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Indicator mineral abundance data for bedrock and till from the Mount Pleasant Sn-W-Mo-Bi-In deposit, New Brunswick

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ABSTRACT

As part of the Geological Survey of Canada's Targeted Geoscience Initiative 4 (TGI-4) Program, till and bedrock samples were collected around the Mount Pleasant Sn-W-Mo-Bi-In deposit in southwest New Brunswick to determine the indicator minerals and their trace element signatures that are indicative of intrusion-hosted polymetallic Sn-W deposits. The purpose of this open file is to report the raw indicator mineral weight and abundance data for bedrock and till samples collected in 2012 for this case study. Samples were processed by the commercial laboratory Overburden Drilling Management Limited, Ottawa, ON, using a combination of tabling, panning, and heavy liquids to recover potential indicator minerals. Sample locations, weights of various fractions produced during sample processing, and indicator mineral grains identified are reported in this open file. Interpretation of results will be presented in future publications.

INTRODUCTION

Several case studies have been published that document the indicator mineral signatures for gold and kimberlites in till, however, none have been published that document indicator mineral signatures of intrusion-hosted polymetallic Sn-W deposits. To address this knowledge gap, the Geological Survey of Canada (GSC), through its Targeted Geoscience Initiative 4 (TGI-4) Program (2010-2015), and the New Brunswick Department of Energy and Mines initiated a study of till and bedrock samples around two intrusion hosted polymetallic W-bearing deposits in southwest and west central New Brunswick (Fig. 1): 1) Mount Pleasant Sn-W-Mo-Bi-In deposit (this study), and 2) the Sisson W-Mo deposit (McClenaghan et al., 2013a,b,c, 2014).

The Mount Pleasant deposit was chosen as a Sn-W indicator mineral test site because: 1) the deposit and district geology are well known; 2) the mineralization subcrops and is directly overlain by till and thus was exposed to direct glacial erosion; 3) the site is easily accessible by road; and 4) a till geochemical dispersal train down-ice from the known mineralization was identified by Szabo et al. (1975) and thus metal-rich till should be available for sampling in this study. The deposit was also selected for detailed study because it contains a significant resource of In, and no till geochemical studies have been published that report glacial dispersal from a significant In source.

The specific objectives of the TGI-4 indicator mineral research project are: 1) to determine the indicator minerals and their trace element composition that is indicative of intrusion-hosted polymetallic Sn-W-Mo deposits; and 2) to establish practical methods for their recovery from glacial sediments and their identification that can be routinely applied in Sn-W-Mo exploration in glaciated terrain. The purpose of this open file is to report the unedited samples processing and indicator mineral abundance data for the bedrock and till samples collected in 2012 for this specific case study. Interpretations of these indicator mineral data, as well as till geochemical data for the <0.063 mm fraction of the same till samples, will be published in subsequent GSC open files.

METHODS

Field sampling

Till and bedrock samples were collected in the summer of 2012 in the Mount Pleasant deposit area. A total of 3 bedrock samples, weighing between 0.3 and 1 kg, were collected for the recovery of indicator minerals to document the indicator mineral signatures of the host rocks and mineralization for comparisons with mineralogy and geochemistry of till.

