Results of Glacial Till Sampling In the Vermilion Greenstone Belt, Northeastern Minnesota

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Abstract

An orientation project to determine variability of glacial till in the Mud Creek area of northeastern Minnesota's Vermilion Greenstone Belt demonstrates that gold grains and pathfinder elements are present in basal till, and that anomalies stand out in contrast to regional background levels. Clastic and chemical variations within the till sample set are sufficient to consider using the basal till as sampling media for gold dispersal mapping.

Of the thirty-two till samples analyzed, four were highly anomalous for gold, with counts of 88 to 1,282 gold grains per 10 kg of –2mm sample, and pristine gold grain proportions up to 98%; up to 8,050 ppb gold in HMC (nonmagnetic heavy mineral concentrates); and up to 1,050 ppb gold in the –63μm silt/clay fraction of till. A suite of bedrock grab samples collected as reference mineralization returned assays up to 12,247 ppb Au, and silver concentrations up to 42,500 ppb. Analytical results for the till samples support an hypothesis that clastic dispersal trains of mineralized material exist in tills in the area.

Within the project area, particulate gold is more anomalous in basal till samples than in the thin drape of overlying melt-out till. The gold grain counts and morphology add a transport distance value to chemical measurements of gold in soils and till, and suggest that the gold in the samples is locally derived. Analytical results for the present study are comparable to larger, more extensive regional evaluations conducted in neighboring Ontario and further confirm anomalous soil and fine fraction gold values reported in earlier Vermilion Greenstone Belt studies.

Further sampling in the area is warranted for the purposes of detecting additional dispersal trains, delineating potential bedrock source areas and defining the shape of mineralized trains. Additional sampling to evaluate methods for stepping out into areas of deeper glacial drift cover and greater drift complexity would also be useful. As demonstrated in this study, analysis of basal till in this portion of the Vermilion Greenstone Belt, particularly for gold grains, offers a capacity to positively detect local, previously unrecognized mineralization both inside and outside of areas of detailed bedrock geologic mapping.

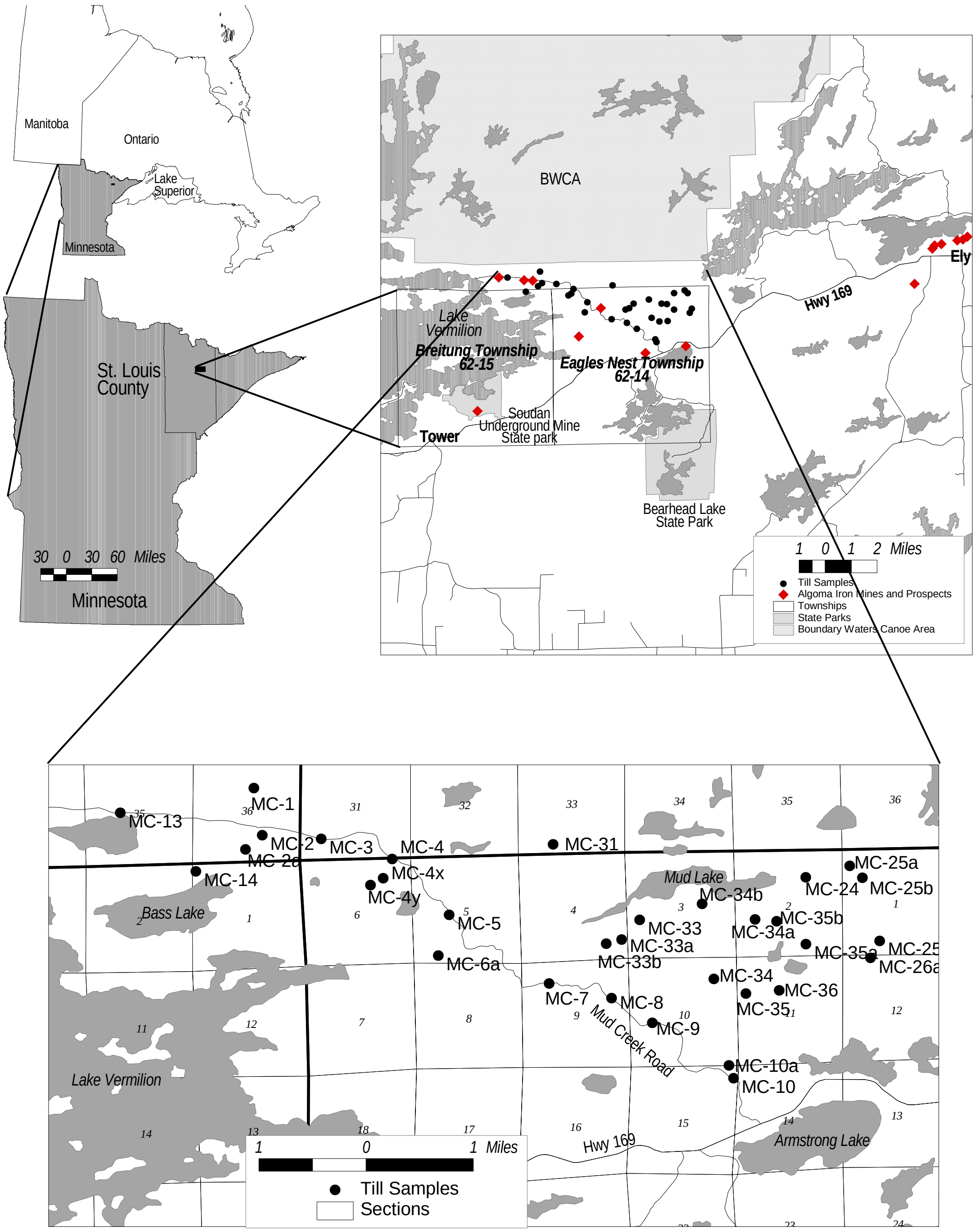

Figure 1. Location of the project area in St. Louis County, Minnesota.

Introduction

Anomalous gold grain counts and elevated pathfinder element values have been returned from analysis of glacial till, mineralized float and bedrock grab samples collected during May-June of 2004, in an area underlain by the Vermilion Greenstone Belt of Minnesota. Several anomalous values are from samples collected down-ice of known occurrences of bedrock gold mineralization. Other anomalous results are from less explored portions of the greenstone belt and from locations up-ice of known bedrock gold occurrences. The anomalous-valued samples were collected as part of a sample set intended for characterizing the thin mantle of locally available till, to determine whether the till exhibits enough clastic and chemical variation to be used as sample media for tracking glacially dispersed rock and mineral fragments back to source.

Project Location and Land Tenure

The project area lies in St. Louis County, Minnesota, and covers approximately 100 km^2 in the north half of Breitung and Eagles Nest Townships, extending into adjoining sections to the north (Fig. 1). The project area is located 14 km (8 miles) northeast of the town of Tower and 20 km (12 miles) west of the town of Ely, and is centered on approximately 92° 07’ west longitude and 47° 52’ north latitude (566000E 5302500N, UTM Zone 15, NAD83).

Mineral rights in the project area belong to the State of Minnesota (~50%) with the remainder belonging to the federal government (~15%) and private interests (~35%). Lakebeds in the area are owned by the State of Minnesota. Previous leasing of state-owned mineral rights during the 1960’s and 1970’s was driven by exploration for base metal deposits, and leasing during the 1980’s and early 1990’s was driven by exploration for gold deposits. While some gold mineralization was discovered during the later exploration episode, all metallic mineral leases on state lands in the area have since lapsed and the mineral rights on state lands are currently available for new exploration.

Climate, Physiography, Access, Infrastructure

The field area is reached from the town of Tower by following U.S. Highway 169 east 17 km (10 miles) to the intersection with Mud Creek Road, then north 5 km (3 miles). Mud Creek Road provides primary access, and is an all-season gravel road that connects to several logging trails in the project area. Wolf Lake Road, another all season road, provides additional access to the eastern part of the project area.

Topography is typical of northeastern Minnesota and northwestern Ontario, with thin veneers of glacial drift partially covering bedrock exposures that occur as knobs and ridges. Valleys bottomed by linear swamps and somewhat thicker glacial sediments occupy the major regional east- northeast trending first order shear zones in the area. Elevations range from 410 to 475 meters above sea level (1350' to 1550' msl). Lowest elevations are on the west side of the project area, at Lake Vermilion. Highest elevations correspond to feldspar porphyries and other competent lithologies in the greenstone belt, and to granitic gneisses and migmatites in the Quetico Subprovince at the northern edge of the project area. Bedrock outcrops are scattered throughout the project area, comprising approximately 15% exposure in the greenstone belt. Small lakes ranging from 1.5 to 100 hectacres (3 to 250 acres) occupy some of the topographic lows. Upland vegetation consists of aspen, jack pine, and red (Norway) pine. Alder, black spruce and shrub swamp vegetation occupy low-lying areas.

Climate is typical of the northern U.S., with snow cover during the months of December to April. Climate does not usually interfere with exploration activities or diamond drilling, except during deep snow cover in the winter and during spring break up, generally during the month of April, when weight restrictions are placed on most highways and gravel roads.

Water is abundant. Power is available in the project area and substantial power infrastructure is in place a few miles south to support the open-pit taconite iron-mines of the Mesabi iron range. Manpower is available in the local Tower-Ely area as well as in the iron range cities a few miles to the south. Large, low-grade deposits containing Copper, Nickel, and Platinum Group Metals are located a few miles southeast of the project area and are currently at the pre-feasibility phase of development. The Copper-Nickel-PGM area also hosts significant Titanium deposits. Associated with the present-day taconite iron mining, there exists a substantial local mining supply infrastructure. Construction materials such as sand and gravel are readily available. A rail system historically served the underground iron mines at Soudan and Ely. Present day rail service is the CN line located 40 km (25 miles) west of the project area.

The project area lies outside the federal Boundary Waters Canoe Area Wilderness. The project area also lies beyond the State designated “Mineral Management Corridor” buffer that surrounds the wilderness area. Two state parks are located within 15 km (9 miles) of the project area. Soudan Underground Mine State Park is a large former hematite mine that hosts underground tours and international particle physics research, and is located 15 km southwest of the project area. Bearhead Lake State Park is located on a lake that is the site of a former turn-of-the-century sawmill, located 15 km southeast of the project area.

Bedrock Geology

The target of the till sampling project is the Archean-age Vermilion Greenstone Belt, part of the Wawa Subprovince (Fig. 2), and particularly that portion of the greenstone belt lying in Breitung and Eagles Nest Townships, east of Lake Vermilion.

The bedrock geologic setting is well-summarized by Peterson and Patelke (2004b) and Jirsa and Boerboom (2003). The Archean supracrustal rock package is informally divided into a “Soudan” assemblage and a “Newton” assemblage on the basis of stratigraphic and structural styles. Mineralized gold occurrences, defined as bedrock samples containing more than 500 ppb Au, are found in both assemblages, as documented in exploration records housed at the Minnesota Department of

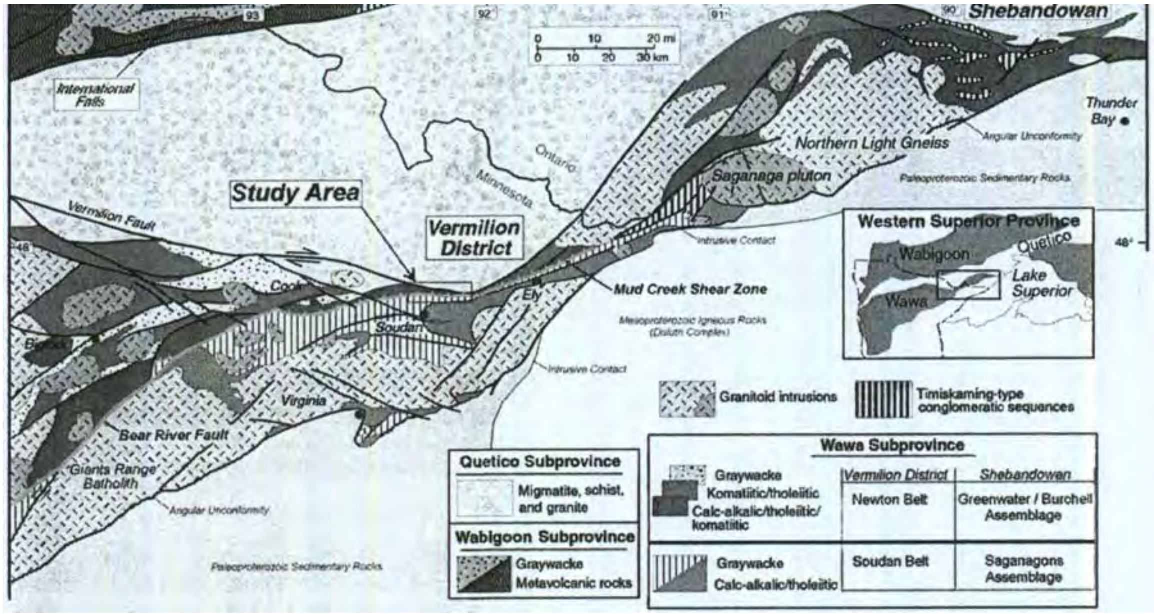

Figure 2. Regional geologic setting of the Vermilion Greenstone Belt (After Peterson and Patelke, 2004).

Natural Resources Mineral Exploration Archives and Drill Core Library. The Newton and Soudan assemblages are roughly equivalent to greenstone belt rocks that crop out further northeast in Ontario, and are there described as the Greenwater/Burchell and Saganagons assemblages of the Shebandowan Greenstone Belt (Peterson, 2001). Historic production of gold and base metals is reported in the Shebandowan belt (Bajc, 2000a), and Shebandowan rocks host Northwestern Ontario's first producing gold mine and several presently active prospects.

Soudan assemblage rocks typically consist of broadly folded calc-alkalic and tholeiitic volcanics overlain by and locally interfingered with turbidite facies rocks; both rock types having been folded (Jirsa and Boerboom, 2003). Newton assemblage rocks crop out north of the Soudan assemblage, as east- to northeast trending volcanic and volcaniclastic sequences, mostly northward younging. Komatiitic flows and peridotite sills are locally abundant in the Newton assemblage. While stratigraphic relationships are largely conformable within assemblages, contacts between rock types are locally obscured by faults (Peterson and Patelke, 2004b). The boundary between the two assemblages is a 1st order shear zone.

The central part of the project area is underlain by Newton assemblage rocks. Soudan assemblage rocks underly the southern portion of the field area. A major subprovince boundary traverses the northern part of the project area, separating the greenstone belt (Wawa Subprovince) from metasedimentary and felsic intrusive rocks that are part of the Quetico Subprovince. Dominant lithologies in the greenstone portion of the project area are tholeiitic pillowed basalts, felsic porphyries, gabbro sills, Algoma-type iron formation, thinly bedded argillite-siltstone, sheared rocks, and occasional late lamprophyric dikes (Peterson and Patelke, 2004b).

Mineral Exploration and Development

The Lake Vermilion region experienced a short, nonproductive gold rush in 1865 that resulted in discovery of some quartz veins in greenstone rocks, but not enough gold was recovered to be profitable. Economically viable Algoma-type iron deposits were found shortly thereafter and much of the region was subsequently tied up in iron mining interests. Algoma-type iron formation was mined at Soudan, Minnesota and at Ely, Minnesota until the 1960's. The mine at Soudan, Minnesota's first iron mine, was operated by US Steel until 1963. Production had reached the 2340' level when operations ceased. A number of small shafts in the project area were sunk on iron prospects during the 1890's (Stenlund, 1985). Together, the Algoma-type iron formations in the greenstone belt are referred to as Minnesota's Vermilion iron range.

Modern metallic mineral exploration records for the Vermilion district date from the 1960's. Reconnaissance exploration of Minnesota's greenstone belts during the 1960's and 1970's used early airborne geophysical systems (In-Phase/Out-of-Phase and Barringer INPUT Mark IV-V). The timing and impetus for these geophysics-dominated exploration programs was apparently the 1964 discovery in Canada by Texas Gulf Sulfur of the giant Kidd Creek base metal deposit in the Abitibi greenstone belt. At about the same time, in 1966, Minnesota's state-owned mineral lands first became available for metallic mineral leasing.

Exploration programs in Minnesota languished during the period from 1974 to 1982 while the State evaluated potential impacts of Copper-Nickel mining in the Late Proterozoic Duluth gabbros and troctolites located a few miles south of the project area. By the time metallic mineral leasing of state-owned lands resumed in Minnesota in 1982, the world-class Hemlo gold deposit on the east side of Lake Superior had been discovered and gold had seen recent price spikes above (US) $500 per ounce in 1980 and 1981. The 1982 State metallic minerals lease sale consequently saw an influx of a new group of exploration companies focused on gold.

In the period from 1980 to the early 1990's, exploration for gold in Minnesota focused on the Wawa and Wabigoon Subprovinces in the northern half of the state. Glacial overburden cover in Minnesota generally thins toward the northeast, and much of the gold exploration activity focused on these more thinly covered areas in Itasca, St. Louis, Lake, Koochiching, Lake of the Woods and Beltrami counties. Competitive gold exploration occurred both east and west of Lake Vermilion, with companies including Cyprus, Freeport, Newmont, Noranda, Normin, Kerr-McGee, BHP, American Shield, Lehmann, Mapco, and Resource Exploration making geological examinations or establishing land positions and conducting reconnaissance mapping and first phase exploration drilling.

In the region of the Vermilion Greenstone Belt (Fig. 3), the Raspberry prospect, located 12 km (8 miles) east of the project area was tested by a total of 36 diamond drill holes during the 1980's, in a series of joint ventures coordinated by American Shield Company. Several float boulders in the area were reported to assay greater than one ounce per ton Au. The Lost Lake prospect in northeastern Itasca County was first discovered by Normin (Boise Cascade) in the 1980's and received a total of 10 diamond drill holes before exploration funding was transferred to other out-of-state projects. In the Garden Lake area at Ely, 25km (13 miles) east of the project area, anomalous gold values up to

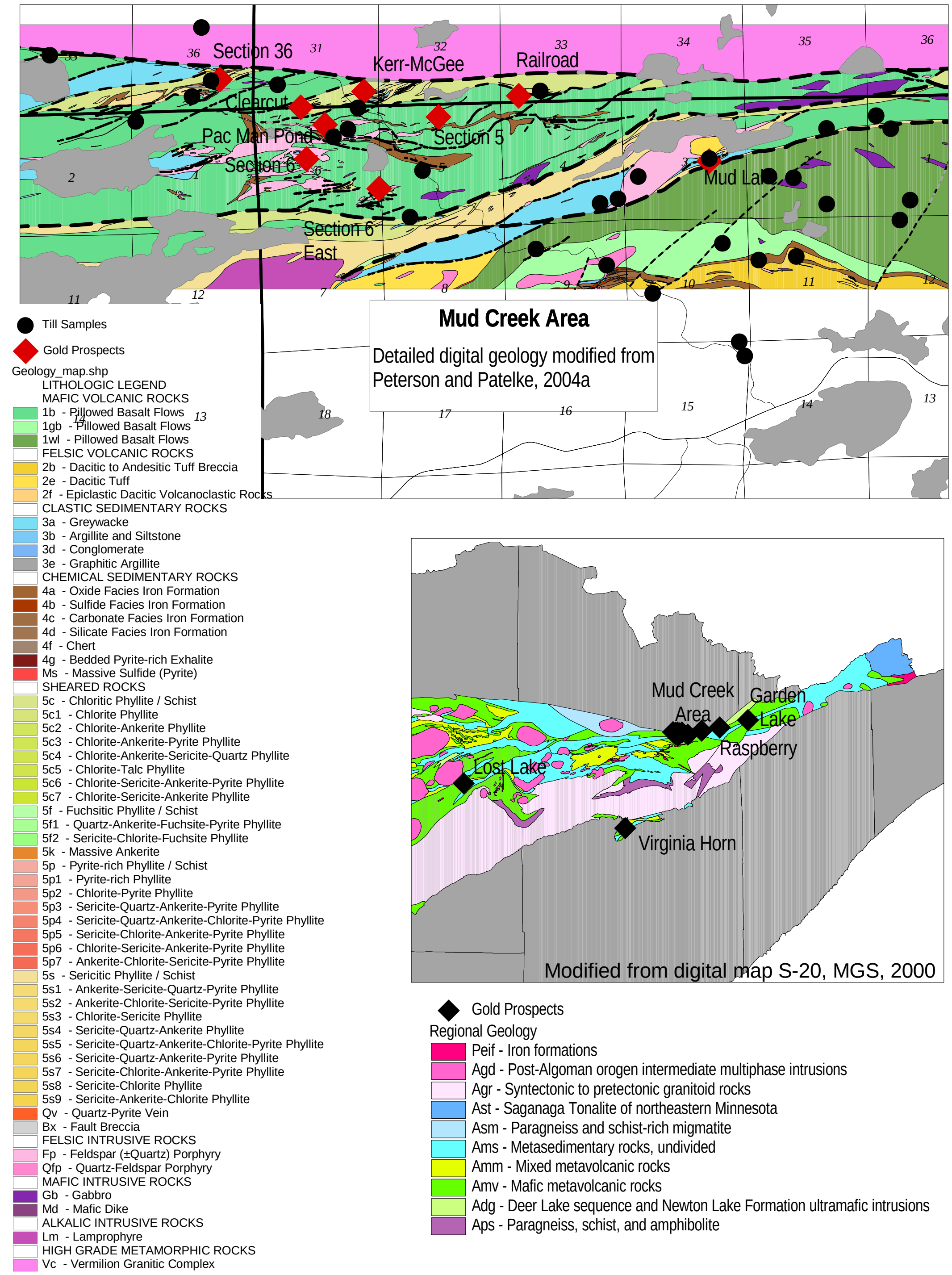

Figure 3. Bedrock geology and gold prospects in the Vermilion Greenstone Belt area.

0.1 ounce per ton Au over 20 feet are reported in association with iron formation. The Virginia Horn prospect was delineated by Newmont and others, in Timiskaming-like rocks, for a total of 26 diamond drill holes, at a location 50 km (30 miles) southwest of the project area (Jirsa, 2000).

Several of the known bedrock gold occurrences and float sample gold anomalies in the Mud Creek area come from a panel of more highly-explored, cross-faulted Newton assemblage rocks that lie between two 1st order regional shears, the Mud Creek Shear Zone and the Vermilion Fault (Fig. 3) (Peterson and Patelke, 2004b). The westward-widening panel of rocks, which occupies the central part of the project area, is informally termed the Bass Lake Sequence (Peterson and Patelke, 2004). Bedrock units located north and south of these regional shears have received less exploration and mapping attention. In the 1980's and early 1990's, several companies worked joint ventures on lands controlled by American Shield Company. Cyprus, Freeport, Chevron Resources, Noranda and others worked in the competition with Kerr-McGee, Newmont, BHP and others. Fifty occurrences of greater than 500 ppb gold, ranging up to 55 ppm Au in float, grab, soil and drill intercepts were found in the Bass Lake Sequence in the panel of rocks between the Vermilion Fault and the Mud Creek Shear Zone.

Government and research geologic mapping by Peterson and Patelke (2004), Jirsa and Boerboom (2003) and Peterson and Jirsa (1999) has resulted in detailed digital compilation of publicly available exploration work and previous bedrock geologic maps. These compilations utilize modern aeromagnetic and gravity interpretations, along with detailed new geologic mapping and synthesis to generate new insights into the structural and geologic history of the bedrock, particularly for the strip of ground in the central part of the present project area.

Deposit Types and Mineralization

Gold occurrences identified in the project area and in the broader Archean greenstone belt terrane are associated with shear zones, commonly within mafic volcanic or mafic intrusive rocks; with iron formation; and with quartz-feldspar porphyries (Peterson and Patelke, 2004b).

The gold prospects are categorized as (1) auriferous quartz-carbonate-pyrite veins and sulfidized zones in iron formation, (2) auriferous quartz-sericite-ankerite-pyrite schists, and (3) felsic intrusive-hosted auriferous quartz veins and stockworks (Peterson and Patelke, 2004b). All of the prospects are found within areas of moderate to strong iron-carbonate alteration, with best mineralization commonly found within sericite alteration zones (Peterson and Patelke, 2004b). Numerous equigranular and porphyritic felsic intrusions occur within the areas of alteration and gold mineralization, and make a good guide for locating mineralized structures (Peterson and Patelke, 2004b). The gold mineralization is generally related to deformation within subsidiary structures associated with movement along the Mud Creek Shear Zone (Peterson and Patelke, 2004b).

Mineralization styles and geologic settings in the Vermilion greenstone belt are strikingly similar to those described by Dimmell and Larouche (2003) in the Moss Lake area of the Shebandowan greenstone belt, located 100 km (60 miles) to the northeast of the present project area.

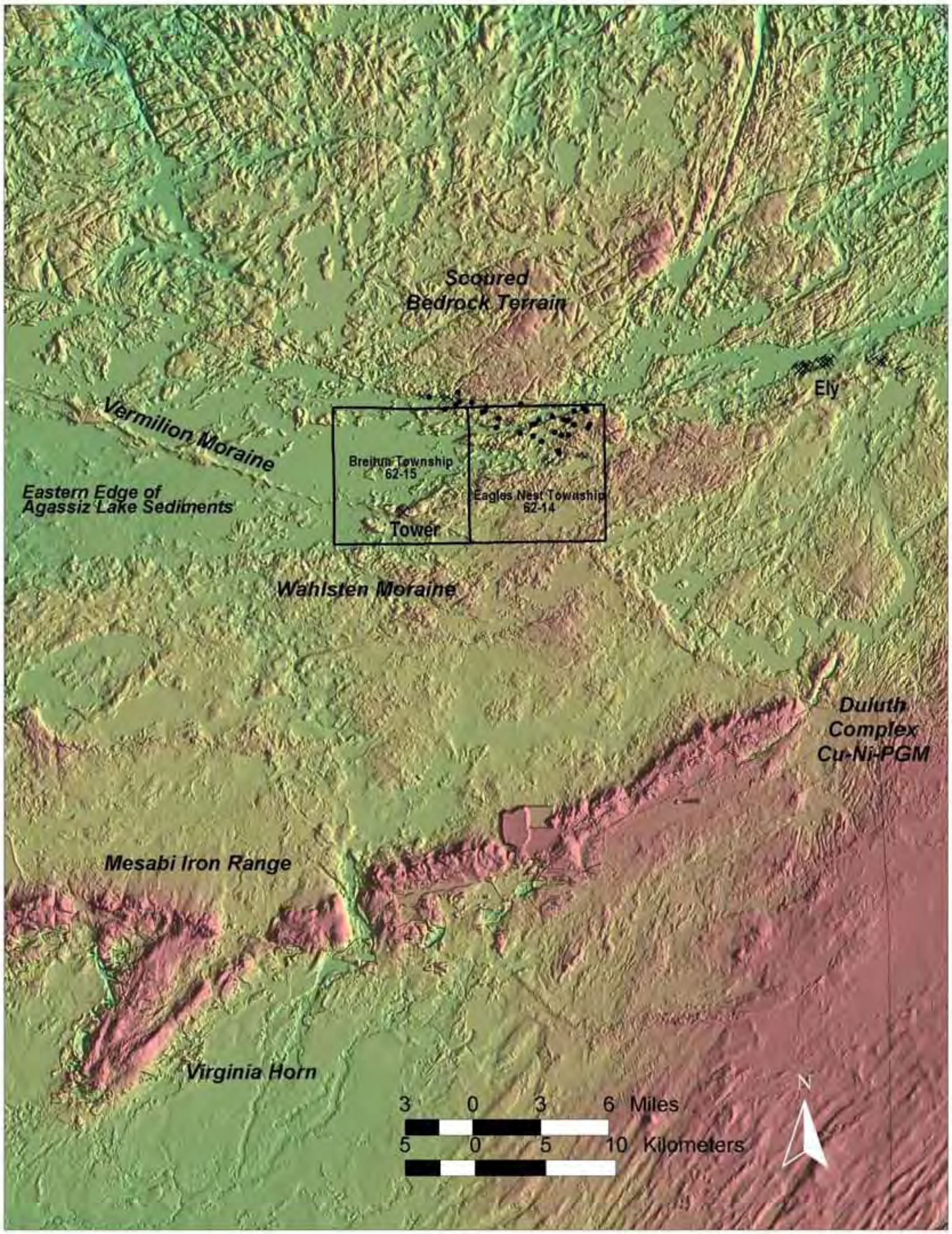

Figure 4. Surface landforms of the Vermilion project area.

Glacial Geology

Till, outwash and lake sediments are present in the project area, and in the broader Lake Vermilion region they are associated with Late Pleistocene retreat of the Rainy Lobe of the Laurentide Ice Sheet (Larson, 2004). North of the Vermilion moraine the landscape is a glacially scoured bedrock terrain (Fig. 4). The surficial deposits unconformably overly the Archean bedrock and typically exist as thin veneers of basal till, localized outwash, or as eskers. Ice flow indicators strike 180-220 degrees from north azimuth (Larson, 2004), indicating an up-ice direction for entrained materials to the north-northeast.

Two till types are readily recognized in the field. A sandy “meltout” till is present that contains numerous well-rounded, coarse-grained cobble-to-boulder sized clasts of gneiss and granitoid. This meltout till thinly mantles much of the project area. On the Quetico Subprovince terrane at the north edge of the project area, the meltout till appears to be the only material available for sampling and lies directly on the bedrock surface. Basal till, generally a meter thick or less, was the primary sampling target. The basal till lies beneath the meltout till and is recognized by an abundance of sharply angular clasts, mostly of supracrustal lithologies, contained in a clayey- to clay-loam rich, often dark-colored matrix. Whether this basal till has incorporated older glacial materials, as was demonstrated in compositional and chemical mixing trends by Martin, et al (1991) for tills of the Wabigoon Subprovince is not resolved in the small sample population of the present study.

Proximal to Lake Vermilion, along the western edge of the project area, basal till and meltout till are overlapped by well-sorted lacustrine sediment.

Project Scope/Design

The orientation project was initiated partly in response to a gold price exceeding (US) $400 per ounce. Availability of public lands for conduct of a project was also a factor. The State of Minnesota owns a significant portion of the mineral rights in the area. In the present case, metallic mineral leases of state-owned lands that had been held in the area since the early 1980’s had lapsed, providing an opportunity to conduct an orientation project in an area of thin glacial drift cover. Alternative project areas, at localities more likely to host base metal occurrences, were deemed less attractive given the current high price of gold. A third objective in conducting the project was to maintain familiarity with advances in analysis of glacial overburden.

