


Speciation of Arsenic in Tailings, Soils and Sediments near Giant Mine: Past and Current Research

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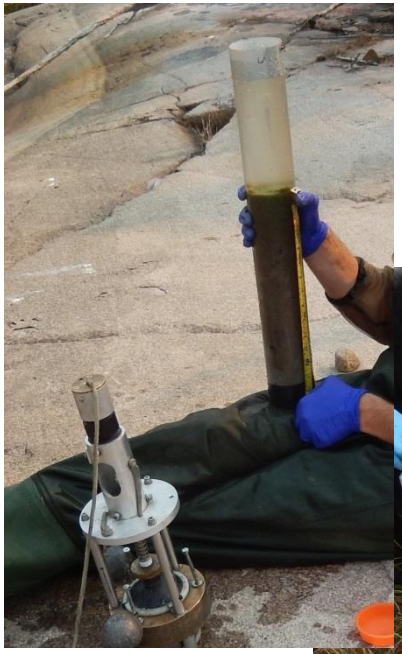
Previous Research: Jamieson Group, Queen's University

- Steve Walker PhD 2006 *The solid-phase speciation of arsenic in roasted and weathered sulfides at the Giant gold mine, Yellowknife, NWT*
- Claudio Andrade MSc 2006 *Arsenic cycling and speciation in mining-impacted sediments and pore-waters from Yellowknife Bay, Great Slave Lake, NWT*
- Skya Fawcett PhD 2009 *Speciation and mobility of antimony and arsenic in mine waste and the aqueous environment in the region of the Giant mine, Yellowknife, Canada*
- Lori Wrye MSc 2008 *Distinguishing between natural and anthropogenic sources of arsenic in soils from the Giant mine, Northwest Territories and the North Brookfield mine, Nova Scotia*
- Mackenzie Bromstad MSc 2011 *The characterization, persistence, and bioaccessibility of roaster-derived arsenic in surface soils at Giant mine, Yellowknife, NWT*
- Tyler Nash MSc 2014 *Arsenic speciation and the controls on its release in contaminated sediments and corresponding toxicological effects at Giant mine, NWT*

