195	1
06	0	63	1
07	0	242	1
08	0	19	1



Description

(0-3 1/2) FINE SAND; OXIDIZED; mod sorted; sm cob near top; last foot poorly sorted w/large pebs; carb-rich.

(3 1/2-20) LOAM TILL; OXIDIZED; unox below 11 ft; firm; calc; abundant carb, fairly common sh; 6-6 1/2 ft silt; lens of sandy till at 19 1/2 ft.

(20-45 1/2) SANDY LOAM TILL; UNOXIDIZED; greenish gray; firm; mod calc-calc; carb fairly common but crystalline dominant; v sandy below 26 ft w/few pebs, mostly sm; fgr sand 34-35 ft; grades back to sandy loam till by 40 ft; cob at 43 ft; grades to loam till by 44 ft, v calc w/much carb.

(45 1/2-54 1/2) FINE SAND; UNOXIDIZED; mod sorted; 45 1/2-47 ft silty mgr-cgr gvl, v poorly sorted, w/common carb pebs.

(54 1/2-64) MEDIUM-COARSE GRAVEL; UNOXIDIZED; silty, v poorly sorted; common carb.

(64-69) GRAVELLY COARSE SAND; UNOXIDIZED; poorly sorted; gvl 67-68 ft.

(69-71 1/2) FINE SAND; UNOXIDIZED; well sorted.

(71 1/2-82 1/2) GRAVELLY COARSE SAND; UNOXIDIZED; poorly sorted; below 76 ft silty, v gvlly & v poorly sorted w/large pebs; cob at 78 1/2 ft.

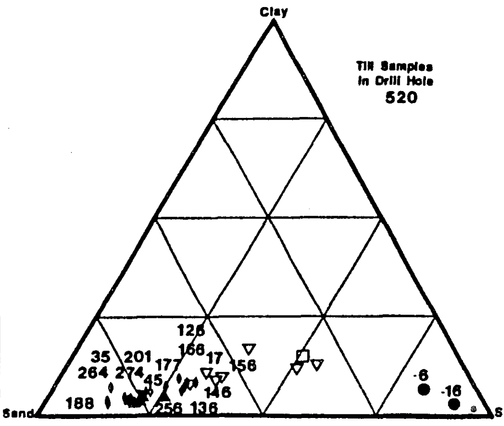
(82 1/2-85) MEDIUM SAND; UNOXIDIZED; mod sorted; v fgr sand at top; mgr-cgr below 84 ft.

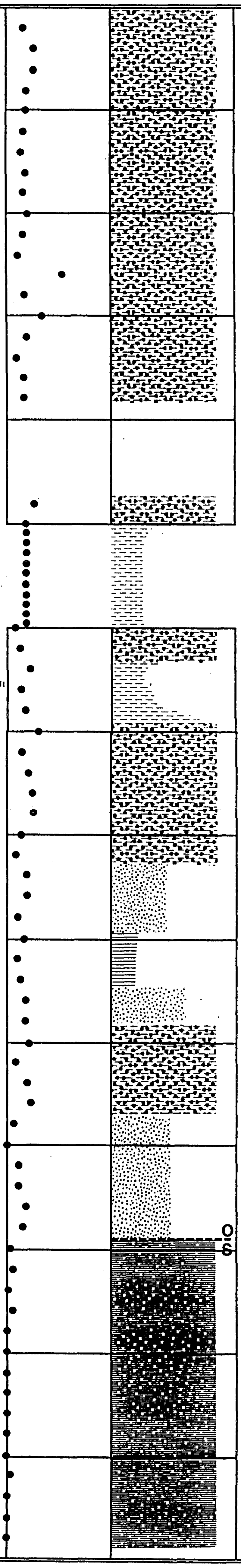
(85-90 1/2) GRAVELLY COARSE SAND; silty, poorly sorted; most pebs fgr-mgr.

(90 1/2-94) COARSE-VERY COARSE SAND; UNOXIDIZED; mod sorted.

(94-96) FINE-COARSE GRAVEL; UNOXIDIZED; silty, v poorly sorted; carb cob at base.
(96-100 1/2) CLAY LOAM TILL; UNOXIDIZED; greenish gray; firm; calc; similar to lower 1 1/2 ft of above till; common carb; sandy zones; gvlly below 100 ft incl cob.
(100 1/2-103) SILTY VERY FINE SAND; UNOXIDIZED; poorly sorted w/sm pebs; grades to v fgr sandy silt.
(103-106) FINE-MEDIUM SAND; UNOXIDIZED; gvlly cgr sand bed at top, pebbly towards base, last 1/2 ft cob; some v fgr sand; carb uncommon.
(106-109) SANDY LOAM TILL; UNOXIDIZED; greenish gray; firm; calc; carb fairly common; last foot gradational to underlying sand.
(109-112) GRAVELLY COARSE SAND; UNOXIDIZED; silty, poorly sorted; grades to till below.
(112-178) SANDY LOAM TILL; UNOXIDIZED; greenish gray; compact; calc; carb fairly common; fairly pebbly but not many large pebs; large cob near top; 113-114 1/2 ft silty cgr sand w/till ball at 114 ft; coarse loamy texture 126-133 ft, another zone below 145 ft; texture is variable, ranging to sandy clay loam in lower part; v compact below 130 ft; cob at 128 1/2, 130 1/2, 137, 139, 144, 159 1/2, 165 1/2 & 169 ft; boulder 164-165 ft.

150	08			
160	09	1	23	1
170	10	0	175	2
180	11	1	478	2
190				
240				
250				
260	12	0	28	1
270	13	0	104	1
280				
290	14	0	64	1
300	15	0	11	1
310	16	0	11	3
320	17	0	18	2
330				





(178-187) NO CORE.

(187-190) SANDY LOAM-LOAM TILL; UNOXIDIZED; greenish gray; compact; calc; as above; abrupt lower contact.
(190-243) CLAYEY SILT; UNOXIDIZED; v well sorted; v calc; massive; silt above 194 ft; carb peb at 205 ft first noted, few grains below, especially below 210 ft; thin clay lam at 224 ft, massive silt-clayey silt below; sand grains v rare; v thin, silty v fgr sand lam at 235 ft; clay lenses or inclusions at 240 ft.

(243-245 1/2) CLAYEY SILT, SILTY CLAY & CLAY; UNOXIDIZED; interbedded; v calc; sandy till bed at 244 ft.
(245 1/2-249) SANDY SILT; UNOXIDIZED; transitional to till below; gvlly in upper part; possibly little 'flow' till at 246 ft.
(249-258) SANDY LOAM TILL; UNOXIDIZED; compact; calc; common sm carb pebs; cob at 251 ft; loamy sand till below 253 1/2 ft w/loamy zones throughout; silty v fgr sand grading to fgr sand below 257 ft, could be drilling artifact.

(258-263 1/2) LOAM TILL; UNOXIDIZED; dark gray; firm; calc; common carb; common dark crystalline pebs.

(263 1/2-269 1/2) SILTY FINE-COARSE SAND; UNOXIDIZED; poorly sorted, w/balls or lenses of till; silty v fgr sand bed at 265 1/2 ft; 268-269 1/2 ft dark gray loam till as above, but more clayey; abrupt lower contact.

(269 1/2-275) SILTY CLAY; UNOXIDIZED; dark gray; few sand grains; pebbly zone at 271 ft; many pebs & sand grains below 273 ft.

(275-278) GRAVELLY COARSE SAND; UNOXIDIZED; silty; v poorly sorted; common large pebs; common carb.
(278-287) LOAM TILL; UNOXIDIZED; compact; calc; common carb; approaches sandy loam texture above 282 ft; many large dark crystalline pebs below 284 ft, incl sm cob at 286 ft.

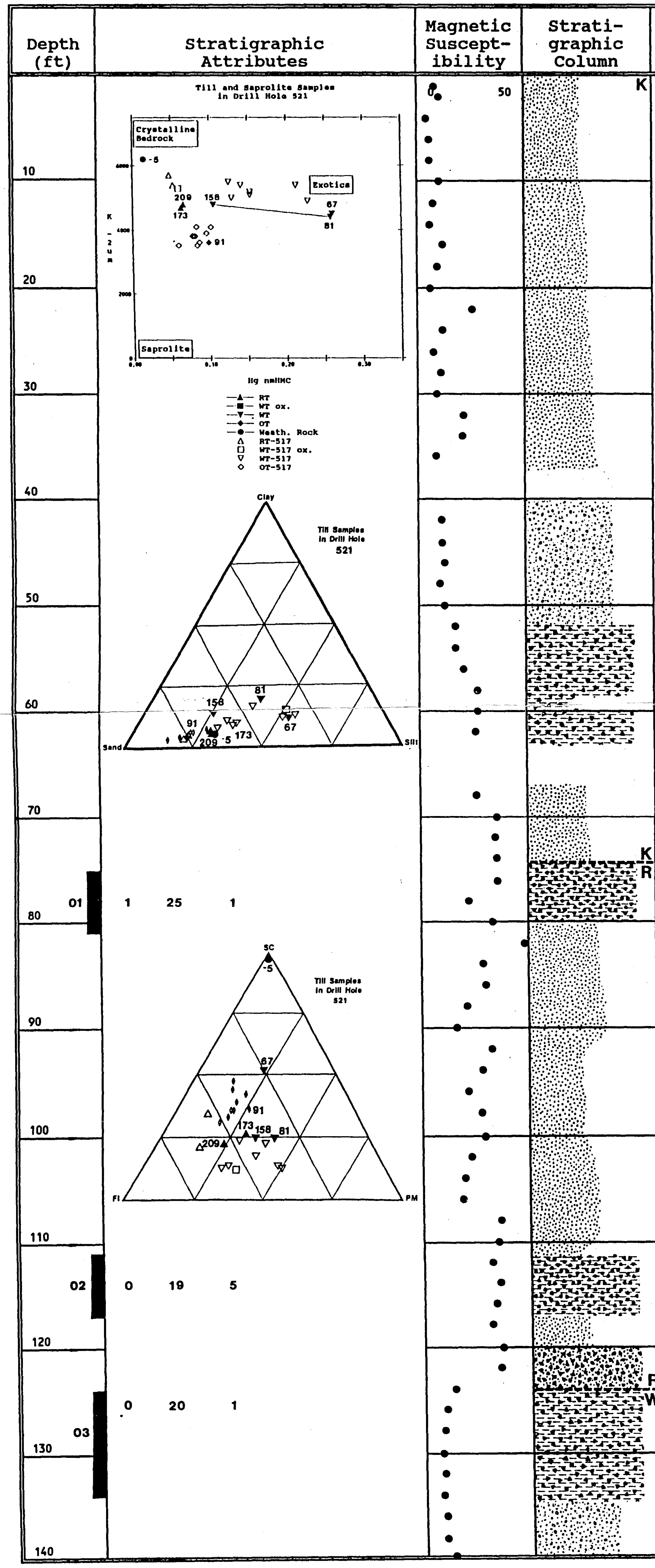
(287-290 1/2) FINE SAND; UNOXIDIZED; well sorted; 287-287 1/2 ft sandy silt; 287 1/2-288 1/2 ft v silty fgr sand, poorly sorted, w/large carb cob at base.
(290 1/2-295) MEDIUM SAND; UNOXIDIZED; fair amount of v cgr sand to gnl; 290 1/2-291 ft large cob over cgr gvl.

(295-299) COARSE SAND; UNOXIDIZED; mod sorted; peb layer at 295 1/2 ft; couple large pebs near base.

(299-300) SAPROLITE; REWORKED; light greenish gray. Matrix is massive clay minerals. Rounded pebbles up to 3 cm. Pebbles seem to be concentrated along a narrow zone 1 ft. down (stone line?).
(300-329) SAPROLITE; KAOLINITIC; light greenish gray, powdery, soft. Very high kaolinite content. Faint horizontal varigation of light greens and grays. Small angular quartz grains. Siderite nodules up to 1 cm. High concentration of dark laminations at 305 ft. Becomes very light and powdery at 313 ft. Slightly calcareous to noncalcareous.

TD = 329'

Drill Hole OB-521



Description

(0-37) VERY FINE SAND; OXIDIZED; well sorted; silty below 6 ft; pebbly at 7 ft; mod sorted w/coarser grains below 7 ft; unox w/fairly common gnl below 10 ft; carb common; v fgr-fgr below 12 ft; pebbly zone at 14 1/2 ft; mostly v fgr sand below 15 1/2 ft; fgr gvl layers at 18 & 19 ft; fgr-cgr sand beds from 24-25 ft; pebbly mgr-cgr sand bed at 26 ft, w/abundant carb, v fgr-fgr sand below; better sorted below 28 ft; more coarse grains below 36 ft.

(37-40) NO CORE; sand.

(40-52 1/2) VERY FINE GRAVEL; UNOXIDIZED; silty; poorly sorted; carb-rich, noted large sh pebs; 40-41 ft silty fgr-cgr sand, poorly sorted; 46-47 ft silty fgr-v cgr sand, poorly sorted; pebs fairly angular; v fgr sand bed at base.

(52 1/2-58) SILTY VERY FINE SAND & LOAM TILL; UNOXIDIZED; mod sorted, w/some coarser grains; 52 1/2-54 ft dark gray loam till, firm, calc, w/common carb; loam till beds also at 55 1/2 ft & 57 1/2-58 ft.

(58-60) VERY FINE SANDY SILT; UNOXIDIZED; interbedded w/loam till, gradational to till below.
(60-63) LOAM TILL; UNOXIDIZED; firm; calc; common carb; matrix rich in silt & fgr sand below 62 ft.
(63-67) NO CORE; probably sand.

(67-74 1/2) SILTY VERY FINE SAND; UNOXIDIZED; well sorted; more coarse grains, not as well sorted below 71 ft; grades to sandy silt below 73 ft; pebbly below 74 ft; cob at base but

(74 1/2-80 1/2) SANDY LOAM TILL; UNOXIDIZED; greenish gray; firm; calc; fairly common carb; sand bed at 76 ft, v sandy till below w/sand beds; cob at 76 1/2 & 79 ft; bed or inclusion of loam till at 79 1/2 ft; loam till w/carb pebs in last 1/2 ft.

(80 1/2-85) GRAVELLY FINE-MEDIUM SAND; UNOXIDIZED; silty; v poorly sorted, many large pebs; cob at 84, 84 1/2 ft.

(85-87) GRAVELLY COARSE-VERY COARSE SAND; UNOXIDIZED; better sorted than above; fair amount of carb.
(87-91) COARSE-VERY COARSE SAND; UNOXIDIZED; well sorted, w/gnl; 88 1/2-91 ft mgr-cgr sand, well sorted, w/abrupt contacts.
(91-100) VERY FINE-FINE SAND; UNOXIDIZED; v well sorted; mostly fgr sand below 95 ft; v fgr sand bed at base.

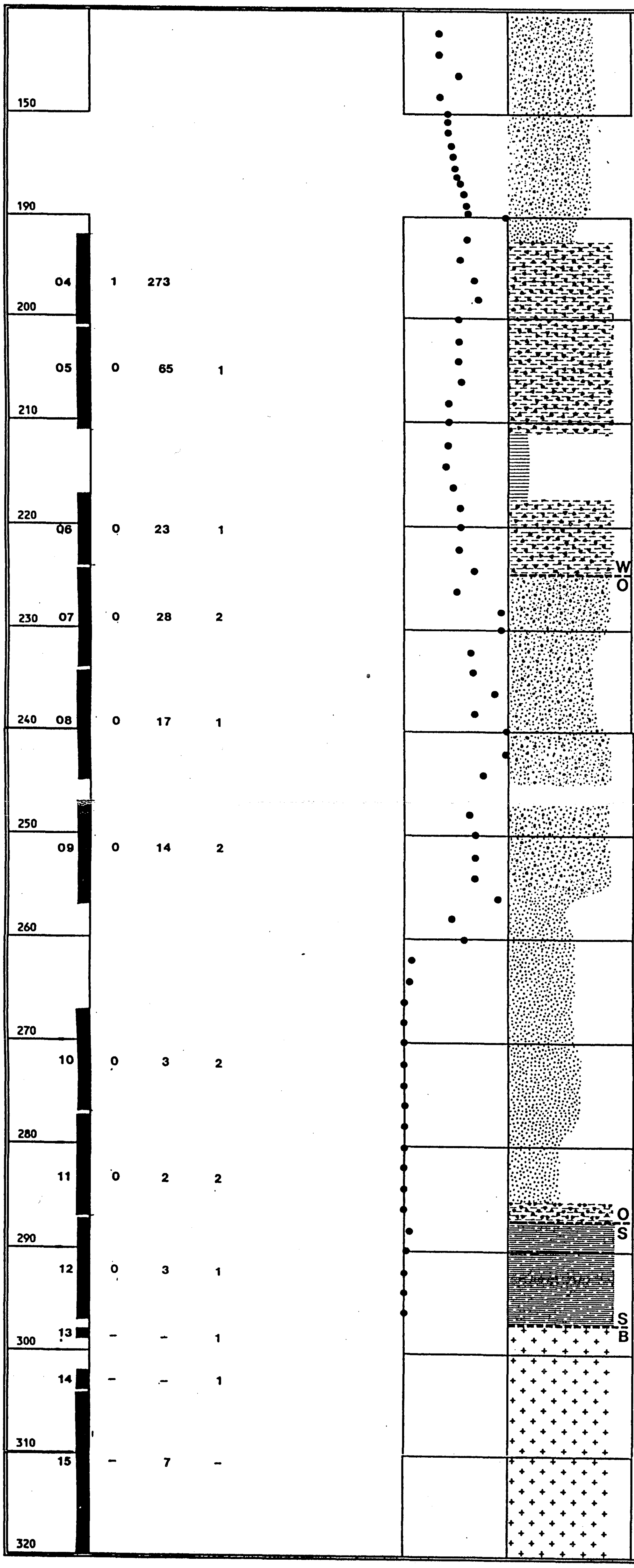
(100-107) FINE-MEDIUM SAND; UNOXIDIZED; not quite as well sorted as above, w/mgr sand beds; mgr-cgr sand bed at 104 1/2 ft & from 106-107 ft.

(107-111) VERY FINE-FINE SAND; UNOXIDIZED; silty v fgr sand below 109 1/2 ft; grades to v fgr sandy silt by 110 1/2 ft; abrupt lower contact.

(111-117) SANDY LOAM TILL; UNOXIDIZED; firm; calc; common carb; little more coarse textured & greener w/depth; sm cob at 115 ft; gradational lower contact.

(117-120 1/2) GRAVELLY FINE SAND; UNOXIDIZED; v poorly sorted; silty; 117-118 1/2 ft v fgr sand, well sorted, w/sandy loam till bed at base.
(120 1/2-124) LOAMY SAND TILL; UNOXIDIZED; loose, w/pebby sand beds; calc; mostly sandy loam till in last foot, sand bed at base; v abrupt lower contact.
(124-135 1/2) CLAY LOAM TILL; UNOXIDIZED; dark gray; compact; calc; common carb; but not dominant, could be mixed; coarser w/depth, cob at 129 ft; mixed w/gvl towards base, clay bed at base.

(135 1/2-153 1/2) VERY FINE-FINE GRAVEL; poorly sorted, silty gvlly fgr sand w/gvl beds 135 1/2-137 ft; couple cobs & some large pebs 137-138 ft, mod sorted below; fair amount of medium pebs; pebs rounded to sub-rounded; v common carb; occ large pebs; large cob at 141, 143 ft; more sandy below 147 ft; gvlly cgr-v cgr sand in last foot.



(153 1/2-167) FINE-MEDIUM GRAVEL; silty, poorly sorted, w/gvlly cgr sand beds; cgr gvl layer at 156 1/2 ft, occ large pebs below; v poorly sorted, v silty & cobbly from 160 1/2-162 ft & 165-167 ft.
(167-175) NO CORE; probably sand & gvl.
(175-190) VERY FINE-VERY COARSE GRAVEL; v poorly sorted; cob at 186, 188, 189 ft.

(190-192) GRAVELLY MEDIUM-COARSE SAND.

(192-204 1/2) SANDY LOAM TILL; UNOXIDIZED; firm-compact; calc; carb fairly common; cob at 194 ft; compact below 195 ft; pebbly sand bed from 200-202 ft probably drilling artifact; 203 1/2-204 1/2 boulder.

(204 1/2-211) LOAM TILL; UNOXIDIZED; similar to above but more clayey, result of incorporating underlying lake sed; grades to clay at 207 ft; 207-208 ft large inclusion of clay-silty clay w/distorted silt lam; clay & loam till to 208 1/2 ft, mostly till 208 1/2-209 1/2 ft, mostly lake sed below, w/till blebs.

(211-217) CLAY & SILTY CLAY; UNOXIDIZED; v well developed lam, w/minor silt; black clay lam have organic aroma; mostly silt in lower foot; few carb grains towards base, but abrupt lower contact.
(217-224) LOAM-CLAY LOAM TILL; UNOXIDIZED; firm; calc; abundant carb; 218-219 ft silt w/few sand grains; compact below 219 ft; most pebs sm; lot of large greenstone pebs at 221 ft; 222 1/2-224 ft pebbly v fgr sandy silt w/little till towards the top, grades into gvl below.
(224-229) VERY COARSE GRAVEL; v silty, v poorly sorted; cob at 226 1/2 ft; 228-229 ft cobs.

(229-239 1/2) FINE-COARSE GRAVEL; little better sorted than above, w/beds of gvlly v cgr sand; 232-232 1/2 ft cobs.

(239 1/2-245) COBBLY VERY COARSE GRAVEL; mostly cobs; v poorly sorted; has silty matrix but not till.

(245-247) NO CORE.
(247-256 1/2) COBBLY COARSE GRAVEL; as above, v silty, v poorly sorted; v abrupt lower contact.
(256 1/2-259) SILTY VERY FINE SAND-SILT; UNOXIDIZED; greenish gray; well sorted; silty v fgr sand grades to silt below 257 1/2 ft; clayey silt towards base; abrupt lower contact.
(259-268) MEDIUM-COARSE SAND; UNOXIDIZED; mod sorted; silt bed at 264 ft, some gnl below.
(268-277) FINE-VERY COARSE SAND; UNOXIDIZED; variable grain size; v fgr sand bed at 269 ft; many gnl at 272 1/2 ft; 272 1/2-274 ft mod sorted silty v fgr sand; 276-277 ft well sorted mgr sand.
(277-285 1/2) VERY FINE-FINE SAND; UNOXIDIZED; well sorted above 280 ft, below interbedded w/mgr-cgr sand; pebbly zone at 284 1/2 ft.
(285 1/2-287 1/2) LOAM TILL; UNOXIDIZED; loose-firm; calc; noted carb pebs; apar much incorporated saprolite.
(287-288) SAPROLITE; REWORKED: light olive-gray. Contains medium to coarse-grained sand, pebbles (5 mm) and angular rock fragments up to 6 cm in matrix of clay minerals. Highly calcareous.
(288-297) SAPROLITE; CHLORITIC; grayish green, dark reddish brown, grayish purple saprolite with relict schistosity. Green from 288-291, red from 291-292, green from 292-293, red from 293-295, and purple 295-297. Well foliated. Abundant mica flakes. Core becomes harder and less weathered at 295 (almost weathered rock). Contains large fragments of weathered rock (3-4 cm). Slightly calcareous to noncalcareous.
(297-320) BEDROCK; dark gray, very fine-grained rock with 0.5% deformed garnets (2 x 4 mm) exhibits greenschist-facies metamorphic assemblage with extensive epidote replacement near quartz veins. Biotite (up to 1 mm long) is abundant adjacent to a quartz vein at 318 feet. Two foliations are present where S_1 ranges between 50° and 60° to CA and S_2 is at 75° to CA. A quartz muscovite phyllonite at 302 to 304 feet is succeeded downward by an S-C tectonite. A fault breccia is intersected from 305 to 316 feet with 0.5 to 7 cm diameter breccia fragments in a chlorite-epidote matrix containing deformed quartz veins. Light gray, clear quartz veins and white crystalline calcite veins were rotated, segmented and brecciated during the faulting. Ductily deformed mafic volcanic breccia clasts are also found locally within the fault-gouge.

Thin section description: sample at 299 feet.

Mineralogy: chlorite, quartz, biotite, muscovite, plagioclase.

Texture: A well developed S-C fabric is developed from the alignment of phyllosilicate minerals and lenses and pods of recrystallized quartz and untwined plagioclase. Grain size ranges from 0.1 to 0.3 mm for the phyllosilicates and 0.05 to 0.1 mm for the quartz and plagioclase.

Lithology: mylonite (with S-C fabric).

TD = 320'

Appendix 280-C. Sampling and analytical methods.

Field Logging and Core Recovery Procedures

Drill core taken by the rotasonic drilling method is recovered in lengths ten to thirty feet long. Cores are dry-drilled to minimize the opportunity for water-washing of the soft sediments and sand layers. Recovered core lengths are extruded from the core barrel into plastic sleeves and broken to four foot lengths. The core sections are then marked with top and bottom orientations and placed into four foot long wooden boxes for shipment and holding until they can be logged and sampled. Martin and others (1988, 1989) describe in detail the mechanics of procedures and equipment used to ensure quality control during rotasonic coring operations.

Descriptive Core Logging

Core recovered during drilling operations at the twenty drill sites was descriptively logged by Gary Meyer, glacial geologist with the Minnesota Geological Survey (MGS). Characteristics noted during logging include texture, Munsell color, reaction to 10% HCl, till compactness, pebble abundance and lithology, presence of organic material, nature of stratigraphic contacts, and sedimentary structures. Textural analysis and 1-2mm sand counts were later performed on 84 grab samples by technicians at the MGS. Results of the latter work are on file at MnDNR in Hibbing.

Thicknesses of stratigraphic units were determined using both the existing core and the notations made on field drilling logs. The field logs were useful for identifying missing core intervals and for determining thicknesses of easily deformed silt-clay layers. Thickness and elevation data for geologic units are listed in Appendix 280-A and Appendix 280-B and are probably accurate to within 1 or 2 feet. Appendix 280-B contains descriptions and profiles of the core recovered from the twenty drill holes.

Core Sampling

Till and saprolite are the primary sample media. Sands, gravels, and silt-clay were sampled only if the basal Quaternary unit was not till or if sampling coverage in the drill hole was sparse. Only two samples of Koochiching lobe till were sampled, in drill hole 516, where Koochiching drift is the only available sampling media. Bedrock core was sampled wherever it was encountered.

Guidelines for sampling were: 1) sample all till-bearing stratigraphic units starting at the base of the Quaternary section and working upwards to the base of the Koochiching lobe drift, 2) make all reasonable effort to ensure that sampled intervals do not cross stratigraphic or compositional boundaries in the core, 3) sample saprolite sections if they exceed ten feet in thickness, 4) when sampling, make sure to exclude the outer surfaces of core, which are potentially cross-contaminated by other stratigraphic units.

Sampling of Glacial Drift: Glacial drift intervals and several saprolite intervals treated as drift were sampled with aluminum splitting tools and plastic scoops to prevent metallic contamination of gold or other metals into the samples. Target weights for samples are: 10kg (8kg minimum) for heavy mineral concentrate processing, 1200g (1kg minimum) for silt/clay extraction, and 200g for matrix carbonate analysis. Most samples represent 5 to 10 feet (1.5-3m) of core.

The 10kg sample of core was sent to a contract laboratory (Overburden Drilling Management) for disaggregation and preparation of Heavy Mineral Concentrates (HMC). Subsamples produced by this procedure are: Heavy Mineral Concentrate (HMC), lights fraction <3.3sp.g. (ltHMC), magnetic HMC fraction >3.3sp.g. (magHMC), and nonmagnetic HMC fraction >3.3sp.g. (nmHMC). During HMC processing, the silt-clay component of the samples is discarded. The granule and pebble (+10mesh) fractions are retained. Nonmagnetic heavy mineral concentrates (nmHMC) are divided after gold grain counting was completed, 3/4 for assay, 1/4 for mineralogy. The 3/4 split is then sent to the analytical laboratory (Bondar-Clegg) for further preparation (crushing to -200mesh).

The 1200g sample of the core interval is packaged and sent to a contract lab (Bondar-Clegg) for disaggregation, textural analysis, and silt-clay separation using the method outlined by the Geological Survey of Canada (Higgins, 1988).

The 200g samples are disaggregated, dried, and dry-sieved in-house to obtain a -63um sample for carbonate analysis.

Sampling of Saprolite and Bedrock: Bedrock, and saprolite samples treated as bedrock, were logged, described, and selected for analysis by Terry Klein, geologist with the U.S. Geological Survey in Reston, Virginia (Klein, 1991). Representative bedrock and saprolite intervals were sampled for petrographic, major element, and trace element analysis. Only a few of the saprolite intervals were analyzed for major element oxides. Core samples were crushed to -200 mesh at the contract laboratory (Bondar-Clegg). Thin section pucks were sent to a petrographic lab. Bedrock and saprolite sample intervals ranged from 1 to 10 feet in length. Bedrock and saprolite cores were also examined for scheelite using an ultra-violet lamp, and for gamma-ray emission by Geiger counting.

Analysis Methods

Physical Measurements: Measurements for physical properties were made semi-quantitatively for munsell color, oxidation state, till compactness, reactivity to 10% HCl, pH, and bulk density.

Munsell color was determined during logging, prior to sampling, by comparing the wetted interior surface of split core with the munsell color chart. Oxidation state was determined during logging by noting the degree of preservation of non-resistant mineral species and by noting oxidation color changes in the predominantly unoxidized drill cores. Till compactness was determined qualitatively during logging on a scale of one (soft) to five (very compact). pH was measured on slurried mixtures of distilled water and disaggregated core using the method described by Davey and El-Ansary (1986). Bulk density measurements were done in-house using the method of Pavich (1989).

Pebble and Mineral Measurements: Mineralogic properties measured include pebble counts and mineral grain counts of non-magnetic Heavy Mineral Concentrate (nmHMC) fractions. Fourteen selected samples of till and saprolite were also subjected to clay matrix X-ray Diffraction (XRD) analysis.

Pebble counts were made on till samples using methods modified from Szabo and others (1975), Kokkola and Pehkonen (1976), and Coker and others (1984). Additional help in devising a practical classification and identification system for pebble counting was provided by Professor J. Welsh (Welsh, unpublished DNR open-file report). Pebbles recovered from the HMC processing were divided into three lithic super-categories, with five size classes from +1" to +4mesh for each category. The number of pebbles counted per sample ranged from 75 to over 2000. Large numbers of pebbles were counted to ensure that reasonable quantities of supracrustal (SC) category pebbles would be available for further sub-division. The supracrustal category pebbles were then divided into eight types of SC pebbles and additional miscellaneous categories. Pebble categories are: P-M (Paleozoic and Mesozoic pebbles of dolomite, limestone, marl, and buff-colored chert), F-I (coarse-grained felsic-to-intermediate plutonic pebbles of granite, granodiorite, and biotite granite-gneiss), and SC (everything else, subdivided as follows: SCm -Mafic plutonic pebbles, SCmv -Mafic volcanic pebbles, SCma -Mafic volcanic-amphibolite pebbles, SCfv -Felsic volcanic pebbles, SCfh -Felsic-intermediate hpabyssal pebbles, SCgn -Gneiss-schist-dark coarse-grained felsics, SCsi -Siliceous including iron formation, SCgy -Graywacke, SCmg -Highly magnetic pebbles but not as a separate sub-category, SCsd -Sulfide or sulfide-bearing, SCms -Meta-sedimentary pebbles but not graywacke, SCmc -Miscellaneous, including graphite).

Mineral counts of the 1/4 split nonmagnetic heavy mineral concentrate (nmHMC) in 57 selected drift and saprolite samples were made with a binocular stereoscope and a good light source. The nmHMC product provided a starting material which was then separated into nonmagnetic and paramagnetic fractions using a custom modified Frantz magnetic separator at the U.S. Geological Survey - Geochemical Branch, in Denver, Colorado. This step helped isolate accessory nonmagnetic minerals from the more abundant paramagnetic rock fragments (Fig. 10).

Mineral grain size, morphology, and color were noted during counting. Mineral types and methods used for estimating counts are: particulate gold (dry-panned), scheelite (under UV-light), pyrite-marcasite-zircon-sphene-rutile-kyanite-native copper-and rock fragments (by grid estimate), and corundum-chalcopyrite-arsenopyrite-molybdenite-pyrite+quartz-epidote-gahnite-galena-and pyrrhotite (by trace grain identification). Mineral grains of unknown identity were isolated and sent for SEM-EDS analysis at Hanna Research Laboratories). Additionally, estimates of siderite percent and number of limonite pisoliths were made on the paramagnetic fraction, for stratigraphic correlation purposes (see Appendix 280-F).

Clay mineralogy determinations were made on fourteen glacial drift and saprolite samples using X-ray Diffraction techniques (oriented slides) via a contract laboratory (Hanna Research Laboratories).

Electromagnetic Measurements

Magnetic Susceptibility was measured on all rotasonic core before splitting, using a handheld magnetic susceptibility meter on unsplit core. Measurements were taken every two feet along the length of each core. Later pebble counts provided a count of magnetic supra-crustal pebbles in each sample having sufficient magnetic character to be attracted to a hand magnet.

Chemical Measurements

Chemical assays were made on the nonmagnetic heavy mineral concentrates (nmHMC), silt-clay (-63um) for Au and Ag, clay (-2um), and magnetic heavy mineral concentrates (magHMC) of glacial drift and selected saprolite samples. Whole rock and/or trace element measurements were made on selected bedrock and saprolite samples. In addition, matrix weak-acid solubility and percent calcium, magnesium, and iron in the soluble portion were measured. The matrix solubility measurements were made on the silt-clay fraction of dry-sieved samples using 4N HNO3.

Detection limits, sample digestion procedures, and analytical methods for nonmagnetic heavy mineral concentrates (nmHMC), clay (-2um), and magnetic heavy mineral concentrates (magHMC) are listed in tables C-1, C2, and C3.

Table C-1. Analytical methods and detection limits for the nmHMC fraction of Baudette area samples.

No.	Item	Element	Sample wt (g)	Detection limit	Digestion method	Measurement method
1	Ag	Silver	0.5	0.1 ppm	HCl-HNO3 (3:1)	AA
2	Al	Aluminum	0.1	200 ppm	HCl-HNO3 (3:1)	ICP
3	As	Arsenic	n/a	1 ppm	none	INAA
4	Au	Gold	n/a	0.001 ppm	none	INAA
5	Ba	Barium	n/a	100 ppm	none	INAA
6	Be	Beryllium	0.1	0.5 ppm	HCl-HNO3 (3:1)	ICP
7	Bi	Bismuth	0.1	2 ppm	HCl-HNO3 (3:1)	ICP
8	Br	Bromine	n/a	1 ppm	none	INAA
9	Ca	Calcium	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
10	Cd	Cadmium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
11	Ce	Cerium	n/a	10 ppm	none	INAA
12	Co	Cobalt	n/a	10 ppm	none	INAA
13	Cr	Chromium	n/a	50 ppm	none	INAA
14	Cs	Cesium	n/a	1 ppm	none	INAA
15	Cu	Copper	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
16	Eu	Europium	n/a	2 ppm	none	INAA
17	Fe	Iron	n/a	500 ppm	none	INAA
18	Ga	Gallium	0.1	2 ppm	HCl-HNO3 (3:1)	ICP
19	Hf	Hafnium	n/a	2 ppm	none	INAA
20	Hg	Mercury	0.5	0.005 ppm	HNO3-HCl-SNCl2	CV-AA
21	Ir	Iridium	n/a	0.1 ppm	none	INAA
22	K	Potassium	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
23	La	Lanthanum	n/a	5 ppm	none	INAA
24	Li	Lithium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
25	Lu	Lutetium	n/a	0.5 ppm	none	INAA
26	Mg	Magnesium	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
27	Mn	Manganese	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
28	Mo	Molybdenum	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
29	Na	Sodium	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
30	Nb	Niobium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
31	Ni	Nickel	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
32	P	Phosphorous	0.1	20 ppm	HCl-HNO3 (3:1)	ICP
33	Pb	Lead	0.1	2 ppm	HCl-HNO3 (3:1)	ICP
34	Rb	Rubidium	0.1	20 ppm	HCl-HNO3 (3:1)	ICP
35	Sb	Antimony	n/a	0.2 ppm	none	INAA
36	Sc	Scandium	n/a	0.5 ppm	none	INAA
37	Se	Selenium	0.5	0.1 ppm	HCl-HNO3 (3:1)	HY-AA
38	Sm	Samarium	n/a	0.2 ppm	none	INAA
39	Sr	Strontium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
40	Ta	Tantalum	n/a	1 ppm	none	INAA
41	Tb	Terbium	n/a	1 ppm	none	INAA
42	Te	Tellurium	n/a	20 ppm	none	INAA
43	Th	Thallium	n/a	0.5 ppm	none	INAA
44	Ti	Titanium	0.1	10 ppm	HCl-HNO3 (3:1)	ICP
45	U	Uranium	n/a	0.5 ppm	none	INAA
46	V	Vanadium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
47	W	Tungsten	n/a	2 ppm	none	INAA
48	Y	Yittrium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
49	Yb	Ytterbium	n/a	5 ppm	none	INAA
50	Zn	Zinc	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
51	Zr	Zirconium	n/a	500 ppm	none	INAA

Table C-2. Analytical methods and detection limits for clay fraction of Baudette area samples.