The project was designed and executed by Mr. David Dahl, a professional geologist employed by the Minnesota Department of Natural Resources. Mr. Dahl supervised the collection, interpretation, review and reporting of the results. The orientation project concept was to collect till samples from an area known to contain bedrock gold occurrences, in order to determine whether till samples would reflect those occurrences. Sample spacing was targeted at 1 sample per 3 km^2 within an area 15 km (9 miles) east-west by 7 km (4 miles) north-south. Projected sample collection was 40 till samples, to be analyzed for gold grains, silt/clay geochemistry, and nonmagnetic heavy mineral concentrate geochemistry.

Sample Collection

Till samples were collected at a density averaging one sample per 3 km^2, roughly controlled by a hexagonal grid overlay of the project area. Additional samples were collected at target-of-opportunity locations as they were encountered. Thirty-two samples were collected from 32 localities. Six of the sampled locations were selected as field twins of sites previously sampled during a separate, more regional analysis of the silt-clay component of area tills (Larson, 2004). The six sites were sampled during a field orientation with P. Larson. Sample collection in the present study was suspended after approximately half of the planned field samples were collected, in order to take advantage of a rapid turn-around window available at the processing lab.

Several till samples were collected down-ice from known occurrences of bedrock gold mineralization. A few samples were collected up-ice from the greenstone belt or from till within the greenstone belt that appeared to be of the meltout variety. Where possible, basal or "lodgement" till was sampled.

Sample collection procedures at each sample site consisted of using a 16" trenching spade to confirm sufficient till presence for sampling purposes. Where enough material was present, a hole was dug to remove A-horizon soil from above the targeted material and to remove B-horizon materials enough to get below vegetative roots. Boulders and bedrock were frequently encountered at depths of less than one meter. Most of the samples were obtained at about ½ meter depth. Targeted sample material was collected into clean 2-gallon plastic pails using a clean trenching spade. A 16mm (5/8") stainless steel sieve was used to screen and discard the +16mm rock fraction of the till material. Sampling tools and sieve were thoroughly cleaned between sampling episodes and appropriate sampling hygiene was practiced regarding jewelry and other potential contaminants.

Samples, once collected, were sealed with tightly fitting plastic lids made to fit that kind of pail. Sides and lid of each pail were labeled with permanent marker identifying which sample was inside. GPS coordinates were recorded for each sample location. Sample locations were marked on high-resolution color digital orthophotograph prints, and brief sample descriptions were recorded in a field notebook or on field maps. Sample pails were stored in a pickup truck during the day and were off-loaded for storage at the end of each field day in a secure location at the Minnesota DNR Lands and Minerals office in Hibbing, Minnesota.

The sealed plastic pails were collected onto a wooden pallet, stacked no more than two pails high, wrapped with shrink-wrap plastic, and shipping labels and customs information were attached. The pallet of samples was forwarded via ground freight (Freightways and Manitoulin carriers) to the Overburden Drilling Management, Ltd. processing lab in Nepean, Ontario. Return shipment of the processed fractions in five 5-gallon pails and one carton was by UPS carrier.

Sample Processing / Quality Control Procedures

Six till sample sites were selected as field twins of sites previously sampled during a study of the silt/clay component of till (Larson, 2004). The field twins were collected to provide some overlap and duplication for comparison of results to earlier projects. Within sample batches, quality control samples consisting of duplicate splits and reference samples were inserted at various points in the sample analysis stream (Hunealt, 2004, pers. comm.).

Each of the till samples was processed at Overburden Drilling Management, Ltd., Nepean, Ontario, Canada. Raw till samples ranged in size from 9.7 to 16.3 kg. At the processing lab, representative 500 gram archive samples were taken from each pail, as well as 400 gram samples from which a silt/clay component was isolated for further analysis. The remainder of each sample was disaggregated, and the heavy mineral component of the –2mm fraction was obtained by wet sieving and gravity tabling. Table feed weights (-2mm material) of samples ranged from 3.8 to 12.0 kg.

Preliminary counts of gold grains were made at the tabling stage, and samples containing 10 or more gold grains at the tabling stage were subsequently micro-panned to yield more exact grain counts, size distributions and grain morphologies. Panned gold grains were then added back to the table concentrate and table concentrates were further concentrated to S.G. > 3.2 g/cm^3 using a methylene iodide density technique. The nonmagnetic portion of the heavy mineral concentrate was then isolated from the methylene iodide concentrate. Finally, the nonmagnetic heavy mineral concentrate was sieved to separate a –0.25mm fraction for INAA analysis. Sample weights for these –0.25mm fractions ranged from 1.8 to 39.3 grams, except for one unusual sample that yielded 497.4 grams.

Following geochemical analysis, the processing lab performed a follow up mineralogical examination of two samples in order to help determine the cause of high REE values returned from instrumental neutron activiation analysis of the -0.25mm HMC fraction, and the lab also examined the sample that contained the large amount of –0.25mm HMC.

For analysis of the –63µ silt/clay fraction of till, duplicate and reference samples consisted of duplicate splits from two field samples and a pair of silt/clay reference samples provided by the processing lab. These control samples were inserted at various positions within the silt/clay geochemistry sample batch. The sample batch for the instrumental neutron activation analysis of silt/clay consisted of 32 field samples plus 4 control samples. Aliquots of the same samples were analyzed by 4-acid digestion/ICP-MS and $LiBO_2$ fusion/ICP-ES, and a further level of quality control was added to the analysis stream by the chemistry lab for these analyses. This additional quality control level entailed splitting one of the submitted silt/clay sub-samples and inserting an additional pair of internal chemistry lab standards to the sample batch. Therefore, for 4-acid/ICP-MS and $LiBO_2$ fusion/ICP-ES analyses, the sample batch consisted of 32 field samples plus 7 control samples.

Control samples for analysis of the nonmagnetic heavy mineral concentrate (HMC) fraction of tills by instrumental neutron activation analysis were prepared from the same pair of field samples used for silt/clay fraction duplicates, except they were derived from the –0.25mm portion of the HMC fraction of these samples. The quality control duplicate samples were inserted at various positions within the batch of –0.25mm HMC geochemistry samples. An additional triplicate split of one of the HMC samples was added to the batch to balance the number of samples submitted for HMC and silt/clay analysis (Hunealt, pers. comm.., 2004). The sample batch of –0.25mm HMC fractions submitted for instrumental neutron activation analysis consisted of 32 field samples plus 4 control samples.

The ICP-MS and ICP-ES analysis of the –63µm silt/clay samples was performed by Acme Analytical Labs, Vancouver, British Columbia, Canada. Trace element analysis by

ICP-MS yielded results for 46 elements, following a 4-acid digestion of a 0.25 gram sub-sample. Whole rock analysis by LiBO2 fusion and ICP-ES analysis for 2.00 gram sub-samples yielded results for 11 oxides and 7 trace elements. Total carbon and total sulfur were measured by LECO, and loss-on-ignition was measured by LOI.

Instrumental neutron activation analysis of the –0.25mm HMC and –0.63um silt/clay sub-samples was performed at Becquerel Labs in Mississauga, Ontario, Canada. INAA analysis yielded results for 35 elements. The primary element of interest in the INAA analysis was gold (Au) concentration, reported as ppb. The sub-sample sizes for –63µm silt/clay INAA analysis ranged from 11 to 17 grams. Sub-sample sizes for –0.25mm HMC INAA analysis ranged from 2.3 to 30 grams.

Rock grab samples and float rock samples were analyzed by the same LiBO2 fusion (2.00 gram sub-sample) and 4 acid digestion techniques (0.25 gram sub-sample) listed above, and by Fire Assay/Ultra-ICP analysis for Au, Pt and Pd (30 gram sub-sample), following crushing of the samples to –10 mesh (-1.65mm), and pulverizing of a 250 gram split to –150 mesh (1.04mm). Rock and float samples tested by these methods were analyzed at Acme Analytical Labs, Vancouver, British Columbia, Canada.

Pebble counts of +9.5 to –16mm (3/8”-5/8”) material returned from the processing lab were made for all 32 samples. The +9.5mm –16mm fraction was obtained from each bag of +2mm material, by sieving the material using a 9.5mm (3/8”) sieve. Lithologies of all pebbles retained on the 3/8” sieve were noted and counted, and the angularity of the pebbles in each sample was recorded.

Results

Gold Grains

Figure 5 and Table 1 summarize gold grain data returned for the till samples. The gold grain counts are as high as 1,282 gold grains per 10kg of -2mm table feed. Pristine grains were recovered from about one-third of the 32 field samples. Highest counts are from samples that contain a recognizable component of altered shear zone or iron formation clasts. Regional background level gold grain counts (50th percentile and lower) are in the range of 0 – 3 gold grains per 10 kg table feed. Several samples that contain 3 to 5 gold grains spatially cluster near samples that contain greater gold grain abundances (Fig. 5).

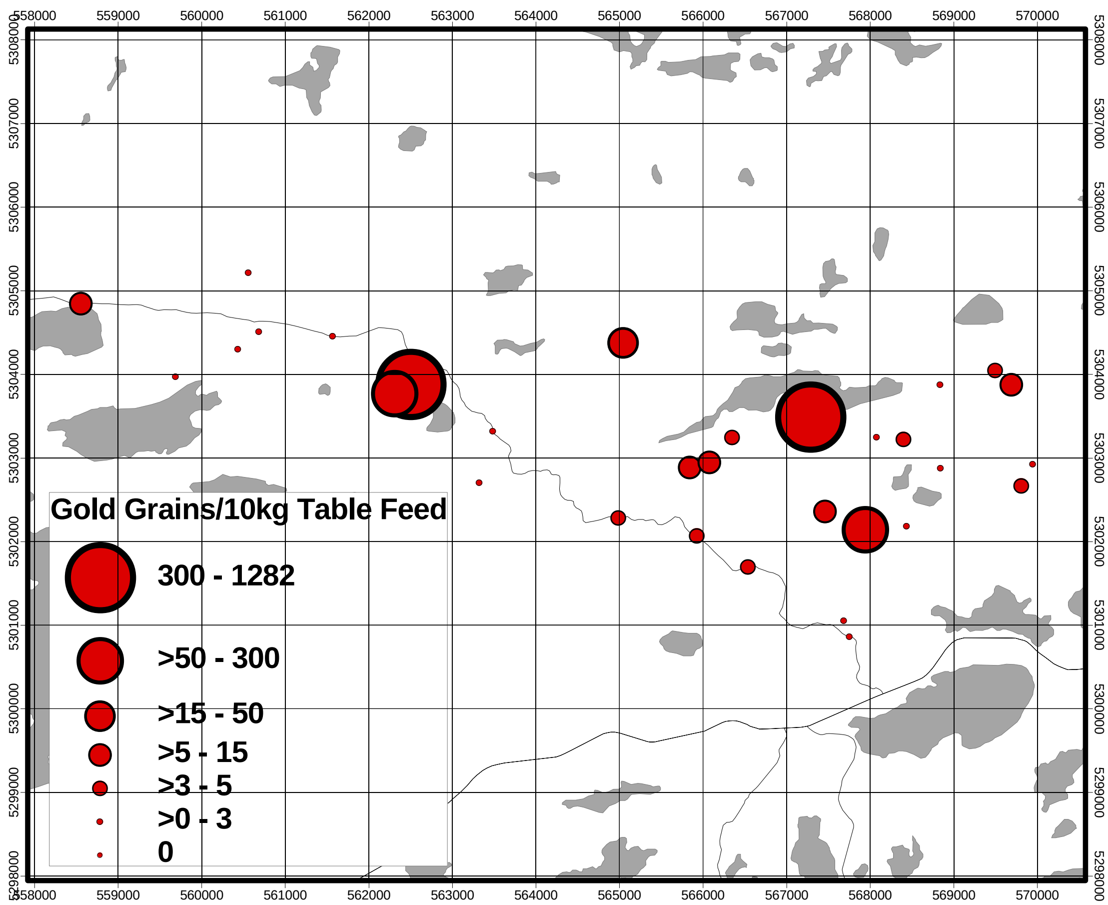

Figure 5. Gold grain counts for thirty-two Vermilion till samples.

Table 1. Gold grain summary data for 32 Vermilion area till samples.

Sample Number	Raw Gold Grain Count	Normalized Gold Grains Per 10 kg Table Feed	Norm. Pristine Gold Grains	Norm. Modified Gold Grains	Norm. Reshaped Gold Grains	Table Split Kg	+2mm Clasts Kg	Table Feed Kg	-0.25mm Nonmag HMC Wt. grams
MC-34b	641	1,282	1,264	10	8	11.2	6.2	5.0	7.5
MC-4x	143	376	303	10	63	9.2	5.4	3.8	6.5
MC-4y	99	190	90	19	81	10.3	5.1	5.2	2.3
MC-35	67	88	65	18	5	10.6	3.0	7.6	15.9
MC-31	6	15	5	5	5	10.5	6.5	4.0	16.2
MC-33a	8	10	4	4	2	11.9	4.1	7.8	2.0
MC-34	9	10	6	2	2	12.4	3.6	8.8	23.1
MC-33b	6	8	5	3	0	11.5	3.9	7.6	5.9
MC-13	6	7	1	2	4	14.1	5.4	8.7	22.5
MC-25b	5	6	1	0	5	11.7	2.8	8.9	13.1
MC-26a	3	5	2	0	3	12.2	5.5	6.7	25.0
MC-9	3	4	0	1	3	11.4	3.6	7.8	39.3
MC-33	2	4	0	0	4	11.5	6.1	5.4	3.7
MC-35b	3	4	0	0	4	11.6	4.6	7.0	6.5
MC-6a	2	3	0	0	3	13.8	6.3	7.5	1.8
MC-7	3	3	1	0	2	13.4	4.1	9.3	13.4
MC-8	2	3	1	2	0	12.2	5.9	6.3	5.8
MC-25a	3	3	0	1	2	12.4	2.9	9.5	10.7
MC-2	1	2	0	0	2	11.1	5.4	5.7	3.3
MC-5	2	2	0	0	2	13.3	3.3	10.0	14.5
MC-34a	2	2	0	2	0	12.1	3.7	8.4	20.7
MC-14	1	1	0	0	1	14.5	2.5	12.0	17.8
MC-24	1	1	0	0	1	12.4	4.0	8.4	8.4
MC-25	1	1	0	0	1	11.5	3.6	7.9	15.7
MC-36	1	1	0	0	1	11.2	2.8	8.4	11.5
MC-1	0	0	0	0	0	11.1	1.6	9.5	5.3
MC-2a	0	0	0	0	0	13.0	5.0	8.0	14.7
MC-3	0	0	0	0	0	13.7	6.1	7.6	4.3
MC-4	0	0	0	0	0	15.0	3.5	11.5	10.1
MC-10	0	0	0	0	0	11.2	2.5	8.7	5.1
MC-10a	0	0	0	0	0	15.8	4.9	10.9	11.8
MC-35a	0	0	0	0	0	13.5	4.7	8.8	497.4

Samples containing 5 or more gold grains per 10 kg –2mm table feed also contain pristine gold grains. Samples that contain 10 or more gold grains per 10 kg –2mm table feed also contain at least 33% pristine grains, up to a high of 98% pristine grains for the sample that returned 1,282 gold grains. The INAA measurements of gold in the -63µm silt/clay and –0.25mm HMC fractions generally corroborate the spatial relationships (Table 2). Samples most suspected of being meltout till all returned background level gold grain counts. Full gold grain processing results are listed in Appendix A.

It is interesting to note that eleven of the fourteen till samples containing greater than three gold grains per 10 kg table feed also have pebble counts dominated by angular to very angular supracrustal clasts. (see Appendix D). The till samples yielding the highest gold grain counts each also displays a significant shear zone clast component or iron formation clast component. This correspondence between highest gold grain counts and shear zone or iron formation materials matches local bedrock geology observations (Peterson and Patelke, 2004). The highest gold grain counts are from samples containing sheared materials. It is undetermined in the present study whether this correspondence reflects a relatively richer shear-mineralized source or is a function of competence of host rock and its ability to liberate gold particles into till matrix, or is the result of another factor.

While the sample population in the present study is small, the results are proportionally similar to those reported in larger regional investigations of the Shebandowan Greenstone Belt and other gold-bearing areas of Ontario (see Bajc, 1999a and 1999b; Bajc, 2000a and 2000b; Averill, 2001 and references therein). These similarities include: (a) background levels of 1-3 grains per 10 kg –2mm table feed at the northern edge of the greenstone belt, (b) recovered gold grains that are mostly silt sized, rarely reaching 75µm wide, (c) analyses of the silt/clay and heavy mineral concentrate fractions by instrumental neutron activation analysis generally corroborate the gold grain counts.

Table 2. Calculated versus analyzed gold (in ppb) for 32 Vermilion area till samples, sorted by Au ppb in –0.25mm HMC distributed to original table feed wt.

Sample Number	-0.25mm Nonmag HMC Wt. Grams	Calc. -0.25mm nmHMC Au	Analyzed -0.25mm nmHMC Au	Analyzed -63µm silt/clay Au	Conc. Factor TblFeed/ -0.25mm nmHMC	AuHMC ppb Concentration Distributed to Table Feed Wt.
MC-4x	6.5	2,206	8,050	85	585	13.770
MC-34b	7.5	2,439	7,340	1,050	667	11.010
MC-35	15.9	817	4,380	8	478	9.163
MC-9	39.3	100	476	48	198	2.398
MC-33	3.7	804	2,300	17	1459	1.576
MC-34	23.1	133	504	14	381	1.323
MC-31	16.2	8	321	53	247	1.300
MC-4y	2.3	2,700	2,680	< 2	2261	1.185
MC-7	13.4	221	740	20	694	1.066
MC-26a	25.0	30	228	10	268	0.851
MC-25	15.7	135	396	5	503	0.787
MC-33b	5.9	1,133	970	14	1288	0.753
MC-13	22.5	18	264	45	387	0.683
MC-8	5.8	69	455	26	1086	0.419
MC-35b	6.5	9	372	5	1077	0.345
MC-25b	13.1	29	190	< 2	679	0.280
MC-10a	11.8	0	244	< 2	924	0.264
MC-2	3.3	25	373	12	1727	0.216
MC-25a	10.7	5	140	4	730	0.192
MC-24	8.4	23	180	5	1000	0.180
MC-33a	2.0	736	645	8	3900	0.165
MC-36	11.5	2	140	< 2	888	0.158
MC-5	14.5	31	98	5	690	0.142
MC-2a	14.7	0	72	8	544	0.132
MC-1	5.3	0	218	< 2	1792	0.122
MC-34a	20.7	27	20	< 2	406	0.049
MC-4	10.1	0	36	5	1139	0.032
MC-3	4.3	0	53	5	1767	0.030
MC-6a	1.8	152	65	7	4167	0.016
MC-35a	497.4	0	< 4	41	674	-
MC-14	17.8	5	< 20	< 2	18	-
MC-10	5.1	0	< 14	< 2	1706	-

Averill (2001) describes dispersal patterns of gold grains related to significant mineralization as typically being less than 1 km long, having anomaly strengths midway along the dispersion train typically in the 20 to 40 grains range (per 10 kg –2mm table feed), and displaying nearly complete deformation of ice-transported gold grains after 1 km of transport. Extension of these generalizations to the Vermilion area till samples yields the following observations: (a) highly anomalous till materials are present in the field area, with gold grain counts ranging from 88 to 1,282 and pristine grain percentages ranging from 33% to 98%, (b) two of the most anomalous and pristine samples (MC-4x and MC-35) are uncorrelated to known Au occurrences, (c) two of the anomalous samples (MC-34 and MC-35) lie in an area more than 1 km outside the area of most frequently explored supracrustal rocks.

Bedrock Mineralization

Five bedrock samples were collected across a quartz-sericite-carbonate-pyrite vein in a shear zone, exposed in an old railroad grade at the north side of the greenstone belt. The locality is called the Railroad Prospect (Fig. 6). The bedrock samples are highly anomalous for Au, Ag, As, Sb, Cu and Zn, and have sporadic anomalies for Cd, Pb and Mn (Table 3 and Appendix B). Together, the bedrock samples offer a glimpse of the chemical attributes of one of the mineralized veins in the project area.

Table 3. Analytical results for mineralized bedrock samples from the Railroad Prospect.

Sample ID	Au Ppb	Ag Ppb	As Ppm	Sb ppm	Cu Ppm	Zn ppm	Pb Ppm	Cd ppm	Ni Ppm	V Ppm	Co Ppm
RR-4	12,247	42,500	640	163.8	1,365	2,777	213	16.0	20	15	25
RR-5	6,239	19,497	214	44.4	296	1,832	54	5.3	9	25	14
RR-3	4,268	17,412	419	35.9	1,480	2,419	24	10.3	45	220	111
RR-1	3,830	18,805	179	595.3	2,409	>10,000	13	151.4	4	10	11
RR-2	424	3,881	65	224.6	583	1,946	5	11.7	1	11	1

Sample ID	Bi Ppm	Sn Ppm	W Ppm	Mo Ppm	Mn ppm	Ca %	Fe %	S %
RR-4	1.3	0.6	1.0	5.2	4,733	5.9	24.6	24.0
RR-5	0.4	0.4	0.2	11.4	10,022	11.7	13.0	9.3
RR-3	1.2	1.6	1.0	0.9	4,618	4.8	22.9	20.1
RR-1	0.4	0.3	0.1	1.5	8,468	13.3	9.0	5.4
RR-2	0.1	0.1	0.5	0.4	9,980	17.0	5.8	0.64

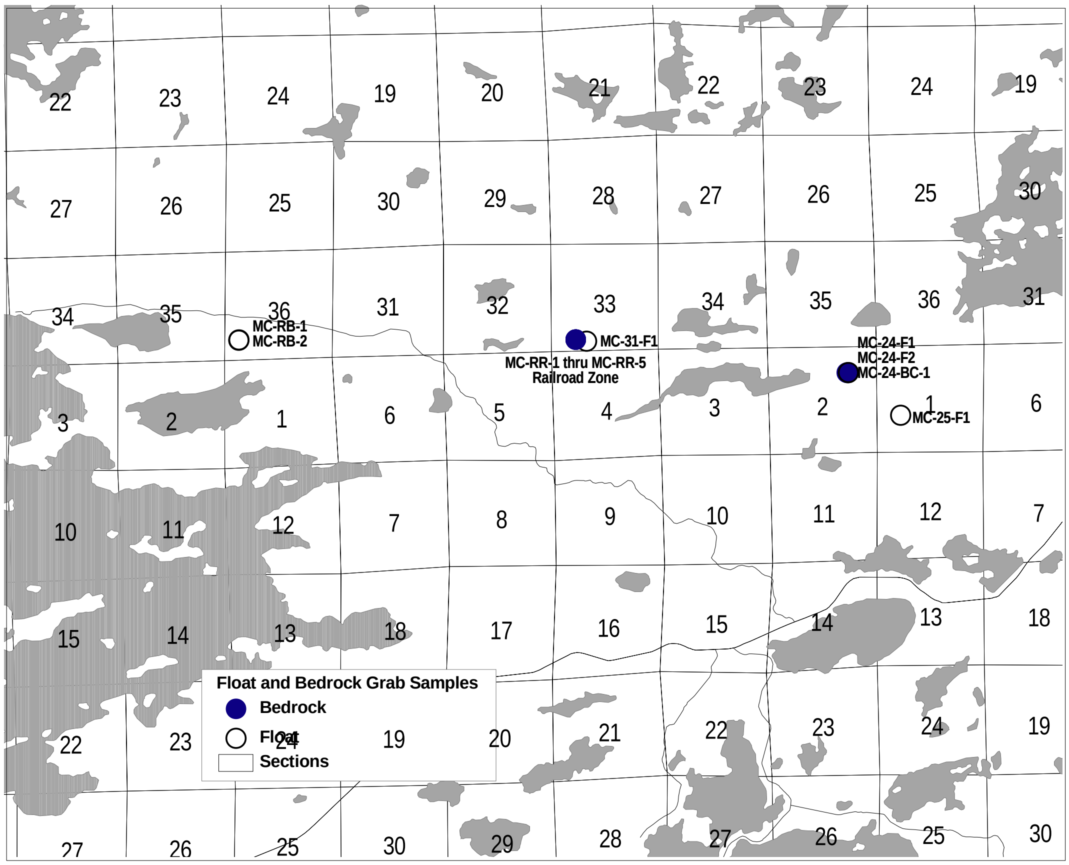

Figure 6. Bedrock and float sample localities.

Till Geochemistry

Elements Au, As and W in both the –63µm and HMC fractions, and Mo and Cu in the –63µm fraction, and Sb, Ta, Zn and Ca in the HMC fraction of the till samples exhibit 8-fold or greater variability in the 95-to-5 percentile portion of the sample population, calculated as:

$$\frac{\text{Element } 95^{th} \text{ percentile value}}{\text{Element } 5^{th} \text{ percentile value}}$$

These same elements also exhibit 3-fold or greater variation in the 85-to-15 percentile portion of the sample population. Table 4 lists metals and oxides exhibiting 4-fold or greater variation in the 95-to5 percentile portion of the till sample population. Listings for the remainder of the analyzed elements are found in Appendix C, along with results for precision pairs and reference materials, and detection limits for all of the elements and oxides measured, as well as descriptive statistics. Figures 7 thru 13 portray the spatial distributions of metals having high variability in the till samples.

Uranium, thorium, halfnium and most of the rare earth elements display up to 12-fold variation in the HMC fraction. The concentrations of these elements track in proportion through the sample population, suggesting that one or two heavy mineral phases are responsible for the variability. Examination of two +0.25mm HMC sample fractions by the processing lab found some monazite ($(Ce,La,Y,Th)PO_4$) (Hunealt, 2004, pers. comm.). The high Th and rare earth element concentrations in the HMC sample fractions led the INAA analysis lab to list the HMC-INAA results as semi-quantitative.

Sample MC-35a, treated separately in Table 4, is highly anomalous for a host of elements. The sample returned highest reported values for Cu (1%), Ag (3 ppm), As, W, Mo, Zn, Ni, Co, Fe, Cd, Bi, Sn, P, Ca, Eu, Lu, Yb and Tb in the –63µm fraction, and for Mo and W in the HMC fraction. The same sample also returned lowest reported values for Al, Na, K, Ba, SiO_2, U, Th, Zr, Hf, Li, Rb and CS in the –63µm fraction, and Sb, As, Cr, Au, Fe, Th, Na, Ta, Hf and REE in the HMC fraction. The sample displayed a distinctive maroon-and-green matrix color, was collected from near bedrock having a prominent sulfide stain, and perhaps represents decomposed sulfide mineralization or gossan. The +2mm pebble fraction of the sample contains mostly one boxwork-epidote-rich composition. This same sample returned a 10-fold higher weight of –0.25mm HMC fraction than the other 31 till samples. Mineralogical examination by the processing lab determined that the dominant dark green mineral making up most of the HMC component of the sample is epidote (Hunealt, pers. comm., 2004).

Table 4. Metals and oxides exhibiting 4-fold or more variability in the 95-to-5 percentile range of 31 Vermilion till samples (excludes U, Th, Hf, REE and Br).

