Mineral Resources Tasmania

Laboratory Report

LJN2018-111.13

LJN2016-025, LJN2016-062, LJN2017-130, LJN2018-073

MINERALOGICAL ANALYSES

RUDGE MINE

An unpublished Mineral Resources Tasmania Report for:

M. Latham

By: R.S. Bottrill, and R Woolley

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Mineral Resources Tasmania
Department of State Growth

Tasmanian Government

Mineral Resources Tasmania

SUMMARY

This sample contains mostly baryte, in parts riddled with very fine sulphide inclusions. The inclusions probably include metacinnabar, sphalerite, polhemusite, montroydite and chalcopyrite. This occurs with some fine grained epithermal-style quartz, and overall is a very unusual occurrence which may be indicative of some epithermal gold and/or silver mineralisation.

INTRODUCTION

Several mineral samples were received from Mathew Latham, for mineralogical analysis. R Bottrill also visited the site to collect more samples, details of which are shown in Table 1 below. As the baryte appeared to contain unidentified sulphide inclusions, some sub-samples were selected for a detailed mineralogical study.

Table 1: Sample details.

Job No.	Reg. No.	Location	Process	Description
LJN2016-025	G406025	Rudges Mine	SEM	Baryte
LJN2016-062	G406291	Rudges Mine	XRD	Baryte
LJN2017-130	G408042	Rudges Mine	XRD	Silica
LJN2018-073, LJN2018-111-13	G408827	Rudges Mine	PB, SEM	Baryte

The long-abandoned mine, known as either Rudges Baryte Mine or Baryta Reward (Gulline, 1969, 1981), lies some 10km E of Sassafras, and consist of one major trench (Fig. 1) and a few smaller pits and trenches. The outcrop in the baryte mine shows the host rock to range from a pale grey quartz sandstone (Fig. 2) to a yellow, gossanous mudstone (Fig. 3), both of Cambrian age (Gulline, 1969). These rocks are brecciated and cemented by coarse grained white to grey or brown baryte. The gossanous matrix suggests the original presence of pyrite and/or iron carbonates, but these were not seen. A sinter-like, vuggy siliceous rock, possibly a silicified dolostone breccia, also occurs near the deposits.

Fig. 1: Outcrop, showing the main trench in the baryte deposit.

Fig. 2: Outcrop beside the trench, showing a sandstone breccia cemented by baryte. FOV: about 500 mm.

Fig. 3: Outcrop beside the trench, showing a gossanous mudstone breccia cemented by baryte. FOV: about 300 mm.

PROCESS

One sample was cut and prepared as a polished block. This, plus some cleavage fragments, were used for SEM/EDS analysis at CSL Laboratories, UTas. Some baryte and silica sub-samples were also extracted for XRD analysis, in the MRT laboratories.

SAMPLE DESCRIPTIONS

Under the stereomicroscope the sample G408042 is a matrix-supported chert breccia, with densely silicified, white clasts in a cream-coloured, vuggy matrix (Fig. 4). The vughs form cavities up to a few cm across, containing small drusy, white quartz crystals to a few mm in size (Fig. 5). It appears to be epithermal quartz replacing a dolostone breccia.

Fig. 4: Sample G408042, reverse of below image, showing silicified breccia, possibly altered dolostone. FOV: about 100 mm.

Fig. 5: Sample G408042, showing drusy, possibly epithermal, quartz crystals on chert. FOV: about 100 mm.

Samples G408827, G406291 and G408827 all are very similar and are mostly coarse grained, white to cream, pinkish and pale brown, translucent to transparent baryte, with cleaved crystals to several cm in size (Fig. 6). Some euhedral, blocky crystals to a few cm also occur in the deposit. There are commonly some densely included zones, due mostly to myriad fine sulphides (Figs. 7 – 10).

High power magnification indicates that the inclusions range from dendritic to rod-like and equant (Figs 7 - 10). These are mostly red to black, or sometimes brassy; they are prismatic to dendritic, but some are rounded or equant. Under the scanning electron microscope the elongate grains, apparently metacinnabar, are typically elongate prisms with a saw-tooth structure along one edge, possibly due to multiple twinning (Figs. 11-12). They are commonly in contact with sphalerite and chalcopyrite, which form equant crystals.