No.	Item	Element	Sample wt (g)	Detection limit	Digestion method	Measurement method
1	Ag	Silver (-63um)	0.1	0.1 ppm	HCl-HNO3 (3:1)	ICP
2	Al	Aluminum	0.1	200 ppm	HCl-HNO3 (3:1)	ICP
3	As	Arsenic	0.5	0.5 ppm	HCl-HNO3 (3:1)	HY-AA
4	Au	Gold (-63um)	30	0.001 ppm	Aqua-Regia	FA-DC
5	B	Boron	1.0	10 ppm	NaOH Fusion	DCP
6	Ba	Barium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
7	Be	Beryllium	0.1	0.5 ppm	HCl-HNO3 (3:1)	ICP
8	Bi	Bismuth	0.1	2 ppm	HCl-HNO3 (3:1)	ICP
9	Ca	Calcium	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
10	Cd	Cadmium	0.5	0.2 ppm	HCl-HNO3 (3:1)	AA
11	Ce	Cerium	0.1	5 ppm	HCl-HNO3 (3:1)	ICP
12	Co	Cobalt	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
13	Cr	Chromium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
14	Cu	Copper	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
15	Fe	Iron	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
16	Ga	Gallium	0.1	2 ppm	HCl-HNO3 (3:1)	ICP
17	K	Potassium	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
18	La	Lanthanum	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
19	Li	Lithium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
20	Mg	Magnesium	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
21	Mn	Manganese	0.5	1 ppm	HCl-HNO3 (3:1)	AA
22	Mo	Molybdenum	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
23	Na	Sodium	0.1	500 ppm	HCl-HNO3 (3:1)	ICP
24	Nb	Niobium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
25	Ni	Nickel	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
26	P	Phosphorous	0.1	50 ppm	HCl-HNO3 (3:1)	ICP
27	Pb	Lead	0.1	2 ppm	HCl-HNO3 (3:1)	ICP
28	Rb	Rubidium	0.1	20 ppm	HCl-HNO3 (3:1)	ICP
29	Sb	Antimony	0.5	0.2 ppm	HCl-HNO3 (3:1)	HY-AA
30	Sc	Scandium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
31	Se	Selenium	n/a	1 ppm	none	XRF
32	Sn	Tin	0.1	20 ppm	HCl-HNO3 (3:1)	ICP
33	Sr	Strontium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
34	Ta	Tantalum	0.1	10 ppm	HCl-HNO3 (3:1)	ICP
35	Te	Tellurium	0.1	10 ppm	HCl-HNO3 (3:1)	ICP
36	Ti	Titanium	0.1	10 ppm	HCl-HNO3 (3:1)	ICP
37	V	Vanadium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
38	W	Tungsten	0.1	10 ppm	HCl-HNO3 (3:1)	ICP
39	Y	Yittrium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
40	Zn	Zinc	0.1	1 ppm	HCl-HNO3 (3:1)	ICP
41	Zr	Zirconium	0.1	1 ppm	HCl-HNO3 (3:1)	ICP

Table C-3. Analytical methods and detection limits for the magHMC fraction of Baudette area samples.

No.	Item	Element	Sample wt. (g)	Detection limit	Digestion method	Measurement method
1	Fe2O3	Iron	0.5	200 ppm	HCl-HNO3-HF	AA
2	MgO	Magnesium	0.5	2 ppm	HCl-HNO3-HF	AA
3	TiO2	Titanium	0.5	20 ppm	HCl-HNO3-HF	AA
4	Ag	Silver	0.5	1 ppm	HCl-HNO3-HF	AA
5	Co	Cobalt	0.5	2 ppm	HCl-HNO3-HF	AA
6	Cr	Cromium	0.5	0.5 ppm	HCl-HNO3-HF	AA
7	Cu	Copper	0.5	1 ppm	HCl-HNO3-HF	AA
8	Mn	Manganese	0.5	0.5 ppm	HCl-HNO3-HF	AA
9	Ni	Nickel	0.5	1 ppm	HCl-HNO3-HF	AA
10	Pb	Lead	0.5	2 ppm	HCl-HNO3-HF	AA
11	V	Vanadium	0.5	10 ppm	HCl-HNO3-HF	AA
12	Zn	Zinc	0.5	0.2 ppm	HCl-HNO3-HF	AA

Note: Detection limits calculated based on instrumental sensitivity, initial sample weight, and dilution. Dilution for metals and TiO2 is 100x. Dilution for MgO is 2,000x. Dilution for Fe2O3 is 10,000x.

Samples were digested using the microwave digestion method of Mathes and others (1983).

Appendix 280-D. Precision and accuracy of assay methods.

Precision and accuracy control for Baudette area samples is made using soil, bedrock, and metal ore standards, and within-project and between-project duplicate samples. Quartz blanks are also used to check for cross contamination of samples during preparation.

Precision

Percent Precision and 2 standard deviation (2 sd) confidence intervals have been calculated for the for the nmHMC assay results (Table D-1) and the -2um (clay) assay results (Table D-2) using the methods outlined by Shiffelbein (1987) and Wise (1987). Elements exhibiting an assay distribution more lognormal than arithmetic have been transformed to log10 values as suggested by Garrett (1969) before proceeding with the precision calculation. Assay results for control samples were also plotted graphically for visual evaluation of precision. Fig. D-1 is an example of such a plot.

The Percent Precision (% P) for each element is calculated by determining the variance of each control group and then using the average of those variances in the precision calculation. The equation as structured gives heavier weighting to variances of the paired sample duplicates in calculating precision.

$$\%Precision = 100 \times t\frac{\sqrt{\frac{\sum_{i=1}^{N}\frac{\sum_{i=1}^{n}(\overline{X}_o - X_{r_i})^2}{n}}{N}}}{\overline{X}_{N\times n}} \qquad \text{Equation 1}$$

n = no. of samples in group
N = no. of groups
$\overline{X}_o$ = mean assay value for the samples in group N
X_{r_i} = assay value for i^{th} replicate in group
$\overline{X}_{N\times n}$ = mean value of all assayed samples in N groups
t = the t-Distribution for N degrees of freedom

N is the number of control sample groups and n is the number of samples analyzed in each control group. For the clay fraction samples N=8, n=7 for SO-1, n=4 for GTS-1, and n=2 for each duplicate pair. For the nmHMC samples N=3, n=6 for PTC-1, n=4 for FER-4, and n=2 for each duplicate pair.

A 2 standard deviation (2 sd) confidence interval (equation 2) is used for stratigraphic interpretations and is calculated as two times the square root of the arithmetic variance derived in equation 1.

$$2\ SD = 2 \times \sqrt{variance} \qquad \text{Equation 2}$$

Accuracy

Accuracy can be approximately determined when certified, recommended, or accepted values of control standard assays are available. Accuracy, where reported for Baudette Area assays, is calculated as a percent variation from certified, recommended, or accepted values, using the coefficient-of-variation calculation of Size (1987). Tables D-1 and D-2 list accuracies for elements where certified, recommended, or accepted standard values are available.

$$\% \ variation = 100 \times \frac{(X_o - \overline{X}_n)^2}{X_o}$$

Equation 3

n = *no. of assayed samples in group*
X_o = *recommended value*
$\overline{X}_n$ = *mean of n assayed values*

Control Samples

Precision and accuracy control for Baudette Area assay samples used the following scheme:

-2um (clay) Assay Control Samples:

<u>SO-1</u> -(CANMET SOIL-1) one control sample per twenty assay samples to measure analytical precision, 7 samples total. These control samples are exposed to digestion and analysis error. The SO-1 samples are suitable for both precision and accuracy calculations.

<u>GTS-1</u> -(CANMET GOLD TAILINGS SAMPLE) four samples of a gold tailings standard interspesed in the total sample population as a double check on analytical precision. The GTS-1 assay results reflect digestion and analysis error. The GTS-1 samples are suitable for both precision and accuracy calculations.

<u>Qtz-1</u> -three sea-sand quartz blanks interspersed in the total population to test cross contamination during preparation. These samples will reflect preparation, digestion, and analysis error, but as blanks they are not suitable for precision and accuracy determinations. Results for the quartz blanks suggest that cross contamination during preparation is not significant factor in these samples.

<u>Sample Duplicates</u> -(within project duplicates) six duplicates (12 samples) were split after preparation. These samples have been exposed to digestion, and analysis errors, but since they were split after preparation, they do not reflect preparation errors. Each sample in the duplicate pair was analyzed adjacent to its partner in the analytical sequence. The clay fraction sample duplicates are suitable for precision calculations.

<u>Inter-Laboratory Duplicates</u> - (between project duplicates) two samples that were earlier analyzed during a previous glacial drift geochemistry project were used to check for variability between data compiled in earlier projects and data compiled in the present project. The samples are not suitable for precision or accuracy calculations, but can be used to compare datasets from different projects.

nmHMC Assay Control Samples:

PTC-1 -(CANMET NOBLE METALS-BEARING SULPHIDE CONCENTRATE) six samples of a platinum-group-element ore standard. The assay results for PTC-1 reflect reference standard variability, digestion, and analysis error. The results are suitable for both precision and accuracy calculations.

FER-4 -(CANMET IRON FORMATION) four samples, each spiked with a gold grain of known size. The FER-4 results are suitable for precision calculations.

Sample Duplicates -six pairs of till samples, each pair sampled along the identical core interval. These samples contain intra-sample preparation, digestion, and analysis errors, and are suitable for precision calculations. The duplicate paired samples were run in separate analytical batches so that between batch error could also be included in the precision determinations.

Table D-1. Precision and accuracy for assays of nmHMC in Baudette area samples.

Item	Element	% P (log)	% P (arith)	2 sd (arith)	FER-4 (mean)	FER-4 cert.	% vari. FER-4	PTC-1 (mean)	PTC-1 cert.	% vari. PTC-1
Ag	Silver	80	185	14	2.3	-	-	17	-	-
Al	Aluminum	17	11	0.1	0.5	0.9	39	0.3	-	-
As	Arsenic	14	55	16	4.8	3.6	32	11	-	-
Au	Gold	28	159	314	6.5	-	-	512	650	99
Ba	Barium	12	68	104	103	43	138	262	-	-
Bi	Bismuth	5	22	9.0	16	-	-	121	-	-
Br	Bromine	63	61	1.8	1.0	-	-	4.8	-	-
Ca	Calcium	164	18	0.2	1.4	1.6	12	0.2	-	-
Cd	Cadmium	140	57	1.0	1.8	-	-	2.5	-	-
Ce	Cerium	6	49	120	10	-	-	33	-	-
Co	Cobalt	3	6	44	10	2.0	400	2730	-	-
Cr	Chromium	4	20	147	50	9.0	456	1930	-	-
Cs	Cesium	255	71	1.0	1.0	0.8	25	2.2	-	-
Cu	Copper	11	2	97	15	13	17	>20,000	52000	-
Eu	Europium	35	37	0.9	2.0	-	-	2	-	-
Fe	Iron	3	9	2.5	27	22	24	23	27	1
Ga	Gallium	44	190	47	2.0	-	-	85	-	-
Hf	Hafnium	24	117	53	2.0	-	-	3.2	-	-
Hg	Mercury	11	38	19	24	-	-	13	-	-
La	Lanthanum	10	44	47	8.0	8.0	0	5.0	-	-
Li	Lithium	18	22	0.9	5.8	7.0	18	4.0	-	-
Lu	Lutetium	132	33	.05	0.5	-	-	0.5	-	-
Mg	Magnesium	102	11	0.1	0.8	0.8	11	2.3	-	-
Mn	Manganese	10	23	0.1	0.1	0.1	15	0.1	-	-
Mo	Molybdenum	20	33	5.0	15.3	-	-	8.3	-	-
Na	Sodium	0	0	0.0	0.0	-	-	0.0	-	-
Nb	Niobium	9	23	3.3	10	-	-	17	-	-
Ni	Nickel	5	1	4.6	4.8	6.0	21	>20,000	94,000	-
P	Phosphorous	8	18	0.0	0.1	0.1	55	0.1	-	-
Pb	Lead	10	30	14	13	8.0	66	76	-	-
Rb	Rubidium	30	118	18	16	-	-	13	-	-
Sb	Antimony	115	34	0.4	1.6	3.0	46	0.2	-	-
Sc	Scandium	10	14	4.3	1.1	1.5	27	4.2	-	-
Se	Selenium	1100	11	0.6	0.1	-	-	18	-	-
Sm	Samarium	15	38	6.5	2.3	2.2	2	0.6	-	-
Sr	Strontium	6	21	8.2	61	62	2	5.7	-	-
Ta	Tantalum	34	41	1.7	1.0	-	-	1.0	-	-
Tb	Terbium	43	51	1.3	1.0	-	-	1.0	-	-
Te	Tellurium	14	52	15	20	-	-	47	-	-
Th	Thorium	16	45	29	0.8	-	-	1.5	-	-
Ti	Titanium	16	22	0.1	0.1	0.0	19	0.1	-	-
U	Uranium	24	53	4.1	0.6	-	-	3.8	-	-
V	Vanadium	11	20	16	6.3	11	43	11	-	-
W	Tungsten	51	187	14	2.3	-	-	8.7	-	-
Y	Yttrium	6	19	5.2	5.5	8.0	31	2.0	-	-
Yb	Ytterbium	20	34	2.8	5.0	0.5	900	5.0	-	-
Zn	Zinc	42	45	30	35	27	28	28	-	-
Zr	Zirconium	9	76	2170	528	18	2830	1270	-	-

Notes: % P =percent precision

2 sd =2x arithmetic standard deviation

mean =average value for control group

cert. =certified assay value of control standard

log =lognormal precision value

arith =arithmetic precision value

PTC-1 =Platinum group standard

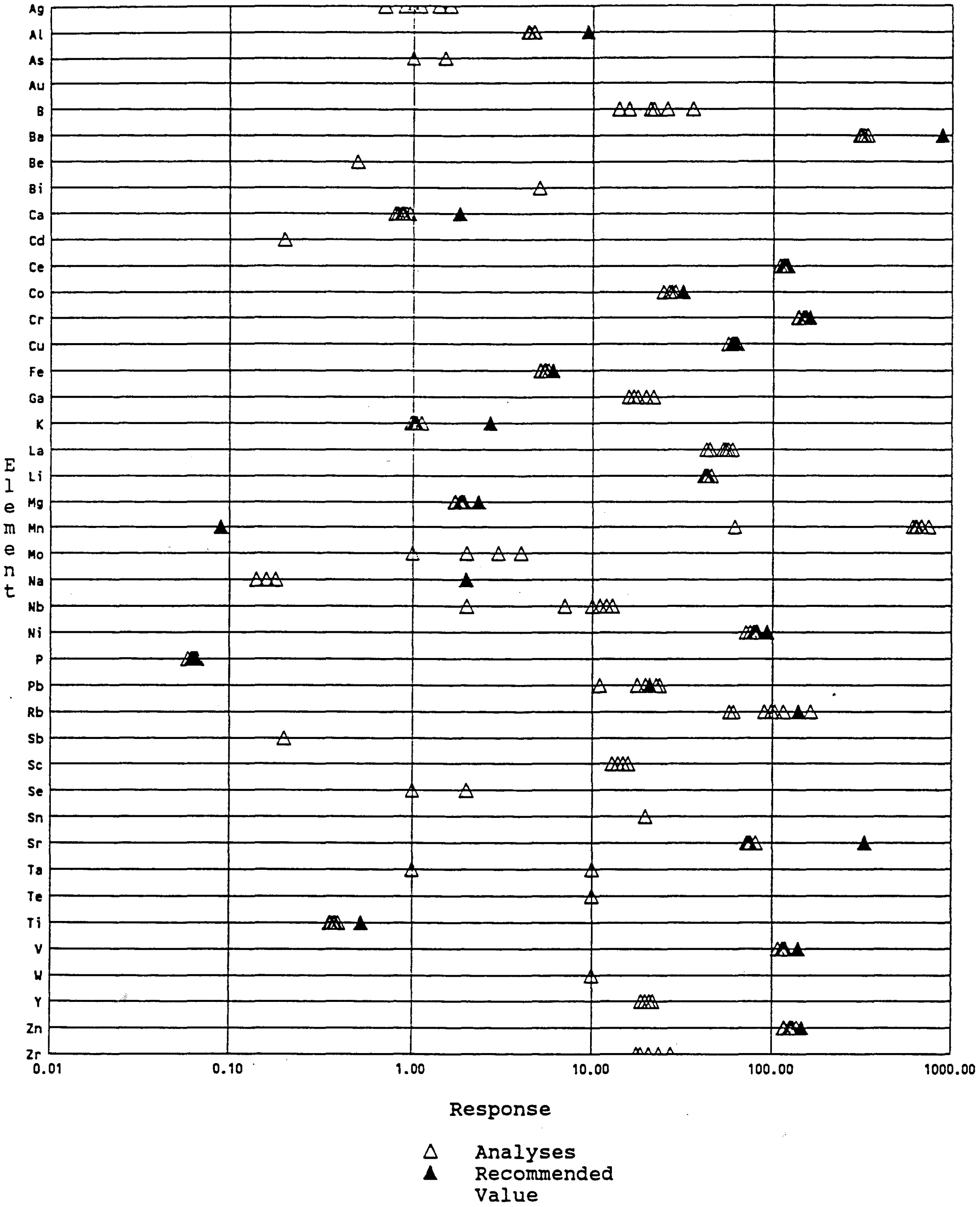
FER-4 =Sulfide ore standard

Table D-2. Precision and accuracy for assays of clay fraction in Baudette area samples.

Item	Element	% P (log)	% P (arith)	2 sd (arith)	GTS-1 (mean)	GTS-1 cert.	% vari. GTS-1	SO-1 (mean)	SO-1 cert.	% vari. SO-1
Ag	Silver	41	50	0.3	0.2	-	-	1.1	-	-
Al	Aluminum	8	8	0.2	1.5	6.4	77	4.4	9.4	53
As	Arsenic	45	20	1.9	47	-	-	1.1	-	-
Au	Gold	98	18	13	279	346	19	-	-	-
B	Boron	7	17	10	154	-	-	21	-	-
Ba	Barium	1	6	12	239	-	-	314	879	64
Be	Beryllium	0	0	0.0	0.5	-	-	0.5	-	-
Bi	Bismuth	0	0	0.0	5.0	-	-	5.0	-	-
Ca	Calcium	10	8	0.2	3.5	3.9	11	0.9	1.8	51
Cd	Cadmium	0	0	0.0	0.2	-	-	0.2	-	-
Ce	Cerium	2	7	5.7	48	-	-	117	-	-
Co	Cobalt	2	7	1.7	28	-	-	27	32	16
Cr	Chromium	1	7	8.1	130	-	-	147	160	8
Cu	Copper	2	7	4.4	97	-	-	61	61	1
Fe	Iron	4	7	0.3	5.5	6.0	8	5.3	6.0	11
Ga	Gallium	5	17	1.6	2.0	-	-	18	-	-
K	Potassium	16	8	0.0	0.2	3.1	92	1.0	2.7	61
La	Lanthanum	7	18	7.8	28	-	-	53	-	-
Li	Lithium	2	6	1.8	20	-	-	44	-	-
Mg	Magnesium	3	6	0.1	2.1	-	-	1.8	2.3	20
Mn	Manganese	10	29	209	1280	-	-	579	0.1	35
Mo	Molybdenum	31	27	2.0	33	-	-	2.7	-	-
Na	Sodium	12	16	0.1	0.0	1.4	96	0.2	2.0	91
Nb	Niobium	37	54	4.4	11	-	-	8.1	-	-
Ni	Nickel	2	9	6.4	87	-	-	79	94	16
P	Phosphorous	14	31	0.1	0.1	-	-	0.1	0.1	1
Pb	Lead	8	22	4.1	35	-	-	20	21	5
Rb	Rubidium	16	54	41	50	-	-	99	139	29
Sb	Antimony	23	56	0.2	1	-	-	0.2	-	-
Sc	Scandium	6	13	1.4	8.7	-	-	14	-	-
Se	Selenium	274	76	1.1	1.2	-	-	1.1	-	-
Sn	Tin	0	0	0.0	20	-	-	20	-	-
Sr	Strontium	2	11	13	400	-	-	76	328	77
Ta	Tantalum	320	224	7.5	7.7	-	-	2.3	-	-
Te	Tellurium	7	20	2.1	13.5	-	-	10	-	-
Ti	Titanium	2	6	0.0	0.0	-	-	0.4	0.5	30
V	Vanadium	2	6	5.4	66	-	-	115	139	18
W	Tungsten	0	0	0.0	10	-	-	10	-	-
Y	Yttrium	3	8	1.3	9.2	-	-	20	-	-
Zn	Zinc	2	7	8.1	150	-	-	127	146	13
Zr	Zirconium	22	41	5.3	22	-	-	21	-	-

Notes:
% P =percent precision
2 sd =2x arithmetic standard deviation
mean =average value for control group
cert. =certified assay value of control standard
log =lognormal precision value
arith =arithmetic precision value
GTS-1 =Gold ore standard
SO-1 =Soil standard

Fig. D-1. Assay results for seven samples of reference standard CANMET SO-1



Appendix 280-E. Variation maps of Baudette area results.

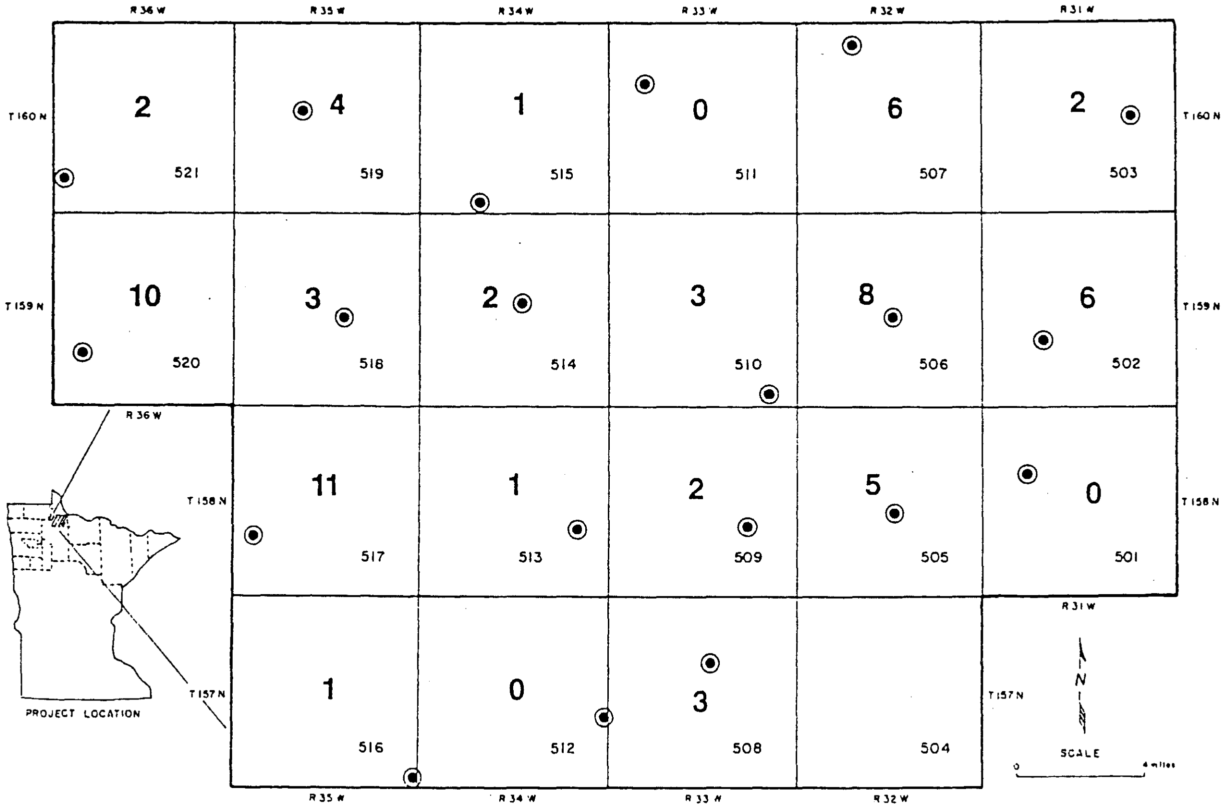
Abbreviations, data key, and other notation

Symbols

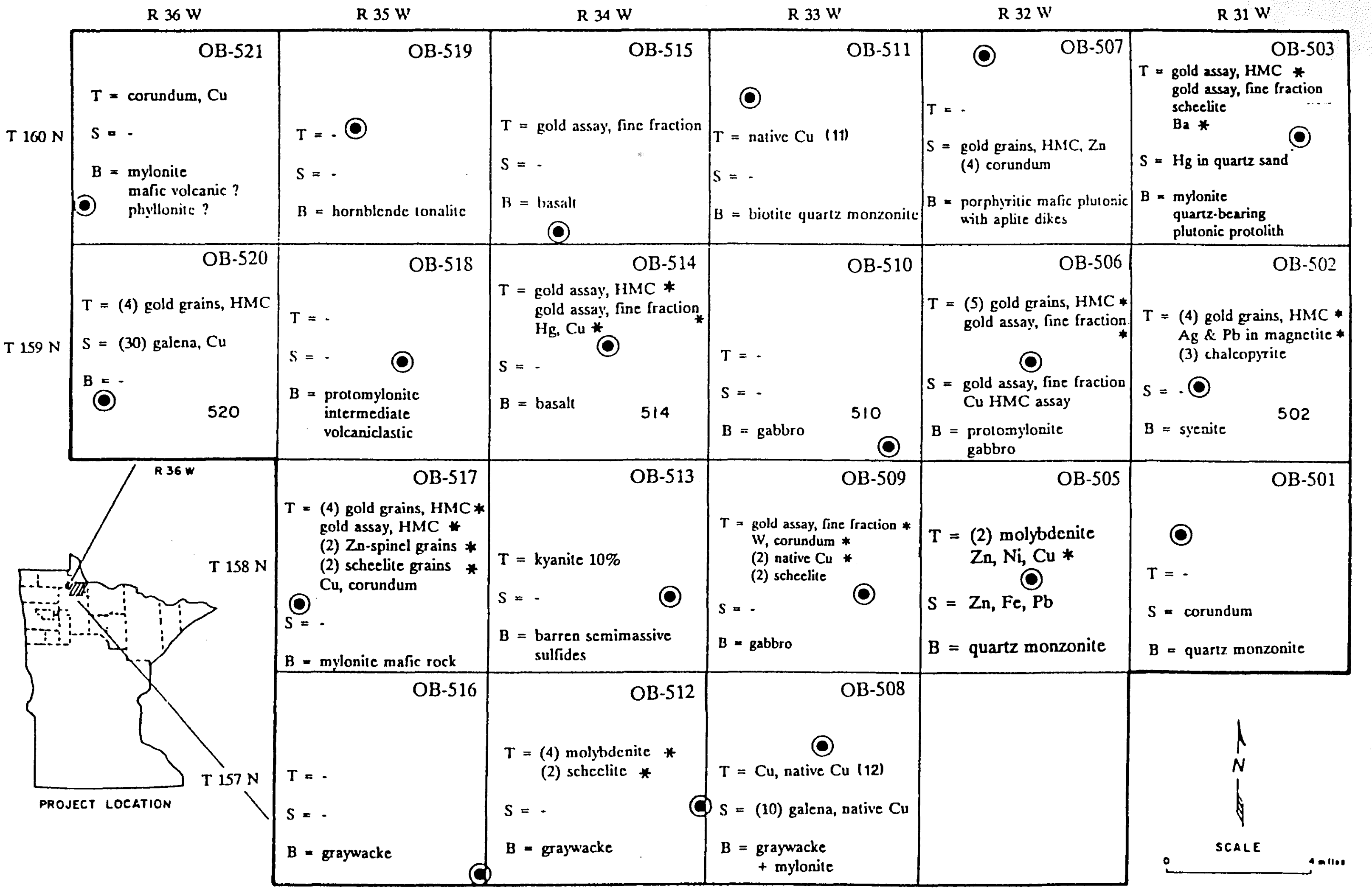
T	=summary of till data in borehole
S	=summary of saprolite data in borehole
B	=bedrock lithology

Notes: data selection criteria are 4 or more gold grains, 10 ppb or more gold in the silt-clay fraction, and 3x median or more of pathfinder element or heavy mineral.

Appendix 280-E. Map 1. Summed gold grain counts for Baudette area drill core, plotted by location.



Appendix 280-E. Map 2. Elevated values of gold, pathfinder elements, heavy minerals in Baudette area glacial drift and saprolite, in contrast to underlying bedrock composition intersected during drilling.



	R 36 W	R 35 W	R 34 W	R 33 W	R 32 W	R 31 W
T 160 N	OB-521 T = corundum, Cu S = - B = mylonite mafic volcanic ? phyllonite ?	OB-519 T = - S = - B = hornblende tonalite	OB-515 T = gold assay, fine fraction S = - B = basalt	OB-511 T = native Cu (11) S = - B = biotite quartz monzonite	OB-507 T = - S = gold grains, HMC, Zn (4) corundum B = porphyritic mafic plutonic with aplite dikes	OB-503 T = gold assay, HMC * gold assay, fine fraction scheelite Ba * S = Hg in quartz sand B = mylonite quartz-bearing plutonic protolith
T 159 N	OB-520 T = (4) gold grains, HMC S = (30) galena, Cu B = - 520	OB-518 T = - S = - B = protomylonite intermediate volcaniclastic	OB-514 T = gold assay, HMC * gold assay, fine fraction * Hg, Cu * S = - B = basalt 514	OB-510 T = - S = - B = gabbro 510	OB-506 T = (5) gold grains, HMC * gold assay, fine fraction * S = gold assay, fine fraction Cu HMC assay B = protomylonite gabbro	OB-502 T = (4) gold grains, HMC * Ag & Pb in magnetite * (3) chalcopyrite S = - B = syenite 502
T 158 N		OB-517 T = (4) gold grains, HMC * gold assay, HMC * (2) Zn-spinel grains * (2) scheelite grains * Cu, corundum S = - B = mylonite mafic rock	OB-513 T = kyanite 10% S = - B = barren semimassive sulfides	OB-509 T = gold assay, fine fraction * W, corundum * (2) native Cu * (2) scheelite S = - B = gabbro	OB-505 T = (2) molybdenite Zn, Ni, Cu * S = Zn, Fe, Pb B = quartz monzonite	OB-501 T = - S = corundum B = quartz monzonite
T 157 N		OB-516 T = - S = - B = graywacke	OB-512 T = (4) molybdenite * (2) scheelite * S = - B = graywacke	OB-508 T = Cu, native Cu (12) S = (10) galena, native Cu B = graywacke + mylonite		

Appendix 280-F. Master index for Baudette area samples.

Column abbreviations and data key

Stratigraphic units

KT =Koochiching till
KG =Koochiching gravel
RT =Rainy till
RS =Rainy sand
RG =Rainy gravel
RL =Rainy lake sediment
WT =Winnipeg till
WS =Winnipeg sand
OT =Old Rainy till
OS =Old Rainy sand
OG =Old Rainy gravel
OL =Old Rainy lake sediment
ASAP =reworked saprolite
SAP =saprolite
SAPZ =saprolite (trace element analysis)
BEDZ =bedrock (trace element analysis)
BED =bedrock

Other abbreviations

na =not applicable
py =pyrite
ODM =Overburden Drilling Management Labs
kg =kilogram
Surf. =surface
elev. =elevation
(msl) =mean sea level
(ft.) =feet
Qtz or qtz =quartz
plut. =plutonic
Bio. =biotite
Plag. =plagioclase
Gran =Granite
Green =Greenstone
Gray =Graywacke
> 4 =greater than four limonite grains
1-4 =one to four limonite grains in sample

Notes:

Sample height data are sample height (in feet) above or below the basal Quaternary contact.

Appendix 280-F. Master index for Baudette area samples.

Sample	Unit	Gold grains /10kg	ODM Remarks	Siderite %	Limonite content	Sampled interval	Area	Surf. elev. (msl)	Bed. elev. (msl)	Quat. base (msl)	Sample height (ft.)	Sample depth (ft.)	Underlying bedrock	Estimated NE up ice bedrock
501-001	RT	0		50	0	131-135	East	1156	942	1021	2	133	Qtz Monzonite	Gran/Green
501-002	SAP	0				135-145	East	1156	942	1021	-5	140	Qtz Monzonite	Gran/Green
501-003	SAP	0				157-163	East	1156	942	1021	-25	160	Qtz Monzonite	Gran/Green
501-004	BEDZ	na				163-166	East	1156	942	1021	-30	165	Qtz Monzonite	Gran/Green
502-001	RT	4	0.1% py	1	0	123-133	East	1137	958	958	51	128	Syenite	Gran/Green
502-002	RT	2	0.5% py	1	0	133-143	East	1137	958	958	41	138	Syenite	Gran/Green
502-003	RT	0		1	0	143-153	East	1137	958	958	31	148	Syenite	Gran/Green
502-004	RS	0				153-163	East	1137	958	958	21	158	Syenite	Gran/Green
502-005	OL	0				167-177	East	1137	958	958	7	172	Syenite	Gran/Green
502-006	BED	na				179-187	East	1137	958	958	-4	183	Syenite	Gran/Green
503-001	RT	0		1	0	111-118	East	1116	857	963	39	115	Mylonite (qtz plut.)	Greenstone
503-002	RT	1		1	0	118-128	East	1116	857	963	30	123	Mylonite (qtz plut.)	Greenstone
503-003	RT	0		1	0	128-138	East	1116	857	963	20	133	Mylonite (qtz plut.)	Greenstone
503-004	RT	0		1	0	138-148	East	1116	857	963	10	143	Mylonite (qtz plut.)	Greenstone
503-005	RT	1		1	0	148-153	East	1116	857	963	3	151	Mylonite (qtz plut.)	Greenstone
503-006	ASAP	1				164-174	East	1116	857	963	-16	169	Mylonite (qtz plut.)	Greenstone
503-007	SAP	0				211-221	East	1116	857	963	-63	216	Mylonite (qtz plut.)	Greenstone
503-008	BEDZ	na				240-247	East	1116	857	963	-91	244	Mylonite (qtz plut.)	Greenstone
503-009	BED	na				247-255	East	1116	857	963	-98	251	Mylonite (qtz plut.)	Greenstone
505-001	RT	1		75	0	140-149	East	1167	906	933	90	145	Bio. qtz monzonite	Greenstone
505-002	OT	3	0.1% py	75	0	224-228	East	1167	906	933	8	226	Bio. qtz monzonite	Greenstone
505-003	OT	1	1 Cu grain	75	0	228-234	East	1167	906	933	3	231	Bio. qtz monzonite	Greenstone
505-004	SAP	0				234-243	East	1167	906	933	-5	239	Bio. qtz monzonite	Greenstone
505-005	BEDZ	na				261-267	East	1167	906	933	-30	264	Bio. qtz monzonite	Greenstone
506-001	RT	5	1.5% py	70	0	166-171	East	1174	943	998	8	169	Mylonite (gabbroic)	Greenstone
506-002	RT	3	1.0% py	70	0	171-176	East	1174	943	998	3	174	Mylonite (gabbroic)	Greenstone
506-003	SAP	0				183-192	East	1174	943	998	-12	188	Mylonite (gabbroic)	Greenstone
506-004	SAP	0				192-199	East	1174	943	998	-19	195	Mylonite (gabrroic)	Greenstone
506-005	BED	na				236-244	East	1174	943	998	-64	240	Mylonite (gabbroic)	Greenstone
507-001	RT	0		1	0	148-155	East	1157	910	918	88	152	Mafic Plutonic	Gran/Green
507-002	RT	0		70	0	155-162	East	1157	910	918	81	159	Mafic Plutonic	Gran/Green
507-003	RL	4	0.1% py			162-168	East	1157	910	918	74	165	Mafic Plutonic	Gran/Green
507-004	OT	1	1 Cu grain	90	0	170-178	East	1157	910	918	65	174	Mafic Plutonic	Gran/Green
507-005	OT	1		90	0	183-189	East	1157	910	918	53	186	Mafic Plutonic	Gran/Green
507-006	OT	1		90	0	197-202	East	1157	910	918	40	200	Mafic Plutonic	Gran/Green
507-007	OS	0				202-207	East	1157	910	918	35	205	Mafic Plutonic	Gran/Green
507-008	OT	1		90	0	207-215	East	1157	910	918	28	211	Mafic Plutonic	Gran/Green
507-009	OS	0				217-227	East	1157	910	918	17	222	Mafic Plutonic	Gran/Green
507-010	OT	1		90	0	227-234	East	1157	910	918	9	231	Mafic Plutonic	Gran/Green
507-011	OL	0				234-239	East	1157	910	918	3	237	Mafic Plutonic	Gran/Green
507-012	SAP	1				239-242	East	1157	910	918	-2	241	Mafic Plutonic	Gran/Green
507-013	BEDZ	na				242-247	East	1157	910	918	-6	245	Mafic Plutonic	Gran/Green
508-001	RT	0		50	0	119-124	East	1191	911	1039	31	122	Graywacke	Greenstone
508-002	RT	1	2 Cu grains	50	0	140-146	East	1191	911	1039	9	143	Graywacke	Greenstone
508-003	RT	2	10 Cu grains	50	0	146-152	East	1191	911	1039	3	149	Graywacke	Greenstone
508-004	SAP	0				153-160	East	1191	911	1039	-5	157	Graywacke	Greenstone
508-005	SAPZ	na				160-168	East	1191	911	1039	-12	164	Graywacke	Greenstone
508-006	SAPZ	na				214-223	East	1191	911	1039	-67	219	Graywacke	Greenstone
508-007	SAP	0				223-232	East	1191	911	1039	-76	228	Graywacke	Greenstone
508-008	SAPZ	na				266-276	East	1191	911	1039	-119	271	Graywacke	Greenstone
508-009	BED	na				280-285	East	1191	911	1039	-131	283	Graywacke	Greenstone
509-001	RT	2	2 Cu grains	40	0	083-092	East	1175	1083	1083	5	88	Gabbro	Greenstone
509-002	BED	na				092-100	East	1175	1083	1083	-4	96	Gabbro	Greenstone
510-001	RT	2	1 Cu grain	40	0	097-102	East	1226	1119	1119	8	100	Plag. cumulate	Gran/Green
510-002	RT	1	1 Cu grain	40	0	102-107	East	1226	1119	1119	3	105	Plag. cumulate	Gran/Green

Appendix 280-F. Master index for Baudette area samples.