	Element	Detection Limit	Outlier MC-35a	Max.	Min.	95th %ile	85th %ile	75th %ile	50th %ile	25th %ile	15th %ile	5th %ile
-63µm	**INAA**											
58	Au	2 ppb	41	1050	< 2	69	36	16	7	3	< 2	< 2
13	As	0.5 ppm	66	55	2	45	27	18	12	8	6	4
8	W	1 ppm	57	20	<1	5	2	2	< 1	< 1	< 1	< 1
5	Sb	0.1 ppm	0.7	1.8	< 0.1	1.0	0.8	0.6	0.4	0.3	0.3	0.2
4	Sc	0.1 ppm	17.8	36.9	6.6	27	18	16	11	9	8	7
4	Ta	0.5 ppm	1.8	<0.5	1.2	1.6	1.4	1.3	1.1	0.7	0.6	0.4
-63µm	**ICPMS**											
12	Mo	0.05 ppm	141.4	9.8	0.4	5.8	2.5	1.8	1.2	0.8	0.7	0.5
10	W	0.1 ppm	53.4	6.9	0.4	4.6	2.3	1.8	1.0	0.8	0.6	0.5
8	As	0.2 ppm	64	56	3	43	27	19	12	9	6	5
8	Cu	0.02 ppm	9697	213	13	155	119	107	58	41	33	20
5	Mn	2 ppm	3190	9132	251	1569	1039	648	536	492	404	293
5	Ag	20 ppb	2949	442	58	307	241	205	152	94	79	59
5	Sb	0.02 ppm	0.76	1.26	0.11	0.99	0.63	0.56	0.39	0.30	0.28	0.19
4	P	0.001 %	0.14	0.17	0.02	0.12	0.09	0.07	0.06	0.05	0.04	0.03
4	Cr	1 ppm	46	239	40	168	113	96	83	67	63	48
4	Sc	0.1 ppm	14.0	36.1	6.2	25.1	17.5	14.7	10.6	8.0	7.7	7.0
-63µm	**ICPES**											
6	Cr2O3	0.001%	0.004	0.032	.002	.021	.012	.010	.008	.006	.005	.004
6	Nb	20 ppm	< 10	55	< 10	36	26	21	< 10	< 10	< 10	< 10
5	MnO	0.01%	0.34	1.05	0.03	0.18	0.12	0.07	0.06	0.06	0.05	0.04
4	P2O5	0.01%	0.51	0.37	0.05	0.28	0.20	0.17	0.14	0.11	0.11	0.07
4	Sc	1 ppm	15	37	7	27	19	17	12	9	8	7
HMC	**INAA**											
533	Au	2 ppb	<4	8050	<20	5860	1636	575	264	119	59	11
53	W	1 ppm	328	57	< 5	53	37	33	12	<5	< 5	< 5
32	As	0.5 ppm	4	539	5	270	134	83	49	33	15	9
22	Sb	0.1 ppm	< 0.5	7.3	< 0.5	6.7	4.2	3.9	2.9	2.2	1.6	< 0.5
12	Ta	0.5 ppm	1	43	2	42	39	35	22	17	13	4
10	Zn	50 ppm	< 50	300	< 50	290	235	215	180	115	63	< 50
8	Ca	1 %	12	9	< 1	8	7	6	4	2	1	1
7	Cr	5 ppm	50	1290	68	589	475	440	340	310	265	85
7	Co	1 ppm	111	238	18	170	110	83	62	45	37	26
4	Sc	0.1 ppm	15	90	11	86	74	67	60	52	44	23

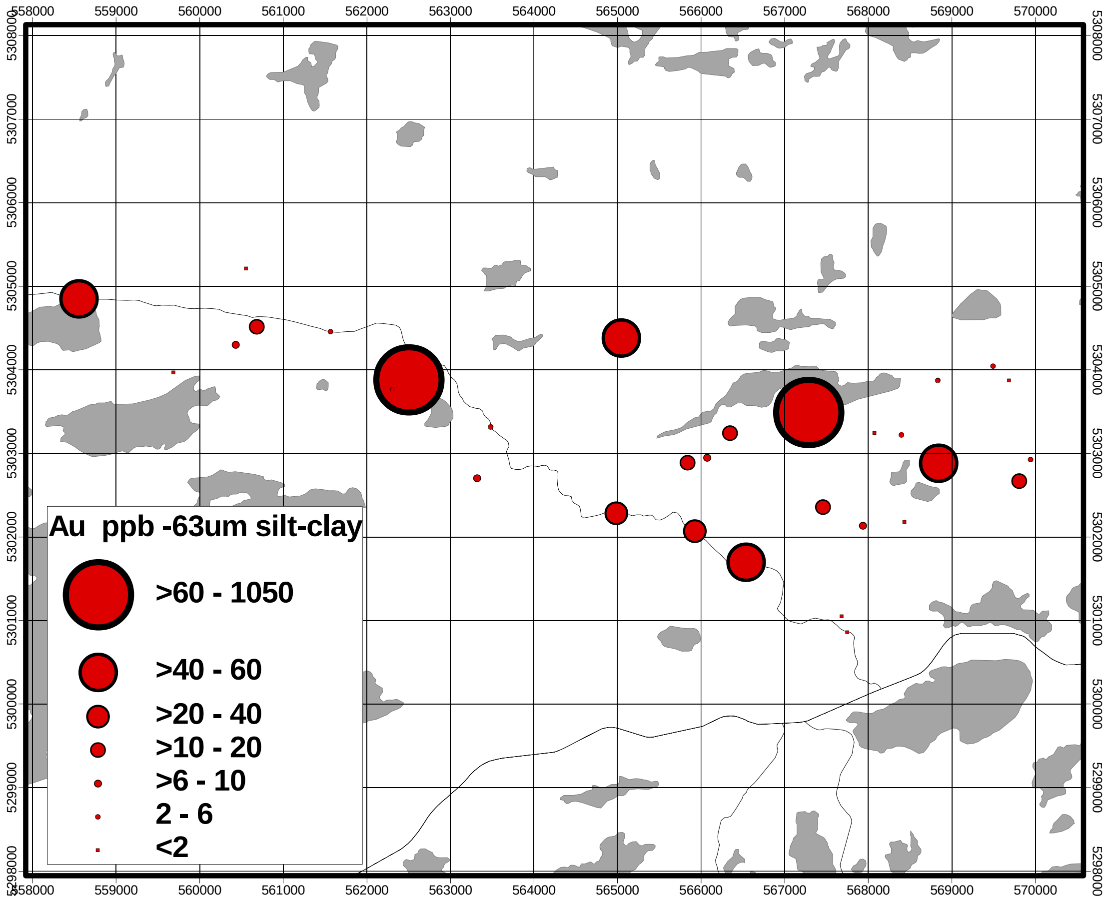

Figure 7. Gold ppb in –63µm silt/clay fraction of Vermilion till samples.

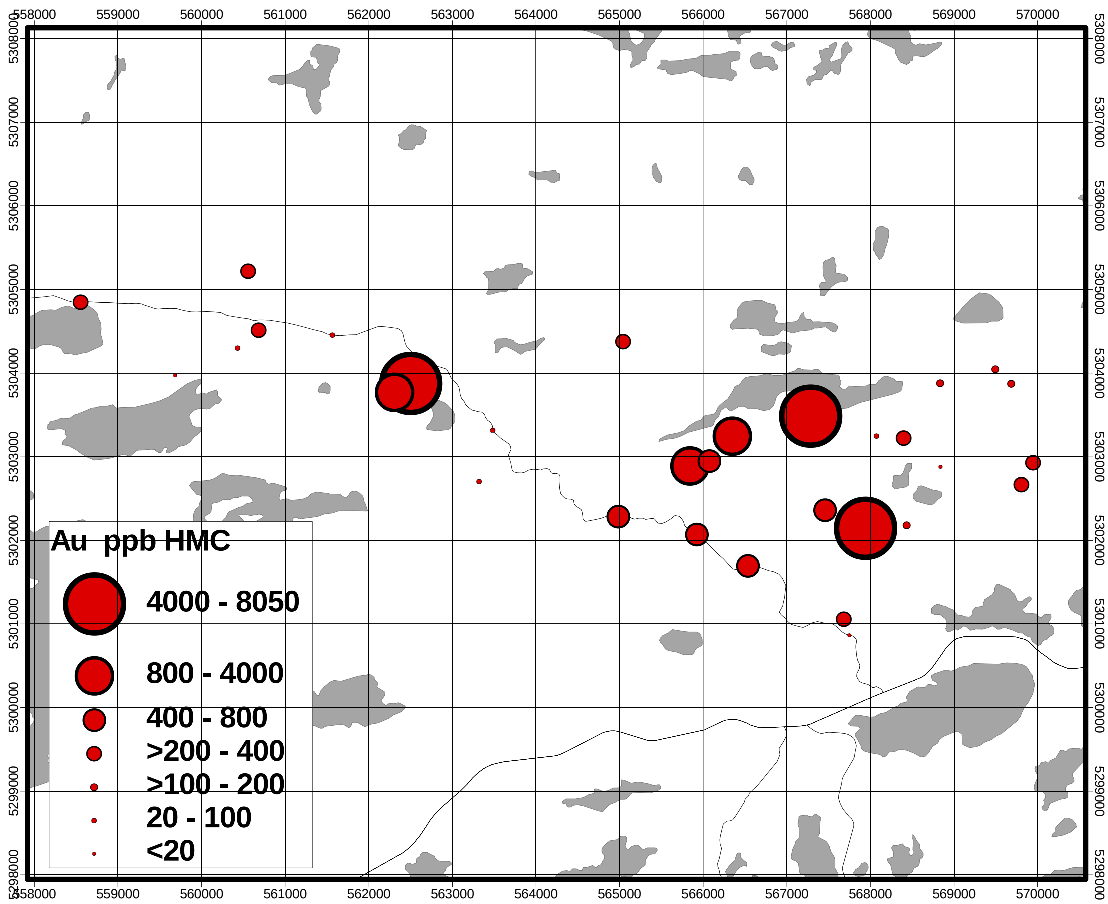

Figure 8. Gold ppb in nonmagnetic heavy mineral concentrates (HMC) of Vermilion till samples.

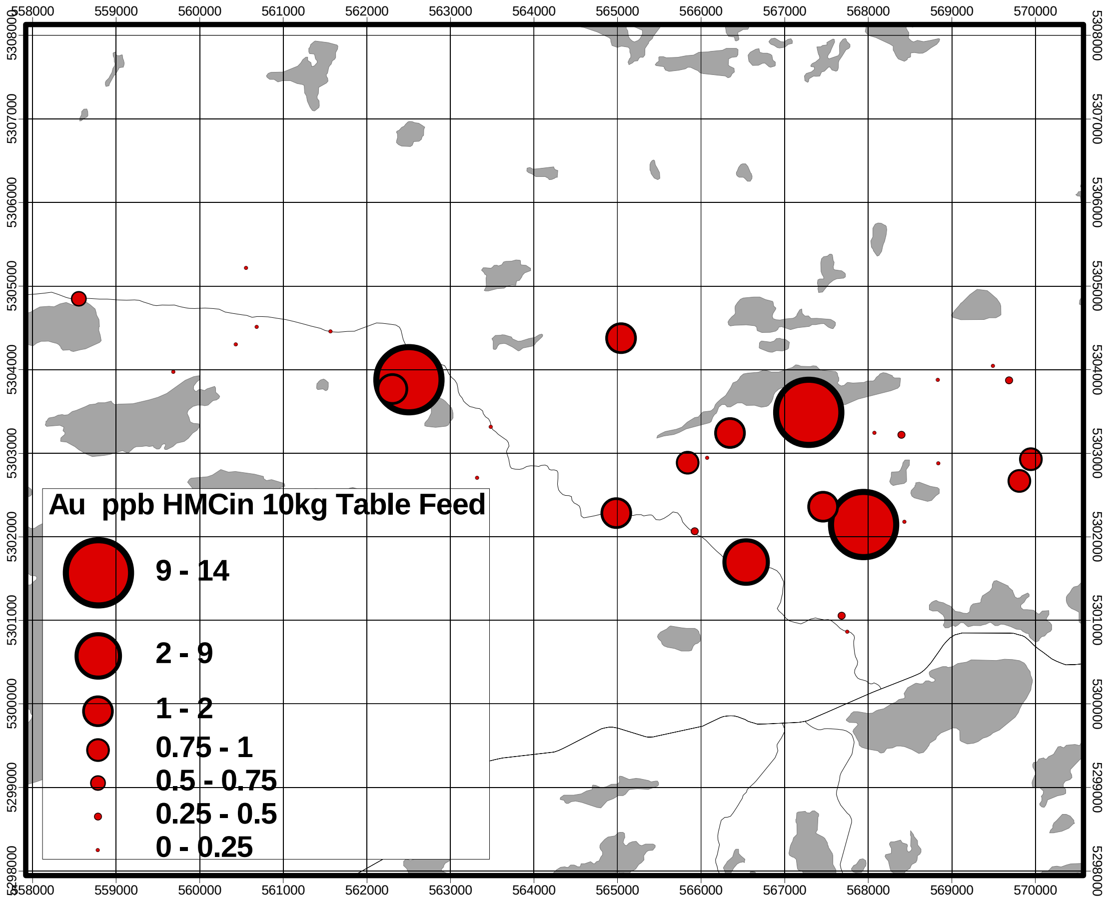

Figure 9. Gold ppb in HMC redistributed to original –2mm table feed weight of Vermilion till samples.

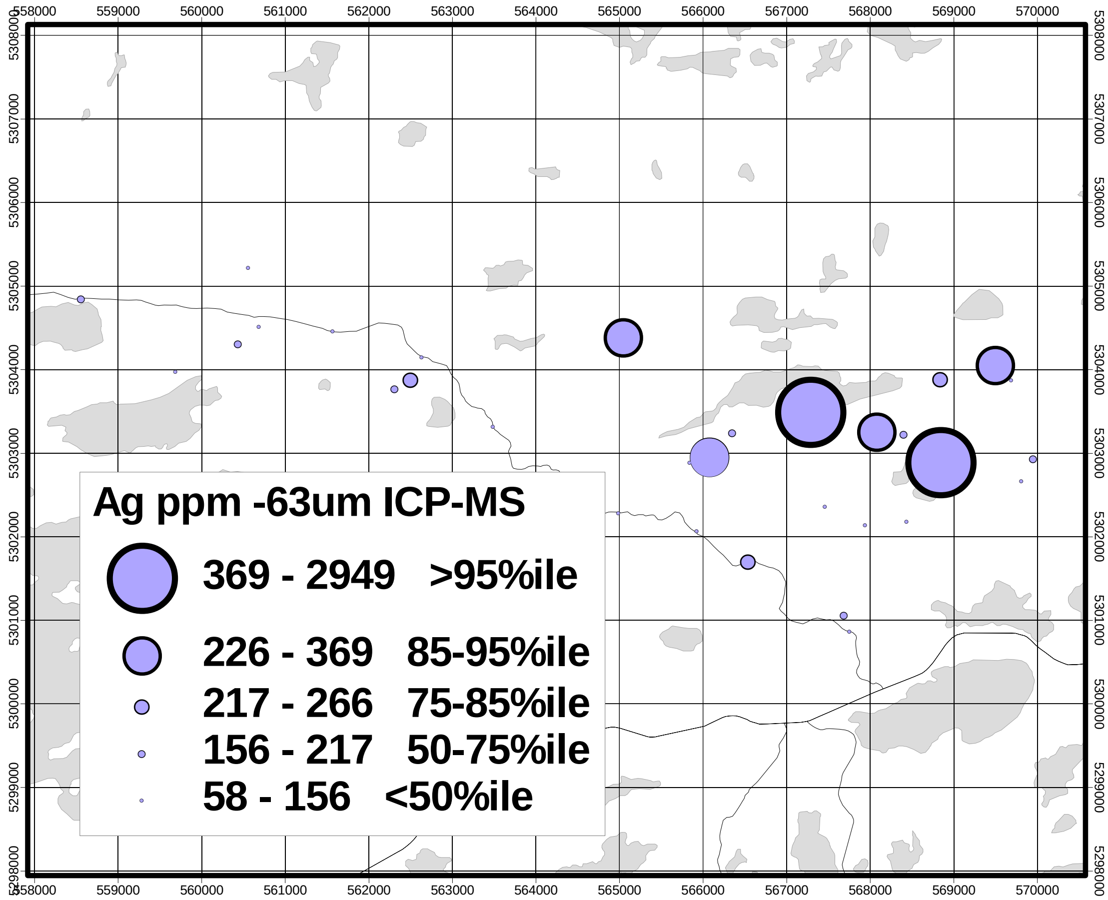

Figure 10. Silver ppb in –63µm silt/clay fraction of Vermilion till samples.

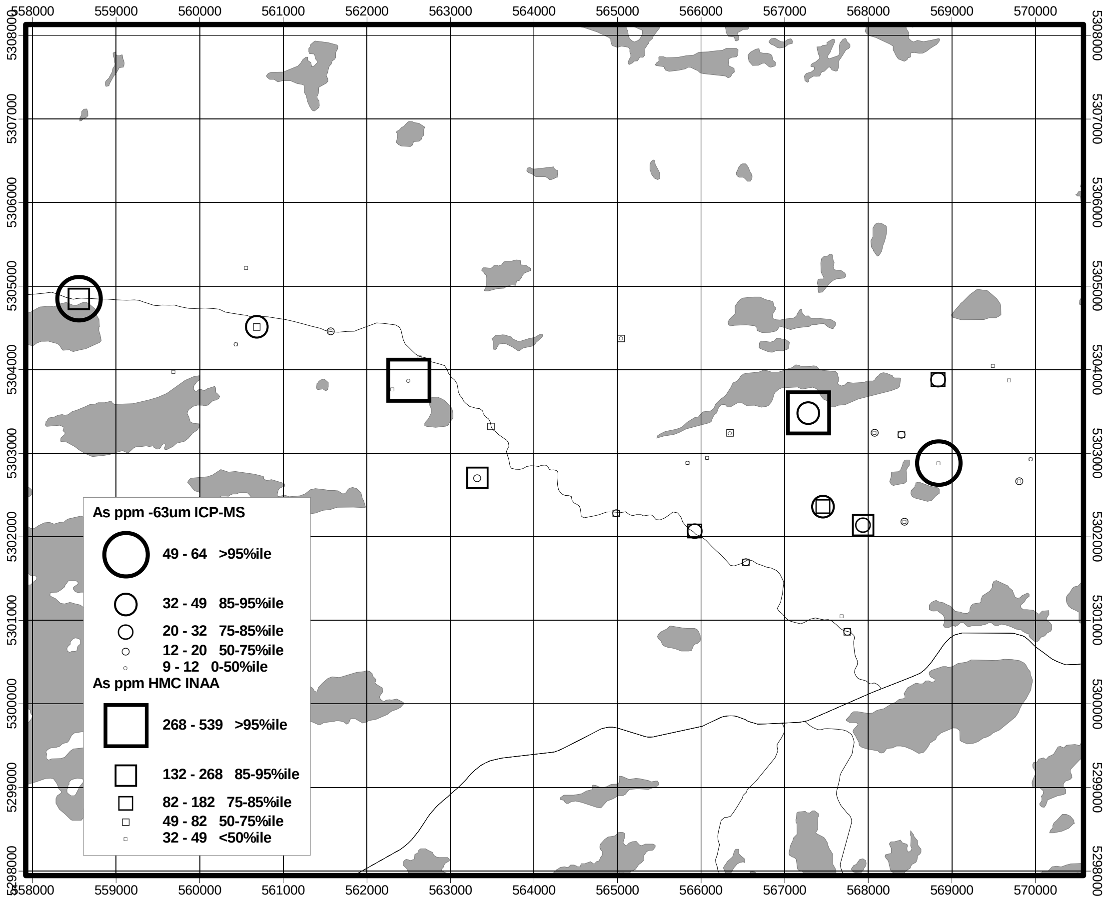

Figure 11. Arsenic ppm in –63µm silt/clay and HMC fractions of Vermilion till samples.

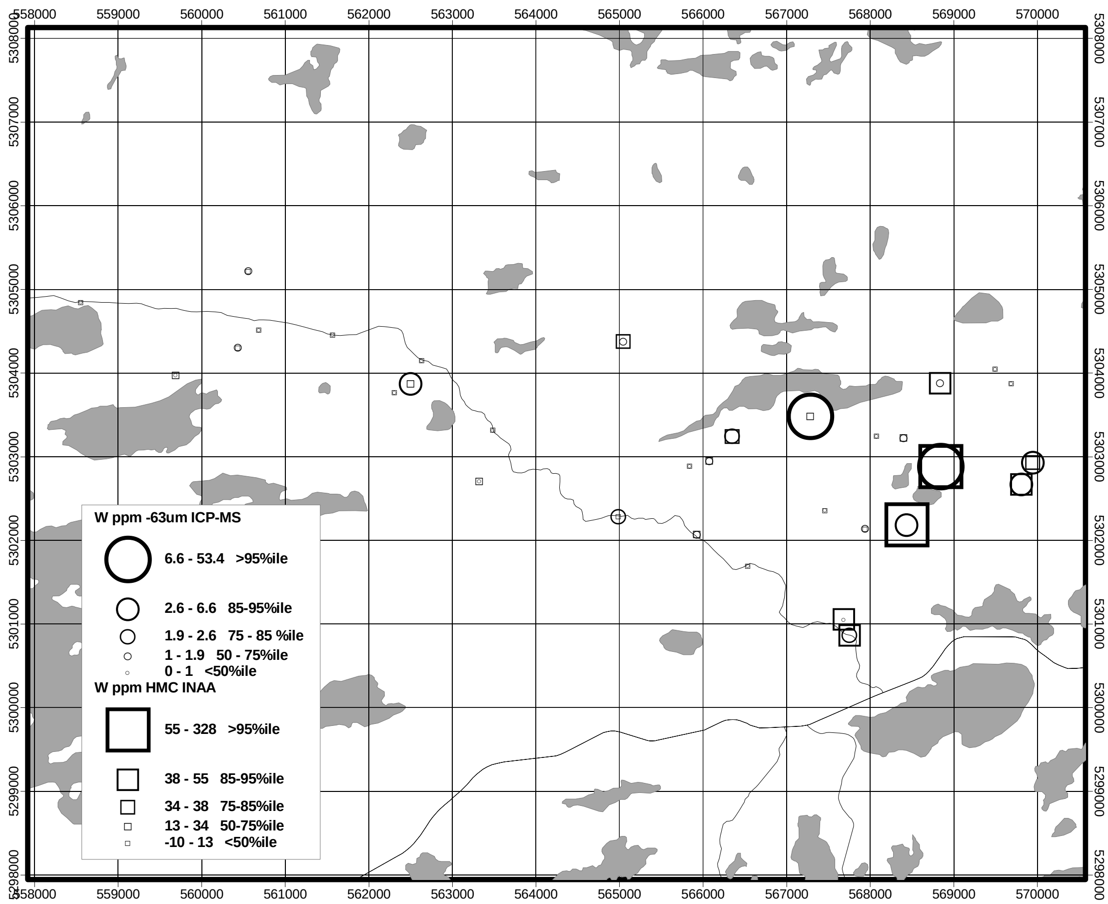

Figure 12. Tungsten ppm in –63µm silt/clay and HMC fractions of Vermilion till samples.

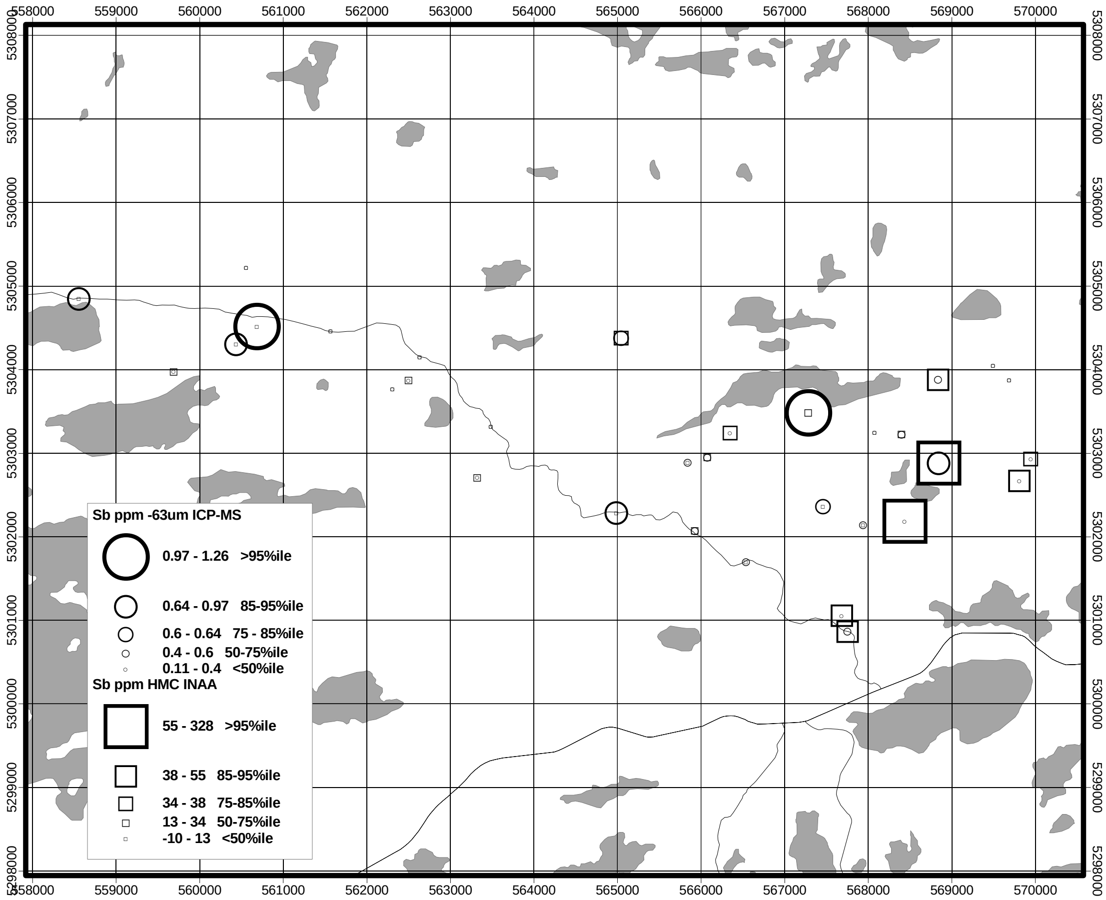

Figure 13. Antimony ppm in –63µm silt/clay and HMC fractions of Vermilion till samples.

Float Samples

Six float rock samples, and one sample of lamprophyric bedrock material were collected while till sampling (Fig. 6). Sample MC-25-F1 is a sample of fresh sulfide float collected adjacent to a heavily sulfide-stained outcropping of mafic volcanics. Samples MC-24-F1 and MC-24-F2 are mineralized float encountered along a snowmobile trail east of Mud Lake. Sample MC-31-F1 is a piece of quartz float collected while taking till sample MC-31. Samples MC-RB-1 and MC-RB-2 are mineralized float collected at a shear zone located west of sample MC-2a, along the southeast side of Rice Bay. Sample MC-24-BC-1 is amphibolitic-lamprophyric material from outcrop on a snowmobile trail near till sample site MC-24. Analytical results for pertinent metal elements are reported in Table 5. Full analytical results for these samples can be found in Appendix B.

Table 5. Pathfinder metal contents for float rock and other bedrock grab samples.

Sample ID	Au ppb	Ag ppb	As ppm	Sb ppm	Cu Ppm	Zn ppm	Pb ppm	Cd Ppm	Ni ppm	V ppm	Co Ppm
MC-25-F1	56	3,616	25	1.2	1,060	46	8	0.1	186	57	361
MC-24-F2	8	3,943	23	0.5	9,884	51	2	0.3	14	50	7
MC-24-F1	<2	340	4	0.3	21	14	13	0.1	7	13	3
MC-RB-1	2	206	10	1.9	115	2,054	5	7.2	22	53	15
MC-RB-2	<2	91	14	0.5	19	13	3	0.1	5	7	4
MC-31-F1	4	191	4	0.1	18	15	1	0.1	2	6	3
MC-24-BC-1	2	86	4	<0.02	17	126	6	0.2	56	289	46

Sample ID	Bi Ppm	Sn ppm	W ppm	Mo ppm	Mn Ppm	Ca %	Fe %	S %
MC-25-F1	2.0	0.3	5.3	5.3	2,459	5.9	26.0	8.0
MC-24-F2	<0.04	0.4	2.8	0.7	122	0.1	2.8	0.7
MC-24-F1	<0.04	0.4	1.8	0.7	477	0.4	0.9	<0.04
MC-RB-1	0.1	0.2	0.1	3.5	1,542	0.1	17.1	0.5
MC-RB-2	<0.04	0.2	2.0	0.6	165	0.1	0.8	0.04
MC-31-F1	<0.04	0.3	<0.1	0.3	4,511	0.1	3.9	<0.04
MC-24-BC-1	0.1	1.2	0.1	0.1	1,888	6.8	8.8	<0.04

Discussion

Till Sheet Characteristics

Compositional variation in till sheets occurs because materials in till are a mixture of materials contributed from numerous sources. These sources exist across a spectrum of scales from continental through provincal, from regional down to area, from lithologic unit down to features within lithologic units such as mineralized areas, and even to smaller features such as variation of mineralized content within mineralized zones. Till sheet composition is transitional in spatial and vertical dimensions. Each different region or project area has unique features in the glacial drift, and application of diagnostic features from one region to another may not be automatic. Still, characteristics encountered in one evaluation can be similar to characteristics found in another. The till sample population in the present Vermilion Greenstone Belt project is similar in some respects, and different in others to tills sampled in larger regional projects.

The sample population in the present study displays characteristics useful for dispersal mapping, owing largely to relatively simple provenance. The samples do not contain Paleozoic limestone-dolomite clasts from the Hudson Bay lowlands area. They do not carry the ubiquitous Nipigon-sourced clinopyroxene grains in the HMC fraction noted by Bajc (2000a). They do not carry Cretaceous shale clasts or Paleozoic limestone-dolomite clasts from the continental interior seaway sedimentary section, as observed in till sheets in western Minnesota. Bedrock exposures in the project area are stripped of the lateritic-saprolitic mantle of decomposed bedrock found in other areas of Minnesota. Till samples from the current project area do not carry Lake Superior basin fill or other Proterozoic rift-related voclanic or intrusive clasts that are found in tills located further south and east of the project area. Stacked till sheets of varying provenance that have been noted in western Minnesota are not recognized in the present project area. And complications in the glacial drift package due to opposing ice transport directions are not evident, as has been found in parts of central Minnesota, where successive glacial transport events sometimes reached almost 180° difference in flow direction.

The Vermilion area till samples, by contrast, appear to have a much simpler, one-generation history complicated only by some outwash and lacustrine sediment occurrences, and a thin mantle of sandy meltout material overlying the basal till. The basal till displays a striking angularity in the pebble- to boulder-sized fraction, with clast lithologies dominated by metavolcanics and hypabyssal intrusives; and displays an increased silt/clay content in the matrix. The Vermilion area glacial drift does display some carryover from up-ice sources, particularly in the melt-out till, in the form of a recognizable Quetico subprovince component, observed in the field as gneiss, migmatite and granitoid pebbles-to-boulders, generally well-rounded on most sides, but often exhibiting one or more angular faces. It is likely that some sand-silt-clay material of Quetico provenance has mixed with the more locally derived source materials. Monazite in the HMC fraction of the till samples, carrying relatively high content of Thorium and Rare Earths, may be an expression of this Quetico provenance carryover.

While the Vermilion samples are compositionally simpler than other drift packages that exist within a 200 km (120 mile) radius, they have similarities to tills sampled from other gold-bearing greenstone belt areas in Ontario, Canada. The Vermilion samples were collected in a field area that offers visible sampling controls. Within the present field area, there exists 15-20% bedrock exposure, and the bedrock topography expression of the area gives some clue as to appropriate sampling locations and to the competence and general strike of the major lithologic units. These visible landform characteristics offer some advantage for drift sampling studies such as Larson (2004) and the present case, where the success rate for sampling till, particularly basal till is higher than would be expected in a drilling or excavation campaign. Drill- or excavator-based studies, such as Martin, et al (1988, 1989, 1991) would be expected to return a lower sampling success rate and anomaly count, as little bedrock control is available to influence sampling, and target materials cannot be verified to exist before deploying the sampling effort. The thinly covered Vermilion Greenstone Belt in the project area seems to be particularly attractive for sampling, because of this available upland bedrock exposure and control.

Comparison to Ontario Studies

The Vermilion till sample results display a similarity to results obtained in other more regional studies over greenstone belts. The Vermilion results compare well with synopses of till characteristics listed by McClenaghan (2001), and Averill (2001) for studies of glacial drift over greenstone belts in Canada, and for gold grain and chemistry patterns associated with significant gold mineralization dispersed by ice transport.

Bajc (2000a, 2000b) reports gold grain counts, indicator mineral counts and fine fraction (-63µm) chemical analysis results for tills in the western Shebandowan Greenstone Belt; and reports gold grain counts, indicator mineral counts, fine fraction (-63um) C-horizon till chemistry, and humus chemistry (-177µm) for the eastern part of the Shebandowan greenstone belt (Bajc, 1999a, 1999b). Vermilion till sample gold grain counts are proportionately similar to results for the western Shebandowan area. Chemistry results for the fine fraction –63µm component of the tills is strikingly similar in background levels, percentiles and anomaly thresholds.