Fig. 6: Sample G408827, showing cleavage fragments of baryte, with fine inclusions. FOV: about 120 mm.

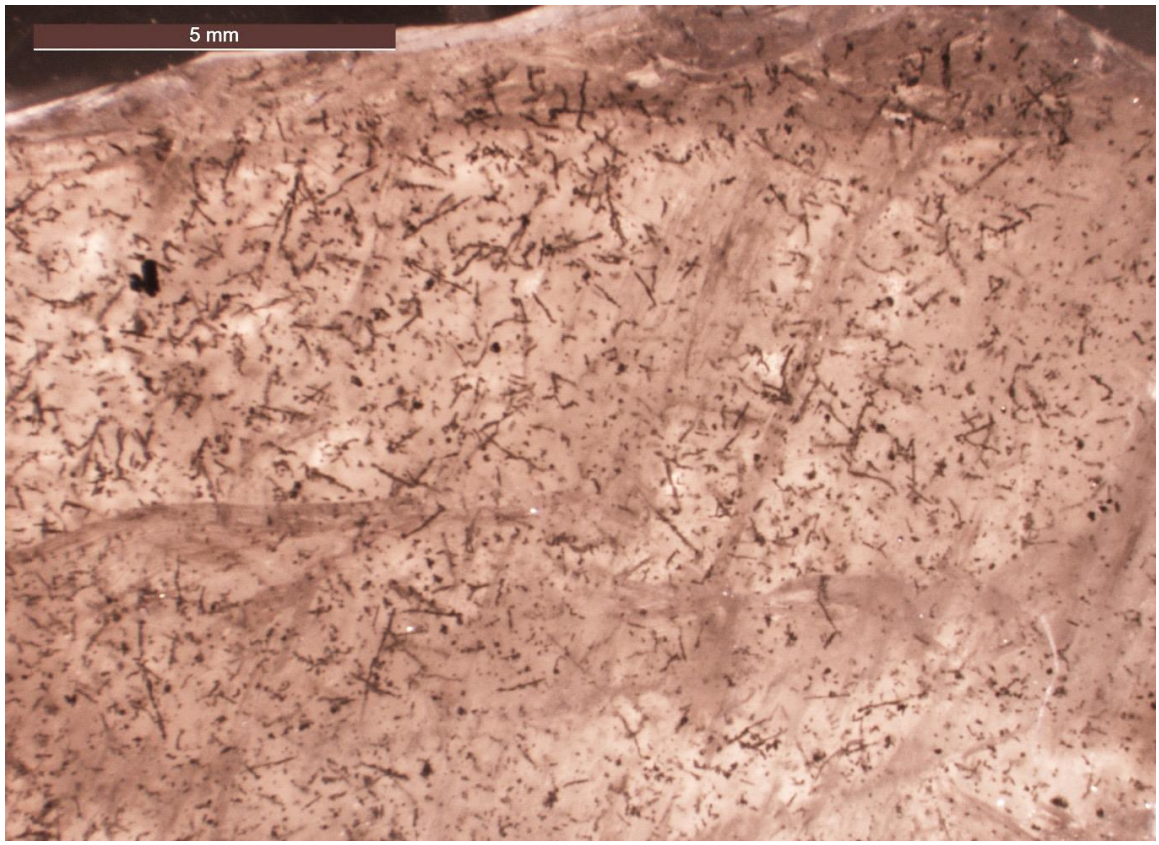

Fig. 7: Sample G407959, showing Metacinnabar and sphalerite inclusions in baryte. FOV ~15mm

Fig. 8: Metacinnabar and sphalerite inclusions in baryte. FOV ~5mm. M Latham.