Sample	Unit	Gold grains /10kg	ODM Remarks	Siderite %	Limonite content	Sampled interval	Area	Surf. elev. (msl)	Bed. elev. (msl)	Quat. base (msl)	Sample height (ft.)	Sample depth (ft.)	Underlying bedrock	Estimated NE up ice bedrock
510-003	BED	na				107-112	East	1226	1119	1119	-3	110	Plag. cumulate	Gran/Green
511-001	RT	0	7 Cu grains	40	0	109-116	West	1196	1026	1053	31	113	Bio. qtz monzonite	Granite
511-002	RT	0	3 Cu grains	40	0	116-123	West	1196	1026	1053	24	120	Bio. qtz monzonite	Granite
511-003	RT	0	1 Cu grain	40	0	127-133	West	1196	1026	1053	13	130	Bio. qtz monzonite	Granite
511-004	WT	0		50	0	133-138	West	1196	1026	1053	8	136	Bio. qtz monzonite	Granite
511-005	WT	0		50	1-4	138-143	West	1196	1026	1053	3	141	Bio. qtz monzonite	Granite
511-006	SAPZ	na				143-147	West	1196	1026	1053	-2	145	Bio. qtz monzonite	Granite
512-001	WT	0		80	> 4	087-095	West	1185	1078	1080	14	91	Graywacke	Gray/Green
512-002	WT	0		80	> 4	095-100	West	1185	1078	1080	8	98	Graywacke	Gray/Green
512-003	WT	0		80	> 4	100-105	West	1185	1078	1080	3	103	Graywacke	Gray/Green
512-004	BED	na				107-117	West	1185	1078	1080	-7	112	Graywacke	Gray/Green
513-001	RT	1		1	0	071-075	West	1200	1093	1107	20	73	Po massive sulfide	Greenstone
513-002	WT	0		60	> 4	075-083	West	1200	1093	1107	14	79	Po massive sulfide	Greenstone
513-003	WT	0		60	> 4	083-088	West	1200	1093	1107	8	86	Po massive sulfide	Greenstone
513-004	WT	0		60	> 4	088-093	West	1200	1093	1107	3	91	Po massive sulfide	Greenstone
513-005	SAP	0				095-101	West	1200	1093	1107	-5	98	Po massive sulfide	Greenstone
513-006	BED	na				106-115	West	1200	1093	1107	-18	111	Po massive sulfide	Greenstone
514-001	RT	0		40	0	165-173	West	1305	1048	1089	47	169	Basalt	Granite
514-002	RT	1		40	0	173-178	West	1305	1048	1089	41	176	Basalt	Granite
514-003	RT	0		40	0	178-183	West	1305	1048	1089	36	181	Basalt	Granite
514-004	RG	0				188-198	West	1305	1048	1089	23	193	Basalt	Granite
514-005	OS	1				198-207	West	1305	1048	1089	14	203	Basalt	Granite
514-006	SAP	0				217-227	West	1305	1048	1089	-6	222	Basalt	Granite
514-007	BED	na				257-262	West	1305	1048	1089	-44	260	Basalt	Granite
515-001	RT	0		90	0	143-153	West	1251	1039	1039	64	148	Basalt	Granite
515-002	RT	0		80	0	153-163	West	1251	1039	1039	54	158	Basalt	Granite
515-003	RT	0		80	> 4	168-176	West	1251	1039	1039	40	172	Basalt	Granite
515-004	OT	0		50	1-4	176-182	West	1251	1039	1039	33	179	Basalt	Granite
515-005	OT	0		50	1-4	182-192	West	1251	1039	1039	25	187	Basalt	Granite
515-006	OT	0		50	1-4	192-202	West	1251	1039	1039	15	197	Basalt	Granite
515-007	OT	1		50	1-4	202-207	West	1251	1039	1039	8	205	Basalt	Granite
515-008	OT	0		50	1-4	207-212	West	1251	1039	1039	3	210	Basalt	Granite
515-009	BED	na				212-223	West	1251	1039	1039	-6	218	Basalt	Granite
516-001	KT	0		25	0	037-042	West	1211	1157	1157	15	40	Graywacke	Graywacke
516-002	KT	0		25	0	042-047	West	1211	1157	1157	10	45	Graywacke	Graywacke
516-003	KG	1				047-054	West	1211	1157	1157	4	51	Graywacke	Graywacke
516-004	BED	na				056-061	West	1211	1157	1157	-5	59	Graywacke	Graywacke
517-001	RT	0		40	0	038-045	West	1255	1035	1035	179	42	Mylonite (mafic)	Greenstone
517-002	RT	1		40	0	045-055	West	1255	1035	1035	170	50	Mylonite (mafic)	Greenstone
517-003	WT	0		10	> 4	055-064	West	1255	1035	1035	161	60	Mylonite (mafic)	Greenstone
517-004	WT	1		1	1-4	064-074	West	1255	1035	1035	151	69	Mylonite (mafic)	Greenstone
517-005	WT	0		1	> 4	074-082	West	1255	1035	1035	142	78	Mylonite (mafic)	Greenstone
517-006	WT	0		25	> 4	082-092	West	1255	1035	1035	133	87	Mylonite (mafic)	Greenstone
517-007	WT	1		25	> 4	092-098	West	1255	1035	1035	125	95	Mylonite (mafic)	Greenstone
517-008	WT	1		50	1-4	103-112	West	1255	1035	1035	113	108	Mylonite (mafic)	Greenstone
517-009	WT	0		50	1-4	113-123	West	1255	1035	1035	102	118	Mylonite (mafic)	Greenstone
517-010	WT	0		50	1-4	123-129	West	1255	1035	1035	94	126	Mylonite (mafic)	Greenstone
517-011	OT	0		50	1-4	136-146	West	1255	1035	1035	79	141	Mylonite (mafic)	Greenstone
517-012	OT	0		50	1-4	146-153	West	1255	1035	1035	71	150	Mylonite (mafic)	Greenstone
517-013	OT	3	0.8% FeS2	50	1-4	153-163	West	1255	1035	1035	62	158	Mylonite (mafic)	Greenstone
517-014	OT	0		50	1-4	163-173	West	1255	1035	1035	52	168	Mylonite (mafic)	Greenstone
517-015	OT	0		50	1-4	173-183	West	1255	1035	1035	42	178	Mylonite (mafic)	Greenstone
517-016	OT	0		50	1-4	183-193	West	1255	1035	1035	32	188	Mylonite (mafic)	Greenstone
517-017	OT	0		50	1-4	193-203	West	1255	1035	1035	22	198	Mylonite (mafic)	Greenstone
517-018	OT	4	1.0% FeS2	50	1-4	203-220	West	1255	1035	1035	9	212	Mylonite (mafic)	Greenstone

Appendix 280-F. Master index for Baudette area samples.

Sample	Unit	Gold grains /10kg	ODM Remarks	Siderite %	Limonite content	Sampled interval	Area	Surf. elev. (msl)	Bed. elev. (msl)	Quat. base (msl)	Sample height (ft.)	Sample depth (ft.)	Underlying bedrock	Estimated NE up ice bedrock
517-019	BED	na				221-229	West	1255	1035	1035	-5	225	Mylonite (mafic)	Greenstone
518-001	RT	0		70	0	105-115	West	1280	1023	1030	140	110	Int. volcanic	Greenstone
518-002	RT	1		60	0	128-134	West	1280	1023	1030	119	131	Int. volcanic	Greenstone
518-003	WS	0				172-182	West	1280	1023	1030	73	177	Int. volcanic	Greenstone
518-004	WT	1		70	0	202-209	West	1280	1023	1030	45	206	Int. volcanic	Greenstone
518-005	WT	0		70	0	209-219	West	1280	1023	1030	36	214	Int. volcanic	Greenstone
518-006	WT	0		70	1-4	219-229	West	1280	1023	1030	26	224	Int. volcanic	Greenstone
518-007	WT	0		70	> 4	235-245	West	1280	1023	1030	10	240	Int. volcanic	Greenstone
518-008	WT	1		70	> 4	245-250	West	1280	1023	1030	3	248	Int. volcanic	Greenstone
518-009	BEDZ	na				263-273	West	1280	1023	1030	-18	268	Int. volcanic	Greenstone
519-001	RT	0		60	0	085-097	West	1233	1048	1071	71	91	Hb. tonalite	Green/Gran
519-002	RT	2	0.8% FeS2	60	0	097-105	West	1233	1048	1071	61	101	Hb. tonalite	Green/Gran
519-003	WT	1		60	1-4	105-115	West	1233	1048	1071	52	110	Hb. tonalite	Green/Gran
519-004	WT	1		70	> 4	140-145	West	1233	1048	1071	20	143	Hb. tonalite	Green/Gran
519-005	WT	0		70	0	152-157	West	1233	1048	1071	8	155	Hb. tonalite	Green/Gran
519-006	WT	0		70	0	157-162	West	1233	1048	1071	3	160	Hb. tonalite	Green/Gran
519-007	BED	na				190-194	West	1233	1048	1071	-30	192	Hb. tonalite	Green/Gran
520-001	RT	0		1	0	020-030	West	1249	920	950	274	25	Saprolite undiff.	Greenstone
520-002	RT	3		1	0	030-040	West	1249	920	950	264	35	Saprolite undiff.	Greenstone
520-003	RT	4		40	0	040-047	West	1249	920	950	256	44	Saprolite undiff.	Greenstone
520-004	WT	0		25	1-4	094-102	West	1249	920	950	201	98	Saprolite undiff.	Greenstone
520-005	OT	1		60	1-4	106-116	West	1249	920	950	188	111	Saprolite undiff.	Greenstone
520-006	OT	0		60	1-4	116-128	West	1249	920	950	177	122	Saprolite undiff.	Greenstone
520-007	OT	0		60	1-4	128-138	West	1249	920	950	166	133	Saprolite undiff.	Greenstone
520-008	OT	0		60	1-4	138-148	West	1249	920	950	156	143	Saprolite undiff.	Greenstone
520-009	OT	1		60	1-4	148-158	West	1249	920	950	146	153	Saprolite undiff.	Greenstone
520-010	OT	0		60	1-4	158-168	West	1249	920	950	136	163	Saprolite undiff.	Greenstone
520-011	OT	1		60	1-4	168-178	West	1249	920	950	126	173	Saprolite undiff.	Greenstone
520-012	OT	0		1	0	250-259	West	1249	920	950	45	255	Saprolite undiff.	Greenstone
520-013	OT	0		1	0	259-269	West	1249	920	950	35	264	Saprolite undiff.	Greenstone
520-014	OT	0		1	0	278-286	West	1249	920	950	17	282	Saprolite undiff.	Greenstone
520-015	OS	0				289-299	West	1249	920	950	5	294	Saprolite undiff.	Greenstone
520-016	SAP	0				300-310	West	1249	920	950	-6	305	Saprolite undiff.	Greenstone
520-017	SAP	0				310-320	West	1249	920	950	-16	315	Saprolite undiff.	Greenstone
521-001	RT	1		1	0	075-081	West	1235	938	948	209	78	Sh. mafic volcanic	Greenstone
521-002	RT	0		10	0	111-117	West	1235	938	948	173	114	Sh. mafic volcanic	Greenstone
521-003	WT	0		75	> 4	124-134	West	1235	938	948	158	129	Sh. mafic volcanic	Greenstone
521-004	OT	1		75	0	192-201	West	1235	938	948	91	197	Sh. mafic volcanic	Greenstone
521-005	WT	0		1	0	201-211	West	1235	938	948	81	206	Sh. mafic volcanic	Greenstone
521-006	WT	0		75	0	217-224	West	1235	938	948	67	221	Sh. mafic volcanic	Greenstone
521-007	OG	0				224-234	West	1235	938	948	58	229	Sh. mafic volcanic	Greenstone
521-008	OG	0				234-245	West	1235	938	948	48	240	Sh. mafic volcanic	Greenstone
521-009	OG	0				247-257	West	1235	938	948	35	252	Sh. mafic volcanic	Greenstone
521-010	OS	0				267-277	West	1235	938	948	15	272	Sh. mafic volcanic	Greenstone
521-011	OS	0				277-287	West	1235	938	948	5	282	Sh. mafic volcanic	Greenstone
521-012	SAP	0				287-297	West	1235	938	948	-5	292	Sh. mafic volcanic	Greenstone
521-013	BED	na				298-299	West	1235	938	948	-12	299	Sh. mafic volcanic	Greenstone
521-014	BED	na				302-304	West	1235	938	948	-16	303	Sh. mafic volcanic	Greenstone
521-015	BEDZ	na				304-320	West	1235	938	948	-25	312	Sh. mafic volcanic	Greenstone

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Column abbreviations and data key

Stratigraphic units

KT	=Koochiching till
KG	=Koochiching gravel
RT	=Rainy till
RS	=Rainy sand
RG	=Rainy gravel
RL	=Rainy lake sediment
WT	=Winnipeg till
WS	=Winnipeg sand
OT	=Old Rainy till
OS	=Old Rainy sand
OG	=Old Rainy gravel
OL	=Old Rainy lake sediment
ASAP	=reworked saprolite
SAP	=saprolite

Other abbreviations

ODM	=Overburden Drilling Management Labs
-63um	=silt + clay fraction
-2um	=clay fraction
nmHMC	=nonmagnetic heavy mineral concentrate
icp	=inductively coupled plasma
aa	=atomic absorption
hyaa	=hydride generation atomic absorption
inaa	=instrumental neutron activation
fadc	=fire assay direct current
dcp	=direct coupled plasma
cvaa	=cold vapor atomic absorption

Notes:

Assay values reported here are listed to 3 significant figures.

Values less than or equal to the detection limits shown in Appendix 280-C (eg. <0.5), are reported here as five-eighths (0.625) of the listed detection limit for that element (eg. 0.3125).

Values originally reported as off scale (eg. >20,000) are listed here as the upper value (e.g. 20,000).

Sample 517-005 had insufficient nmHMC to use for INAA analysis, so null values are registered for those nmHMC INAA results.

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Ag -63um icp	Ag nmhmc aa	Al -2um icp	Al nmhmc icp	As -2um hyaa	As nmhmc inaa	Au -63um fadc	Au nmhmc inaa/fadc	B -2um dcp	Ba -2um icp	Ba nmhmc inaa	Be -2um icp	Be nmhmc icp	Bi -2um icp	Bi nmhmc icp	Br nmhmc inaa	Ca -2um icp
501-001	RT	0.9	4.7	14500	7400	0.3	19	0.003	0.231	80	25	63	0.3	0.3	3.1	3	1.9	1200
501-002	SAP	0.3	3.2	14400	6200	0.3	1	0.001	0.010	70	12	150	0.3	0.3	3.1	20	1.9	600
501-003	SAP	0.5	4.3	23500	6300	0.3	6	0.001	0.006	58	41	180	0.3	0.3	3.1	14	1.9	900
502-001	RT	0.7	1.7	30200	14300	1.0	23	0.002	0.053	29	144	63	0.3	0.3	3.1	3	1.9	12300
502-002	RT	1.0	1.5	32800	12500	1.0	19	0.005	0.079	29	148	63	0.3	0.3	3.1	3	1.9	14500
502-003	RT	0.9	1.4	30600	15300	1.5	18	0.004	0.118	14	167	63	0.3	0.3	3.1	3	1.9	17700
502-004	RS	0.8	2.6	29400	5300	3.0	18	0.008	0.012	37	128	63	0.3	0.3	3.1	3	1.9	14100
502-005	OL	0.8	2.6	27100	9900	2.0	21	0.001	0.106	39	117	170	0.3	0.3	3.1	3	1.9	11100
503-001	RT	0.9	1.2	25500	13900	1.5	31	0.002	0.034	37	166	63	0.3	0.3	3.1	3	1.9	29700
503-002	RT	0.6	1.4	28600	15400	1.0	31	0.001	0.887	19	164	63	0.3	0.3	3.1	3	1.9	18100
503-003	RT	0.7	1.9	27600	12900	1.0	20	0.002	0.064	64	156	63	0.3	0.3	3.1	3	1.9	15700
503-004	RT	0.7	1.3	28800	11600	1.0	22	0.023	0.240	28	137	250	0.3	0.3	3.1	3	1.9	17800
503-005	RT	0.6	1.9	26900	17900	0.3	17	0.001	0.170	25	438	63	0.3	0.3	3.1	3	1.9	13100
503-006	ASAP	0.3	0.8	8200	2200	0.3	19	0.002	0.116	74	58	63	0.3	0.3	3.1	3	1.9	600
503-007	SAP	0.3	3.1	9500	5600	0.3	1	0.002	0.003	88	15	63	0.3	0.3	3.1	20	1.9	700
505-001	RT	1.2	2.3	28600	5600	1.0	27	0.001	0.213	40	151	63	0.3	0.3	3.1	8	1.9	32800
505-002	OT	1.1	2.7	33600	6300	1.0	26	0.002	0.019	46	113	150	0.3	0.3	3.1	10	1.9	9000
505-003	OT	0.9	3.1	34400	6400	1.0	31	0.001	0.200	31	121	63	0.3	0.3	3.1	11	1.9	6000
505-004	SAP	0.8	3.7	36300	5500	0.3	30	0.001	0.016	38	101	210	0.3	0.3	3.1	22	1.9	1700
506-001	RT	0.8	2.5	34500	6000	1.0	29	0.034	0.101	57	102	63	0.3	0.3	3.1	3	1.9	11200
506-002	RT	1.1	1.7	37700	6500	1.0	42	0.008	0.232	42	155	150	0.3	0.3	3.1	3	1.0	19900
506-003	SAP	0.3	3.1	33600	13400	0.3	11	0.018	0.003	58	98	410	0.3	0.3	3.1	18	1.9	5500
506-004	SAP	0.3	1.9	29200	10100	0.3	9	0.005	0.019	76	94	270	0.3	0.3	3.1	7	1.9	1200
507-001	RT	0.6	1.5	24000	12300	1.5	24	0.001	0.079	47	152	63	0.3	0.3	3.1	3	1.0	32200
507-002	RT	2.9	1.9	23200	7500	1.0	18	0.001	0.014	26	126	63	0.3	0.3	3.1	3	1.9	46100
507-003	RL	0.7	3.3	23300	5400	1.0	19	0.003	0.122	40	124	63	0.3	0.3	3.1	3	1.9	48300
507-004	OT	0.7	2.7	24700	5100	1.0	19	0.001	0.038	52	87	120	0.3	0.3	3.1	8	1.9	10100
507-005	OT	0.8	2.8	27600	4500	1.5	17	0.001	0.115	47	91	63	0.3	0.3	3.1	14	1.9	12100
507-006	OT	0.7	2.8	25600	4400	1.5	17	0.002	0.022	56	99	63	0.3	0.3	3.1	12	1.0	9000
507-007	OS	1.0	2.6	28700	4500	2.0	25	0.004	0.098	60	91	63	0.3	0.3	3.1	17	1.9	10300
507-008	OT	0.8	2.5	23800	5200	2.0	23	0.001	0.035	58	92	120	0.3	0.3	3.1	12	1.9	12700
507-009	OS	0.8	2.2	25100	4300	3.0	24	0.001	0.010	88	107	100	0.3	0.3	3.1	16	1.9	13800
507-010	OT	0.7	2.6	25900	5000	2.0	28	0.001	0.055	61	97	130	0.3	0.3	3.1	6	1.9	11700
507-011	OL	2.4	2.6	26800	4300	2.0	19	0.003	0.055	54	118	63	0.3	0.3	3.1	8	1.9	12500
507-012	SAP	0.3	0.1	29900	6000	2.0	7	0.002	0.617	50	59	63	0.3	0.3	3.1	3	1.9	2800
508-001	RT	1.1	1.7	26700	8600	2.0	25	0.003	0.080	49	180	63	0.3	0.3	3.1	3	1.0	41900
508-002	RT	0.7	2.2	29400	9300	1.0	30	0.003	0.072	46	165	63	0.3	0.3	3.1	3	2.0	26200
508-003	RT	2.1	2.5	31700	15000	1.8	39	0.001	0.275	38	177	63	0.3	0.3	3.1	3	1.9	24500
508-004	SAP	0.5	4.3	22800	8200	0.3	40	0.001	0.245	59	28	63	0.3	0.3	3.1	9	1.9	1000
508-007	SAP	0.3	2.7	23700	5100	0.3	1	0.002	0.011	48	30	63	0.3	0.3	3.1	22	1.9	700
509-001	RT	0.9	1.9	32900	10200	1.0	20	0.015	0.083	54	188	63	0.3	0.3	3.1	3	1.9	24000
510-001	RT	1.1	2.1	32300	11000	3.0	24	0.002	0.093	31	159	63	0.3	0.3	3.1	3	1.9	27900
510-002	RT	1.4	2.1	21800	9900	2.0	35	0.001	0.027	32	142	63	0.3	0.3	3.1	3	1.9	28000
511-001	RT	1.5	2.7	18800	7000	2.0	22	0.001	0.127	44	122	63	0.3	0.3	3.1	3	1.9	50100
511-002	RT	0.3	2.6	26100	9400	1.0	14	0.001	0.009	42	131	63	0.3	0.3	3.1	3	1.9	47800
511-003	RT	0.6	3.2	24600	9800	1.0	36	0.001	0.122	35	127	63	0.3	0.3	3.1	3	1.9	50300
511-004	WT	0.3	2.2	17600	10500	1.0	63	0.002	0.028	51	116	63	0.3	0.3	3.1	3	1.9	10000
511-005	WT	0.7	3.5	23200	7300	1.0	58	0.001	0.024	41	133	63	0.3	0.3	3.1	3	2.0	37700
512-001	WT	0.9	3.0	23900	8400	2.5	79	0.001	0.038	99	115	63	0.3	0.3	3.1	3	1.9	39200
512-002	WT	0.8	3.8	25600	7200	3.0	112	0.001	0.058	122	121	63	0.3	0.3	3.1	7	1.9	41300
512-003	WT	0.6	3.6	24700	6900	3.0	84	0.001	0.027	131	100	63	0.3	0.3	3.1	12	1.9	44000
513-001	RT	0.3	2.2	22500	11400	2.0	54	0.003	0.418	47	140	63	0.3	0.3	3.1	3	1.9	65500
513-002	WT	0.8	3.0	19900	5700	3.0	70	0.001	0.017	103	122	63	0.3	0.3	3.1	9	3.0	63300
513-003	WT	1.6	3.0	20900	5300	3.0	44	0.003	0.021	132	100	63	0.3	0.3	3.1	8	1.9	41600
513-004	WT	1.0	3.0	19800	4500	2.5	47	0.002	0.023	130	103	150	0.3	0.3	3.1	10	1.9	36800

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Ag -63um icp	Ag nmhmc aa	Al -2um icp	Al nmhmc icp	As -2um hyaa	As nmhmc inaa	Au -63um fadc	Au nmhmc inaa/fadc	B -2um dcp	Ba -2um icp	Ba nmhmc inaa	Be -2um icp	Be nmhmc icp	Bi -2um icp	Bi nmhmc icp	Br nmhmc inaa	Ca -2um icp
513-005	SAP	0.9	0.1	25600	8100	0.3	62	0.003	0.156	65	82	63	0.3	0.3	6.0	3	1.9	29100
514-001	RT	1.1	2.6	23000	13700	1.5	22	0.002	0.017	29	130	63	0.3	0.3	3.1	3	1.9	53100
514-002	RT	0.9	1.5	24800	12000	1.5	36	0.014	0.341	10	117	63	0.3	0.3	3.1	3	1.9	41600
514-003	RT	1.1	1.8	26300	10800	2.0	42	0.003	0.081	15	147	63	0.3	0.3	3.1	3	1.9	38200
514-004	RG	1.2	2.9	23000	4500	2.5	22	0.001	0.003	35	90	110	0.3	0.3	3.1	23	1.9	38700
514-005	OS	1.0	2.2	22300	10200	1.5	27	0.001	0.057	36	65	63	0.3	0.3	3.1	3	1.9	12200
514-006	SAP	0.8	2.7	47600	11000	0.3	2	0.011	0.019	15	33	63	0.7	0.3	9.0	25	1.9	3600
515-001	RT	0.9	2.9	29200	4800	1.0	21	0.002	0.026	19	143	110	0.3	0.3	3.1	9	1.9	42300
515-002	RT	0.9	2.7	30600	6300	1.0	40	0.001	0.053	17	124	63	0.3	0.3	3.1	6	1.9	41300
515-003	RT	1.1	2.9	25400	6400	1.5	25	0.010	0.017	40	96	63	0.3	0.3	3.1	10	1.9	31200
515-004	OT	0.8	2.2	26600	8100	1.3	21	0.002	0.054	29	124	63	0.3	0.3	3.1	3	1.9	60800
515-005	OT	0.8	2.5	27600	10000	1.0	21	0.001	0.066	29	139	63	0.3	0.3	3.1	3	2.0	54300
515-006	OT	0.9	2.3	26700	12300	1.0	25	0.001	0.066	38	150	63	0.3	0.3	3.1	3	2.0	59100
515-007	OT	0.9	1.9	25900	14100	1.5	24	0.001	0.046	39	150	63	0.3	0.3	3.1	3	1.9	56800
515-008	OT	2.1	1.9	28600	10800	1.0	23	0.001	0.597	37	122	63	0.3	0.3	3.1	3	1.9	39600
516-001	KT	0.3	2.0	21600	11900	2.0	39	0.001	0.042	37	125	63	0.3	0.3	3.1	3	1.9	93000
516-002	KT	0.3	2.2	24100	10100	2.0	46	0.001	0.054	39	125	180	0.3	0.3	3.1	3	1.9	85700
516-003	KG	0.3	1.7	28300	10900	3.0	86	0.001	0.023	27	255	63	0.3	0.3	3.1	3	1.9	75100
517-001	RT	0.5	1.7	26000	9900	1.8	28	0.001	0.047	30	132	63	0.3	0.3	3.1	3	2.0	59700
517-002	RT	0.9	2.2	23900	10000	1.0	41	0.002	0.268	24	121	63	0.3	0.3	3.1	3	1.9	63000
517-003	WT	0.6	3.0	20300	10200	1.0	79	0.001	0.100	56	108	63	0.3	0.3	3.1	3	1.9	10000
517-004	WT	0.3	1.7	20400	13600	1.0	72	0.001	0.538	51	111	63	0.3	0.3	3.1	3	1.9	10000
517-005	WT	0.3	1.8	20200	16100	2.0	1	0.001	0.028	71	128	63	0.3	0.3	3.1	3		10000
517-006	WT	0.3	3.4	17800	10900	1.5	79	0.001	0.127	58	119	63	0.3	0.3	3.1	3	1.9	10000
517-007	WT	0.3	3.0	20400	10600	1.0	62	0.001	0.025	53	127	63	0.3	0.3	3.1	3	1.9	10000
517-008	WT	0.3	2.8	20800	9300	1.0	47	0.001	0.178	57	128	63	0.3	0.3	3.1	3	1.9	78400
517-009	WT	0.3	3.0	20600	9200	2.0	65	0.002	0.182	67	135	63	0.3	0.3	3.1	3	1.9	82900
517-010	WT	0.6	2.7	21000	10600	3.0	54	0.002	0.038	61	128	63	0.3	0.3	3.1	3	1.9	74400
517-011	OT	0.9	2.6	22400	10100	2.5	36	0.002	0.016	32	109	63	0.3	0.3	3.1	3	1.9	67800
517-012	OT	0.8	2.5	22600	9700	3.0	54	0.002	0.042	33	97	63	0.3	0.3	3.1	3	1.9	73300
517-013	OT	0.7	2.5	22400	13200	2.0	50	0.001	0.166	33	111	63	0.3	0.3	3.1	3	2.0	74900
517-014	OT	1.0	2.1	21500	13200	2.0	39	0.003	0.052	34	100	63	0.3	0.3	3.1	3	2.0	67400
517-015	OT	1.1	2.0	24400	9400	2.0	42	0.005	0.021	39	123	130	0.3	0.3	3.1	3	1.9	81500
517-016	OT	0.3	1.4	25600	11400	3.0	47	0.006	0.039	35	121	63	0.3	0.3	3.1	3	1.9	75700
517-017	OT	1.6	2.2	23700	10700	2.0	73	0.003	0.185	40	124	63	0.3	0.3	3.1	3	1.9	76100
517-018	OT	0.7	1.9	26000	9700	2.5	54	0.001	0.609	37	120	63	0.3	0.3	3.1	3	2.0	68200
518-001	RT	0.7	2.4	22200	7600	1.5	47	0.003	0.037	44	121	63	0.3	0.3	3.1	3	1.9	76100
518-002	RT	0.8	2.5	24600	10800	1.0	44	0.006	0.055	47	124	63	0.3	0.3	3.1	3	1.9	69100
518-003	WS	1.5	2.8	27000	7700	2.0	32	0.022	0.052	41	115	63	0.3	0.3	3.1	3	1.9	30100
518-004	WT	0.3	3.1	14200	4600	3.0	74	0.001	0.237	62	126	63	0.3	0.3	3.1	14	1.9	10000
518-005	WT	0.3	3.0	19200	4300	4.0	79	0.001	0.025	73	131	63	0.3	0.3	3.1	15	3.0	84800
518-006	WT	0.9	3.2	21800	3700	5.0	74	0.001	0.013	87	154	180	0.3	0.3	3.1	10	2.0	56600
518-007	WT	0.9	3.6	23500	6200	3.0	60	0.002	0.016	126	110	63	0.3	0.3	3.1	13	2.0	50500
518-008	WT	1.1	3.6	30800	7400	3.0	62	0.001	0.091	104	107	63	0.3	0.3	3.1	3	1.9	43400
519-001	RT	0.3	2.5	17900	7900	2.0	22	0.001	0.049	25	109	63	0.3	0.3	3.1	3	1.9	85200
519-002	RT	0.6	2.7	18100	8500	2.0	27	0.001	0.046	41	118	130	0.3	0.3	3.1	7	1.9	84900
519-003	WT	0.7	3.6	21100	8300	2.0	48	0.002	0.014	36	123	63	0.3	0.3	3.1	3	1.9	93600
519-004	WT	1.2	3.4	20500	5300	5.0	50	0.002	0.048	84	92	63	0.3	0.3	3.1	3	2.0	38100
519-005	WT	1.4	3.0	34100	7700	4.0	48	0.004	0.032	41	118	63	0.3	0.3	3.1	3	1.9	22600
519-006	WT	1.3	3.8	28000	7700	3.0	47	0.003	0.025	46	111	63	0.3	0.3	3.1	3	1.9	19100
520-001	RT	0.8	1.6	27800	15000	3.0	36	0.001	0.086	24	181	63	0.3	0.3	3.1	3	1.9	55500
520-002	RT	1.0	1.1	27100	14100	2.0	19	0.001	0.023	22	142	63	0.3	0.3	3.1	3	1.9	52200
520-003	RT	0.7	2.3	22700	11000	2.0	30	0.001	0.021	29	111	63	0.3	0.3	3.1	3	1.9	88500
520-004	WT	0.3	2.7	23800	10400	2.0	58	0.001	0.031	51	118	63	0.3	0.3	3.1	3	1.9	89200
520-005	OT	1.0	2.7	24400	9400	2.0	32	0.001	0.195	24	108	160	0.3	0.3	3.1	5	1.9	68100

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Ag -63um icp	Ag nmhmc aa	Al -2um icp	Al nmhmc icp	As -2um hyaa	As nmhmc inaa	Au -63um fadc	Au nmhmc inaa/fadc	B -2um dcp	Ba -2um icp	Ba nmhmc inaa	Be -2um icp	Be nmhmc icp	Bi -2um icp	Bi nmhmc icp	Br nmhmc inaa	Ca -2um icp
520-006	OT	0.7	2.4	27200	11000	2.0	39	0.001	0.063	27	111	63	0.3	0.3	3.1	3	2.0	61800
520-007	OT	1.0	2.6	28100	8900	2.5	54	0.001	0.242	42	123	63	0.3	0.3	3.1	3	1.9	53300
520-008	OT	1.1	1.8	26800	9600	2.0	88	0.001	0.019	37	118	63	0.3	0.3	3.1	3	1.9	72900
520-009	OT	1.1	2.4	27000	12500	2.0	43	0.001	0.023	38	121	63	0.3	0.3	3.1	3	1.9	71500
520-010	OT	1.2	2.2	23900	10100	3.0	40	0.002	0.175	42	138	63	0.3	0.3	3.1	3	1.9	68400
520-011	OT	1.3	2.7	24200	11100	3.0	38	0.002	0.478	43	124	63	0.3	0.3	3.1	3	1.9	74200
520-012	OT	0.3	2.1	21500	15900	2.5	35	0.001	0.028	47	149	63	0.3	0.3	3.1	3	1.9	10000
520-013	OT	1.2	2.2	25100	10700	2.0	21	0.001	0.104	51	157	63	0.3	0.3	3.1	3	1.9	76500
520-014	OT	0.3	1.8	21000	12800	1.0	30	0.001	0.064	40	144	63	0.3	0.3	3.1	3	1.9	10000
520-015	OS	1.8	2.8	21900	5900	9.0	34	0.001	0.011	25	124	180	0.3	0.3	3.1	9	1.9	25400
520-016	SAP	1.4	5.4	21500	5000	1.0	32	0.003	0.011	27	45	130	0.3	0.3	3.1	18	1.9	800
520-017	SAP	3.6	6.4	20300	3200	1.0	1	0.002	0.018	30	62	320	0.5	0.3	3.1	13	1.9	900
521-001	RT	1.0	2.1	23700	11400	2.0	38	0.001	0.025	63	150	63	0.3	0.3	3.1	3	1.9	79100
521-002	RT	0.7	3.1	20500	12600	1.0	26	0.005	0.019	41	126	63	0.3	0.3	3.1	3	1.9	86300
521-003	WT	1.2	2.5	17400	8500	1.5	49	0.001	0.020	68	112	63	0.3	0.3	3.1	3	1.9	71800
521-004	OT	1.2	2.3	22200	11200	1.5	54	0.001	0.273	29	125	63	0.3	0.3	3.1	3	1.9	83100
521-005	WT	1.0	2.7	22400	15300	2.5	85	0.001	0.065	54	121	63	0.3	0.3	3.1	3	1.9	84500
521-006	WT	0.3	3.0	21300	6500	3.0	124	0.001	0.023	47	116	63	0.3	0.3	3.1	3	1.9	10000
521-007	OG	1.6	3.3	30200	5600	3.0	97	0.002	0.028	49	115	110	0.3	0.3	3.1	17	4.0	49800
521-008	OG	2.1	3.0	33100	5500	3.0	103	0.001	0.017	34	100	63	0.6	0.3	3.1	8	1.9	39700
521-009	OG	2.8	3.5	33700	5000	3.0	58	0.002	0.014	31	124	63	0.5	0.3	7.0	18	3.0	37000
521-010	OS	1.9	3.1	25100	4200	4.5	18	0.002	0.003	40	123	63	0.3	0.3	3.1	14	1.9	15300
521-011	OS	1.8	3.4	28100	5600	3.0	19	0.002	0.020	40	140	63	0.3	0.3	3.1	11	1.0	11000
521-012	SAP	1.6	1.6	41600	23200	1.5	1	0.001	0.003	64	134	63	0.3	0.3	3.1	3	1.9	3900

Note: All values are reported in parts per million (ppm).