The present results are also comparable to the results reported for 383 surface samples collected from the Beardmore-Geraldton Greenstone Belt area of Ontario (Thoreifson and Kristjannson, 1994), and to the Michipicoten River – Wawa area sampled by Morris, et al (1994) in northeastern Ontario.

Comparison to Other Vermilion Studies

In the immediate Vermilion project area, three studies of soils and fine-fraction-of-till have been reported (Alminas, 1992), Alminas and Cartwright (1992), Larson (2004). Other results of property-specific soils studies conducted in the 1980's and early 1990's are found in the mineral exploration archives at MnDNR. The three reported studies have yielded overlapping Au anomalies. Figure 14 depicts over-posting of results from these studies.

Alminas (1992), McHugh, et al (1990) and Grimes, et al (1981) reported results for 754 samples of A-horizon soils collected by the U.S. Geological Survey in cooperation with the Minnesota Geological Survey during 1970-1971, from a 226 square mile portion of the Vermilion Greenstone Belt. The sample collection sites at many locales correspond to swales and drainageways in the landscape. The –177µm fraction of the A-horizon samples was analyzed for 31 elements, including gold by electro-thermal atomic absorption spectrometry. Six of eight samples comprising the 99^{th} percentile (>60 ppb Au), and eight of the sixteen samples comprising the 98^{th} percentile (>30ppb Au) were collected from a 6 x 22 km (3.5 x 13 mile) portion of the belt that includes most of the present project area. Highest measured values for A-horizon soils were 1100, 1000, 140, 140, 85, 73, and 62 ppb Au, respectively. Fifty percent of samples in the 93-98 percentile grouping (10-29 ppb Au, 19 samples) were collected in this same area or from locations slightly down-ice. Based on the A-horizon gold results, Alminas identified two major areas of anomalous gold values, one at Lake Vermilion, and an eastern major area of

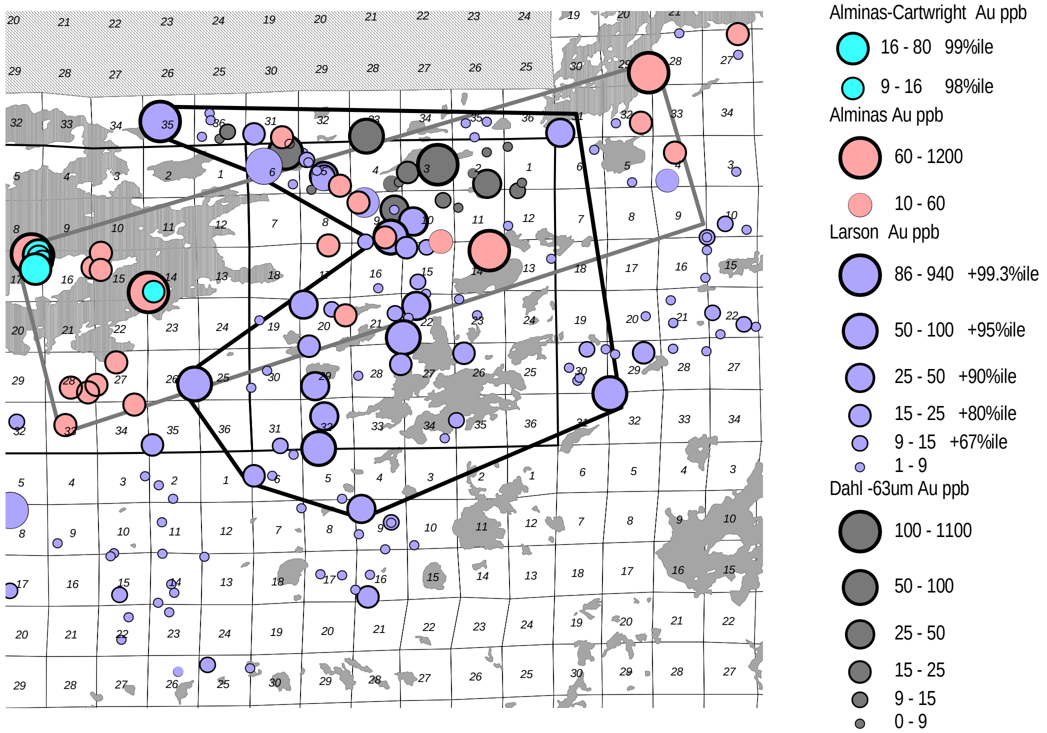

Figure 14. Comparison of gold analysis results for four geochemical studies in the Vermilion Greenstone Belt. The gray outline highlights anomalous samples from Alminas (1992). The darker outline highlights anomalous samples from Larson (2004).

anomalous gold values in the area between Fall and Jasper Lakes, encompassing approximately 77 km^2 (30 sq. miles). The major gold anomalies and several lesser gold anomalies identified by Alminas correspond to several of the gold prospects and bedrock gold occurrences in the area (Garden Lake area, Madden Lake area, Ojibway-Triangle Lakes area, Raspberry/Longstorff Bay of Shagawa Lake, Lake Vermilion area, and north-northeast of Gafvert Lake). It is a bit unclear in the literature whether the prospects and occurrence discoveries pre-date the A-horizon soil survey, or if the prospects are follow up on the A-horizon anomalies, since dates on available exploration data begin around 1980.

Alminas and Cartwright (1992), in a cooperative project between the U.S. Geological Survey and Minnesota Department of Natural Resources, collected 600 B-horizon soil samples from an area that overlapped and extended the west end of the Alminas 1970's A-horizon soil study. The B-horizon soil work by Alminas and Cartwright confirmed the A-horizon gold values obtained twenty years earlier in the eastern portion of Lake Vermilion, and additionally found a strong, coincident, multi-sample, township-sized base-metal anomaly that touches the western edge of the 1970's project area. The base-metal anomaly, which lies between the Birch Point and Grassy Point peninsulas in the central portion of the Lake, touches or overlaps the gold enriched area of Lake Vermilion identified in the 1970's data of Alminas.

Larson (2004) reports results for the chemical analysis of the -63µm fine fraction of 151 till samples collected in the vicinity of the western major gold anomaly area outlined by Alminas. Larson also extended the sampling area south to Wahlsten (Wahlsten moraine) and southeast to Putnam Lake and Eagles Nest Lakes. Gold content of these samples reinforce the anomalous area described by Alminas. One sample collected by Larson at the northwest corner of the field area returned a 99th percentile value of 940 ppb Au. Most of the samples at the 87th percentile (>20 ppb, 20 of 151 samples) of the Larson study lie in the general anomaly area described by Alminas.

Present Gold Grain Study

The present till sampling study extends examination of the gold anomaly area identified by Alminas to heavy mineral concentrates and gold grain counts. Gold contents in the –63µm fine fraction of the till samples corroborate the Alminas and Larson work, and confirm that particulate gold grain trains can be detected in the area, at clearly anomalous levels. The gold grain data give substance to transport distance of the gold, which is a valuable dimension not available in the elemental concentrations provided by the fine fraction data. The gold grain counts also provide an independent means of confirming the presence of particulate gold in the glacial drift, and appear to offer some assistance in delimiting mineralized subcrop areas within the soil anomaly area. McClenaghan (2001) points out that pristine gold grain shape can be preserved some distance from source if the gold particles are transported in pyrite, and then subsequently liberated in the till by weathering of the pyrite. In such a case, true gold grain transport distances from source would be greater than estimated from gold grain shape.

The analyzed HMC fraction Au results for the Vermilion samples are generally greater than those calculated by observation of visible gold in table concentrates. This may reflect the very fine grain size of the gold. Analyzed gold in the –63um fraction of the till samples is also generally greater than that calculated by distributing the analyzed HMC gold content to the original –2mm table feed. McClenaghan (2001) notes that gold grains associated with pyrite in weathered tills can exhibit iron oxide coatings that make it difficult to separate some gold grains into the HMC fraction. Pyrite has been observed in association with mineralized outcrops of quartz-carbonate-sericite-pyrite veins in the project area. The degree of possible effect due to the semi-quantitative results for the HMC INAA analyses is undetermined.

Calculations to distribute the gold content of the HMC samples to the original –2mm fraction of the till samples yield results in the range from 0.05 to 13.8 ppb. Distributed values greater than 0.30 ppb correspond to samples having anomalous gold grains. Three samples that had high gold grain counts yielded distributed values of 9.2 to 13.8 ppb Au. That the distributed Au values are lower than those obtained from INAA analysis of the –63µm silt/clay fraction may indicate that some of the gold in the original samples is finer than generally recovered during the concentration process (<10um grain size or attached to oxides), or may indicate that the HMC-INAA semi-quantitative results are skewed.

McClenaghan (2001) notes that pathfinder elements are only partially usable as aids in tracking dispersal from Canadian gold deposits. Arsenic is the most commonly associated of the elements, but is not diagnostic. Anomalous Sb, Ag and Cd contents, along with Zn also show up in association with some gold dispersal trains, but again, are non-diagnostic. This similarly appears to be the case for the Vermilion till samples.

McClenaghan (2001) additionally notes that HMC and fine fraction silt/clay anomalies are not always coincident in till at the regional level, but are more so at the property scale, and such is the case for the present study, where anomalous gold grain counts, HMC Au values and –63µm Au values occur in the same area, but not necessarily all in the same sample.

Regional Backgrounds From Other Minnesota Greenstone Studies

Results from the present project area are clearly anomalous compared to results from regional stratigraphic reconnaissance projects conducted in other parts of Minnesota. Martin, et al (1988, 1989, 1991) conducted drilling-based evaluation of the glacial stratigraphic package across large areas of northern Minnesota during three regional projects. Two of the projects were conducted over Wawa subprovince greenstone rocks, 50-100 km west of the present field area, and one study was conducted over Wabigoon subprovince greenstone rocks farther to the west. These drilling projects established the regional glacial stratigraphy for areas of deeper glacial drift cover. They also demonstrated an increasingly complex provenance for glacial drift in the north-central and northwestern part of the state, where materials carried from the northwest (Keewatin ice sector) have interfingered with the granite-greenstone materials of Laurentide provenance (Nichols and Burtt, 1993). Glacial drift recovered by rotasonic, mud rotary and air rotary drilling methods was analyzed by Martin, et al for gold grains, HMC chemistry/mineralogy, fine fraction chemistry, and pebble counts. At the one-boring-per-township (100 km^2) drill spacing, regional scale variations in the glacial package could be observed and regional background values established for till sheets encountered. With the exception of one anomalous result in the Linden Grove area, gold grains from these projects were mostly reshaped and predominantly coarser than 100µm. Gold in the HMC fractions was low-valued (<925 ppb Au), and gold in the –63µm fine fraction was similarly low-valued (<35 ppb Au). As a result, these projects focused on establishing regional background level values for gold grains, HMC chemistry and mineralogy, fine fraction chemistry, and pebble counts. Some low-level anomalies were resolved using anomaly threshold values of 3x median of the regional backgrounds.

In the Baudette area (Martin, et al, 1991) of the Wabigoon subprovince, low Au values were returned for 121 till samples recovered from 20 rotasonic borings. Four of the 121 samples returned –63um analyses of 14 - 34 ppb Au. Four samples returned gold grain counts of 4 or 5 grains per 10 kg sample. Three samples returned HMC analyses of 597, 609 and 887 ppb Au. A barren massive sulfide was encountered in the bedrock during the program. Results from this project used values of 10x median as expected values for head-of-train dispersals, and 3x median as the cutoff for dispersal tails. In the Effie area, Martin, et al (1989) report very few pristine gold grains. Gold grains encountered in the Effie area were mostly reshaped and coarse. One saprolite sample from the Effie area contained 338 ppb Au. The Orr-Littlefork area (Martin, et al, 1988) yielded one sample with 33 pristine gold grains and coincident pathfinders in the HMC. Samples from a mud- rotary drill hole (#20801) yielded several samples containing up to 1,000 grains of arsenopyrite and gold grain counts of 6-11 grains, with HMC fractions rich in pyrite, up to 80% pyrite.

Conclusions

Gold grains and pathfinder element concentrations in the till sample suite collected from the Vermilion Greenstone Belt area are present at sufficiently contrasting and elevated values to consider using the basal till as a sample media for gold dispersal mapping. Several of the 32 samples in the sample population returned anomalously high concentrations of pathfinder elements and gold grains, up to 1,282 gold grains per 10 kg of –2mm sample, and pristine gold grain proportions up to 98%; 8,050 ppb gold in HMC (nonmagnetic heavy mineral concentrates); and 1,050 ppb gold in –63µm fraction of till. A suite of bedrock grab samples collected as reference mineralization returned assays up to 12,247 ppb for gold, and silver concentrations up to 42,500 ppb. The analytical results for the till sample set confirm the hypothesis that clastic dispersal trains of mineralized material do exist in tills in the area. These results are proportionately comparable to more extensive regional evaluations conducted in neighboring Ontario, and confirm anomalous soil and fine fraction gold values found in earlier Vermilion

Greenstone Belt studies. The gold grain counts in particular add a transport distance value to the chemical measurements of gold content in the soils and till. Particulate gold is more anomalous in basal till samples than in the thin drape of meltout till.

Further work is warranted to densify the sample network for the purposes of detecting additional dispersal trains, delineating potential bedrock source areas, and to give shape and character to the mineralized trains recognized in the present study. The present study area makes a good test area for evaluating what methods might allow step out sampling into areas of deeper glacial drift cover and drift complexity. Till analysis in this part of the Vermilion Greenstone Belt, particularly for gold grains, as demonstrated in even a small sample population, provides a capability to positively detect areas of local, previously unrecognized mineralization both inside and outside of areas of detailed bedrock geologic mapping.

Recommendations

The geologic setting of Archean supracrustal rocks in the Vermilion Greenstone belt is clearly similar to that of gold-producing areas in North America. Mineralized zones have been encountered close to shear zones in the bedrock and anomalous soil and glacial drift has been documented. The area of Breitung and Eagles Nest Townships is the most notable amongst anomalous localities in the greenstone belt. This may be due partly to the increased sampling attention that has been paid in this area by government and research reconnaissance projects. Other areas of the greenstone belt have received less modern evaluation and exploration attention.

Follow up work in this area has several readily identifiable paths. First, due diligence should be taken to confirm the anomalous gold grain results returned from this study, by collection of sample twins at anomalous locations. The sample network in the project area should be densified, to perhaps to 400 meters, to close the anomalies on the up-ice side and as a next level of control for characterizing the variety, distribution and thickness of the locally derived tills. Denser sampling should also better delineate the identified gold grain and pathfinder element anomalies. Expanding the gold grain and heavy mineral methodology to the composite area of gold anomalies outlined by the Alminas and Larson studies would serve several purposes, (a) it would add transport distance information to the larger area of anomalous gold values, which would help target specific sheared areas within the major gold anomaly area and help to determine the extent to which the Murray Shear Zone or other as yet unidentified mineralized areas are contributing to the larger gold anomaly, (b) it would help resolve the character of local dispersal trains to serve as reference for step outs to deeper and more complex glacial drift areas in Minnesota, and (c) it would provide an area for testing sampling density for detection of mineralized areas in deeper drift cover.

Reconnaissance sampling to the west, into deeper drift in the Cook area at the west side of Lake Vermilion would test more complex tills covered by lacustrine sediments (eastern edge of Lake Agassiz sediments) and give some insight into sampling patterns and sampling density needed to intersect more deeply buried dispersal trains, and would place better control on the stratigraphy of the drift package in that region.

An interesting possible follow up project would be to sample glacial drift in the Virginia Horn area a few miles to the south to observe whether gold grains are carried in the drift there, and to see if buried weathered iron deposit (natural ore deposit) material can be detected and mapped as dispersal trains in the drift.

A sampling project eastward of the current project location, through the Fernberg corridor, could confirm the general trend of mineralization for an additional area of relatively simple drift and through the other gold-anomalous areas identified by both Alminas and first stage exploration projects, in order to better delineate the types of dispersal to be found in the greenstone belt.

Additional geologic/geophysical mapping in the area south of the Mud Creek Shear Zone might also better resolve the geologic detail in an area where elevated Au, Ag, Mo, Sb and As values occur with elevated gold grain counts. These activities would help identify the areas of highest mineral potential within the larger anomalies and increase the knowledge base available for management of state-owned lands.

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DATA TRANSMITTAL REPORT

DATE: 9-Jul-04

ATTENTION: **Mr. David Dahl**

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NO. OF PAGES: ____________

PROJECT: **Lake Vermilion**

FILE NAME: **Minnesota - Dahl - MC - July 2004**

SAMPLE NUMBERS: **MC - 1, 2, 2a, 3, 4, 4y, 4x, 5, 6a, 7 to 10, 10a, 13, 14, 24, 25, 25a, 25b, 26a, 31, 33, 33a, 33b, 34, 34a, 34b, 35, 35a, 35b and 36**

BATCH NUMBER: **2060**

NO. OF SAMPLES: **32**

THESE SAMPLES WERE PROCESSED FOR: **Gold Grain Count including HMC finishing.**

SPECIFICATIONS:
1. Submitted by client 9.7 to 16.3 kg till samples prescreened to -16 mm in the field.
2. Clay + silt fraction (<63 µ) prepared from ±400 gram subsample.
3. Heavy liquid separation specific gravity: 3.20.
4. Nonferromagnetic heavy mineral fraction sieved to 0.25 mm.
5. All sample fractions are presently stored.

REMARKS: ____________

*Prescreened to -16 mm in the field.

OVERBURDEN DRILLING MANAGEMENT LIMITED
GOLD GRAIN SUMMARY SHEET

Project: Lake Vermilion
Filename: Minnesota - Dahl - MC - July 2004
Total Number of Samples in this Report = 32

Batch Number: 2060

Sample Number	Number of Visible Gold Grains				-0.25 mm Nonmag	Calculated PPB Visible Gold in -0.25 mm NMHMC			
	Total	Reshaped	Modified	Pristine	HMC Weight	Total	Reshaped	Modified	Pristine
MC-1	0	0	0	0	5.3	0	0	0	0
MC-2	1	1	0	0	3.3	25	25	0	0
MC-2a	0	0	0	0	14.7	0	0	0	0
MC-3	0	0	0	0	4.3	0	0	0	0
MC-4	0	0	0	0	10.1	0	0	0	0
MC-4y	99	42	10	47	2.3	2700	1800	142	758
MC-4x	143	24	4	115	6.5	2206	140	28	2038
MC-5	2	2	0	0	14.5	31	31	0	0
MC-6a	2	2	0	0	1.8	152	152	0	0
MC-7	3	2	0	1	13.4	221	206	0	14
MC-8	2	0	1	1	5.8	69	0	64	4
MC-9	3	2	1	0	39.3	100	99	1	0
MC-10	0	0	0	0	5.1	0	0	0	0
MC-10a	0	0	0	0	11.8	0	0	0	0
MC-13	6	3	2	1	22.5	18	12	5	1
MC-14	1	1	0	0	17.8	5	5	0	0
MC-24	1	1	0	0	8.4	23	23	0	0
MC-25	1	1	0	0	15.7	135	135	0	0
MC-25a	3	2	1	0	10.7	5	3	2	0
MC-25b	5	4	0	1	13.1	29	15	0	15
MC-26a	3	2	0	1	25.0	30	23	0	8
MC-31	6	2	2	2	16.2	8	0	7	2
MC-33	2	2	0	0	3.7	804	804	0	0
MC-33a	8	2	3	3	2.0	736	507	198	31
MC-33b	6	0	2	4	5.9	1133	0	757	376
MC-34	9	2	2	5	23.1	133	44	29	61
MC-34a	2	0	2	0	20.7	27	0	27	0
MC-34b	641	4	5	632	7.5	2439	21	30	2389
MC-35	67	4	14	49	15.9	817	231	158	428
MC-35a	0	0	0	0	497.4	0	0	0	0
MC-35b	3	3	0	0	6.5	9	9	0	0
MC-36	1	1	0	0	11.5	2	2	0	0

*Prescreened to -16 mm in the field.

OVERBURDEN DRILLING MANAGEMENT LIMITED
DETAILED GOLD GRAIN SHEET

Project: Lake Vermilion
Filename: Minnesota - Dahl - MC - July 2004
Total Number of Samples in this Report = 32

Batch Number: 2060

Sample Number	Panned Yes/No	Dimensions (microns) Thickness	Width	Length	Number of Visible Gold Grains Reshaped	Modified	Pristine	Total	-0.25 mm Nonmag HMC Weight	Calculated V.G. Assay in 0.25 mm NMHMC (ppb)	Remarks
MC-1	No	NO VISIBLE GOLD									
MC-2	No	8 C	25	50	1			1			
								1	3.3	25	
MC-2a	No	NO VISIBLE GOLD									
MC-3	No	NO VISIBLE GOLD									
MC-4	No	NO VISIBLE GOLD									
MC-4y	Yes	3 C	15	15	28	1	16	45			~2% pyrite.
		4 C	15	25	5	1	16	22			
		7 C	15	50		2	1	3			
		5 C	25	25	2	5	9	16			
		8 C	25	50	2	1	2	5			
		10 C	25	75	1		2	3			
		13 C	50	75	1			1			
		15 C	50	100	1			1			
		15 C	75	75			1	1			
		18 C	75	100	1			1			
		20 C	100	100	1			1			
								99	2.3	2700	
MC-4x	Yes	3 C	15	15	15	1	42	58			No sulphides.
		4 C	15	25	5	1	29	35			
		5 C	25	25	2		27	29			
		8 C	25	50	1	2	8	11			
		13 C	25	100			1	1			
		10 C	50	50			2	2			
		13 C	50	75			2	2			
		15 C	50	100	1			1			
		18 C	75	100			2	2			
		25 C	75	175			1	1			
		29 C	125	175			1	1			
								143	6.5	2206	
MC-5	No	8 C	25	50	1			1			
		13 C	50	75	1			1			
								2	14.5	31	
MC-6a	No	8 C	25	50	1			1			
		10 C	25	75	1			1			
								2	1.8	152	
MC-7	No	10 C	50	50			1	1			
		15 C	75	75	1			1			
		22 C	100	125	1			1			
								3	13.4	221	
MC-8	No	5 C	25	25			1	1			
		13 C	50	75		1		1			
								2	5.8	69	
MC-9	No	5 C	25	25		1		1			
		8 C	25	50	1			1			
		27 C	100	175	1			1			
								3	39.3	100	

*Prescreened to -16 mm in the field.

OVERBURDEN DRILLING MANAGEMENT LIMITED
DETAILED GOLD GRAIN SHEET

Project: Lake Vermilion
Filename: Minnesota - Dahl - MC - July 2004
Total Number of Samples in this Report = 32

Batch Number: 2060

Sample Number	Panned Yes/No	Dimensions (microns)			Number of Visible Gold Grains				-0.25 mm Nonmag HMC Weight	Calculated V.G. Assay in 0.25 mm NMHMC (ppb)	Remarks
		Thickness	Width	Length	Reshaped	Modified	Pristine	Total			
MC-10	No	NO VISIBLE GOLD									
MC-10a	No	NO VISIBLE GOLD									
MC-13	No	2 C	10	10	1			1			
		5 C	25	25		1	1	2			
		8 C	25	50	1	1		2			
		10 C	50	50	1			1			
								6	22.5	18	
MC-14	No	8 C	25	50	1			1			
								1	17.8	5	
MC-24	No	10 C	25	75	1			1			
								1	8.4	23	
MC-25	No	22 C	75	150	1			1			
								1	15.7	135	
MC-25a	No	3 C	15	15	1			1			
		5 C	25	25	1	1		2			
								3	10.7	5	
MC-25b	No	3 C	15	15	1			1			
		5 C	25	25	1			1			
		8 C	25	50	2			2			
		10 C	25	75			1	1			
								5	13.1	29	
MC-26a	No	10 C	50	50	1		1	2			
		13 C	50	75	1			1			
								3	25.0	30	
MC-31	No	2 C	10	10	2		1	3			
		5 C	25	25		1	1	2			
		8 C	25	50		1		1			
								6	16.2	8	
MC-33	No	8 C	25	50	1			1			
		25 C	75	175	1			1			
								2	3.7	804	
MC-33a	Yes	4 C	15	25		1	1	2			No sulphides.
		5 C	25	25			2	2			
		10 C	50	50		2		2			
		13 C	50	75	1			1			
		15 C	50	100	1			1			
								8	2.0	736	
MC-33b	No	10 C	50	50			1	1			
		13 C	50	75			1	1			
		15 C	50	100			1	1			
		15 C	75	75		1		1			
		18 C	75	100			1	1			
		27 C	125	150		1		1			
								6	5.9	1133	

*Prescreened to -16 mm in the field.

Minnesota Department of Natural Resources

OVERBURDEN DRILLING MANAGEMENT LIMITED
DETAILED GOLD GRAIN SHEET

Project: Lake Vermilion
Filename: Minnesota - Dahl - MC - July 2004
Total Number of Samples in this Report = 32

Batch Number: 2060

Sample Number	Panned Yes/No	Dimensions (microns)			Number of Visible Gold Grains				-0.25 mm Nonmag HMC Weight	Calculated V.G. Assay in 0.25 mm NMHMC (ppb)	Remarks
		Thickness	Width	Length	Reshaped	Modified	Pristine	Total			
MC-34	No	2 C	10	10	1		2	3			
		4 C	15	25			1	1			
		5 C	25	25		1		1			
		13 C	50	75			1	1			
		18 C	50	125	1			1			
		15 C	75	75		1		1			
		18 C	75	100			1	1			
								9	23.1	133	
MC-34a	No	10 C	50	50		1		1			
		13 C	50	75		1		1			
								2	20.7	27	
MC-34b	Yes	2 C	10	10			191	191			No sulphides.
		4 C	15	25		1	206	207			
		5 C	25	25	3	2	146	151			
		8 C	25	50	1	2	72	75			
		15 C	25	125			1	1			
		10 C	50	50			9	9			
		13 C	50	75			6	6			
		18 C	75	100			1	1			
								641	7.5	2439	
MC-35	Yes	2 C	10	10		2	9	11			No sulphides.
		3 C	15	15		2	4	6			
		4 C	15	25		2	7	9			
		5 C	25	25	1	2	5	8			
		8 C	25	50		2	12	14			
		13 C	25	100		1		1			
		10 C	50	50		2	5	7			
		13 C	50	75			5	5			
		15 C	50	100	1		1	2			
		20 C	75	125	1	1		2			
		22 C	75	150			1	1			
		20 C	100	100	1			1			
								67	15.9	817	
MC-35a	No	NO VISIBLE GOLD									
MC-35b	No	4 C	15	25	1			1			
		5 C	25	25	2			2			
								3	6.5	9	
MC-36	No	5 C	25	25	1			1			
								1	11.5	2	

*Prescreened to -16 mm in the field.

OVERBURDEN DRILLING MANAGEMENT LIMITED
LABORATORY SAMPLE LOG

Project: Lake Vermilion
Filename: Minnesota - Dahl - MC - July 2004
Total Number of Samples in this Report = 32

Batch Number: 2060

Sample Number *	Weight (kg)				Clasts >2.0 mm					Matrix <2.0 mm							Class
						Percentage				Distribution					Colour		
	Bulk Rec'd	Table Split	+2 mm Clasts	Table Feed	Size	V/S	GR	LS	OT	S/U	SD	ST	CY	Org	Sand	Clay	
MC-1	11.6	11.1	1.6	9.5	P	Tr	100	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-2	11.6	11.1	5.4	5.7	P	100	Tr	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-2a	13.5	13.0	5.0	8.0	P	90	10	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-3	14.2	13.7	6.1	7.6	P	90	10	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-4	15.5	15.0	3.5	11.5	P	15	85	0	0	U	Y	Y	Y	N	BE	BE	TILL
MC-4y	10.8	10.3	5.1	5.2	P	95	5	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-4x	9.7	9.2	5.4	3.8	P	100	Tr	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-5	13.8	13.3	3.3	10.0	P	80	20	0	0	U	Y	Y	Y	N	BE	BE	TILL
MC-6a	14.3	13.8	6.3	7.5	P	20	80	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-7	13.9	13.4	4.1	9.3	P	70	30	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-8	12.7	12.2	5.9	6.3	P	20	80	0	0	U	Y	Y	Y	N	BE	BE	TILL
MC-9	11.9	11.4	3.6	7.8	P	20	80	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-10	11.7	11.2	2.5	8.7	P	90	10	0	0	U	Y	Y	Y	N	GY	GY	TILL
MC-10a	16.3	15.8	4.9	10.9	P	80	20	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-13	14.6	14.1	5.4	8.7	P	20	80	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-14	15.0	14.5	2.5	12.0	P	20	80	0	0	U	Y	Y	Y	N	BE	BE	TILL
MC-24	12.9	12.4	4.0	8.4	P	60	40	0	0	U	+	Y	-	N	LOC	LOC	TILL
MC-25	12.0	11.5	3.6	7.9	P	60	40	0	0	U	Y	Y	Y	N	LOC	LOC	TILL
MC-25a	13.4	12.4	2.9	9.5	P	10	90	0	0	U	-	+	Y	N	MOC	MOC	TILL
MC-25b	12.7	11.7	2.8	8.9	P	20	80	0	0	U	+	Y	-	N	BE	BE	TILL
MC-26a	13.2	12.2	5.5	6.7	P	90	10	0	0	U	+	Y	-	N	MOC	MOC	TILL
MC-31	11.5	10.5	6.5	4.0	P	100	Tr	0	0	U	Y	Y	Y	N	DOC	DOC	TILL
MC-33	12.5	11.5	6.1	5.4	P	90	10	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-33a	12.9	11.9	4.1	7.8	P	5	95	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-33b	12.5	11.5	3.9	7.6	P	20	80	0	0	U	Y	Y	Y	N	LOC	LOC	TILL
MC-34	13.4	12.4	3.6	8.8	P	40	60	0	0	U	+	Y	-	N	LOC	LOC	TILL
MC-34a	13.1	12.1	3.7	8.4	P	20	80	0	0	U	Y	Y	Y	N	LOC	LOC	TILL
MC-34b	12.2	11.2	6.2	5.0	P	100	Tr	0	0	U	Y	Y	Y	N	DOC	DOC	TILL
MC-35	11.6	10.6	3.0	7.6	P	95	5	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-35a	14.5	13.5	4.7	8.8	P	0	100	0	0	U	Y	Y	Y	N	DOC	DOC	TILL
MC-35b	12.6	11.6	4.6	7.0	P	95	5	0	0	U	Y	Y	Y	N	MOC	MOC	TILL
MC-36	12.2	11.2	2.8	8.4	P	20	80	0	0	U	Y	Y	Y	N	DOC	DOC	TILL

* MC-1 to MC-25: One 0.5 kg subsample taken (omitted to take second subsample). MC-25a to MC-36: Two 0.5 kg subsamples taken.