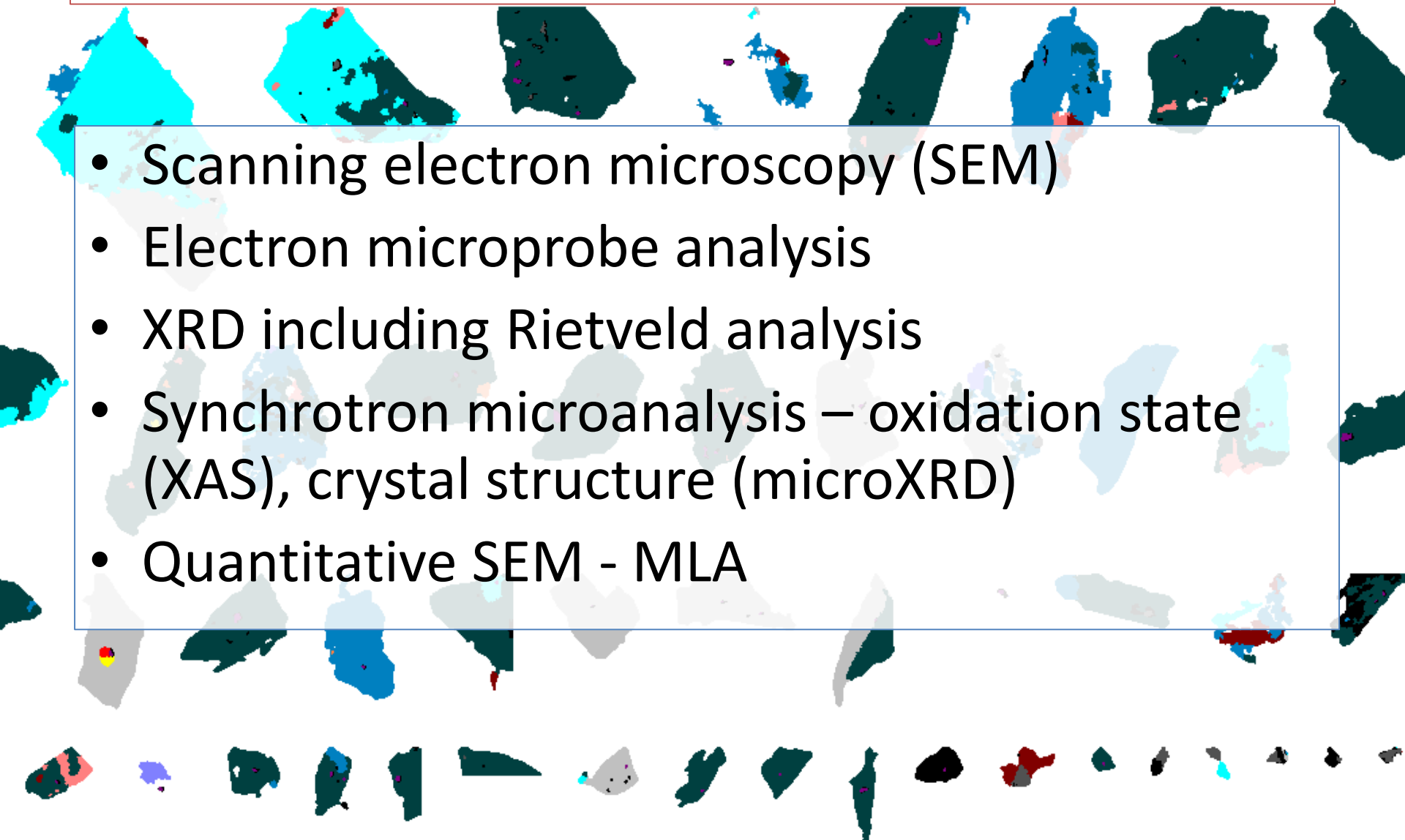
- *7 journal articles to date*

Current Research: Jamieson Group

- Martin Van Den Berghe MSc *Mobility of arsenic in lake sediments west of Giant Mine*
- Chris Schuh PhD *Arsenic in lake sediments and pore waters in the Yellowknife region*
- Kirsten Maitland MSc *Speciation of arsenic in soils in the Yellowknife region*