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Ca nmhmc icp	Cd -2um aa	Cd nmhmc icp	Ce -2um icp	Ce nmhmc inaa	Co -2um icp	Co nmhmc inaa	Cr -2um icp	Cr nmhmc inaa	Cs nmhmc inaa	Cu -2um icp	Cu nmhmc icp	Eu nmhmc inaa	Fe nmhmc inaa	Fe tot -2um icp	Ga -2um icp	Ga nmhmc icp
501-001	RT	19300	0.1	0.6	62	230	7	81	45	310	2.0	21	50	5	220000	13300	6	1
501-002	SAP	20800	0.1	3.0	28	71	17	58	21	82	0.6	10	73	1	310000	10300	6	1
501-003	SAP	19900	0.1	2.0	73	190	19	62	27	130	9.0	29	38	7	300000	30700	10	1
502-001	RT	24200	0.1	0.6	83	430	22	81	134	340	0.6	67	64	4	160000	41400	10	7
502-002	RT	22400	0.1	0.6	83	580	22	80	126	410	0.6	57	49	3	180000	42100	11	8
502-003	RT	20400	0.1	0.6	72	550	24	68	122	400	0.6	62	47	6	180000	42200	10	9
502-004	RS	15500	0.1	3.0	73	240	28	65	134	150	0.6	74	64	1	290000	49000	10	1
502-005	OL	21000	0.1	1.0	76	330	31	59	136	330	0.6	67	94	4	240000	50700	11	1
503-001	RT	17700	0.1	0.6	61	600	20	110	123	400	0.6	71	89	4	200000	36800	3	5
503-002	RT	19300	0.1	0.6	61	650	23	89	129	470	0.6	73	72	1	200000	41500	8	8
503-003	RT	15800	0.1	0.6	56	770	21	85	109	440	0.6	57	76	5	190000	39200	8	9
503-004	RT	14700	0.1	0.6	71	610	21	88	122	670	0.6	58	152	1	210000	37700	9	11
503-005	RT	19700	0.1	0.6	136	670	21	93	162	410	0.6	63	133	4	210000	33500	9	9
503-006	ASAP	3400	0.1	4.0	46	390	6	98	232	620	0.6	64	91	5	270000	4600	4	1
503-007	SAP	26000	0.4	2.0	8	49	13	38	53	130	0.6	31	31	1	300000	3500	6	1
505-001	RT	15100	0.1	1.0	97	360	26	71	128	240	0.6	65	128	4	310000	46300	6	1
505-002	OT	18600	0.1	2.0	111	250	40	87	172	400	2.0	70	220	4	310000	75500	15	1
505-003	OT	17500	0.1	3.0	143	330	34	100	143	210	0.6	62	700	1	310000	69300	15	1
505-004	SAP	15000	0.1	3.0	255	560	33	110	139	31	3.0	39	242	10	300000	87900	17	1
506-001	RT	13600	0.1	2.0	81	250	31	92	103	390	0.6	58	117	3	330000	55600	11	1
506-002	RT	12600	0.1	0.6	90	260	32	120	94	300	0.6	52	79	1	340000	58100	9	1
506-003	SAP	14200	0.1	3.0	150	31	16	150	26	170	0.6	12	29	1	300000	32000	6	2
506-004	SAP	7700	0.1	2.0	153	63	25	120	59	130	0.6	71	732	5	290000	33400	8	1
507-001	RT	17100	0.1	0.6	57	560	17	62	92	490	0.6	39	49	4	200000	33000	1	7
507-002	RT	15200	0.1	0.6	52	400	17	67	88	380	0.6	50	47	4	250000	30600	1	1
507-003	RL	15000	0.1	0.6	51	250	18	69	84	200	0.6	51	73	2	290000	31800	1	1
507-004	OT	17300	0.1	0.6	51	120	24	68	85	190	0.6	53	56	1	260000	36700	9	1
507-005	OT	17200	0.1	0.6	54	120	27	70	134	150	0.6	63	53	1	310000	47400	9	1
507-006	OT	13400	0.1	2.0	74	200	24	54	90	200	0.6	52	44	1	300000	32400	10	1
507-007	OS	13900	0.1	2.0	82	180	29	96	105	240	0.6	66	68	2	340000	40400	11	1
507-008	OT	13200	0.1	0.6	78	280	22	77	95	280	0.6	63	70	2	300000	31000	7	1
507-009	OS	13100	0.1	2.0	61	130	26	83	137	150	0.6	63	63	1	350000	38400	8	1
507-010	OT	11100	0.1	0.6	73	240	20	88	93	360	0.6	54	119	3	300000	28800	9	1
507-011	OL	14100	0.1	0.6	85	180	24	81	106	270	0.6	60	177	1	320000	36100	10	1
507-012	SAP	18900	0.1	0.6	68	130	12	120	143	180	1.0	30	139	1	190000	46800	8	4
508-001	RT	17000	0.1	2.0	66	490	20	85	94	360	0.6	51	203	1	240000	36900	1	1
508-002	RT	17500	0.1	0.6	79	510	26	89	122	450	0.6	68	369	1	230000	44000	6	3
508-003	RT	22400	0.1	1.0	86	580	30	94	135	340	0.6	69	461	3	230000	48300	8	3
508-004	SAP	14400	0.1	2.0	157	250	40	110	154	31	0.6	96	669	1	290000	57100	16	1
508-007	SAP	18000	0.1	0.6	180	360	23	38	218	110	0.6	55	105	1	310000	62400	20	1
509-001	RT	17500	0.1	0.6	90	480	27	89	114	320	0.6	73	255	5	240000	47300	9	3
510-001	RT	18100	0.1	0.6	63	490	26	72	137	340	0.6	80	98	4	220000	48400	7	4
510-002	RT	16200	0.1	1.0	70	590	19	86	106	460	0.6	50	88	4	230000	36000	5	4
511-001	RT	16100	0.1	0.6	49	680	18	78	75	390	0.6	47	215	3	250000	31200	1	1
511-002	RT	18000	0.1	0.6	53	630	19	73	89	410	0.6	50	386	3	240000	35500	1	2
511-003	RT	16200	0.1	0.6	43	640	90	76	68	410	0.6	38	135	3	230000	31400	1	4
511-004	WT	20300	0.1	0.6	3	850	12	42	51	630	0.6	34	162	1	250000	25800	1	1
511-005	WT	16600	0.1	0.6	63	530	15	60	45	360	0.6	37	329	1	290000	29400	2	1
512-001	WT	18400	0.1	2.0	60	380	18	76	77	340	0.6	42	170	3	260000	31600	1	1
512-002	WT	14800	0.1	2.0	61	330	18	82	75	220	0.6	38	290	1	320000	30500	1	1
512-003	WT	14300	0.1	2.0	60	380	17	91	65	250	0.6	34	164	1	310000	28000	1	1
513-001	RT	15600	0.1	0.6	28	740	19	61	66	630	0.6	44	76	1	240000	33000	1	3
513-002	WT	14800	0.1	0.6	37	390	16	74	53	310	0.6	36	114	1	320000	26700	1	1
513-003	WT	15800	0.1	0.6	60	320	18	66	60	290	0.6	37	122	2	320000	27000	1	1
513-004	WT	16400	0.1	2.0	55	350	18	91	64	240	0.6	40	165	2	330000	28100	1	1

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Ca nmhmc icp	Cd -2um aa	Cd nmhmc icp	Ce -2um icp	Ce nmhmc inaa	Co -2um icp	Co nmhmc inaa	Cr -2um icp	Cr nmhmc inaa	Cs nmhmc inaa	Cu -2um icp	Cu nmhmc icp	Eu nmhmc inaa	Fe nmhmc inaa	Fe tot -2um icp	Ga -2um icp	Ga nmhmc icp
513-005	SAP	15400	0.1	2.0	41	26	14	350	80	160	0.6	40	910	1	270000	38000	4	1
514-001	RT	18100	0.1	0.6	53	880	16	78	70	510	0.6	35	271	4	240000	30400	1	4
514-002	RT	17800	0.1	0.6	58	860	17	72	73	560	0.6	37	260	5	220000	31700	1	5
514-003	RT	18400	0.1	0.6	61	610	19	67	88	470	0.6	45	44	5	220000	35800	2	3
514-004	RG	18500	0.1	2.0	48	130	28	74	89	120	0.6	58	98	1	320000	47000	1	1
514-005	OS	17300	0.1	0.6	47	770	24	72	56	470	0.6	36	90	6	230000	37400	11	4
514-006	SAP	15200	0.1	3.0	22	6	44	51	57	31	0.6	81	299	1	330000	10000	12	1
515-001	RT	18300	0.1	0.6	63	410	20	73	92	290	1.0	40	111	5	310000	36100	1	1
515-002	RT	15900	0.1	3.0	57	350	29	82	127	200	1.0	63	107	1	300000	48400	2	1
515-003	RT	17800	0.1	2.0	60	410	25	72	81	380	0.6	44	69	1	310000	35100	5	1
515-004	OT	15100	0.1	1.0	48	610	21	59	96	520	1.0	50	54	3	270000	38400	1	1
515-005	OT	15000	0.2	0.6	65	770	22	48	97	560	0.6	52	34	1	260000	40900	1	1
515-006	OT	16100	0.1	0.6	62	780	21	64	81	630	0.6	51	50	1	260000	38700	1	1
515-007	OT	18100	0.1	0.6	61	600	20	50	91	470	0.6	51	74	2	240000	39300	1	1
515-008	OT	18500	0.1	0.6	47	520	23	54	80	350	0.6	61	141	6	230000	48400	3	1
516-001	KT	21500	0.1	0.6	20	770	17	63	68	810	0.6	41	93	5	230000	29900	1	2
516-002	KT	18700	0.1	0.6	29	750	31	68	79	740	0.6	43	105	3	240000	33500	1	1
516-003	KG	16900	0.1	1.0	46	560	25	62	107	630	0.6	48	114	4	250000	39700	1	1
517-001	RT	15400	0.1	0.6	40	740	16	65	73	560	0.6	33	55	4	240000	32500	1	1
517-002	RT	17200	0.1	0.6	38	990	15	70	73	680	0.6	31	57	4	230000	31100	1	4
517-003	WT	17300	0.1	0.6	3	1240	14	100	59	1200	0.6	32	140	7	260000	27300	1	3
517-004	WT	18500	0.1	0.6	3	1010	14	84	56	890	0.6	33	119	1	240000	27500	1	7
517-005	WT	11100	0.1	2.0	3	710	13	29	49	110		32	72		10000	26300	1	6
517-006	WT	13500	0.1	0.6	3	900	12	100	49	720	0.6	29	400	1	310000	22400	1	1
517-007	WT	15300	0.1	3.0	3	900	13	87	52	790	0.6	31	199	1	290000	24100	1	1
517-008	WT	13000	0.1	2.0	37	740	15	83	63	580	0.6	37	99	5	310000	26100	1	1
517-009	WT	14800	0.1	0.6	28	990	14	77	61	720	0.6	38	109	4	310000	24600	1	1
517-010	WT	12300	0.2	3.0	35	710	15	84	65	470	0.6	38	96	1	330000	25000	1	1
517-011	OT	12800	0.1	2.0	34	630	19	73	78	500	0.6	36	82	7	290000	29600	1	1
517-012	OT	13000	0.1	2.0	24	560	20	61	97	550	1.0	41	67	4	300000	32300	1	1
517-013	OT	13900	0.1	2.0	24	790	18	72	84	550	0.6	39	84	3	280000	31700	1	1
517-014	OT	12700	0.1	2.0	28	540	18	69	81	490	0.6	37	58	1	290000	31600	1	1
517-015	OT	11100	0.1	1.0	32	610	19	76	77	550	0.6	45	124	1	280000	33800	1	1
517-016	OT	11900	0.1	1.0	40	550	20	77	76	520	0.6	44	63	6	270000	35200	1	1
517-017	OT	13400	0.1	0.6	37	640	19	77	74	630	0.6	43	76	1	260000	33800	1	1
517-018	OT	10500	0.1	0.6	42	510	21	84	84	540	0.6	47	86	4	280000	37200	1	1
518-001	RT	15600	0.1	0.6	39	550	18	59	69	380	0.6	35	53	5	240000	30900	1	1
518-002	RT	17600	0.1	2.0	42	800	19	77	81	630	0.6	44	77	5	280000	33500	1	1
518-003	WS	22400	0.1	2.0	71	620	23	65	102	570	0.6	47	103	1	250000	36200	5	1
518-004	WT	13300	0.1	2.0	3	470	13	78	45	350	0.6	32	91	1	350000	24200	1	1
518-005	WT	12700	0.1	2.0	19	360	16	75	61	340	0.6	39	80	1	350000	26500	1	1
518-006	WT	12900	0.1	2.0	57	470	19	79	63	410	0.6	47	90	1	330000	29300	1	1
518-007	WT	14300	0.1	1.0	56	390	15	71	57	290	0.6	30	127	3	380000	26300	1	1
518-008	WT	15900	0.1	2.0	54	330	27	58	106	370	0.6	38	342	1	340000	39500	1	1
519-001	RT	14600	0.1	2.0	10	550	16	64	74	520	0.6	32	59	1	280000	29900	1	1
519-002	RT	16200	0.1	0.6	13	610	15	62	58	510	0.6	32	328	1	280000	28300	1	1
519-003	WT	15200	0.1	1.0	13	610	17	78	67	540	0.6	33	99	4	280000	31800	1	1
519-004	WT	15200	0.1	2.0	65	680	17	50	56	410	2.0	34	50	1	310000	23300	1	1
519-005	WT	14600	0.1	1.0	76	430	33	97	132	370	0.6	76	206	3	310000	53600	9	1
519-006	WT	13000	0.1	3.0	82	630	31	110	120	460	0.6	80	161	1	310000	51300	9	1
520-001	RT	16400	0.1	0.6	74	710	20	65	113	580	1.0	46	56	3	210000	38100	1	7
520-002	RT	19000	0.1	0.6	69	590	21	62	106	450	0.6	42	47	4	190000	37400	1	6
520-003	RT	15900	0.2	0.6	25	490	17	63	80	460	0.6	38	70	1	230000	33400	1	1
520-004	WT	17500	0.1	0.6	31	670	19	68	70	560	0.6	38	94	1	250000	32800	1	1
520-005	OT	14700	0.1	2.0	38	330	24	69	171	400	0.6	58	96	1	310000	38600	1	1

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Ca nmhmc icp	Cd -2um aa	Cd nmhmc icp	Ce -2um icp	Ce nmhmc inaa	Co -2um icp	Co nmhmc inaa	Cr -2um icp	Cr nmhmc inaa	Cs nmhmc inaa	Cu -2um icp	Cu nmhmc icp	Eu nmhmc inaa	Fe nmhmc inaa	Fe tot -2um icp	Ga -2um icp	Ga nmhmc icp
520-006	OT	14600	0.1	2.0	36	430	21	71	114	420	0.6	49	88	2	280000	35100	1	1
520-007	OT	14600	0.1	2.0	51	510	22	86	90	520	0.6	54	95	3	280000	37400	1	1
520-008	OT	15100	0.1	0.6	36	520	23	63	91	460	0.6	51	76	4	270000	39300	1	1
520-009	OT	15000	0.1	1.0	37	610	24	75	97	510	0.6	54	75	1	260000	41300	1	1
520-010	OT	14500	0.1	1.0	42	530	21	58	98	420	1.0	52	61	1	270000	37900	1	1
520-011	OT	13700	0.1	0.6	40	570	22	63	97	650	0.6	48	57	1	260000	38000	1	1
520-012	OT	18700	0.1	0.6	12	960	15	68	69	960	3.0	35	61	1	180000	31900	1	6
520-013	OT	13600	0.1	0.6	49	1000	19	55	70	1200	3.0	40	46	1	250000	35900	1	5
520-014	OT	14500	0.1	0.6	3	1080	16	38	69	1000	0.6	35	53	1	250000	31300	1	5
520-015	OS	17000	0.1	4.0	149	230	40	77	227	120	1.0	105	69	2	330000	65300	8	1
520-016	SAP	16500	0.1	1.0	381	430	45	100	112	88	0.6	45	341	2	330000	51900	14	1
520-017	SAP	16500	0.1	3.0	1726	870	76	150	91	80	0.6	86	1899	17	310000	71400	22	1
521-001	RT	14400	0.1	2.0	31	820	17	68	64	590	0.6	37	64	4	240000	31000	1	4
521-002	RT	17900	0.1	0.6	27	1080	18	52	77	810	0.6	35	57	8	240000	30400	1	1
521-003	WT	13300	0.1	2.0	30	630	13	75	59	480	0.6	33	104	1	290000	22700	1	1
521-004	OT	12900	0.1	2.0	25	480	116	64	82	490	0.6	39	189	4	300000	32500	1	1
521-005	WT	20200	0.2	2.0	28	920	16	78	55	750	0.6	38	263	1	260000	28400	1	1
521-006	WT	17200	0.2	2.0	9	510	15	100	59	430	0.6	34	213	5	300000	27900	1	1
521-007	OG	16800	0.1	1.0	61	190	34	130	110	110	0.6	108	385	1	350000	53500	1	1
521-008	OG	16000	0.1	2.0	68	250	51	120	154	220	1.0	149	531	1	330000	77500	4	1
521-009	OG	17300	0.1	0.6	65	200	45	100	181	98	1.0	147	276	1	340000	69300	7	1
521-010	OS	18500	0.1	2.0	109	260	42	82	150	170	0.6	66	61	1	330000	51800	13	1
521-011	OS	19300	0.1	2.0	113	340	38	71	132	140	0.6	67	70	2	300000	47800	14	1
521-012	SAP	8300	0.1	1.0	151	88	24	46	129	180	1.0	74	126	1	240000	47700	14	1

Note: All values are reported in parts per million (ppm).

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Hf nmhmc inaa	Hg nmhmc cvaa	Ir nmhmc inaa	K -2um icp	K nmhmc icp	La -2um icp	La nmhmc inaa	Li -2um icp	Li nmhmc icp	Lu nmhmc inaa	Mg -2um icp	Mg nmhmc icp	Mn -2um aa	Mn nmhmc icp	Mo -2um icp	Mo nmhmc icp	Na -2um icp
501-001	RT	130	0.024	0.06	1200	313	55	140	10	3	2.2	2900	10400	65	2400	1.0	1.3	15800
501-002	SAP	38	0.015	0.06	313	313	5	33	5	2	0.9	1000	16900	15	3000	0.6	1.3	7200
501-003	SAP	63	0.024	0.06	2600	1400	109	300	28	19	3.7	3600	21100	89	6400	0.6	1.3	13900
502-001	RT	91	0.012	0.06	5300	313	45	180	26	3	2.1	14500	5000	603	2400	0.6	1.3	24100
502-002	RT	120	0.015	0.06	6000	313	47	240	30	4	2.7	16000	4800	560	2500	0.6	1.3	16000
502-003	RT	93	0.015	0.06	6200	313	41	220	35	4	2.6	15900	5400	607	2500	0.6	1.3	16800
502-004	RS	29	0.027	0.06	5100	313	39	94	30	4	1.7	12900	10800	576	5400	2.0	1.3	19500
502-005	OL	99	0.032	0.06	4800	313	41	170	26	4	1.9	9200	9500	442	3900	2.0	1.3	20600
503-001	RT	80	0.012	0.06	6700	313	40	250	35	4	2.8	15500	5800	675	2900	3.0	1.3	10000
503-002	RT	150	0.015	0.06	6700	313	38	280	34	4	3.6	16400	5100	663	2300	0.6	1.3	12300
503-003	RT	140	0.011	0.06	6000	313	35	340	35	4	3.3	15700	4100	603	1600	2.0	1.3	12800
503-004	RT	130	0.030	0.06	6200	313	42	260	35	3	3.7	14800	4800	598	1800	0.6	7.0	9000
503-005	RT	120	0.009	0.06	3900	313	34	290	30	5	3.1	11700	6000	451	2600	0.6	1.3	10500
503-006	ASAP	120	0.255	0.06	313	313	9	190	17	3	2.9	1000	3200	14	1900	0.6	5.0	4400
503-007	SAP	1	0.064	0.06	313	313	1	8	19	6	0.3	1400	26800	9	2400	0.6	1.3	5600
505-001	RT	97	0.030	0.06	5100	313	54	160	32	3	3.2	15300	9400	606	10800	0.6	1.3	9000
505-002	OT	96	0.036	0.06	4300	313	48	120	21	3	2.4	12300	10100	497	10900	3.0	1.3	10700
505-003	OT	82	0.042	0.06	5700	500	55	130	20	4	2.3	11200	11000	469	12300	2.0	1.3	8500
505-004	SAP	88	0.069	0.06	5300	1000	94	310	11	3	2.8	9500	14400	224	16400	3.0	1.3	8600
506-001	RT	49	0.051	0.06	4300	313	42	120	25	4	1.8	11700	10400	399	8000	2.0	1.3	19800
506-002	RT	59	0.054	0.06	5800	900	46	110	25	4	2.3	14400	9300	590	9500	3.0	1.3	15900
506-003	SAP	9	0.023	0.06	2700	5400	52	23	10	9	0.3	12000	8800	114	3500	0.6	1.3	20800
506-004	SAP	3	0.027	0.06	4400	4100	114	43	31	9	6.4	7800	10800	136	17600	0.6	1.3	14900
507-001	RT	130	0.027	0.06	5100	313	39	240	36	4	3.5	15000	5500	784	2000	3.0	1.3	8300
507-002	RT	100	0.038	0.06	4700	313	39	180	32	3	2.5	15700	7000	604	2800	0.6	1.3	6800
507-003	RL	64	0.045	0.06	4400	313	39	100	31	3	1.6	15600	10200	524	4000	0.6	1.3	5600
507-004	OT	45	0.042	0.06	2500	313	25	63	27	5	0.7	8700	13300	360	3600	0.6	1.3	13100
507-005	OT	31	0.051	0.06	2500	313	28	51	29	5	0.7	8600	14300	529	3900	3.0	1.3	11300
507-006	OT	32	0.051	0.06	3400	313	35	84	35	5	0.9	8300	10900	362	3800	0.6	1.3	11700
507-007	OS	30	0.078	0.06	3500	313	37	81	36	4	1.7	9600	11100	491	7200	0.6	1.3	13600
507-008	OT	60	0.054	0.06	2900	313	36	120	34	4	1.6	7400	9300	418	5000	1.0	1.3	11100
507-009	OS	17	0.072	0.06	2800	313	29	54	39	4	1.1	8100	10800	502	7000	3.0	8.0	15800
507-010	OT	70	0.066	0.06	2900	313	33	120	39	4	1.8	7700	8100	417	4100	0.6	1.3	5000
507-011	OL	43	0.036	0.06	4000	313	41	75	36	3	1.4	11000	10500	552	5800	0.6	1.3	5700
507-012	SAP	52	0.027	0.06	2500	313	12	57	17	3	2.4	6000	7500	84	18700	0.6	1.3	7400
508-001	RT	130	0.023	0.06	5900	313	45	200	39	3	3.2	17000	7100	740	5400	0.6	1.3	7300
508-002	RT	130	0.021	0.06	5500	313	45	220	35	3	3.1	15900	6200	614	4800	0.6	1.3	12000
508-003	RT	130	0.023	0.06	6000	313	48	240	34	5	2.9	16200	7900	668	5700	0.6	1.3	10500
508-004	SAP	62	0.033	0.06	700	313	136	140	6	3	4.0	2600	10300	53	13600	0.6	1.3	6200
508-007	SAP	1	0.018	0.06	1000	313	9	6	6	2	0.3	3100	12800	63	24400	0.6	1.3	6100
509-001	RT	130	0.020	0.06	5600	313	47	210	35	4	3.4	17400	7300	103	5100	0.6	1.3	9900
510-001	RT	110	0.030	0.06	5700	313	39	210	38	4	3.2	16800	7000	667	3300	2.0	1.3	12100
510-002	RT	130	0.024	0.06	5600	313	45	270	34	4	3.5	14600	6100	838	2600	3.0	1.3	11900
511-001	RT	130	0.032	0.06	4800	313	41	290	28	3	3.5	15000	7700	664	3500	3.0	1.3	18100
511-002	RT	140	0.038	0.06	5100	313	39	260	33	4	3.5	15700	8700	625	4900	0.6	1.3	20600
511-003	RT	130	0.033	0.06	5000	313	38	270	34	4	3.5	16200	6700	639	3000	0.6	1.3	20900
511-004	WT	201	0.078	0.06	3900	313	33	400	29	4	4.2	15800	8600	825	3700	0.6	1.3	9700
511-005	WT	100	0.102	0.06	7100	313	35	260	32	4	2.6	12700	10000	463	4400	4.0	1.3	13400
512-001	WT	94	0.120	0.06	5900	313	37	180	34	5	2.0	12400	9500	617	5100	0.6	1.3	9000
512-002	WT	79	0.162	0.06	7400	313	36	160	36	5	1.8	11700	10000	466	6100	2.0	1.3	10600
512-003	WT	41	0.162	0.06	6700	313	37	160	35	5	2.5	10900	10200	462	6000	0.6	6.0	7000
513-001	RT	160	0.072	0.06	3800	313	35	340	26	3	4.0	14700	6600	849	3400	0.6	1.3	9900
513-002	WT	78	0.157	0.06	4700	313	34	170	30	4	2.1	12200	9300	605	5100	0.6	1.3	6900
513-003	WT	74	0.303	0.06	5700	313	31	150	30	4	1.8	9800	10100	376	5200	0.6	1.3	7000
513-004	WT	87	0.204	0.06	5000	313	28	160	27	4	1.9	9400	9800	395	5300	0.6	1.3	8000

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Hf nmhmc inaa	Hg nmhmc cvaa	Ir nmhmc inaa	K -2um icp	K nmhmc icp	La -2um icp	La nmhmc inaa	Li -2um icp	Li nmhmc icp	Lu nmhmc inaa	Mg -2um icp	Mg nmhmc icp	Mn -2um aa	Mn nmhmc icp	Mo -2um icp	Mo nmhmc icp	Na -2um icp
513-005	SAP	17	0.048	0.06	3000	313	27	18	30	6	1.0	14400	5100	594	3400	2.0	1.3	8000
514-001	RT	150	0.036	0.06	5200	313	41	400	37	5	3.6	16700	7100	678	5000	0.6	1.3	7300
514-002	RT	170	0.249	0.06	4900	313	39	390	33	4	4.0	16800	6100	636	3500	0.6	1.3	10000
514-003	RT	120	0.027	0.06	5600	313	40	270	33	4	4.0	16700	7200	573	3100	2.0	1.3	11000
514-004	RG	11	0.072	0.06	3600	313	31	54	24	3	1.1	14000	12100	622	12200	3.0	1.3	12100
514-005	OS	160	0.029	0.06	2900	313	22	350	19	4	4.1	7400	6200	268	3300	0.6	1.3	26600
514-006	SAP	1	0.012	0.06	1000	313	9	6	24	15	0.3	16000	15300	333	21300	7.0	1.3	21500
515-001	RT	140	0.069	0.06	5900	313	43	190	34	3	3.5	17000	10200	573	7000	6.0	1.3	14700
515-002	RT	59	0.061	0.06	5600	313	40	150	32	3	2.1	18000	8800	826	8500	5.0	1.3	14900
515-003	RT	120	0.069	0.06	3700	313	32	170	25	3	2.5	10400	9900	455	5600	5.0	1.3	14200
515-004	OT	120	0.048	0.06	4500	313	40	270	30	3	3.4	14300	8000	620	4700	6.0	1.3	9200
515-005	OT	120	0.036	0.06	4800	313	46	340	31	3	4.3	13700	7900	662	4800	5.0	1.3	10400
515-006	OT	120	0.054	0.06	4700	313	45	350	32	4	3.8	14600	8100	744	4500	5.0	1.3	8300
515-007	OT	98	0.044	0.06	4700	313	44	270	31	4	3.7	13900	8700	754	5600	6.0	1.3	11200
515-008	OT	75	0.047	0.06	4900	313	32	240	29	4	2.1	14400	9000	723	6300	5.0	1.3	13100
516-001	KT	215	0.063	0.06	4700	313	40	330	33	4	4.1	16300	7300	713	3800	2.0	1.3	8600
516-002	KT	190	0.075	0.06	4900	313	40	320	35	4	4.1	16700	7200	749	4100	5.0	1.3	9700
516-003	KG	99	0.099	0.06	8600	313	43	250	36	4	2.8	19500	6900	642	4500	4.0	1.3	14200
517-001	RT	150	0.048	0.06	5700	313	36	330	35	3	4.4	16900	6100	595	3200	2.0	1.3	12600
517-002	RT	230	0.053	0.06	5400	313	36	430	34	3	4.9	17300	6100	583	2500	2.0	1.3	12700
517-003	WT	372	0.153	0.06	5200	313	37	551	34	3	7.0	16900	6000	614	2000	4.0	1.3	6400
517-004	WT	281	0.129	0.06	5000	313	39	450	35	4	6.3	17000	4700	616	1900	3.0	1.3	5200
517-005	WT		0.060		5300	313	37	346	33	3		16000	4900	569	2300	3.0	15.0	4900
517-006	WT	238	0.228	0.06	4900	313	37	420	32	4	4.6	16600	6500	549	3500	3.0	1.3	4200
517-007	WT	271	0.213	0.06	5400	313	40	400	37	4	5.5	17000	6500	597	2900	5.0	1.3	5400
517-008	WT	170	0.141	0.06	5400	313	42	350	35	4	4.3	15600	7400	626	4200	4.0	1.3	6900
517-009	WT	214	0.125	0.06	5500	313	39	460	34	3	4.4	16000	8000	591	3700	5.0	1.3	5100
517-010	WT	110	0.153	0.06	5100	313	38	300	33	4	4.2	15500	7400	605	3900	5.0	1.3	4500
517-011	OT	120	0.081	0.06	3800	313	34	290	29	3	3.4	15000	7600	750	4600	4.0	1.3	16400
517-012	OT	110	0.087	0.06	3600	313	32	250	27	3	3.7	15600	7900	579	5000	6.0	1.3	15000
517-013	OT	170	0.084	0.06	3500	313	33	370	26	4	4.1	16000	7300	680	4200	4.0	1.3	15400
517-014	OT	96	0.060	0.06	3500	313	32	240	26	4	3.3	15500	7300	657	5000	5.0	1.3	19500
517-015	OT	120	0.078	0.06	3800	313	38	280	29	3	3.6	16300	5800	851	3700	4.0	1.3	10100
517-016	OT	110	0.083	0.06	4100	313	39	250	30	3	3.6	16500	5800	830	4200	3.0	1.3	10600
517-017	OT	160	0.096	0.06	3900	313	38	300	31	3	4.3	16200	6600	795	3700	4.0	1.3	9800
517-018	OT	120	0.102	0.06	4100	313	37	240	31	3	2.8	16600	5500	864	4400	3.0	1.3	8900
518-001	RT	140	0.063	0.06	4900	313	39	250	32	3	2.7	16500	7300	614	4300	2.0	1.3	8200
518-002	RT	200	0.096	0.06	5000	313	38	350	33	3	4.5	15000	8100	653	3900	4.0	1.3	6700
518-003	WS	262	0.096	0.06	4600	313	34	290	32	4	4.8	12400	10300	498	3600	6.0	1.3	11400
518-004	WT	160	0.345	0.06	3100	313	29	210	25	4	3.0	18700	6300	625	4200	5.0	6.0	5900
518-005	WT	91	0.348	0.06	3900	313	33	170	32	4	2.1	16900	6200	600	4100	5.0	1.3	5500
518-006	WT	180	0.333	0.06	4600	313	39	210	37	4	3.6	14700	6100	590	4100	4.0	10.0	5700
518-007	WT	65	0.192	0.06	6600	313	34	180	37	5	2.0	11700	10200	457	3700	4.0	1.3	4700
518-008	WT	81	0.219	0.06	5400	313	29	160	42	5	1.8	16300	9300	474	3600	6.0	5.0	9000
519-001	RT	98	0.087	0.10	3600	313	29	240	26	3	3.2	16800	7400	537	6200	4.0	1.3	13700
519-002	RT	130	0.090	0.06	3700	313	30	280	27	3	3.9	15800	7900	601	5200	3.0	1.3	12000
519-003	WT	130	0.129	0.06	4200	313	34	280	31	3	3.0	17500	7500	669	4700	4.0	1.3	9800
519-004	WT	150	0.135	0.06	3200	313	33	340	33	4	3.5	9200	8300	510	3300	5.0	1.3	5200
519-005	WT	61	0.051	0.06	4900	313	33	200	29	3	2.3	11300	8300	616	7200	6.0	1.3	5300
519-006	WT	100	0.054	0.06	4900	313	34	310	27	3	2.6	10500	7400	538	6300	4.0	1.3	7600
520-001	RT	170	0.042	0.06	6200	313	47	320	37	4	4.2	19200	5100	710	2200	6.0	1.3	9700
520-002	RT	140	0.033	0.06	5300	313	43	260	35	3	4.1	18300	5000	713	2200	2.0	1.3	7900
520-003	RT	110	0.096	0.06	4400	313	38	210	30	4	3.5	19900	6700	741	4300	3.0	1.3	8500
520-004	WT	170	0.204	0.06	5600	313	41	310	35	3	3.8	19000	8000	634	3400	4.0	1.3	7500
520-005	OT	62	0.068	0.06	3900	313	35	150	27	4	2.5	16100	10200	625	5900	6.0	1.3	8600

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Hf nmhmc inaa	Hg nmhmc cvaa	Ir nmhmc inaa	K -2um icp	K nmhmc icp	La -2um icp	La nmhmc inaa	Li -2um icp	Li nmhmc icp	Lu nmhmc inaa	Mg -2um icp	Mg nmhmc icp	Mn -2um aa	Mn nmhmc icp	Mo -2um icp	Mo nmhmc icp	Na -2um icp
520-006	OT	70	0.066	0.06	4300	313	30	190	29	3	2.2	14100	9700	642	6000	4.0	1.3	6800
520-007	OT	120	0.087	0.06	4500	313	31	230	31	4	3.6	13900	7900	702	5000	4.0	1.3	6900
520-008	OT	92	0.069	0.06	4300	313	29	230	29	3	3.6	16700	7600	746	4800	5.0	1.3	7300
520-009	OT	120	0.081	0.06	4300	313	29	270	29	4	3.3	16800	7400	895	5600	4.0	1.3	6900
520-010	OT	97	0.087	0.06	4100	313	31	240	29	3	2.6	15200	7800	851	5400	6.0	1.3	7400
520-011	OT	130	0.096	0.06	4300	313	31	290	29	3	3.0	16000	7400	681	4700	7.0	1.3	7500
520-012	OT	281	0.084	0.06	4000	313	33	430	29	4	4.1	15600	6200	565	2400	3.0	1.3	8400
520-013	OT	256	0.078	0.06	4100	313	36	450	30	3	5.0	13800	4700	624	1800	5.0	1.3	12200
520-014	OT	264	0.075	0.06	3600	313	33	500	28	4	6.0	15300	5200	904	2400	3.0	1.3	7800
520-015	OS	24	0.045	0.06	2700	500	46	99	17	4	1.6	10100	11500	626	9200	16.0	1.3	13200
520-016	SAP	12	0.036	0.06	1000	700	167	110	7	4	0.7	1800	12600	34	9200	3.0	1.3	6700
520-017	SAP	1	0.012	0.06	1200	1100	751	642	6	3	1.4	2000	15900	57	4400	5.0	1.3	7400
521-001	RT	180	0.066	0.06	4800	313	32	380	32	3	4.4	17600	5800	622	3100	4.0	1.3	10500
521-002	RT	221	0.063	0.06	4700	313	33	510	31	4	5.0	15400	7300	732	3300	4.0	1.3	6400
521-003	WT	130	0.105	0.06	4800	313	29	290	26	3	3.8	14300	7400	605	4100	3.0	1.3	7100
521-004	OT	71	0.099	0.06	3600	313	30	230	28	3	3.2	14600	7800	624	5300	4.0	1.3	8800
521-005	WT	261	0.258	0.06	4400	313	33	460	38	4	5.4	14800	6300	624	3300	3.0	1.3	4500
521-006	WT	140	0.258	0.06	4400	313	32	220	37	4	3.3	16300	7500	636	4900	4.0	7.0	7400
521-007	OG	10	0.099	0.06	4900	313	27	67	34	4	1.4	15400	9000	946	12500	6.0	1.3	10800
521-008	OG	8	0.078	0.06	4300	313	20	93	32	4	1.2	16300	9000	1119	11300	8.0	4.0	10200
521-009	OG	16	0.051	0.06	4300	313	20	82	32	4	1.6	17600	10700	1014	11900	11.0	5.0	10100
521-010	OS	30	0.033	0.06	3800	313	35	110	21	4	1.5	6600	14000	386	7400	9.0	1.3	17900
521-011	OS	71	0.045	0.06	5100	313	36	160	23	4	2.0	8800	13200	303	6400	7.0	1.3	22000
521-012	SAP	8	0.015	0.06	6200	900	60	49	39	8	9.0	18200	8800	120	7300	3.0	1.3	19100

Note: All values are reported in parts per million (ppm).