*Prescreened to -16 mm in the field.

OVERBURDEN DRILLING MANAGEMENT LIMITED
LABORATORY SAMPLE LOG

Project: Lake Vermilion
Filename: Minnesota - Dahl - MC - July 2004
Total Number of Samples in this Report = 32

	<2.0 mm Table Concentrate (g)						
		Heavy Liquid Separation S.G 3.20					
					Nonferromagnetic HMC		
Sample Number	Total	Heavy Liquid Lights	Total HMC	Mag HMC	Total	-0.25 mm	+0.25 mm
MC-1	671.7	660.5	11.2	1.4	9.8	5.3	4.5
MC-2	330.0	322.6	7.4	2.9	4.5	3.3	1.2
MC-2a	974.8	931.8	43.0	16.9	26.1	14.7	11.4
MC-3	662.0	655.1	6.9	1.5	5.4	4.3	1.1
MC-4	837.6	816.4	21.2	6.0	15.2	10.1	5.1
MC-4y	368.8	363.9	4.9	1.9	3.0	2.3	0.7
MC-4x	318.0	289.3	28.7	7.0	21.7	6.5	15.2
MC-5	834.5	800.1	34.4	12.8	21.6	14.5	7.1
MC-6a	416.6	391.9	24.7	12.0	12.7	1.8	10.9
MC-7	545.0	499.2	45.8	17.0	28.8	13.4	15.4
MC-8	559.1	548.8	10.3	2.5	7.8	5.8	2.0
MC-9	436.3	315.1	121.2	16.7	104.5	39.3	65.2
MC-10	421.4	408.2	13.2	5.3	7.9	5.1	2.8
MC-10a	571.2	507.1	64.1	40.2	23.9	11.8	12.1
MC-13	708.2	665.5	42.7	6.8	35.9	22.5	13.4
MC-14	709.2	683.6	25.6	0.8	24.8	17.8	7.0
MC-24	671.0	655.9	15.1	3.3	11.8	8.4	3.4
MC-25	609.2	580.3	28.9	5.8	23.1	15.7	7.4
MC-25a	403.4	384.4	19.0	5.3	13.7	10.7	3.0
MC-25b	621.2	598.9	22.3	5.2	17.1	13.1	4.0
MC-26a	623.4	572.6	50.8	6.3	44.5	25.0	19.5
MC-31	281.4	240.2	41.2	1.6	39.6	16.2	23.4
MC-33	244.1	237.7	6.4	2.1	4.3	3.7	0.6
MC-33a	315.7	305.2	10.5	3.7	6.8	2.0	4.8
MC-33b	446.3	432.1	14.2	5.1	9.1	5.9	3.2
MC-34	690.1	641.7	48.4	12.6	35.8	23.1	12.7
MC-34a	479.7	441.3	38.4	11.2	27.2	20.7	6.5
MC-34b	341.0	325.5	15.5	4.1	11.4	7.5	3.9
MC-35	582.3	483.1	99.2	73.5	25.7	15.9	9.8
MC-35a	811.2	146.2	665.0	0.1	664.9	497.4	167.5
MC-35b	259.1	249.5	9.6	1.5	8.1	6.5	1.6
MC-36	340.1	319.9	20.2	6.2	14.0	11.5	2.5

*Prescreened to -16 mm in the field.

OVERBURDEN DRILLING MANAGEMENT LIMITED

Project: Lake Vermilion
Filename: Minnesota - Dahl - MC - July 2004
Total Number of Samples in this Report = 32

Sample	Clay + Silt Separation (g)		
Number	Subsample	+63 µm	-63 µm
MC-1	425.1	337.8	87.3
MC-2	421.8	390.1	31.7
MC-2a	492.9	419.9	73.0
MC-3	756.5	694.0	62.5
MC-4	437.9	366.4	71.5
MC-4y	436.8	363.7	73.1
MC-4x	428.1	353.7	74.4
MC-5	485.3	431.2	54.1
MC-6a	516.4	456.5	59.9
MC-7	515.0	432.4	82.6
MC-8	423.3	364.0	59.3
MC-9	392.3	340.9	51.4
MC-10	399.8	361.7	38.1
MC-10a	402.0	265.4	136.6
MC-13	414.0	383.0	31.0
MC-14	351.0	234.3	116.7
MC-24	432.9	391.7	41.2
MC-25	455.8	406.8	49.0
MC-25a	396.6	327.6	69.0
MC-25b	391.9	300.0	91.9
MC-26a	464.9	410.9	54.0
MC-31	415.2	378.0	37.2
MC-33	420.1	372.2	47.9
MC-33a	436.0	392.9	43.1
MC-33b	460.4	406.1	54.3
MC-34	520.0	463.8	56.2
MC-34a	456.3	393.0	63.3
MC-34b	409.9	375.7	34.2
MC-35	433.5	395.1	38.4
MC-35a	444.4	408.9	35.5
MC-35b	454.0	414.5	39.5
MC-36	443.1	385.8	57.3

*Prescreened to -16 mm in the field.

Minnesota Department of Natural Resources

Appendix B. Bedrock grab and float sample analytical results, Project 365, Vermilion Area

Sample	Mo rock ICP ppm	Cu rock ICP ppm	Pb rock ICP ppm	Zn rock ICP ppm	Ag rock ICP ppb	Ni rock ICP ppm	Co rock ICP ppm	Mn rock ICP ppm	Fe rock ICP Wt%	As rock ICP ppm	U rock ICP ppm	Au rock ICP ppm	Th rock ICP ppm	Sr rock ICP ppm	Cd rock ICP ppm	Sb rock ICP ppm	Bi rock ICP ppm	V rock ICP ppm	Ca rock ICP Wt%	P rock ICP Wt%	La rock ICP ppm	Cr rock ICP ppm	Mg rock ICP Wt%	Ba rock ICP ppm	Ti rock ICP Wt%	Al rock ICP Wt%	Na rock ICP Wt%	K rock ICP Wt%	W rock ICP ppm	Zr rock ICP ppm	Sn rock ICP ppm	Be rock ICP ppm
MC-25-F1	5.25	1060.04	7.89	45.8	3616	186.4	360.8	2459	25.97	25.1	0.2	-0.1	0.8	38	0.06	1.19	2.00	57	5.91	0.021	2	34	2.76	22	0.101	1.65	0.076	0.10	5.3	22.9	0.3	-1
MC-24-BC-1	0.14	17.45	6.24	126.2	86	55.5	46.1	1888	8.84	4.0	0.4	-0.1	1.1	585	0.21	-0.02	0.07	289	6.81	0.110	16	196	5.28	552	0.704	7.53	1.975	1.42	0.1	54.7	1.2	1
MC-24-F1	0.74	20.54	13.37	13.9	340	6.7	3.1	477	0.88	3.9	-0.1	-0.1	0.1	10	0.08	0.33	-0.04	13	0.35	0.005	1	12	0.18	13	0.021	0.38	0.060	0.06	1.8	3.1	0.4	-1
MC-24-F2	0.66	9884.41	1.53	50.8	3943	13.5	7.0	122	2.80	23.3	0.1	-0.1	0.1	4	0.27	0.47	-0.04	50	0.06	0.005	-1	21	0.50	21	0.103	1.19	0.182	0.15	2.8	6.4	0.4	-1
MC-31-F1	0.31	17.92	0.98	14.9	191	2.0	3.2	4511	3.94	4.3	0.1	-0.1	0.1	10	0.07	0.14	-0.04	6	0.09	0.006	1	4	0.12	105	0.009	0.20	0.043	0.02	-0.1	3.3	0.3	-1
MC-RR-1	1.45	2409.32	13.15	10000.0	18805	3.5	11.1	8468	8.97	179.0	-0.1	3.6	-0.1	90	151.43	595.29	0.38	10	13.30	0.005	2	7	6.87	5	0.001	0.12	0.021	0.02	0.1	0.7	0.3	-1
MC-RR-2	0.38	582.65	5.14	1945.8	3881	1.3	1.4	9980	5.83	64.7	-0.1	0.3	-0.1	93	11.72	224.64	0.06	11	16.96	0.002	1	11	8.56	8	0.001	0.09	0.023	0.02	0.5	0.5	0.1	-1
MC-RR-3	0.93	1480.20	24.27	2418.7	17412	44.9	110.7	4618	22.87	418.6	0.1	5.0	0.5	42	10.33	35.92	1.24	220	4.80	0.081	7	38	3.24	37	0.076	4.62	0.402	1.01	1.0	48.4	1.6	1
MC-RR-4	5.16	1365.60	212.70	2777.0	42500	20.2	25.0	4733	24.60	640.4	-0.1	12.5	-0.1	35	16.01	163.79	1.25	15	5.85	0.013	5	6	2.19	8	0.006	0.38	0.059	0.04	1.0	3.5	0.6	-1
MC-RR-5	11.43	296.14	54.24	1832.0	19497	8.9	13.7	10022	13.04	213.6	-0.1	5.6	-0.1	78	5.28	44.40	0.40	25	11.69	0.016	3	5	6.29	14	0.007	0.41	0.047	0.10	0.2	4.0	0.4	-1
MC-RB-1	3.48	115.08	4.70	2053.5	206	22.2	14.5	1542	17.13	10.3	-0.1	-0.1	0.2	17	7.16	1.88	0.05	53	0.05	0.046	2	19	0.25	19	0.010	1.51	0.262	0.09	0.1	13.4	0.2	-1
MC-RB-2	0.64	18.72	2.82	13.0	91	5.4	3.7	165	0.77	14.0	-0.1	-0.1	0.1	18	0.04	0.46	-0.04	7	0.05	0.006	-1	4	0.03	110	0.008	1.14	0.143	0.43	2.0	4.9	0.2	-1

Note: Column headings identify element or oxide, sample type, and analysis method

First 2-5 characters identify the element or oxide analyzed

rock = Rock (Sample type)

ICP = ICP-MS elemental analysis, 0.25 gram subsample, 4-acid digestion

ICP-ES = Whole rock oxide and elemental analysis, 2.00 gram subsample, LiBO2 Fusion/ICP-ES analysis

FA-ICP = Fire Assay/Ultra-ICP analysis for Au, Pt, Pd, 30 gram subsample

All analyses performed by Acme Analytical Labs, Vancouver, British Columbia, Canada, Job #A403105

Minnesota Department of Natural Resources

Appendix B. Bedrock grab and float sample analytical results, Project 365, Vermilion Area

Sample	Sc rock ICP ppm	S rock ICP Wt%	Y rock ICP ppm	Ce rock ICP ppm	Pr rock ICP ppm	Nd rock ICP ppm	Sm rock ICP ppm	Eu rock ICP ppm	Gd rock ICP ppm	Tb rock ICP ppm	Dy rock ICP ppm	Ho rock ICP ppm	Er rock ICP ppm	Tm rock ICP ppm	Yb rock ICP ppm	Lu rock ICP ppm	Hf rock ICP ppm	Li rock ICP ppm	Rb rock ICP ppm	Ta rock ICP ppm	Nb rock ICP ppm	Cs rock ICP ppm	Ga rock ICP ppm	Au rock FA-ICP ppb	Pt rock FA-ICP ppb	Pd rock FA-ICP ppb
MC-25-F1	5.9	7.99	3.6	3.29	0.3	1.3	0.4	0.2	0.4	0.1	0.5	0.1	0.4	0.1	0.5	0.1	0.82	0.9	2.0	0.2	1.57	0.1	6.68	56	2	2
MC-24-BC-1	36.0	-0.04	26.6	50.51	7.1	37.4	8.2	2.3	6.4	1.0	5.0	0.9	3.1	0.4	2.9	0.3	2.30	32.9	53.9	0.3	4.32	1.3	21.51	2	3	29
MC-24-F1	1.8	-0.04	1.9	1.61	0.2	1.2	0.4	0.5	0.4	0.1	0.3	0.1	0.2	-0.1	0.2	-0.1	0.09	2.5	2.6	-0.1	0.23	0.2	1.19	-2	-2	-2
MC-24-F2	3.4	0.74	1.2	1.16	0.1	0.8	0.3	0.1	0.2	0.1	0.3	0.1	0.2	-0.1	0.2	-0.1	0.22	6.3	5.6	-0.1	0.37	0.3	2.86	8	-2	3
MC-31-F1	6.6	-0.04	3.1	3.00	0.3	1.7	0.7	0.3	0.8	0.2	0.8	0.1	0.5	-0.1	0.5	0.1	0.11	1.4	1.1	-0.1	0.28	0.1	0.85	4	-2	-2
MC-RR-1	5.0	5.36	9.5	3.87	0.5	3.2	1.5	1.6	1.9	0.3	1.5	0.3	0.9	0.1	0.7	0.1	0.02	0.6	0.7	-0.1	0.12	0.1	0.91	3830	-2	-2
MC-RR-2	9.1	0.64	10.5	2.75	0.4	2.4	1.5	1.3	1.6	0.3	1.8	0.3	0.9	0.1	0.7	0.1	-0.02	1.3	0.6	-0.1	0.10	0.1	0.85	424	-2	-2
MC-RR-3	23.6	20.14	9.7	14.70	2.0	10.5	2.9	1.7	2.0	0.4	1.6	0.3	1.1	0.2	1.2	0.2	1.66	25.1	24.3	-0.1	0.48	1.5	17.93	4268	-2	3
MC-RR-4	6.3	24.02	8.0	9.48	1.3	7.0	2.2	1.2	2.0	0.3	1.4	0.2	0.7	0.1	0.6	0.1	0.12	1.3	1.1	-0.1	0.17	0.1	2.43	12247	3	3
MC-RR-5	5.0	9.34	7.5	5.36	0.7	4.1	1.6	1.3	1.4	0.3	1.4	0.2	0.7	0.1	0.5	0.1	0.14	2.0	2.7	-0.1	0.19	0.2	2.22	6239	2	2
MC-RB-1	6.9	0.45	3.1	4.80	0.6	2.9	0.9	0.4	0.7	0.1	0.6	0.1	0.4	-0.1	0.4	0.1	0.35	7.6	3.0	-0.1	0.15	0.1	5.19	2	-2	-2
MC-RB-2	0.6	0.04	0.4	1.04	0.1	0.4	0.1	-0.1	0.1	-0.1	0.1	-0.1	0.1	-0.1	-0.1	-0.1	0.15	1.8	14.0	-0.1	0.25	0.6	2.89	-2	-2	-2

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Appendix B. Bedrock grab and float sample analytical results, Project 365, Vermilion Area

Sample	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ba	Ni	Sr	Zr	Y	Nb	Sc	LOI	TOT_C	TOT_S	SUM
	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock	rock
	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	LOI	LECO	LECO	
	Wt%	Wt%	Wt%	Wt%	Wt%	Wt%	Wt%	Wt%	Wt%	Wt%	Wt%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	Wt%	Wt%	Wt%	Wt%
MC-25-F1	37.17	3.63	38.87	3.79	7.74	0.10	0.10	0.14	0.08	0.24	0.002	19	120	38	42	-10	11	6	8.0	0.04	8.82	99.88
MC-24-BC-1	46.63	15.34	12.20	8.49	9.55	2.75	1.63	0.99	0.27	0.20	0.017	498	52	665	96	25	42	43	1.6	0.04	0.07	99.83
MC-24-F1	96.81	0.71	1.11	0.22	0.40	0.03	0.05	0.04	-0.01	0.05	0.001	11	-20	10	-10	-10	-10	2	0.5	0.09	0.02	99.92
MC-24-F2	89.93	2.35	3.85	0.86	0.10	0.25	0.15	0.19	-0.01	0.01	-0.001	19	-20	-10	-10	-10	-10	5	1.4	0.03	0.87	99.10
MC-31-F1	92.21	0.40	5.39	0.19	0.15	0.05	0.02	0.01	-0.01	0.52	-0.001	103	-20	11	-10	-10	-10	7	1.1	0.07	0.03	100.06
MC-RR-1	18.65	0.25	11.35	10.74	20.09	-0.01	0.02	-0.01	0.03	0.88	-0.001	9	-20	99	-10	10	-10	7	23.8	8.95	5.82	85.84
MC-RR-2	14.63	0.16	6.59	12.45	23.10	0.02	0.02	-0.01	0.02	0.92	-0.001	-5	-20	81	-10	-10	-10	9	32.1	10.77	0.59	90.03
MC-RR-3	12.33	9.58	30.53	4.64	6.46	0.50	1.07	1.13	0.20	0.45	-0.001	142	-20	40	88	30	27	30	21.5	2.41	21.18	88.43
MC-RR-4	14.13	0.94	28.89	3.11	9.03	0.08	0.04	0.05	0.06	0.46	0.001	6	-20	32	16	22	-10	6	22.8	2.55	25.37	79.60
MC-RR-5	18.45	0.90	16.73	9.46	17.58	0.02	0.08	0.05	0.06	1.01	-0.001	11	-20	71	-10	11	-10	5	15.9	7.87	10.37	80.25
MC-RB-1	65.45	3.23	24.11	0.42	0.08	0.34	0.11	0.21	0.12	0.17	0.002	19	-20	17	12	-10	-10	9	5.6	0.66	0.52	99.85
MC-RB-2	95.83	2.12	1.06	0.04	0.06	0.13	0.39	0.02	-0.01	0.02	-0.001	98	-20	18	-10	-10	-10	-1	0.6	0.04	0.04	100.29

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Appendix C. Till Geochemistry Results for Vermilion Till Samples.

Sample numbers = MC-1, MC-2, MC-2a, etc.
Sample MC-35a, an outlier, is listed at bottom of sample list and not included in descriptive statistics

Detect. Limits = Detection Limits as listed by chemistry lab or on lab report.
< substit. Val. = value substituted for values reported as "less than"

ICP = Inductively Coupled Plasma - Mass Spectrometry (of -63um silt/clay fraction), Acme Labs
ICP-ES = Inductively Coupled Plasma - Emission Spectroscopy ("whole rock" analysis of -63um silt/clay), Acme Labs
INAA = Instrumental Neutron Activation Analysis (-63um silt/clay or nonmagnetic Heavy Mineral Concentrate), Acme Labs - Becquerel Labs

ppm = parts per milion
ppb = parts per billion (1,000 ppb = 1 ppm)
% or Wt% = weight percent (10,000ppm = 1 wt%)

Maximum = maximum value for 31 till samples (MC-35a excluded)
Minimum = minimum value for 31 till samples (MC-35a excluded)
Max/Min Var. = Maximum value divided by minimum value, rounded to an integer
95 / 5 Var. = 95th percentile value divided by 5th percentile value, rounded to an integer

% difference = for duplicate pairs
% difference = 100 * (ABS(sample2 - sample1)) / ((sample1 + sample2) / 2) rounded to integer
ODM REF = values for ODM silt/clay reference material

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P	La	Cr	Mg	Ba
	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	ppm	ppm	%	ppm
	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
MC-1	2.67	42.98	21.81	100.1	80	36.6	10.7	251	3.10	5.7	2.4	0.1	10.8	113	0.11	0.39	0.23	110	0.57	0.097	26	84	0.60	464
MC-2	0.51	58.85	15.44	60.3	107	29.6	15.3	1339	5.35	35.4	1.2	0.1	11.7	204	0.08	1.26	0.12	163	0.58	0.061	31	70	0.55	525
MC-2a	1.91	80.49	14.24	166.5	167	34.4	18.5	616	6.92	11.7	1.5	0.1	7.3	126	0.19	0.64	0.35	111	0.82	0.091	18	83	0.80	435
MC-3	0.49	213.25	13.50	178.2	76	96.8	39.7	1100	4.02	12.6	1.0	0.1	8.8	156	0.12	0.29	0.10	125	1.18	0.025	21	239	1.87	465
MC-4	0.38	12.63	22.30	50.2	60	21.3	9.0	371	2.01	2.9	1.7	0.1	11.6	219	0.10	0.11	0.15	57	1.00	0.045	27	43	0.60	646
MC-4y	1.39	58.47	12.64	156.9	161	30.8	21.4	1375	6.10	5.1	1.8	0.1	7.7	118	0.17	0.37	0.18	165	0.52	0.071	29	66	0.83	467
MC-4x	1.50	20.72	15.95	91.9	220	31.9	12.2	894	4.93	10.3	1.8	0.1	8.2	132	0.11	0.39	0.38	104	0.56	0.064	24	68	0.54	539
MC-5	0.58	36.30	21.66	44.5	84	24.4	11.0	389	2.53	7.0	1.8	0.1	15.4	255	0.09	0.17	0.23	62	1.00	0.065	31	40	0.53	658
MC-6a	0.96	54.59	18.75	75.0	104	41.3	18.6	493	3.83	13.6	1.5	0.1	11.4	209	0.08	0.27	0.15	102	0.90	0.044	26	114	1.04	522
MC-7	1.03	103.43	21.77	68.6	123	42.8	17.6	498	2.75	18.5	1.5	0.1	12.6	283	0.10	0.64	0.62	66	1.11	0.080	31	53	0.67	638
MC-8	1.03	78.59	16.87	108.5	117	71.0	31.1	657	4.38	29.4	1.1	0.1	6.5	233	0.10	0.59	0.34	140	1.06	0.068	20	111	1.12	536
MC-9	1.12	57.70	13.54	87.5	217	45.1	18.4	1762	6.61	12.5	1.6	0.1	7.9	166	0.13	0.42	0.18	105	0.97	0.047	26	94	0.94	458
MC-10	1.72	38.45	13.24	129.2	78	54.8	15.9	573	5.25	19.2	1.9	0.1	7.6	144	0.06	0.52	0.25	167	0.65	0.065	29	169	1.89	651
MC-10a	0.68	30.42	14.59	119.7	159	35.8	15.4	536	2.99	6.9	1.6	0.1	6.9	207	0.14	0.28	0.13	84	1.04	0.033	24	78	0.84	577
MC-13	0.84	54.07	18.11	98.4	184	77.7	28.4	638	4.50	56.1	1.9	0.1	11.4	257	0.14	0.80	0.21	117	1.19	0.113	36	167	1.31	634
MC-14	1.17	23.09	17.31	76.8	127	28.9	10.7	496	2.16	5.4	1.7	0.1	8.9	211	0.10	0.22	0.15	79	1.03	0.024	26	64	0.68	613
MC-24	0.94	114.70	10.71	125.7	217	58.7	36.1	978	7.53	21.0	1.0	0.1	6.9	125	0.13	0.41	0.19	258	0.63	0.042	16	99	2.19	375
MC-25	1.68	109.70	29.32	76.9	172	48.0	21.6	498	3.73	11.6	1.6	0.1	10.3	261	0.13	0.33	0.25	102	1.33	0.057	23	88	1.04	588
MC-25a	0.76	19.72	16.45	138.5	276	33.4	13.5	491	3.21	5.4	1.7	0.1	8.2	212	0.18	0.31	0.16	92	0.97	0.055	25	71	0.80	611
MC-25b	0.76	37.05	16.92	63.0	58	43.9	15.8	494	3.36	8.9	2.0	0.1	9.3	306	0.08	0.21	0.16	104	1.43	0.063	35	94	1.05	635
MC-26a	9.84	164.47	14.04	43.3	80	47.3	23.9	492	4.49	12.3	1.3	0.1	8.5	251	0.11	0.31	0.23	105	1.63	0.073	19	97	1.03	473
MC-31	5.13	146.08	9.60	124.9	310	28.0	20.6	9132	15.58	11.3	1.6	0.1	4.8	68	0.27	0.61	0.16	161	0.34	0.129	20	62	0.87	408
MC-33	2.36	131.03	17.44	83.5	167	38.7	13.5	285	3.34	9.6	1.4	0.1	7.5	190	0.10	0.38	0.39	72	0.73	0.081	30	55	0.80	583
MC-33a	2.86	49.45	22.37	92.0	304	29.5	12.1	300	3.53	11.3	1.7	0.1	8.6	227	0.16	0.42	0.41	82	0.90	0.171	24	63	0.73	608
MC-33b	2.12	74.03	19.92	66.1	126	44.0	19.8	551	3.56	11.3	1.6	0.1	13.0	256	0.10	0.44	0.25	94	1.02	0.049	26	83	1.02	606
MC-34	1.03	90.70	20.33	125.6	116	65.4	31.4	549	4.43	43.5	1.4	0.1	8.7	175	0.12	0.62	0.24	116	0.99	0.057	22	95	1.07	484
MC-34a	0.84	49.63	19.09	97.6	261	48.5	23.8	503	4.06	18.5	1.5	0.1	11.2	223	0.12	0.39	0.21	117	1.04	0.057	27	77	1.01	550
MC-34b	6.52	123.90	14.09	99.8	442	64.4	22.6	458	7.13	42.5	1.8	0.7	6.3	143	0.13	1.18	0.28	146	0.52	0.065	30	116	0.64	615
MC-35	1.34	43.55	11.80	98.4	152	59.0	17.2	630	4.51	23.9	1.7	0.1	7.0	165	0.15	0.46	0.15	95	0.80	0.036	19	77	0.80	538
MC-35b	1.59	113.81	12.82	147.7	193	47.2	25.9	613	5.24	17.8	1.3	0.1	6.2	164	0.20	0.47	0.42	168	1.13	0.069	19	95	1.14	417
MC-36	1.33	50.56	21.45	49.5	58	42.3	20.7	418	3.38	15.5	1.4	0.1	11.4	257	0.10	0.29	0.34	88	1.15	0.051	24	85	0.76	601
MC-35a	141.40	9696.69	18.14	242.5	2949	207.7	370.8	3190	22.24	63.6	1.5	0.1	4.2	77	3.89	0.76	56.10	129	3.78	0.140	29	46	1.31	51

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca	P	La	Cr	Mg	Ba
	ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	ppm	ppm	%	ppm
	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
Detect. Limits	0.05	0.02	0.02	0.2	20	0.1	0.2	2	0.02	0.2	0.1	1.0	0.1	1	0.02	0.02	0.04	1	0.02	0.001	0	1	0.02	1
< substit. Val.												0.1												
Maximum n=31	9.84	213.25	29.32	178.2	442	96.8	39.7	9132	15.58	56.1	2.4	0.7	15.4	306	0.27	1.26	0.62	258	1.63	0.171	36	239	2.19	658
95%ile n=31	5.83	155.28	22.34	161.7	307	74.4	33.8	1569	7.33	43.0	2.0	0.1	12.8	272	0.20	0.99	0.42	168	1.38	0.121	33	168	1.88	649
85%ile n=31	2.52	119.30	21.72	133.9	241	61.7	27.2	1039	6.36	26.7	1.8	0.1	11.5	257	0.17	0.63	0.37	162	1.17	0.086	31	113	1.13	635
75%ile n=31	1.82	106.57	20.13	125.3	205	51.7	23.2	648	5.25	18.9	1.8	0.1	11.3	242	0.14	0.56	0.31	133	1.09	0.072	29	96	1.05	612
50%ile n=31	1.17	57.70	16.87	97.6	152	42.8	18.5	536	4.06	12.3	1.6	0.1	8.6	207	0.12	0.39	0.23	105	0.99	0.063	26	83	0.84	550
25%ile n=31	0.84	40.72	13.79	71.8	94	32.7	14.4	492	3.35	9.3	1.4	0.1	7.4	150	0.10	0.30	0.16	90	0.69	0.048	22	67	0.71	470
15%ile n=31	0.72	33.36	13.03	61.7	79	29.6	12.2	404	3.05	6.3	1.3	0.1	6.9	129	0.10	0.28	0.15	81	0.58	0.043	20	63	0.62	461
5%ile n=31	0.50	20.22	11.26	47.0	59	26.2	10.7	293	2.35	5.3	1.1	0.1	6.3	116	0.08	0.19	0.13	64	0.52	0.029	19	48	0.55	413
Minimum n=31	0.38	12.63	9.60	43.3	58	21.3	9.0	251	2.01	2.9	1.0	0.1	4.8	68	0.06	0.11	0.10	57	0.34	0.024	16	40	0.53	375
Max/Min Var.	26	17	3	4	8	5	4	36	8	19	2	12	3	5	5	11	6	5	5	7	2	6	4	2
95/5 Var.	12	8	2	3	5	3	3	5	3	8	2	1	2	2	2	5	3	3	3	4	2	4	3	2
85/15 Var.	3	4	2	2	3	2	2	3	2	4	1	1	2	2	2	2	2	2	2	2	2	2	2	1
75/25 Var.	2	3	1	2	2	2	2	1	2	2	1	1	2	2	1	2	2	1	2	2	1	1	1	1
dst5 (wr=so17)	12.59	141.72	29.95	162.2	354	29.5	14.4	1060	4.12	22.0	7.1	<.1	6.5	342	5.21	6.61	5.74	120	2.24	0.114	25	225	1.17	687
dst5 (wr=so17)	12.20	143.12	28.31	168.4	335	29.2	14.1	1063	4.15	21.7	6.8	<.1	6.2	331	5.11	6.50	5.49	121	2.20	0.107	24	234	1.25	666
% difference	**3**	**1**	**6**	**4**	**6**	**1**	**2**	**0**	**1**	**1**	**4**		**5**	**3**	**2**	**2**	**4**	**1**	**2**	**6**	**4**	**4**	**7**	**3**
MC-24	0.94	114.70	10.71	125.7	217	58.7	36.1	978	7.53	21.0	1.0	<.1	6.9	125	0.13	0.41	0.19	258	0.63	0.042	16	99	2.19	375
MC-24-RE	0.93	115.02	10.50	130.4	201	60.4	38.9	952	7.38	20.5	1.1	<.1	7.2	126	0.11	0.45	0.20	279	0.68	0.041	16	104	2.17	367
% difference	**1**	**0**	**2**	**4**	**8**	**3**	**7**	**3**	**2**	**2**	**10**		**4**	**1**	**17**	**9**	**5**	**8**	**8**	**2**	**0**	**5**	**1**	**2**
MC-1c	1.07	56.83	14.25	86.6	228	42.1	18.1	1736	6.54	13.0	1.6	<.1	7.8	167	0.17	0.43	0.18	115	1.01	0.050	27	96	0.95	479
MC-9	1.12	57.70	13.54	87.5	217	45.1	18.4	1762	6.61	12.5	1.6	<.1	7.9	166	0.13	0.42	0.18	105	0.97	0.047	26	94	0.94	458
% difference	**5**	**2**	**5**	**1**	**5**	**7**	**2**	**1**	**1**	**4**	**0**		**1**	**1**	**27**	**2**	**0**	**9**	**4**	**6**	**4**	**2**	**1**	**4**
MC-26c	11.94	189.48	17.93	50.2	83	56.4	27.7	496	5.17	15.0	1.6	<.1	9.7	293	0.16	0.37	0.29	123	1.73	0.081	23	103	1.05	567
MC-26a	9.84	164.47	14.04	43.3	80	47.3	23.9	492	4.49	12.3	1.3	<.1	8.5	251	0.11	0.31	0.23	105	1.63	0.073	19	97	1.03	473
% difference	**19**	**14**	**24**	**15**	**4**	**18**	**15**	**1**	**14**	**20**	**21**		**13**	**15**	**37**	**18**	**23**	**16**	**6**	**10**	**19**	**6**	**2**	**18**
MC-4c	4.90	112.52	25.28	212.1	207	83.4	29.2	790	4.22	7.7	6.2	<.1	10.0	251	0.23	0.50	0.67	182	1.80	0.073	37	64	1.17	644
MC-35c	4.51	105.42	22.98	211.7	180	80.0	28.8	759	4.44	7.6	6.0	<.1	10.0	230	0.20	0.67	0.66	157	1.74	0.065	37	71	1.17	602
% difference	**8**	**7**	**10**	**0**	**14**	**4**	**1**	**4**	**5**	**1**	**3**		**0**	**9**	**14**	**29**	**2**	**15**	**3**	**12**	**0**	**10**	**0**	**7**
ODM-REF		84	21	180	200	70				6														

