DNR Open-File Project 392: Regional Survey of Gold in Till, Cook Area, St. Louis County

Pebble Counts and Assay Data

Andrea D. Reed, M.Sc.

Lands and Minerals Division

Mineral Potential Evaluation Section

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Publication Notification

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Minnesota Dept. of Natural Resources
Lands and Minerals Division
Central Office
500 Lafayette Road
St. Paul, Minnesota 55155-4049
Tel: (651) 259-5959

Minnesota Dept. of Natural Resources
Lands and Minerals Division
Drill Core Library and Mineral Exploration Archives
1525 3rd Avenue East
Hibbing, Minnesota 55746
Tel: (218)-231-8484

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Abstract

The Minnesota Department of Natural Resources (DNR) manages mineral rights on approximately 12 million acres of land in the state of Minnesota. The royalties and rentals on these lands help to fund Minnesota's School and University Trusts, the state General Fund, and local governments. In order to better manage the State's mineral interests the DNR maintains and collects mineral exploration data.

This project, *Pebble Counts and Assay Data*, is a small part of the much larger DNR Open-File Project 392: Regional Survey of Gold in Till, Cook Area, St. Louis County (Project 392). Project 392 took till samples from state-managed mineral rights in the Wawa geological subprovince, which is historically known for hosting gold deposits in Ontario and Quebec. In this part of Project 392, pebbles contained within collected till samples were examined in an attempt to determine if there are any correlations between high concentrations of gold grains and rock type.

A visual assessment showed that nearly all pebbles are generally common to Archean granite-greenstone subprovinces. More silica-rich or strongly cemented rock tends to be more angular. Angularity of clasts increases somewhat with decreasing clast size. A map showing the distribution of rock types along with the associated gold grain shapes revealed a possible glacial dispersal train in the eastern portion of the Project 392 area.

Assay results generally indicate that the gold content of the pebbles is below the detection limit for the method used. However, there were some anomalous findings. Greenstone rocks (metabasalt to meta-andesite) were the most likely to have an anomalous assay, though the highest gold anomalies occur in rocks that are not greenstone, such as metasediment or rhyolite. Follow-up semi-quantitative XRF work showed only a slight elevation in gold pathfinder elements in some metasedimentary pebbles.

Overall, this study found that there are no definite correlations between the assay values of specific rock types and gold grain counts. The distribution of anomalous assay values suggest that gold mineralization may occur most often where there are changes in rock types. To aid in identifying where changes in rock types occur, a study on dispersal trains in the area may be a possible solution.

Introduction

The Minnesota Department of Natural Resources (DNR) manages mineral rights on approximately 12 million acres of land in the state of Minnesota. The royalties and rentals on these lands help to fund Minnesota's School and University Trusts, the state General Fund, and local governments.

The DNR maintains and collects mineral exploration data, in order to improve the earnings for the Trusts and the General Fund from leasing state mineral holdings. This data is collected from the efforts of private companies looking for mineral deposits in accordance with State Statute and Administrative Rule (MN Statute 103I.605; MN Administrative Rule 6125.0700). Some private mineral exploration and mining companies voluntarily donate their historical data as project and funding cycles end. A third method of data accumulation is conducted by the DNR itself, which sends geologists into the field to look for interesting geological trends using geophysical, geochemical, and other sampling techniques.

As it so happens, a majority of these State-managed mineral rights are located in northeastern Minnesota (Figure 1), covering three geological subprovinces of the Canadian Shield: the Wawa, Quetico, and Wabigoon. The Wawa and Wabigoon subprovince in particular have a long history of mining along their stretches through Ontario and Quebec. Mining camps in Ontario along these subprovinces stop at the Minnesota border (Figure 2). Geologists know that the rocks continue on; the hopes of mineable minerals continuing on the Minnesota side of the subprovinces have always been high.

This project, *Pebble Counts and Assay Data*, is a small part of the much larger DNR Open-File Project 392: Regional Survey of Gold in Till, Cook Area, St. Louis County (Project 392). Project 392 took till samples from state-managed mineral rights in the Wawa subprovince, which is historically known for hosting gold mineralization in Ontario and Quebec. After collection, the Minnesota tills were examined for grains of gold. Samples with pristine gold grains indicate that the gold came from a nearby source, whereas gold grains that have been reshaped indicate a more distance source for the gold (Figure 3). *Pebble Counts and Assay Data* examines the rocks collected in the till samples in an attempt to determine if there are any correlations between high concentrations of gold grains and rock type. Such a correlation may indicate a host lithology or lithologies for the apparently local gold occurring in the area.

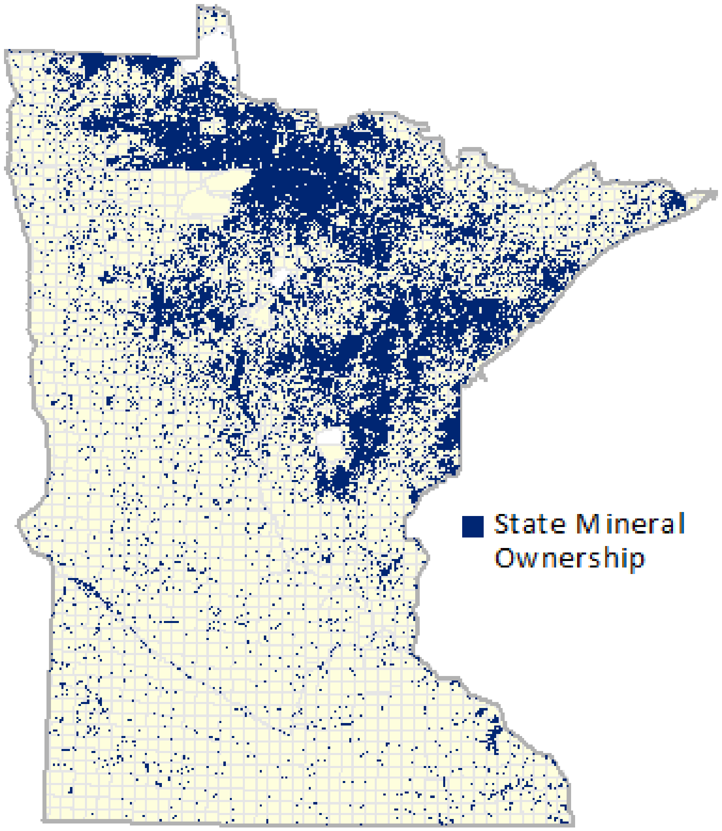

Figure 1: Distribution of State-owned minerals in Minnesota. Each dark blue point represents a 40-acre tract. Adapted from Minnesota Minerals Coordinating Committee (2016).

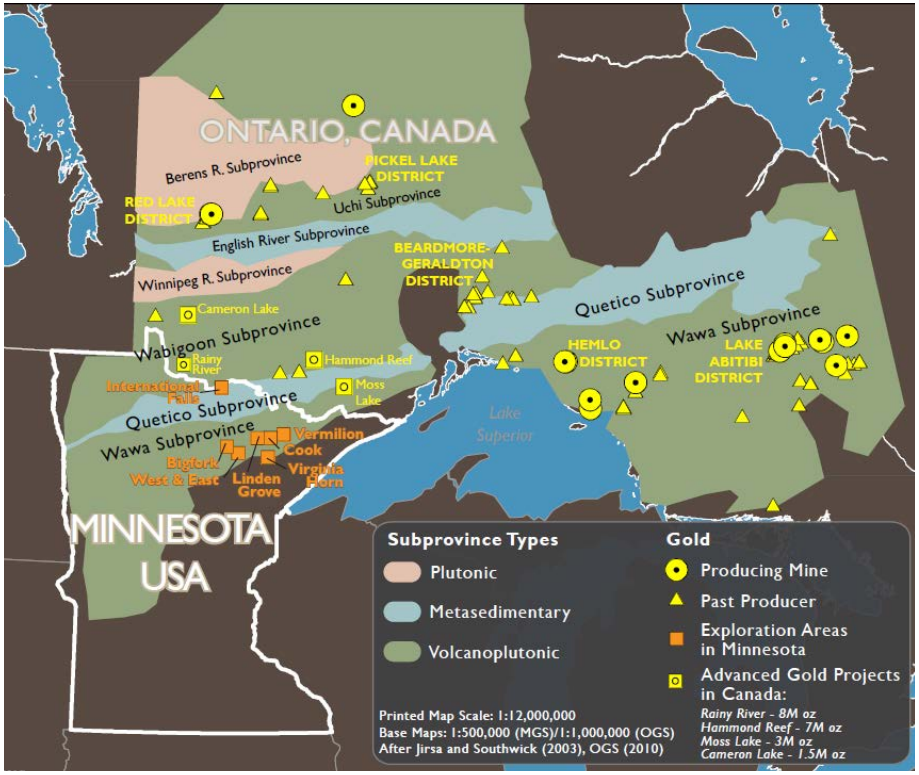

Figure 2: Current exploration projects, currently producing mines, and past producing mines in the Wawa and Wabigoon subprovinces in Ontario. Exploration projects are denoted by the orange squares in Minnesota. Adapted from Minnesota Department of Natural Resources (2016a).

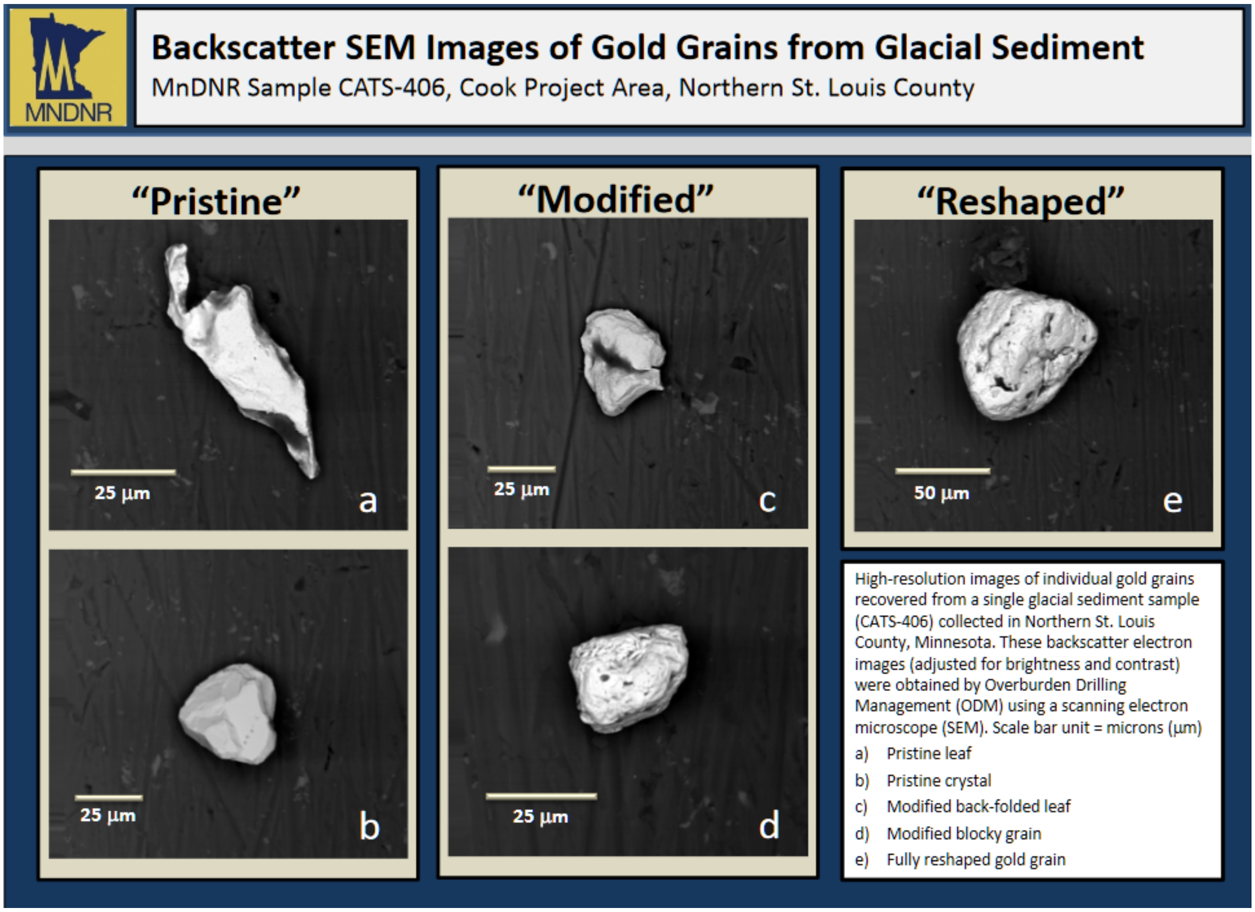

Figure 3: Examples of pristine, modified, and reshaped gold grains. Adapted from Elsenheimer (2016).

Project Location and Land Tenure

Project 392 glacial till samples were collected in northern St. Louis County, Minnesota in an area that covers approximately 267 square miles. It is bounded to the north by Lake Vermilion, to the east by Bear Head Lake State Park, changes to the bedrock geology that is less favorable to hosting gold mineralization in the south, and active mineral leasing to the east.

Pebble Counts and Assay Data samples were primarily selected from focus areas within the greater Project 392 that showed high counts of pristine gold grains. These focus areas are located in the eastern portion of the Project 392 area (Figure 4).

The State of Minnesota manages mineral rights in slightly more than half of the Project 392 area. Most of those mineral rights on tax forfeited lands, with potential revenues going to the local communities. The next largest potential mineral revenue beneficiary in the area is the State's Permanent School Funds. The remainder of any potential revenue earned goes to the General Fund. This same potential revenue distribution pattern holds in the *Pebble Counts and Assay Data* focus areas, with the State managing most of the mineral rights.

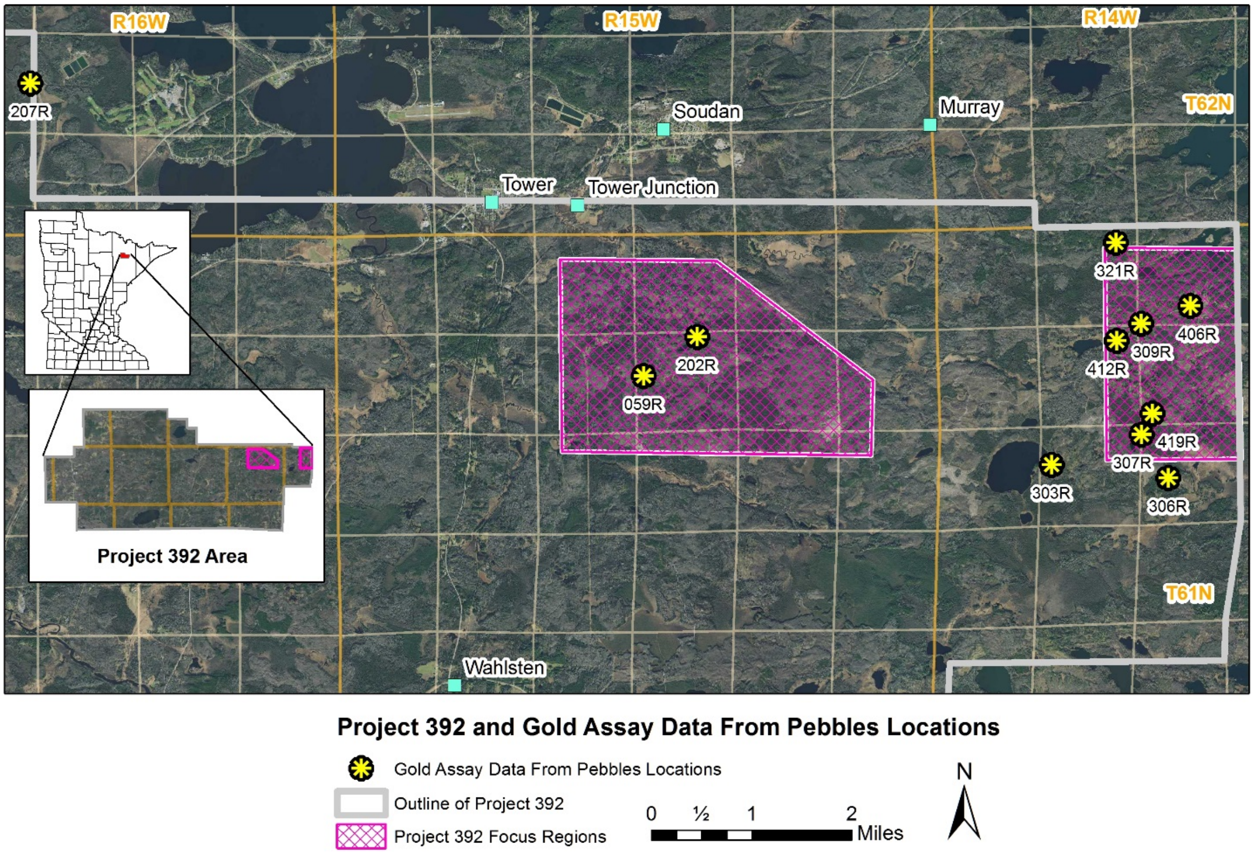

Figure 4: Location of Project 392 as well as the locations and names of till samples selected for *Pebble Counts and Assay Data*. Town locations adapted from United States Geological Survey (2015).