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Na nmhmc icp	Nb -2um icp	Nb nmhmc icp	Ni -2um icp	Ni nmhmc icp	P -2um icp	P nmhmc icp	Pb -2um icp	Pb nmhmc icp	Rb -2um icp	Rb nmhmc icp	Sb -2um hyaa	Sb nmhmc inaa	Sc -2um icp	Sc nmhmc inaa	Se -2um xrf	Se nmhmc hyaa
501-001	RT	313	0.6	12	25	63	14880	720	18	63	51	13	0.2	0.7	2	39	0.6	0.3
501-002	SAP	313	0.6	14	13	15	5990	670	32	38	13	34	0.2	0.1	1	17	0.6	0.1
501-003	SAP	313	0.6	16	39	65	12860	870	18	57	13	13	0.3	0.5	6	19	0.6	0.1
502-001	RT	313	2.0	14	65	34	20290	720	12	30	40	13	0.3	0.5	9	62	0.6	0.6
502-002	RT	313	3.0	15	65	36	11830	870	15	32	13	13	0.2	0.4	9	67	0.6	0.5
502-003	RT	313	3.0	14	67	30	12150	870	14	37	27	13	0.2	0.6	9	71	0.6	0.3
502-004	RS	313	3.0	12	70	33	15280	840	12	28	98	13	0.3	0.8	10	52	1.0	0.2
502-005	OL	313	2.0	13	79	43	16120	1360	13	36	88	13	0.3	0.9	11	62	0.6	0.2
503-001	RT	313	4.0	14	66	54	6490	960	13	31	55	13	0.2	0.4	7	70	0.6	0.9
503-002	RT	313	3.0	14	68	40	8190	1340	14	32	55	13	0.2	0.5	8	80	0.6	0.8
503-003	RT	500	2.0	15	59	32	8770	1350	12	32	32	13	0.2	0.4	8	82	0.6	0.7
503-004	RT	313	3.0	7	67	56	5520	770	12	34	70	13	0.2	1.7	8	110	0.6	0.1
503-005	RT	600	2.0	15	52	45	7430	1020	14	44	28	13	0.2	0.4	10	81	0.6	0.7
503-006	ASAP	313	0.6	8	11	84	3010	570	12	37	13	13	0.2	2.7	3	92	0.6	0.3
503-007	SAP	313	0.6	16	19	81	4100	940	4	10	13	13	0.1	0.1	2	79	0.6	0.1
505-001	RT	313	5.0	13	84	48	5940	950	13	35	54	13	0.2	0.7	11	52	0.6	0.2
505-002	OT	313	3.0	12	126	54	6310	2110	17	34	28	13	0.2	0.9	20	46	1.0	0.2
505-003	OT	313	2.0	13	103	665	4970	1640	16	50	73	13	0.2	1.0	16	44	1.0	0.3
505-004	SAP	313	2.0	16	94	78	4760	1670	21	110	123	13	0.2	0.9	19	38	1.0	0.1
506-001	RT	313	2.0	12	74	66	13050	1220	7	40	27	13	0.2	1.6	14	58	0.6	0.2
506-002	RT	313	4.0	11	65	60	9270	1320	12	40	34	13	0.2	2.2	16	63	1.0	0.2
506-003	SAP	313	0.6	14	13	46	9970	3520	6	26	13	22	0.2	1.0	14	44	2.0	0.1
506-004	SAP	313	0.6	12	52	61	8730	1550	9	27	22	13	0.3	0.8	18	57	1.0	0.2
507-001	RT	313	4.0	15	49	36	5260	1100	16	29	108	13	0.2	0.8	7	82	0.6	0.2
507-002	RT	313	5.0	12	51	34	4400	1120	10	29	31	13	0.1	0.7	7	66	0.6	0.2
507-003	RL	313	5.0	11	52	44	3340	1100	11	27	55	13	0.2	0.8	7	54	0.6	0.2
507-004	OT	313	2.0	11	58	56	9240	1190	9	31	49	13	0.3	0.8	9	47	0.6	0.1
507-005	OT	313	2.0	12	63	56	7690	980	12	29	13	29	0.3	0.7	11	54	2.0	0.1
507-006	OT	313	1.0	11	56	53	8690	980	15	35	70	29	0.2	1.0	8	48	0.6	0.1
507-007	OS	313	2.0	13	62	74	9980	1190	14	35	13	13	0.2	1.1	10	49	0.6	0.2
507-008	OT	313	2.0	11	65	70	7670	1060	16	43	13	13	0.3	1.0	8	55	2.0	0.1
507-009	OS	313	2.0	14	66	61	12110	1070	13	25	13	13	0.3	0.9	8	48	2.0	0.1
507-010	OT	313	1.0	10	58	60	2840	940	11	43	13	13	0.2	1.2	8	59	1.0	0.1
507-011	OL	313	1.0	10	62	57	3820	1140	13	29	31	13	0.2	0.8	9	49	1.0	0.1
507-012	SAP	313	0.6	1	26	54	3760	3020	9	32	13	13	0.1	0.5	17	64	0.6	0.1
508-001	RT	313	5.0	12	60	38	3960	1840	15	34	157	13	0.2	0.9	9	63	0.6	0.2
508-002	RT	313	4.0	14	83	42	7460	1870	14	33	27	13	0.2	0.9	10	67	1.0	0.4
508-003	RT	313	4.0	15	91	55	5920	1570	12	40	39	13	0.2	0.8	11	66	0.6	0.4
508-004	SAP	313	0.6	14	127	57	4760	1040	29	89	13	13	0.2	0.1	8	43	0.6	0.2
508-007	SAP	313	0.6	15	90	22	4350	780	34	166	13	61	0.1	0.3	12	34	0.6	0.1
509-001	RT	313	4.0	13	83	43	5420	1620	13	37	13	13	0.2	0.9	12	69	0.6	0.3
510-001	RT	313	4.0	13	68	42	6990	1400	15	40	43	13	0.2	0.9	11	70	0.6	0.3
510-002	RT	313	4.0	13	54	43	9500	1460	2	34	13	13	0.2	0.8	7	75	1.0	0.5
511-001	RT	313	5.0	13	56	53	15730	1580	4	42	13	13	0.2	0.7	6	68	0.6	0.1
511-002	RT	313	5.0	15	65	47	15870	1140	10	41	13	13	0.2	0.6	8	65	1.0	0.2
511-003	RT	313	4.0	15	47	33	16160	1130	14	39	35	13	0.3	0.8	7	72	0.6	0.3
511-004	WT	500	7.0	16	39	40	7230	1550	12	48	107	13	0.3	1.3	5	62	0.6	0.4
511-005	WT	313	7.0	15	30	51	10320	1030	11	140	155	13	0.2	1.3	6	44	0.6	0.5
512-001	WT	313	8.0	14	51	92	6580	1720	13	59	127	48	0.2	1.5	8	41	1.0	1.2
512-002	WT	313	8.0	15	51	128	7560	1440	12	77	150	33	0.3	1.6	7	38	3.0	2.0
512-003	WT	313	8.0	14	48	111	4800	1300	14	71	106	13	0.2	1.3	7	39	0.6	1.2
513-001	RT	313	10.0	12	47	43	6420	1250	11	45	76	13	0.3	1.1	7	73	3.0	0.3
513-002	WT	313	10.0	14	46	97	5130	1300	14	50	95	13	0.2	1.6	6	41	0.6	1.4
513-003	WT	313	8.0	14	53	84	4910	1630	12	52	111	13	0.2	1.5	7	34	2.0	3.2
513-004	WT	313	8.0	13	54	97	6080	1660	13	52	35	13	0.3	2.0	7	37	0.6	2.7

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Na nmhmc icp	Nb -2um icp	Nb nmhmc icp	Ni -2um icp	Ni nmhmc icp	P -2um icp	P nmhmc icp	Pb -2um icp	Pb nmhmc icp	Rb -2um icp	Rb nmhmc icp	Sb -2um hyaa	Sb nmhmc inaa	Sc -2um icp	Sc nmhmc inaa	Se -2um xrf	Se nmhmc hyaa
513-005	SAP	313	7.0	4	44	177	5410	830	8	68	59	13	0.1	6.2	16	46	0.6	20.0
514-001	RT	500	10.0	15	47	40	4760	1410	12	46	130	13	0.2	0.5	7	73	1.0	0.3
514-002	RT	313	9.0	13	48	34	6980	1470	12	48	115	28	0.2	0.5	8	76	1.0	0.2
514-003	RT	313	9.0	14	53	33	7600	1410	14	31	63	13	0.2	0.5	8	73	4.0	0.3
514-004	RG	313	9.0	15	56	31	8850	1380	13	22	93	13	0.2	0.6	10	24	0.6	0.3
514-005	OS	500	5.0	14	40	33	24710	1250	18	38	104	42	0.3	0.7	8	76	3.0	0.2
514-006	SAP	313	7.0	15	48	13	14900	1620	20	3	148	13	0.2	0.1	29	19	0.6	0.2
515-001	RT	313	9.0	12	53	37	10760	1470	7	29	99	13	0.2	0.9	8	44	0.6	0.2
515-002	RT	313	9.0	14	76	47	10570	1280	8	31	133	13	0.3	0.8	11	46	0.6	0.5
515-003	RT	313	8.0	12	50	48	11390	1530	9	39	128	13	0.3	1.0	8	49	1.0	0.3
515-004	OT	313	10.0	11	53	30	6330	1280	8	35	137	13	0.3	0.8	8	65	0.6	0.3
515-005	OT	313	10.0	12	56	30	6810	1320	10	35	124	13	0.3	0.8	8	76	0.6	0.3
515-006	OT	313	11.0	11	53	32	5550	1260	9	36	103	13	0.6	0.9	8	74	0.6	0.3
515-007	OT	500	11.0	11	59	31	7970	1450	10	34	110	13	0.2	0.9	8	63	0.6	0.4
515-008	OT	313	9.0	11	51	31	8650	1560	12	32	146	13	0.3	0.8	11	49	0.6	0.2
516-001	KT	313	16.0	13	47	53	6040	1520	10	41	54	13	0.2	1.0	6	68	0.6	0.2
516-002	KT	313	17.0	12	50	41	6830	1270	13	56	131	13	0.2	1.2	7	70	0.6	0.4
516-003	KG	313	17.0	14	70	76	10810	920	16	44	107	13	0.3	1.2	8	61	0.6	1.4
517-001	RT	313	14.0	15	45	33	8540	1190	11	33	69	13	0.2	0.7	7	79	0.6	0.2
517-002	RT	313	14.0	14	43	32	8970	1660	9	46	53	13	0.2	1.0	7	76	0.6	0.9
517-003	WT	313	18.0	19	38	81	4870	1620	11	73	71	13	0.3	1.5	6	74	0.6	0.5
517-004	WT	313	19.0	17	38	64	3650	1180	10	59	53	13	0.2	1.8	6	84	1.0	0.5
517-005	WT	313	18.0	14	35	38	3350	960	13	60	121	13	0.2	0.1	6	26	2.0	0.1
517-006	WT	313	18.0	18	35	106	3230	1290	9	71	86	13	0.3	1.8	5	63	0.6	1.1
517-007	WT	313	18.0	18	38	96	3890	1290	10	76	109	13	0.2	1.8	6	66	0.6	0.7
517-008	WT	313	15.0	15	46	87	4390	1130	13	57	13	13	0.2	1.4	6	67	0.6	0.5
517-009	WT	313	15.0	15	46	102	3290	1350	12	84	133	13	0.3	1.7	6	66	0.6	0.7
517-010	WT	313	15.0	17	46	83	2940	1010	12	132	97	13	0.2	1.6	6	66	2.0	0.5
517-011	OT	313	15.0	13	46	53	13470	1050	12	48	54	13	0.3	1.2	6	70	0.6	0.3
517-012	OT	313	16.0	15	51	51	11630	1040	11	42	79	13	0.3	1.3	6	65	0.6	0.3
517-013	OT	313	15.0	13	46	48	12040	1260	9	47	44	13	0.3	1.4	6	70	0.6	0.4
517-014	OT	313	15.0	14	45	43	15820	880	10	41	33	13	0.3	1.3	6	74	1.0	0.2
517-015	OT	313	17.0	12	49	44	7230	1080	11	40	58	13	0.2	1.2	7	76	1.0	0.3
517-016	OT	313	16.0	14	54	48	7670	990	11	38	66	13	0.3	1.3	8	70	1.0	0.4
517-017	OT	313	17.0	14	51	47	7130	1090	15	38	75	13	0.4	1.2	7	70	1.0	0.5
517-018	OT	313	16.0	12	54	52	6020	860	14	36	52	13	0.3	1.6	8	66	0.6	0.5
518-001	RT	313	16.0	16	45	30	5770	1350	11	35	29	13	0.3	0.9	6	55	3.0	0.1
518-002	RT	313	15.0	17	51	47	4040	1500	13	49	46	13	0.3	1.5	7	65	0.6	0.2
518-003	WS	500	12.0	15	62	70	7640	1890	12	47	35	13	0.4	1.4	8	58	3.0	0.2
518-004	WT	313	18.0	17	39	155	4390	1420	11	91	67	13	0.4	2.4	4	34	1.0	0.9
518-005	WT	313	16.0	15	49	129	3780	1220	15	74	13	13	0.4	2.9	5	32	1.0	1.2
518-006	WT	313	15.0	15	58	122	3960	1480	14	70	22	13	0.3	2.7	6	36	0.6	1.5
518-007	WT	313	13.0	16	42	76	3300	1550	10	54	79	13	0.3	2.3	6	36	0.6	2.5
518-008	WT	313	13.0	15	87	66	6490	1410	10	45	13	13	0.9	2.5	8	38	0.6	2.6
519-001	RT	313	17.0	15	40	31	10850	1020	10	35	57	13	0.3	0.8	5	59	0.6	0.3
519-002	RT	313	17.0	17	40	38	9010	1280	9	39	26	13	0.3	0.9	5	61	2.0	0.2
519-003	WT	313	18.0	18	45	74	6900	940	10	41	79	13	0.3	1.3	6	61	2.0	0.3
519-004	WT	313	11.0	16	42	75	3820	1520	15	46	13	13	0.4	2.0	5	42	0.6	0.4
519-005	WT	313	11.0	15	82	69	3410	1200	17	35	73	13	0.3	1.4	12	45	0.6	0.5
519-006	WT	313	10.0	15	80	86	5010	1280	15	43	57	13	0.3	1.7	12	48	0.6	0.6
520-001	RT	313	17.0	20	57	31	6260	1040	16	31	96	13	0.4	0.8	8	79	1.0	0.4
520-002	RT	313	16.0	18	57	27	4750	920	12	31	47	13	0.3	0.6	8	76	2.0	0.2
520-003	RT	313	18.0	17	48	44	6130	1150	11	42	37	13	0.3	0.9	7	66	0.6	0.3
520-004	WT	313	18.0	20	48	66	4750	1320	14	59	51	13	0.3	1.5	6	56	1.0	0.3
520-005	OT	313	16.0	15	81	60	5360	940	13	35	13	35	0.4	1.5	9	57	0.6	0.3

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Na nmhmc icp	Nb -2um icp	Nb nmhmc icp	Ni -2um icp	Ni nmhmc icp	P -2um icp	P nmhmc icp	Pb -2um icp	Pb nmhmc icp	Rb -2um icp	Rb nmhmc icp	Sb -2um hyaa	Sb nmhmc inaa	Sc -2um icp	Sc nmhmc inaa	Se -2um xrf	Se nmhmc hyaa
520-006	OT	313	14.0	15	59	63	3890	1060	13	35	109	13	0.3	1.2	10	62	1.0	0.3
520-007	OT	313	15.0	13	60	67	4100	1190	14	41	82	13	0.3	1.5	10	60	0.6	0.6
520-008	OT	313	18.0	14	56	44	4420	1170	16	34	45	13	0.4	1.3	9	71	1.0	0.2
520-009	OT	313	18.0	15	63	56	4430	900	13	40	45	13	0.3	1.3	9	66	0.6	0.5
520-010	OT	313	17.0	13	60	61	5000	1070	13	42	62	13	0.4	1.2	8	64	1.0	0.2
520-011	OT	313	18.0	15	54	51	5010	890	16	49	129	13	0.3	1.2	8	63	0.6	0.3
520-012	OT	313	19.0	19	43	36	6060	1190	11	57	13	13	0.4	1.4	7	69	0.6	0.1
520-013	OT	313	18.0	17	45	30	8550	990	17	54	13	39	0.2	1.4	8	86	1.0	0.1
520-014	OT	313	20.0	18	43	34	5000	1020	12	46	62	13	0.4	1.6	7	78	0.6	0.1
520-015	OS	313	15.0	15	103	54	11340	1020	22	26	22	21	1.3	0.9	10	36	0.6	0.5
520-016	SAP	313	12.0	15	50	51	5980	1120	10	146	71	13	0.3	1.1	10	30	2.0	0.3
520-017	SAP	313	42.0	18	88	33	7400	1350	63	971	13	13	1.0	0.5	11	16	0.6	0.1
521-001	RT	313	18.0	19	48	36	7790	990	12	42	34	13	0.4	0.8	7	76	0.6	0.4
521-002	RT	313	18.0	18	46	35	4420	1590	9	47	29	13	0.3	0.9	7	75	0.6	0.1
521-003	WT	313	16.0	14	42	68	4430	1200	10	53	30	13	0.4	1.3	6	63	3.0	0.5
521-004	OT	313	18.0	14	46	52	5450	890	10	33	52	13	0.4	1.2	7	67	0.6	0.3
521-005	WT	500	17.0	22	71	74	3350	1230	12	83	93	13	0.4	1.5	7	59	0.6	0.4
521-006	WT	313	19.0	17	47	95	5880	1320	9	62	64	13	0.3	2.1	7	37	0.6	1.2
521-007	OG	313	16.0	15	84	75	7650	1370	22	60	51	33	0.5	2.8	12	29	1.0	1.8
521-008	OG	313	16.0	14	116	65	6620	1420	22	119	75	13	0.6	2.7	14	29	0.6	1.2
521-009	OG	313	16.0	16	131	51	6690	1250	23	43	74	13	0.8	2.0	14	32	1.0	0.5
521-010	OS	313	10.0	16	84	35	14450	1230	27	26	46	43	0.6	0.6	11	36	0.6	0.1
521-011	OS	313	10.0	15	92	43	17280	1360	24	29	51	60	0.5	0.7	10	42	1.0	0.1
521-012	SAP	313	10.0	8	121	24	10730	1110	21	18	56	13	0.2	0.1	6	129	1.0	0.1

Note: All values are reported in parts per million (ppm).

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Sm nmhmc inaa	Sn -2um icp	Sn nmhmc icp	Sr -2um icp	Sr nmhmc icp	Ta -2um icp	Ta nmhmc inaa	Tb nmhmc inaa	Te -2um icp	Te nmhmc inaa	Th nmhmc inaa	Ti -2um icp	Ti nmhmc icp	U nmhmc inaa	V -2um icp	V nmhmc icp
501-001	RT	35	12.5	12.5	10	91	0.6	9	5	6.3	12.5	67	313	6530	15	26	155
501-002	SAP	8	12.5	12.5	5	39	0.6	6	2	6.3	12.5	19	313	980	6	23	130
501-003	SAP	69	12.5	12.5	20	53	0.6	2	6	6.3	12.5	21	313	313	10	36	115
502-001	RT	44	12.5	12.5	62	153	0.6	8	5	6.3	12.5	111	670	10850	15	79	173
502-002	RT	50	12.5	12.5	70	117	0.6	10	5	6.3	12.5	154	910	9550	18	83	165
502-003	RT	44	12.5	12.5	66	125	0.6	10	5	6.3	12.5	155	940	10600	17	80	152
502-004	RS	19	12.5	12.5	62	52	0.6	4	3	6.3	12.5	52	890	3720	6	80	169
502-005	OL	32	12.5	12.5	49	99	0.6	8	4	6.3	12.5	69	940	6410	10	80	164
503-001	RT	45	12.5	12.5	65	111	0.6	10	6	6.3	12.5	154	1490	8560	14	70	136
503-002	RT	51	12.5	12.5	66	115	0.6	11	6	6.3	12.5	184	1800	9420	21	79	125
503-003	RT	55	12.5	12.5	62	82	0.6	14	7	6.3	12.5	232	1720	8230	22	75	117
503-004	RT	44	12.5	12.5	58	95	0.6	16	6	6.3	12.5	148	1710	13580	21	75	243
503-005	RT	49	12.5	12.5	192	115	0.6	12	6	6.3	12.5	187	950	10710	18	87	157
503-006	ASAP	28	12.5	12.5	54	38	0.6	20	4	6.3	12.5	127	313	11120	21	99	695
503-007	SAP	2	12.5	12.5	6	67	0.6	1	1	6.3	12.5	5	313	313	1	37	484
505-001	RT	29	12.5	12.5	57	47	0.6	6	4	6.3	12.5	58	1280	5850	9	79	171
505-002	OT	19	12.5	12.5	40	54	0.6	4	3	6.3	12.5	41	1080	5820	6	104	230
505-003	OT	22	12.5	12.5	38	48	0.6	4	3	6.3	12.5	43	1080	5550	6	89	190
505-004	SAP	43	12.5	12.5	46	44	0.6	2	4	6.3	12.5	39	580	2470	10	77	146
506-001	RT	19	12.5	12.5	43	45	0.6	7	2	6.3	12.5	64	500	5940	7	106	233
506-002	RT	19	12.5	12.5	60	45	0.6	7	4	6.3	12.5	61	840	8490	6	113	192
506-003	SAP	8	12.5	12.5	185	47	0.6	6	2	6.3	12.5	3	313	1410	1	95	1593
506-004	SAP	19	12.5	12.5	34	30	0.6	5	9	6.3	12.5	3	313	6550	1	75	861
507-001	RT	42	12.5	12.5	64	92	0.6	9	5	6.3	12.5	143	1520	9070	16	63	116
507-002	RT	31	12.5	12.5	58	60	0.6	8	4	6.3	12.5	98	1260	6170	12	57	128
507-003	RL	18	12.5	12.5	60	51	0.6	6	2	6.3	12.5	60	1160	4360	7	60	165
507-004	OT	14	12.5	12.5	58	53	0.6	5	2	6.3	12.5	46	720	3710	6	71	195
507-005	OT	11	12.5	12.5	68	49	0.6	5	2	6.3	12.5	36	770	3510	4	80	210
507-006	OT	15	12.5	12.5	59	45	0.6	5	1	6.3	12.5	53	800	3440	6	65	201
507-007	OS	14	12.5	12.5	53	39	0.6	4	2	6.3	12.5	52	790	2800	5	74	176
507-008	OT	21	12.5	12.5	52	46	0.6	7	3	6.3	12.5	77	730	4210	9	57	174
507-009	OS	10	12.5	12.5	56	35	0.6	3	2	6.3	12.5	32	620	1880	3	63	162
507-010	OT	20	12.5	12.5	57	46	0.6	6	3	6.3	12.5	73	780	4540	10	63	185
507-011	OL	14	12.5	12.5	54	43	0.6	4	2	6.3	12.5	39	1000	4290	5	74	177
507-012	SAP	17	12.5	12.5	34	45	0.6	10	3	6.3	12.5	23	313	21370	4	44	91
508-001	RT	34	12.5	12.5	62	76	0.6	7	5	6.3	12.5	110	1430	7210	14	72	192
508-002	RT	39	12.5	12.5	55	86	0.6	8	4	6.3	12.5	116	1300	7070	14	79	205
508-003	RT	41	12.5	12.5	64	121	0.6	7	4	6.3	12.5	131	1060	9110	15	84	242
508-004	SAP	33	12.5	12.5	11	48	0.6	5	3	6.3	12.5	43	313	4450	6	110	126
508-007	SAP	1	12.5	12.5	12	21	0.6	1	1	6.3	12.5	12	313	313	1	162	88
509-001	RT	37	12.5	12.5	96	84	0.6	10	5	6.3	12.5	114	1720	8160	15	86	163
510-001	RT	37	12.5	12.5	64	87	0.6	10	4	6.3	12.5	123	1300	7890	14	94	157
510-002	RT	45	12.5	12.5	49	74	0.6	11	5	6.3	12.5	166	1480	7300	18	62	131
511-001	RT	46	12.5	12.5	47	59	0.6	11	5	6.3	12.5	188	1040	5340	18	52	141
511-002	RT	44	12.5	12.5	51	70	0.6	11	6	6.3	12.5	163	580	7600	16	62	156
511-003	RT	45	12.5	12.5	55	69	0.6	12	5	6.3	12.5	175	600	7620	17	55	133
511-004	WT	54	12.5	12.5	73	66	0.6	14	6	6.3	12.5	245	800	6930	24	41	134
511-005	WT	35	12.5	12.5	42	48	0.6	6	6	6.3	12.5	145	1150	4360	12	45	123
512-001	WT	34	12.5	12.5	56	60	0.6	7	5	6.3	12.5	131	800	4550	15	59	173
512-002	WT	29	12.5	12.5	63	40	0.6	18	4	6.3	12.5	94	540	2510	12	57	163
512-003	WT	26	12.5	12.5	68	35	0.6	11	3	6.3	12.5	103	313	2290	10	55	142
513-001	RT	50	12.5	12.5	53	56	0.6	13	6	6.3	12.5	220	860	6220	19	58	127
513-002	WT	27	12.5	12.5	63	44	0.6	6	4	6.3	12.5	114	600	2640	14	48	148
513-003	WT	23	12.5	12.5	65	44	0.6	4	3	6.3	12.5	95	313	2380	12	50	159
513-004	WT	25	12.5	12.5	60	42	0.6	4	4	6.3	12.5	100	313	2320	13	52	145

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

		Sm	Sn	Sn	Sr	Sr	Ta	Ta	Tb	Te	Te	Th	Ti	Ti	U	V	V
		nmhmc	-2um	nmhmc	-2um	nmhmc	-2um	nmhmc	nmhmc	-2um	nmhmc	nmhmc	-2um	nmhmc	nmhmc	-2um	nmhmc
Sample	Unit	inaa	icp	icp	icp	icp	icp	inaa	inaa	icp	inaa	inaa	icp	icp	inaa	icp	icp
513-005	SAP	4	12.5	12.5	42	15	0.6	4	2	6.3	12.5	12	810	19860	1	116	169
514-001	RT	58	12.5	12.5	55	83	0.6	14	7	6.3	12.5	269	1390	8970	24	56	145
514-002	RT	58	12.5	12.5	54	83	0.6	14	6	6.3	12.5	268	1450	8750	22	57	147
514-003	RT	45	12.5	12.5	53	84	0.6	9	6	6.3	12.5	170	1440	7040	17	62	127
514-004	RG	10	12.5	12.5	43	34	0.6	1	2	6.3	12.5	22	800	1850	2	73	117
514-005	OS	54	12.5	12.5	22	72	0.6	12	7	6.3	12.5	207	313	8180	21	66	127
514-006	SAP	2	12.5	12.5	40	28	0.6	1	1	6.3	12.5	1	313	313	0	286	129
515-001	RT	32	12.5	12.5	61	45	0.6	6	4	6.3	12.5	83	1070	4240	12	65	131
515-002	RT	24	12.5	12.5	69	45	0.6	6	3	6.3	12.5	81	1170	3720	9	83	114
515-003	RT	28	12.5	12.5	40	47	0.6	7	4	6.3	12.5	99	660	4500	12	63	153
515-004	OT	39	12.5	12.5	57	47	0.6	9	5	6.3	12.5	162	980	4740	15	61	129
515-005	OT	47	12.5	12.5	54	47	0.6	10	6	6.3	12.5	206	1040	4960	17	64	126
515-006	OT	48	12.5	12.5	55	57	0.6	14	5	6.3	12.5	210	1090	6110	18	63	134
515-007	OT	40	12.5	12.5	52	69	0.6	10	4	6.3	12.5	153	970	6720	13	59	153
515-008	OT	42	12.5	12.5	39	55	0.6	7	5	6.3	12.5	136	920	6660	12	73	227
516-001	KT	55	12.5	12.5	65	77	0.6	14	7	6.3	12.5	196	1050	8460	24	54	133
516-002	KT	50	12.5	12.5	65	59	0.6	13	7	6.3	12.5	195	1130	7320	20	62	126
516-003	KG	39	12.5	12.5	60	52	0.6	10	4	6.3	12.5	158	1520	7810	14	80	125
517-001	RT	50	12.5	12.5	59	59	0.6	10	5	6.3	12.5	205	1270	6980	19	63	125
517-002	RT	64	12.5	12.5	58	60	0.6	15	7	6.3	12.5	284	1390	7360	28	59	124
517-003	WT	79	12.5	12.5	81	51	0.6	19	8	6.3	12.5	340	1070	8330	39	49	140
517-004	WT	71	12.5	12.5	83	85	0.6	19	9	6.3	12.5	254	1110	11460	30	51	141
517-005	WT		12.5	12.5	85	45	0.6	1		6.3	20.0		920	8410		51	179
517-006	WT	61	12.5	12.5	86	45	0.6	21	9	6.3	12.5	265	960	6660	31	46	140
517-007	WT	60	12.5	12.5	90	48	0.6	14	8	6.3	12.5	238	1010	7100	33	50	144
517-008	WT	51	12.5	12.5	78	41	0.6	14	6	6.3	12.5	215	1000	5680	22	56	143
517-009	WT	63	12.5	12.5	97	41	0.6	13	7	6.3	12.5	270	750	5380	32	59	129
517-010	WT	40	12.5	12.5	96	40	0.6	12	4	6.3	12.5	175	790	5540	18	64	137
517-011	OT	41	12.5	12.5	57	47	0.6	9	5	6.3	12.5	186	960	5800	17	55	149
517-012	OT	36	12.5	12.5	60	44	0.6	12	4	6.3	12.5	152	880	5260	14	54	143
517-013	OT	51	12.5	12.5	61	48	0.6	11	6	6.3	12.5	236	1010	6650	20	55	147
517-014	OT	34	12.5	12.5	56	50	0.6	9	4	6.3	12.5	145	930	6430	13	54	146
517-015	OT	41	12.5	12.5	75	41	0.6	10	6	6.3	12.5	183	1070	4870	16	61	123
517-016	OT	38	12.5	12.5	69	50	0.6	9	4	6.3	12.5	158	1020	6400	14	64	142
517-017	OT	44	12.5	12.5	73	41	0.6	12	6	6.3	12.5	186	1020	5720	19	61	131
517-018	OT	38	12.5	12.5	68	42	0.6	11	4	6.3	12.5	165	1060	5470	14	66	139
518-001	RT	47	12.5	12.5	58	49	0.6	14	5	6.3	12.5	176	1130	5560	19	55	121
518-002	RT	55	12.5	12.5	66	57	0.6	14	7	6.3	12.5	222	1040	7530	24	62	151
518-003	WS	45	12.5	12.5	41	67	0.6	11	6	6.3	12.5	154	950	7130	24	72	143
518-004	WT	29	12.5	12.5	71	33	0.6	6	4	6.3	12.5	121	510	2780	16	43	79
518-005	WT	25	12.5	12.5	77	30	0.6	6	4	6.3	12.5	106	610	2360	12	54	77
518-006	WT	31	12.5	12.5	77	34	0.6	7	5	6.3	12.5	120	700	2240	17	64	79
518-007	WT	26	12.5	12.5	84	47	0.6	4	3	6.3	12.5	114	520	2300	13	51	186
518-008	WT	25	12.5	12.5	82	66	0.6	5	3	6.3	12.5	118	570	2470	13	66	176
519-001	RT	37	12.5	12.5	57	44	0.6	10	4	6.3	12.5	137	1010	5690	13	48	136
519-002	RT	43	12.5	12.5	53	45	0.6	11	5	6.3	12.5	168	930	6300	16	48	144
519-003	WT	43	12.5	12.5	60	45	0.6	11	6	6.3	12.5	183	1220	5990	19	56	143
519-004	WT	47	12.5	12.5	61	47	0.6	9	6	6.3	12.5	212	313	3300	22	50	144
519-005	WT	30	12.5	12.5	43	44	0.6	7	4	6.3	12.5	111	900	4280	11	97	206
519-006	WT	43	12.5	12.5	42	42	0.6	9	5	6.3	12.5	172	690	4840	17	92	218
520-001	RT	53	12.5	12.5	60	80	0.6	12	6	6.3	12.5	184	1830	10280	22	74	153
520-002	RT	48	12.5	12.5	55	104	0.6	12	7	6.3	12.5	156	1710	10530	18	71	132
520-003	RT	38	12.5	12.5	58	58	0.6	10	5	6.3	12.5	128	1210	7320	15	58	133
520-004	WT	52	12.5	12.5	56	43	0.6	12	6	6.3	12.5	215	1170	7480	23	59	139
520-005	OT	23	12.5	12.5	53	38	0.6	6	3	6.3	12.5	86	930	5060	9	67	165

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	Sm nmhmc inaa	Sn -2um icp	Sn nmhmc icp	Sr -2um icp	Sr nmhmc icp	Ta -2um icp	Ta nmhmc inaa	Tb nmhmc inaa	Te -2um icp	Te nmhmc inaa	Th nmhmc inaa	Ti -2um icp	Ti nmhmc icp	U nmhmc inaa	V -2um icp	V nmhmc icp
520-006	OT	28	12.5	12.5	56	45	0.6	11	4	6.3	12.5	114	970	5220	10	64	163
520-007	OT	36	12.5	12.5	58	49	0.6	10	5	6.3	12.5	143	1000	5000	15	71	153
520-008	OT	35	12.5	12.5	65	46	0.6	9	5	6.3	12.5	137	1060	5020	13	69	123
520-009	OT	41	12.5	12.5	65	57	0.6	8	5	6.3	12.5	161	1140	6740	15	74	150
520-010	OT	36	12.5	12.5	66	48	0.6	8	4	6.3	12.5	145	1000	5370	13	65	130
520-011	OT	44	12.5	12.5	62	51	0.6	11	7	6.3	12.5	189	890	6210	16	62	147
520-012	OT	73	12.5	21.0	67	80	0.6	20	9	6.3	12.5	314	990	11370	32	55	168
520-013	OT	69	12.5	12.5	63	53	0.6	21	8	6.3	12.5	277	900	8870	29	65	155
520-014	OT	70	12.5	12.5	72	55	0.6	30	10	6.3	12.5	320	830	9640	29	55	142
520-015	OS	17	12.5	12.5	43	36	0.6	3	2	6.3	12.5	57	800	2320	5	98	125
520-016	SAP	20	12.5	12.5	12	28	0.6	2	2	6.3	12.5	45	313	1200	5	158	179
520-017	SAP	114	12.5	12.5	30	29	0.6	1	9	6.3	12.5	43	313	313	7	112	111
521-001	RT	59	12.5	12.5	51	57	0.6	14	6	6.3	12.5	250	1040	8890	24	59	139
521-002	RT	68	12.5	12.5	52	60	0.6	17	7	6.3	12.5	318	1090	7610	26	51	154
521-003	WT	43	12.5	12.5	58	41	0.6	9	5	6.3	12.5	187	730	5030	19	50	141
521-004	OT	34	12.5	12.5	59	40	0.6	11	4	6.3	12.5	148	890	5360	12	53	142
521-005	WT	60	12.5	12.5	72	82	0.6	14	7	6.3	12.5	259	980	10970	23	56	141
521-006	WT	32	12.5	12.5	73	45	0.6	9	4	6.3	12.5	132	1100	5550	16	51	97
521-007	OG	12	12.5	12.5	58	35	0.6	5	2	6.3	12.5	34	1190	2000	4	92	88
521-008	OG	15	12.5	48.0	55	34	0.6	5	1	6.3	12.5	53	1310	2150	4	121	91
521-009	OG	14	12.5	12.5	58	39	0.6	1	2	6.3	12.5	37	1530	1950	5	121	111
521-010	OS	17	12.5	12.5	43	36	0.6	3	2	6.3	12.5	64	560	1900	6	121	168
521-011	OS	25	12.5	12.5	43	41	0.6	4	4	6.3	12.5	91	560	2810	11	98	155
521-012	SAP	9	12.5	12.5	56	13	0.6	1	6	6.3	12.5	23	313	810	4	68	48

Note: All values are reported in parts per million (ppm).

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

		W	W	Y	Y	Yb	Zn	Zn	Zr	Zr	nmHMC
		-2um	nmhmc	-2um	nmhmc	nmhmc	-2um	nmhmc	-2um	nmhmc	(g)
Sample	Unit	icp	inaa	icp	icp	inaa	icp	icp	icp	inaa	inaa
501-001	RT	6.3	3	28	53	10	60	178	1	6200	11.4
501-002	SAP	6.3	651	5	29	8	21	161	1	940	10.7
501-003	SAP	6.3	7	37	111	18	159	515	2	3300	8.2
502-001	RT	6.3	7	14	71	12	91	54	2	4600	10.5
502-002	RT	6.3	3	15	72	12	98	51	3	6500	13.1
502-003	RT	6.3	3	12	73	11	92	48	2	4500	13.5
502-004	RS	6.3	3	13	37	6	98	86	4	1300	13.3
502-005	OL	6.3	3	14	58	9	125	111	4	6500	12.3
503-001	RT	6.3	13	11	71	13	90	64	6	4900	8.3
503-002	RT	6.3	3	10	69	15	89	50	4	7300	15.0
503-003	RT	6.3	5	9	69	15	86	38	4	6400	12.9
503-004	RT	6.3	10	13	63	19	92	103	8	7400	10.4
503-005	RT	6.3	11	20	86	14	79	71	2	6900	8.3
503-006	ASAP	6.3	3	12	39	13	18	265	1	5400	10.9
503-007	SAP	6.3	3	1	8	3	17	110	1	313	11.5
505-001	RT	6.3	5	19	55	15	119	135	5	5700	11.1
505-002	OT	6.3	4	17	48	12	176	150	5	5000	13.1
505-003	OT	6.3	12	15	48	12	179	272	8	4400	11.8
505-004	SAP	6.3	29	16	71	11	273	1953	7	6600	7.6
506-001	RT	6.3	3	24	44	9	108	126	4	2600	10.2
506-002	RT	6.3	8	20	44	11	106	119	4	3200	13.2
506-003	SAP	6.3	14	15	28	3	34	87	1	313	12.6
506-004	SAP	6.3	3	107	256	37	102	171	2	313	5.3
507-001	RT	6.3	5	11	64	13	74	49	9	5400	14.2
507-002	RT	6.3	3	12	46	13	77	59	12	5300	11.0
507-003	RL	6.3	3	13	34	7	81	87	9	3900	11.2
507-004	OT	6.3	3	12	27	3	68	88	3	1800	10.4
507-005	OT	6.3	3	13	25	3	72	88	4	1300	13.4
507-006	OT	6.3	7	13	28	3	82	80	3	1800	10.3
507-007	OS	6.3	3	14	34	3	86	91	3	1800	8.9
507-008	OT	6.3	7	15	36	8	90	91	4	3200	11.5
507-009	OS	6.3	34	13	27	5	79	87	3	313	15.5
507-010	OT	6.3	8	14	35	6	77	83	4	2800	12.2
507-011	OL	6.3	3	14	32	8	88	100	9	2900	7.4
507-012	SAP	6.3	3	4	36	11	57	458	2	3000	10.2
508-001	RT	6.3	3	14	55	16	94	79	6	7600	5.4
508-002	RT	6.3	39	14	57	17	105	63	4	6400	11.5
508-003	RT	6.3	3	14	77	16	111	88	3	6100	10.0
508-004	SAP	6.3	3	26	81	21	98	192	3	4300	1.1
508-007	SAP	6.3	14	4	10	3	82	199	3	313	9.0
509-001	RT	6.3	244	14	64	19	108	84	8	7500	11.2
510-001	RT	6.3	3	13	59	12	96	69	3	6400	12.8
510-002	RT	6.3	6	12	59	16	104	59	5	5900	13.5
511-001	RT	6.3	3	12	58	11	148	77	3	5400	9.5
511-002	RT	6.3	10	13	68	14	85	73	1	6300	10.9
511-003	RT	6.3	3	12	63	12	80	54	2	6300	12.4
511-004	WT	6.3	3	13	74	12	69	88	4	10000	6.5
511-005	WT	6.3	3	10	53	12	116	103	3	5900	3.3
512-001	WT	6.3	14	17	55	11	78	135	4	5900	12.1
512-002	WT	6.3	19	19	47	10	74	153	2	3900	8.6
512-003	WT	6.3	3	21	46	8	68	160	2	2900	11.3
513-001	RT	6.3	3	15	61	14	75	63	3	8500	15.6
513-002	WT	6.3	3	17	38	7	78	116	3	4400	10.7
513-003	WT	6.3	3	19	34	6	81	142	2	4300	9.5
513-004	WT	6.3	3	18	33	9	93	159	2	4300	12.3

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	W -2um icp	W nmhmc inaa	Y -2um icp	Y nmhmc icp	Yb nmhmc inaa	Zn -2um icp	Zn nmhmc icp	Zr -2um icp	Zr nmhmc inaa	nmHMC (g) inaa
513-005	SAP	6.3	3	12	19	3	132	301	4	313	9.9
514-001	RT	6.3	12	13	91	18	83	72	8	8200	8.7
514-002	RT	6.3	3	13	80	14	77	62	7	8600	12.2
514-003	RT	6.3	3	13	70	14	89	61	4	6000	14.3
514-004	RG	6.3	3	14	37	6	87	111	3	313	9.1
514-005	OS	6.3	3	13	73	17	86	58	3	6900	13.1
514-006	SAP	6.3	5	6	11	3	183	117	5	313	11.6
515-001	RT	6.3	3	14	50	13	86	109	2	6700	12.5
515-002	RT	6.3	3	13	44	6	95	84	2	2500	12.0
515-003	RT	6.3	3	15	52	13	81	97	2	6300	9.8
515-004	OT	6.3	3	18	52	14	84	74	3	6800	13.4
515-005	OT	6.3	3	20	61	16	90	73	6	6100	12.3
515-006	OT	6.3	8	20	69	18	91	71	6	7100	10.5
515-007	OT	6.3	3	20	66	15	94	74	4	4500	12.3
515-008	OT	6.3	3	15	58	7	104	79	4	5200	10.5
516-001	KT	6.3	15	15	77	18	77	115	3	11000	9.1
516-002	KT	6.3	3	16	66	16	82	81	4	9100	11.0
516-003	KG	6.3	26	14	61	17	84	73	3	5600	6.3
517-001	RT	6.3	3	13	66	18	80	56	2	7700	12.9
517-002	RT	6.3	3	13	70	20	74	51	3	12000	13.7
517-003	WT	6.3	16	14	80	26	65	88	5	19000	2.8
517-004	WT	6.3	3	15	93	23	68	80	9	14000	4.3
517-005	WT	6.3	3	14	92		61	67	10	313	
517-006	WT	6.3	3	14	71	22	60	140	16	15000	4.9
517-007	WT	6.3	3	15	71	19	64	194	4	15000	3.7
517-008	WT	6.3	9	15	62	19	75	112	5	9800	8.6
517-009	WT	6.3	3	17	64	15	77	138	5	11000	8.1
517-010	WT	6.3	3	16	61	15	79	185	14	5100	1.7
517-011	OT	6.3	8	15	59	15	72	87	2	6800	10.0
517-012	OT	6.3	9	14	54	15	69	80	2	4300	10.0
517-013	OT	6.3	3	15	70	16	69	80	2	10000	8.9
517-014	OT	6.3	3	13	62	18	68	69	2	5400	9.9
517-015	OT	6.3	3	18	50	17	75	62	3	5900	12.8
517-016	OT	6.3	3	18	56	15	79	64	2	6200	12.8
517-017	OT	6.3	3	17	54	16	80	91	4	8900	10.8
517-018	OT	6.3	21	17	50	13	81	66	3	7500	12.1
518-001	RT	6.3	3	14	56	8	80	72	5	7300	11.3
518-002	RT	6.3	16	15	70	13	82	96	6	11000	3.9
518-003	WS	6.3	3	15	65	20	102	110	4	13000	10.5
518-004	WT	6.3	3	15	45	13	64	199	5	7400	7.1
518-005	WT	6.3	3	17	40	13	91	192	7	5100	5.3
518-006	WT	6.3	9	18	40	13	95	272	7	8900	5.7
518-007	WT	6.3	3	21	34	8	67	119	11	3600	9.3
518-008	WT	6.3	3	19	34	7	75	112	4	4400	9.0
519-001	RT	6.3	3	11	55	13	59	87	3	4800	11.1
519-002	RT	6.3	3	12	60	16	64	78	3	6300	11.4
519-003	WT	6.3	3	14	57	13	71	83	5	7600	11.7
519-004	WT	6.3	3	19	48	11	65	139	6	7600	10.0
519-005	WT	6.3	3	18	47	8	116	113	10	3200	10.7
519-006	WT	6.3	11	19	54	12	120	105	4	6100	9.9
520-001	RT	6.3	8	15	84	19	89	45	6	6500	13.5
520-002	RT	6.3	3	15	77	17	83	45	8	7400	11.9
520-003	RT	6.3	3	14	64	18	73	83	4	6200	7.7
520-004	WT	6.3	14	14	69	11	80	89	5	8400	7.2
520-005	OT	6.3	3	16	51	10	74	103	4	2800	10.2

Appendix 280-G. Baudette area assays. Nonmagnetic heavy mineral concentrate and clay fraction of till and non-till samples.