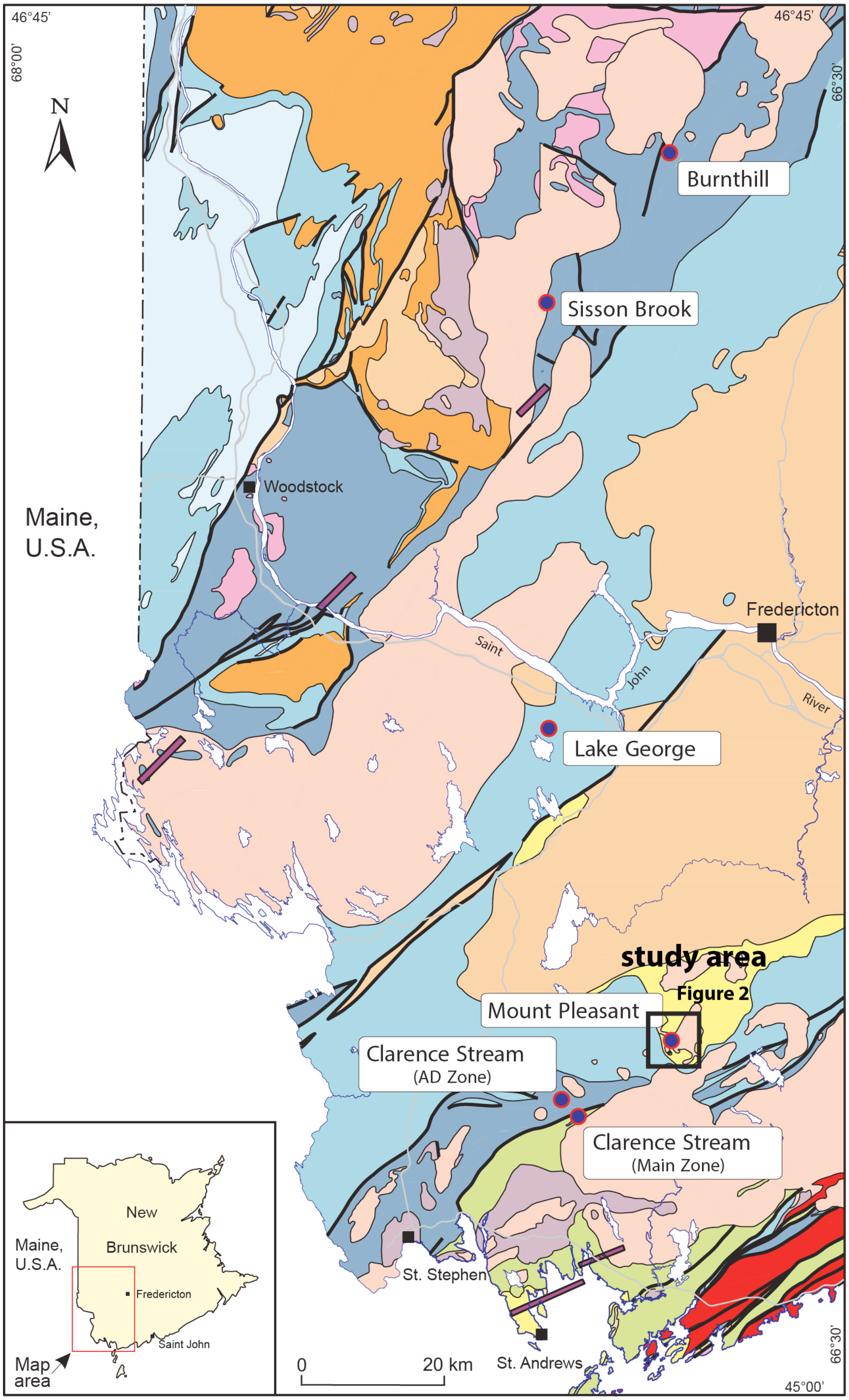

Figure 1. Location of the Mount Pleasant Sn-W-Mo-Bi-In deposit in central New Brunswick (modified from Fyffe et al., 2010).