Access, Climate, Physiography, Land Use, and Infrastructure

The Project 392 is easily accessible from US Highway 53 (for western sample sites) and Minnesota Highway 169 (for eastern sample sites and focus regions). Individual sample locations are typically accessed from local county roads and logging trails.

Climate is characteristic of the northern United States, with cold winters and warm summers. Snow usually covers the ground between the months of December and April. The arrival of spring in April and May can make access to the area difficult, with many roads having weight restrictions placed upon them. Logging trails can become impassable from the snow-melt in the spring or after heavy rains.

Primarily, the topography consists of bedrock-controlled low hills with wetlands occupying the valleys between them. A glacial moraine of the Rainy lobe provides a low topographic high oriented roughly east-west in the area.

Land use follows the trends provided by the topography and climate. The majority of the land is forested, with roughly half of it being wetlands: a major land use consists of forestry products as well as hunting and motorized recreational pursuits. Small amounts of land within the Project 392 area are used for agriculture, sand and gravel operations, and residential/business development, particularly in the small populated areas around the edges of the area and some of the interior (USGS 2011, Minnesota Department of Natural Resources 1990s).

Water and power are available in the Project 392 area. In addition to road access, at the time of this writing, there is CN-operated rail line that is routed through the western portion of the area (Figure 5). A local workforce is available from the area; additional labor, along with mine suppliers and educators, can be located on the taconite-mining Mesabi Iron Range, a short distance to the south.

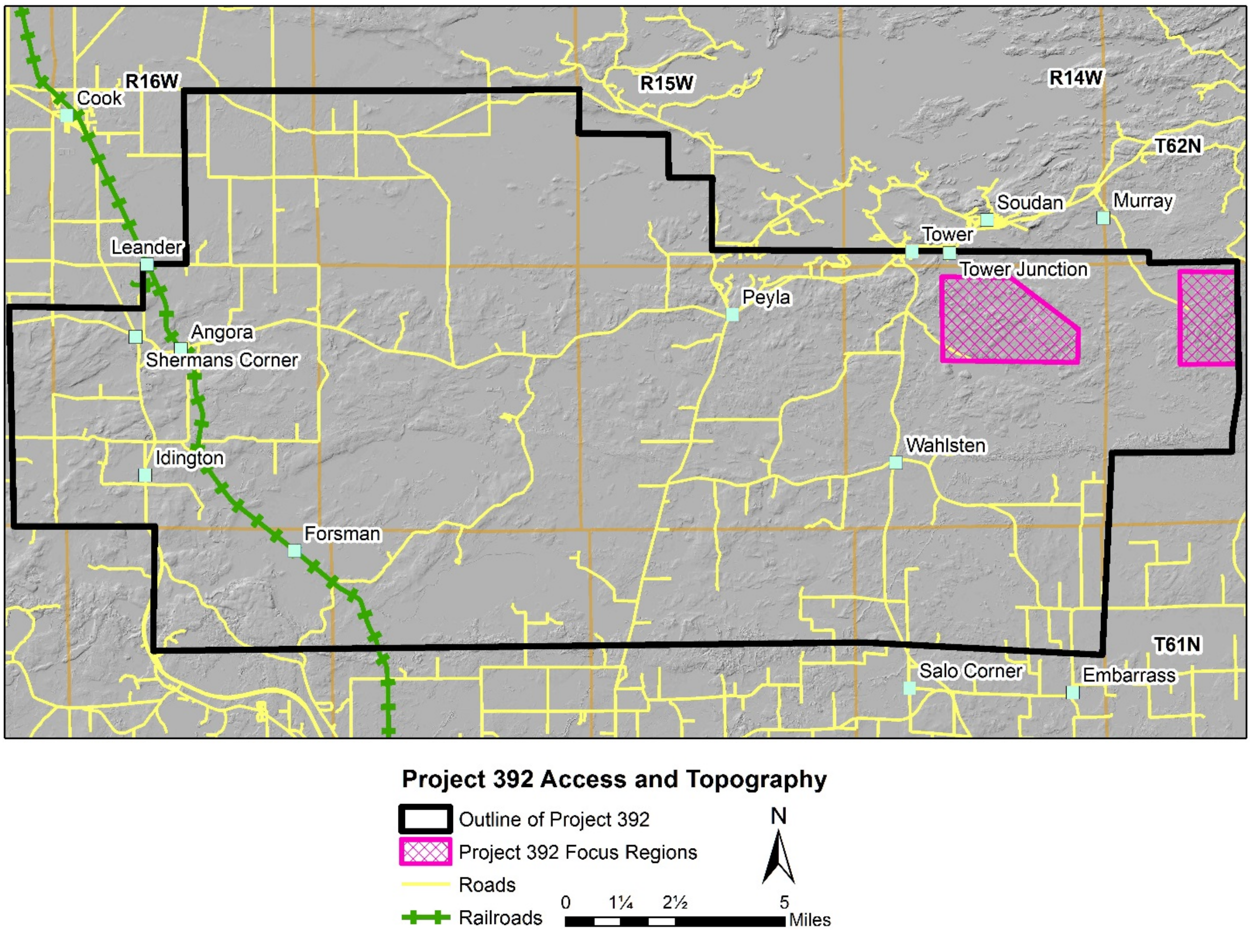

Figure 5: Map showing the location of roads and a railroad in the Project 392 area. The background of the image is a three-meter resolution LiDAR image showing changes in elevation. Total relief is approximately 300 feet. Adapted from United States Geological Survey (2015); Minnesota Department of Transportation (2008); Minnesota Department of Transportation (2012); and Minnesota Department of Natural Resources and Minnesota Geospatial Information Office (2012).

Surficial and Bedrock Geology

The surficial geology in the Project 392 area of interest primarily consists of ground moraine from the Rainy Lobe as well as segments of end moraine of the Rainy Lobe. In the north western part of the area, lake modified till from the Des Moines Lobe is also present. In the north and the southwest areas of Project 392, there are patches of peat (Minnesota Geological Survey and Minnesota Geospatial Information Office, 1982; Figure 6).

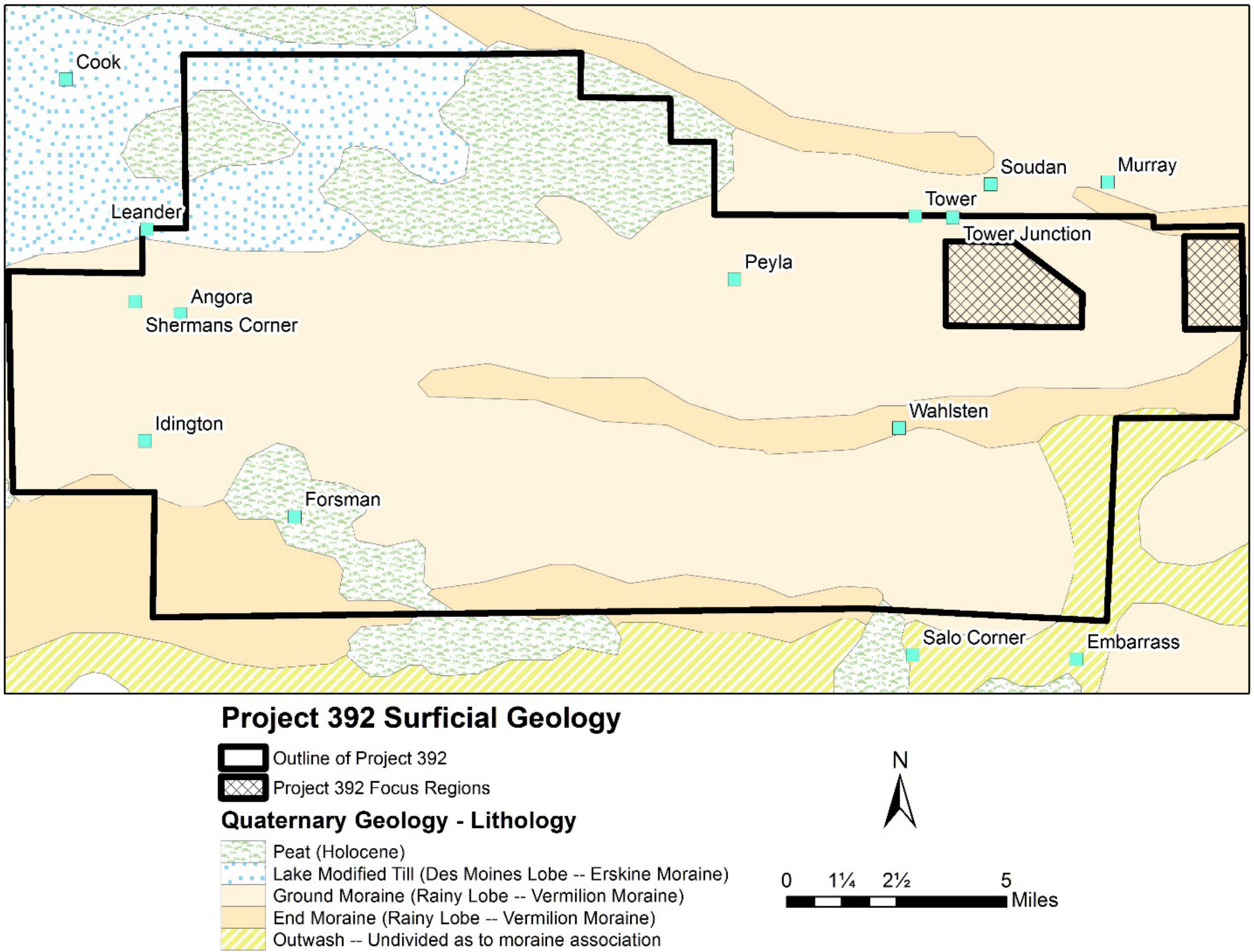

Figure 6: Surficial geologic map of Project 392. Modified from Minnesota Geological Survey and Minnesota Geospatial Information Office (1982) and United States Geological Survey (2015).

As is common with the geology of the Wawa subprovince, the bedrock is best generalized as "greenstone belt." A greenstone belt mostly contains sequences of basaltic and andesitic lava flows. Interspersed between these lava flows, there are also oceanic basin sedimentary packages (greywackes and iron formations) mixed with volcanic ash flows. Intrusions of mafic to felsic material occurs throughout the area, with more intrusions located to the southwest. A few periods of regional deformation resulted in ductile folding, greenschist to amphibolite-facies metamorphism, as well as shearing and faulting. Several major faults bisect the Project 392 area and have slight southwest-northeast trends (Minnesota Geological Society 2011, Jirsa *et al*. 2016, Severson 2011; Figure 7).

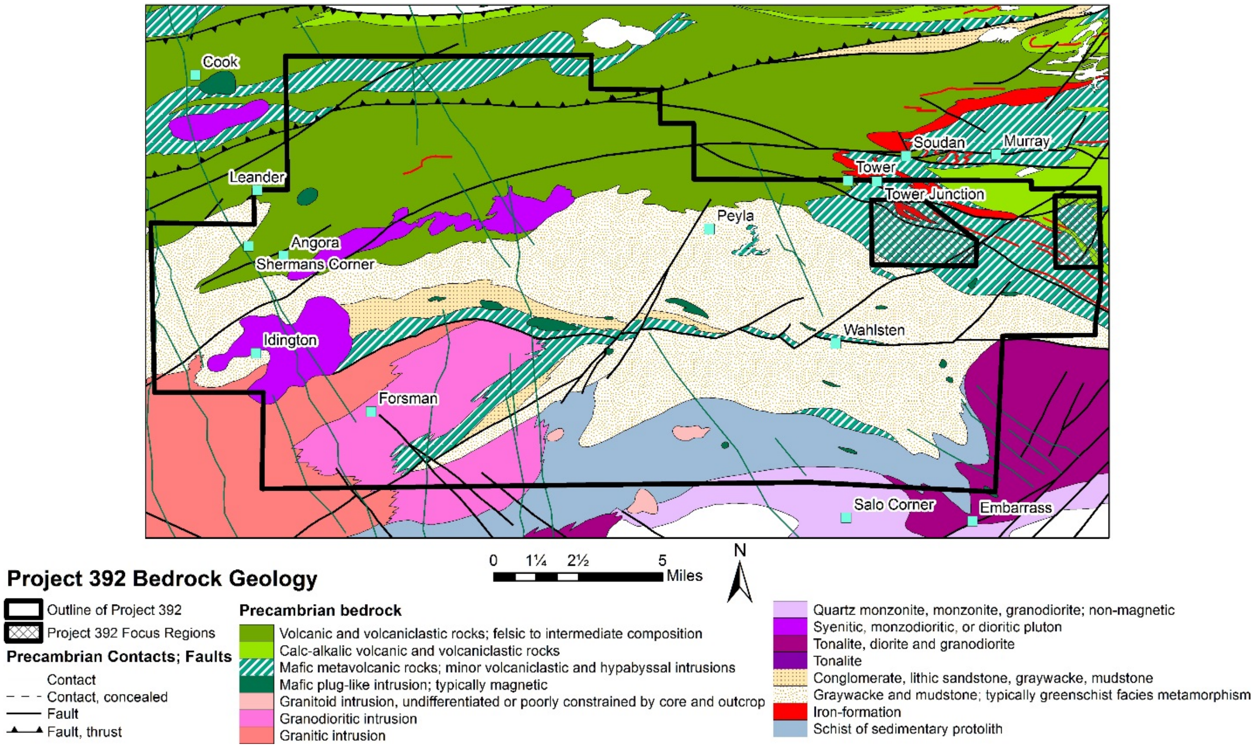

Figure 7: Geologic map of Project 392. Modified from Minnesota Geological Society (2011) and United States Geological Survey (2015).

Mineral Exploration and Development

There is a very long history of mineral exploration around and within the Project 392 area, starting with a gold rush in 1865 (Dahl 2005). Gold was not found in any profitable amounts and explorers in the area soon turned their interest to iron deposits in the area instead. Iron exploration resulted in the Soudan Mine, located just to the northeast of Project 392. The Soudan Mine operated from 1882 until 1963 (Minnesota Department of Natural Resources 2016b).

Mineral exploration experienced a resurgence in the region starting in the 1960s, taking advantage of nearly a century's worth of technological improvements since the last time the area was heavily explored. With the minor exceptions of periodic negative changes in the political climate and commodities markets, mineral exploration has continued in the area since the 1960s to the present, with a particular emphasis on gold in the more recent years (Dahl 2005, Severson 2011).

Deposit Types and Mineral Potential

The mineral potential for gold in the bedrock of Project 392 is relatively high, due to favorable geology (Severson 2011). However, due to the swamp and glacial cover, it is difficult to determine exactly where and what form a deposit may take. Data acquired from previous exploration indicate that the Lost Lake area (found within Project 392's bounds) is potentially the most promising (Severson 2011). The Lost Lake area is associated with a pluton, potentially similar to the Kirkland Lake gold deposits (Peterson 2001 *in* Severson 2011). The pluton can be seen centered in the western portion of the Project 392 area in Figure 7 – the west end of the pluton is adjacent to the town of Angora.

In the regional area surrounding Project 392, Linden Grove located to the west and the Western Vermilion District to the northeast are also prospective gold mineralization localities. Till sampling at Linden Grove turned up anomalous amounts of gold grains and gold values in heavy mineral concentrates. It is also the site of several converging faults, making it a potentially attractive target (Severson 2011).