Sample	Unit	W -2um icp	W nmhmc inaa	Y -2um icp	Y nmhmc icp	Yb nmhmc inaa	Zn -2um icp	Zn nmhmc icp	Zr -2um icp	Zr nmhmc inaa	nmHMC (g) inaa
520-006	OT	11.0	3	16	58	12	72	98	8	5300	9.5
520-007	OT	6.3	3	17	53	11	90	86	6	5700	11.7
520-008	OT	6.3	3	18	50	14	87	88	6	5100	8.8
520-009	OT	6.3	3	18	63	12	93	86	7	6200	9.1
520-010	OT	6.3	3	18	54	14	88	86	6	5000	10.8
520-011	OT	6.3	3	18	62	13	86	85	6	7400	7.6
520-012	OT	6.3	3	18	104	17	71	72	5	14000	3.3
520-013	OT	6.3	3	20	81	23	79	52	4	13000	4.6
520-014	OT	6.3	45	19	85	23	72	53	6	9700	2.6
520-015	OS	6.3	3	20	38	8	95	105	6	313	10.8
520-016	SAP	6.3	3	63	47	3	52	133	6	313	7.5
520-017	SAP	6.3	3	172	140	5	96	217	4	313	8.5
521-001	RT	6.3	3	15	77	16	83	64	7	9300	12.3
521-002	RT	6.3	14	15	80	16	77	78	9	13000	6.2
521-003	WT	6.3	16	14	55	14	69	121	11	7600	12.5
521-004	OT	13.0	9	17	59	14	73	76	6	4300	12.2
521-005	WT	6.3	3	17	88	22	84	97	15	9900	1.0
521-006	WT	6.3	3	17	46	12	81	150	4	8000	4.1
521-007	OG	6.3	3	18	41	7	135	102	3	313	10.1
521-008	OG	6.3	7	17	36	5	139	97	2	313	12.8
521-009	OG	6.3	3	16	42	9	122	109	3	1500	10.5
521-010	OS	6.3	3	26	41	6	123	118	3	1800	10.5
521-011	OS	6.3	3	23	49	12	120	116	2	3100	12.9
521-012	SAP	6.3	3	4	128	58	71	45	2	1600	12.0

Note: All values are reported in parts per million (ppm).

Appendix 280-H. Baudette area assays. Magnetic heavy mineral concentrate samples from tills and saprolite.

Column abbreviations and data key

Stratigraphic units

KT	=Koochiching till
RT	=Rainy till
WT	=Winnipeg till
OT	=Old Rainy till
ASAP	=reworked saprolite
SAP	=saprolite

Other abbreviations

magHMC	=magnetic heavy mineral concentrate
aa	=atomic absorption
wt%	=weight percent

Notes:

Assay values reported here are listed to 3 or 4 significant figures depending on the element analyzed.

Ag analysis detection limit is 2.0 ppm. Values less than 2 ppm (eg. 1.3) were assayed at less than detection limit, and the result is reported here as five-eighths (0.625) of the detection limit.

Appendix 280-H. Baudette area assays. Magnetic heavy mineral concentrate samples from tills and saprolite.

Sample	Unit	Fe2O3 magHMC aa (wt%)	MgO magHMC aa (wt%)	TiO2 magHMC aa (wt%)	Ag magHMC aa	Co magHMC aa	Cr magHMC aa	Cu magHMC aa	Mn magHMC aa	Ni magHMC aa	Pb magHMC aa	V magHMC aa	Zn magHMC aa
501-001	RT	85.8	0.6	4.3	6.0	128	2660	32	1102	194	78	1600	428
501-002	SAP	80.1	2.5	2.8	4.0	1772	1000	42	1296	174	98	800	372
501-003	SAP	85.8	3.7	1.1	4.0	186	240	28	2126	144	88	400	742
502-001	RT	85.8	0.6	5.6	8.0	152	1280	30	1206	188	94	1800	374
502-002	RT	88.7	0.5	5.6	8.0	154	1320	26	1156	194	94	1800	408
502-003	RT	85.8	0.5	4.5	6.0	114	1180	22	1118	162	70	1600	432
503-001	RT	88.7	0.8	4.9	6.0	138	1180	36	1282	164	64	1800	478
503-002	RT	85.8	0.5	4.6	2.0	130	1080	30	1006	174	92	1600	376
503-003	RT	88.7	0.5	4.7	4.0	138	1140	26	1126	188	94	1600	388
503-004	RT	80.1	0.5	4.4	6.0	116	1220	28	1098	164	66	1600	446
503-005	RT	74.4	0.6	6.3	6.0	150	1700	58	1160	218	90	2000	472
503-006	ASAP	86.0	0.7	27.4	6.0	509	1387	127	3108	227	139	1850	479
505-001	RT	85.8	0.6	6.1	6.0	142	1420	46	2354	248	80	1600	484
505-002	OT	88.7	0.8	4.9	1.3	118	2020	42	3460	138	32	1400	404
505-003	OT	85.8	1.2	5.5	1.3	138	1700	54	4080	152	38	1600	444
505-004	SAP	85.8	1.8	5.3	1.3	128	440	54	4420	100	48	1200	638
506-001	RT	82.9	0.5	5.7	1.3	114	1420	40	1930	182	34	1800	430
506-002	RT	85.8	0.6	5.7	2.0	118	1100	60	2394	184	36	1600	368
506-003	SAP	85.8	1.2	7.2	2.0	322	140	20	4460	54	40	3600	188
506-004	SAP	85.8	0.9	7.8	2.0	280	120	24	4220	58	38	3600	182
507-001	RT	85.8	0.5	4.7	1.3	96	1100	24	1240	142	34	1600	494
507-002	RT	85.8	0.5	4.9	1.3	96	1480	26	1318	164	42	1600	440
507-004	OT	85.8	0.8	7.5	2.0	128	2500	64	2148	186	42	1400	468
507-005	OT	88.7	0.6	5.1	1.3	122	1600	36	1666	158	38	1600	400
507-006	OT	82.9	0.9	12.1	1.3	202	1980	38	1844	182	46	1800	472
507-008	OT	82.9	0.5	10.6	1.3	118	1340	36	1900	148	48	1800	430
507-010	OT	85.8	0.5	12.8	1.3	132	1580	40	1726	176	42	1600	460
507-012	SAP	75.9	1.3	13.0	2.4	152	2616	178	3423	315	182	1516	2938
508-001	RT	85.8	0.6	8.7	1.3	124	1200	34	1524	136	62	1800	354
508-002	RT	85.8	0.5	8.3	1.3	136	1260	38	1418	146	44	2000	336
508-003	RT	85.8	0.5	7.6	1.3	126	1240	34	1306	178	34	2000	326
508-004	SAP	84.2	0.7	10.4	1.9	139	1333	62	1624	316	46	2169	347
509-001	RT	85.8	0.7	7.4	1.3	208	2000	32	1462	170	42	1800	348
510-001	RT	88.7	0.4	10.6	1.3	100	1200	30	1440	136	46	2000	404
510-002	RT	85.8	0.4	8.9	1.3	106	1180	30	1300	154	54	1800	388
511-001	RT	88.7	0.3	9.4	1.3	104	1160	54	1436	136	40	2000	468
511-002	RT	85.8	0.4	11.0	1.3	110	1120	26	1550	138	46	2000	428
511-003	RT	82.9	0.4	11.9	4.0	106	1100	20	1424	148	56	2000	464
511-004	WT	85.8	0.4	2.9	4.0	92	1000	22	1056	144	34	1400	336
511-005	WT	60.9	0.5	7.0	4.0	104	1140	40	1300	180	112	1400	392
512-001	WT	91.5	0.5	5.9	4.0	116	1800	36	1618	278	38	1600	412
512-002	WT	82.9	0.6	5.2	4.0	176	3080	52	1760	538	40	1600	420
512-003	WT	85.8	0.5	5.9	2.0	138	2580	48	1800	352	44	1600	416
513-001	RT	91.5	0.3	4.3	2.0	112	1420	18	1140	164	34	1600	364
513-002	WT	80.1	0.7	3.8	4.0	126	1620	30	2064	200	38	1400	366
513-003	WT	85.8	0.9	3.7	1.3	114	3140	42	2742	190	36	1400	486
513-004	WT	82.9	0.8	5.4	2.0	112	3120	50	2122	202	38	1600	494
514-001	RT	85.8	0.3	3.7	1.3	98	760	118	1472	122	46	1600	420
514-002	RT	85.8	0.5	4.5	2.0	92	760	26	1604	114	44	1800	420
514-003	RT	85.8	0.6	6.0	2.0	96	880	28	1800	124	44	1800	404
514-006	SAP	69.0	1.4	4.0	3.5	103	276	241	6000	155	45	2069	203
515-001	RT	68.6	0.6	22.9	2.0	134	1800	48	2948	176	42	2400	494
515-002	RT	85.8	0.9	10.8	2.0	118	880	70	1968	182	42	1400	378
515-003	RT	88.7	0.5	12.2	2.0	128	1560	26	2280	138	40	1800	384
515-004	OT	88.7	0.4	11.4	4.0	122	1440	20	1492	162	44	1800	374

Appendix 280-H. Baudette area assays. Magnetic heavy mineral concentrate samples from tills and saprolite.

Sample	Unit	Fe2O3 magHMC aa (wt%)	MgO magHMC aa (wt%)	TiO2 magHMC aa (wt%)	Ag magHMC aa	Co magHMC aa	Cr magHMC aa	Cu magHMC aa	Mn magHMC aa	Ni magHMC aa	Pb magHMC aa	V magHMC aa	Zn magHMC aa
515-005	OT	88.7	0.5	10.6	1.3	114	1400	32	1752	150	30	1600	374
515-006	OT	88.7	0.5	11.2	2.0	120	1460	28	1698	172	32	1600	370
515-007	OT	85.8	0.6	14.1	2.0	126	1360	38	1916	184	38	2200	440
515-008	OT	68.6	0.8	26.4	1.3	118	780	64	3020	142	34	3200	536
516-001	KT	91.5	0.4	7.8	2.0	98	1580	30	1174	146	24	1800	352
516-002	KT	88.7	0.5	8.6	2.0	114	1220	34	1628	128	30	1600	348
517-001	RT	88.7	0.3	9.3	1.3	106	980	24	1204	138	42	2000	420
517-002	RT	91.5	0.4	6.6	2.0	98	1160	22	1420	124	38	1800	428
517-003	WT	88.7	0.4	7.7	2.0	106	1000	30	1112	146	48	1600	298
517-004	WT	88.7	0.3	6.9	2.0	108	1040	28	940	134	36	1800	306
517-005	WT	94.4	0.2	6.6	2.0	96	1000	20	902	140	36	1600	296
517-006	WT	94.4	0.3	5.8	1.3	100	980	26	952	146	38	1600	306
517-007	WT	91.5	0.3	5.4	1.3	92	960	26	874	130	36	1600	288
517-008	WT	91.5	0.3	8.4	2.0	98	1080	24	1132	128	30	1800	332
517-009	WT	94.4	0.2	7.2	2.0	100	1160	22	1026	132	32	1800	324
517-010	WT	88.7	0.3	10.2	1.3	112	1080	24	1130	180	36	1800	346
517-011	OT	85.8	0.3	12.6	1.3	116	1360	24	1314	144	38	1800	400
517-012	OT	82.9	0.4	13.1	1.3	168	1220	24	1374	150	46	2000	382
517-013	OT	88.7	0.3	11.5	1.3	120	1360	34	1118	156	32	1800	382
517-014	OT	88.7	0.4	12.5	2.0	112	1120	22	1364	136	34	1600	380
517-015	OT	85.8	0.3	12.4	1.3	124	1260	18	1200	148	44	1800	382
517-016	OT	82.9	0.4	14.7	2.0	118	1440	24	1316	146	44	1800	404
517-017	OT	85.8	0.3	14.1	2.0	114	1520	18	1190	156	28	1600	386
517-018	OT	85.8	0.3	14.0	2.0	122	1360	20	1312	146	30	1800	404
518-001	RT	85.8	0.4	12.8	1.3	100	1180	20	1350	130	34	1800	430
518-002	RT	88.7	0.3	2.5	2.0	98	1160	20	1068	128	38	1200	356
518-004	WT	85.8	0.3	2.5	4.0	106	1600	22	956	252	48	1000	384
518-005	WT	83.4	0.4	11.8	1.5	135	1634	23	1141	322	44	1634	497
518-006	WT	88.7	0.4	12.4	1.3	168	1820	26	1136	596	52	1600	462
518-007	WT	85.8	0.5	14.7	2.0	156	1960	34	1392	332	46	1800	446
518-008	WT	82.9	0.4	12.0	2.0	142	1860	36	1124	278	44	1800	446
519-001	RT	88.7	0.4	11.4	2.0	112	920	20	1472	120	30	1600	346
519-002	RT	85.8	0.4	8.4	2.0	104	1000	50	1648	126	32	1600	324
519-003	WT	91.5	0.3	4.7	1.3	98	1160	26	1018	130	38	1400	360
519-004	WT	82.9	0.3	14.9	1.3	118	1640	16	1338	186	24	2200	492
519-005	WT	74.4	0.4	17.0	1.3	160	1740	28	1536	174	32	2400	552
519-006	WT	82.9	0.4	15.4	2.0	164	1900	32	1480	176	38	2200	490
520-001	RT	85.8	0.3	11.7	1.3	116	1140	18	1062	146	28	2000	454
520-002	RT	85.8	0.6	11.5	1.3	110	1120	20	1442	140	30	2000	454
520-003	RT	85.8	0.5	11.5	2.0	110	1080	20	1536	136	26	2000	400
520-004	WT	91.5	0.3	8.6	1.3	106	880	24	1154	136	24	1800	332
520-005	OT	88.7	0.3	12.0	1.3	140	1300	26	1450	174	28	1800	420
520-006	OT	88.7	0.4	14.3	1.3	122	1340	30	1488	158	36	2000	400
520-007	OT	85.8	0.4	12.7	2.0	124	1560	24	1360	192	38	1800	408
520-008	OT	85.8	0.4	14.8	1.3	134	1380	22	1400	190	34	1800	386
520-009	OT	88.7	0.5	14.9	2.0	140	1680	20	1482	178	48	1800	416
520-010	OT	82.9	0.5	13.6	2.0	156	1460	26	1536	196	38	1800	388
520-011	OT	91.5	0.3	9.2	1.3	130	1400	18	1010	182	28	1800	388
520-012	OT	85.8	0.3	7.6	1.3	106	960	22	1080	146	40	1400	290
520-013	OT	94.4	0.2	7.5	2.0	122	1060	18	812	142	30	1800	298
520-014	OT	88.7	0.3	8.9	2.0	116	1060	26	1004	136	30	1600	312
520-016	SAP	74.4	0.6	19.6	2.0	200	1180	1006	2208	228	44	2400	614
521-001	RT	88.7	0.4	9.5	1.3	108	1060	22	1242	124	26	2000	388
521-002	RT	88.7	0.4	9.6	2.0	120	1320	18	1202	150	28	1800	316
521-003	WT	91.5	0.3	9.4	2.0	166	1200	26	1162	156	66	1800	342

Appendix 280-H. Baudette area assays. Magnetic heavy mineral concentrate samples from tills and saprolite.

Sample	Unit	Fe2O3 magHMC aa (wt%)	MgO magHMC aa (wt%)	TiO2 magHMC aa (wt%)	Ag magHMC aa	Co magHMC aa	Cr magHMC aa	Cu magHMC aa	Mn magHMC aa	Ni magHMC aa	Pb magHMC aa	V magHMC aa	Zn magHMC aa
521-004	OT	91.5	0.3	9.2	2.0	142	1120	24	1250	146	32	1800	328
521-005	WT	94.4	0.3	7.3	2.0	132	1280	46	916	190	30	1600	326
521-006	WT	94.4	0.3	9.6	2.0	156	1420	32	1026	282	48	1800	434

Note: All values are reported in parts per million (ppm) unless otherwise indicated. All analyses by flame AA.

Appendix 280-I. Baudette area bedrock and saprolite samples analyzed as bedrock. Trace element and oxide assays.

Column abbreviations and data key

Stratigraphic units

BEDZ =Bedrock, trace elements only
SAPZ =Saprolite, trace elements only
BED =Bedrock, trace elements and oxides

Other abbreviations

icp =inductively coupled plasma
aa =atomic absorption
hyaa =hydride generation atomic absorption
inaa =instrumental neutron activation
fadc =fire assay direct current
dcp =direct coupled plasma
cvaa =cold vapor atomic absorption
xrf =x-ray fluoresence

Notes:

Assay values reported here are listed to 3 significant figures.

Values less than or equal to the detection limits shown in Appendix 280-C (eg. <0.5), are reported here as five-eighths (0.625) of the listed detection limit for that element (eg. 0.3125).

Appendix 280-I. Baudette area bedrock and saprolite samples assayed as bedrock.

Sample	Unit	Ag	Al	Au	B	Ba	Be	Bi	Br	Ca	Cd	Ce	Co	Cr	Cs	Cu	Eu	Fe
		aa	icp	inaa	dcp	inaa	icp	icp	inaa	icp	icp	inaa	inaa	inaa	inaa	icp	inaa	inaa
501-004	BEDZ	0.1	28100	0.003	18	1200	0.3	5	1.9	2300	0.6	110	19	220	43.0	37	4	65000
503-008	BEDZ	0.1	24600	0.003	222	150	0.3	3	1.9	19700	0.6	31	27	190	1.0	39	1	55000
505-005	BEDZ	0.1	14700	0.003	32	1700	0.3	3	5.0	4900	0.6	76	15	210	1.0	18	1	36000
507-013	BEDZ	0.1	36600	0.003	34	150	0.3	3	1.9	8300	0.6	19	52	470	2.0	52	1	55000
508-005	SAPZ	0.1	14300	0.003	26	100	0.3	3	1.9	1400	0.6	79	25	280	2.0	69	1	38000
508-006	SAPZ	0.2	14400	0.003	40	210	0.3	3	1.9	1500	0.6	92	14	250	0.6	86	1	35000
508-008	SAPZ	0.1	11600	0.005	30	690	0.3	3	1.9	2600	0.6	44	6	160	0.6	62	1	19000
511-006	SAPZ	0.1	8200	0.003	13	340	0.3	3	1.9	2500	0.6	24	6	300	0.6	11	1	14000
518-009	BEDZ	0.1	28200	0.003	18	120	0.3	3	1.9	7900	0.6	36	25	210	0.6	99	1	45000
521-015	BEDZ	0.1	34400	0.007	29	210	0.3	3	1.9	12000	0.6	79	24	180	4.0	48	1	36000

Note: All values are reported as parts per million (ppm) unless otherwise indicated.

Appendix 280-I (continued).

Sample	Unit	Ga	Hf	Hg	Ir	K	La	Li	Lu	Mg	Mn	Mo	Na	Nb	Ni	P	Pb
		icp	inaa	cvaa	inaa	icp	inaa	icp	inaa	icp	icp	icp	icp	icp	icp	icp	icp
501-004	BEDZ	15	1	0.009	0.06	6900	160	47	2.0	9500	313	1.3	900	4	112	313	17
503-008	BEDZ	8	3	0.018	0.06	3100	11	13	0.3	13300	600	1.3	2300	5	69	850	3
505-005	BEDZ	10	3	0.006	0.06	1900	32	5	0.3	5600	313	1.3	1800	2	40	1460	3
507-013	BEDZ	12	1	0.012	0.06	3300	12	14	0.6	13000	313	1.3	1000	4	133	720	9
508-005	SAPZ	9	3	0.010	0.06	1100	67	3	0.3	2400	1100	1.3	600	2	55	313	17
508-006	SAPZ	8	3	0.009	0.06	1100	34	4	0.3	2100	800	1.3	700	1	32	313	12
508-008	SAPZ	5	3	0.003	0.06	2200	13	4	0.3	3000	700	1.3	800	1	16	313	9
511-006	SAPZ	4	3	0.003	0.06	3200	7	10	0.3	3400	313	1.3	1400	1	7	313	3
518-009	BEDZ	10	3	0.015	0.06	1300	15	28	0.3	16500	313	1.3	1400	3	91	630	4
521-015	BEDZ	10	3	0.008	0.06	6200	33	21	0.3	16400	313	1.3	1700	4	37	920	13

Note: All values are reported as part per million (ppm) unless otherwise indicated.

Appendix 280-I (continued).

Sample	Unit	Sb	Sc	Se	Sm	Sn	Sr	Ta	Tb	Te	Th	Ti	U	V	W	Y	Yb	Zn	Zr inaa	nm (g)
		inaa	inaa	hyaa	inaa	icp	icp	inaa	inaa	inaa	inaa	icp	inaa	icp	inaa	icp	inaa	icp		inaa
501-004	BEDZ	0.1	16	0.1	24	12.5	42	1	4	12.5	5	1160	5	47	3	219	12	989	313	7.9
503-008	BEDZ	0.1	18	0.1	4	12.5	73	1	1	12.5	1	313	0	50	3	16	3	62	313	9.6
505-005	BEDZ	0.1	9	0.1	4	12.5	46	1	1	12.5	9	313	1	27	6	6	3	162	313	10.7
507-013	BEDZ	0.1	18	0.1	3	12.5	74	1	1	12.5	1	730	0	55	3	23	3	130	313	10.0
508-005	SAPZ	0.1	8	0.1	12	12.5	9	1	1	12.5	2	313	1	52	3	17	3	89	313	6.7
508-006	SAPZ	0.1	12	0.1	3	12.5	16	1	1	12.5	6	313	1	72	3	3	3	45	313	8.9
508-008	SAPZ	0.1	6	0.1	2	12.5	12	1	1	12.5	3	313	1	33	3	2	3	39	313	7.8
511-006	SAPZ	0.1	3	0.1	1	12.5	17	1	1	12.5	1	610	0	14	3	2	3	50	313	9.3
518-009	BEDZ	0.8	17	0.1	3	12.5	79	1	1	12.5	2	700	0	55	3	8	3	67	313	9.9
521-015	BEDZ	0.1	9	0.5	5	12.5	122	1	1	12.5	5	870	1	59	4	7	3	71	313	9.3

Note: All values are reported in parts per million (ppm) unless otherwise noted.

Appendix 280-I. Baudette area bedrock samples, trace element and oxide assays.

Sample	Unit	Ag	As	Au	B	Ba	Be	Bi	Ce	Co	Cr	Cu	Ga	Hg	La	Li	Mo	Nb
		icp	hyaa	fadc	dcp	icp	icp	icp	icp	icp	icp	icp	icp	cvaa	icp	icp	icp	icp
502-006	BED	0.3	0.3	0.001	15	45	0.3	3.1	70	6	82	10	3	0.003	35	2	0.6	2.0
503-009	BED	0.3	0.5	0.005	29	25	0.3	3.1	27	29	119	50	9	0.003	17	16	0.6	6.0
506-005	BED	0.3	0.3	0.010	17	79	0.3	3.1	7	38	204	136	4	0.003	11	14	0.6	7.0
508-009	BED	0.3	0.5	0.004	27	36	0.3	3.1	48	12	117	35	8	0.003	22	5	0.6	3.0
509-002	BED	0.3	2.0	0.002	41	162	0.3	3.1	20	23	143	85	7	0.003	13	12	0.6	5.0
510-003	BED	0.3	0.5	0.008	17	214	0.3	3.1	69	13	137	98	7	0.003	31	10	0.6	5.0
512-004	BED	0.3	4.0	0.003	44	284	0.3	3.1	63	25	320	63	14	0.003	32	54	0.6	3.0
513-006	BED	0.3	0.3	0.030	17	7	0.3	11.0	23	75	188	327		0.003	23	6	0.6	8.0
514-007	BED	0.3	0.3	0.001	16	11	0.3	3.1	17	44	68	93	16	0.003	15	14	0.6	5.0
515-009	BED	0.3	0.3	0.002	19	11	0.3	3.1	3	17	123	86	5	0.003	5	16	0.6	4.0
516-004	BED	0.3	0.5	0.001	35	509	0.3	3.1	51	24	241	53	14	0.033	28	31	0.6	3.0
517-019	BED	0.3	3.0	0.003	81	196	0.3	3.1	25	35	567	107		0.003	15	44	0.6	5.0
519-007	BED	0.3	0.7	0.008	31	225	0.3	3.1	98	22	228	447	7	0.003	44	21	0.6	4.0
521-013	BED	0.3	0.3	0.001	41	84	0.3	3.1	83	27	145	64	11	0.003	42	41	0.6	4.0
521-014	BED	0.3	0.3	0.001	23	373	0.3	3.1	60	13	172	75	14	0.003	34	43	0.6	3.0

Appendix 280-I (continued).

Sample	Unit	Ni	Pb	Rb	Sb	Sc	Se	Sn	Sr	Ta	Te	V	W	Y	Zn	Zr
		icp	icp	icp	hyaa	icp	xrf	icp	icp	icp	icp	icp	icp	icp	icp	icp
502-006	BED	8	4	35	0.1	1	0.6	12.5	126	0.6	6.3	42	6.3	8	107	20
503-009	BED	74	1	69	0.1	13	0.6	12.5	85	0.6	6.3	59	6.3	16	60	8
506-005	BED	72	1	13	0.1	10	0.6	12.5	32	0.6	6.3	128	6.3	8	74	4
508-009	BED	30	4	13	0.1	1	0.6	12.5	32	0.6	6.3	25	6.3	5	56	14
509-002	BED	77	1	13	0.1	4	0.6	12.5	205	0.6	6.3	108	6.3	5	28	6
510-003	BED	23	3	13	0.1	14	0.6	12.5	45	0.6	6.3	82	6.3	19	86	7
512-004	BED	83	7	13	0.1	12	0.6	12.5	12	0.6	6.3	115	6.3	9	98	14
513-006	BED	75	14	21	0.1	6	0.6	12.5	18	0.6	6.3	43	6.3	6	190	9
514-007	BED	28	5	34	0.2	20	0.6	12.5	42	0.6	6.3	274	6.3	13	124	11
515-009	BED	47	1	21	0.1	5	0.6	12.5	16	0.6	6.3	56	6.3	5	30	8
516-004	BED	76	6	60	0.1	13	0.6	12.5	20	0.6	6.3	112	6.3	9	84	12
517-019	BED	239	5	99	0.2	4	0.6	12.5	118	0.6	6.3	126	6.3	7	70	14
519-007	BED	74	4	140	0.1	5	0.6	12.5	49	0.6	6.3	104	6.3	8	49	10
521-013	BED	106	4	23	0.1	4	0.6	12.5	23	0.6	6.3	63	6.3	6	79	12
521-014	BED	28	6	143	0.1	10	0.6	12.5	208	0.6	6.3	100	6.3	6	127	14

Note: All values are reported in parts per million (ppm) unless otherwise indicated.

Appendix 280-I (continued).

Sample	Unit	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Total	F	Cr	Ta	Pd	Pt	Au	S
		pct	pct	pct	pct	pct	pct	pct	pct	pct	pct	pct	pct	si	xrf	icp	fadc	fadc	fadc	total
502-006	BED	62.0	0.28	19.00	3.43	0.03	0.31	2.41	7.24	3.23	0.35	1.55	99.83	128	94	1.9	0.001	0.003	0.001	0.001
503-009	BED	55.0	0.75	15.60	7.92	0.12	2.97	3.52	4.14	1.01	0.35	8.11	99.49	272	217	1.9	0.001	0.003	0.005	0.001
506-005	BED	54.4	0.85	14.80	10.50	0.26	4.06	8.55	2.11	0.43	0.20	3.97	100.13	255	117	1.9	0.017	0.015	0.010	0.070
508-009	BED	70.1	0.35	14.50	3.32	0.05	0.94	2.26	3.15	2.88	0.15	2.35	100.05	273	139	1.9	0.002	0.003	0.004	0.001
509-002	BED	48.9	0.82	15.90	10.20	0.17	7.57	11.20	2.73	0.74	0.50	1.43	100.16	465	91	1.9	0.001	0.003	0.002	0.213
510-003	BED	53.0	1.04	15.00	13.70	0.38	3.05	7.50	4.56	1.00	0.40	0.14	99.77	535	134	1.9	0.001	0.003	0.008	0.333
512-004	BED	62.6	0.63	17.00	7.01	0.10	2.85	2.29	4.38	2.14	0.20	1.66	100.86	670	450	1.9	0.003	0.003	0.003	0.115
513-006	BED	37.8	0.26	6.96	30.40	0.57	2.05	6.00	1.21	0.87	0.30	11.78	98.20	125	157	1.9	0.008	0.008	0.030	17.86
514-007	BED	50.8	1.78	12.80	18.80	0.28	5.07	5.86	0.92	0.07	0.50	3.98	100.86	217	119	1.9	0.001	0.003	0.001	0.108
515-009	BED	55.3	0.62	14.10	10.30	0.17	6.56	7.95	2.96	0.50	0.19	1.54	100.18	158	191	1.9	0.010	0.009	0.002	0.094
516-004	BED	63.0	0.57	14.50	6.75	0.10	3.09	5.67	2.75	2.53	0.24	1.32	100.51	468	316	1.9	0.003	0.003	0.001	0.340
517-019	BED	49.0	0.87	12.30	11.50	0.18	11.50	6.21	3.05	2.47	0.45	2.36	99.89	710	779	5.0	0.005	0.003	0.003	0.024
519-007	BED	58.9	0.56	14.30	6.96	0.10	4.93	6.41	3.83	2.58	0.45	1.32	100.34	757	175	1.9	0.016	0.006	0.008	0.024
521-013	BED	54.8	0.71	19.20	8.10	0.08	4.18	0.36	0.43	5.55	0.21	4.80	98.41	413	108	10.0	0.001	0.003	0.001	0.034
521-014	BED	58.1	0.76	17.10	6.69	0.08	4.14	1.13	1.58	4.92	0.24	5.48	100.21	714	230	1.9	0.002	0.003	0.001	0.023

Note: All values are reported in parts per million (ppm) unless otherwise indicated.

Appendix 280-J. Baudette area sample component weights and percents reported by contract laboratory.

Column abbreviations and data key

Stratigraphic units

KT = Koochiching till
KG = Koochiching gravel
RT = Rainy till
RS = Rainy sand
RG = Rainy gravel
RL = Rainy lake sediment
WT = Winnipeg till
WS = Winnipeg sand
OT = Old Rainy till
OS = Old Rainy sand
OG = Old Rainy gravel
OL = Old Rainy lake sediment
ASAP = reworked saprolite
SAP = saprolite

Other abbreviations

ODM = Overburden Drilling Management Laboratories
kg = kilogram
g = gram
wt. = weight
nmHMC = nonmagnetic (+3.3 specific gravity) heavy
ltHMC = light (-3.3 specific gravity) heavy mineral
magHMC = magnetic heavy mineral concentrate
sol. = soluble
wt% = weight percent

Notes:

"Matrix as % of sample" column = (total sample wt. - +10mesh wt.) / (total sample wt.)

Weak acid soluble portion is that portion of the -63um fraction soluble in 10% HCl.

Weak acid soluble percents are measured on separate splits of core sampled identically to other assayed samples.

% sand-silt-clay by Bondar-Clegg on sample split used for silt/clay analysis.

Appendix 280-J. Baudette area sample and subsample weights and percents reported by contract laboratory.

Sample	Unit	ODM wt. (kg)	+10mesh g/10kg	ltHMC g/10kg	nmHMC g/10kg	magHMC g/10kg	Matrix as % of sample	% sand	% silt	% clay	Weak acid %sol.	Acid sol. Ca wt%	Acid sol. Mg wt%	Acid sol. Fe wt%
501-001	RT	10.8	214	109	27	4	98	52	41	6	8	0.6	0.4	1.0
501-002	SAP	11.8	53	166	23	2	99	50	38	12	6	0.2	0.1	0.4
501-003	SAP	10.7	228	170	34	2	97	60	29	11	9	0.3	0.4	1.0
502-001	RT	8.1	1974	436	44	11	80	73	24	2	10	1.0	0.5	1.3
502-002	RT	8.8	1424	525	42	13	86	76	21	3	9	1.0	0.5	1.2
502-003	RT	10.0	1225	409	40	12	88	80	18	2	11	1.1	0.6	1.2
502-004	RS	7.2	794	230	46	3	92	89	9	1	15	1.6	0.7	2.3
502-005	OL	7.9	0	414	75	5	100	89	10	1	18	1.6	0.8	3.2
503-001	RT	8.5	1235	210	22	8	88	66	29	5	12	1.6	0.8	1.3
503-002	RT	11.2	1366	194	33	13	86	72	25	2	9	1.0	0.5	1.2
503-003	RT	9.8	1220	259	26	13	88	72	25	2	9	0.9	0.5	1.1
503-004	RT	8.3	907	281	22	9	91	83	15	2	42	10.0	2.2	1.6
503-005	RT	8.0	1080	176	28	8	89	71	24	5	9	0.9	0.5	1.2
503-006	ASAP	10.0	433	250	73	1	96	82	11	7	7	0.2	0.1	1.1
503-007	SAP	8.3	470	171	410	0	95	23	59	18	3	0.2	0.1	0.2
505-001	RT	9.2	1114	388	31	4	89	73	22	5	15	1.8	0.9	2.0
505-002	OT	8.0	1834	169	86	11	82	76	19	5	19	1.7	1.1	3.9
505-003	OT	9.3	980	363	53	7	90	83	13	4	24	3.2	1.4	3.6
505-004	SAP	9.9	141	297	22	1	99	68	24	8	16	0.4	0.8	4.4
506-001	RT	7.9	2218	360	69	5	78	70	25	5	18	1.8	1.1	3.2
506-002	RT	9.7	4125	68	34	3	59	87	10	3	14	1.1	0.9	3.6
506-003	SAP	11.7	470	242	74	21	95	47	39	13	22	0.5	2.0	5.3
506-004	SAP	8.0	99	193	17	5	99	38	56	6	10	0.2	0.8	2.2
507-001	RT	11.5	875	160	31	11	91	75	21	5	19	3.6	1.4	1.4
507-002	RT	9.1	405	218	29	7	96	48	43	9	14	2.0	1.0	1.2
507-003	RL	8.0	358	221	48	4	96	44	46	10	24	4.7	1.7	1.7
507-004	OT	9.0	974	202	134	7	90	77	19	4	12	1.5	0.5	1.7
507-005	OT	7.8	1968	201	131	4	80	85	13	3	16	1.9	0.6	2.6
507-006	OT	8.4	1671	246	116	3	83	79	17	4	15	1.8	0.6	2.5
507-007	OS	10.9	2510	316	109	6	75	85	12	3	18	1.9	0.6	2.5
507-008	OT	8.9	1313	173	98	7	87	76	19	5	14	1.4	0.6	2.0
507-009	OS	11.0	201	245	160	5	98	91	7	2	18	1.8	0.8	2.6
507-010	OT	9.8	920	185	68	4	92	68	22	10	25	1.4	0.7	2.9
507-011	OL	7.8	46	229	23	1	100	22	51	27	21	1.3	0.9	2.6
507-012	SAP	7.5	109	281	78	1	99	64	27	9	15	0.5	0.6	3.3
508-001	RT	8.8	501	242	14	6	95	33	57	9	16	1.8	0.9	1.4
508-002	RT	10.0	2305	155	38	14	77	73	23	4	16	2.0	1.0	2.2
508-003	RT	9.2	2267	139	37	14	78	72	23	6	16	1.9	1.0	2.0
508-004	SAP	8.4	196	160	8	1	98	41	49	10	9	0.2	0.2	2.4
508-007	SAP	9.5	237	213	22	0	98	38	53	9	8	0.1	0.2	2.2
509-001	RT	9.9	1543	206	37	12	85	75	21	4	13	1.4	0.8	1.8
510-001	RT	8.9	1156	255	41	12	88	79	19	2	11	1.2	0.6	1.2
510-002	RT	12.3	1354	157	28	10	86	72	24	4	12	1.5	0.8	1.4
511-001	RT	8.9	1111	204	22	8	89	70	27	4	22	4.2	1.7	1.2
511-002	RT	11.2	881	238	30	10	91	73	23	4	22	4.1	1.7	1.3
511-003	RT	9.7	1416	130	30	10	86	79	18	3	17	3.2	1.3	1.1
511-004	WT	10.1	890	131	17	6	91	58	35	7	39	9.4	3.0	1.2
511-005	WT	8.7	1497	198	11	2	85	72	24	4	19	3.7	1.4	1.4
512-001	WT	10.1	493	141	27	3	99	42	47	11	25	5.5	1.5	1.8
512-002	WT	10.7	827	178	19	1	92	39	52	10	26	5.8	1.5	1.7
512-003	WT	10.6	486	185	43	2	95	43	46	11	26	6.2	1.6	1.7
513-001	RT	11.3	933	151	29	6	90	83	15	3	27	6.4	1.9	1.3
513-002	WT	9.0	660	302	27	3	93	54	37	9	31	7.4	2.3	1.4
513-003	WT	8.4	368	205	44	3	96	66	28	6	27	6.5	1.6	1.7
513-004	WT	8.1	944	112	53	3	91	55	38	7	26	5.7	1.5	1.8

Appendix 280-J. Baudette area sample and subsample weights and percents reported by contract laboratory.