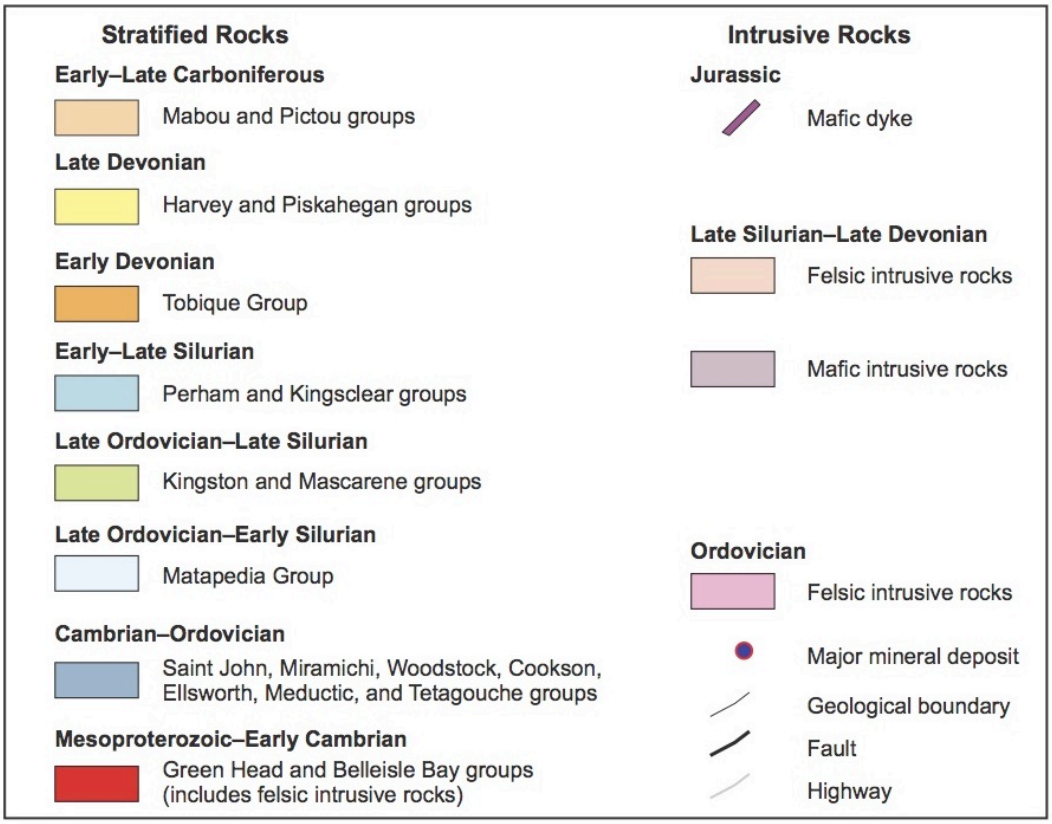

Figure 1. (cont.) Bedrock geology legend (from Fyffe et al., 2010).

Bedrock sample locations are listed in **Appendix A**. Lithologies sampled included: 1) 12-MPB-1021 fluorite rich sample, grab sample from waste rock pile on the north side of the North Zone; 2) 12-MPB-1040 rhyolite-chert breccia with fluorite-filled vugs from the Fire Tower zone; 3) 12-CBD-004 sulphidized and veined quartz breccia from the Fire Tower Zone.

In 2012, 24 large (~15 kg) till samples (12-MPB-1001 to -1026) were collected up-ice (to the NW), proximal to, and at varying distances down-ice (generally SE) of the deposit (Fig. 2). Till samples were collected from hand dug holes, road cuts, and surface trenches. One field duplicate till sample was collected from the same sample hole to assess field variability: 12-MPB-1011 is a duplicate of 12-MPB-1010. Till sample locations are listed in **Appendix A**. Detailed notes and photos were taken at each sample site and will be included in a subsequent GSC open file.

Sample processing and indicator mineral picking

All samples were shipped to Overburden Drilling Management Limited (ODM), Ottawa, ON for processing and production of heavy mineral concentrates. The unmodified reports prepared by ODM are reported in **Appendices B1** and **B2**

Bedrock samples

Three bedrock samples were processed following the flow chart depicted in Figure 3. Each bedrock sample was first examined and described by geologists at ODM (**Appendix C**) and then disaggregated at ODM using a custom built CNT Spark-2 electric pulse disaggregator