The Western Vermilion District is better explored than the aforementioned sites. Exploration companies and other workers in the area have determined that gold tends to be associated with rheological contrasts and the Vermilion Fault (Severson 2011). The Vermilion Fault is not a feature that extends into the Project 392 area, though several faults intersecting it do (Minnesota Geological Society 2011). Several models for gold deposition may apply to the Western Vermilion District; one of the better tested models is for shear-hosted lode gold (Severson 2011).

Project Methods

Pebble Counts and Assay Data takes advantage of previously collected duplicate till samples from the larger Project 392. Initially, duplicate till samples were selected from the larger 392 set by identifying statistically anomalous high gold grain count samples from each of the pristine, reshaped, and modified gold categories from the analyzed till samples. Several zero to very low gold grain counts till samples were then selected in order to see if pebble lithology remained constant or varied with gold count. After some discussion with others interested in the project, it was noted that the eastern-most focus area in Project 392 showed a pattern of gold-grain quantities that could possibly be linked to a glacial dispersion train (Figure 8). A combination of these ideas resulted in the final selection of samples (Figure 4; Table 1).

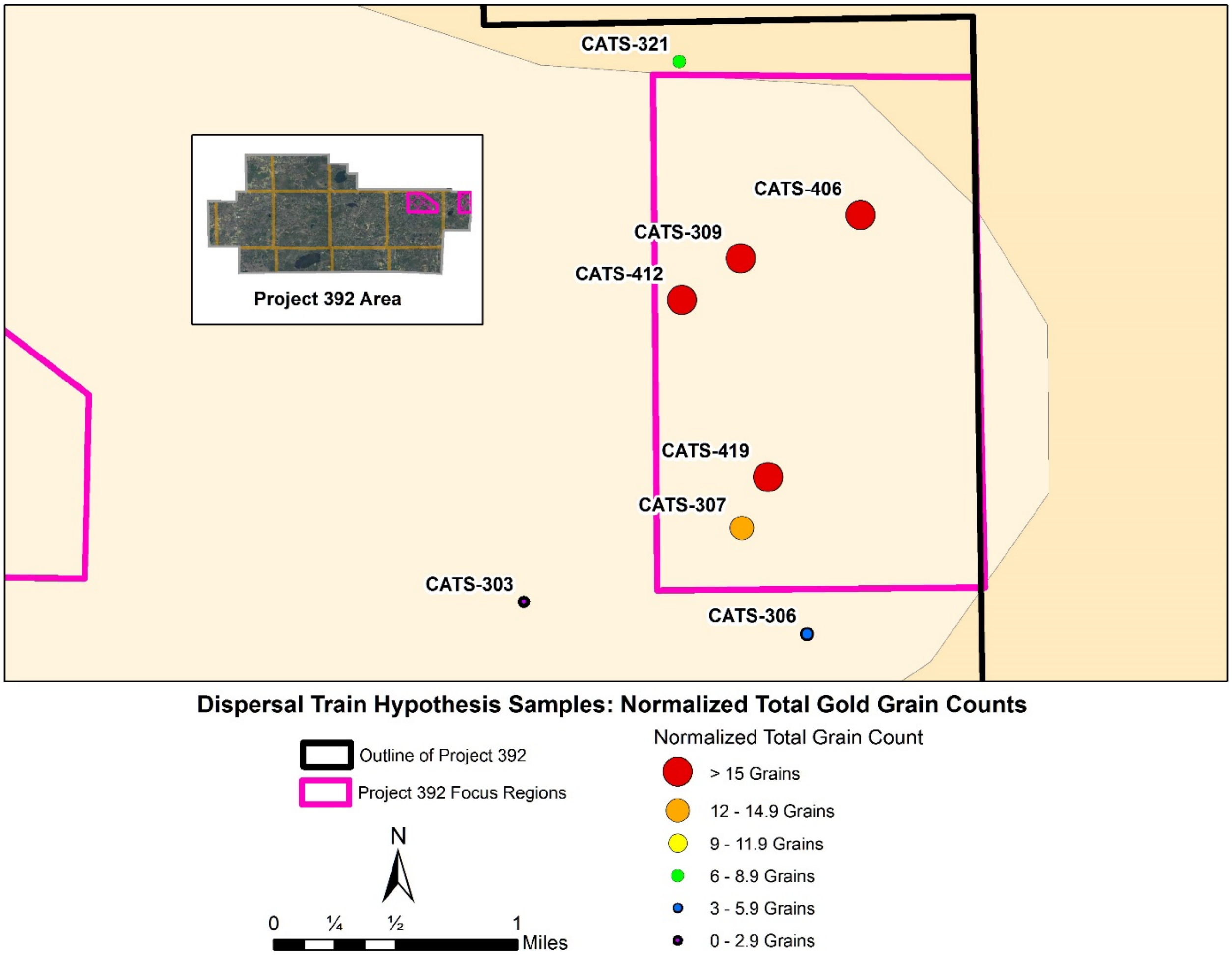

Figure 8: Normalized gold grain quantities in the eastern-most focus area, possibly showing a glacial dispersal train. Background colors share the same key as Figure 6.

The first step after sample selection, was to prepare the pebbles for examination. The fine fraction of till material (everything less than ¼" in diameter) was sieved off and stored for use in possible future studies. The pebbles were then rinsed and scrubbed clean using a plastic scrub brush under tap water.

If the resulting number of cleaned pebbles were deemed to be in excess of "200" pebbles, a random portion of the sample set was selected to be examined. In order to better assure a randomized sample set, the cleaned pebbles were dumped onto a clean surface and stirred 40 times. After stirring, a cone-shaped pile was made and was then split in half using a ruler as a straight-line aid. If there were still more than "200" pebbles present, the right hand pile of rocks was split using the ruler again, with the bottom half being chosen as the final population sets. In multiple cases after this exercise, it was necessary to examine the entire population of pebbles in full so as to achieve the necessary weights needed for assay among each lithological category.

Cleaned pebbles were then tipped into a stack of brass sieves with mesh sizes of 2.5”, 2”, 1.5”, 1.25”, 1”, 0.75”, 0.625”, 0.5”, 0.375”, and 0.25”. The stack was shaken by hand for approximately 5 minutes. Sieves were unstacked one-by-one, with the contents being emptied onto a clean surface and labeled with a tag indicating clast size. Clasts that were stuck in the sieve screen were removed and put within that screen size pebble class. Photographs of each size fraction were taken to document each subpopulation.

Pebbles were examined using a 10x hand lens, scribe, magnet and a spray bottle of water to help enhance color and textural features. Occasionally, a rock hammer was employed to reveal a fresh surface of the pebble. Some unusual features prompted the receipt of a second opinion and in some cases, analysis from a hand-held semi-quantitative XRF device manufactured Innov-X Systems operating in Soil Analysis Mode.

After separating pebbles from each size fraction into broad lithological categories, pebbles classified into the same lithology for the sample were combined. (See Appendix A for lithological descriptions and representative photos; see Appendix B for size fraction distribution and angularity.) A nearly random selection of approximately half of the pebbles in each lithology per sample were selected to submit to assay. Rocks larger than 4” in diameter were avoided, when possible, so as to give a more complete suite of variations within each of the broad lithological categories. At times, the entire lithological sample was submitted to make a good sample mass (30 g) for gold assay. Occasionally, submission of entire lithology group was not enough to make an adequate sample mass. In these cases, the most similar rocks (such as fine-grained pink granite and coarse-grained pink granite) were combined to achieve at least the minimum mass.

Samples were then submitted to Activation Laboratories, Ltd for analysis using their Fire Assay with INAA package (see Appendix C for sample listing and results). Prior to analysis, the samples were crushed and then 100 g was split off for pulverization. Laboratory duplicate samples were derived from the same pulverized 100 g, rather than going back to the initial crushed sample. After receipt of the assay data, “duplicate” pebbles (pebbles retained after sending representative pebbles to the laboratory) associated with the most promising assay were analyzed with a hand-held semi-quantitative XRF device manufactured Innov-X Systems operating in Soil Analysis Mode and in Alloy Mode.

To better test the possibility of a dispersal train of clasts, plots were made showing the sample location and variety of clasts found at each sample site. Dispersal train possibilities were investigated in two ways. The first way examined the raw clast counts for each lithological category (a long standing method for identifying dispersal trains; Shilts 1973). The second way, looking at the percent volume for each lithology at a given sample site, was employed when the results of the first method did not clearly obvious trends. Volume calculations for each sample were calculated using the following equations, assuming each pebble approximates a sphere:

$$D_e = (D_{max} - D_{min})/(\ln(D_{max}/D_{min}))$$

Where D_e is the effective diameter of a pebble, D_{max} is the maximum diameter of a pebble, and D_{min} is the minimum diameter of a pebble for all pebbles in a given sieve size (Rimstedt 2013 and references therein). D_e can then be used to calculate the volume of a spherical pebble using the equation:

$$V_p = 4/3\pi(D_e/2)^3$$

Where V_p is the volume of a pebble and D_e is the effective diameter.

Results

Till samples selected from Project 392

The gold-bearing characteristics of the till samples that resulted from the statistical and dispersion hypothesis selection process are given in Table 1 below.

Table 1: Summary of the gold-bearing characteristics for till samples chosen for this project. The column "Dispersal Train Hypothesis Member?" indicates as to whether the sample was included due to trends observed in the eastern part of the Project 392 area.

Till Sample	Duplicate Till Sample	Normalized Total Gold Grain Count	Most Common Gold Grain Shape Type	Dispersal Train Hypothesis Member?
CATS-059	CATS-059R	12.3	Pristine	No
CATS-202	CATS-202R	27.7	Pristine	No
CATS-207	CATS-207R	7.8	Reshaped and Modified	No
CATS-234	CATS-234R	3.9	Pristine	No
CATS-303	CATS-303R	0	-	Yes
CATS-306	CATS-306R	3.8	Even distribution of Pristine, Reshaped, and Modified	Yes
CATS-307	CATS-307R	12.3	Modified	Yes
CATS-309	CATS-309R	18.4	Modified	Yes
CATS-321	CATS-321R	8.1	Reshaped	Yes
CATS-406	CATS-406R	75.7	Pristine	Yes
CATS-412	CATS-412R	74.6	Pristine	Yes
CATS-419	CATS-419R	32.9	Pristine	Yes

Sieving and preliminary XRF identification

Sieving of the pebbles revealed that the smaller the size fraction, the greater number of clasts there are. Visual assessment identified that for the most part, angularity of the clasts is apparently dependent on the competency of the lithology. Angularity also increased somewhat with decreasing size fraction. Furthermore, all clasts can be sorted into 15 broad lithological categories by visual inspection: greenstone, foliated rock, metasediment, greenish-weathering granite, crisp feldspar granite, coarse-grained pink granite, fine-grained pink granite, quartz, mafic intrusive, gossan, epidotized/silicified rock, "honest" sedimentary rock, intrusive veins, metatuff, and rhyolite or similar. (See Appendix A and B for details.)

XRF work was conducted on some of the foliated rock pebbles bearing crusts of decomposing minerals. The crusts and host rocks are enriched in iron, with occasionally elevated (yet generally still low) levels of titanium, manganese, chromium, and zinc. (See Appendix D, Tables 16 and 17 for details.)

Assays and statistics

Assay results indicate that gold content in the pebbles is below the detection limit of one part per billion (ppb) in most cases. The maximum value assayed is 99 ppb for metasedimentary rock in sample CATS307R006 (from duplicate till sample CATS-307R). Using the value of "zero" to represent samples assaying below the detection limit, the average value of gold is approximately 3 ppb. Globally, un-mineralized greenstone belt rock assay values for gold typically range between 1 to just over 5 ppb (Kwong and Crocket 1978, Saager *et al*. 1982, Crocket 1991).

Statistically speaking for this dataset, samples with gold assays greater than or equal to 5 ppb can be considered minor outliers; greater than 9 ppb can be considered major outliers. Dahl (2005), suggests that three times the median un-mineralized value for a given area can be considered a low-level anomaly, with more significant anomalies being 10 times the average un-mineralized value. Because this study used "zero" when doing statistical calculations to indicate the values for those rocks below the detection limit, the median value of the assays works out to be zero. Since three or 10 times zero is still zero, substituting the average gold assay value was used to determine anomaly levels. This would mean gold assays greater than 9 ppb are low-level anomalies and greater than 30 ppb are more significant anomalies. Table 2 shows the samples with outlying values of gold. For more details, see Appendix C and data released on July 15, 2016 for DNR Open-File Project 392: Regional Survey of Gold in Till, Cook Area, St. Louis County.

Table 2: Assay samples with statistically anomalous gold values for this project.

Assay Number	Sample Bucket	Lithological Category	Gold Assay Value (ppb)	Minor or Major Outlier	Anomaly Level, Dahl (2005)
CATS059R001	CATS-059R	Greenstone	5	Minor	-
CATS059R010	CATS-059R	Greenish-weathering granite	7	Minor	-
CATS303R001	CATS-303R	Mafic intrusive	6	Minor	-
CATS303R007	CATS-303R	Greenish-weathering granite	9	Minor	Low
CATS303R012	CATS-303R	Foliated rock	6	Minor	-
CATS306R007	CATS-306R	Epidotized/silicified rock + Quartz	7	Minor	-
CATS307R006	CATS-307R	Metasediment	99	Major	More Significant
CATS307R008	CATS-307R	Greenstone	5	Minor	-
CATS309R006	CATS-309R	Crisp + Greenish + Fine pink granite	6	Minor	-
CATS321R003	CATS-321R	Rhyolite or Similar	18	Major	Low
CATS406R008	CATS-406R	Greenstone	5	Minor	-
CATS406R011	CATS-406R	Mafic intrusive	5	Minor	-
CATS412R005	CATS-412R	Greenish-weathering granite	5	Minor	-
CATS412R007	CATS-412R	Greenstone	8	Minor	-

Semi-quantitative XRF analysis of metasedimentary samples

As only a partial set of the metasedimentary pebbles were sent from the CATS-307R sample bucket, the opportunity was available for deeper investigation as to a possible specific metasedimentary pebble type responsible for the spike seen in the gold assay. Representative pebbles of the most commonly occurring metasediments (chert, metagreywacke, schist, etc.) were selected for semi-quantitative XRF analysis. No anomalous gold was indicated in any of the representative metasedimentary samples. There is a slight elevation in the gold pathfinder elements of chromium, zinc, vanadium, barium, mercury, molybdenum, tin, silver and copper (B. Frey, pers. comm., Dubé & Gosselin 2007, Groves *et. al*. 2003). Results are presented in Appendix D, Tables 18 through 21.

Dispersal train hypothesis trends

Testing of the dispersal train hypothesis through plots showing the distribution of pebble lithology at each sample site did not work as well as hoped. There are some loose pebble lithology trends in samples CATS-419R (northernmost sample), CATS-307R and CATS-306R (southernmost sample) in the eastern focus area that possibly indicate a dispersal train. These trends are best observed in terms of total clast counts, rather than as a percent volume distribution of lithology, which resulted in fewer observable trends. When considering total clast counts, from north to south, there is a decrease in the number of metasedimentary (157 clasts down to 42 clasts), epidotized/silicified rock (57 clasts down to 10 clasts), and metatuff clasts (7 clasts down to 0 clasts). There is an increase in the number of greenish-weathering granite (16 clasts up to 70 clasts), crisp feldspar granite (17 clasts up to 56 clasts), and fine-grained pink granite clasts (9 clasts up to 45 clasts—see Figure 9). When considering percent volume distribution of lithologies for each sample (north to south), the only trends that can be seen is a decrease epidotized/silicified rock (4.8% down to 1.8%) and an increase in coarse-grained pink granite clasts (0.1% up to 3.3%; Figure 10).