Sample	Unit	ODM wt. (kg)	+10mesh g/10kg	ltHMC g/10kg	nmHMC g/10kg	magHMC g/10kg	Matrix as % of sample	% sand	% silt	% clay	Weak acid %sol.	Acid sol. Ca wt%	Acid sol. Mg wt%	Acid sol. Fe wt%
513-005	SAP	10.0	1346	216	23	0	87	41	49	10	16	2.3	1.0	2.5
514-001	RT	8.8	1161	296	20	10	89	68	28	4	13	2.0	1.0	1.1
514-002	RT	9.6	1468	159	24	13	85	79	18	3	15	2.3	1.0	1.2
514-003	RT	9.6	1431	143	33	14	86	76	21	3	14	2.4	1.1	1.2
514-004	RG	9.4	1960	184	55	3	80	90	8	2	22	3.6	1.3	2.9
514-005	OS	9.4	3667	255	36	11	63	76	21	3	19	3.1	1.2	2.1
514-006	SAP	8.9	3002	104	94	0	70	54	39	7	33	0.6	2.2	10.7
515-001	RT	9.7	1022	275	63	4	90	76	21	3	12	1.9	0.9	1.1
515-002	RT	8.8	2700	181	47	9	73	73	22	4	15	2.3	1.0	2.2
515-003	RT	9.7	745	226	52	5	93	80	17	2	15	2.8	1.1	1.3
515-004	OT	8.8	924	267	33	5	91	71	24	5	19	3.6	1.3	1.4
515-005	OT	9.8	1105	213	27	6	89	73	22	5	20	4.0	1.4	1.7
515-006	OT	8.0	858	167	25	5	91	67	27	6	23	5.1	1.7	1.9
515-007	OT	11.2	1143	198	29	5	89	69	25	6	23	5.2	1.6	1.9
515-008	OT	9.5	2143	147	47	10	79	76	20	5	6	0.1	0.2	2.4
516-001	KT	9.3	1242	111	21	6	88	62	33	6	35	8.4	2.5	1.5
516-002	KT	11.9	1386	208	17	6	87	64	31	5	30	7.0	2.1	1.5
516-003	KG	9.1	5014	102	17	6	50	80	17	3	30	6.9	2.6	1.8
517-001	RT	10.7	955	256	27	10	90	77	20	3	18	3.9	1.4	1.0
517-002	RT	12.0	1251	101	20	12	87	75	21	4	19	4.1	1.4	1.2
517-003	WT	10.6	1042	93	8	7	90	56	35	9	8	0.9	0.5	1.1
517-004	WT	10.0	685	65	10	5	93	54	35	10	39	9.8	2.3	1.7
517-005	WT	9.4	441	190	3	2	96	34	51	15	36	9.0	2.2	1.5
517-006	WT	10.8	660	108	12	5	93	32	55	13	34	7.8	2.2	1.3
517-007	WT	9.0	541	93	11	5	95	37	51	12	36	8.5	2.3	1.6
517-008	WT	10.5	822	280	18	5	92	62	30	8	30	6.6	2.1	1.7
517-009	WT	9.9	902	94	17	5	91	57	32	11	32	7.0	2.2	1.7
517-010	WT	8.4	815	205	9	2	92	45	38	17	31	6.8	2.1	1.7
517-011	OT	9.6	1115	370	25	5	89	72	22	6	24	5.2	1.7	1.6
517-012	OT	9.4	1443	277	29	5	86	73	21	6	24	5.1	1.6	1.6
517-013	OT	10.7	1574	106	21	6	84	74	21	5	23	5.0	1.6	1.7
517-014	OT	10.2	1092	289	30	6	89	80	16	4	22	4.6	1.5	1.5
517-015	OT	12.3	1279	133	25	5	87	74	21	5	24	5.0	1.6	4.7
517-016	OT	9.0	1338	281	27	6	84	78	18	4	22	4.7	1.6	1.8
517-017	OT	8.6	1628	126	22	6	84	83	13	3	24	5.3	1.7	1.7
517-018	OT	7.7	1157	426	25	5	88	74	21	5	23	4.4	1.6	2.0
518-001	RT	12.1	639	320	20	6	94	59	36	5	23	5.1	1.7	1.3
518-002	RT	8.0	636	199	14	4	94	49	42	9	23	4.9	1.6	1.6
518-003	WS	9.4	4	222	26	3	100	39	57	4	18	3.8	1.4	1.1
518-004	WT	9.4	1135	196	16	1	89	55	36	9	54	12.6	4.4	1.5
518-005	WT	8.5	651	208	16	1	93	46	43	11	48	11.6	3.8	1.7
518-006	WT	8.6	791	52	18	1	92	37	46	17	36	8.3	2.6	1.9
518-007	WT	8.7	547	225	41	2	94	53	34	12	28	7.0	1.6	2.0
518-008	WT	9.9	644	94	46	2	94	52	35	13	26	6.0	1.5	2.6
519-001	RT	9.9	2614	262	26	6	76	80	17	4	28	7.2	1.8	1.6
519-002	RT	12.0	1538	172	21	7	85	83	14	3	32	7.4	2.1	2.9
519-003	WT	10.0	1684	230	24	7	83	73	22	5	30	6.8	2.0	1.7
519-004	WT	7.8	890	126	52	3	91	66	26	8	34	7.0	2.4	2.1
519-005	WT	10.2	969	278	46	5	90	55	34	11	19	2.2	0.9	3.8
519-006	WT	8.3	1014	109	42	6	90	63	28	9	18	2.1	1.0	3.6
520-001	RT	10.9	956	345	23	11	90	76	21	3	16	3.0	1.3	1.3
520-002	RT	9.3	713	469	33	16	93	78	19	3	15	2.9	1.1	1.2
520-003	RT	8.5	1369	356	21	9	87	70	25	4	27	6.0	2.1	1.5
520-004	WT	8.1	1669	244	24	10	83	74	21	5	31	7.1	2.4	1.5
520-005	OT	10.0	1473	168	50	5	85	83	14	3	22	4.4	1.5	1.9

Appendix 280-J. Baudette area sample and subsample weights and percents reported by contract laboratory.

Sample	Unit	ODM wt. (kg)	+10mesh g/10kg	ltHMC g/10kg	nmHMC g/10kg	magHMC g/10kg	Matrix as % of sample	% sand	% silt	% clay	Weak acid %sol.	Acid sol. Ca wt%	Acid sol. Mg wt%	Acid sol. Fe wt%
520-006	OT	7.3	1132	360	37	5	89	68	25	7	22	4.5	1.5	1.8
520-007	OT	9.6	1128	106	29	5	89	64	27	9	23	4.8	1.6	1.9
520-008	OT	8.2	1260	223	21	4	87	61	31	8	27	5.0	1.8	1.3
520-009	OT	8.8	1219	373	23	23	88	64	29	7	27	5.0	1.8	1.7
520-010	OT	10.9	1223	310	24	4	88	65	28	6	27	5.1	1.8	1.5
520-011	OT	7.9	952	315	22	4	90	63	29	8	25	5.8	2.1	1.8
520-012	OT	9.2	1087	138	10	6	89	70	26	4	26	6.6	2.0	1.0
520-013	OT	9.6	1041	157	14	6	90	78	18	4	26	5.9	1.2	1.1
520-014	OT	9.2	1242	224	5	11	88	64	29	7	32	7.5	2.1	1.2
520-015	OS	7.9	434	336	121	6	96	93	6	1	16	1.8	0.6	3.0
520-016	SAP	9.5	323	298	45	1	97	11	83	7	5	0.1	0.1	1.1
520-017	SAP	10.3	213	24	22	0	98	6	91	3	4	0.1	0.0	0.7
521-001	RT	12.0	1509	317	23	12	85	66	29	5	20	4.5	1.5	1.0
521-002	RT	9.7	814	114	17	6	92	66	28	6	31	6.0	1.8	1.1
521-003	WT	12.2	744	127	19	4	93	61	25	14	30	6.3	1.8	1.5
521-004	OT	10.1	1502	290	34	5	85	67	26	7	26	5.8	1.4	1.5
521-005	WT	9.6	758	130	6	2	92	41	39	20	44	10.3	2.6	1.5
521-006	WT	9.4	594	171	14	2	94	35	52	12	47	10.6	3.1	1.2
521-007	OG	9.8	6664	295	23	1	33	88	10	2	26	4.6	3.2	2.5
521-008	OG	9.6	5822	150	36	2	42	88	11	2	20	2.6	0.8	3.2
521-009	OG	9.6	5128	199	31	1	49	88	11	2	18	2.4	0.8	3.1
521-010	OS	8.7	675	352	137	1	93	90	9	1	16	1.8	0.5	2.8
521-011	OS	8.9	766	82	145	0	92	86	12	2	17	1.7	0.7	3.0
521-012	SAP	8.5	1227	131	102	0	88	65	30	5	19	0.7	1.4	3.5

Appendix 280-K. Physical properties of Baudette area samples.

Column abbreviations and data key

Stratigraphic units

KT =Koochiching till
KG =Koochiching gravel
RT =Rainy till
RS =Rainy sand
RG =Rainy gravel
RL =Rainy lake sediment
WT =Winnipeg till
WS =Winnipeg sand
OT =Old Rainy till
OS =Old Rainy sand
OG =Old Rainy gravel
OL =Old Rainy lake sediment
ASAP =reworked saprolite
SAP =saprolite
SAPZ =saprolite (trace element analysis)
BEDZ =bedrock (trace element analysis)
BED =bedrock

Other abbreviations

= (null), property not measured
susc. =magnetic susceptibility
(cgs) =centimeter/grams/second
Ox. =oxidation
ox =oxidized
un =unoxidized
dens. =density

Appendix 280-K. Physical properties of Baudette area samples.

Sample	Unit	Munsell color	Mean susc. (cgs)	Ox. state	Till compact-ness	pH	Bulk dens.
501-001	RT	5 G 7/1	9	un	4		1.9
501-002	SAP	5 GY 6/1	1			8.4	1.8
501-003	SAP	5 GY 6/1	1			5.7	1.8
501-004	BEDZ	5 G 7/1	0			7.5	1.7
502-001	RT	5 GY 5/1	29	un	3		
502-002	RT	5 GY 5/1	46	un	3		
502-003	RT	5 GY 5/1	50	un	3		
502-004	RS	5 Y 6/1	50	un			
502-005	OL	5 GY 5/1	58	un			
502-006	BED		125				
503-001	RT	5 GY 5/1	19	un	3		
503-002	RT	5 GY 5/1	14	un	3		
503-003	RT	5 GY 5/1	16	un	3		
503-004	RT	5 GY 5/1	15	un	3		
503-005	RT	5 GY 5/1	10	un	3		
503-006	ASAP	5 Y 8/1	1				
503-007	SAP	5 G 8/1	1			8.7	1.8
503-008	BEDZ	5 G 7/1	1			9.4	2.0
503-009	BED	5 G 7/1	2				
505-001	RT	5 GY 5/1	13	un	2		
505-002	OT	5 G 5/1	15	un	1		
505-003	OT	5 G 5/1	12	un	1		
505-004	SAP	5 G 4/1	3			8.6	1.9
505-005	BEDZ		13			8.2	2.0
506-001	RT	5 GY 5/1	36	un	3		
506-002	RT	5 GY 5/1	36	un	4		2.1
506-003	SAP	5 GY 4/1	29			9.7	1.5
506-004	SAP	10GY 5/2	21			9.4	1.7
506-005	BED		88				2.8
507-001	RT	5 Y 5/1	6	un	2		
507-002	RT	5 Y 5/1	6	un	3		
507-003	RL	5 GY 6/1	5	un	3		
507-004	OT	10YR 6/3	10	ox	3		
507-005	OT	5 YR 6/3	12	ox	3		
507-006	OT	5 Y 5/1	9	un	3		
507-007	OS	5 Y 5/1	11	un			
507-008	OT	5 Y 5/1	11	un	1		
507-009	OS	5 Y 5/1	20	un			
507-010	OT	5 Y 5/1	24	un	5		
507-011	OL	5 GY 6/3	23	un			
507-012	SAP	5 GY 3/2	18			8.9	1.7
507-013	BEDZ		19			8.8	1.9
508-001	RT	5 GY 5/1	12	un	3		
508-002	RT	5 GY 5/1	24	un	3		
508-003	RT	5 GY 5/1	35	un	4		
508-004	SAP	5 G 6/1	8			8.3	1.7
508-005	SAPZ	5 G 6/1	6			8.8	1.8
508-006	SAPZ	5 BG 7/2	12				
508-007	SAP	5 G 6/1	12			9.2	1.9
508-008	SAPZ	5 G 5/2	17			8.9	1.9
508-009	BED		16				2.4
509-001	RT	5 GY 5/1	16	un	3		
509-002	BED		2936				
510-001	RT	5 GY 5/1	23	un	3		
510-002	RT	5 GY 5/1	25	un	3		

Appendix 280-K. Physical properties of Baudette area samples.

Sample	Unit	Munsell color	Mean susc. (cgs)	Ox. state	Till compact-ness	pH	Bulk dens.
510-003	BED		271				
511-001	RT	5 GY 5/1	20	un	3		
511-002	RT	5 GY 5/1	18	un	3		
511-003	RT	10 Y 6/1	15	un	3		
511-004	WT	5 Y 5/1	12	un	4		1.9
511-005	WT	10GY 6/1	8	un	4		
511-006	SAPZ	5 G 6/1	2			9.0	
512-001	WT	5 YR 5/2	3	ox	5		
512-002	WT	10YR 6/2	1	ox	4		
512-003	WT	10YR 6/2	0	ox	4	8.8	2.0
512-004	BED		23			8.5	
513-001	RT	3 GY 6/1	4	un	4		
513-002	WT	5 Y 5/2	5	ox	4		
513-003	WT	10YR 5/2	5	ox	4		
513-004	WT	10YR 5/2	6	ox	4		2.0
513-005	SAP	5 G 6/1	5			8.5	1.8
513-006	BED		339				2.8
514-001	RT	10 Y 6/1	13	un	4		
514-002	RT	5 Y 5/2	16	un	4		
514-003	RT	10YR 5/2	10	un	4		
514-004	RG	10YR 5/2	7	un			
514-005	OS	7 Y 6/1	5	un			
514-006	SAP	10GY 3/2	4			7.9	1.9
514-007	BED		2127				2.5
515-001	RT	5 GY 6/1	11	un	3		
515-002	RT	5 GY 6/1	11	un	3		
515-003	RT	5 GY 6/1	6	un	3		
515-004	OT	10 Y 5/1	6	un	4		
515-005	OT	10 Y 5/1	7	un	4		
515-006	OT	5 G 5/1	7	un	4		2.1
515-007	OT	5 G 5/1	7	un	4		
515-008	OT	5 G 5/1	9	un	4		
515-009	BED		62				
516-001	KT	5 Y 5/1	15	un	4		
516-002	KT	5 Y 5/1	17	un	4		
516-003	KG	5 Y 5/1	18	un			
516-004	BED		38				
517-001	RT	3 Y 4/1	20	un	1		
517-002	RT	5 Y 5/1	19	un	4		
517-003	WT	5 Y 5/1	16	un	5		
517-004	WT	5 Y 5/1	18	un	5		
517-005	WT	3 Y 4/2	18	ox	4		
517-006	WT	3 Y 4/2	22	un	4		
517-007	WT	3 Y 4/2	22	un	4		
517-008	WT	5 Y 4/2	18	un	4		
517-009	WT	3 Y 4/1	15	un	5		
517-010	WT	5 Y 4/1	12	un	5		
517-011	OT	5 Y 5/1	12	un	3		
517-012	OT	5 Y 5/1	15	un	3		
517-013	OT	5 Y 5/1	12	un	3		
517-014	OT	5 Y 5/1	10	un	3		
517-015	OT	5 Y 5/1	12	un	3		
517-016	OT	5 Y 5/1	11	un	3		
517-017	OT	5 Y 5/1	9	un	3		
517-018	OT	5 Y 5/1	10	un	3		

Appendix 280-K. Physical properties of Baudette area samples.

Sample	Unit	Munsell color	Mean susc. (cgs)	Ox. state	Till compactness	pH	Bulk dens.
517-019	BED		313				
518-001	RT	3 GY 6/1	13	un	3		
518-002	RT	5 Y 5/1	9	un	4		
518-003	WS	6 GY 4/1	25	un			
518-004	WT	5 Y 3/2	23	un	4		
518-005	WT	5 Y 3/2	22	un	4		
518-006	WT	3 Y 3/1	21	un	5		
518-007	WT	10YR 4/2	21	ox	4		
518-008	WT	10YR 4/2	23	ox	4		
518-009	BEDZ	5 G 6/1	9				1.9
519-001	RT	10 Y 6/1	9	un	3		
519-002	RT	10 Y 6/1	7	un	4		
519-003	WT	10 Y 6/1	9	un	4		
519-004	WT	5 Y 3/2	9	un	5		
519-005	WT	3 Y 3/2	10	un	4		
519-006	WT	10YR 3/3	7	un	4		
519-007	BED		1302				
520-001	RT	3 GY 6/1	17	un	3		
520-002	RT	3 GY 6/1	18	un	3		
520-003	RT	3 GY 6/1	14	un	3		
520-004	WT	3 GY 5/1	18	un	3		
520-005	OT	3 GY 5/1	8	un	3		
520-006	OT	3 GY 5/1	7	un	4		
520-007	OT	3 GY 5/1	7	un	5		
520-008	OT	3 GY 5/1	8	un	5		
520-009	OT	3 GY 5/1	7	un	5		
520-010	OT	3 GY 5/1	7	un	5		
520-011	OT	3 GY 5/1	7	un	5		
520-012	OT	10 Y 5/1	9	un	4		
520-013	OT	7 Y 4/1	5	un	3		
520-014	OT	5 Y 5/1	7	un	5		2.0
520-015	OS	5 Y 5/1	4	un		8.0	1.6
520-016	SAP	5 GY 8/1	1			8.3	2.3
520-017	SAP	5 GY 8/1	0			8.3	2.0
521-001	RT	5 GY 6/1	24	un	3		
521-002	RT	5 Y 5/1	26	un	3		
521-003	WT	3 Y 4/1	7	un	4		
521-004	OT	10 Y 5/1	24	un	4		
521-005	WT	5 Y 3/1	19	un	4		
521-006	WT	5 Y 5/1	23	un	3		
521-007	OG	5 Y 5/1	29	un			
521-008	OG	5 Y 5/1	36	un			
521-009	OG	5 Y 5/1	29	un			
521-010	OS	5 Y 5/1	0	un			
521-011	OS	5 Y 5/1	0	un	3		
521-012	SAP	10 R 3/4	1			9.0	1.9
521-013	BED		0				
521-014	BED		0				
521-015	BEDZ		0				

Appendix 280-L. Mineralogy of nonmagnetic heavy mineral concentrate fraction from till and saprolite samples in the Baudette area.

Column abbreviations and data key

Stratigraphic units

KT =Koochiching till
RT =Rainy till
WT =Winnipeg till
OT =Old Rainy till
ASAP =reworked saprolite
SAP =saprolite

Other abbreviations

ct. =count
T =trace, < 1%
morph. =morphology
w/ =with
=(null) not present in sample

morphology

fr =frosted rounded
a =anhedral
s =subhedral
e =euhedral

size

s =small, < .1mm
m =medium, .1mm - .5mm
l =large, >.5mm - 1mm
vl =very large, >1mm - 2mm

color

c =clear
p =pink
l =lavender
t =light brown
ro =red-orange
b =brown

Appendix 280-L. Mineralogy of nonmagnetic heavy mineral concentrate fraction from till and saprolite samples in the Baudette area.

Sample	Unit	Scheelite grain ct.	Pyrite (%)	Pyrite morph.	Pyrite size	Marcasite (%)	Marcasite size	Zircon (%)	Zircon morph.	Zircon size	Zircon color	Sphene (%)	Sphene morph.	Sphene size
501-001	RT		60	a-s	s-l	T	s-m	30	fr-e	s	c,p,l	5	a-s	s-m
501-002	SAP		50	a-e	s-l			35	fr-e	s	c,p,l,t	10	s	s
501-003	SAP	1	50	a-e	s-l	T	l	45	fr-e	s	c,l	T	s	s
502-002	RT	2	30	a-e	s-l	T	m-l	30	fr-e	s-l	l,c,p,t	35	a-e	s-l
503-002	RT	1	35	a-s	s-l			25	fr-e	s-l	c,p,l,t	20	a-s	s-l
503-005	RT	1	70	a-s	s-l			5	a-e	s	c,ro,t,p	10	a-s	s-m
503-006	ASAP	1	30	a-s	s-l			45	fr-e	s	c,p,l	20	a-s	s
503-007	SAP	3						99	a-s	s	c,l,p	T	a-s	s
505-001	RT		60	a-e	s-l	T	m-l	30	fr-e	s-m	c,l,p,t	1	a-s	s
505-002	RT	1	80	a-s	s-l	T	l	15	a-e	s-m	c,l,p,t,r	1	a-s	s
505-003	RT		70	a-s	s-l	T	l	25	a-e	s	c,p,l,t	1	a-s	s-l
505-004	SAP		85	a-s	s-l	T	l	10	fr-e	s	c,l,p	T	a-s	s
506-002	RT		90	a-s	s-l	T	l	5	fr-e	s	p,c,l	T	s	s
506-004	SAP		25	a-s	s-l			70	a-s	s	c,p,l	T	a	s
507-002	RT	3	30	a-s	s-l	T	l	40	fr-e	s	p,c,l,t	25	a-s	s-m
507-003	RL		75	a-e	s-l	T	l	20	fr-e	s	c,l,p	2	a-s	s-l
507-012	SAP		10	a-s	s-l	T	l	85	fr-e	s	c,p	T	a-s	s
508-003	RT		60	a-s	l			30	a-s	s	p,c,l	5	a-s	s
508-004	SAP		65	a-e	s-l	T	l	30	a-e	s	c,p,l,t	2	a-s	s
508-007	SAP		T	a-s	s-l			99	e-a	s-m	c,l,t	T	e-s	s
509-001	RT	2	5	a-s	s-l	T	l	65	fr-e	s	c,l,p	25	a-s	s-l
510-002	RT	3	35	a-s	s-l	T	s-m	50	fr-e	s	c,l,p,t	10	a-s	s-m
511-002	RT		50	a-s	s-l	T	l	45	a-e	s	c,l,p,r	T	a-s	s-l
511-004	WT	1	80	a-e	s-l	T	m-l	15	fr-e	s	c,p,t,l	5	a-s	s-l
511-005	WT	1	90	a-e	s-l	T	s-l	5	a-e	s-m	p,c,l,t,r	T	s	s
512-001	WT	2	90	a-e	s-l	T	l	5	a-e	s	c,p	T	s	s
512-002	WT	1	95	a-e	s-l	T	l	1	a-e	s	c,l,p	T	s	s
512-003	WT		95	a-s	s-l	T	s-l	1	a-s	s	c,p,t	T	a-s	s
513-001	RT		50	a-e	s-l	T	l	25	fr-e	s	p,l,t,c	5	a-s	s
513-005	SAP		99	a-e	s-l	T	l	T	fr-e	s	c,p	T	s	s
514-001	RT	1	35	a-s	s-l	T	l	25	a-e	s	c,p,l	35	a-s	s-m
514-006	SAP		20	a-s	s-l			75	a-e	s	c,p	T	a-s	s
515-008	OT	3	40	a-e	l			50	fr-e	s	l,p,c	T	s	s
516-001	KT	1	70	a-e	s-l	T	l	20	a-e	s	c,p,ro	5	s	s
516-002	KT	1	60	a-e	s-l	T	s-l	35	a-e	s	c,p,l	1	s	s
517-002	RT	1	65	a-e	s-l	T	l	30	a-e	vs	l,p,c,t	2	a-s	s
517-003	WT		90	a-e	s-l	T	s-l	5	a-e	s	c,p,t	2	s	s
517-004	WT		75	a-s	s-l			20	a-e	s	c,t	2	a-s	s
517-006	WT		75	a-e	s-l	T	s-l	20	fr-e	s	p,c,l	1	s	s
517-010	WT		98	a-e	s-l	T	s-l	T	a-e	s	c,p,l	T	s	s
517-011	OT		90	a-s	s-l	T	s-l	5	a-e	s-l	p,c,t	1	a-s	s
517-017	OT	2	60	a-e	s-l	T	l	35	fr-e	s-m	c,p,l	2	a-s	s
517-018	OT	2	85	a-e	vl			10	fr-e	s	ro,p,c,l	1	a-s	s
518-004	WT	3	99	a-s	s-l	T	s-l	T	fr-s	s	l,p,t	T	a-s	s
518-005	WT		95	a-e	s-l	T	s-l	1	fr-e	s	c,p,l	T	s	s
518-006	WT	1	98	a-e	s-l	T	s-l	T	fr-e	s-m	c,p,b,ro	T	a-s	s
519-004	WT		90	a-e	s-l	T	l	5	a-e	s-m	p,c,r,l	T	s	s
520-007	OT	2	75	a-e	s-l	T	m-l	20	a-e	s	p,l	1	a-s	s
520-008	OT	2	60	a-e	s-l	T	m-l	35	fr-e	s-m	c,p,ro,l	1	a-s	s
520-011	OT		80	a-e	s-l	T	l	15	fr-e	s	p,c,l	1	s	s

Appendix 280-L. Mineralogy of nonmagnetic heavy mineral concentrate fraction from till and saprolite samples in the Baudette area.

Sample	Unit	Scheelite grain ct.	Pyrite (%)	Pyrite morph.	Pyrite size	Marcasite (%)	Marcasite size	Zircon (%)	Zircon morph.	Zircon size	Zircon color	Sphene (%)	Sphene morph.	Sphene size
520-016	SAP		75	a-s	s-l	T	s-l	20	a-e	s-m	c,p,l	T	s	s
520-017	SAP		20	s	s			10	a-e	s-m	c,t	T	s	s
521-004	WT	3	85	a-e	s-l	T	l	10	fr-e	s	p,l,c,ro	5	a-s	s
521-005	OT		95	a-s	s-l	T	s-l	2	fr-e	s	c,p,t	T	s-e	s-m
521-006	WT		98	a-s	s-l	T	s-l	1	fr-e	s	c,p,t	T	s	s
521-011	OT		60	a-s	s-l	T	s-l	30	fr-e	s-m	c,p,l	T	s	s
521-012	SAP		25	a-s	s-l			70	fr-e	s-m	c,p	T	s	s

Appendix 280-L. Mineralogy of nonmagnetic heavy mineral concentrate fraction from till and saprolite samples in the Baudette area.

Sample	Unit	Rutile (%)	Rutile morph.	Rutile size	Kyanite (%)	Kyanite morph.	Kyanite size	Kyanite color	Rock Frag. (%)	Other
501-001	RT	T	a-s	s	T	s	s-m	clear	T	1 corundum
501-002	SAP								T	
501-003	SAP								T	
502-002	RT				T	s	s	clear	T	3 chalcopyrite
503-002	RT	T	s	s	T	s	s-m	clear	T	1 arsenopyrite
503-005	RT	T	s	s	T	s	s	clear	T	
503-006	ASAP	T	a	s	T	s	s	clear		
503-007	SAP								T	
505-001	RT				T	s	s	clear	T	2 molybdenite
505-002	RT				T	s	s	clear	T	
505-003	RT	T	s	s	T	s	s-m	clear	T	1 limonite on pyrite
505-004	SAP				T	s	s	clear	T	2 pyrite w/ quartz
506-002	RT	T	s	s	T	s	s	clear		
506-004	SAP								T	
507-002	RT				T	s	s-m	clear	T	
507-003	RL	T	s	s	T	s	s	clear	T	1 corundum, 1 small gold flake
507-012	SAP	T	s-e	s					T	4 corundum
508-003	RT				T	s-e	s	clear	T	1 pyrite w/quartz
508-004	SAP				T	s	s	clear		1 pyrite w/quartz, 1 globular Cu
508-007	SAP	T	s	s					T	10 galena
509-001	RT									1 corundum, pyrite w/quartz
510-002	RT	T	s-e	s						
511-002	RT	T	e	s-m						
511-004	WT				T	s	s	clear, 1 blue	T	
511-005	WT	T	s	s	T	s	s-m	clear		pyrite w/quartz
512-001	WT				T	s	s	clear	T	4 molybdenite
512-002	WT				T	s	s	clear, yellow	T	1 molybdenite
512-003	WT				T	s	s-m	clear, 1 blue	T	
513-001	RT	T	s	s	10	s	s	clear, 3 blue	T	
513-005	SAP				T	s	s	clear		many pyrite w/quartz
514-001	RT	T	s-e	s-m	T	a-s	l	clear	T	pyrite w/quartz, 3 globular Cu
514-006	SAP									
515-008	OT	T	s	s	5	s	s-l	clear, blue	T	
516-001	KT	T	s	s	T	s	s-m	clear	T	
516-002	KT				T	s	s	clear	T	
517-002	RT				T	s	s	clear	T	1 corundum, 1 small gold flake
517-003	WT				T	s	s	clear	T	
517-004	WT	T	s	s	T	s	s	clear	T	
517-006	WT				T	s	s	clear		1 epidote attached to pyrite
517-010	WT				T	s	s	clear		
517-011	OT	T	s	s	1	s	s-l	clear, 1 blue		
517-017	OT				1	s	s-l	clear	T	chalcopyrite?
517-018	OT				T	s	s-vl	clear, 2 blue	T	2 gahnite
518-004	WT				T	s	s	clear		
518-005	WT				T	s	s	clear		
518-006	WT	T	s	s	T	s	s	clear	T	
519-004	WT	T	s	s	T	s	s-m	clear, 1 blue		pyrite w/ quartz, 2 shell frags.
520-007	OT				1	s	s-m	clear		
520-008	OT				T	s	s	clear	T	pyrite w/ quartz
520-011	OT				1	s	s-m	clear, 1 blue	T	

Appendix 280-L. Mineralogy of nonmagnetic heavy mineral concentrate fraction from till and saprolite samples in the Baudette area.

Sample	Unit	Rutile (%)	Rutile morph.	Rutile size	Kyanite (%)	Kyanite morph.	Kyanite size	Kyanite color	Rock Frag. (%)	Other
520-016	SAP								T	1 large galena, pyrite w/ quartz
520-017	SAP								65	30 galena, trace chalcopyrite
521-004	WT				T	s	s	clear	T	1 corundum
521-005	OT				1	s	s-l	clear	T	
521-006	WT	T	e	s	T	s	s-l	clear	T	1 pyrrhotite
521-011	OT				T	s	s	clear		
521-012	SAP				T	s	s-m	clear	T	

Appendix 280-M. Baudette area pebble counts. Super-category counts per 10 kg sample by size fraction.

Column abbreviations and data key

Stratigraphic units

KT =Koochiching till
RT =Rainy till
WT =Winnipeg till
OT =Old Rainy till
ASAP =reworked saprolite
SAP =saprolite

Clast types

PM =Paleozoic-Mesozoic
FI =felsic to intermediate plutonic
SC =supracrustal

Size fractions

+1 =1" and larger pebble fraction
+3/4 =3/4" to -1" pebble fraction
+3/8 =3/8" to -3/4" pebble fraction
+1/4 =1/4" to -3/8" pebble fraction
4m =4mesh to -1/4" pebble fraction

Other abbreviations

ct =count
peb =pebble

Appendix 280-M. Baudette area pebble counts. Super-category counts per 10kg sample by size fraction.

Sample	Unit	PM ct +1	PM ct +3/4	PM ct +3/8	PM ct +1/4	PM ct +4m	Total PM ct	FI ct +1	FI ct +3/4	FI ct +3/8	FI ct +1/4	FI ct +4m	Total FI ct	SC ct +1	SC ct +3/4	SC ct +3/8	SC ct +1/4	SC ct +4m	Total SC ct	Total peb ct
501-001	RT	0	0	1	0	1	2	0	3	6	19	51	79	0	0	6	19	51	76	156
502-001	RT	0	0	0	2	5	7	4	10	53	186	323	577	1	6	54	105	200	367	951
502-002	RT	0	0	5	2	9	16	0	8	64	167	290	528	0	3	35	99	198	335	880
502-003	RT	0	0	2	5	8	15	1	10	35	112	252	410	0	4	26	69	142	241	666
503-001	RT	1	0	0	1	8	11	2	2	44	91	181	320	1	2	34	72	172	281	612
503-002	RT	0	0	1	3	4	8	1	5	45	131	267	449	1	1	45	72	207	326	783
503-003	RT	0	0	3	3	5	11	1	5	53	130	203	392	0	3	35	99	153	290	693
503-004	RT	0	0	0	1	1	2	0	6	43	90	210	349	0	2	19	54	134	210	561
503-005	RT	0	0	0	3	4	6	1	6	30	56	189	283	0	3	36	54	119	211	500
505-001	RT	0	0	2	1	23	26	0	4	32	74	154	264	3	13	35	50	133	234	524
505-002	OT	0	0	3	10	38	50	3	3	39	70	176	290	5	19	29	83	171	306	646
505-003	OT	0	0	2	5	11	18	2	5	37	51	142	237	1	0	9	39	105	154	409
506-001	RT	0	0	8	30	41	78	0	8	47	76	214	344	0	6	96	210	391	704	1127
506-002	RT	0	2	18	132	330	481	5	13	36	276	333	664	3	5	105	173	376	663	1808
507-001	RT	0	0	4	3	15	22	1	1	36	92	186	316	0	3	17	58	112	190	527
507-002	RT	0	0	3	7	22	32	0	1	15	44	96	156	0	1	9	30	62	101	289
507-004	OT	0	1	2	9	16	28	0	0	27	83	168	278	2	0	20	82	163	268	573
507-005	OT	0	0	15	32	28	76	3	14	90	145	200	451	1	5	90	149	208	453	979
507-006	OT	0	0	0	11	26	37	1	4	52	143	305	505	1	4	45	111	200	361	902
507-008	OT	0	0	2	3	26	31	1	4	48	135	251	439	1	3	36	100	190	330	801
507-010	OT	0	0	1	11	13	26	0	4	38	61	174	278	0	1	35	67	159	262	565
508-001	RT	0	0	2	1	5	8	1	0	10	31	56	98	1	2	15	30	63	110	216
508-002	RT	0	0	4	10	21	35	1	7	67	118	230	423	8	10	103	162	368	651	1109
508-003	RT	1	0	3	10	22	36	1	5	59	133	245	442	7	13	79	75	335	509	987
509-001	RT	0	0	4	7	18	29	3	2	39	98	247	390	4	5	54	70	176	308	727
510-001	RT	0	0	3	6	10	19	0	4	38	76	178	297	1	1	54	101	220	378	693
510-002	RT	0	0	6	5	15	25	3	6	50	120	195	374	0	7	31	85	138	261	660
511-001	RT	0	1	11	28	35	75	0	7	45	113	218	383	0	4	27	42	106	179	637
511-002	RT	0	1	4	7	25	38	1	4	33	92	197	327	0	1	18	30	98	147	512
511-003	RT	0	0	15	24	100	139	3	4	45	126	265	443	0	2	21	84	131	237	820
511-004	WT	0	0	15	78	165	258	0	5	14	27	99	145	0	2	11	34	68	115	518
511-005	WT	0	2	11	24	61	99	1	1	15	53	380	451	0	3	2	16	49	71	621
512-001	WT	0	0	5	13	39	56	0	2	12	28	84	126	0	1	18	45	85	149	331
512-002	WT	0	0	1	8	27	36	2	5	34	77	169	286	0	2	22	30	51	106	428
512-003	WT	0	0	4	16	30	50	1	1	8	34	66	110	0	0	17	58	116	191	351
513-001	RT	0	0	8	42	112	162	2	3	18	57	145	224	0	3	21	54	139	217	603
513-002	WT	0	2	8	66	109	184	0	0	10	29	80	119	1	1	16	33	91	142	446
513-003	WT	0	0	1	20	52	74	0	0	7	20	62	89	0	0	10	44	101	155	318
513-004	WT	0	0	5	20	47	72	0	1	10	14	47	72	2	2	21	42	121	189	332
514-001	RT	0	0	2	10	41	53	1	10	69	110	267	458	0	1	17	53	102	174	685
514-002	RT	4	0	3	20	24	51	4	5	65	159	321	554	1	1	20	66	134	222	827
514-003	RT	0	1	7	11	38	57	1	3	67	153	279	503	0	7	49	71	110	238	798
515-001	RT	0	0	4	15	25	44	3	5	53	129	257	446	0	1	14	45	104	165	656
515-002	RT	0	2	13	43	113	170	3	17	97	230	436	783	1	16	69	149	377	613	1566
515-003	RT	0	0	5	20	56	80	2	2	18	44	147	213	1	2	8	32	80	124	418
515-004	OT	0	0	14	42	67	123	1	1	27	59	175	264	1	1	24	41	139	206	592
515-005	OT	0	0	13	29	95	137	0	7	35	77	164	283	0	1	19	61	142	223	643
515-006	OT	0	0	18	40	81	139	0	3	28	56	159	245	0	0	11	34	103	148	531
515-007	OT	0	1	10	29	88	127	1	3	27	69	139	238	1	2	18	65	128	213	579
515-008	OT	0	1	13	25	64	103	2	7	46	149	408	614	4	5	44	120	234	407	1124
516-001	KT	0	2	25	87	165	278	1	3	27	78	162	272	2	4	22	42	67	137	687
516-002	KT	0	5	39	105	177	327	1	2	26	113	207	348	0	1	39	65	166	271	945
517-001	RT	0	2	16	34	78	129	2	3	45	131	294	475	0	1	14	44	79	137	741
517-002	RT	0	1	15	22	63	100	3	6	49	98	248	403	0	0	22	62	111	194	698
517-003	WT	1	2	40	106	186	334	0	3	31	78	202	314	0	0	23	28	71	122	770

Appendix 280-M. Baudette area pebble counts. Super-category counts per 10kg sample by size fraction.