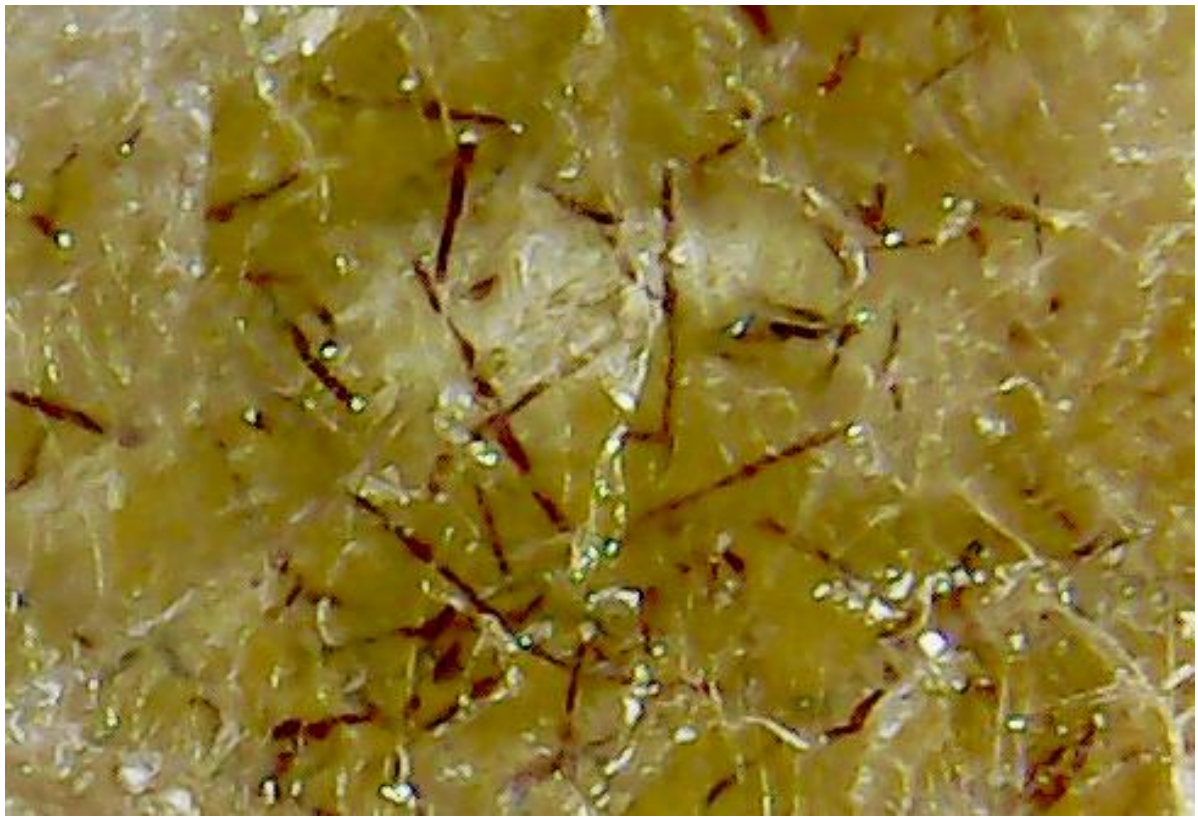

Fig. 9: Metacinnabar rods in baryte. FOV ~4mm. M Latham.