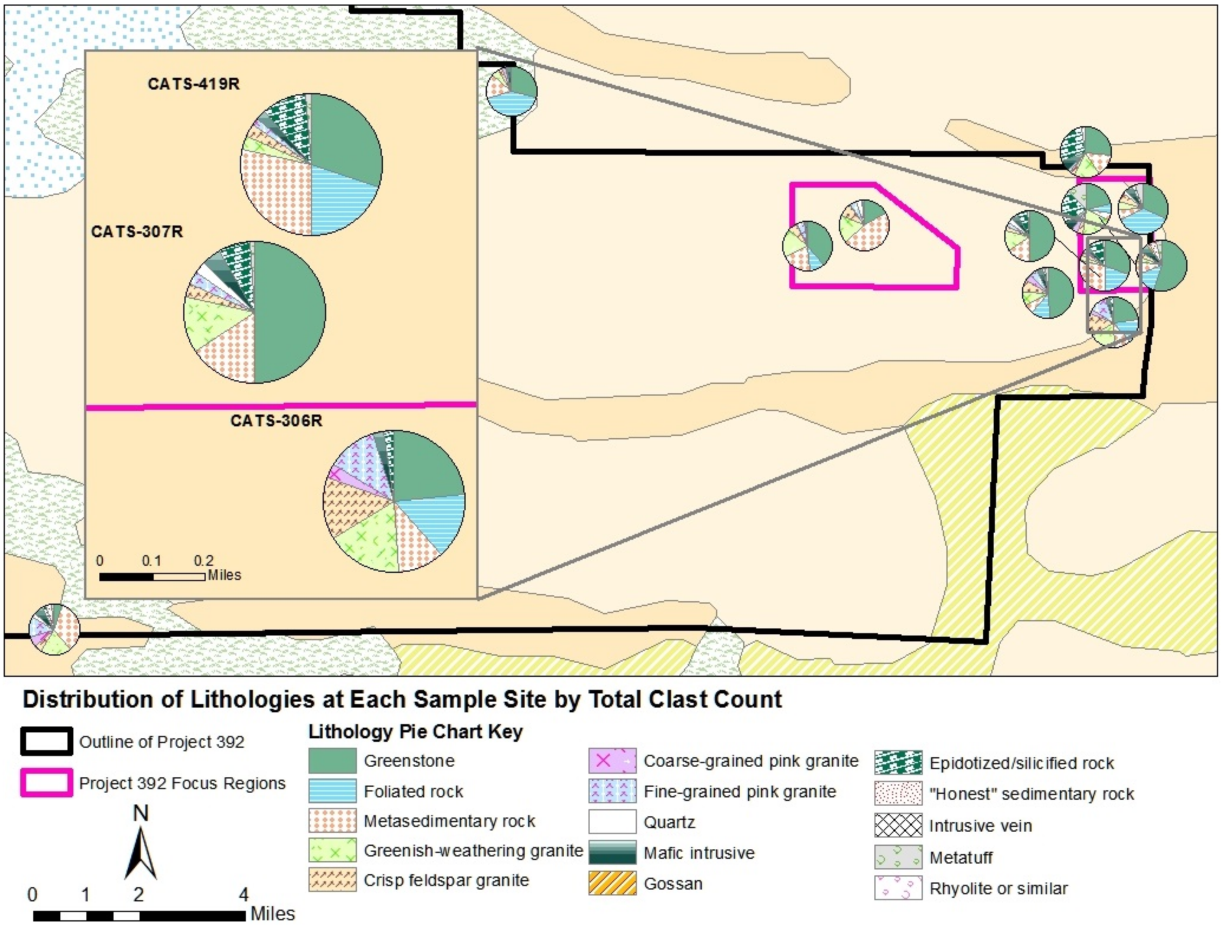

Figure 9: Distribution of lithology at each sample site by total clast count. Key for the background is the same as that as Figure 6. The inset map shows CATS-419R, CATS-307R, and CATS-306R in their geographically correct locations. It is easy to see the marked decrease in metasedimentary rock and epidotized/silicified rock. (The metatuff slice also decreases though due to low starting number of clasts is much more difficult to pick out). Marked increases are easy to spot for greenish-weathering granite, crisp feldspar granite, and fine-grained pink granite.

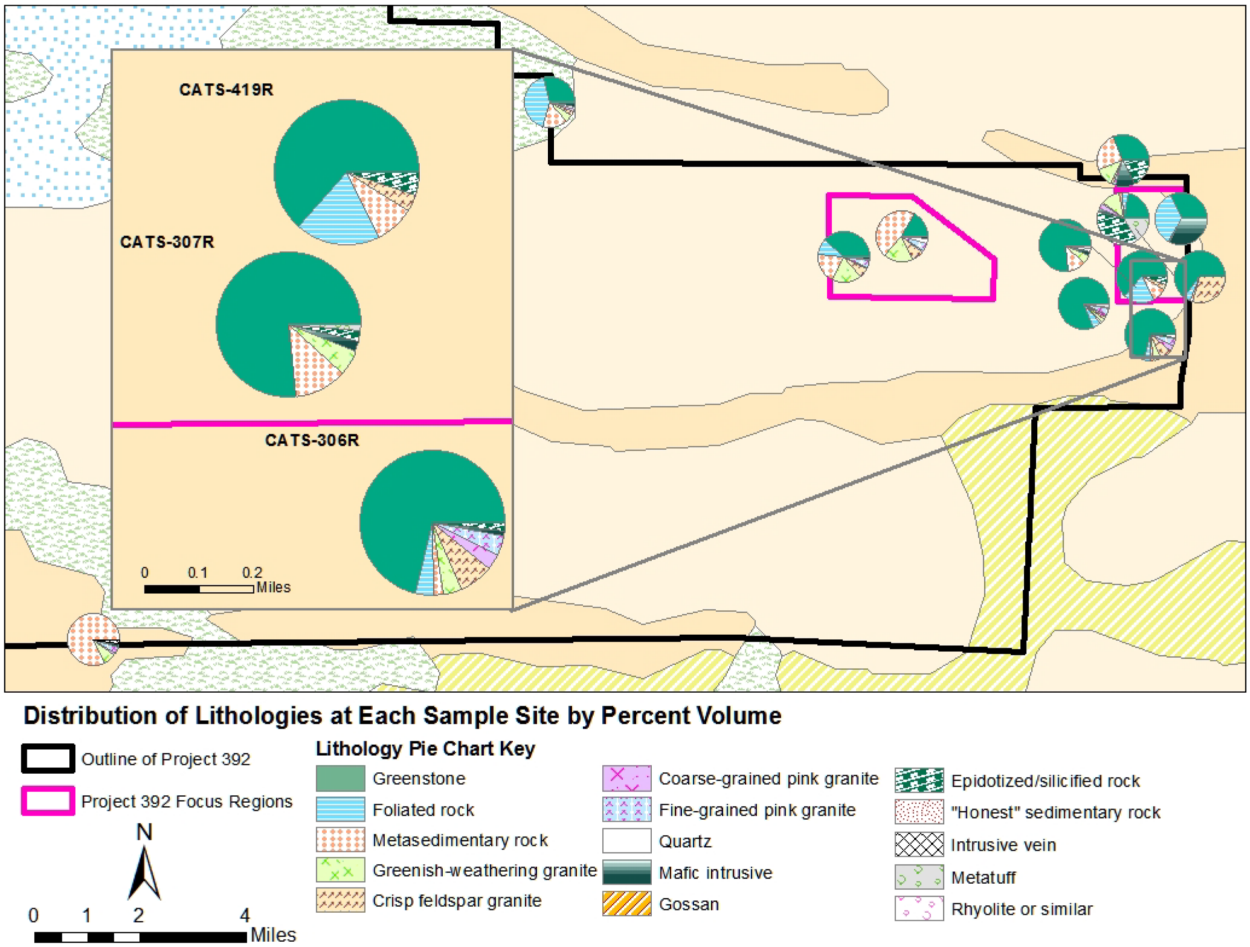

Figure 10: Distribution of lithology at each sample site by percent volume. Key for the background is the same as that as Figure 6. The inset map shows CATS-419R, CATS-307R, and CATS-306R in their geographically correct locations. It is easy to see the marked increase in greenish-weathering granite and coarse-grained pink granite from north to south.

Discussion

Overall, the results from this project present few new discoveries: generally, they confirm what is already known. However a few things of note may have broader implications for any future till studies done in the area.

Clast characteristics

When it comes to clast angularity and lithology, the visual assessment indicating that more silica-rich or strongly cemented rock tends to be more angular is not an unusual finding. What does add a point of interest is that angularity of clasts increases somewhat with decreasing clast size. This is probably a result of the usual crushing action of glacial transport (Flint 1971). In light of this, it is necessary to assume the possibility of pristine gold grains being released from larger boulders, rather than solely at the point of origin. It may also be possible that the distribution of gold and rocks is the result of re-working from multiple glaciations, as multiple glaciations are known through surficial evidence and from overburden drilling logs (Wright

1972, Martin *et. al*. 1991). The small scope of this study may not be large enough to determine if elevated rock types or gold grain counts are derived from a large, mineralized boulder, from the actual point of origin, or glacial re-working.

A plot showing the average value of assayed pebble gold in the "duplicate" sample versus the number of normalized total gold grains in till from the "original" sample (Figure 11) may support the idea that gold is liberated from clasts during transport. The slight downward trend could indicate that the more gold seen in the rocks, the fewer gold grains would be expected in the till. With an R^2 correlation coefficient of 0.0638 for a best fit line to the data (as opposed to an R^2 correlation coefficient of one, which indicates a perfect fit), it is more likely that if a larger data set were to be examined, it would reveal no such trend at all.

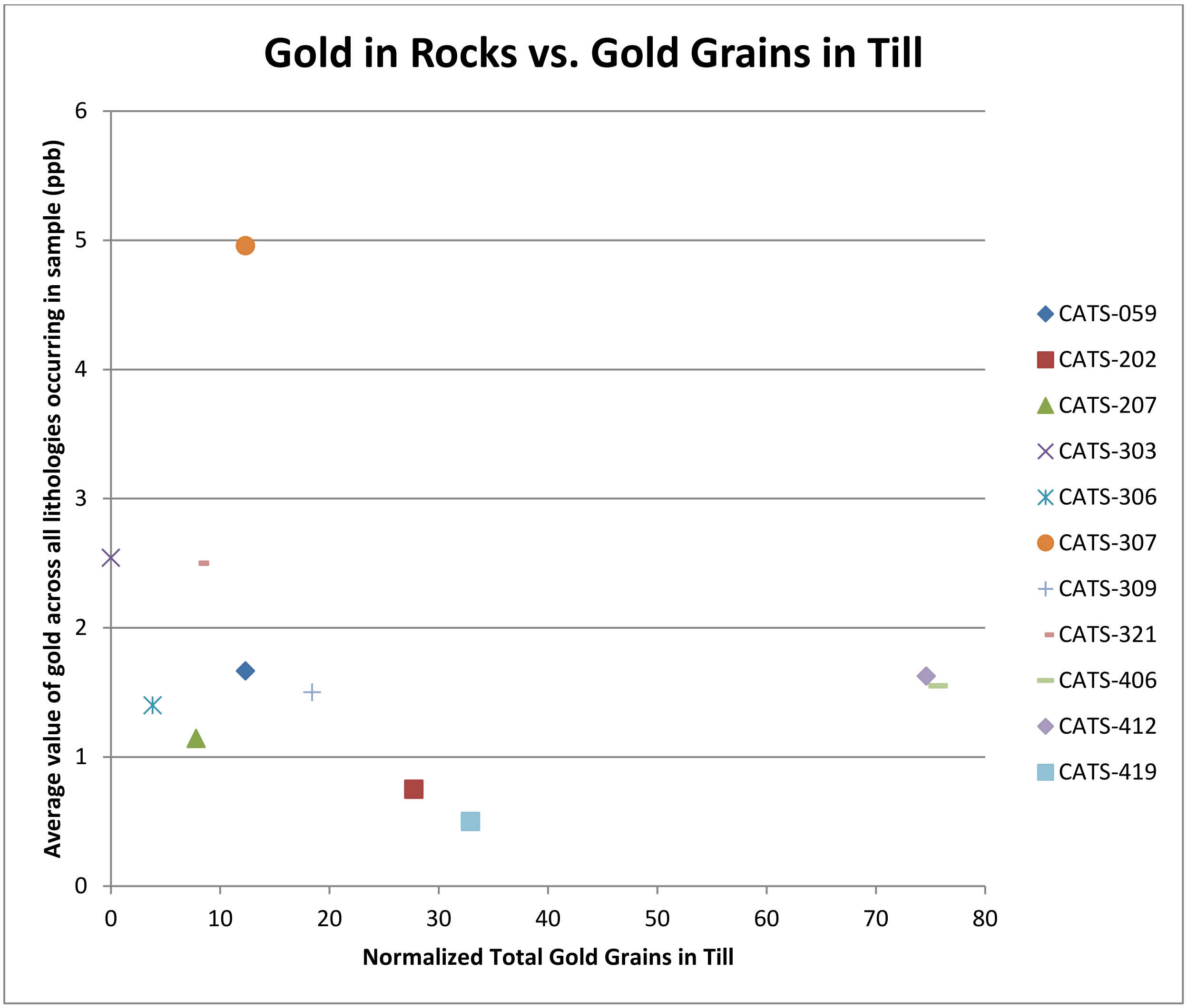

Figure 11: Plot showing the average value of gold assayed in pebbles for each duplicate till sample (this study) versus the number of normalized total gold grains in each original till sample (the larger Project 392 study). Linear regression fitted to this data (not shown) has an R^2 value of 0.0638.

In fact, with such a low correlation coefficient in this dataset, it is fair to say that there is no real correlation between the pebbles and the gold grains found in the till samples. This can also be confirmed by comparing the gold grain counts from Table 1 with the clast type and assay data presented in Table 2 (Table 3).

Table 3: This table combines the data from Table 1 and Table 2 to allow for easier comparisons between gold grain counts found in till and the assay values of pebbles found in the same till samples.

Sample Location Name	Normalized Total Gold Grain Count	Most Common Gold Grain Shape Type	Lithology with Anomalous Gold Assay	Gold Assay Values (ppb)
CATS-059	12.3	Pristine	Greenstone and Greenish-weathering granite	5 and 7, respectively
CATS-202	27.7	Pristine	No anomalous assays	-
CATS-207	7.8	Reshaped and Modified	No anomalous assays	-
CATS-234	3.9	Pristine	Did not assay	-
CATS-303	0	-	Mafic intrusive, Greenish-weathering granite, and Foliated rock	6, 9, and 6, respectively
CATS-306	3.8	Even distribution of Pristine, Reshaped, and Modified	Epidotized/silicified rock + Quartz	7
CATS-307	12.3	Modified	Metasediment and Greenstone	99 and 5, respectively
CATS-309	18.4	Modified	Crisp + Greenish + Fine pink granite	6
CATS-321	8.1	Reshaped	Rhyolite or similar	18
CATS-406	75.7	Pristine	Greenstone and Mafic intrusive	5 and 5, respectively
CATS-412	74.6	Pristine	Greenish-weathering granite and Greenstone	5 and 8, respectively
CATS-419	32.9	Pristine	No anomalous assays	-

Assay data

Assay results for this study fall well within the usual values for greenstone belts around the world. Greenstone (metabasalt to meta-andesite) is the rock type from this study most likely to have a statistically anomalous assay (and is also the dominant rock type in the region; Figure 7), though no greenstone samples meet the Dahl (2005) criteria for anomaly levels as seen in Table 2. The statistically highest gold anomalies and those that meet the Dahl (2005) criteria occur in rocks that are not greenstone—metasediment, rhyolite or similar, and greenish-weathering granite. This may suggest that for a gold-bearing system in the Project 392 area, a change in lithology is important in order for gold to be deposited. Changing lithology can provide the rheological contrast other studies in the Western Vermilion District suggest as important

(Severson 2011). That the semi-quantitative XRF work did not reveal any additional information about possible gold mineralization systems is disappointing though not unexpected, having a much higher detection limit (1 ppm) than the assay package used (1 ppb).

Dispersal train

With regards to the dispersal train hypothesis, Krumbein's glacial dispersal train model describes the distribution of clasts as exponentially increasing for a given bedrock lithology as a glacier moves across the bedrock unit. Once the glacier finishes crossing the unit, the number of clasts from the bedrock lithology decreases exponentially (Parent *et. al.* 1996 and references therein). This does describe the distribution of gold grain quantities looking from north to south in Figure 8 very well. However, the clast counts for lithologies discovered in those samples does not support this hypothesis particularly well except for the three southern-most samples, where there is a marked decrease in some clast lithologies and an increase in others.