Sample	Unit	PM ct +1	PM ct +3/4	PM ct +3/8	PM ct +1/4	PM ct +4m	Total PM ct	FI ct +1	FI ct +3/4	FI ct +3/8	FI ct +1/4	FI ct +4m	Total FI ct	SC ct +1	SC ct +3/4	SC ct +3/8	SC ct +1/4	SC ct +4m	Total SC ct	Total peb ct
517-004	WT	0	1	16	65	156	238	0	2	14	50	99	165	0	1	9	18	51	79	482
517-005	WT	0	0	10	27	53	89	0	1	10	43	67	120	0	0	7	10	32	49	259
517-006	WT	0	3	9	44	79	135	0	4	22	81	44	151	0	0	10	19	26	56	342
517-007	WT	0	1	8	23	74	107	1	3	14	49	117	184	0	0	2	11	41	54	346
517-008	WT	0	1	19	36	89	145	1	3	21	58	121	204	0	0	7	30	50	87	435
517-009	WT	0	1	16	61	118	196	1	4	26	69	85	185	0	1	7	28	72	108	489
517-010	WT	0	0	27	73	124	224	0	1	19	73	162	255	0	1	13	44	55	113	592
517-011	OT	0	0	18	40	99	156	0	3	36	108	181	329	0	3	21	66	134	224	709
517-012	OT	0	0	18	55	128	201	1	3	50	127	253	434	0	2	46	90	159	297	932
517-013	OT	0	1	18	29	73	121	3	5	34	71	202	314	2	2	53	79	151	287	721
517-014	OT	0	1	11	45	87	144	2	1	26	100	140	270	2	4	26	81	166	279	693
517-015	OT	1	0	17	50	138	207	4	2	28	118	200	351	2	0	28	96	207	333	890
517-016	OT	0	1	19	28	88	136	0	6	34	76	258	373	0	6	44	97	182	329	838
517-017	OT	0	1	7	43	119	170	3	7	29	86	193	319	2	3	43	83	137	269	757
517-018	OT	0	0	1	48	77	126	1	0	25	81	156	262	1	1	43	95	157	297	686
518-001	RT	0	0	6	16	31	53	2	2	12	40	118	175	0	2	9	30	53	93	321
518-002	RT	0	0	11	40	90	141	0	1	23	44	105	173	1	0	3	16	40	60	374
518-004	WT	0	3	57	220	394	674	0	0	20	37	73	131	0	1	12	20	52	85	890
518-005	WT	0	0	36	133	294	464	0	1	2	12	33	48	0	0	6	8	27	41	553
518-006	WT	0	0	35	120	124	279	0	3	6	14	23	47	0	0	6	15	34	55	380
518-007	WT	0	0	8	40	84	132	0	2	13	22	61	98	0	0	6	23	67	95	325
518-008	WT	0	0	1	23	56	80	0	0	6	28	53	87	0	3	39	80	159	281	447
519-001	RT	2	4	44	137	303	491	4	6	87	205	457	759	0	1	30	96	158	285	1534
519-002	RT	0	2	29	90	223	343	2	4	56	87	216	364	0	3	22	54	113	192	899
519-003	WT	0	2	26	98	112	238	1	5	52	108	246	412	1	7	32	64	112	216	866
519-004	WT	0	5	29	74	172	281	0	1	9	33	99	142	1	0	19	40	72	132	555
519-005	WT	0	0	2	21	39	62	1	2	25	45	136	209	1	5	26	78	143	254	525
519-006	WT	0	0	2	19	41	63	0	0	18	58	159	235	0	2	51	70	158	281	578
520-001	RT	0	0	4	16	34	53	3	6	30	94	202	335	0	0	18	39	84	142	530
520-002	RT	0	0	4	18	30	53	1	2	32	67	167	269	0	0	13	33	81	127	448
520-003	RT	0	1	46	102	187	336	1	2	34	79	221	338	0	2	27	62	118	209	884
520-004	WT	0	0	58	132	232	422	0	7	74	157	230	468	0	4	41	65	117	227	1117
520-005	OT	0	0	9	49	97	155	0	1	41	130	283	455	1	5	28	61	151	246	856
520-006	OT	0	0	12	32	122	166	0	1	38	97	166	303	1	0	34	77	200	312	781
520-007	OT	0	2	10	42	97	151	1	4	17	86	166	274	0	2	36	91	165	294	719
520-008	OT	0	0	13	43	105	161	0	2	27	68	133	230	2	4	44	76	148	273	665
520-009	OT	0	0	11	34	111	157	1	3	19	56	111	191	1	7	34	89	175	306	653
520-010	OT	0	0	18	63	101	183	0	5	64	72	143	283	0	3	46	81	153	283	749
520-011	OT	0	3	14	43	94	153	1	1	20	44	116	184	0	4	16	48	91	159	496
520-012	OT	0	3	29	70	183	285	1	1	22	57	164	245	0	0	15	39	70	124	653
520-013	OT	0	2	31	85	169	288	0	1	28	76	154	259	0	0	21	29	90	140	686
520-014	OT	0	0	34	37	166	237	0	3	16	99	133	251	0	0	42	78	114	235	723
521-001	RT	2	0	28	51	109	189	2	10	50	116	282	459	0	3	32	48	90	173	822
521-002	RT	0	2	11	39	122	174	0	4	29	57	127	216	0	2	10	33	69	114	505
521-003	WT	0	2	17	53	93	166	0	2	27	64	161	253	0	0	9	39	72	120	539
521-004	OT	0	0	26	61	110	197	0	4	45	91	144	283	0	5	41	84	162	292	772
521-005	WT	0	3	13	57	120	193	1	2	8	47	99	157	0	0	11	35	72	119	469
521-006	WT	0	1	7	30	118	156	0	1	7	33	76	117	0	1	19	68	107	196	469

Note: PM =Paleozoic-Mesozoic, FI =Felsic to Intermediate plutonic, SC =Supracrustal.

Appendix 280-N. Baudette area pebble counts, +1/4" - 3/8" pebbles.

Column abbreviations and data key

Stratigraphic units

KT =Koochiching till
RT =Rainy till
WT =Winnipeg till
OT =Old Rainy till
ASAP =reworked saprolite
SAP =saprolite

Clast type abbreviations

Raw =total number of pebbles
PM =Paleozoic-Mesozoic
FI =felsic-intermediate plutonic
Maf. =mafic
Gnss =gneiss
SC =supracrustal
Meta sed. =metasediment
Misc. =miscellaneous
+1/4 =1/4" to -3/8" pebble fraction
ct =count
volc. =volcanic
hyp. =hypabyssal
amph. =amphibolite
plut. =plutonic
Fplut. =coarse grained felsic plutonic
Sil. =siliceous nonsedimentary
Sfd. =sulfide
Mag. =magnetic
peb =pebble
qtz. =quartz
gns =grains

Notes:

Raw counts are total number of pebbles counted (not normalized to a 10 kg sample).

Appendix 280-N. Baudette area pebble counts, +1/4" - 3/8" pebbles.

Sample	Unit	Raw +1/4 Peb ct	Raw +1/4 SC ct	% PM ct +1/4	% FI ct +1/4	% SC ct +1/4	% SC FI volc.	% SC FI hyp.	% SC Maf. volc.	% SC Maf. amph.	% SC Maf. plut.	% SC Gnss. Fplut.	% SC Gray-wacke	% SC Sil.	% SC Sfd.	% SC Mag.	% SC Meta sed.	% SC Misc.	% SC Remarks
501-001	RT	40	19	0	50	50	5	0	0	5	16	53	0	0	5	5	5	11	misc=siderite
502-001	RT	238	82	1	63	36	9	6	15	18	22	24	0	2	0	0	2	1	misc=siderite
502-002	RT	236	82	1	62	37	10	4	22	15	7	37	0	5	1	7	0	0	
502-003	RT	186	69	3	60	37	3	4	17	13	6	46	1	1	1	3	3	3	misc=siderite
503-001	RT	139	60	1	55	44	10	0	43	10	3	25	2	5	0	3	2	0	
503-002	RT	231	76	1	64	35	14	3	17	17	16	26	0	3	0	4	4	0	
503-003	RT	227	87	1	56	43	5	3	25	14	14	37	0	1	1	9	0	0	
503-004	RT	121	47	1	62	37	2	2	21	19	15	30	2	2	4	13	2	0	
503-005	RT	90	48	2	50	48	27	2	23	6	19	13	0	0	6	4	2	2	felsic vol. all same
505-001	RT	115	42	1	59	40	7	5	36	12	5	29	0	0	0	12	7	0	
505-002	OT	130	67	6	43	51	1	0	36	4	19	24	7	4	0	21	3	0	
505-003	OT	88	36	6	53	41	6	3	28	6	6	31	11	3	6	8	0	3	misc=siderite, sfd=pebs
506-001	RT	250	157	10	24	66	6	4	22	10	4	34	6	5	1	4	4	3	misc=siderite
506-002	RT	564	165	23	48	30	12	1	26	13	2	32	10	1	0	1	2	0	
507-001	RT	176	67	2	60	38	1	0	21	13	7	42	9	0	6	3	0	0	sfd=bearing gns
507-002	RT	73	27	8	55	37	11	0	26	19	0	33	11	0	0	0	0	0	
507-004	OT	157	32	5	48	47	9	0	34	3	6	19	16	0	0	0	13	0	
507-005	OT	254	104	10	44	46	22	4	17	6	5	29	12	0	1	4	2	3	
507-006	OT	222	92	4	54	42	7	7	25	9	11	21	17	3	0	3	1	0	
507-008	OT	212	83	1	57	42	12	0	31	6	2	22	16	0	0	13	2	8	misc=unknown
507-010	OT	137	65	8	44	48	8	0	26	8	14	23	12	2	3	5	5	0	sfd=qtz.grain
508-001	RT	54	20	2	50	48	0	0	10	10	40	40	0	0	0	30	0	0	
508-002	RT	290	177	3	41	56	3	0	6	14	10	58	4	2	0	9	3	0	
508-003	RT	200	138	5	61	35	3	1	11	12	7	54	9	4	0	17	0	0	
509-001	RT	173	66	4	56	40	2	2	11	3	8	76	0	0	0	11	0	0	
510-001	RT	163	87	3	42	55	3	0	34	7	6	45	2	1	0	6	1	0	
510-002	RT	259	112	2	57	41	4	0	19	8	10	48	6	2	4	4	0	0	sfd=bearing gns
511-001	RT	163	38	15	62	23	3	5	16	8	21	42	0	0	3	3	3	0	sfd=peb
511-002	RT	145	35	6	71	23	3	9	20	9	34	14	3	3	3	6	3	0	
511-003	RT	226	77	10	54	36	3	8	23	12	8	25	21	0	0	1	0	1	misc=qtz.grain gossan
511-004	WT	140	74	56	19	24	11	0	14	4	15	20	24	0	1	3	11	0	
511-005	WT	81	14	26	57	17	7	0	7	0	14	21	29	7	14	7	0	0	sfd=qtz.grain
512-001	WT	86	44	15	33	52	5	0	14	0	14	48	9	2	5	2	0	5	sfd=bearing,misc=grap
512-002	WT	123	32	7	67	26	0	9	13	0	13	56	3	0	0	0	6	0	
512-003	WT	114	62	15	32	54	2	0	13	29	3	37	10	0	5	0	0	2	sfd=bearing,misc=sider
513-001	RT	173	58	28	37	35	7	3	14	3	12	31	28	0	2	3	0	0	
513-002	WT	115	30	51	23	26	10	3	13	0	3	37	30	0	0	0	3	0	
513-003	WT	71	24	24	24	52	8	0	8	4	13	42	21	0	0	4	0	4	
513-004	WT	61	30	26	18	56	10	20	10	0	10	40	7	0	3	0	0	0	sfd=bearing gns
514-001	RT	153	44	6	63	31	9	0	16	2	11	52	2	5	2	2	0	0	sfd=bearing
514-002	RT	235	57	8	65	27	2	7	14	7	14	42	4	5	0	9	5	0	
514-003	RT	226	61	5	65	30	2	0	15	16	8	49	7	2	0	3	2	0	
515-001	RT	184	41	8	68	24	7	2	27	2	22	37	0	2	0	5	0	0	
515-002	RT	371	123	10	54	35	4	1	28	15	4	33	11	2	2	7	2	0	
515-003	RT	93	30	20	46	33	0	0	20	0	7	40	27	3	0	3	3	0	
515-004	OT	125	36	30	42	29	11	0	11	0	11	39	19	3	0	0	6	0	
515-005	OT	163	57	17	46	37	2	2	19	4	11	19	37	2	0	4	4	2	misc=graphite
515-006	OT	104	35	31	43	26	3	0	20	3	9	46	14	3	3	6	0	0	sfd=peb
515-007	OT	182	68	18	42	40	7	4	29	0	4	25	28	1	0	4	0	0	
515-008	OT	280	115	9	51	41	3	0	12	2	56	12	16	0	0	23	0	0	all mag=mplu
516-001	KT	193	34	42	38	20	3	0	24	0	18	21	32	3	0	12	0	0	
516-002	KT	336	73	37	40	23	11	4	27	8	4	16	19	8	0	4	1	0	
517-001	RT	223	46	16	63	21	17	0	24	11	9	24	9	0	4	2	2	0	sfd=peb+qtz.grain
517-002	RT	218	70	12	54	34	4	1	16	4	10	40	9	14	0	4	1	0	
517-003	WT	225	30	50	37	13	0	7	10	10	7	20	47	0	0	3	0	0	

Appendix 280-N. Baudette area pebble counts, +1/4" - 3/8" pebbles.

Sample	Unit	Raw +1/4 Peb ct	Raw +1/4 SC ct	% PM ct +1/4	% FI ct +1/4	% SC ct +1/4	% SC FI volc.	% SC FI hyp.	% SC Maf. volc.	% SC Maf. amph.	% SC Maf. plut.	% SC Gnss. Fplut	% SC Gray-wacke	% SC Sil.	% SC Sfd.	% SC Mag.	% SC Meta sed.	% SC Misc.	% SC Remarks
517-004	WT	133	18	49	38	14	11	0	0	6	0	33	44	6	0	0	0	0	
517-005	WT	74	8	34	54	12	0	13	0	0	0	25	63	0	0	0	0	0	
517-006	WT	156	8	31	56	13	0	0	0	0	13	25	50	13	0	0	0	0	
517-007	WT	75	10	28	59	13	0	0	0	0	20	10	40	10	0	0	20	0	
517-008	WT	131	37	29	47	24	5	0	14	8	14	30	22	5	3	8	0	0	sfd=bearing
517-009	WT	156	25	38	44	18	0	0	8	0	24	20	36	8	4	0	0	0	sfd=peb
517-010	WT	159	35	38	38	23	0	0	17	0	11	34	34	0	0	0	3	0	
517-011	OT	205	62	19	51	31	5	2	15	0	10	27	29	5	2	0	6	0	
517-012	OT	256	87	20	46	33	3	6	21	7	8	22	26	1	3	7	2	0	sfd=peb+2bearing
517-013	OT	191	73	16	40	44	18	5	25	0	1	18	29	3	1	12	0	0	sfd=qtz.grain
517-014	OT	231	80	20	44	36	13	1	18	5	8	19	28	3	1	5	6	0	sfd=bearing
517-015	OT	325	112	19	45	36	4	2	14	6	12	33	26	0	0	5	3	0	
517-016	OT	180	75	14	38	48	13	1	19	3	4	32	21	0	3	4	4	0	sfd=qtz.grain,mudball
517-017	OT	182	76	20	41	39	5	0	21	14	16	14	26	0	1	1	1	0	sfd=bearing
517-018	OT	172	93	22	36	42	2	0	15	10	15	19	19	2	1	1	16	0	
518-001	RT	104	35	18	47	35	3	3	17	9	14	26	23	6	0	3	0	0	
518-002	RT	80	12	40	44	16	0	17	17	0	42	17	8	0	0	8	0	0	
518-004	WT	261	19	79	13	7	0	0	0	0	0	53	32	0	5	0	11	0	
518-005	WT	130	7	87	8	5	0	0	57	0	14	14	0	0	0	0	0	14	
518-006	WT	128	15	80	9	10	33	0	7	0	0	20	27	0	7	0	0	7	misc=siderite
518-007	WT	74	21	47	26	27	5	0	5	0	0	38	38	5	5	0	5	0	
518-008	WT	130	76	18	22	61	8	0	75	1	1	5	7	0	3	0	0	0	
519-001	RT	434	88	31	47	22	3	7	13	1	7	27	39	0	0	2	3	0	
519-002	RT	277	65	39	38	23	2	5	15	5	11	31	26	5	0	2	2	0	
519-003	WT	270	57	36	40	24	2	0	26	4	5	32	30	2	0	11	0	0	
519-004	WT	115	30	50	23	27	3	0	3	0	3	20	30	0	3	0	37	0	
519-005	WT	147	78	14	31	54	14	3	27	3	4	29	17	1	1	0	1	0	sfd=qtz.grain
519-006	WT	122	58	13	39	48	9	3	14	7	12	33	19	2	2	0	0	0	sfd=peb
520-001	RT	163	41	10	63	26	5	2	20	5	10	49	5	2	2	7	0	0	
520-002	RT	110	31	15	56	28	6	3	6	32	6	26	13	0	3	3	3	0	sfd=sfdschist
520-003	RT	207	50	42	32	26	6	0	14	10	28	30	10	0	0	6	2	0	
520-004	WT	287	55	37	44	18	5	2	18	9	20	25	18	0	2	9	0	0	sfd=qtz.grain
520-005	OT	240	62	20	54	25	3	8	21	10	10	21	24	2	2	5	0	0	sfd=qtz.grain
520-006	OT	150	66	15	47	37	2	3	14	11	6	30	33	2	0	2	0	0	
520-007	OT	210	85	19	40	41	8	2	16	6	9	32	19	0	5	8	2	0	sfd=2peb,2bearing
520-008	OT	153	55	23	37	41	5	4	16	4	2	42	24	2	0	4	2	0	
520-009	OT	157	75	19	31	50	9	1	28	9	11	23	17	1	0	3	0	0	
520-010	OT	235	39	29	33	37	13	0	13	3	8	21	33	5	5	3	0	0	sfd=qtx.grain+bearing
520-011	OT	107	38	32	33	36	3	3	13	8	0	34	24	0	0	3	16	0	
520-012	OT	152	37	42	34	24	3	0	8	3	3	32	43	0	0	3	8	0	
520-013	OT	183	27	45	40	15	4	0	7	0	0	33	52	0	0	0	4	0	
520-014	OT	197	70	17	46	37	1	0	16	7	16	20	30	0	3	4	7	0	sfd=qtz.grain+bearing
521-001	RT	258	48	24	54	22	7	0	19	5	10	36	20	0	3	2	0	0	sfd=mvol+gabbroid
521-002	RT	125	33	30	44	26	3	0	23	0	16	3	45	3	6	0	0	0	sfd=peb+qtz.grain
521-003	WT	191	39	34	41	25	2	0	13	7	13	24	33	7	2	2	0	0	sfd=peb
521-004	OT	239	84	26	38	36	7	12	22	0	7	15	32	2	0	1	1	0	button bit
521-005	WT	134	35	41	34	25	3	6	23	0	3	23	39	0	3	3	0	0	
521-006	WT	123	59	23	25	52	14	9	25	9	14	14	11	2	0	0	2	0	

Note: PM =Paleozoic-Mesozoic, FI =Felsic to Intermediate plutonic, SC =Supracrustal.

Appendix 280-O. X-ray diffraction results for 14 selected Baudette area till and saprolite samples.

Column abbreviations and data key

Stratigraphic units

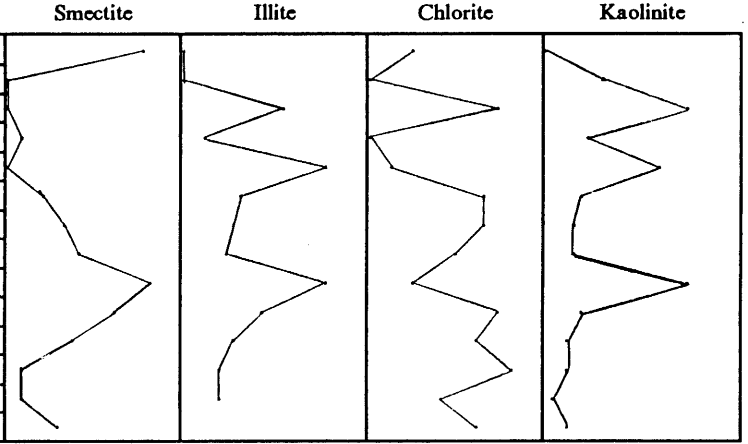
RT =	Rainy till
WT =	Winnipeg till
OT =	Old Rainy till
SAP =	saprolite

Other abbreviations

(ft) =	feet

Appendix 280-O. X-ray diffraction clay mineralogy for selected Baudette area till and saprolite samples.

Sample #	Sample Interval (ft)	Unit
506-003	180-183	SAP
506-004	190-208	SAP
506-006	208-215	SAP
507-012	239-243	SAP
520-017	300-329	SAP
518-002	128-134	RT
521-002	111-117	RT
518-004	202-209	WT
518-007	235-245	WT
521-003	124-134	WT
521-006	217-224	WT
520-005	106-116	OT
520-012	250-259	OT
521-004	192-201	OT



Note: For comparison, XRD peak heights of the clay minerals in each sample have been internally normalized (highest response =100%). XRD patterns were run using identical instrument parameters. Results are semi-quantitative.

Appendix 280-P. Baudette area gold data summary.

Column abbreviations and data key

Stratigraphic units

KT	=Koochiching till
KG	=Koochiching gravel
RT	=Rainy till
RS	=Rainy sand
RG	=Rainy gravel
RL	=Rainy lake sediment
WT	=Winnipeg till
WS	=Winnipeg sand
OT	=Old Rainy till
OS	=Old Rainy sand
OG	=Old Rainy gravel
OL	=Old Rainy lake sediment
ASAP	=reworked saprolite
SAP	=saprolite
SAPZ	=saprolite (trace element analysis)
BEDZ	=bedrock (trace element analysis)
BED	=bedrock

Other abbreviations

	=(null) no data or no analysis
ft.	=feet
py	=pyrite
ODM	=Overburden Drilling Management Labs
nmHMC	=nonmagnetic heavy mineral concentrate
um	=micron
Ox.	=oxidation
ox	=oxidized
un	=unoxidized
kg	=kilogram
g	=gram
ug	=microgram
fadc	=fire assay direct current

Notes:

Gold values reported for bedrock pulps and saprolite pulps (BEDZ and SAPZ) are included in the column of data labeled "Au -63um fadc". The BEDZ and SAPZ data are on whole rock pulps, not -63um fraction.

Appendix 280-P. Baudette area gold data summary.

Sample	Unit	Sampled interval	Sample height (ft.)	Gold grains /10kg	ODM Remarks	Au nmHMC inaa/fadc	nmHMC g/10kg	Au nmHMC ug/10kg	ODM est. Au assay nmHMC	Au -63um fadc	Ox. state
501-001	RT	131-135	2	0		0.231	27	6	0.000	0.003	un
501-002	SAP	135-145	-5	0		0.010	23	0	0.000	0.001	un
501-003	SAP	157-163	-25	0		0.006	34	0	0.000	0.001	un
501-004	BEDZ	163-166	-30			0.003			0.000	0.002	un
502-001	RT	123-133	51	4	0.1% py	0.053	44	2	0.335	0.002	un
502-002	RT	133-143	41	2	0.5% py	0.079	42	3	0.014	0.005	un
502-003	RT	143-153	31	0		0.118	40	5	0.000	0.004	un
502-004	RS	153-163	21	0		0.012	46	1	0.000	0.008	un
502-005	OL	167-177	7	0		0.106	75	8	0.000	0.001	un
502-006	BED	179-187	-4							0.001	un
503-001	RT	111-118	39	0		0.034	22	1	0.000	0.002	un
503-002	RT	118-128	30	1		0.887	33	29	0.691	0.001	un
503-003	RT	128-138	20	0		0.064	26	2	0.000	0.002	un
503-004	RT	138-148	10	0		0.240	22	5	0.000	0.023	un
503-005	RT	148-153	3	1		0.170	28	5	0.096	0.001	un
503-006	ASAP	164-174	-16	1		0.116	73	8	0.009	0.002	un
503-007	SAP	211-221	-63	0		0.003	410	1	0.000	0.002	un
503-008	BEDZ	240-247	-91			0.003					un
503-009	BED	247-255	-98							0.005	un
505-001	RT	140-149	90	1		0.213	31	7	0.197	0.001	un
505-002	OT	224-228	8	3	0.1% py	0.019	86	2	0.027	0.002	un
505-003	OT	228-234	3	1	1 Cu grain	0.200	53	11	0.116	0.001	un
505-004	SAP	234-243	-5	0		0.016	22	0	0.000	0.001	un
505-005	BEDZ	261-267	-30			0.003					un
506-001	RT	166-171	8	5	1.5% py	0.101	69	7	0.533	0.034	un
506-002	RT	171-176	3	3	1.0% py	0.232	34	8	0.305	0.008	un
506-003	SAP	183-192	-12	0		0.003	74	0	0.000	0.018	un
506-004	SAP	192-199	-19	0		0.019	17	0	0.000	0.005	un
506-005	BED	236-244	-64							0.010	un
507-001	RT	148-155	88	0		0.079	31	2	0.000	0.001	un
507-002	RT	155-162	81	0		0.014	29	0	0.000	0.001	un
507-003	RL	162-168	74	4	0.1% py	0.122	48	6	0.215	0.003	un
507-004	OT	170-178	65	1	1 Cu grain	0.038	134	5	0.070	0.001	ox
507-005	OT	183-189	53	1		0.115	131	15	0.041	0.001	ox
507-006	OT	197-202	40	1		0.022	116	3	0.024	0.002	un
507-007	OS	202-207	35	0		0.098	109	11	0.000	0.004	un
507-008	OT	207-215	28	1		0.035	98	3	0.024	0.001	un
507-009	OS	217-227	17	0		0.010	160	2	0.000	0.001	un
507-010	OT	227-234	9	1		0.055	68	4	0.028	0.001	un
507-011	OL	234-239	3	0		0.055	23	1	0.000	0.003	un
507-012	SAP	239-242	-2	1		0.617	78	48	0.181	0.002	un
507-013	BEDZ	242-247	-6			0.003					un
508-001	RT	119-124	31	0		0.080	14	1	0.000	0.003	un
508-002	RT	140-146	9	1	2 Cu grains	0.072	38	3	0.038	0.003	un
508-003	RT	146-152	3	2	10 Cu grains	0.275	37	10	0.087	0.001	un
508-004	SAP	153-160	-5	0		0.245	8	2	0.000	0.001	un
508-005	SAPZ	160-168	-12			0.003					un
508-006	SAPZ	214-223	-67			0.003					un
508-007	SAP	223-232	-76	0		0.011	22	0	0.000	0.002	un
508-008	SAPZ	266-276	-119			0.005					un
508-009	BED	280-285	-131							0.004	un
509-001	RT	083-092	5	2	2 Cu grains	0.083	37	3	0.055	0.015	un
509-002	BED	092-100	-4							0.002	un
510-001	RT	097-102	8	2	1 Cu grain	0.093	41	4	0.214	0.002	un
510-002	RT	102-107	3	1	1 Cu grain	0.027	28	1	0.006	0.001	un

Appendix 280-P. Baudette area gold data summary.

Sample	Unit	Sampled interval	Sample height (ft.)	Gold grains /10kg	ODM Remarks	Au nmHMC inaa/fadc	nmHMC g/10kg	Au nmHMC ug/10kg	ODM est. Au assay nmHMC	Au -63um fadc	Ox. state
510-003	BED	107-112	-3							0.008	un
511-001	RT	109-116	31	0	7 Cu grains	0.127	22	3	0.000	0.001	un
511-002	RT	116-123	24	0	3 Cu grains	0.009	30	0	0.000	0.001	un
511-003	RT	127-133	13	0	1 Cu grain	0.122	30	4	0.000	0.001	un
511-004	WT	133-138	8	0		0.028	17	0	0.000	0.002	un
511-005	WT	138-143	3	0		0.024	11	0	0.000	0.001	un
511-006	SAPZ	143-147	-2			0.003					un
512-001	WT	087-095	14	0		0.038	27	1	0.000	0.001	ox
512-002	WT	095-100	8	0		0.058	19	1	0.000	0.001	ox
512-003	WT	100-105	3	0		0.027	43	1	0.000	0.001	ox
512-004	BED	107-117	-7							0.003	un
513-001	RT	071-075	20	1		0.418	29	12	0.202	0.003	un
513-002	WT	075-083	14	0		0.017	27	0	0.000	0.001	ox
513-003	WT	083-088	8	0		0.021	44	1	0.000	0.003	ox
513-004	WT	088-093	3	0		0.023	53	1	0.000	0.002	ox
513-005	SAP	095-101	-5	0		0.156	23	4	0.000	0.003	un
513-006	BED	106-115	-18							0.030	un
514-001	RT	165-173	47	0		0.017	20	0	0.000	0.002	un
514-002	RT	173-178	41	1		0.341	24	8	0.661	0.014	un
514-003	RT	178-183	36	0		0.081	33	3	0.000	0.003	un
514-004	RG	188-198	23	0		0.003	55	0	0.000	0.001	un
514-005	OS	198-207	14	1		0.057	36	2	0.008	0.001	un
514-006	SAP	217-227	-6	0		0.019	94	2	0.000	0.011	un
514-007	BED	257-262	-44							0.001	un
515-001	RT	143-153	64	0		0.026	63	2	0.000	0.002	un
515-002	RT	153-163	54	0		0.053	47	2	0.000	0.001	un
515-003	RT	168-176	40	0		0.017	52	1	0.000	0.010	un
515-004	OT	176-182	33	0		0.054	33	2	0.000	0.002	un
515-005	OT	182-192	25	0		0.066	27	2	0.000	0.001	un
515-006	OT	192-202	15	0		0.066	25	2	0.000	0.001	un
515-007	OT	202-207	8	1		0.046	29	1	0.118	0.001	un
515-008	OT	207-212	3	0		0.597	47	28	0.000	0.001	un
515-009	BED	212-223	-6							0.002	un
516-001	KT	037-042	15	0		0.042	21	1	0.000	0.001	un
516-002	KT	042-047	10	0		0.054	17	1	0.000	0.001	un
516-003	KG	047-054	4	1		0.023	17	0	0.123	0.001	un
516-004	BED	056-061	-5							0.001	un
517-001	RT	038-045	179	0		0.047	27	1	0.000	0.001	un
517-002	RT	045-055	170	1		0.268	20	5	0.099	0.002	un
517-003	WT	055-064	161	0		0.100	8	1	0.000	0.001	un
517-004	WT	064-074	151	1		0.538	10	5	0.371	0.001	un
517-005	WT	074-082	142	0		0.028	3	0	0.000	0.001	ox
517-006	WT	082-092	133	0		0.127	12	2	0.000	0.001	un
517-007	WT	092-098	125	1		0.025	11	0	0.221	0.001	un
517-008	WT	103-112	113	1		0.178	18	3	0.190	0.001	un
517-009	WT	113-123	102	0		0.182	17	3	0.000	0.002	un
517-010	WT	123-129	94	0		0.038	9	0	0.000	0.002	un
517-011	OT	136-146	79	0		0.016	25	0	0.000	0.002	un
517-012	OT	146-153	71	0		0.042	29	1	0.000	0.002	un
517-013	OT	153-163	62	3	0.8% FeS2	0.166	21	3	0.059	0.001	un
517-014	OT	163-173	52	0		0.052	30	2	0.000	0.003	un
517-015	OT	173-183	42	0		0.021	25	1	0.000	0.005	un
517-016	OT	183-193	32	0		0.039	27	1	0.000	0.006	un
517-017	OT	193-203	22	0		0.185	22	4	0.000	0.003	un
517-018	OT	203-220	9	4	1.0% FeS2	0.609	25	15	0.918	0.001	un

Appendix 280-P. Baudette area gold data summary.

Sample	Unit	Sampled interval	Sample height (ft.)	Gold grains /10kg	ODM Remarks	Au nmHMC inaa/fadc	nmHMC g/10kg	Au nmHMC ug/10kg	ODM est. Au assay nmHMC	Au -63um fadc	Ox. state
517-019	BED	221-229	-5							0.003	un
518-001	RT	105-115	140	0		0.037	20	1	0.000	0.003	un
518-002	RT	128-134	119	1		0.055	14	1	0.007	0.006	un
518-003	WS	172-182	73	0		0.052	26	1	0.000	0.022	un
518-004	WT	202-209	45	1		0.237	16	4	0.319	0.001	un
518-005	WT	209-219	36	0		0.025	16	0	0.000	0.001	un
518-006	WT	219-229	26	0		0.013	18	0	0.000	0.001	un
518-007	WT	235-245	10	0		0.016	41	1	0.000	0.002	ox
518-008	WT	245-250	3	1		0.091	46	4	0.033	0.001	ox
518-009	BEDZ	263-273	-18			0.003					un
519-001	RT	085-097	71	0		0.049	26	1	0.000	0.001	un
519-002	RT	097-105	61	2	0.8% FeS2	0.046	21	1	0.335	0.001	un
519-003	WT	105-115	52	1		0.014	24	0	0.321	0.002	un
519-004	WT	140-145	20	1		0.048	52	2	0.016	0.002	un
519-005	WT	152-157	8	0		0.032	46	1	0.000	0.004	un
519-006	WT	157-162	3	0		0.025	42	1	0.000	0.003	un
519-007	BED	190-194	-30							0.008	un
520-001	RT	020-030	274	0		0.086	23	2	0.000	0.001	un
520-002	RT	030-040	264	3		0.023	33	1	0.088	0.001	un
520-003	RT	040-047	256	4		0.021	21	0	0.037	0.001	un
520-004	WT	094-102	201	0		0.031	24	1	0.000	0.001	un
520-005	OT	106-116	188	1		0.195	50	10	0.251	0.001	un
520-006	OT	116-128	177	0		0.063	37	2	0.000	0.001	un
520-007	OT	128-138	166	0		0.242	29	7	0.000	0.001	un
520-008	OT	138-148	156	0		0.019	21	0	0.000	0.001	un
520-009	OT	148-158	146	1		0.023	23	1	0.000	0.001	un
520-010	OT	158-168	136	0		0.175	24	4	0.000	0.002	un
520-011	OT	168-178	126	1		0.478	22	11	0.668	0.002	un
520-012	OT	250-259	45	0		0.028	10	0	0.000	0.001	un
520-013	OT	259-269	35	0		0.104	14	1	0.000	0.001	un
520-014	OT	278-286	17	0		0.064	5	0	0.000	0.001	un
520-015	OS	289-299	5	0		0.011	121	1	0.000	0.001	un
520-016	SAP	300-310	-6	0		0.011	45	0	0.000	0.003	un
520-017	SAP	310-320	-16	0		0.018	22	0	0.000	0.002	un
521-001	RT	075-081	209	1		0.025	23	1	0.068	0.001	un
521-002	RT	111-117	173	0		0.019	17	0	0.000	0.005	un
521-003	WT	124-134	158	0		0.020	19	0	0.000	0.001	un
521-004	OT	192-201	91	1		0.273	34	9	0.371	0.001	un
521-005	WT	201-211	81	0		0.065	6	0	0.000	0.001	un
521-006	WT	217-224	67	0		0.023	14	0	0.000	0.001	un
521-007	OG	224-234	58	0		0.028	23	1	0.000	0.002	un
521-008	OG	234-245	48	0		0.017	36	1	0.000	0.001	un
521-009	OG	247-257	35	0		0.014	31	0	0.000	0.002	un
521-010	OS	267-277	15	0		0.003	137	0	0.000	0.002	un
521-011	OS	277-287	5	0		0.020	145	3	0.000	0.002	un
521-012	SAP	287-297	-5	0		0.003	102	0	0.000	0.001	un
521-013	BED	298-299	-12							0.001	un
521-014	BED	302-304	-16							0.001	un
521-015	BEDZ	304-320	-25			0.007					un