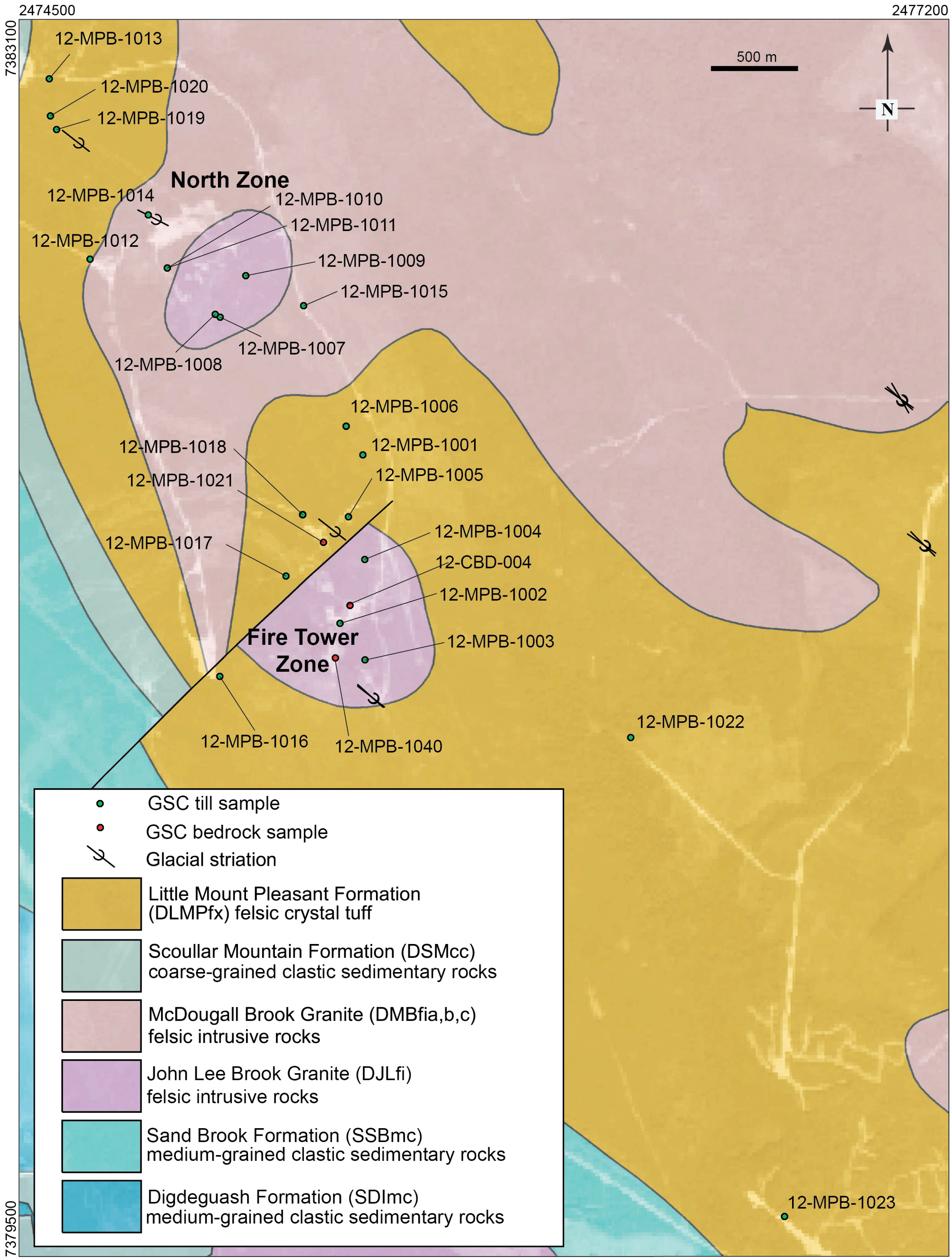

Figure 2. Till and bedrock sample locations plotted on a Google Earth™ image for the Mount Pleasant deposit area combined with bedrock geology modified fromMcLeod et al. (2005).

(EPD) instead of a conventional rock crusher to preserve natural grain sizes, textures, and shapes. The weight of material disaggregated ranged from 70 to 620 g. Each sample was placed in a metal chamber that was then filled with water and sealed. Electric pulses were then applied to the sample. The rapid scattering of electric pulses through the sample leads to explosions, which occur preferentially along grain boundaries, the natural zones of weakness in a rock sample. The explosions along grain boundaries result in liberated individual, undamaged mineral grains that are recovered in their original shape and form regardless of grain size (Rudashevski et al., 2002; Lastra et al., 2003; Cabri et al., 2008). The <2.0 mm material of each bedrock sample was then processed at ODM to produce a non-ferromagnetic heavy mineral concentrate for picking indicator minerals, and weights for all fractions produced are reported in **Appendix B1**. The <2.0 mm material was passed over a shaking table. The <0.25 mm heavy table concentrate was micro-panned to recover any gold, sulphides, and other indicator minerals. The minerals in the panned concentrates were counted and their size and shape characteristics recorded and then returned to the sample. The heavy table concentrate was then sieved at 0.18 mm. The 0.18 to 2.0 mm pre-concentrate was then further refined using heavy liquid separation in methylene iodide diluted to a specific gravity (SG) of 3.2.