This disagreement in the dispersal train hypothesis is resolved when taking into account gold grain shape in the dispersal train hypothesis area (Figure 12). In the case of gold grains, it is generally thought the grains would get rounder (modified and reshaped) further away from the source of origin, though the exponential increase total grains followed by an exponential decrease is expected (McClenaghan 2001). From north to south in the focus region, the grain shapes do not reflect what might be expected in a dispersal train: grains start out reshaped and then at peak grain counts, grains are pristine. Taking into account the possibility that pristine grains might exist further than expected from the source site due to the breaking of larger clasts, the abundance of pristine grains in the central part of the dispersal train hypothesis area is slightly better supported. However, the southern three samples (CATS-419, CATS-307, CATS-306, north to south, respectively) still most clearly show what might be expected as a "textbook" example of a dispersal train: the grains start as pristine and become more rounded and fewer in quantity to the south. All that is missing is the first initial exponential increase in quantity, which is most likely due to distances in the sample spacing.

Taken together—the changes in lithological distribution and gold grain shape and quantity—it does appear that a short dispersal train exists in the southern part of the eastern-most focus region of the Project 392 area. The identification of any large-scale dispersal trains would require more data than this study can provide.

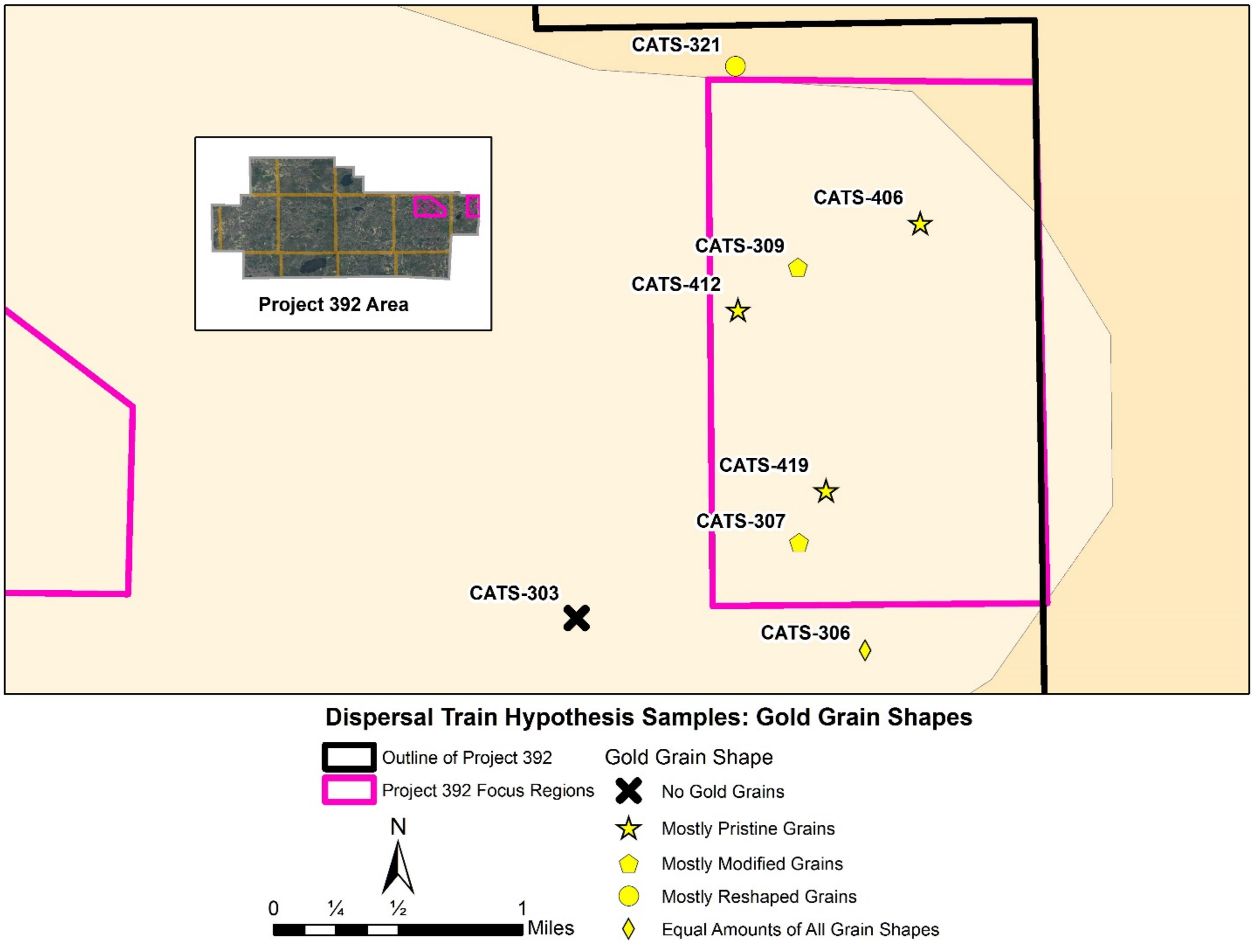

Figure 12: Gold grain shapes for the glacial dispersal train hypothesis area. Compare with Figure 8.

Sources of error

There are some possible sources of error that may have prevented the results from being seen more clearly. Primarily, the largest source of potential error is imprecise categorization of pebbles. Lithological categories were not settled on until after the examination of several buckets of till and the resulting categories may have been too broad. Initially, the categories were narrower but even in the early stages, it looked like there may not be enough pebbles to get an appropriate assay. Even with the broadening of scope in the lithological categories, in some cases there were still not enough pebbles to make weight, leading to possible dilution of the sample. In the midst of the shift in categories, some pebbles were undoubtedly miss-categorized, in addition to any "regular" misidentification that occurred.

On a much smaller scale of error sources, the pebbles sent to assay may have been imperfectly cleaned, leaving micronuggets of gold adhered to the pebbles. Given that the assays did not indicate very high gold content even in the most anomalous samples, this is unlikely.

Another small error source resides in the assumptions used for the equations of the percent volume estimates. The equations assume all the rocks approximate spheres, that there is a relatively flat distribution of grain sizes for each sieve class, and that the range between the largest diameter and smallest diameter clast in a sieve class is very small. Foliated rocks tended to be elongate, rather than spherical and the range in sieve classes did vary by more than an inch, in some cases.

Lastly, sample CATS-234R was examined with regards to pebble quantity, size, lithology, and angularity but was neglected to be sent to assay.

Conclusions

Pebble Counts and Assay Data examined the rocks collected in the till samples in an attempt to determine if there are any correlations between high concentrations of gold grains and rock type. This study discovered that there are no definite correlations between the assay values of specific rock types and gold grain counts. However, it did find that there are some trends that might point in the direction of gold mineralization and understanding the local geology:

- The anomalous assay values for greenstone pebbles versus anomalous assay values for other pebble types suggest a change in lithology might be important for hosting a gold deposit in this area.
- While the hypothesized dispersal train did not exist for the full length of the eastern-most focus region of the Project 392 area, a short dispersal train most likely does exist in the southern part of the eastern-most area.

Recommendations for Additional Work

Considering the conclusions made above together, searching for glacial dispersal trains may help narrow down the locations for contacts between different rock types that are otherwise buried. Combined with gold grain counts, such a study may reveal which of those contacts are mineralized.

If such a study is to be continued in the Project 392 area, it would be best to look more into glacial dispersal train patterns across the entire study area. Ideally, the spacing between sample sites would be a bit narrower than they are at present. Using the possible dispersal train identified in this study as a guide, the north-south spacing between samples should be no greater than ¼ mile. Using a similar east-west spacing may provide better control on any complexity in glacial movement that may have occurred than the assumed north to south direction.

Acknowledgements

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Appendix A: Lithological Descriptions

Greenstone

Figure 13: A handful of pebbles representative of the greenstone lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

Black to gray to gray-green to rusty brown gray colored slightly metamorphosed mafic rock, ranging from basalt to andesite and rarely, what might be a mafic ash flow. Clasts usually have a massive texture. Trace features include pyrite mineralization as well as unidentified, heavily oxidized sulfides; quartz veining; faint signs of movement and deformation (*e.g.*, slicken lines, foliation, stretched amygdules); vuggy dissolution features; vesicles and amygdules; porphyritic textures; magnetism; and light alteration (epidotization, silicification, and/or hematization; possibly an instance of albitization and serpentinization).

Foliated rock

Figure 14: A handful of pebbles representative of the foliated lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long

This category contains rocks of many unidentifiable protoliths due to their fine grain size and strongly foliated texture. Suspected to mostly be of an extrusive igneous origin (massive to volcaniclastic flows), with a few being of a sedimentary origin (primarily iron formation or greywacke). The rocks may have derived from either a regional metamorphic event or localized shearing events. Foliation is most often phyllitic but is occasionally slaty or schistose. Rocks in this category can be of any color, ranging from black to rusty reds and browns to silvery gray-greens, though most have a gray-green color. Trace features include pronounced dark striations (possibly serpentine); fractures apparently unrelated to foliation; crusts of decomposing minerals (likely once were sulfides); bold pinstripes of unidentified fine-grained minerals reminiscent of modern art; porphyroblastic texture; elongated vugs; and light alteration (silicification and epidotization; on some clasts it almost appears that the foliation event postdates epidotization).

Metasediment

Figure 15: A handful of pebbles representative of the metasediment lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

Often rock of apparently clastic origin, such as a metagreywacke, or rocks with an apparently high silica content that are not obviously altered from silicification, like chert. Also included in this category are iron formation rocks, such as pebbles of magnetite. Colors range from browns and yellows to pale greens to grays and blacks and the very occasional bright jasper red. It is not unusual for rocks to have speckled rusty spots. It can be difficult to differentiate these rocks from metatuff and other rocks from a volcaniclastic origin, as well as when the level of foliation crosses into the “foliated rock” category – there is some overlap between these categories. Trace features include pyrite mineralization; slight alteration (primarily epidotization); and veins of quartz or feldspar.

Greenish-weathering granite

Figure 16: A handful of pebbles representative of the greenish-weathering granite lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

These granitoid clasts have dioritic to granitic compositions. It is possible they derive from a single, heterogeneous source or from multiple sources. It is even a possibility they are derived from a saprolitic phase of granitic bedrock. Primarily, these clasts are white with pale green, yellow and/or brown to rusty tones, apparently due to the weathering of a mafic component, sericitic alteration, or weathering of sulfide minerals. Grain sizes are generally fine for a granite, though always visible. Rare features include pink feldspar, attached fragments of host rock and possible porphyritic quartz.

Crisp feldspar granite

Figure 17: A handful of pebbles representative of the crisp feldspar granite lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

Clasts have sharply defined grain boundaries with the plagioclase being much whiter than the other mineral components. This gives the plagioclase feldspar a very “crisp” appearance. The rough modal mineralogy is 50% white plagioclase, 20% pale pink potassium feldspar, 15% gray quartz and 15% black hornblende. The modal mineralogy suggests the clasts are derived from a monzonite, rather than granite. On rare occasion, the feldspars are dominantly pink, rather than white. It is unknown if this change represents a different source or merely the heterogeneity of the source body. Trace features include rusty stains, magnetite grains, aligned biotite grains, garnet grains, and fragments of what looks like recrystallized host rock.

Coarse-grained pink granite

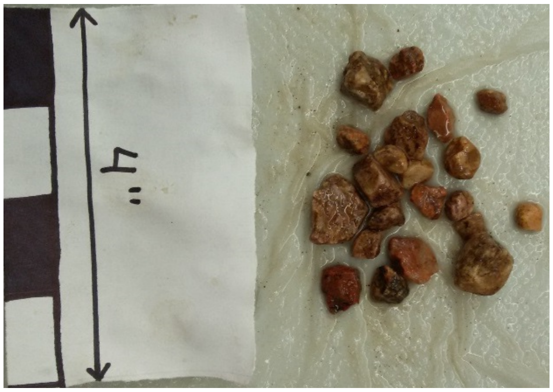

Figure 18: A handful of pebbles representative of the coarse-grained pink granite lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

Coarse-grained pink granite consists of medium to very large-grained granitoid clasts that are predominantly pink in color. Clast compositions range from being nearly 100% quartz to 100% feldspar. Some of the color, especially for the nearly red clasts, might be attributable to later hematization, rather than primary Fe-enrichment but is not known. Trace features include grain-size and color changes from dark pink fine-grained rock to light pink coarse-grained rock and some greenish-color alteration, in the manner of the greenish-weathering granite.

Fine-grained pink granite

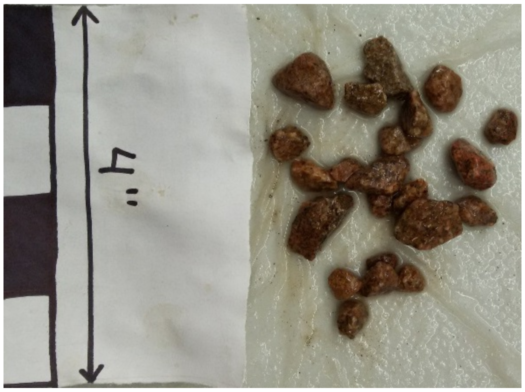

Figure 19: A handful of pebbles representative of the fine-grained pink granite lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

Fine-grained pink granite consists of fine- to medium-grained granitoid clasts that are predominantly pink in color. These granitoids are primarily composed of feldspar and quartz, often with a sprinkling of mafic minerals (biotite) that can be recessively weathering. Rare features include magnetite grains and alteration (silicification, hematization, and epidotization).

Quartz

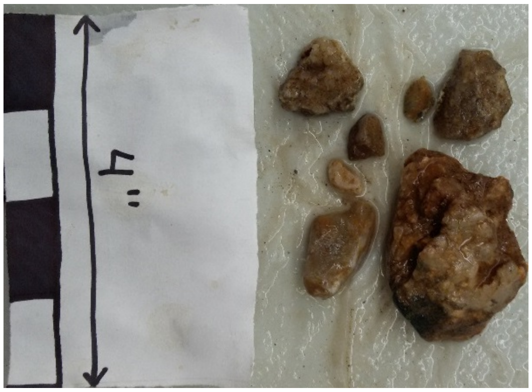

Figure 20: A handful of pebbles representative of the quartz lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

These pebbles consist almost entirely of pure quartz with minimal fragments host rock attached to it. Where host rock is present, it is often black with vugs or shows additional signs of alteration (epidotization, albitization). Quartz clasts usually resemble rock shards and are translucent gray to milky white and occasionally colorless or brown. Sometimes pebbles are tinged green or yellow. In one instance, a pebble was chalcedony-like in appearance; another pebble was vuggy.

Mafic intrusive

Figure 21: A handful of pebbles representative of the mafic intrusive lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

Generally coarse to medium grained dark-colored igneous rocks; occasionally fine-grained (diabase). Compositions range from gabbro to diorite. Rare features include epidotization, slight foliation, magnetism, rusty stains, feldspar phenocrysts, post-epidotization quartz-feldspar veins, and friable grains (saprolitic?).

Gossan

Figure 22: A pebble representative of the gossan lithological category. Pebble has been left dry to better show color. Each block on the scale card is one inch long.

These rocks are rare, rusty brown-black and have the appearance of heavy weathering. Goethite is a possible major mineral constituent in some pebbles. A couple of the pebbles were very fragile and vuggy.

Epidotized/silicified rock

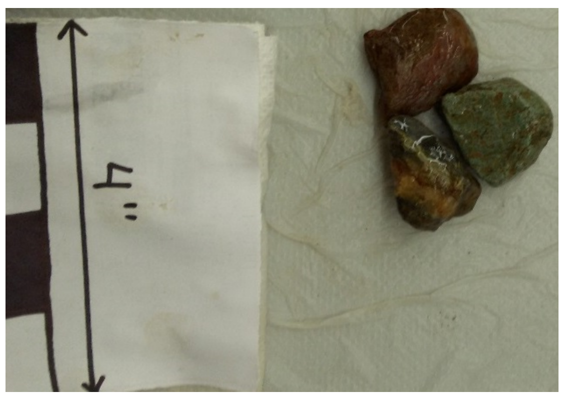

Figure 23: Pebbles representative of the epidotized/silicified rock lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

Clasts are likely derived from a diverse variety of sources, from extrusive mafic igneous rock to intrusive felsic igneous rock to greywacke. However due to strong alteration, it is difficult to determine what the clast is other than it is now whitish pale green to dark gray greens to browns and very hard. Rare features these rocks sometimes display are rusty patches and hematization, quartz veining, angular vugs suggesting dissolution, and magnetism.