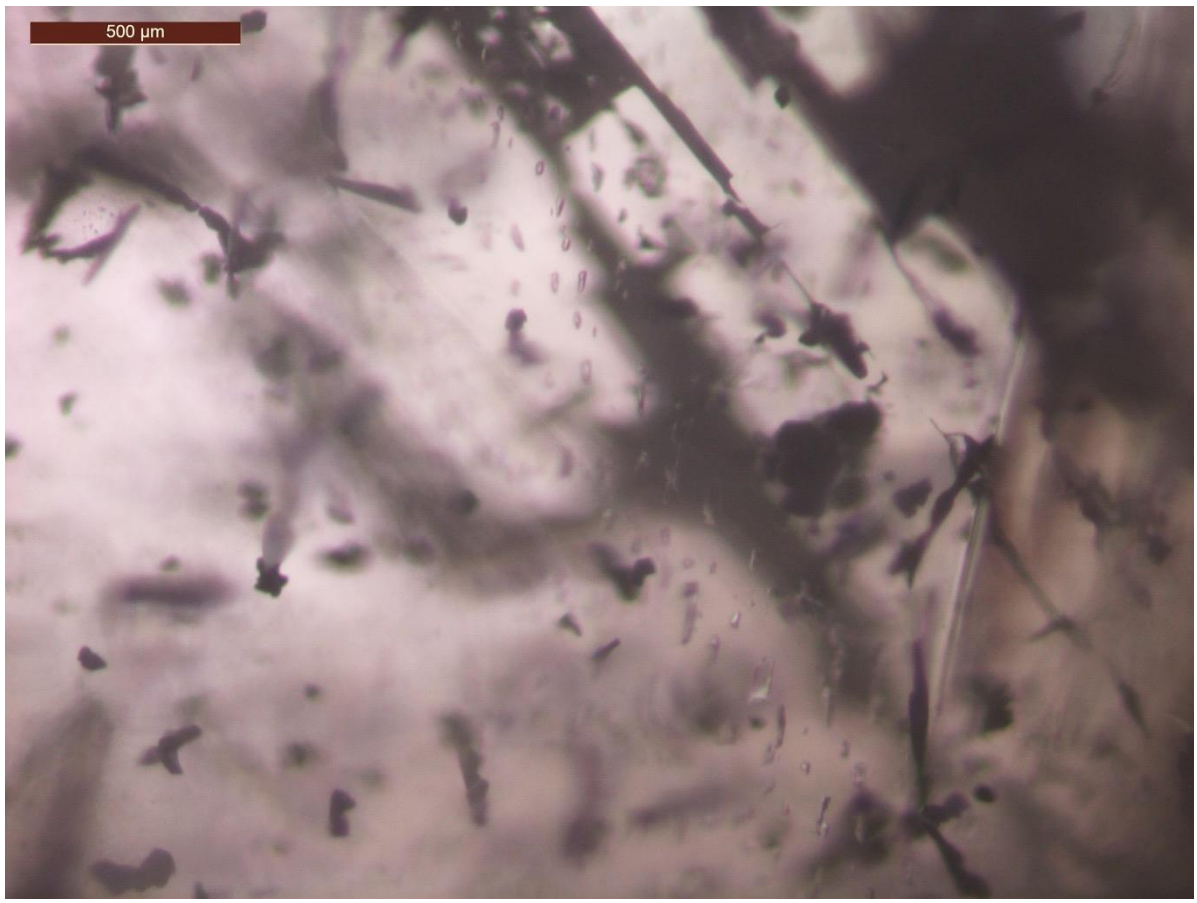

Fig. 10: Sample G408827, Metacinnabar and other inclusions in baryte. FOV ~2.5mm.

Fig. 11: Sample G408827, Electron image showing pale grey metacinnabar replacing, dark grey chalcopyrite, in medium grey baryte.