The ferromagnetic fraction was then separated using a hand magnet. The non-ferromagnetic heavy mineral fraction was sieved into four size fractions: 0.18-0.25, 0.25-0.5, 0.5-1.0, 1.0-2.0 mm. The 0.18-0.25 mm fraction was archived and the 0.25-0.5 mm fraction was further subjected to paramagnetic separations using a Carpco® magnetic separator at 0.6, 0.8, and 1.0 amps to facilitate mineral identification in this fine size fraction based in part on the minerals' magnetic properties. As part of this research, selected mineral grains will be imaged with a scanning electron microscope (SEM) and analyzed by electron microprobe and laser ablation inductively coupled plasma mass spectrometry analyses (LA-ICP-MS) (Fig. 4).

At ODM, three quartz blank bedrock samples (12-MPB-BLK, 12-MPB-1021BLK,12-CBD-004BLK) were inserted into the batch to monitor potential cross contamination between samples. Blank samples are identified by the letters 'BLK' in their sample number. The results for the quartz blank samples are reported along with the bedrock samples in **Appendix B1.**

Till samples

A total of 26 till samples plus two GSC in-house 'blanks'(see below for details), labeled 12-MPB-1001 and 12-MPB-1032 were shipped to ODM for heavy mineral separation and indicator mineral picking. The blank samples were inserted into the till batch by GSC personnel prior to processing, to monitor carry over contamination in the indicator mineral processing laboratory. They are identified as Bathurst blank in **Appendix A**. These "blank" samples are weathered Silurian-Devonian granite (grus) of the South Nepisiguit River Plutonic Suite (Wilson, 2007) collected in the Miramichi Highlands approximately 66 km west of Bathurst, New Brunswick (McClenaghan et al., 2012; Plouffe et al., 2013). The material is unconsolidated and has the appearance of moderately sorted, monolithologic sand. It does not contain any precious or base metal indicator minerals except for rare pyrite or gold grains. Results for these two samples are reported along with the till samples.

Similar to the bedrock samples, the <2.0 mm fraction of till was processed to produce a non-ferromagnetic heavy mineral concentrate for selection of indicator minerals as outlined in Figure 4. The weights for all fractions produced are reported in **Appendix B2**. First, 10 to 15 kg of the <2.0 mm material was passed over a shaking table and the heavy table concentrate recovered and micropanned to recover any gold, sulphides, tin, and tungsten minerals in the <0.25 mm fraction. The minerals in the panned concentrates were counted and their size and shape characteristics recorded and then returned to the sample. Concentrates were then sieved at 0.25 mm. The 0.25 to 2.0 mm pre-concentrate was then further refined using heavy liquid separation in methylene iodide diluted to a SG of 3.2.

The SG <3.2 material was further refined using heavy liquid with SG 3.0. The SG <3.0 material was archived. The SG 3.0-3.2 was washed and then sieved at 0.25, 0.5, and 1.0 mm, with the 0.25-0.5 mm fraction examined for indicator minerals.

The SG >3.2 fraction was subjected to a ferromagnetic separation using a hand magnet. The ferromagnetic fraction was archived and the non-ferromagnetic heavy mineral fraction was sieved into three size fractions: 0.25-0.5, 0.5-1.0, 1.0-2.0 mm. The 0.25-0.5 mm fraction was further subjected to paramagnetic separations using a Carpco® magnetic separator to produce <0.6 amp (strongly paramagnetic), 0.6 to 0.8 amp (moderately paramagnetic), 0.8 to 1.0 amp (weakly paramagnetic) and >1.0 amp (non-paramagnetic fractions) to assist counting and picking indicator minerals in this fine-grained fraction. The 0.25-0.5 mm fraction was cleaned with oxalic acid to remove oxidation stains (tarnish) from the grains and restore their natural colour, most importantly for sulphide minerals, which facilitates optical mineral identification. As for the bedrock samples, selected mineral grains will be imaged with a SEM and analyzed by electron microprobe and LA-ICP-MS (Fig. 4).