“Honest” sedimentary rock

Figure 24: A handful of pebbles representative of the “honest” sedimentary rock lithological category. Pebbles have been left dry to better show textures. Each block on the scale card is one inch long.

These pebbles are poorly cemented, friable, and consist of medium- to well-sorted, sand-sized grains apparently dominantly composed of quartz. Color is beige to black; some of the darker grains are magnetite and biotite. It is a distinct possibility that the darker colored pebbles in this category are actually saprolites.

Intrusive veins

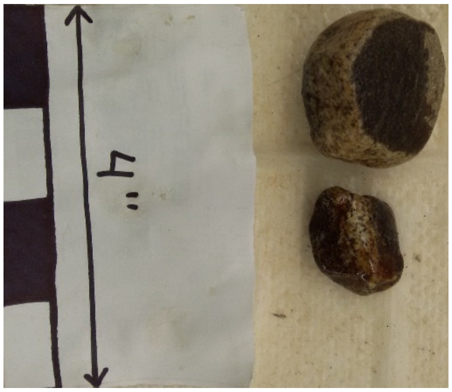

Figure 25: Pebbles representative of the intrusive veins lithological category. Pebbles have been spritzed with water to better show color and textures. Each block on the scale card is one inch long.

Granitoid material sandwiched between fragments of what is presumed to be host rock. Not particularly common, as it is easily sorted into any of the other granitoid categories in the case of absent host rock. Veins are typically white; host rock is typically black and may be metasedimentary.

Metatuff

Figure 26: A handful of pebbles representative of the metatuff lithological category. Pebbles have been left dry to better show textures. Each block on the scale card is one inch long.

Fine-grained to very fine-grained competent, apparently clastic rock that ranges in color from white to brown to gray-green to black. (Light-colored pebbles and those with a seemingly high silica content were generally classified as “rhyolite or similar”.) Difficult to distinguish from metagreywackes and other similar fine-grained metasedimentary rock (such as chert). Rare features include the slight foliation and minor alteration (epidotization).

Rhyolite or similar

Figure 27: A handful of pebbles representative of the rhyolite or similar category. Pebbles have been left dry to allow for a better visual comparison with the metatuff. Each block on the scale card is one inch long.

Similar to the metatuff described above but with a seemingly high silica content and a felsic nature. Usually white to pink in color with no visible grains; it possible all clasts described this way are chert. Rare features include slight alteration (epidotization) and rust stains.

Appendix B: Size Fraction and Angularity Results Summary Tables

Sample bucket CATS-059R

Table 4: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-059R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	0	0	0	0	0	0	0	$21^{\%}$	110	$364^{\%}$
Foliated Rock	0	0	0	0	0	0	0	0	21^{Δ}	$109^{\%}$
Metasediment	0	0	0	0	0	0	0	8	49	196^{Δ}
Greenish-Weathering Granite	0	0	0	0	0	0	0	12^{Δ}	47^{Δ}	183
Crisp Feldspar Granite	0	0	0	0	0	0	0	$2^{\&}$	15^{Δ}	59^{Δ}
Coarse-grained pink granite	0	0	0	0	0	0	0	0	5^{Δ}	8^{Δ}
Fine-grained pink granite	0	0	0	0	0	0	0	$1^{\%}$	9^{Δ}	45^{Δ}
Quartz	0	0	0	0	0	0	0	5^{Δ}	$2^{\#}$	11^{Δ}
Mafic Intrusive	0	0	0	0	0	0	0	$2^{\%}$	2^{Δ}	11^{Δ}
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	0	0	0	0	0	0	0	0
“Honest” sedimentary rock	0	0	0	0	0	0	0	0	0	0
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	0	0	0	0	0	0	0	0	0
Rhyolite or Similar	0	0	0	0	0	0	0	0	0	0

Sample bucket CATS-202R

Table 5: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-202R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5"	2"	1.5"	1.25"	1"	0.75"	0.625"	0.5"	0.375"	0.25"
Greenstone	0	0	0	0	0	0	0	$5^{\%}$	12^{Δ}	$61^{\&}$
Foliated Rock	0	0	0	0	0	0	0	0	0	0
Metasediment	0	0	0	0	0	0	0	$6^{\%}$	45^{Δ}	$169^{\%}$
Greenish-Weathering Granite	0	0	0	0	0	0	0	$2^{\%}$	15^{Δ}	68^{Δ}
Crisp Feldspar Granite	0	0	0	0	0	0	0	0	12^{Δ}	27^{Δ}
Coarse-grained pink granite	0	0	0	0	0	0	0	0	$1^{\%}$	4^{Δ}
Fine-grained pink granite	0	0	0	0	0	0	0	0	$2^{\&}$	18^{Δ}
Quartz	0	0	0	0	0	0	0	1	4^{Δ}	12^{Δ}
Mafic Intrusive	0	0	0	0	0	0	0	$1^{\%}$	1^{Δ}	4^{Δ}
Gossan	0	0	0	0	0	0	0	0	0	1^{Δ}
Epidotized/silicified rock	0	0	0	0	0	0	0	0	0	0
"Honest" sedimentary rock	0	0	0	0	0	0	0	0	0	0
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	0	0	0	0	0	0	0	0	0
Rhyolite or Similar	0	0	0	0	0	0	0	0	0	0

Sample bucket CATS-207R

Table 6: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-207R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	0	0	0	0	0	0	0	12^{Δ}	$37^{\#}$	106^{Δ}
Foliated Rock	0	0	0	0	0	0	0	$9^{\&}$	$38^{\%}$	171^{Δ}
Metasediment	0	0	0	0	0	0	$1^{\%}$	$3^{\%}$	15	68^{Δ}
Greenish-Weathering Granite	0	0	0	0	0	0	0	1	0	23
Crisp Feldspar Granite	0	0	0	0	0	0	0	2	2	10
Coarse-grained pink granite	0	0	0	0	0	0	0	2	2	6
Fine-grained pink granite	0	0	0	0	0	0	0	0	3	0
Quartz	0	0	0	0	0	0	0	0	0	$6^{\%}$
Mafic Intrusive	0	0	0	0	0	0	0	1	4	12^{Δ}
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	0	0	0	0	0	0	0	0
“Honest” sedimentary rock	0	0	0	0	0	0	0	0	0	0
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	0	0	0	0	0	0	0	3	0
Rhyolite or Similar	0	0	0	0	0	0	0	0	0	0

Sample bucket CATS-234R

Table 7: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-234R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	0	0	0	0	0	0	0	0	2@	12&
Foliated Rock	0	0	0	0	0	0	0	0	0	0
Metasediment	1^{Δ}	0	0	0	$1^{\&}$	$9^{\&}$	$8^{\&}$	$16^{\%}$	$17^{\%}$	$38^{\%}$
Greenish-Weathering Granite	0	0	$1^{@}$	$4^{\&}$	$4^{\%}$	0	0	0	6	37
Crisp Feldspar Granite	0	0	0	0	0	$1^{@}$	0	$1^{@}$	5	6
Coarse-grained pink granite	0	0	0	0	$3^{\%}$	0	0	$2^{\&}$	2	11
Fine-grained pink granite	0	0	0	0	0	$8^{@}$	$8^{\%}$	$4^{@}$	11	5
Quartz	0	0	0	0	0	0	0	0	3^{Δ}	3^{Δ}
Mafic Intrusive	0	0	0	0	0	$3^{@}$	$3^{\%}$	$4^{@}$	0	7
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	0	0	0	0	0	0	0	$7^{\%}$
“Honest” sedimentary rock	0	0	0	0	0	0	0	$1^{\bigcirc}$	$2^{\bigcirc}$	$6^{\bigcirc}$
Intrusive Veins	0	0	$1^{@}$	0	0	0	$1^{\%}$	0	0	0
Metatuff	0	0	0	0	0	0	$3^{\&}$	0	$2^{\&}$	0
Rhyolite or Similar	0	0	0	0	0	0	0	0	0	0

Sample bucket CATS-303R

Table 8: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-303R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	$1^{\%}$	$4^{\%}$	9	7^{Δ}	$11^{\%}$	$30^{\&}$	$41^{\&}$	$54^{\&}$	$74^{\%}$	$138^{\&}$
Foliated Rock	0	0	0	4^{Δ}	$2^{\%}$	11^{Δ}	10^{Δ}	14^{Δ}	18^{Δ}	32^{Δ}
Metasediment	0	0	0	$1^{@}$	0	0	$4^{\%}$	$7^{@}$	$33^{\#}$	0
Greenish-Weathering Granite	0	0	0	0	0	$3^{\%}$	$3^{@}$	$15^{\%}$	$17^{\%}$	$23^{\%}$
Crisp Feldspar Granite	0	0	0	0	1	$2^{\%}$	$1^{\%}$	12^{Δ}	13	30
Coarse-grained pink granite	0	0	0	0	0	5	$3^{\&}$	$10^{\&}$	7	7
Fine-grained pink granite	0	$1^{\%}$	0	$1^{@}$	4	$1^{@}$	$3^{\%}$	0	4	23
Quartz	0	0	0	0	0	0	0	1^{Δ}	3^{Δ}	1^{Δ}
Mafic Intrusive	0	0	0	$1^{@}$	0	$3^{\%}$	$2^{\%}$	$9^{\&}$	0	$15^{\%}$
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	0	0	$2^{\%}$	$1^{\%}$	0	3^{Δ}	$7^{\%}$	0
“Honest” sedimentary rock	0	0	0	0	$1^{@}$	$1^{@}$	$1^{@}$	0	0	0
Intrusive Veins	0	0	0	$1^{@}$	0	$1^{\&}$	0	0	0	0
Metatuff	0	0	$1^{\#}$	1^{Δ}	0	0	0	1	3	$9^{\#}$
Rhyolite or Similar	0	0	0	0	0	$1^{\%}$	0	0	0	0

Sample bucket CATS-306R

Table 9: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-306R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	1^{Δ}	0	$2^{\%}$	1^{Δ}	5^{Δ}	5^{Δ}	5	$13^{@}$	19	42
Foliated Rock	0	0	0	1^{Δ}	1^{Δ}	5^{Δ}	5^{Δ}	$9^{\%}$	5^{Δ}	35
Metasediment	0	0	0	$2^{\&}$	0	1	$2^{@}$	14^{Δ}	$9^{\&}$	14^{Δ}
Greenish-Weathering Granite	0	0	0	2	$1^{\%}$	4^{Δ}	7^{Δ}	11^{Δ}	22^{Δ}	23
Crisp Feldspar Granite	0	1^{Δ}	$1^{\%}$	1	2	$2^{\%}$	$2^{\&}$	8	14^{Δ}	25
Coarse-grained pink granite	0	0	$1^{\&}$	0	2	1	3^{Δ}	3^{Δ}	$2^{\&}$	1
Fine-grained pink granite	0	0	$1^{@}$	0	0	3^{Δ}	1^{Δ}	6^{Δ}	9^{Δ}	25
Quartz	0	0	0	0	0	0	0	$1^{\&}$	0	3^{Δ}
Mafic Intrusive	0	0	0	0	2	$1^{@}$	0	4^{Δ}	1^{Δ}	$2^{\%}$
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	0	$1^{\&}$	2^{Δ}	3^{Δ}	0	$1^{\%}$	3^{Δ}	0
“Honest” sedimentary rock	0	0	0	0	$1^{\bigcirc}$	0	0	0	0	0
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	0	0	0	0	0	0	0	0	0
Rhyolite or Similar	0	0	0	0	0	0	0	0	0	0

Sample bucket CATS-307R

Table 10: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-307R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	$1^{@}$	$1^{\&}$	$1^{\&}$	$7^{\&}$	$4^{@}$	7	$7^{\&}$	16^{Δ}	56^{Δ}	238^{Δ}
Foliated Rock	0	0	0	0	0	0	0	0	0	0
Metasediment	0	$1^{@}$	2	2	$1^{\bigcirc}$	$5^{\%}$	$3^{@}$	13^{Δ}	$22^{\&}$	57
Greenish-Weathering Granite	0	0	$1^{\&}$	0	$2^{\bigcirc}$	1	$4^{\%}$	$8^{\%}$	$18^{\&}$	53^{Δ}
Crisp Feldspar Granite	0	0	0	0	0	0	0	$11^{\%}$	1	9^{Δ}
Coarse-grained pink granite	0	0	0	$1^{@}$	0	0	0	1^{Δ}	0	0
Fine-grained pink granite	0	0	0	0	0	0	0	0	3	16^{Δ}
Quartz	0	0	0	0	1^{Δ}	0	$1^{@}$	1^{Δ}	2	15^{Δ}
Mafic Intrusive	0	0	0	0	$1^{@}$	4	2^{Δ}	3^{Δ}	$8^{\&}$	$11^{@}$
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	0	0	$2^{\%}$	2^{Δ}	$3^{\&}$	0	8	33
“Honest” sedimentary rock	0	0	0	0	0	0	0	0	0	0
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	0	0	$1^{\&}$	$2^{\&}$	2^{Δ}	0	2^{Δ}	1	0
Rhyolite or Similar	0	0	0	0	0	0	0	0	0	0

Sample bucket CATS-309R

Table 11: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-309R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	2^{Δ}	1^{Δ}	1^{Δ}	$4^{\bigcirc}$	3^{Δ}	$4^{\%}$	14^{Δ}	15^{Δ}	33^{Δ}	$6^{\%}$
Foliated Rock	0	0	3	0	2^{Δ}	5	0	2^{Δ}	6	3^{Δ}
Metasediment	0	0	1^{Δ}	1^{Δ}	0	1^{Δ}	$3^{\%}$	3	2^{Δ}	2^{Δ}
Greenish-Weathering Granite	0	0	0	0	0	0	0	3^{Δ}	$1^{\&}$	$1^{@}$
Crisp Feldspar Granite	$1^{@}$	0	0	0	$1^{\bigcirc}$	0	$1^{\%}$	$1^{\&}$	1^{Δ}	0
Coarse-grained pink granite	0	0	0	0	0	0	0	0	0	0
Fine-grained pink granite	0	0	0	0	0	0	0	$1^{\&}$	0	0
Quartz	0	0	0	0	0	0	0	0	0	0
Mafic Intrusive	0	0	0	0	$2^{@}$	0	$1^{\%}$	4^{Δ}	0	$2^{\&}$
Gossan	0	0	0	0	$1^{@}$	0	0	1	0	0
Epidotized/silicified rock	0	0	0	0	0	0	0	0	0	0
“Honest” sedimentary rock	0	0	0	0	0	0	$3^{@}$	$3^{@}$	$2^{@}$	0
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	0	0	0	0	0	0	$1^{\%}$	3^{Δ}	1^{Δ}
Rhyolite or Similar	0	0	0	0	0	1^{Δ}	0	0	0	0

Sample bucket CATS-321R

Table 12: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-321R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	0	0	$3^{@}$	$1^{\&}$	$8^{@}$	$7^{@}$	$13^{\&}$	$26^{\&}$	$24^{\&}$	$25^{\%}$
Foliated Rock	0	0	0	0	0	0	0	0	0	0
Metasediment	0	0	$3^{@}$	0	$6^{@}$	$5^{\&}$	$3^{\%}$	6	$15^{\%}$	$19^{\&}$
Greenish-Weathering Granite	0	0	$1^{@}$	0	0	$4^{\%}$	7	8	$10^{\%}$	$33^{\%}$
Crisp Feldspar Granite	0	0	0	0	0	$1^{@}$	$4^{\%}$	0	0	$4^{\%}$
Coarse-grained pink granite	0	0	0	0	$1^{@}$	0	0	0	$1^{\&}$	$3^{\%}$
Fine-grained pink granite	0	0	0	0	0	$2^{\&}$	0	1^{Δ}	0	$5^{\%}$
Quartz	0	0	0	0	0	$1^{@}$	0	1^{Δ}	0	1^{Δ}
Mafic Intrusive	0	0	$1^{@}$	1	$1^{@}$	$9^{@}$	$3^{\&}$	0	4	7
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	$1^{\&}$	$3^{\&}$	0	$4^{\&}$	$11^{\&}$	$13^{\&}$	17	63
“Honest” sedimentary rock	0	0	0	0	0	0	0	0	0	0
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	0	0	0	0	0	0	0	0	0
Rhyolite or Similar	0	0	0	0	0	0	$1^{\%}$	$7^{\%}$	$2^{\&}$	0