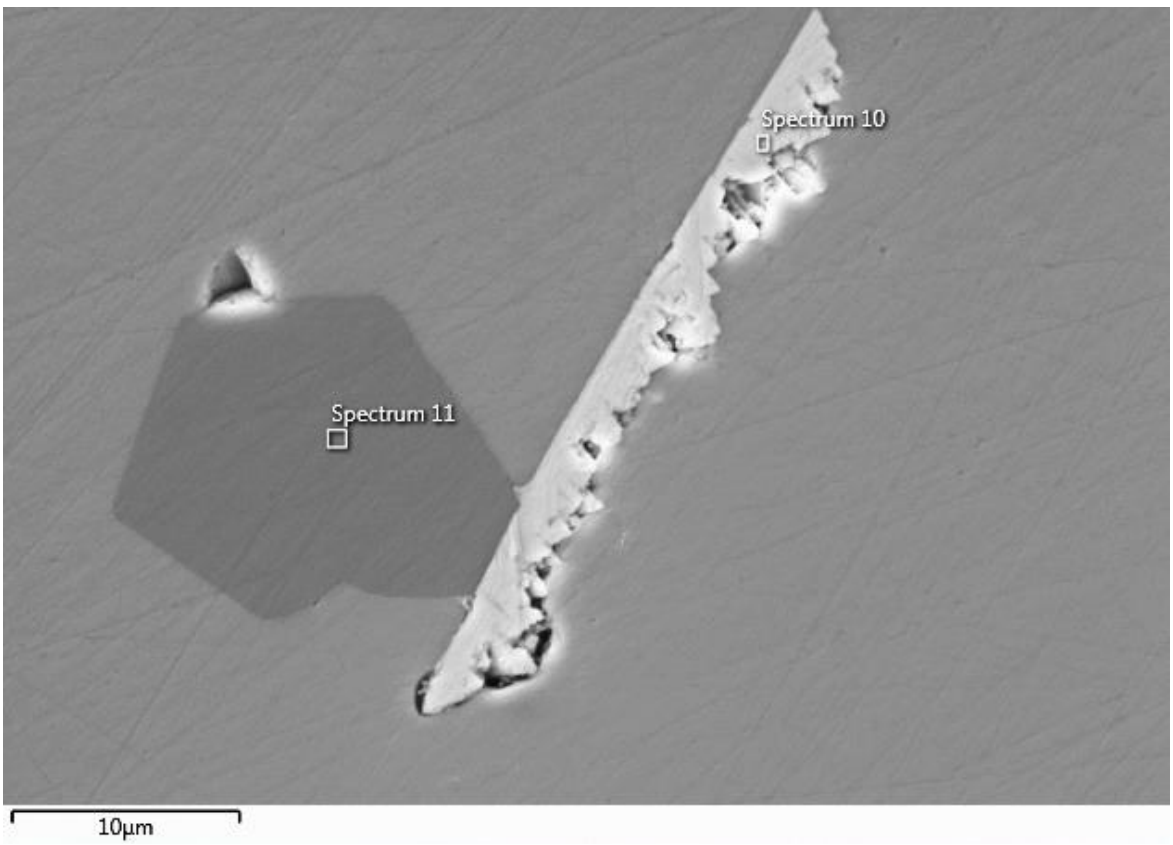

Fig. 12: Sample G408827, Electron image showing pale grey metacinnabar adjacent to dark grey chalcopyrite, in medium grey baryte.

XRD ANALYSES

The samples were prepared, examined and analysed in the MRT laboratories, Rosny Park, Tasmania. They were run on a Rigaku Miniflex 600 X-Ray Diffractometer system: a 600W generator 150mm goniometer with a Cu tube; 40kV/15mA, sample spinner and a D/teX Ultra High Speed 1D Detector with Be window, -3º to 145º 2Ø scanning range and 2º - 140º 2Ø measuring range, with a scanning speed of 0.01 to 100º/min, A graphite monochromator and a Kß Ni- filter, The analysis software used is the PDXL2 using the ICCD database.

The results are shown in Appendix 1 and indicate only baryte and quartz; no sulphides were detected.

SEM/EDAX ANALYSES

The samples were analysed by SEM-EDS, with analytical conditions shown in Appendix 1, and results given in Appendix 2 and images shown in Figs. 6- 7. The red-black, mostly prismatic crystals are ragged or denticulate, perhaps due to multiple twinning or parallel growth.

The red prismatic crystals range in composition between HgS and $(Zn_{0.64}Hg_{0.36})S$ and commonly contain significant Se (<14at.%). Based on this solid solution chemistry the mercury sulphide is most likely Metacinnabar, and crystals with Zn>Hg are most likely the rare mineral Polhemusite (Zn,Hg)S, although it could possibly be mercurian Sphalerite. Cinnabar is typically lighter in colour also.

There is also some Chalcopyrite in some specimens (Figs 6 -7).

One analysis indicates mostly Hg, with minor Zn, Se and Ba, and no S. This is most likely Montroydite (HgO), which resembles cinnabar and metacinnabar; no native mercury was visible.