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Ti	Al	Na	K	W	Zr	Sn	Be	Sc	S	Y	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
MC-1	0.415	7.20	0.925	1.33	1.0	95.8	1.5	1	7.5	0.02	8.5	52.42	5.3	19.2	3.9	0.6	2.5	0.4	2.1	0.3	1.0	0.2	1.0	0.2
MC-2	0.233	8.16	1.979	2.41	0.5	120.7	1.7	2	23.0	0.02	16.4	59.41	7.4	30.8	6.8	1.4	5.2	0.7	3.0	0.5	1.9	0.2	1.8	0.3
MC-2a	0.354	5.63	0.997	1.25	1.0	74.6	1.4	1	8.1	0.02	9.1	42.46	3.7	14.3	2.8	0.6	2.2	0.4	1.8	0.3	1.2	0.1	1.0	0.1
MC-3	0.311	6.78	1.550	1.94	0.4	75.1	1.0	1	17.7	0.02	8.2	60.80	4.2	15.7	2.8	0.5	2.0	0.4	1.7	0.3	1.0	0.1	1.0	0.1
MC-4	0.247	7.54	2.285	2.90	0.6	123.5	1.3	1	6.2	0.02	8.3	68.06	5.9	21.6	4.2	0.6	2.5	0.4	1.7	0.3	1.0	0.1	1.0	0.1
MC-4y	0.371	7.11	1.283	1.20	0.9	84.3	1.7	1	17.3	0.02	14.5	59.98	6.6	26.7	5.8	1.2	4.5	0.8	3.1	0.5	1.7	0.2	1.8	0.2
MC-4x	0.355	6.22	0.999	1.48	2.7	86.7	2.3	1	6.8	0.02	9.7	60.84	4.9	18.4	3.7	0.8	2.4	0.4	1.8	0.3	1.1	0.1	1.2	0.2
MC-5	0.214	7.05	2.134	2.98	0.4	133.0	1.3	2	7.2	0.02	9.6	75.78	6.5	23.3	4.7	0.7	3.0	0.5	2.0	0.3	1.0	0.1	1.1	0.1
MC-6a	0.289	7.09	1.862	2.23	0.5	108.5	1.2	1	12.9	0.02	9.6	72.29	5.6	19.8	3.9	0.7	2.7	0.4	1.9	0.3	1.1	0.1	1.0	0.1
MC-7	0.240	7.03	2.493	2.62	2.0	100.7	1.3	1	9.1	0.02	11.4	116.99	6.6	25.2	4.6	0.8	3.1	0.6	2.5	0.4	1.3	0.2	1.2	0.2
MC-8	0.349	7.71	1.794	1.80	1.4	84.1	1.2	1	14.9	0.02	10.1	44.80	4.2	16.4	3.3	0.7	2.6	0.4	2.0	0.4	1.3	0.2	1.2	0.2
MC-9	0.322	6.58	1.255	1.60	0.7	92.4	1.6	1	12.4	0.02	12.2	53.91	5.5	21.3	4.1	0.8	2.9	0.5	2.2	0.4	1.4	0.2	1.4	0.2
MC-10	0.393	9.26	1.209	2.83	2.0	105.5	3.3	2	19.4	0.02	12.9	62.22	6.4	24.3	4.4	0.9	2.8	0.5	2.3	0.4	1.5	0.2	1.4	0.2
MC-10a	0.386	6.68	1.716	1.97	0.9	105.1	2.1	1	8.3	0.02	8.8	54.50	4.9	18.2	3.4	0.7	2.1	0.4	1.7	0.3	1.1	0.2	1.2	0.2
MC-13	0.323	7.76	2.081	2.34	0.5	128.2	2.0	2	14.4	0.04	13.2	114.76	8.1	30.9	6.0	1.2	4.1	0.7	2.8	0.5	1.4	0.2	1.5	0.2
MC-14	0.453	6.14	1.636	2.08	0.8	126.6	1.6	1	7.9	0.02	10.8	56.94	5.7	21.5	4.0	0.7	2.5	0.4	2.0	0.3	1.1	0.2	1.1	0.2
MC-24	0.378	7.75	1.232	1.42	1.4	69.3	1.2	1	27.1	0.02	8.4	56.15	3.8	15.0	3.1	0.7	2.4	0.4	1.7	0.3	1.1	0.1	1.2	0.2
MC-25	0.307	7.17	2.083	2.03	2.6	92.6	1.4	1	10.3	0.02	9.1	57.23	4.7	16.5	3.3	0.6	2.2	0.4	1.9	0.3	1.1	0.2	1.1	0.1
MC-25a	0.394	6.20	1.517	1.94	0.9	120.0	1.9	1	9.8	0.02	10.0	53.20	5.2	19.3	3.7	0.7	2.5	0.4	2.0	0.3	1.1	0.2	1.2	0.2
MC-25b	0.370	7.47	2.191	2.52	0.6	126.6	1.8	1	10.6	0.02	12.5	77.86	7.1	26.4	5.1	0.9	3.6	0.6	2.6	0.4	1.3	0.2	1.3	0.2
MC-26a	0.310	7.06	2.074	1.80	6.4	80.0	1.1	1	11.0	0.02	9.7	70.35	4.1	14.9	3.3	0.7	2.5	0.4	2.1	0.4	1.1	0.1	1.1	0.1
MC-31	0.238	5.79	0.518	0.80	1.6	83.3	2.5	1	36.1	0.02	17.3	45.72	4.9	21.5	5.5	1.4	4.8	0.8	3.9	0.7	2.3	0.3	2.5	0.3
MC-33	0.276	7.41	1.888	2.19	1.9	87.6	1.3	1	7.8	0.02	7.1	61.92	6.5	23.7	4.2	0.8	2.5	0.4	1.7	0.2	0.9	0.1	0.9	0.1
MC-33a	0.296	7.32	1.970	2.16	1.3	105.9	1.6	2	7.4	0.02	8.1	51.42	4.8	17.9	3.2	0.6	2.4	0.4	1.7	0.3	1.0	0.1	0.9	0.1
MC-33b	0.285	7.52	2.185	2.28	0.8	105.5	1.5	1	9.6	0.02	8.3	76.69	5.3	19.1	3.5	0.6	2.6	0.4	1.8	0.3	1.0	0.1	0.9	0.1
MC-34	0.370	6.97	1.557	1.58	0.8	87.8	1.4	1	12.4	0.02	10.0	89.78	4.7	17.2	3.3	0.7	2.3	0.4	2.0	0.4	1.2	0.2	1.2	0.2
MC-34a	0.369	7.25	1.904	2.26	0.9	110.6	1.5	1	11.6	0.02	10.0	71.20	5.9	21.1	3.9	0.7	2.8	0.4	2.1	0.3	1.2	0.2	1.1	0.2
MC-34b	0.238	7.81	2.046	1.83	6.9	85.6	1.5	1	17.1	0.02	11.2	58.84	6.6	23.7	4.3	1.0	3.2	0.5	2.3	0.4	1.2	0.2	1.4	0.2
MC-35	0.450	6.60	1.262	1.72	1.1	108.0	1.4	1	7.9	0.02	8.2	46.16	3.9	14.4	2.7	0.5	2.0	0.3	1.6	0.3	0.9	0.1	1.2	0.2
MC-35b	0.469	6.22	1.190	1.55	1.3	93.7	1.4	1	11.8	0.15	11.0	42.03	4.0	15.3	3.0	0.6	2.5	0.3	2.3	0.4	1.3	0.2	1.6	0.2
MC-36	0.297	6.82	1.934	1.87	2.7	99.9	1.4	1	8.7	0.02	8.3	77.27	5.1	17.6	3.4	0.6	2.4	0.3	1.8	0.3	0.9	0.1	1.2	0.1
MC-35a	0.294	3.46	0.040	0.11	53.4	55.5	5.6	1	14.0	0.02	33.0	48.25	7.3	30.3	6.3	2.8	5.9	0.8	5.2	0.9	3.2	0.5	4.2	0.6

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Ti	Al	Na	K	W	Zr	Sn	Be	Sc	S	Y	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	%	%	%	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP	ICP
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
Detect. Limits	0.001	0.02	0.002	0.02	0.1	0.2	0.1	1	0.1	0.04	0.1	0.02	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
< substit. Val.								1		0.02														
Maximum n=31	0.469	9.26	2.493	2.98	6.9	133.0	3.3	2	36.1	0.15	17.3	116.99	8.1	30.9	6.8	1.4	5.2	0.8	3.9	0.7	2.3	0.3	2.5	0.3
95%ile n=31	0.452	7.99	2.238	2.87	4.6	127.4	2.4	2	25.1	0.03	15.5	102.27	7.3	28.8	5.9	1.3	4.7	0.8	3.1	0.5	1.8	0.2	1.8	0.3
85%ile n=31	0.394	7.73	2.109	2.47	2.3	122.1	2.0	2	17.5	0.02	12.7	76.98	6.6	24.8	4.9	1.0	3.4	0.6	2.6	0.4	1.4	0.2	1.5	0.2
75%ile n=31	0.375	7.50	2.060	2.27	1.8	109.6	1.7	1	14.7	0.02	11.3	71.75	6.5	23.5	4.4	0.8	3.0	0.5	2.3	0.4	1.3	0.2	1.4	0.2
50%ile n=31	0.323	7.09	1.794	1.94	1.0	99.9	1.5	1	10.6	0.02	9.7	59.98	5.3	19.3	3.9	0.7	2.5	0.4	2.0	0.3	1.1	0.2	1.2	0.2
25%ile n=31	0.287	6.64	1.259	1.59	0.8	86.2	1.3	1	8.0	0.02	8.5	53.56	4.7	16.9	3.3	0.6	2.4	0.4	1.8	0.3	1.0	0.1	1.1	0.1
15%ile n=31	0.244	6.22	1.200	1.45	0.6	83.7	1.3	1	7.7	0.02	8.3	48.79	4.2	15.5	3.2	0.6	2.3	0.4	1.7	0.3	1.0	0.1	1.0	0.1
5%ile n=31	0.236	5.97	0.961	1.23	0.5	74.9	1.2	1	7.0	0.02	8.2	43.63	3.9	14.7	2.8	0.6	2.1	0.3	1.7	0.3	0.9	0.1	0.9	0.1
Minimum n=31	0.214	5.63	0.518	0.80	0.4	69.3	1.0	1	6.2	0.02	7.1	42.03	3.7	14.3	2.7	0.5	2.0	0.3	1.6	0.2	0.9	0.1	0.9	0.1
Max/Min Var.	2	2	5	4	17	2	3	2	6	6	2	3	2	2	3	3	3	3	2	4	3	3	3	3
95/5 Var.	2	1	2	2	10	2	2	2	4	1	2	2	2	2	2	2	2	3	2	2	2	2	2	3
85/15 Var.	2	1	2	2	4	1	2	2	2	1	2	2	2	2	2	2	2	2	2	1	1	2	1	2
75/25 Var.	1	1	2	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2
dst5 (wr=so17)	0.431	6.85	1.734	1.36	10.1	46.3	6.5	2	12.4	0.04	14.9	51.86	5.2	21.0	4.3	1.0	3.6	0.6	2.8	0.5	1.8	0.2	1.7	0.2
dst5 (wr=so17)	0.415	6.88	1.755	1.36	9.9	43.9	6.4	2	12.1	0.04	14.0	50.20	5.1	19.7	4.2	1.0	3.5	0.5	2.9	0.5	1.5	0.2	1.9	0.2
% difference	**4**	**0**	**1**	**0**	**2**	**5**	**2**	**0**	**2**	**0**	**6**	**3**	**2**	**6**	**2**	**0**	**3**	**18**	**4**	**0**	**18**	**0**	**11**	**0**
MC-24	0.378	7.75	1.232	1.42	1.4	69.3	1.2	1	27.1	<.04	8.4	56.15	3.8	15.0	3.1	0.7	2.4	0.4	1.7	0.3	1.1	0.1	1.2	0.2
MC-24-RE	0.368	7.59	1.201	1.45	1.3	72.8	1.0	1	27.7	<.04	8.6	54.56	3.6	14.6	3.2	0.6	2.0	0.4	1.7	0.3	1.0	0.1	1.0	0.2
% difference	**3**	**2**	**3**	**2**	**7**	**5**	**18**	**0**	**2**		**2**	**3**	**5**	**3**	**3**	**15**	**18**	**0**	**0**	**0**	**10**	**0**	**18**	**0**
MC-1c	0.322	6.48	1.255	1.74	0.7	97.4	1.7	1	12.4	0.04	12.7	54.01	5.6	21.5	4.1	0.9	3.1	0.5	2.3	0.4	1.4	0.2	1.5	0.2
MC-9	0.322	6.58	1.255	1.60	0.7	92.4	1.6	1	12.4	<.04	12.2	53.91	5.5	21.3	4.1	0.8	2.9	0.5	2.2	0.4	1.4	0.2	1.4	0.2
% difference	**0**	**2**	**0**	**8**	**0**	**5**	**6**	**0**	**0**		**2**	**0**	**1**	**0**	**0**	**6**	**3**	**0**	**2**	**0**	**0**	**0**	**3**	**0**
MC-26c	0.312	7.19	2.106	1.77	8.2	95.7	1.5	2	11.8	<.04	11.7	86.37	4.8	18.1	3.7	0.8	2.8	0.5	2.4	0.4	1.4	0.2	1.2	0.2
MC-26a	0.310	7.06	2.074	1.80	6.4	80.0	1.1	1	11.0	<.04	9.7	70.35	4.1	14.9	3.3	0.7	2.5	0.4	2.1	0.4	1.1	0.1	1.1	0.1
% difference	**1**	**2**	**2**	**2**	**25**	**18**	**31**	**67**	**7**		**19**	**20**	**16**	**19**	**11**	**13**	**11**	**22**	**13**	**0**	**24**	**67**	**9**	**67**
MC-4c	0.538	7.91	1.800	1.77	2.5	130.2	2.0	2	18.8	0.07	31.4	82.58	10.1	44.6	10.3	2.1	8.2	1.4	6.5	1.1	3.8	0.5	3.8	0.5
MC-35c	0.499	7.87	1.491	1.87	2.3	125.7	2.0	2	16.3	0.07	28.7	80.08	9.9	42.1	10.1	1.9	7.7	1.0	5.9	1.0	3.3	0.5	3.9	0.5
% difference	**8**	**1**	**19**	**5**	**8**	**4**	**0**	**0**	**14**	**0**	**9**	**3**	**2**	**6**	**2**	**10**	**6**	**33**	**10**	**10**	**14**	**0**	**3**	**0**
ODM-REF																								

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Hf	Li	Rb	Ta	Nb	Cs	Ga
	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	ICP	ICP	ICP	ICP	ICP	ICP	ICP
	<63um	<63um	<63um	<63um	<63um	<63um	<63um
MC-1	3.60	46.7	59.2	0.6	7.78	3.9	15.43
MC-2	4.56	26.8	114.1	0.3	4.42	3.9	20.05
MC-2a	2.67	27.4	65.1	0.4	5.75	4.6	13.99
MC-3	3.10	25.9	87.9	0.3	3.82	3.1	13.81
MC-4	4.54	27.3	122.7	0.5	6.20	3.7	15.62
MC-4y	3.08	41.9	73.2	0.6	8.56	3.1	19.05
MC-4x	3.00	41.6	95.4	0.6	8.60	5.1	16.44
MC-5	4.99	19.7	119.2	0.4	5.66	3.5	16.01
MC-6a	3.72	26.0	100.2	0.4	5.30	2.9	15.09
MC-7	3.71	18.6	100.5	0.3	4.65	2.8	15.59
MC-8	3.05	27.5	94.4	0.3	4.73	2.9	17.02
MC-9	3.35	27.1	87.3	0.4	6.02	3.8	14.74
MC-10	3.62	36.9	114.0	0.5	6.58	4.1	25.21
MC-10a	3.82	26.7	96.1	0.6	7.02	3.2	14.89
MC-13	4.30	32.3	108.2	0.4	5.94	3.9	18.33
MC-14	4.19	29.9	103.1	0.6	10.14	4.1	15.20
MC-24	2.62	35.2	70.5	0.3	4.30	2.9	18.79
MC-25	3.29	22.3	78.8	0.4	5.58	3.0	15.85
MC-25a	4.41	32.4	97.1	0.6	8.39	4.2	16.95
MC-25b	4.18	36.1	98.2	0.5	7.39	3.5	17.67
MC-26a	2.76	15.9	66.8	0.3	3.88	2.2	14.04
MC-31	2.74	49.7	52.3	0.4	5.57	3.4	18.84
MC-33	3.57	27.5	100.8	0.4	5.34	4.0	17.13
MC-33a	3.73	28.0	98.5	0.4	6.43	3.9	17.55
MC-33b	3.96	30.4	100.1	0.4	5.57	4.0	17.35
MC-34	3.27	27.9	69.0	0.4	5.37	3.3	14.86
MC-34a	3.92	26.1	87.1	0.4	6.20	3.7	16.27
MC-34b	3.03	30.7	79.9	0.3	4.49	3.9	20.45
MC-35	4.04	29.3	65.4	0.5	7.75	4.2	14.11
MC-35b	3.09	29.6	68.9	0.4	6.41	3.4	16.49
MC-36	3.40	18.6	80.8	0.4	5.51	2.6	15.34
MC-35a	1.79	6.0	7.2	0.3	4.89	0.8	21.31

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Hf ppm ICP <63um	Li ppm ICP <63um	Rb ppm ICP <63um	Ta ppm ICP <63um	Nb ppm ICP <63um	Cs ppm ICP <63um	Ga ppm ICP <63um
Detect. Limits	0.02	0.1	0.1	0.1	0.04	0.1	0.02
< substit. Val.							
Maximum n=31	4.99	49.7	122.7	0.6	10.14	5.1	25.21
95%ile n=31	4.55	44.3	116.7	0.6	8.58	4.4	20.25
85%ile n=31	4.25	36.5	105.7	0.6	7.77	4.1	18.82
75%ile n=31	4.00	32.4	100.4	0.5	6.80	4.0	17.61
50%ile n=31	3.60	27.9	94.4	0.4	5.75	3.7	16.27
25%ile n=31	3.09	26.4	71.9	0.4	5.32	3.1	15.15
15%ile n=31	3.02	24.1	67.9	0.3	4.57	2.9	14.80
5%ile n=31	2.71	18.6	62.2	0.3	4.09	2.7	14.02
Minimum n=31	2.62	15.9	52.3	0.3	3.82	2.2	13.81
Max/Min Var.	2	3	2	2	3	2	2
95/5 Var.	2	2	2	2	2	2	1
85/15 Var.	1	2	2	2	2	1	1
75/25 Var.	1	1	1	1	1	1	1
dst5 (wr=so17)	1.70	24.5	59.7	0.6	8.57	8.4	16.75
dst5 (wr=so17)	1.59	23.6	57.5	0.5	8.19	8.1	17.07
% difference	**7**	**4**	**4**	**18**	**5**	**4**	**2**
MC-24	2.62	35.2	70.5	0.3	4.30	2.9	18.79
MC-24-RE	2.64	35.4	68.9	0.3	4.37	2.9	19.39
% difference	**1**	**1**	**2**	**0**	**2**	**0**	**3**
MC-1c	3.22	26.9	89.3	0.5	6.06	3.7	14.94
MC-9	3.35	27.1	87.3	0.4	6.02	3.8	14.74
% difference	**2**	**0**	**1**	**11**	**0**	**1**	**1**
MC-26c	3.30	17.8	79.3	0.4	5.01	2.6	16.62
MC-26a	2.76	15.9	66.8	0.3	3.88	2.2	14.04
% difference	**18**	**11**	**17**	**29**	**25**	**17**	**17**
MC-4c	4.95	78.1	73.2	0.8	9.97	6.0	17.70
MC-35c	4.29	76.9	65.8	0.7	9.09	5.3	17.55
% difference	**14**	**2**	**11**	**13**	**9**	**12**	**1**
ODM-REF							

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ba	Ni	Sr	Zr	Y	Nb	Sc	LOI	TOT/C	TOT/S	SUM
	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%	%
	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	LOI	LECO	LECO	ICP-ES
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
MC-1	52.54	13.93	4.93	1.05	0.87	1.12	1.67	0.67	0.23	0.03	0.006	442	48	136	236	11	55	8	22.6	4.75	0.04	99.76
MC-2	62.81	15.45	7.53	0.92	0.82	2.48	3.14	0.98	0.13	0.15	0.005	512	33	239	196	36	6	24	5.4	0.39	0.01	99.95
MC-2a	63.42	11.48	9.69	1.36	1.25	1.26	1.64	0.60	0.21	0.07	0.008	417	41	148	170	10	6	9	8.7	1.06	0.01	99.78
MC-3	63.17	13.73	6.47	3.40	1.78	2.04	2.55	0.49	0.06	0.13	0.032	457	90	189	126	6	6	19	5.4	0.72	0.01	99.36
MC-4	68.39	14.10	3.11	1.00	1.44	2.72	3.76	0.39	0.11	0.04	0.005	676	28	274	190	12	6	7	4.6	0.65	0.01	99.80
MC-4y	62.00	13.45	8.32	1.38	0.75	1.63	1.50	1.05	0.15	0.15	0.005	426	33	124	219	30	14	19	9.3	1.16	0.01	99.79
MC-4x	58.20	12.69	7.12	0.91	0.84	1.30	1.89	0.65	0.15	0.10	0.005	528	32	146	227	13	20	7	15.2	2.66	0.02	99.17
MC-5	68.61	14.16	3.68	0.94	1.38	2.84	3.59	0.39	0.15	0.05	0.002	653	32	291	231	13	24	8	3.9	0.33	0.01	99.84
MC-6a	65.85	13.91	5.56	1.79	1.29	2.47	2.87	0.52	0.11	0.06	0.011	556	40	246	195	13	6	13	4.6	0.51	0.01	99.16
MC-7	69.45	13.68	3.95	1.23	1.60	3.21	3.00	0.42	0.17	0.06	0.006	619	49	324	162	12	6	9	3.1	0.24	0.01	100.02
MC-8	62.85	14.51	6.32	2.00	1.58	2.28	2.29	0.57	0.16	0.07	0.010	514	68	260	118	12	6	17	7.2	1.15	0.01	99.95
MC-9	58.96	12.79	9.27	1.64	1.42	1.65	2.09	0.58	0.12	0.20	0.010	459	53	196	186	18	26	14	11.0	2.42	0.02	99.84
MC-10	61.55	17.30	6.46	3.08	0.79	1.58	2.78	0.61	0.13	0.06	0.013	580	46	143	111	10	6	17	5.5	0.33	0.01	99.96
MC-10a	67.37	13.05	4.59	1.38	1.62	2.19	2.47	0.66	0.07	0.06	0.008	586	63	258	236	14	6	9	6.2	1.14	0.01	99.81
MC-13	60.84	15.07	6.39	2.24	1.66	2.69	2.88	0.65	0.26	0.07	0.023	618	81	301	241	18	6	16	6.4	1.21	0.01	99.32
MC-14	71.16	12.63	3.05	1.27	1.56	2.12	2.57	0.77	0.05	0.06	0.005	611	40	236	278	18	6	9	4.5	0.90	0.01	99.89
MC-24	55.73	15.05	10.59	3.57	0.91	1.64	1.66	1.05	0.10	0.11	0.007	364	68	142	166	23	6	30	8.7	0.77	0.01	99.21
MC-25	61.42	14.34	5.89	1.84	1.95	2.76	2.46	0.52	0.12	0.06	0.009	588	69	306	194	12	30	12	8.0	1.06	0.01	99.52
MC-25a	64.68	12.77	4.39	1.43	1.33	2.06	2.35	0.68	0.12	0.06	0.008	566	33	228	298	14	42	10	9.5	1.27	0.01	99.53
MC-25b	66.70	14.01	4.45	1.74	1.85	2.77	2.73	0.60	0.14	0.05	0.011	615	42	329	293	15	26	10	4.2	0.31	0.01	99.41
MC-26a	60.44	13.81	6.56	1.76	2.45	2.75	2.18	0.51	0.16	0.06	0.007	504	52	289	126	13	6	12	9.2	2.10	0.02	100.00
MC-31	39.60	11.82	22.30	1.43	0.44	0.72	0.93	0.92	0.29	1.05	0.002	351	40	66	159	35	6	37	20.3	3.05	0.03	99.89
MC-33	61.25	14.26	4.83	1.34	1.04	2.45	2.72	0.46	0.17	0.04	0.005	591	47	230	174	13	19	9	10.5	1.63	0.02	99.20
MC-33a	61.61	14.25	4.73	1.20	1.21	2.56	2.62	0.49	0.37	0.03	0.007	589	25	242	183	10	25	7	10.8	1.84	0.02	100.01
MC-33b	64.13	15.33	5.22	1.78	1.45	2.99	2.91	0.49	0.11	0.06	0.008	628	48	290	182	14	14	11	5.2	0.62	0.01	99.82
MC-34	60.52	14.68	6.77	1.88	1.53	2.17	2.10	0.66	0.12	0.07	0.019	528	107	225	202	17	6	15	9.1	1.38	0.01	99.75
MC-34a	64.06	14.56	5.86	1.86	1.52	2.64	2.59	0.64	0.14	0.06	0.008	570	55	263	223	16	21	13	5.7	0.57	0.01	99.77
MC-34b	55.34	15.67	10.51	1.16	0.73	2.91	2.17	0.65	0.14	0.05	0.017	626	66	170	176	19	6	18	10.3	1.18	0.02	99.78
MC-35	63.02	12.77	6.36	1.33	1.18	1.68	1.95	0.77	0.08	0.07	0.008	550	67	191	259	17	11	9	10.6	1.31	0.01	99.95
MC-35b	58.94	12.94	7.62	2.11	1.74	1.92	2.10	0.81	0.19	0.07	0.008	429	46	183	187	18	15	13	10.7	1.42	0.01	99.25
MC-36	63.05	13.80	4.78	1.27	1.72	2.62	2.79	0.50	0.11	0.05	0.009	560	47	278	185	13	6	8	8.7	1.05	0.01	99.53
MC-35a	26.14	8.10	37.95	2.53	6.70	0.06	0.15	0.46	0.51	0.34	0.004	52	208	77	152	36	6	15	16.6	1.70	0.02	99.61