- Alex Bailey MSc *Speciation of arsenic in tailings at Giant Mine (PROPOSED)*



Selected methods of speciation for soils & sediments

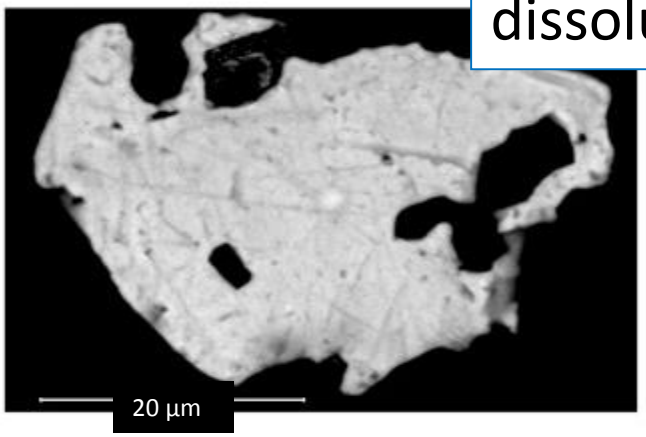


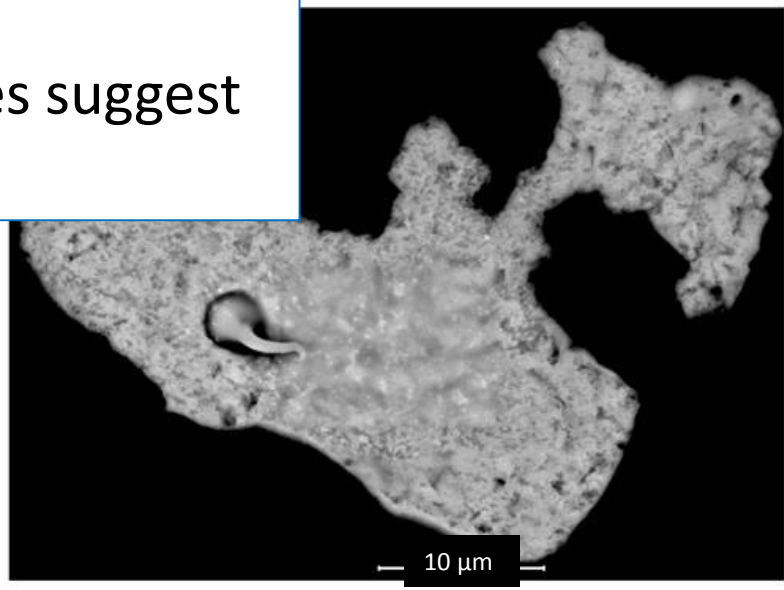
- Scanning electron microscopy (SEM)
- Electron microprobe analysis
- XRD including Rietveld analysis
- Synchrotron microanalysis – oxidation state (XAS), crystal structure (microXRD)
- Quantitative SEM - MLA