DISCUSSION

This is a mineralogical association that appears unique in Tasmania. Mercury minerals are rare in the state, recorded only from the Jane River goldfield, sparsely in the Cygnet goldfield and possibly in the Shepherd and Murphy mine (Bottrill & Baker, 2008). The occurrence with baryte is unusual though, and may suggest an epithermal origin, and suggest that the area may have potential for gold and silver.

REFERENCES

Gulline, A.B., 1969. J C Rudges barite prospect. MRT Document TR14_16_17

Gulline, A.B., 1981. Frankford. MRT Document ER8215S0: Geological Survey Explanatory Report. Geological Atlas 1 mile series, zone 7 sheet 38 (8215S)

Everard, G.B., 1969. Notes on specimens collected at various localities - Frankford area. MRT Document TR14_135_144C

R.S. Bottrill
MINERALOGIST/PETROLOGIST

R.N. Woolley
TECHNICAL OFFICER

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Appendix 1: Laboratory Report – SEM analytical conditions

Hitachi SU-70 analytical field emission SEM

- Installed February 2011
- Schottky thermal field emission source
- Ultra-high resolution (1.0 nm @ 15kV, 1.6 nm @ 1kV for SE imaging)
- High vacuum operation only (i.e. no variable pressure in chamber)
- Hitachi in-chamber and in-lens scintillation detectors, Super ExB filter, beam deceleration
- Hitachi in-chamber 5-segment solid state BSE detector, retractable
- In-column Faraday cup with picoammeter for beam current measurement
- Anticontamination cold plate, liquid nitrogen cooled
- 5 axis motorised fully eucentric stage, XYZ range 110x110x40mm
- Oxford AZtec EDS/EBSD system with
    - X-Max 80 SDD EDS, MnKa 125 eV resolution, elements B-U, large area hyperspectral mapping, standardless and standards-based quantification, feature analysis
    - HKL NordlysNano EBSD camera & forescatter detector system, HKL & Channel 5 software packages, Synergy EDS/EBSD integration, HKL, ICSD & American Mineralogist phase databases
- NEW June 2017: Gatan ChromaCL2 colour cathodoluminescence imaging system with integrated BSE detector, Digital Micrograph 3 software, automated mosaic acquisition, simultaneous acquisition of SE, iBSE and colour CL images.

Label:	am 179
Element List Type:	Current Spectrum
Processing Option:	All Elements
Specimen Coating:	On
Beam Calibration Element Coating:	Off
Coating Element:	Carbon
Coating Thickness:	20 nm
Coating Density:	2.25 g/cm³
Automatic Line Selection:	Disabled
Normalization:	Enabled
Thresholding:	Sigma level = 1
Detector Window Correction:	Enabled
Deconvolution Elements:	None
Selected Standards:	Minerals_15kV_2017-10-20 [User]
Pulse Pile Up Correction:	Succeeded
Detector file:	X-Max 3
Efficiency:	File based

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Appendix 2: Laboratory Report – SEM Analyses (relative atomic proportions based on cation totals)

Table 1: G408827 EDS analyses (at%)