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	SiO2	Al2O3	Fe2O3	MgO	CaO	Na2O	K2O	TiO2	P2O5	MnO	Cr2O3	Ba	Ni	Sr	Zr	Y	Nb	Sc	LOI	TOT/C	TOT/S	SUM
	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%	%
	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	ICP-ES	LOI	LECO	LECO	ICP-ES
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
Detect. Limits	0.04	0.03	0.04	0.01	0.01	0.01	0.04	0.01	0.01	0.01	0.001	5	30	10	10	10	20	1	0.1	0.01	0.01	
< substit. Val.																6	6				0.01	
Maximum n=31	71.16	17.30	22.30	3.57	2.45	3.21	3.76	1.05	0.37	1.05	0.032	676	107	329	298	36	55	37	22.6	4.75	0.04	100.02
95%ile n=31	69.03	15.56	10.55	3.24	1.90	2.95	3.37	1.02	0.28	0.18	0.021	641	86	315	286	33	36	27	17.8	2.86	0.03	100.01
85%ile n=31	67.04	15.06	8.80	2.06	1.73	2.77	2.90	0.79	0.20	0.12	0.012	619	68	291	239	19	26	19	10.8	1.97	0.02	99.95
75%ile n=31	64.41	14.54	7.33	1.85	1.61	2.71	2.79	0.68	0.17	0.07	0.010	601	65	276	229	18	21	17	10.4	1.40	0.02	99.89
50%ile n=31	62.81	13.93	6.32	1.43	1.42	2.28	2.47	0.61	0.14	0.06	0.008	560	47	236	190	14	6	12	8.7	1.14	0.01	99.78
25%ile n=31	60.48	13.00	4.76	1.25	0.98	1.67	2.10	0.51	0.11	0.06	0.006	482	40	177	172	12	6	9	5.4	0.64	0.01	99.47
15%ile n=31	58.57	12.77	4.42	1.11	0.83	1.61	1.78	0.49	0.11	0.05	0.005	436	33	145	161	12	6	8	4.6	0.45	0.01	99.29
5%ile n=31	53.94	12.23	3.40	0.93	0.74	1.19	1.57	0.41	0.07	0.04	0.004	391	30	130	122	10	6	7	4.1	0.32	0.01	99.19
Minimum n=31	39.60	11.48	3.05	0.91	0.44	0.72	0.93	0.39	0.05	0.03	0.002	351	25	66	111	6	6	7	3.1	0.24	0.01	99.16
Max/Min Var.	2	2	7	4	6	4	4	3	7	35	16	2	4	5	3	6	9	5	7	20	7	1
95/5 Var.	1	1	3	3	3	2	2	3	4	5	6	2	3	2	2	3	6	4	4	9	4	1
85/15 Var.	1	1	2	2	2	2	2	2	2	2	2	1	2	2	1	2	4	2	2	4	2	1
75/25 Var.	1	1	2	1	2	2	1	1	2	1	2	1	2	2	1	2	3	2	2	2	2	1
dst5 (wr=so17)	61.58	13.81	5.84	2.35	4.67	4.12	1.41	0.59	0.99	0.53	0.436	401	30	306	345	27	28	23	3.4	2.41	5.34	99.87
dst5 (wr=so17)	61.55	13.80	5.84	2.34	4.67	4.12	1.41	0.59	0.99	0.53	0.436	400	28	307	345	27	32	23	3.4	2.39	5.29	99.82
% difference	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**13**	**0**	**0**	**1**	**1**	**0**
MC-24	55.73	15.05	10.59	3.57	0.91	1.64	1.66	1.05	0.10	0.11	0.007	364	68	142	166	23	<10	30	8.7	0.77	0.01	99.21
MC-24-RE	56.17	15.16	10.69	3.61	0.91	1.64	1.69	1.06	0.10	0.11	0.008	368	67	143	154	23	21	30	8.6	0.78	0.01	99.85
% difference	**1**	**1**	**1**	**1**	**0**	**0**	**2**	**1**	**0**	**0**	**13**	**1**	**1**	**1**	**8**	**0**		**0**	**1**	**1**	**0**	**1**
MC-1c	59.48	12.86	9.19	1.62	1.41	1.56	2.14	0.57	0.10	0.20	0.006	448	41	193	214	13	<10	13	10.4	2.53	0.01	99.65
MC-9	58.96	12.79	9.27	1.64	1.42	1.65	2.09	0.58	0.12	0.20	0.010	459	53	196	186	18	26	14	11.0	2.42	0.02	99.84
% difference	**1**	**1**	**1**	**1**	**1**	**6**	**2**	**2**	**18**	**0**	**50**	**2**	**26**	**2**	**14**	**32**		**7**	**6**	**4**	**67**	**0**
MC-26c	60.21	13.75	6.49	1.75	2.45	2.70	2.20	0.50	0.16	0.06	0.009	505	53	287	137	13	<10	12	9.6	2.01	0.02	100.00
MC-26a	60.44	13.81	6.56	1.76	2.45	2.75	2.18	0.51	0.16	0.06	0.007	504	52	289	126	13	<10	12	9.2	2.10	0.02	100.00
% difference	**0**	**0**	**1**	**1**	**0**	**2**	**1**	**2**	**0**	**0**	**25**	**0**	**2**	**1**	**8**	**0**		**0**	**4**	**4**	**0**	**0**
MC-4c	55.59	16.27	6.60	2.16	2.57	2.25	2.35	0.86	0.17	0.09	0.006	638	89	271	434	36	21	18	10.7	1.68	0.12	99.80
MC-35c	55.32	16.39	6.29	2.06	2.52	2.28	2.70	0.84	0.15	0.08	0.006	629	82	256	348	38	<10	16	10.9	1.59	0.14	99.70
% difference	**0**	**1**	**5**	**5**	**2**	**1**	**14**	**2**	**13**	**12**	**0**	**1**	**8**	**6**	**22**	**5**		**12**	**2**	**6**	**15**	**0**
ODM-REF													70									

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Weight	Sb	As	Ba	Br	Ca	Ce	Cs	Cr	Co	Eu	Au	Hf	Ir	Fe	La	Lu	Hg	Mo	Nd	Ni	Rb	Sm	Sc
	grams	ppm	ppm	ppm	ppm	Wt %	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppb	Wt %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
MC-1	11.84	0.4	5.4	410	25.0	1	53	5	84	12	0.7	1	7	3	3.50	29.0	0.27	1	1	23	60	61	4.1	9.1
MC-2	13.76	1.8	37.0	450	3.7	1	61	4	75	17	1.6	12	7	3	5.60	38.0	0.62	1	1	32	60	110	7.5	25.8
MC-2a	14.18	0.7	12.0	410	4.2	1	40	5	80	22	0.7	8	5	3	7.31	19.0	0.25	1	1	13	60	61	2.9	9.4
MC-3	11.85	0.3	13.0	470	3.1	1	61	3	300	46	0.6	5	4	3	4.63	23.0	0.19	1	1	14	60	92	3.1	19.8
MC-4	12.87	0.2	2.2	660	4.7	1	72	4	47	12	0.8	5	7	3	2.16	34.0	0.20	1	1	24	140	130	4.6	6.6
MC-4y	12.56	0.4	3.6	400	5.0	1	51	2	58	20	1.2	1	7	3	6.07	29.0	0.55	1	1	25	60	58	5.5	19.4
MC-4x	11.21	0.5	9.5	550	10.0	1	58	5	59	13	0.9	85	6	3	5.08	25.0	0.30	1	1	18	100	74	3.7	7.5
MC-5	15.19	0.1	5.8	660	3.9	1	75	3	45	13	0.7	5	7	6	2.59	35.0	0.22	1	1	21	130	130	4.7	7.3
MC-6a	16.32	0.4	13.0	590	4.6	2	73	3	130	21	1.0	7	6	3	4.12	31.0	0.25	1	1	20	130	97	4.2	13.7
MC-7	15.20	0.6	18.0	610	3.4	2	110	2	65	20	0.8	20	6	3	2.95	34.0	0.22	1	1	21	60	96	4.7	10.0
MC-8	14.43	0.6	27.0	550	3.6	1	40	3	100	31	0.6	26	4	3	4.42	21.0	0.22	1	1	14	60	85	3.1	16.1
MC-9	14.41	0.5	13.0	450	6.2	2	52	4	86	18	0.9	48	6	3	6.72	29.0	0.30	1	1	20	60	88	4.2	13.2
MC-10	11.32	0.4	14.0	540	1.0	1	50	4	150	13	0.8	1	3	3	4.37	27.0	0.22	1	1	21	60	99	3.8	15.9
MC-10a	12.20	0.3	6.8	590	4.1	1	52	3	83	17	0.7	1	7	3	3.14	26.0	0.29	1	1	19	60	100	3.6	9.1
MC-13	13.61	0.8	55.4	550	6.7	1	100	4	170	28	1.1	45	7	3	4.58	38.0	0.27	1	1	29	60	110	5.5	15.0
MC-14	14.45	0.3	4.2	550	2.5	1	53	4	71	12	0.6	1	8	3	2.11	28.0	0.31	1	1	21	60	110	3.9	8.2
MC-24	12.45	0.5	20.0	320	4.1	1	54	3	100	37	0.7	5	4	3	7.73	18.0	0.39	1	1	15	60	61	3.5	29.0
MC-25	15.26	0.3	10.0	530	5.0	1	56	3	94	22	0.8	5	5	3	3.78	25.0	0.20	1	1	18	60	87	3.5	10.1
MC-25a	13.46	0.3	3.3	560	4.1	1	47	4	84	13	0.6	4	7	3	3.05	25.0	0.28	1	1	20	60	86	3.5	10.0
MC-25b	14.57	0.2	7.3	550	3.0	1	72	4	110	15	1.1	1	7	3	3.11	36.0	0.28	1	1	26	60	100	4.7	10.2
MC-26a	13.96	0.3	12.0	480	8.7	2	75	3	89	24	0.7	10	4	3	4.58	22.0	0.21	1	7	21	60	63	3.4	11.8
MC-31	10.98	0.8	11.0	330	10.0	1	37	3	54	18	1.3	53	5	3	16.90	20.0	0.64	1	1	20	60	69	5.3	36.9
MC-33	12.53	0.4	10.0	590	4.4	1	64	3	67	14	0.9	17	5	3	3.42	34.0	0.18	1	1	27	60	120	4.3	8.1
MC-33a	14.07	0.4	11.0	550	7.0	1	48	4	65	12	0.6	8	5	3	3.38	24.0	0.19	1	1	20	60	97	3.4	7.5
MC-33b	16.95	0.4	11.0	620	3.5	1	76	4	92	20	0.8	14	5	3	3.69	30.0	0.20	1	1	19	60	100	3.8	10.5
MC-34	14.73	0.8	46.0	490	5.7	1	94	4	120	34	0.7	14	5	3	4.78	26.0	0.26	1	1	19	60	78	3.9	14.0
MC-34a	16.72	0.4	18.0	540	3.2	1	71	4	94	23	0.8	1	6	6	4.17	31.0	0.25	1	1	24	60	90	4.3	12.3
MC-34b	14.06	1.2	44.0	640	4.7	1	55	3	130	22	1.0	1050	5	3	7.70	32.0	0.28	1	1	23	60	91	4.7	17.1
MC-35	15.94	0.5	26.0	500	4.2	1	45	4	91	17	0.6	8	7	3	4.55	22.0	0.29	1	1	17	60	66	2.9	8.5
MC-35b	13.60	0.6	16.0	460	5.1	1	43	3	93	28	0.7	5	6	10	5.72	22.0	0.32	1	1	17	60	81	3.4	14.8
MC-36	15.72	0.2	14.0	570	6.2	1	73	3	87	22	0.6	1	5	3	3.57	26.0	0.20	1	1	19	60	80	3.6	9.2
MC-35a	15.17	0.7	65.7	30	4.9	6	40	1	47	444	3.2	41	4	10	29.80	33.0	0.83	1	127	27	180	22	6.6	17.8

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Weight	Sb	As	Ba	Br	Ca	Ce	Cs	Cr	Co	Eu	Au	Hf	Ir	Fe	La	Lu	Hg	Mo	Nd	Ni	Rb	Sm	Sc
	grams	ppm	ppm	ppm	ppm	Wt %	ppm	ppm	ppm	ppm	ppm	ppb	ppm	ppb	Wt %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
Detect. Limits		0.1	0.5	50	0.5	1	3	1	5	1	0.2	2	1	5	0.01	0.5	0.05	1	1	5	20	15	0.1	0.1
< substit. Val.		0.1		30		1		1				1		3				1	1		60			
Maximum n=31	16.95	1.8	55.4	660	25.0	2	110	5	300	46	1.6	1050	8	10	16.90	38.0	0.64	1	7	32	140	130	7.5	36.9
95%ile n=31	16.52	1.0	45.0	650	10.0	2	97	5	160	36	1.3	69	7	6	7.72	37.0	0.59	1	1	28	130	125	5.5	27.4
85%ile n=31	15.49	0.8	26.5	600	6.9	1	75	4	125	28	1.1	36	7	3	6.40	34.0	0.32	1	1	25	60	110	4.7	18.3
75%ile n=31	14.96	0.6	18.0	580	6.0	1	73	4	100	23	0.9	16	7	3	5.34	31.5	0.30	1	1	23	60	100	4.7	15.5
50%ile n=31	14.06	0.4	12.0	550	4.4	1	56	4	87	20	0.8	7	6	3	4.37	27.0	0.26	1	1	20	60	90	3.9	10.5
25%ile n=31	12.55	0.3	8.4	465	3.7	1	51	3	69	14	0.7	3	5	3	3.40	23.5	0.22	1	1	19	60	76	3.5	9.1
15%ile n=31	12.03	0.3	5.6	430	3.3	1	46	3	62	13	0.6	1	5	3	3.08	22.0	0.20	1	1	17	60	65	3.4	8.2
5%ile n=31	11.27	0.2	3.5	365	2.8	1	40	3	51	12	0.6	1	4	3	2.38	19.5	0.19	1	1	14	60	61	3.0	7.4
Minimum n=31	10.98	0.1	2.2	320	1.0	1	37	2	45	12	0.6	1	3	3	2.11	18.0	0.18	1	1	13	60	58	2.9	6.6
Max/Min Var.	2	30	25	2	25	3	3	3	7	4	3	875	3	3	8	2	4	1	7	2	2	2	3	6
95/5 Var.	1	5	13	2	4	3	2	2	3	3	2	58	2	2	3	2	3	1	1	2	2	2	2	4
85/15 Var.	1	3	5	1	2	2	2	1	2	2	2	30	2	1	2	2	2	1	1	1	1	2	1	2
75/25 Var.	1	2	2	1	2	2	1	1	1	2	1	6	1	1	2	1	1	1	1	1	1	1	1	2
dst5 (wr=so17)																								
dst5 (wr=so17)																								
% difference																								
MC-24																								
MC-24-RE																								
% difference																								
MC-1c	14.91	0.4	13.0	440	6.3	1	50	4	86	20	0.8	14	6	-5	6.85	29.0	0.28	-1	-1	21	120	84	4.3	13.3
MC-9	14.41	0.5	13.0	450	6.2	2	52	4	86	18	0.9	48	6	-5	6.72	29.0	0.30	-1	-1	20	-100	88	4.2	13.2
% difference	**3**	**22**	**0**	**2**	**2**	**67**	**4**	**0**	**0**	**11**	**12**	**110**	**0**		**2**	**0**	**7**			**5**		**5**	**2**	**1**
MC-26c	14.88	0.4	12.0	460	8.9	2	72	3	87	23	0.8	5	4	-5	4.47	21.0	0.21	-1	5	15	-100	71	3.3	11.6
MC-26a	13.96	0.3	12.0	480	8.7	2	75	3	89	24	0.7	10	4	-5	4.58	22.0	0.21	-1	7	21	-100	63	3.4	11.8
% difference	**6**	**29**	**0**	**4**	**2**	**0**	**4**	**0**	**2**	**4**	**13**	**67**	**0**		**2**	**5**	**0**		**33**	**33**		**12**	**3**	**2**
MC-4c	14.15	0.6	7.6	570	7.6	2	71	5	67	34	2.0	8	12	-5	4.76	41.0	0.68	-1	-3	32	200	71	10.0	17.8
MC-35c	14.39	0.5	7.1	650	8.1	2	74	5	68	30	1.8	7	11	-5	4.53	39.0	0.69	-1	-4	39	-100	69	10.0	17.2
% difference	**2**	**18**	**7**	**13**	**6**	**0**	**4**	**0**	**1**	**13**	**11**	**13**	**9**		**5**	**5**	**1**			**20**		**3**	**0**	**3**
ODM-REF			6									11									70			

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Se	Ag	Na	Sr	Ta	Tb	Th	Sn	W	U	Yb	Zn
	ppm	ppm	Wt %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
MC-1	2	3	0.89	300	1.3	0.3	11.0	60	1	2.7	1.5	150
MC-2	2	3	1.99	300	1.1	1.2	12.0	60	1	1.5	3.7	310
MC-2a	2	3	1.00	300	1.4	0.3	7.5	60	1	1.7	1.4	190
MC-3	2	3	1.57	300	0.7	0.3	10.0	60	1	0.9	1.3	350
MC-4	2	3	2.16	300	1.4	0.3	13.0	60	1	2.0	1.3	120
MC-4y	2	3	1.21	300	1.8	0.9	7.8	60	1	2.0	3.3	260
MC-4x	2	3	1.00	300	1.3	0.6	8.6	60	3	1.6	1.8	96
MC-5	2	3	2.19	300	1.1	0.6	16.0	60	1	2.0	1.4	120
MC-6a	2	3	1.91	300	1.3	0.3	13.0	60	1	2.3	1.4	220
MC-7	2	3	2.54	300	0.6	0.3	13.0	60	1	1.4	1.4	200
MC-8	2	3	1.72	300	1.1	0.3	6.3	60	1	1.0	1.4	220
MC-9	2	3	1.20	300	0.9	0.5	8.3	60	1	1.5	1.8	160
MC-10	2	3	1.08	300	0.3	0.3	6.6	60	1	1.2	1.2	190
MC-10a	2	3	1.59	300	1.6	0.3	7.7	60	1	1.9	1.6	170
MC-13	2	3	2.02	300	1.2	0.3	11.0	60	1	2.2	1.6	200
MC-14	2	3	1.58	300	0.6	0.3	9.5	60	1	1.6	1.7	140
MC-24	2	3	1.17	300	0.6	0.3	7.7	60	2	0.3	2.3	270
MC-25	2	3	2.09	300	0.5	0.3	11.0	60	2	1.4	1.2	140
MC-25a	2	3	1.49	300	1.2	0.6	8.2	60	1	2.0	1.6	160
MC-25b	2	3	1.96	300	0.9	0.3	10.0	60	1	2.4	1.5	120
MC-26a	2	3	1.96	300	1.2	0.3	10.0	60	7	1.6	1.3	110
MC-31	2	3	0.50	300	1.2	1.2	5.4	60	2	0.9	3.9	140
MC-33	2	3	1.82	300	1.0	0.3	8.0	60	2	2.0	1.1	120
MC-33a	2	3	1.90	300	1.5	0.3	8.7	60	1	1.9	1.2	130
MC-33b	2	3	2.16	300	1.2	0.3	15.0	60	1	2.1	1.2	150
MC-34	2	3	1.59	300	0.7	0.6	11.0	60	1	1.3	1.6	200
MC-34a	2	3	1.86	300	1.3	0.3	13.0	60	1	1.5	1.4	150
MC-34b	2	3	2.06	300	1.1	0.3	7.1	60	20	0.3	1.6	190
MC-35	2	3	1.19	300	0.3	0.6	7.6	60	1	1.8	1.6	110
MC-35b	2	3	1.40	300	0.7	0.7	7.0	60	1	1.4	1.8	190
MC-36	2	3	1.90	300	0.6	0.3	12.0	60	3	1.6	1.2	94
MC-35a	6	3	0.04	300	1.2	0.9	4.9	60	57	0.3	4.3	190

	Wt	Sb	As	Ba	Br	Ca	Ce	Cs	Cr	Co
	grams	ppm	ppm	ppm	ppm	Wt %	ppm	ppm	ppm	ppm
	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA
	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC
MC-1	5.27	0.3	11.0	30	9.3	1	3350	1	320	18
MC-2	3.18	3.5	81.1	30	4.9	1	4330	1	330	113
MC-2a	14.67	6.8	42.0	30	2.6	5	1900	1	250	66
MC-3	4.39	3.6	34.0	30	0.3	4	2540	1	1290	29
MC-4	10.03	0.3	6.1	30	0.3	4	3770	1	320	36
MC-4y	2.29	0.3	31.0	30	0.3	1	2030	1	330	238
MC-4x	6.52	2.8	281.0	160	3.1	1	394	1	75	60
MC-5	14.42	2.3	56.4	30	4.4	4	3440	3	270	37
MC-6a	10.71	2.6	138.0	30	2.8	6	2040	1	280	46
MC-7	15.41	3.9	58.4	30	0.3	5	1650	1	260	84
MC-8	5.67	6.6	129.0	30	0.3	4	1460	1	340	63
MC-9	19.65	2.3	67.8	80	2.2	2	230	1	94	25
MC-10	5.09	4.2	61.8	30	0.3	7	1260	1	440	54
MC-10a	11.75	3.5	40.0	30	0.3	6	934	1	380	43
MC-13	22.39	4.3	258.0	30	0.3	6	1270	1	310	42
MC-14	17.74	0.3	4.9	30	5.3	4	3480	1	440	26
MC-24	8.28	2.4	85.0	30	0.3	3	2660	1	360	111
MC-25	15.64	2.0	17.0	30	4.1	7	1390	1	460	63
MC-25a	10.74	2.9	44.0	30	6.7	1	3210	5	490	47
MC-25b	13.07	1.2	12.0	30	4.1	5	2750	1	618	54
MC-26a	12.44	2.2	13.0	200	0.3	7	826	1	310	81
MC-31	16.26	3.6	68.9	30	2.1	2	110	1	68	123
MC-33	3.66	3.2	49.0	30	0.3	1	2220	1	360	86
MC-33a	4.82	2.1	32.0	30	0.3	1	3010	1	410	68
MC-33b	5.95	4.1	42.0	30	0.3	4	2590	1	310	62
MC-34	23.01	3.9	93.1	30	0.3	9	1220	2	560	65
MC-34a	20.62	2.2	48.0	30	4.1	8	1980	2	532	57
MC-34b	7.58	7.3	539.0	220	3.3	3	1260	1	330	216
MC-35	15.73	5.0	170.0	30	3.0	5	654	1	350	109
MC-35b	6.42	3.4	49.0	30	0.3	4	1570	1	360	48
MC-36	11.47	2.7	38.0	30	6.8	5	2130	3	460	64
MC-35a	29.93	0.3	4.4	30	1.0	12	81	1	50	111

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Se	Ag	Na	Sr	Ta	Tb	Th	Sn	W	U	Yb	Zn
	ppm	ppm	Wt %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA
	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um	<63um
Detect. Limits	3	5	0.01	500	0.5	0.5	0.2	100	1	0.5	0.2	50
< substit. Val.	2	3		300	0.3	0.3		60	1	0.3		
Maximum n=31	2	3	2.54	300	1.8	1.2	16.0	60	20	2.7	3.9	350
95%ile n=31	2	3	2.18	300	1.6	1.1	14.0	60	5	2.4	3.5	290
85%ile n=31	2	3	2.08	300	1.4	0.6	13.0	60	2	2.1	1.8	220
75%ile n=31	2	3	1.98	300	1.3	0.6	11.5	60	2	2.0	1.7	200
50%ile n=31	2	3	1.72	300	1.1	0.3	9.5	60	1	1.6	1.5	160
25%ile n=31	2	3	1.21	300	0.7	0.3	7.7	60	1	1.4	1.3	125
15%ile n=31	2	3	1.13	300	0.6	0.3	7.3	60	1	1.1	1.2	120
5%ile n=31	2	3	0.95	300	0.4	0.3	6.5	60	1	0.6	1.2	103
Minimum n=31	2	3	0.50	300	0.3	0.3	5.4	60	1	0.3	1.1	94
Max/Min Var.	1	1	5	1	6	4	3	1	33	9	4	4
95/5 Var.	1	1	2	1	4	4	2	1	8	4	3	3
85/15 Var.	1	1	2	1	2	2	2	1	3	2	2	2
75/25 Var.	1	1	2	1	2	2	1	1	3	1	1	2
dst5 (wr=so17)												
dst5 (wr=so17)												
% difference												
MC-24												
MC-24-RE												
% difference												
MC-1c	-3	-5	1.24	-500	1.3	0.6	8.4	-100	-1	1.7	1.8	180
MC-9	-3	-5	1.20	-500	0.9	0.5	8.3	-100	-1	1.5	1.8	160
% difference			**3**		**36**	**18**	**1**			**13**	**0**	**12**
MC-26c	-3	-5	1.92	-500	0.8	-0.5	10.0	-100	7	1.6	1.2	100
MC-26a	-3	-5	1.96	-500	1.2	-0.5	10.0	-100	7	1.6	1.3	110
% difference			**2**		**40**		**0**		**0**	**0**	**8**	**10**
MC-4c	-3	-5	1.74	-500	1.4	1.4	8.8	-100	2	6.9	4.1	390
MC-35c	-3	-5	1.61	-500	2.0	1.2	9.4	-100	2	6.3	4.1	230
% difference			**8**		**35**	**15**	**7**		**0**	**9**	**0**	**52**
ODM-REF												180

	Wt	Sb	As	Ba	Br	Ca	Ce	Cs	Cr	Co
	grams	ppm	ppm	ppm	ppm	Wt %	ppm	ppm	ppm	ppm
	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA
	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC
Detect. Limits		0.1	0.5	50	0.5	1	3	1	5	1
< substit. Val.		0.3		30	0.3	1		1		
Maximum n=31	23.01	7.3	539.0	220	9.3	9	4330	5	1290	238
95%ile n=31	21.51	6.7	269.5	180	6.8	8	3625	3	589	170
85%ile n=31	17.00	4.3	133.5	30	4.7	7	3280	2	475	110
75%ile n=31	15.53	3.9	83.1	30	4.1	6	2705	1	440	83
50%ile n=31	10.74	2.9	49.0	30	2.1	4	1980	1	340	62
25%ile n=31	5.81	2.2	33.0	30	0.3	2	1260	1	310	45
15%ile n=31	4.96	1.6	15.0	30	0.3	1	880	1	265	37
5%ile n=31	3.42	0.3	8.6	30	0.3	1	312	1	85	26
Minimum n=31	2.29	0.3	4.9	30	0.3	1	110	1	68	18
Max/Min Var.	10	24	110	7	31	9	39	5	19	13
95/5 Var.	6	22	32	6	23	8	12	3	7	7
85/15 Var.	3	3	9	1	16	7	4	2	2	3
75/25 Var.	3	2	3	1	14	3	2	1	1	2
dst5 (wr=so17)										
dst5 (wr=so17)										
% difference										
MC-24										
MC-24-RE										
% difference										
MC-1c	19.55	2.4	70.4	-50	1.6	2	220	-1	94	26
MC-9	19.65	2.3	67.8	80	2.2	2	230	-1	94	25
% difference	**1**	**4**	**4**		**32**	**0**	**4**		**0**	**4**
MC-26c	12.59	2.1	14.0	-50	2.4	8	776	-1	310	86
MC-26a	12.44	2.2	13.0	200	-2.1	7	826	-1	310	81
% difference	**1**	**5**	**7**			**13**	**6**		**0**	**6**
MC-4c	29.97	0.6	3.8	-50	1.4	11	81	-1	51	112
MC-35c	30.02	0.7	4.0	-50	1.6	11	80	-1	48	111
% difference	**0**	**15**	**5**		**13**	**0**	**1**		**6**	**1**
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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Eu	Au	Hf	Ir	Fe	La	Lu	Hg	Mo	Nd	Ni	Rb	Sm	Sc	Se	Ag	Na	Sr	Ta	Tb	Th	Sn	W	U	Yb	Zn
	ppm	ppb	ppm	ppb	Wt %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	Wt %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA
	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC
MC-1	7.3	218	181	3	23.40	1630.0	6.75	2	6	1240	60	15	200.0	89.9	2	3	0.23	300	35.0	14.0	822.0	60	1	36.0	30.9	180
MC-2	10.0	373	120	3	31.50	2110.0	4.90	2	6	1630	60	15	266.0	60.4	2	3	0.30	300	39.0	19.0	1140.0	60	1	47.0	18.0	30
MC-2a	7.3	72	72	3	28.70	934.0	2.60	2	6	720	60	15	122.0	52.5	2	3	0.31	300	22.0	8.6	474.0	60	1	20.0	10.0	110
MC-3	8.4	53	117	3	17.90	1210.0	4.40	2	6	972	60	15	160.0	85.3	2	3	0.30	300	32.0	11.0	580.0	60	5	28.0	20.0	290
MC-4	11.0	36	147	3	22.30	1850.0	5.33	2	6	1400	60	15	237.0	79.7	2	3	0.45	300	43.0	16.0	926.0	60	8	41.0	24.3	160
MC-4y	8.2	2680	120	3	23.50	965.0	4.30	2	6	777	60	15	130.0	59.1	2	3	0.42	300	17.0	11.0	443.0	60	1	26.0	21.4	190
MC-4x	1.6	8050	21	3	43.70	191.0	0.71	2	6	160	60	31	26.0	10.9	2	3	0.18	300	4.2	1.9	91.7	60	32	5.5	3.2	30
MC-5	12.0	98	155	3	25.40	1710.0	5.60	2	6	1240	60	15	217.0	75.7	2	3	0.48	300	35.0	16.0	830.0	60	1	37.0	24.8	130
MC-6a	7.4	65	103	3	29.70	984.0	3.70	2	6	765	60	15	127.0	57.3	2	3	0.43	300	22.0	8.9	482.0	60	18	22.0	17.0	120
MC-7	6.7	740	73	3	32.00	802.0	3.50	2	6	619	60	15	107.0	51.3	2	3	0.37	300	21.0	8.7	380.0	60	9	20.0	17.0	95
MC-8	6.9	455	80	3	21.80	685.0	3.40	2	6	581	60	37	96.3	63.0	2	3	0.35	300	28.0	7.6	303.0	60	14	18.0	17.0	230
MC-9	2.0	476	14	3	43.70	118.0	0.70	2	6	100	60	39	17.1	16.2	2	3	0.21	300	2.7	1.4	49.7	60	4	3.5	3.7	30
MC-10	5.6	2	73	3	22.10	598.0	2.50	2	6	511	60	15	81.9	51.9	2	3	0.41	300	18.0	5.6	255.0	60	39	14.0	11.0	230
MC-10a	5.0	244	64	3	21.40	441.0	2.30	2	6	360	60	15	61.3	54.3	2	3	0.41	300	14.0	5.1	184.0	60	53	13.0	12.0	180
MC-13	7.7	264	76	3	20.10	617.0	2.20	2	6	507	60	15	86.4	61.7	2	3	0.46	300	14.0	6.1	293.0	60	5	15.0	11.0	150
MC-14	11.0	2	210	3	15.10	1730.0	5.98	2	6	1280	60	15	221.0	85.7	2	3	0.43	300	42.0	16.0	815.0	60	23	40.0	24.5	290
MC-24	10.0	180	86	3	23.40	1280.0	4.80	2	6	1040	60	15	166.0	63.9	2	3	0.40	300	38.0	10.0	578.0	60	52	34.0	24.0	210
MC-25	6.2	396	69	3	17.40	661.0	3.10	2	6	552	60	37	88.5	57.9	2	3	0.42	300	20.0	6.6	284.0	60	34	20.0	15.0	170
MC-25a	11.0	140	137	3	23.00	1570.0	5.46	2	6	1210	500	15	193.0	65.5	2	3	0.34	300	42.0	13.0	675.0	60	1	37.0	25.4	240
MC-25b	10.0	190	154	3	21.10	1340.0	5.33	2	6	1080	60	15	172.0	70.0	2	3	0.38	300	35.0	12.0	548.0	60	1	34.0	25.7	130
MC-26a	4.1	228	44	3	15.30	383.0	2.00	2	6	320	350	15	53.4	50.8	2	3	0.33	300	11.0	4.4	172.0	60	38	11.0	10.0	110
MC-31	2.8	321	10	3	48.30	54.5	2.10	2	6	54	60	31	13.0	29.6	2	3	0.06	300	2.2	3.1	17.0	60	36	0.3	13.0	30
MC-33	8.5	2300	110	3	22.00	1080.0	4.20	2	6	864	60	45	140.0	60.3	2	3	0.39	300	31.0	10.0	475.0	60	35	30.0	20.0	220
MC-33a	8.4	645	149	3	28.90	1450.0	6.43	2	6	1180	60	15	188.0	66.2	2	3	0.26	300	42.0	14.0	717.0	60	23	47.0	29.9	160
MC-33b	8.0	970	132	3	24.10	1240.0	5.74	2	6	980	420	58	161.0	73.0	2	3	0.38	300	37.0	12.0	594.0	60	12	33.0	27.3	240
MC-34	6.9	504	62	3	22.70	599.0	2.90	2	6	480	300	20	82.9	61.9	2	3	0.40	300	21.0	6.4	255.0	60	6	16.0	15.0	300
MC-34a	9.4	20	94	3	20.60	963.0	3.90	2	6	789	60	15	131.0	67.1	2	3	0.52	300	28.0	10.0	420.0	60	1	25.0	20.1	200
MC-34b	4.6	7340	54	3	38.40	616.0	2.20	2	6	500	380	15	77.6	32.3	2	3	0.25	300	16.0	6.3	265.0	60	28	12.0	10.0	30
MC-35	3.8	4380	46	3	31.20	319.0	1.90	2	6	260	60	18	42.9	37.9	2	3	0.33	300	11.0	3.3	133.0	60	9	10.0	10.0	190
MC-35b	6.6	372	68	3	17.60	736.0	3.20	2	6	629	60	30	97.9	54.4	2	3	0.26	300	20.0	7.2	316.0	60	14	18.0	16.0	210
MC-36	7.2	140	106	3	21.70	1020.0	4.20	2	6	817	60	15	131.0	56.8	2	3	0.32	300	30.0	9.1	453.0	60	57	29.0	20.1	180
MC-35a	5.2	2	5	3	10.60	38.0	0.62	2	43	40	60	15	7.5	15.1	2	3	0.03	300	1.0	0.9	5.3	60	328	1.1	3.7	30