Sample bucket CATS-406R

Table 13: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-406R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	1^{Δ}	0	0	1	2^{Δ}	0	3^{Δ}	9^{Δ}	$24^{\%}$	63^{Δ}
Foliated Rock	$1^{\%}$	0	$2^{\%}$	0	3	5^{Δ}	8^{Δ}	15^{Δ}	16^{Δ}	69^{Δ}
Metasediment	0	0	0	0	1^{Δ}	2	0	$3^{\&}$	3^{Δ}	16^{Δ}
Greenish-Weathering Granite	0	0	0	0	0	1^{Δ}	1	1	1^{Δ}	12^{Δ}
Crisp Feldspar Granite	0	1^{Δ}	0	0	0	2^{Δ}	0	7^{Δ}	5^{Δ}	5^{Δ}
Coarse-grained pink granite	0	0	0	1	1	0	0	0	0	1
Fine-grained pink granite	0	0	0	0	0	0	0	0	0	0
Quartz	0	0	0	0	0	0	1	0	1^{Δ}	5^{Δ}
Mafic Intrusive	1	1	1	1	0	0	1	3	$2^{\%}$	5^{Δ}
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	0	0	0	0	0	2	5^{Δ}	0
“Honest” sedimentary rock	0	0	0	0	0	0	0	0	0	0
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	0	0	0	1	0	1	1	7^{Δ}	8^{Δ}
Rhyolite or Similar	0	0	0	0	0	0	0	0	0	0

Sample bucket CATS-412R

Table 14: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-412R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	0	0	$1^{@}$	$1^{@}$	0	$5^{@}$	$3^{@}$	$7^{@}$	$6^{\%}$	$17^{\&}$
Foliated Rock	0	0	0	0	$1^{\&}$	1^{Δ}	0	0	0	$9^{\&}$
Metasediment	0	0	0	0	0	$1^{@}$	$1^{\bigcirc}$	0	0	6^{Δ}
Greenish-Weathering Granite	0	0	0	0	$1^{@}$	$5^{\&}$	$1^{\&}$	$3^{\&}$	$1^{\&}$	$26^{\%}$
Crisp Feldspar Granite	0	0	0	0	0	0	0	0	$1^{\%}$	6^{Δ}
Coarse-grained pink granite	0	0	0	0	0	$2^{@}$	0	$1^{\&}$	$1^{@}$	$3^{\%}$
Fine-grained pink granite	0	0	0	0	0	0	0	0	0	0
Quartz	0	0	0	0	0	0	0	0	0	0
Mafic Intrusive	0	0	0	0	0	$1^{\%}$	0	3^{Δ}	2^{Δ}	4^{Δ}
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	$3^{@}$	$2^{@}$	2	0	$4^{\&}$	$5^{@}$	8	$17^{\%}$
“Honest” sedimentary rock	0	0	0	0	0	0	0	0	0	0
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	$1^{@}$	0	$1^{@}$	0	$2^{\&}$	$1^{\%}$	$1^{@}$	5	$12^{\%}$
Rhyolite or Similar	0	0	0	0	0	0	0	0	0	0

Sample bucket CATS-419R

Table 15: Summary of physical attributes for clasts found in Project 392 sample bucket CATS-419R. Size fractions of the sieves used head each column and lithology of pebble head each row. Each cell gives the number of clasts for the specified lithology and size fraction. The most common angularity for the given lithology and size fraction designated by superscripted special character (# = very angular, Δ = angular, % = subangular, & = subround, @ = round, ◯ = well rounded). The absence of a special character by the clast count indicates angularity was not documented.

	2.5”	2”	1.5”	1.25”	1”	0.75”	0.625”	0.5”	0.375”	0.25”
Greenstone	$1^{@}$	$2^{\&}$	$5^{\%}$	$4^{@}$	14^{Δ}	6^{Δ}	$5^{\%}$	$18^{\%}$	34^{Δ}	78^{Δ}
Foliated Rock	0	$1^{\%}$	$7^{\%}$	$9^{\%}$	0	11^{Δ}	8^{Δ}	$5^{\%}$	19^{Δ}	49^{Δ}
Metasediment	0	0	0	0	$8^{\&}$	$19^{\&}$	$16^{\&}$	23^{Δ}	$30^{\&}$	$61^{\%}$
Greenish-Weathering Granite	0	0	0	0	$1^{\&}$	0	1	0	$4^{\%}$	10^{Δ}
Crisp Feldspar Granite	0	0	$2^{\%}$	0	$1^{\&}$	0	1	0	$3^{\%}$	10^{Δ}
Coarse-grained pink granite	0	0	0	0	0	0	1	0	0	2^{Δ}
Fine-grained pink granite	0	0	0	$1^{\bigcirc}$	0	$2^{\&}$	1	1	$3^{\%}$	1^{Δ}
Quartz	0	0	0	0	0	0	0	0	0	0
Mafic Intrusive	0	0	0	$1^{\bigcirc}$	$1^{\&}$	$1^{\&}$	1	3	$2^{\%}$	4^{Δ}
Gossan	0	0	0	0	0	0	0	0	0	0
Epidotized/silicified rock	0	0	$2^{\%}$	2^{Δ}	0	0	0	0	22^{Δ}	31^{Δ}
“Honest” sedimentary rock	0	0	0	0	0	0	$1^{\bigcirc}$	0	0	$3^{\bigcirc}$
Intrusive Veins	0	0	0	0	0	0	0	0	0	0
Metatuff	0	0	0	0	3^{Δ}	0	2^{Δ}	0	0	2^{Δ}
Rhyolite or Similar	0	0	0	0	0	0	0	0	0	0

Appendix C: Sample Listing and Assay Results

Table 16: List of samples sent to assay. Some lithological categories needed to be combined in order to achieve appropriate sample weights; combinations were based on presumed similarities in chemical composition. The "Rock Duplicate?" column indicates that the pebbles for the lithological category were split between two different assay samples. A dash (-) indicates the value of gold was below the detection limit.

Project 392 Sample Bucket	Assay Sample Number	Lithological Category	Rock Duplicate?	Gold Value (ppb)
CATS-059R	CATS059R001	Greenstone	No	5
CATS-059R	CATS059R002	Metasediment	No	3
CATS-059R	CATS059R003	Foliated rock	No	-
CATS-059R	CATS059R004	Greenish-weathering granite	No	1
CATS-059R	CATS059R005	Crisp feldspar granite	No	-
CATS-059R	CATS059R006	Coarse-grained pink granite	No	-
CATS-059R	CATS059R007	Fine-grained pink granite	No	-
CATS-059R	CATS059R008	Quartz	No	3
CATS-059R	CATS059R009	Mafic intrusive	No	-
CATS-059R	CATS059R010	Greenish-weathering granite	Duplicate of CATS059R004	7
CATS-202R	CATS202R001	Greenstone + Mafic intrusive	No	4
CATS-202R	CATS202R002	Metasediment + all Gossan	No	1
CATS-202R	CATS202R003	Coarse + Fine-grained pink granite	No	-
CATS-202R	CATS202R004	Greenish-Weathering Granite	No	-
CATS-202R	CATS202R005	Quartz	No	-
CATS-202R	CATS202R006	Crisp feldspar granite	No	-
CATS-202R	CATS202R007	Metasediment	Duplicate of CATS202R002*	-
CATS-207R	CATS207R001	Coarse + Fine-grained pink granite	No	-
CATS-207R	CATS207R002	Metatuff + Quartz	No	4
CATS-207R	CATS207R003	Greenstone + Mafic intrusive	No	-
CATS-207R	CATS207R004	Crisp feldspar granite	No	1
CATS-207R	CATS207R005	Greenish-weathering granite	No	-
CATS-207R	CATS207R006	Metasediment	No	3
CATS-207R	CATS207R007	Foliated rock	No	-
CATS-207R	CATS207R008	Foliated rock	Duplicate of CATS207R007	-
CATS-303R	CATS303R001	Metatuff + Quartz + Rhyolite	No	-
CATS-303R	CATS303R002	Mafic intrusive	No	6
CATS-303R	CATS303R003	Intrusive veins	No	-
CATS-303R	CATS303R004	Metasediment	No	4
CATS-303R	CATS303R005	Epidotized/silicified rock	No	4
CATS-303R	CATS303R006	Crisp feldspar granite	No	-
CATS-303R	CATS303R007	Greenish-weathering granite	No	9
CATS-303R	CATS303R008	Coarse-grained pink granite	No	3
CATS-303R	CATS303R009	"Honest" sedimentary rock	No	1

Project 392 Sample Bucket	Assay Sample Number	Lithological Category	Rock Duplicate?	Gold Value (ppb)
CATS-303R	CATS303R010	Fine-grained pink granite	No	-
CATS-303R	CATS303R011	Greenstone	No	-
CATS-303R	CATS303R012	Foliated rock	No	6
CATS-303R	CATS303R013	Greenish-weathering granite	Duplicate of CATS303R007	4
CATS-306R	CATS306R001	Mafic intrusive	No	2
CATS-306R	CATS306R002	"Honest" sedimentary rock	No	-
CATS-306R	CATS306R003	Metasediment	No	4
CATS-306R	CATS306R004	Fine-grained pink granite	No	-
CATS-306R	CATS306R005	Greenish-weathering granite	No	-
CATS-306R	CATS306R006	Coarse-grained pink granite	No	-
CATS-306R	CATS306R007	Epidotized/silicified rock + Quartz	No	7
CATS-306R	CATS306R008	Foliated rock	No	-
CATS-306R	CATS306R009	Crisp feldspar granite	No	-
CATS-306R	CATS306R010	Greenstone	No	-
CATS-306R	CATS306R011	Foliated rock	Duplicate of CATS306R008	2
CATS-307R	CATS307R001	Quartz	No	-
CATS-307R	CATS307R002	Coarse + Fine-grained pink granite	No	-
CATS-307R	CATS307R003	Mafic intrusive	No	-
CATS-307R	CATS307R004	Metatuff	No	-
CATS-307R	CATS307R005	Greenish-weathering granite	No	1
CATS-307R	CATS307R006	Metasediment	No	99
CATS-307R	CATS307R007	Epidotized/silicified rock	No	-
CATS-307R	CATS307R008	Greenstone	No	5
CATS-307R	CATS307R009	Metasediment	Duplicate of CATS307R6	2
CATS-309R	CATS309R001	Rhyolite + Quartz	No	-
CATS-309R	CATS309R002	"Honest" sedimentary rock	No	4
CATS-309R	CATS309R003	Gossan	No	2
CATS-309R	CATS309R004	Mafic intrusive	No	-
CATS-309R	CATS309R005	Metasediment	No	-
CATS-309R	CATS309R006	Crisp + Greenish + Fine Pink Granite	No	6
CATS-309R	CATS309R007	Foliated rock	No	-
CATS-309R	CATS309R008	Greenstone	No	-
CATS-309R	CATS309R009	Foliated rock	Duplicate of CATS309R007	-
CATS-321R	CATS321R001	Quartz	No	-
CATS-321R	CATS321R002	Coarse-grained pink granite	No	1
CATS-321R	CATS321R003	Rhyolite or similar	No	18
CATS-321R	CATS321R004	Crisp feldspar granite	No	1
CATS-321R	CATS321R005	Fine-grained pink granite	No	-
CATS-321R	CATS321R006	Greenish-weathering granite	No	-
CATS-321R	CATS321R007	Mafic intrusive	No	-

Project 392 Sample Bucket	Assay Sample Number	Lithological Category	Rock Duplicate?	Gold Value (ppb)
CATS-321R	CATS321R008	Metasediment	No	-
CATS-321R	CATS321R009	Epidotized/silicified rock	No	-
CATS-321R	CATS321R010	Greenstone	No	3
CATS-321R	CATS321R011	Epidotized/silicified rock	Duplicate of CATS321R009	1
CATS-406R	CATS406R001	Coarse-grained pink granite	No	-
CATS-406R	CATS406R002	Epidotized/silicified rock	No	2
CATS-406R	CATS406R003	Greenish-weathering granite	No	2
CATS-406R	CATS406R004	Quartz	No	1
CATS-406R	CATS406R005	Metatuff	No	-
CATS-406R	CATS406R006	Crisp feldspar granite	No	-
CATS-406R	CATS406R007	Metasediment	No	-
CATS-406R	CATS406R008	Greenstone	No	5
CATS-406R	CATS406R009	Mafic intrusive	No	4
CATS-406R	CATS406R010	Foliated rock	No	1
CATS-406R	CATS406R011	Mafic intrusive	Duplicate of CATS406R009	5
CATS-412R	CATS412R001	Coarse + Crisp feldspar granite	No	-
CATS-412R	CATS412R002	Mafic intrusive	No	2
CATS-412R	CATS412R003	Metasediment	No	-
CATS-412R	CATS412R004	Foliated rock	No	-
CATS-412R	CATS412R005	Greenish-weathering granite	No	5
CATS-412R	CATS412R006	Metatuff	No	-
CATS-412R	CATS412R007	Greenstone	No	8
CATS-412R	CATS412R008	Epidotized/silicified rock	No	2
CATS-412R	CATS412R009	Greenstone	Duplicate of CATS412R007	-
CATS-419R	CATS419R001	“Honest” sedimentary rock	No	-
CATS-419R	CATS419R002	Fine-grained pink granite	No	-
CATS-419R	CATS419R003	Crisp feldspar granite	No	-
CATS-419R	CATS419R004	Mafic intrusive	No	-
CATS-419R	CATS419R005	Epidotized/silicified rock	No	1
CATS-419R	CATS419R006	Metatuff	No	-
CATS-419R	CATS419R007	Greenish-weathering granite	No	-
CATS-419R	CATS419R008	Coarse-grained pink granite	No	-
CATS-419R	CATS419R009	Greenstone	No	1
CATS-419R	CATS419R010	Foliated rock	No	-
CATS-419R	CATS419R011	Metasediment	No	3
CATS-419R	CATS419R012	Epidotized/silicified rock	Duplicate of CATS419005	2

*CATS202R007 is not an exact duplicate of CATS202R002, as it was difficult to adequately distribute the gossan clasts. CATS202R007 did not contain any gossan clasts.

Appendix D: XRF Analysis Results

Table 17: Semi-quantitative XRF analysis of decomposed mineral crusts on foliated rock pebbles from duplicate till bucket CATS-207R. These results should not be compared to any other analytical data. The system was operating in Soil Mode. Nine pebbles were analyzed in two different spots (three in the case of CATS 207R-5). Values are in parts per million. A dash (-) indicates the value of the element was below the detection limit. Error for each value is given in the next table.

	CATS 207R-1	CATS 207R-1	CATS 207R-2	CATS 207R-2	CATS 207R-3	CATS 207R-3	CATS 207R-4	CATS 207R-4	CATS 207R-5	CATS 207R-5	CATS 207R-5	CATS 207R-6	CATS 207R-6	CATS 207R-7	CATS 207R-7	CATS 207R-8	CATS 207R-8	CATS 207R-9	CATS 207R-9
Ti	3290	6829	3596	2750	3334	1621	5810	4277	5463	4845	6198	4080	4541	3776	3312	3736	4955	1301	6679
Cr	108	185	96	82	95	27	97	230	76	35	136	126	108	105	64	224	259	37	550
Mn	293	336	-	30	1902	17	1526	91	762	436	1248	697	161	66	52	2829	293	-	419
Fe	30642	39249	29481	36911	51124	20599	58738	12627	55622	56907	81252	41568	64477	65954	50839	62688	48778	25552	62310
Co	238	147	223	255	199	198	391	292	419	471	439	165	489	471	309	338	535	112	201
Ni	7	18	40	60	36	40	-	-	6	11	-	48	62	44	51	54	50	64	178
Cu	5	9	14	12	14	11	16	11	13	12	10	22	33	31	28	8	11	11	34
Zn	56	67	54	65	49	49	47	22	100	83	77	58	283	293	240	62	79	48	117
As	7	12	3	4	24	1	30	14	10	7	14	19	9	4	2	6	4	5	51
Se	1	-	-	1	-	-	2	-	2	-	3	1	1	1	1	1	1	1	1
Rb	31	32	83	67	27	14	123	155	77	87	92	39	40	37	33	86	76	9	117
Sr	263	264	198	159	217	227	168	140	349	358	329	167	85	81	81	121	103	21	82
Zr	74	120	61	52	64	70	146	91	111	131	129	158	125	119	102	70	69	8	74
Mo	-	-	-	-	-	-	5	28	2	1	-	-	-	-	-	8	1	11	-
Ag	2	-	9	-	9	5	-	-	-	-	-	24	-	-	-	4	4	-	7
Cd	18	24	13	7	2	5	8	6	19	25	16	22	21	-	21	10	11	27	12
Sn	-	1	10	-	17	10	-	-	54	1	30	10	-	-	10	11	-	-	9
Sb	-	4	-	-	14	17	-	-	9	-	13	-	25	-	-	-	-	-	5
Ba	204	178	446	308	395	143	558	471	410	507	738	445	251	369	338	474	361	126	633
Au	-	1	-	-	-	1	-	2	-	-	-	-	-	-	-	2	-	1	-
Hg	3	-	4	3	1	-	5	2	2	7	6	3	7	5	4	4	6	-	7
Pb	3	5	3	2	24	4	24	15	7	-	7	8	-	3	2	15	9	4	3

Table 18: Error values for semi-quantitative XRF analysis of decomposed mineral crusts on foliated rock pebbles from duplicate till bucket CATS-207R. Nine pebbles were analyzed in two different spots (three in the case of CATS 207R-5). Values are in parts per million. These results should not be compared to any other analytical data.