Mineral picking
The 0.25-0.5, 0.5-1.0, 1.0-2.0 mm non-ferromagnetic heavy mineral (SG >3.2) and mid density (SG 3.0-3.2) fractions of till samples and the heavy mineral fraction of bedrock samples were examined by trained personnel at ODM and indicator minerals counted/selected including cassiterite, scheelite, fluorite, gold, and sulphide minerals, as well as potential oxide and silicate indicators of massive sulphide deposits. The visual identification of a number of limited mineral grains was verified with a scanning electron microscope (SEM).

Digital data files
ODM produced a digital data file for each sample batch processed: (1) 2012 bedrock samples (**Appendix B1**); (2) 2012 till samples (**Appendix B2**). Each data file consists of several worksheets. For till samples, the weights of the fractions produced during sample processing are reported in five worksheets: "Tabling Data"; "Processing Wts" (SG >3.2); "Mid density weights" (SG 3.0-3.2); "HM Fractions" (<0.25 mm table concentrate weights); and "Paramag" (weights for the paramagnetic fractions).

For bedrock samples, the weights of fractions generated during bedrock disaggregation and subsequent heavy liquid separation are listed in the worksheets: "EPD weights"; " Processed weights" (SG >3.2); "Mid density weights" (SG 3.0-3.2); "Paramag" (weights for the SG> 3.2 paramagnetic fractions); and "Mid Density Paramag" (weights for the SG 3.0-3.2 paramagnetic fractions).

Gold grain data generated from panning each till and bedrock sample are reported in two worksheets: "Gold summary" and "Detailed VG", which describe the abundance, size, and shape of the visible gold and sulphide grains observed during panning.