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	Eu	Au	Hf	Ir	Fe	La	Lu	Hg	Mo	Nd	Ni	Rb	Sm	Sc	Se	Ag	Na	Sr	Ta	Tb	Th	Sn	W	U	Yb	Zn
	ppm	ppb	ppm	ppb	Wt %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	Wt %	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA
	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC	HMC
Detect. Limits	0.2	2	1	5	0.01	0.5	0.05	1	1	5	20	15	0.1	0.1	3	5	0.01	500	0.5	0.5	0.2	100	1	0.5	0.2	50
< substit. Val.		2		3				2	6		60	15			2	3		300				60	1	0.3		30
Maximum n=31	12.0	8050	210	3	48.30	2110.0	6.75	2	6	1630	500	58	266.0	89.9	2	3	0.52	300	43.0	19.0	1140.0	60	57	47.0	30.9	300
95%ile n=31	11.0	5860	168	3	43.70	1790.0	6.21	2	6	1340	400	42	229.0	85.5	2	3	0.47	300	42.0	16.0	878.0	60	53	44.0	28.6	290
85%ile n=31	10.0	1635	148	3	31.75	1600.0	5.53	2	6	1225	180	34	196.5	74.4	2	3	0.43	300	38.5	14.0	766.0	60	37	37.0	25.1	235
75%ile n=31	9.0	575	126	3	29.30	1310.0	5.12	2	6	1060	60	25	169.0	66.7	2	3	0.42	300	35.0	12.0	587.0	60	33	34.0	24.2	215
50%ile n=31	7.3	264	86	3	23.00	963.0	3.70	2	6	765	60	15	127.0	60.3	2	3	0.37	300	22.0	8.9	443.0	60	12	22.0	17.0	180
25%ile n=31	5.9	119	66	3	21.25	607.5	2.40	2	6	504	60	15	82.4	52.2	2	3	0.30	300	16.5	6.2	260.0	60	3	14.5	11.5	115
15%ile n=31	4.4	59	50	3	19.00	412.0	2.15	2	6	340	60	15	57.4	44.4	2	3	0.26	300	12.5	4.8	178.0	60	1	11.5	10.0	63
5%ile n=31	2.4	11	18	3	16.35	154.5	1.31	2	6	130	60	15	21.6	22.9	2	3	0.20	300	3.5	2.5	70.7	60	1	4.5	6.9	30
Minimum n=31	1.6	2	10	3	15.10	54.5	0.70	2	6	54	60	15	13.0	10.9	2	3	0.06	300	2.2	1.4	17.0	60	1	0.3	3.2	30
Max/Min Var.	8	4025	21	1	3	39	10	1	1	30	8	4	20	8	1	1	9	1	20	14	67	1	57	157	10	10
95/5 Var.	5	533	10	1	3	12	5	1	1	10	7	3	11	4	1	1	2	1	12	6	12	1	53	10	4	10
85/15 Var.	2	28	3	1	2	4	3	1	1	4	3	2	3	2	1	1	2	1	3	3	4	1	37	3	3	4
75/25 Var.	2	5	2	1	1	2	2	1	1	2	1	2	2	1	1	1	1	1	2	2	2	1	13	2	2	2
dst5 (wr=so17)																										
dst5 (wr=so17)																										
% difference																										
MC-24																										
MC-24-RE																										
% difference																										
MC-1c	1.9	160	13	-5	46.00	111.0	0.67	-1	-3	91	-100	31	16.6	16.4	-3	-5	0.21	-500	2.9	1.4	48.7	-210	3	3.9	3.8	-50
MC-9	2.0	476	14	-5	43.70	118.0	0.70	-1	-4	100	-100	39	17.1	16.2	-3	-5	0.21	-500	2.7	1.4	49.7	-220	4	3.5	3.7	-50
% difference	**5**	**99**	**7**		**5**	**6**	**4**			**9**		**23**	**3**	**1**			**0**		**7**	**0**	**2**		**29**	**11**	**3**	
MC-26c	3.8	180	40	-15	15.50	363.0	1.90	-1	-9	310	-100	-15	5.0	52.8	-7	-5	0.31	-500	12.0	4.3	160.0	-400	39	10.0	10.0	89
MC-26a	4.1	228	44	-20	15.30	383.0	2.00	-1	-11	320	350	-15	53.4	50.8	-9	-5	0.33	-500	11.0	4.4	172.0	-440	38	11.0	10.0	110
% difference	**8**	**24**	**10**		**1**	**5**	**5**			**3**			**166**	**4**			**6**		**9**	**2**	**7**		**3**	**10**	**0**	**21**
MC-4c	5.4	-2	5	-5	10.80	38.0	0.63	-1	44	40	-100	-15	7.5	15.2	-3	-5	0.03	-500	0.7	0.8	5.5	-100	314	0.9	3.8	-50
MC-35c	5.5	-4	5	-5	10.60	38.0	0.61	-1	38	37	-100	-15	7.5	15.0	-3	-5	0.03	-500	0.8	0.8	5.3	-100	309	-0.5	3.7	-50
% difference	**2**		**0**		**2**	**0**	**3**		**15**	**8**			**0**	**1**			**0**		**13**	**0**	**4**		**2**		**3**	
ODM-REF																										

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	Tot-VG Raw-Ct ODM Till	Rshp-VG Raw-Ct ODM Till	Mod-VG Raw-Ct ODM Till	Pris-VG Raw-Ct ODM Till	Weight grams ODM <0.25mm	Tot-Au ppb ODM <0.25mm	Rshp-Au ppb ODM <0.25mm	Mod-Au ppb ODM <0.25mm	Pris-Au ppb ODM <0.25mm	Sample kg ODM Till	Tbl-Split kg ODM Till	Clasts kg ODM >2mm	Tbl-Feed kg ODM <2mm	Size pebble ODM >2mm	Vol/Sed % ODM >2mm	Gran. % ODM >2mm	Ls/Dol % ODM >2mm	Other % ODM >2mm	Sorting unsorted ODM <2mm	Sand normal ODM <2mm	Silt normal ODM <2mm
MC-1	0	0	0	0	5.3	0	0	0	0	11.6	11.1	1.6	9.5	P	Tr	100	0	0	U	Y	Y
MC-2	1	1	0	0	3.3	25	25	0	0	11.6	11.1	5.4	5.7	P	100	Tr	0	0	U	Y	Y
MC-2a	0	0	0	0	14.7	0	0	0	0	13.5	13.0	5.0	8.0	P	90	10	0	0	U	Y	Y
MC-3	0	0	0	0	4.3	0	0	0	0	14.2	13.7	6.1	7.6	P	90	10	0	0	U	Y	Y
MC-4	0	0	0	0	10.1	0	0	0	0	15.5	15.0	3.5	11.5	P	15	85	0	0	U	Y	Y
MC-4y	99	42	10	47	2.3	2700	1800	142	758	10.8	10.3	5.1	5.2	P	95	5	0	0	U	Y	Y
MC-4x	143	24	4	115	6.5	2206	140	28	2038	9.7	9.2	5.4	3.8	P	100	Tr	0	0	U	Y	Y
MC-5	2	2	0	0	14.5	31	31	0	0	13.8	13.3	3.3	10.0	P	80	20	0	0	U	Y	Y
MC-6a	2	2	0	0	1.8	152	152	0	0	14.3	13.8	6.3	7.5	P	20	80	0	0	U	Y	Y
MC-7	3	2	0	1	13.4	221	206	0	14	13.9	13.4	4.1	9.3	P	70	30	0	0	U	Y	Y
MC-8	2	0	1	1	5.8	69	0	64	4	12.7	12.2	5.9	6.3	P	20	80	0	0	U	Y	Y
MC-9	3	2	1	0	39.3	100	99	1	0	11.9	11.4	3.6	7.8	P	20	80	0	0	U	Y	Y
MC-10	0	0	0	0	5.1	0	0	0	0	11.7	11.2	2.5	8.7	P	90	10	0	0	U	Y	Y
MC-10a	0	0	0	0	11.8	0	0	0	0	16.3	15.8	4.9	10.9	P	80	20	0	0	U	Y	Y
MC-13	6	3	2	1	22.5	18	12	5	1	14.6	14.1	5.4	8.7	P	20	80	0	0	U	Y	Y
MC-14	1	1	0	0	17.8	5	5	0	0	15.0	14.5	2.5	12.0	P	20	80	0	0	U	Y	Y
MC-24	1	1	0	0	8.4	23	23	0	0	12.9	12.4	4.0	8.4	P	60	40	0	0	U	+	Y
MC-25	1	1	0	0	15.7	135	135	0	0	12.0	11.5	3.6	7.9	P	60	40	0	0	U	Y	Y
MC-25a	3	2	1	0	10.7	5	3	2	0	13.4	12.4	2.9	9.5	P	10	90	0	0	U	-	+
MC-25b	5	4	0	1	13.1	29	15	0	15	12.7	11.7	2.8	8.9	P	20	80	0	0	U	+	Y
MC-26a	3	2	0	1	25.0	30	23	0	8	13.2	12.2	5.5	6.7	P	90	10	0	0	U	+	Y
MC-31	6	2	2	2	16.2	8	0	7	2	11.5	10.5	6.5	4.0	P	100	Tr	0	0	U	Y	Y
MC-33	2	2	0	0	3.7	804	804	0	0	12.5	11.5	6.1	5.4	P	90	10	0	0	U	Y	Y
MC-33a	8	2	3	3	2.0	736	507	198	31	12.9	11.9	4.1	7.8	P	5	95	0	0	U	Y	Y
MC-33b	6	0	2	4	5.9	1133	0	757	376	12.5	11.5	3.9	7.6	P	20	80	0	0	U	Y	Y
MC-34	9	2	2	5	23.1	133	44	29	61	13.4	12.4	3.6	8.8	P	40	60	0	0	U	+	Y
MC-34a	2	0	2	0	20.7	27	0	27	0	13.1	12.1	3.7	8.4	P	20	80	0	0	U	Y	Y
MC-34b	641	4	5	632	7.5	2439	21	30	2389	12.2	11.2	6.2	5.0	P	100	Tr	0	0	U	Y	Y
MC-35	67	4	14	49	15.9	817	231	158	428	11.6	10.6	3.0	7.6	P	95	5	0	0	U	Y	Y
MC-35b	3	3	0	0	6.5	9	9	0	0	12.6	11.6	4.6	7.0	P	95	5	0	0	U	Y	Y
MC-36	1	1	0	0	11.5	2	2	0	0	12.2	11.2	2.8	8.4	P	20	80	0	0	U	Y	Y
MC-35a	0	0	0	0	497.4	0	0	0	0	14.5	13.5	4.7	8.8	P	0	100	0	0	U	Y	Y

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Tot-VG Raw-Ct ODM Till	Rshp-VG Raw-Ct ODM Till	Mod-VG Raw-Ct ODM Till	Pris-VG Raw-Ct ODM Till	Weight grams ODM <0.25mm	Tot-Au ppb ODM <0.25mm	Rshp-Au ppb ODM <0.25mm	Mod-Au ppb ODM <0.25mm	Pris-Au ppb ODM <0.25mm	Sample kg ODM Till	Tbl-Split kg ODM Till	Clasts kg ODM >2mm	Tbl-Feed kg ODM <2mm	Size pebble ODM >2mm	Vol/Sed % ODM >2mm	Gran. % ODM >2mm	Ls/Dol % ODM >2mm	Other % ODM >2mm	Sorting unsorted ODM <2mm	Sand normal ODM <2mm	Silt normal ODM <2mm
Detect. Limits																					
< substit. Val.																					
Maximum n=31	641	42	14	632	39.3	2700	1800	757	2389	16.3	15.8	6.5	12.0		100	100					
95%ile n=31	121	14	8	82	24.1	2323	655	178	1398	15.3	14.8	6.3	11.2		100	94					
85%ile n=31	9	4	3	5	19.3	810	179	47	218	14.3	13.8	6.0	9.5		95	81					
75%ile n=31	6	2	2	2	15.8	186	117	28	15	13.7	13.2	5.4	8.9		90	80					
50%ile n=31	2	2	0	0	10.7	29	15	0	0	12.7	11.9	4.1	7.9		65	60					
25%ile n=31	1	0	0	0	5.6	5	0	0	0	12.0	11.2	3.4	6.9		20	10					
15%ile n=31	0	0	0	0	4.0	0	0	0	0	11.6	11.1	2.9	5.6		20	10					
5%ile n=31	0	0	0	0	2.2	0	0	0	0	11.2	10.4	2.5	4.5		12	5					
Minimum n=31	0	0	0	0	1.8	0	0	0	0	9.7	9.2	1.6	3.8		5	5					
Max/Min Var.															20	20					
95/5 Var.															8	19					
85/15 Var.															5	8					
75/25 Var.															5	8					
dst5 (wr=so17)																					
dst5 (wr=so17)																					
% difference																					
MC-24																					
MC-24-RE																					
% difference																					
MC-1c																					
MC-9																					
% difference																					
MC-26c																					
MC-26a																					
% difference																					
MC-4c																					
MC-35c																					
% difference																					
ODM-REF																					

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Appendix C. Till Geochemistry Results for 31 Vermilion Till Samples (includes substitutions for <) plus summary statistics and precision pairs.

	Clay normal ODM <2mm	Org present ODM <2mm	Colour color ODM Sand	Colour color ODM Clay	Sample Type ODM Till	Weight grams ODM TblConc	Weight grams ODM HLL-Lite	Weight grams ODM Tot-HMC	Weight grams ODM magHMC	Weight grams ODM nmHMC	nmHMC grams ODM <0.25mm	nmHMC grams ODM >0.25mm	silt/clay grams ODM Tot-sub	Weight grams ODM >63sub	Weight grams ODM <63sub	Total-VG Norm-Cnt DNR Till	Rshp-VG Norm-Ct DNR Till	Mod-VG Norm-Ct DNR Till	Pris-VG Norm-Ct DNR Till	HMC-Au ppb DNR Tbl-Feed	Conc-x nmHMC DNR Till
MC-1	Y	N	MOC	MOC	TILL	671.7	660.5	11.2	1.4	9.8	5.3	4.5	425.1	337.8	87.3	0.0	0.0	0.0	0.0	0.12	1792
MC-2	Y	N	MOC	MOC	TILL	330.0	322.6	7.4	2.9	4.5	3.3	1.2	421.8	390.1	31.7	1.8	1.8	0.0	0.0	0.22	1727
MC-2a	Y	N	MOC	MOC	TILL	974.8	931.8	43.0	16.9	26.1	14.7	11.4	492.9	419.9	73.0	0.0	0.0	0.0	0.0	0.13	544
MC-3	Y	N	MOC	MOC	TILL	662.0	655.1	6.9	1.5	5.4	4.3	1.1	756.5	694.0	62.5	0.0	0.0	0.0	0.0	0.03	1767
MC-4	Y	N	BE	BE	TILL	837.6	816.4	21.2	6.0	15.2	10.1	5.1	437.9	366.4	71.5	0.0	0.0	0.0	0.0	0.03	1139
MC-4y	Y	N	MOC	MOC	TILL	368.8	363.9	4.9	1.9	3.0	2.3	0.7	436.8	363.7	73.1	190.4	80.8	19.2	90.4	1.19	2261
MC-4x	Y	N	MOC	MOC	TILL	318.0	289.3	28.7	7.0	21.7	6.5	15.2	428.1	353.7	74.4	376.3	63.2	10.5	302.6	13.77	585
MC-5	Y	N	BE	BE	TILL	834.5	800.1	34.4	12.8	21.6	14.5	7.1	485.3	431.2	54.1	2.0	2.0	0.0	0.0	0.14	690
MC-6a	Y	N	MOC	MOC	TILL	416.6	391.9	24.7	12.0	12.7	1.8	10.9	516.4	456.5	59.9	2.7	2.7	0.0	0.0	0.02	4167
MC-7	Y	N	MOC	MOC	TILL	545.0	499.2	45.8	17.0	28.8	13.4	15.4	515.0	432.4	82.6	3.2	2.2	0.0	1.1	1.07	694
MC-8	Y	N	BE	BE	TILL	559.1	548.8	10.3	2.5	7.8	5.8	2.0	423.3	364.0	59.3	3.2	0.0	1.6	1.6	0.42	1086
MC-9	Y	N	MOC	MOC	TILL	436.3	315.1	121.2	16.7	104.5	39.3	65.2	392.3	340.9	51.4	3.8	2.6	1.3	0.0	2.40	198
MC-10	Y	N	GY	GY	TILL	421.4	408.2	13.2	5.3	7.9	5.1	2.8	399.8	361.7	38.1	0.0	0.0	0.0	0.0	0.00	1706
MC-10a	Y	N	MOC	MOC	TILL	571.2	507.1	64.1	40.2	23.9	11.8	12.1	402.0	265.4	136.6	0.0	0.0	0.0	0.0	0.26	924
MC-13	Y	N	MOC	MOC	TILL	708.2	665.5	42.7	6.8	35.9	22.5	13.4	414.0	383.0	31.0	6.9	3.4	2.3	1.1	0.68	387
MC-14	Y	N	BE	BE	TILL	709.2	683.6	25.6	0.8	24.8	17.8	7.0	351.0	234.3	116.7	0.8	0.8	0.0	0.0	0.00	674
MC-24	-	N	LOC	LOC	TILL	671.0	655.9	15.1	3.3	11.8	8.4	3.4	432.9	391.7	41.2	1.2	1.2	0.0	0.0	0.18	1000
MC-25	Y	N	LOC	LOC	TILL	609.2	580.3	28.9	5.8	23.1	15.7	7.4	455.8	406.8	49.0	1.3	1.3	0.0	0.0	0.79	503
MC-25a	Y	N	MOC	MOC	TILL	403.4	384.4	19.0	5.3	13.7	10.7	3.0	396.6	327.6	69.0	3.2	2.1	1.1	0.0	0.16	888
MC-25b	-	N	BE	BE	TILL	621.2	598.9	22.3	5.2	17.1	13.1	4.0	391.9	300.0	91.9	5.6	4.5	0.0	1.1	0.28	679
MC-26a	-	N	MOC	MOC	TILL	623.4	572.6	50.8	6.3	44.5	25.0	19.5	464.9	410.9	54.0	4.5	3.0	0.0	1.5	0.85	268
MC-31	Y	N	DOC	DOC	TILL	281.4	240.2	41.2	1.6	39.6	16.2	23.4	415.2	378.0	37.2	15.0	5.0	5.0	5.0	1.30	247
MC-33	Y	N	MOC	MOC	TILL	244.1	237.7	6.4	2.1	4.3	3.7	0.6	420.1	372.2	47.9	3.7	3.7	0.0	0.0	1.58	1459
MC-33a	Y	N	MOC	MOC	TILL	315.7	305.2	10.5	3.7	6.8	2.0	4.8	436.0	392.9	43.1	10.3	2.6	3.8	3.8	0.17	3900
MC-33b	Y	N	LOC	LOC	TILL	446.3	432.1	14.2	5.1	9.1	5.9	3.2	460.4	406.1	54.3	7.9	0.0	2.6	5.3	0.75	1288
MC-34	-	N	LOC	LOC	TILL	690.1	641.7	48.4	12.6	35.8	23.1	12.7	520.0	463.8	56.2	10.2	2.3	2.3	5.7	1.32	381
MC-34a	Y	N	LOC	LOC	TILL	479.7	441.3	38.4	11.2	27.2	20.7	6.5	456.3	393.0	63.3	2.4	0.0	2.4	0.0	0.05	406
MC-34b	Y	N	DOC	DOC	TILL	341.0	325.5	15.5	4.1	11.4	7.5	3.9	409.9	375.7	34.2	1282.0	8.0	10.0	1264.0	11.01	667
MC-35	Y	N	MOC	MOC	TILL	582.3	483.1	99.2	73.5	25.7	15.9	9.8	433.5	395.1	38.4	88.2	5.3	18.4	64.5	9.16	478
MC-35b	Y	N	MOC	MOC	TILL	259.1	249.5	9.6	1.5	8.1	6.5	1.6	454.0	414.5	39.5	4.3	4.3	0.0	0.0	0.35	1077
MC-36	Y	N	DOC	DOC	TILL	340.1	319.9	20.2	6.2	14.0	11.5	2.5	443.1	385.8	57.3	1.2	1.2	0.0	0.0	0.19	730
MC-35a	Y	N	DOC	DOC	TILL	811.2	146.2	665.0	0.1	664.9	497.4	167.5	444.4	408.9	35.5	0.0	0.0	0.0	0.0	0.14	18

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	Clay normal ODM <2mm	Org present ODM <2mm	Colour color ODM Sand	Colour color ODM Clay	Sample Type ODM Till	Weight grams ODM TblConc	Weight grams ODM HLL-Lite	Weight grams ODM Tot-HMC	Weight grams ODM magHMC	Weight grams ODM nmHMC	nmHMC grams ODM <0.25mm	nmHMC grams ODM >0.25mm	silt/clay grams ODM Tot-sub	Weight grams ODM >63sub	Weight grams ODM <63sub	Total-VG Norm-Cnt DNR Till	Rshp-VG Norm-Ct DNR Till	Mod-VG Norm-Ct DNR Till	Pris-VG Norm-Ct DNR Till	HMC-Au ppb DNR Tbl-Feed	Conc-x nmHMC DNR Till
Detect. Limits																					
< substit. Val.																					
Maximum n=31						974.8	931.8	121.2	73.5	104.5	39.3	65.2	756.5	694.0	136.6	1282.0	80.8	19.2	1264.0	13.77	4167
95%ile n=31						836.1	808.3	81.7	28.6	42.1	24.1	21.5	518.2	460.2	104.3	283.4	35.6	14.5	196.5	10.09	3081
85%ile n=31						699.2	663.0	47.1	14.8	32.3	19.3	14.3	489.1	425.6	78.5	12.7	4.8	4.4	5.5	1.45	1747
75%ile n=31						666.5	648.4	42.0	11.6	25.9	15.8	11.8	458.4	408.9	72.3	7.4	3.6	2.4	2.7	1.13	1374
50%ile n=31						545.0	483.1	22.3	5.3	15.2	10.7	5.1	433.5	385.8	56.2	3.2	2.1	0.0	0.0	0.28	730
25%ile n=31						354.9	324.1	12.2	2.7	8.6	5.6	2.9	414.6	362.7	42.2	1.2	0.0	0.0	0.0	0.14	524
15%ile n=31						324.0	310.2	10.0	1.8	7.3	4.0	1.8	400.9	339.4	38.3	0.0	0.0	0.0	0.0	0.04	397
5%ile n=31						270.3	244.9	6.7	1.5	4.4	2.2	0.9	392.1	282.7	33.0	0.0	0.0	0.0	0.0	0.01	258
Minimum n=31						244.1	237.7	4.9	0.8	3.0	1.8	0.6	351.0	234.3	31.0	0.0	0.0	0.0	0.0	0.00	198
Max/Min Var.						4	4	25	92	35	22	109	2	3	4					13770	21
95/5 Var.						3	3	12	20	10	11	24	1	2	3					1062	12
85/15 Var.						2	2	5	8	4	5	8	1	1	2					36	4
75/25 Var.						2	2	3	4	3	3	4	1	1	2					8	3
dst5 (wr=so17)																					
dst5 (wr=so17)																					
% difference																					
MC-24																					
MC-24-RE																					
% difference																					
MC-1c																					
MC-9																					
% difference																					
MC-26c																					
MC-26a																					
% difference																					
MC-4c																					
MC-35c																					
% difference																					
ODM-REF																					

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Appendix D. Pebble Counts for +3/8-5/8" (9.5-16mm) Fraction of Till Samples.

MC-	34b	35a	31	3	04x	04y	2	35b	33	26a	35	8	9	24	10	10a	33a	02a	13	25	7	34	36	06a	34a	14	25a	33b	5	25b	4	1
% SC	**100**	**100**	**100**	**100**	**99**	**99**	**98**	**97**	**96**	**96**	**96**	**94**	**92**	**87**	**86**	**86**	**84**	**82**	**80**	**67**	**67**	**64**	**62**	**50**	**48**	**44**	**43**	**43**	**27**	**20**	**14**	**4**
Quetico	**3**	**0**	**3**	**3**	**5**	**8**	**13**	**10**	**30**	**24**	**11**	**41**	**19**	**58**	**25**	**62**	**69**	**91**	**100**	**115**	**119**	**100**	**78**	**356**	**184**	**136**	**170**	**177**	**240**	**225**	**256**	**127**
granitoid	3	0	2	3	5	8	13	10	29	22	11	41	18	51	25	46	62	77	77	104	89	80	78	300	142	119	146	106	176	165	251	73
metased	0	0	1	0	0	0	0	0	1	2	0	0	1	7	0	16	7	14	21	11	30	20	0	56	42	17	24	61	64	60	5	54
Vermilion	**880**	**399**	**814**	**631**	**557**	**537**	**726**	**373**	**701**	**606**	**248**	**636**	**222**	**387**	**151**	**393**	**367**	**415**	**392**	**233**	**241**	**180**	**126**	**363**	**168**	**107**	**127**	**135**	**87**	**55**	**41**	**5**
(q)fp/tuff	0	0	0	0	0	0	0	0	19	22	0	199	0	0	38	239	320	0	0	8	31	0	0	25	7	0	0	82	0	15	0	0
basalt	0	0	0	0	0	0	13	368	2	580	74	21	64	0	0	88	37	305	88	203	79	34	106	310	0	0	29	44	82	14	35	4
mafic volc.	0	0	0	628	0	0	0	0	0	0	39	409	82	179	29	0	7	0	4	0	0	118	0	0	128	83	89	0	0	0	0	0
chlor shear	0	0	640	0	0	536	0	0	0	0	0	0	0	196	0	0	0	0	300	0	0	0	0	0	0	0	0	0	0	0	0	0
sericite shear	880	0	0	0	0	0	712	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	17	0	0
siltstone	0	0	0	0	0	0	0	0	668	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
magnetic fe fm	0	0	0	0	152	0	0	0	0	1	82	0	3	0	2	18	0	41	0	1	6	4	0	3	7	0	5	0	0	4	0	0
nmag fe fm	0	0	0	0	404	0	0	1	2	1	58	0	65	0	3	48	0	69	0	4	10	14	0	13	4	0	4	3	2	1	0	0
quartzose	0	0	174	3	1	1	1	4	0	0	0	6	8	12	1	2	0	0	0	1	4	3	9	0	2	10	0	4	3	0	0	1
undiff SC	0	27	0	0	0	0	0	0	0	0	3	1	0	0	0	0	3	0	0	0	0	7	11	0	17	14	0	0	0	0	6	0
epidote-rich	0	372	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gray schist/silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
f.g gabbro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
gray chrty sed.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108	0	0	0	0	0	0	0	0	0	0	0
Total Cnt.	883	399	817	634	562	545	739	383	731	630	0	677	241	445	176	455	436	506	492	348	360	280	204	719	352	243	297	312	327	280	297	132

Supracrustal Percentages																																
Vermilion																																
(q)fp/tuff	0	0	0	0	0	0	0	0	3	4	0	31	0	0	25	61	87	0	0	3	13	0	0	7	4	0	0	61	0	27	0	0
basalt	0	0	0	0	0	0	2	99	0	96	30	3	29	0	0	22	10	73	22	87	33	19	84	85	0	0	23	33	94	25	85	80
mafic volc.	0	0	0	100	0	0	0	0	0	0	16	64	37	46	19	0	2	0	1	0	0	66	0	0	76	78	70	0	0	0	0	0
chlor shear	0	0	79	0	0	100	0	0	0	0	0	0	0	51	0	0	0	0	77	0	0	0	0	0	0	0	0	0	0	0	0	0
sericite shear	100	0	0	0	0	0	98	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	31	0	0
siltstone	0	0	0	0	0	0	0	0	95	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
magnetic fe fm	0	0	0	0	27	0	0	0	0	0	33	0	1	0	1	5	0	10	0	0	2	2	0	1	4	0	4	0	0	7	0	0
nmag fe fm	0	0	0	0	73	0	0	0	0	0	23	0	29	0	2	12	0	17	0	2	4	8	0	4	2	0	3	2	2	2	0	0
quartzose	0	0	21	0	0	0	0	1	0	0	0	1	4	3	1	1	0	0	0	0	2	2	7	0	1	9	0	3	3	0	0	20
undiff SC	0	7	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	4	9	0	10	13	0	0	0	0	15	0
epidote-rich	0	93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
gray schist/silt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	52	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
f.g. gabbro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
gray cherty sed.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45	0	0	0	0	0	0	0	0	0	0	0