	CATS 207R-1	CATS 207R-1	CATS 207R-2	CATS 207R-2	CATS 207R-3	CATS 207R-3	CATS 207R-4	CATS 207R-4	CATS 207R-5	CATS 207R-5	CATS 207R-5	CATS 207R-6	CATS 207R-6	CATS 207R-7	CATS 207R-7	CATS 207R-8	CATS 207R-8	CATS 207R-9	CATS 207R-9
Ti +/-	153	197	164	158	169	123	220	169	206	205	237	183	195	190	177	198	196	122	223
Cr +/-	25	27	25	26	26	22	31	27	29	30	33	28	29	29	28	32	30	23	33
Mn +/-	19	21	16	17	35	14	36	16	28	25	35	26	23	22	20	47	23	15	26
Fe +/-	217	279	213	266	353	148	447	107	409	427	612	306	467	477	370	471	360	181	453
Co +/-	32	37	32	36	41	26	49	24	46	48	57	39	50	50	44	50	44	29	48
Ni +/-	8	9	9	9	9	8	11	8	10	11	12	10	11	11	10	11	11	8	12
Cu +/-	2	2	2	3	3	2	3	2	3	3	3	3	3	3	3	3	3	2	3
Zn +/-	3	3	3	3	3	2	3	2	4	3	4	3	6	6	5	3	3	2	4
As +/-	1	2	1	1	2	1	2	2	2	2	2	2	2	2	2	2	2	1	2
Se +/-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rb +/-	1	1	1	1	1	1	2	2	1	2	2	1	1	1	1	2	1	1	2
Sr +/-	3	3	2	2	2	2	2	2	3	4	3	2	1	1	1	2	2	1	1
Zr +/-	2	2	2	2	2	2	3	2	3	3	3	3	2	2	2	2	2	2	2
Mo +/-	3	3	3	3	3	3	4	3	3	3	4	3	3	3	3	4	3	3	3
Ag +/-	7	8	8	8	8	7	8	8	8	8	9	8	8	8	8	8	8	7	8
Cd +/-	9	10	10	10	10	9	10	10	10	10	11	10	10	10	10	11	10	9	10
Sn +/-	16	16	17	17	17	16	18	16	18	18	19	18	18	18	18	19	18	16	18
Sb +/-	18	18	18	19	18	17	19	18	20	20	20	20	20	20	20	21	20	17	19
Ba +/-	65	75	70	70	74	56	91	70	84	86	99	78	82	82	77	87	81	57	90
Au +/-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hg +/-	1	1	2	2	1	1	2	2	2	2	2	2	2	2	2	2	2	1	2
Pb +/-	2	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	1	2

Table 19: Semi-quantitative XRF analysis results for unusually strongly-foliated metasedimentary pebbles from till sample CATS-307R. These results should not be compared to any other analytical data. The system was operating in Alloy Mode. Eight pebbles were analyzed at one point, with the exception of pebble 3, which was analyzed in four locations. Values are in percent. A dash (-) indicates the value of the element was below the detection limit. Error for each value is given in the next table.

	1	2	3a	3b	3c	3d	4	5	6	7	8
Mg	-	-	-	-	-	-	-	-	-	-	-
Al	20.94	17.44	15.01	16.76	13.12	15.98	17.10	25.05	24.69	18.77	26.53
Si	56.63	59.99	44.23	43.59	42.97	40.83	67.83	45.02	50.56	54.54	43.62
P	-	-	-	-	-	-	-	-	-	-	-
Ti	1.70	0.98	1.08	1.10	1.25	1.06	1.34	1.26	1.56	1.35	1.04
V	-	-	-	-	0.09	0.1	-	0.13	-	-	0.11
Cr	0.12	0.06	0.08	-	0.06	0.05	0.12	-	0.11	-	0.10
Mn	0.23	0.30	0.59	0.59	0.61	0.62	0.16	0.14	0.31	0.34	0.34
Fe	20.18	21.09	38.58	37.58	41.44	40.92	13.3	28.2	22.52	24.81	28.01
Co	-	-	-	-	-	-	-	-	-	-	-
Ni	0.05	0.07	0.10	0.09	0.10	0.12	0.07	0.05	0.12	0.09	0.08
Cu	-	-	0.03	-	0.02	-	-	-	-	-	0.02
Zn	-	0.02	0.05	0.04	0.06	0.06	0.02	0.05	0.03	0.03	0.05
Se	-	-	-	-	-	-	-	-	-	-	-
Br	-	-	-	-	-	-	-	-	-	-	-
Zr	0.14	0.05	0.04	0.04	0.03	0.03	0.06	0.09	0.07	0.07	0.10
Nb	-	-	-	-	-	-	-	-	-	-	-
Mo	-	-	-	-	-	-	-	-	-	-	-
Ru	-	-	-	-	-	-	-	-	-	-	-
Rh	-	-	-	-	-	-	-	-	-	-	-
Pd	-	-	-	-	-	-	-	-	-	-	-
Ag	-	-	-	-	-	-	-	-	-	-	-
Cd	-	-	-	-	-	-	-	-	-	-	-
Sn	-	-	-	-	-	-	-	-	-	-	-
Sb	-	-	-	-	-	-	-	-	-	-	-
Hf	-	-	-	-	-	-	-	-	-	-	-
Ta	-	-	-	-	-	-	-	-	-	-	-
W	-	-	-	-	-	-	-	-	-	-	-
Re	-	-	-	-	-	-	-	-	-	-	-
Ir	-	-	0.21	0.22	0.25	0.23	-	-	-	-	-
Pt	-	-	-	-	-	-	-	-	-	-	-
Au	-	-	-	-	-	-	-	-	-	-	-
Hg	-	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-	-
Bi	-	-	-	-	-	-	-	-	-	-	-

Table 20: Error values given for semi-quantitative XRF analysis results for unusually strongly-foliated metasedimentary pebbles from till sample CATS-307R. The system was operating in Alloy Mode. Eight pebbles were analyzed at one point, with the exception of pebble 3, which was analyzed in four locations. Values are in percent. A dash (-) indicates the value of the element was below the detection limit; error was not recorded. These results should not be compared to any other analytical data.

	1	2	3a	3b	3c	3d	4	5	6	7	8
Mg +/-	-	-	-	-	-	-	-	-	-	-	-
Al +/-	1.11	1.09	1.26	1.21	1.24	1.15	0.99	1.21	1.17	1.23	1.18
Si +/-	0.48	0.46	0.47	0.45	0.45	0.43	0.47	0.48	0.48	0.48	0.47
P +/-	-	-	-	-	-	-	-	-	-	-	-
Ti +/-	0.06	0.05	0.04	0.04	0.04	0.04	0.06	0.05	0.06	0.05	0.05
V +/-	-	-	-	-	0.02	0.02	-	0.02	-	-	0.02
Cr +/-	0.02	0.02	0.01	-	0.01	0.01	0.02	-	0.02	-	0.02
Mn +/-	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02	0.01
Fe +/-	0.08	0.08	0.10	0.10	0.10	0.09	0.07	0.09	0.08	0.09	0.09
Co +/-	-	-	-	-	-	-	-	-	-	-	-
Ni +/-	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cu +/-	-	-	0.00	-	0.00	-	-	-	-	-	0.00
Zn +/-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Se +/-	-	-	-	-	-	-	-	-	-	-	-
Br +/-	-	-	-	-	-	-	-	-	-	-	-
Zr +/-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nb +/-	-	-	-	-	-	-	-	-	-	-	-
Mo +/-	-	-	-	-	-	-	-	-	-	-	-
Ru +/-	-	-	-	-	-	-	-	-	-	-	-
Rh +/-	-	-	-	-	-	-	-	-	-	-	-
Pd +/-	-	-	-	-	-	-	-	-	-	-	-
Ag +/-	-	-	-	-	-	-	-	-	-	-	-
Cd +/-	-	-	-	-	-	-	-	-	-	-	-
Sn +/-	-	-	-	-	-	-	-	-	-	-	-
Sb +/-	-	-	-	-	-	-	-	-	-	-	-
Hf +/-	-	-	-	-	-	-	-	-	-	-	-
Ta +/-	-	-	-	-	-	-	-	-	-	-	-
W +/-	-	-	-	-	-	-	-	-	-	-	-
Re +/-	-	-	-	-	-	-	-	-	-	-	-
Ir +/-	-	-	0.02	0.02	0.02	0.02	-	-	-	-	-
Pt +/-	-	-	-	-	-	-	-	-	-	-	-
Au +/-	-	-	-	-	-	-	-	-	-	-	-
Hg +/-	-	-	-	-	-	-	-	-	-	-	-
Pb +/-	-	-	-	-	-	-	-	-	-	-	-
Bi +/-	-	-	-	-	-	-	-	-	-	-	-

Table 21: Semi-quantitative XRF analysis results for metasedimentary pebbles from till sample CATS-307R. These results should not be compared to any other analytical data. The system was operating in Soil Mode. 15 pebbles were analyzed at one location, with the exception of pebbles E and K (analyzed in two locations) and E (analyzed in three locations). Relatively high rate of initial mistaken lithological identity in this group. Values are in parts per million. A dash (-) indicates the value of the element was below the detection limit. Error for each value is given in the next table. Sublithology codes: SIF = high silica/chert and iron formation; MIG = very fine grained migmatite?; MTG = metagreywacke; MISC = miscategorized and probably of igneous origin.

	A	B	C	D	E	E	E	F	F	G	H	I	J	K	K	L	M	N	O
Lithology	SIF	SIF	SIF	SIF	MIG	MIG	MIG	MTG	MTG	MTG	MTG	MTG	MTG	MISC	MISC	MISC	MISC	MISC	MISC
Ti	779	3521	4261	2562	4713	1143	848	5053	3907	5534	5226	6807	6421	22158	20061	2758	4829	3643	3398
Cr	27	135	95	2	48	21	47	261	104	207	169	121	142	79	116	83	208	277	74
Mn	68	545	928	654	567	114	87	65	312	646	285	742	1429	1192	1825	108	2551	593	579
Fe	5154	33387	35199	37698	50999	10563	8073	93416	43738	75183	55593	53996	103264	122078	126080	31545	55917	57161	39284
Co	-	59	173	262	294	51	8	551	253	323	142	180	262	554	210	168	155	194	115
Ni	25	5	2	20	56	30	30	108	61	180	150	80	109	56	123	107	83	150	107
Cu	14	22	25	26	16	14	9	27	90	15	36	17	12	76	61	34	11	23	13
Zn	9	43	38	38	36	18	15	74	52	65	50	51	60	59	52	65	46	65	51
As	1	5	1	12	1	1	1	3	5	1	7	3	2	5	6	1	4	-	3
Se	1	1	2	-	1	-	-	-	1	2	1	-	2	4	1	1	1	-	-
Rb	66	96	116	79	21	70	74	10	17	28	23	14	22	30	36	17	20	15	25
Sr	198	406	289	407	349	356	366	136	105	194	82	206	175	292	348	25	451	176	218
Zr	52	124	177	141	97	61	61	71	55	64	99	99	40	114	110	67	50	82	78
Mo	6	-	23	7	13	-	5	-	-	1	-	-	12	-	-	-	13	-	-
Ag	19	11	-	4	-	12	21	4	-	10	-	16	-	-	-	26	-	-	-
Cd	32	18	1	-	-	18	20	6	25	1	-	27	18	24	21	25	26	13	4
Sn	-	-	27	26	-	32	6	4	-	51	5	-	-	20	38	-	2	-	-
Sb	-	9	18	23	-	10	8	38	-	-	10	-	1	-	67	5	-	-	20
Ba	599	393	744	645	363	317	458	596	303	339	303	341	391	840	795	281	516	352	313
Au	1	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Hg	3	10	10	3	7	2	2	4	-	6	4	6	9	9	10	-	1	3	3
Pb	5	-	8	5	2	1	2	2	4	2	3	1	-	-	-	1	11	-	-

Table 22: Error values given for semi-quantitative XRF analysis results for metasedimentary pebbles from till sample CATS-307R. The system was operating in Soil Mode. 15 pebbles were analyzed at one location, with the exception of pebbles E and K (analyzed in two locations) and E (analyzed in three locations). Relatively high rate of initial mistaken lithological identity in this group. Values are in parts per million. These results should not be compared to any other analytical data. A dash (-) indicates the value of the element was below the detection limit. Sublithology codes: SIF = high silica/chert and iron formation; MIG = very fine grained migmatite?; MTG = metagreywacke; MISC = miscategorized and probably of igneous origin.

	A	B	C	D	E	E	E	F	F	G	H	I	J	K	K	L	M	N	O
Lithology	SIF	SIF	SIF	SIF	MIG	MIG	MIG	MTG	MTG	MTG	MTG	MTG	MTG	MISC	MISC	MISC	MISC	MISC	MISC
Ti +/-	109	236	198	171	199	113	113	226	186	228	194	223	267	454	418	149	219	180	178
Cr +/-	20	46	30	27	29	20	21	33	30	34	28	30	39	43	41	24	34	29	29
Mn +/-	12	34	29	25	26	14	13	25	23	30	22	28	42	44	48	17	47	26	25
Fe +/-	49	346	277	284	385	83	70	693	334	585	394	409	862	1082	1070	221	448	405	301
Co +/-	13	48	38	39	45	19	17	61	42	57	44	46	70	81	79	32	49	45	39
Ni +/-	6	13	10	10	11	7	7	13	10	13	11	11	15	16	16	9	12	11	11
Cu +/-	2	4	3	3	3	2	2	3	4	3	3	3	4	5	5	3	3	3	3
Zn +/-	2	4	3	3	3	2	2	3	3	3	3	3	4	4	4	3	3	3	3
As +/-	1	2	2	2	2	1	1	2	2	2	2	2	2	2	2	1	2	1	1
Se +/-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Rb +/-	1	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sr +/-	2	5	3	4	4	3	3	2	2	3	1	3	3	4	4	1	5	2	3
Zr +/-	2	4	3	3	3	2	2	2	2	2	2	3	3	3	3	2	3	2	2
Mo +/-	3	5	4	3	4	3	3	4	3	4	3	3	4	4	4	3	4	3	3
Ag +/-	7	11	8	8	8	7	7	8	8	9	8	8	9	10	10	7	9	8	8
Cd +/-	9	14	11	10	11	9	9	11	10	11	10	11	12	13	12	10	11	10	10
Sn +/-	16	24	19	18	19	16	16	19	18	20	17	19	21	22	21	17	20	17	18
Sb +/-	17	26	20	20	20	18	18	21	20	22	19	21	23	24	24	18	22	19	20
Ba +/-	54	105	85	78	83	53	55	97	79	95	79	87	111	150	142	65	93	78	77
Au +/-	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hg +/-	1	3	2	2	2	1	1	2	2	2	2	2	2	2	2	1	2	2	2
Pb +/-	1	2	2	2	2	1	1	2	2	2	2	2	2	2	2	1	2	2	2