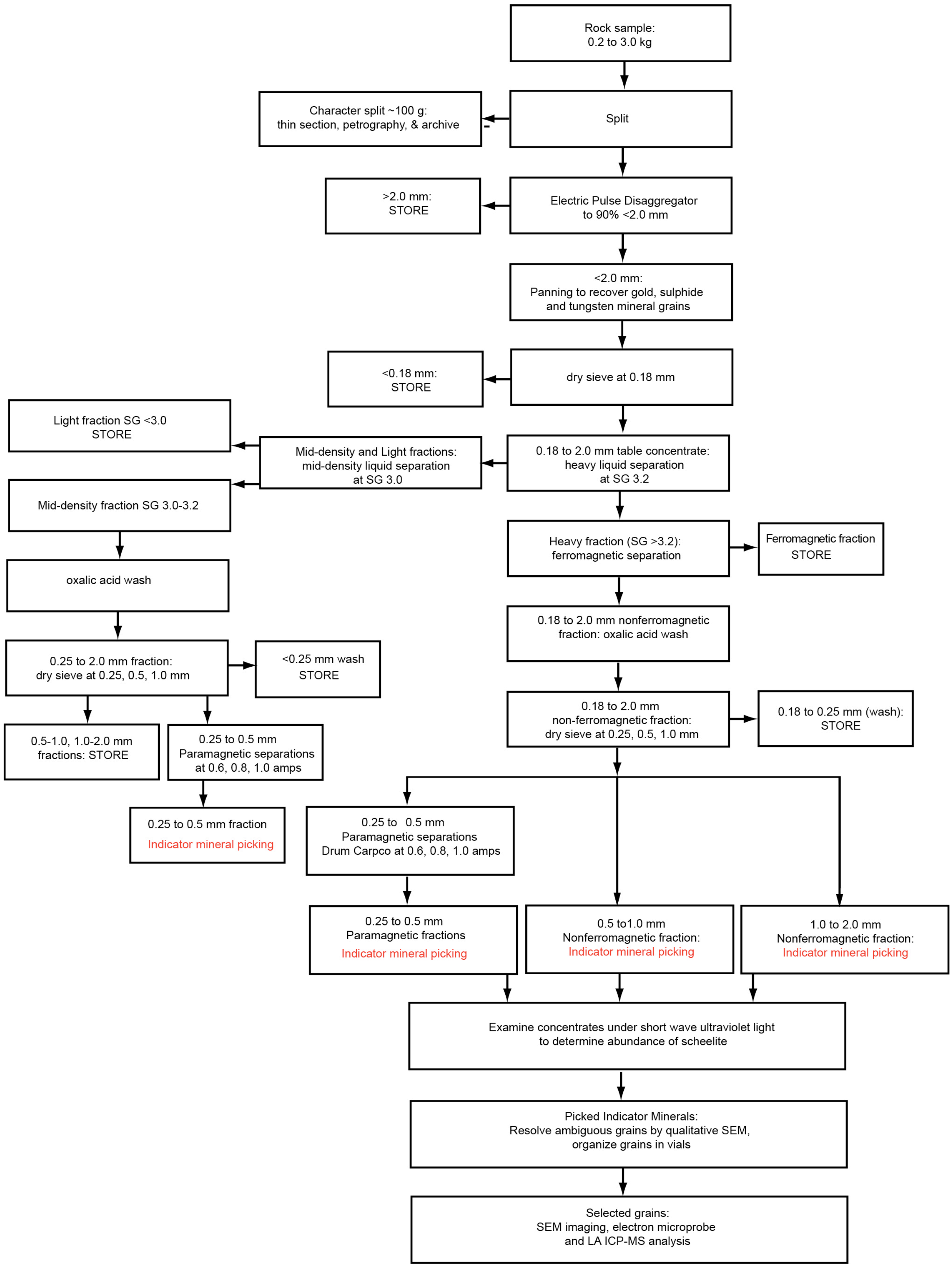

Figure 3. Flow sheet outlining the sample processing and picking procedures used for Mount Pleasant bedrock samples at Overburden Drilling Management Limited.