Spectrum Label	O	S	Si	Fe	Cu	Zn	Se	Sr	Ba	Hg	cations
Spectrum 1 HgS	0.00	0.84	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.87	1.00
Spectrum 2 baryte	3.24	0.95	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Spectrum 3 cpy	0.00	2.01	0.00	0.99	1.01	0.00	0.00	0.00	0.00	0.00	2.00
Spectrum 5 cpy	0.00	2.01	0.00	0.98	1.02	0.00	0.00	0.00	0.00	0.00	2.00
Spectrum 6 baryte	3.35	0.96	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00
Spectrum 7 HgS	0.00	0.91	0.00	0.00	0.00	0.02	0.09	0.00	0.01	0.88	1.00
Spectrum 8 HgS	0.00	0.88	0.00	0.00	0.00	0.00	0.11	0.00	0.01	0.88	1.00
Spectrum 9 cpy	0.00	1.99	0.00	0.99	1.01	0.00	0.00	0.00	0.00	0.00	2.00
Spectrum 10 HgS	0.00	0.79	0.00	0.00	0.00	0.00	0.14	0.00	0.02	0.84	1.00
Spectrum 12 cpy	0.00	1.97	0.00	1.00	1.00	0.00	0.00	0.00	0.00	0.00	2.00
Spectrum 13 HgS	0.00	0.00	0.47	0.01	0.02	0.02	0.04	0.00	0.00	0.44	1.00
Spectrum 14 HgS	0.00	0.00	0.49	0.00	0.00	0.02	0.03	0.00	0.01	0.45	1.00
Spectrum 15 HgS	0.00	0.00	0.49	0.00	0.00	0.02	0.03	0.00	0.00	0.46	1.00
Spectrum 16 HgS	0.00	0.00	0.46	0.00	0.00	0.01	0.06	0.00	0.01	0.46	1.00
Spectrum 17 cpy	0.00	0.00	1.01	0.49	0.50	0.00	0.00	0.00	0.00	0.00	2.00
Spectrum 18 baryte	0.45	0.01	0.21	0.00	0.00	0.00	0.00	0.00	0.79	0.00	1.00
Spectrum 19 baryte	1.82	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.52	0.00	1.00
Spectrum 20 baryte	1.75	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.51	0.00	1.00
Spectrum 22 cpy	0.00	0.00	1.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	2.00

Table 2: G406025 EDS analyses (relative atomic proportions based on 1 cation)

Phase	O	S	Cl	Al	Si	Fe	Zn	Se	Ba	Hg
Polhemusite	0.00	0.73	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.36
Polhemusite	0.05	0.73	0.00	0.00	0.00	0.00	0.60	0.01	0.00	0.40
Polhemusite	0.00	0.73	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.41
Metacinnabar	0.18	0.80	0.09	0.00	0.00	0.00	0.27	0.02	0.03	0.67
Metacinnabar	0.30	0.88	0.00	0.00	0.00	0.00	0.13	0.03	0.04	0.80
Metacinnabar	0.42	0.91	0.00	0.00	0.00	0.00	0.09	0.00	0.03	0.88
Metacinnabar	0.26	1.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.97
Metacinnabar	0.00	0.91	0.00	0.00	0.00	0.00	0.10	0.04	0.00	0.87
Metacinnabar	0.12	1.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
Metacinnabar	0.00	1.00	0.00	0.00	0.00	0.00	0.05	0.02	0.00	0.92
Metacinnabar	0.00	0.98	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.92
Metacinnabar	0.00	0.98	0.00	0.00	0.00	0.02	0.00	0.04	0.00	0.93
Metacinnabar+	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.93
Montroydite?	0.15	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.03	0.90
Barite	5.07	1.09	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Barite	5.06	1.07	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Barite	4.75	1.02	0.00	0.00	0.00	0.00	0.02	0.00	0.98	0.00
Barite	4.49	0.99	0.00	0.02	0.02	0.00	0.00	0.00	0.96	0.00
Barite	3.63	0.87	0.00	0.06	0.06	0.00	0.00	0.00	0.89	0.00
Barite	3.05	0.79	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Barite	4.65	0.98	0.00	0.02	0.00	0.00	0.03	0.00	0.95	0.00
Barite	4.09	0.98	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Barite	3.55	0.85	0.00	0.07	0.06	0.00	0.00	0.00	0.87	0.00
Barite	4.08	0.97	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Barite	4.60	1.04	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
Barite	4.60	1.06	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00

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Appendix 3: Laboratory Report –XRD Analyses

Client: R. Bottrill
Sample Source: Rudges Barite Mine
MRT Job Number: LJN2017-130
Analysis: Approximate Mineralogy
Method: X-Ray Diffraction

Results (XRD):

Sample	***Minerals Identified***
G406291	Baryte
G408042	Quartz

Peak overlap may interfere with identifications and quantitative calculations.
Amorphous minerals and minerals present in trace amounts may not be detected.

Analyst: R N Woolley
Date: 14 December 2017