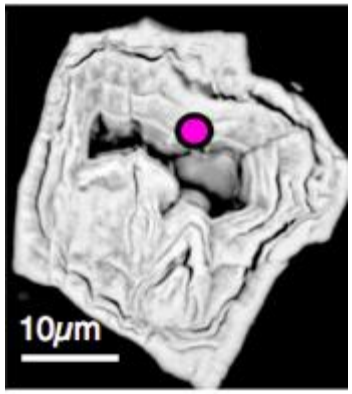
ARSENIC SPECIES IN SOILS

Dominant host is arsenolite As_2O_3

Rims are absent, textures suggest dissolution



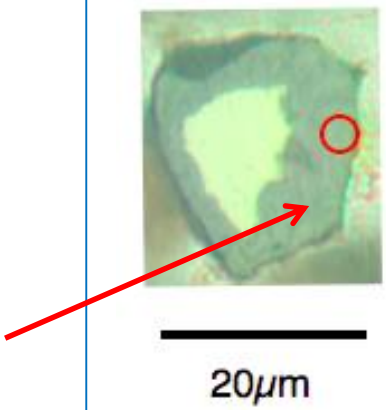




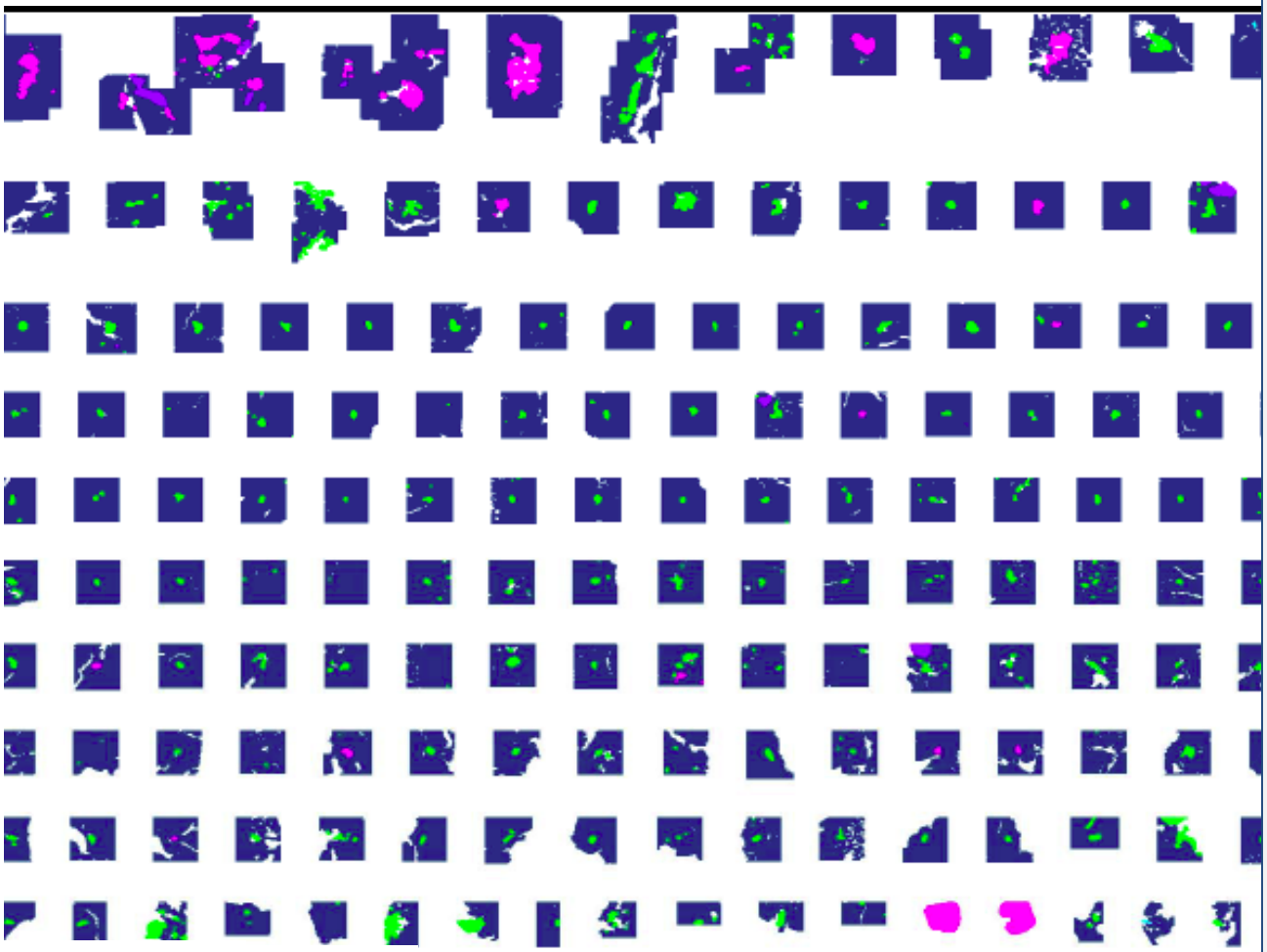
Rare As hosts include:

Roaster-generated maghemite with As^{3+} and As^{5+}

Goethite rim on pyrite with As^{3+}



SEM-MLA used to find all arsenic-rich particles and to calculate relative proportions



From roaster emissions

Pink = arsenic trioxide

29% of all As-rich grains

Green = arsenic sulfide

71% of all As-rich grains

Aqua = arsenopyrite

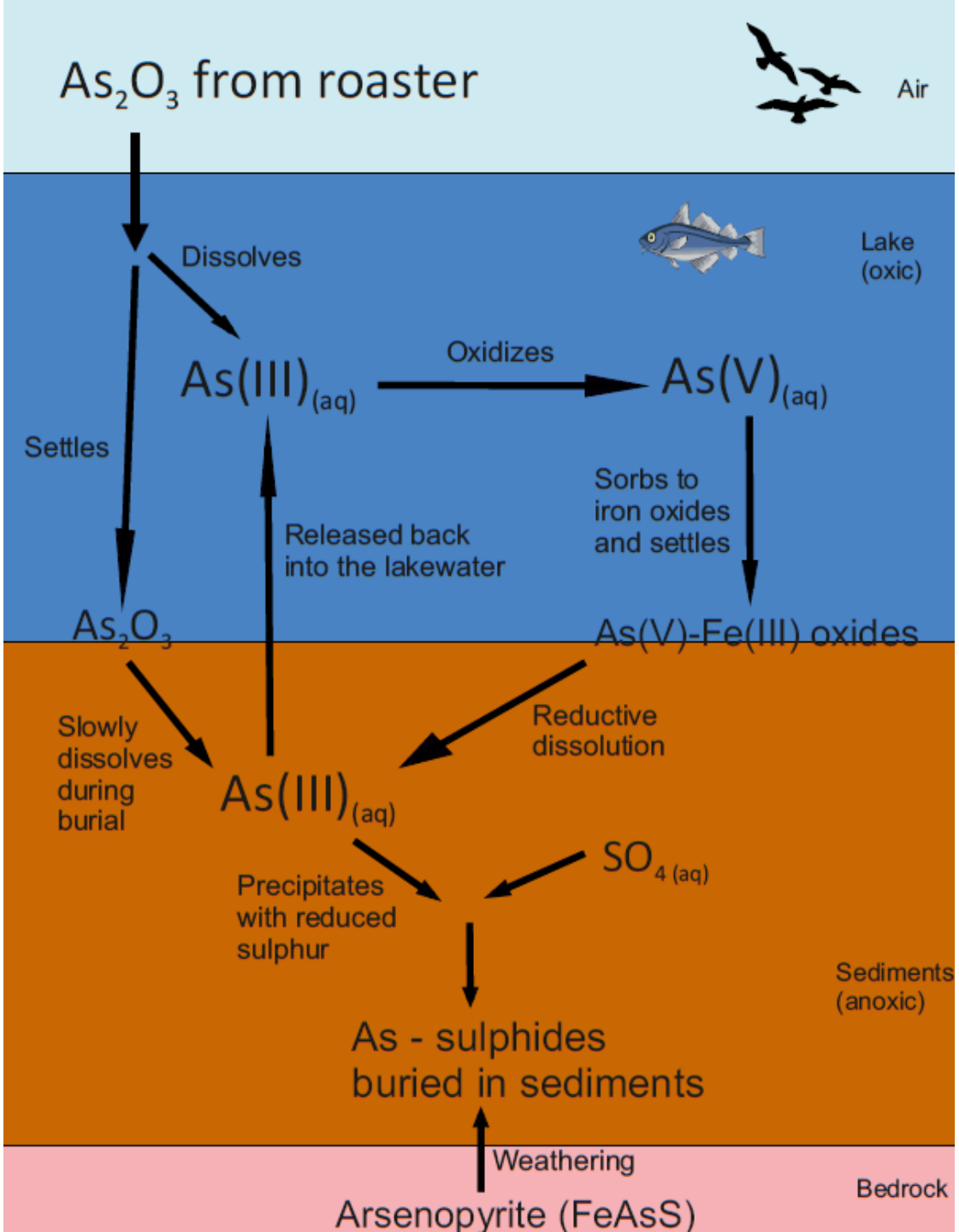
0.2% of all As-rich grains

Natural

Anthropogenic source

Cycling of Arsenic in Lakes

(Van Den Berghe, 2014)



Geogenic (natural) source

Outcrop soils can have >5000 mg/kg As
but do not look like contaminated sites

FIND THE CONTAMINATED SITE

Tailings average 5000 mg/kg As and look like industrial sites

Publications

Walker, S.W., Jamieson, H.E., Lanzirotti, A., Andrade, C.F. 2005 Determining arsenic speciation in iron oxides derived from a gold-roasting operation: Application of synchrotron micro-XRD and micro-XANES at the grain scale. Canadian Mineralogist 43, 1205-1224

Andrade, C.F., Jamieson, H.E., Praharaj, T., Fortin, D., Kyser, T.K. 2010. Biogeochemical cycling of arsenic in mine-impacted sediments and co-existing pore waters. Applied Geochemistry 25, 199–211.

Fawcett, S.E., Jamieson, H.E. 2011. The Distinction between ore processing and post-depositional transformation on the speciation of As and Sb in mine waste and sediment Chemical Geology 283, 109-118

Walker, S.R., Jamieson, H.E., Lanzirotti, A., Hall, G. E. M., Peterson, R.C. 2015. The effect of ore roasting on arsenic oxidation state and solid phase speciation in gold mine tailings. Geochemistry: Exploration, Environment, Analysis. In press.

Fawcett, S.E., H. Jamieson, D. Nordstrom, B. McCleskey. 2015. Arsenic and antimony geochemistry of mine wastes, associated waters and sediments at the Giant Mine, Yellowknife, Northwest Territories, Canada. Applied Geochemistry, in press. http://dx.doi.org/10.1016/j.apgeochem.2014.12.012

Bromstad, M., Jamieson, H.E. the characterization, persistence, and bioaccessibility of roaster-derived arsenic in surface soils at Giant mine, NWT, In preparation

Bromstad, M., Nash, T.J., Dobosz, A. Jamieson, H.E. 2015 Characterization of soil samples from Giant Mine, NWT. Report submitted to Golder Associates

Bromstad, M., Nash, T.J., Dobosz, A. Jamieson, H.E. 2015 Characterization of sediment samples from Giant Mine, NWT. Report submitted to Golder Associates