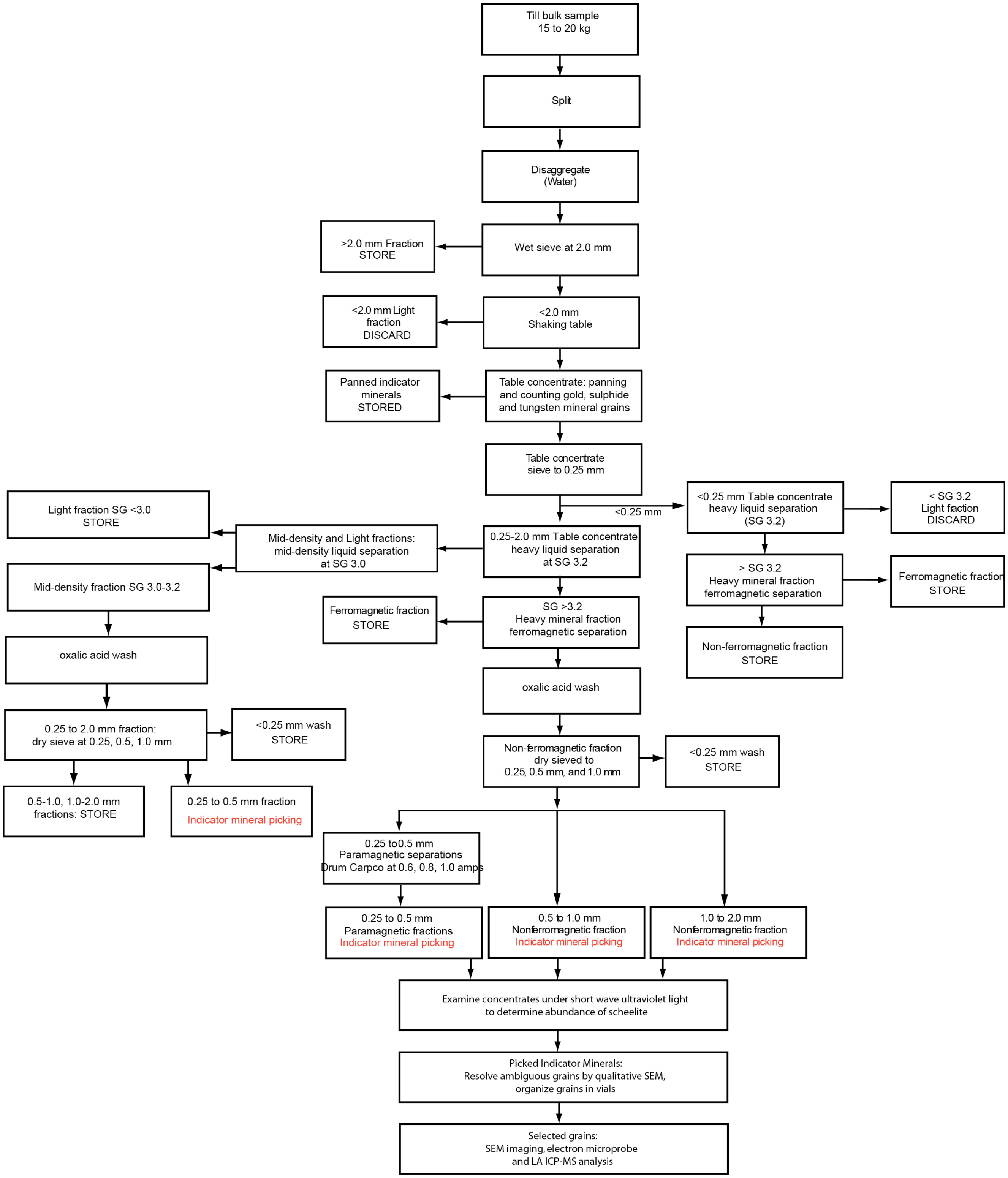

Figure 4. Flow sheet outlining the sample processing and picking procedures used for Mount Pleasant till samples at Overburden Drilling Management Limited.

Indicator minerals (0.25-2.0 mm in size) of Sn-W deposits are listed in worksheets: "MMSIM" for the SG >3.2 fractions; and "Mid Density MMSIM" for the SG 3.0 to 3.2 fractions.

ACKNOWLEDGMENTS

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Appendix C: Bedrock binocular microscope hand sample descriptions by Overburden Drilling Management Ltd.

by S.A. Averill

12-MPB-1021 SULPHIDIZED FLUORITE VEIN.
Sawn 8 cm hand specimen. Coarse (up to 2 cm), open space filling, distinctly colour zoned (purple, pink, colourless, pale brown) fluorite crystals (70%) cemented with finer-grained (0.1-1 mm), mostly massive to locally disseminated black sphalerite (30%) with minor galena (<1%) and trace finer-grained (<0.1 mm) pyrite. Disseminated phase of sphalerite is intergrown with similar-sized grains (0.3-1 mm) of mostly colourless fluorite and up to 10% harder, greasy grey, quartz-like topaz (SEM confirmed).

12-CBD-004 SULPHIDIZED AND VEINED QUARTZ BRECCIA.
Pale grey, nonmagnetic, polyphase breccia consisting of fragments of quartz ranging in size from 0.1 mm to 5 cm, with the largest fragment itself internally finely brecciated at 0.1-0.3 mm scale with local coarser patches at 0.5-1 mm scale. Fine breccia is semi-mylonitic with minimal porosity and is cemented with 1-5% black sphalerite (SEM confirmed) and traces of molybdenite and pyrite. Coarser breccia is more porous and cemented with up to 20% black sphalerite occurring as aggregates of fine, 0.1-0.3 mm crystals. Breccia is cut by a 1.5 cm wide quartz vein, mostly very fine-grained with local coarse-grained patches, mineralized with 3% disseminated sphalerite, 1% pyrite and trace fluorite.

12-MPB-1040 BRECCIATED AND MINERALIZED QUARTZ VEIN.
Sawn 10 cm hand specimen. Pale buff, semi-aphanitic quartz vein weakly and patchily jigsaw brecciated with 10% coarser-grained (0.3-2 mm), vuggy, crystalline cement consisting subequally of fluorite (mostly as purple to nearly black, tourmaline-like crystals but locally as botryoidal brown masses; both black and brown phases SEM confirmed), colourless hexagonal quartz crystals (SEM confirmed; no topaz identified) and amorphous limonite/goethite representing oxidized sulphides of unknown mineralogy.