XRD Analysis

conducted on

Seven (7) Samples

for

TNG Limited

Mineralogy Report No. MIN1413(E)

January 2013

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1. INTRODUCTION

Seven (7) samples from TNG Limited were submitted for semi-quantitative XRD analysis.

The aim of this mineralogical investigation was to characterise the following:

- Identify and quantify all minerals present in the samples while taking the XRD machines detection limits into account.

The mineralogical work was requested by **Mr Ben Cooke** (ALS Minerals Division) on behalf of the project operator and was undertaken by **Mr Ian Davies** (ALS Metallurgy - Mineralogy) and supervised by **Mr Karsten Winter** (ALS Metallurgy - Mineralogy)

2. SAMPLES RECEIVED

The following samples were received:

- MH0134
- MH0141
- MH0142
- MH0154
- MH0189
- MH0193
- MH0206

3. ANALYTICAL PROCEDURES

The samples were pressed into a back-packed sample holder.

The XRD traces were collected under the following instrument conditions:

XRD	Panalytical Empyrean
Radiation	Cu Kα 1.5406
Generator	45 kV 40 mA
Angular Range	5° to 65° 2θ
Time/Step	1s
Step Size	0.02° 2θ
Divergence Slit	0.5 mm
Anti-Scatter Slit	0.5°
Slit Type	Fixed
Rotation Speed	120 rpm

4. RESULTS

Mineral ID	MASS PERCENT (%)						
	MH0134	MH0141	MH0142	MH0154	MH0189	MH0193	MH0206
Clay Mineral	< 1	< 1	-1	-1	-2	-1	-1
Kaolinite	-2	-1	36	0	0	-1	0
Clinochlore	16	15	-1	0	0	11	0
Muscovite	7	4	1	-1	1	0	2
Hemimorphite	0	0	0	0	0	13	0
Alpha Quartz	71	71	56	46	67	27	25
Malachite	1	4	0	3	2	7	25
Cerussite	0	0	0	25	0	33	0
Caledonite	0	0	0	2	0	0	0
Atacamite	0	0	0	0	2	0	0
Osarizawaite	0	0	4	0	0	0	0
Brochantite	0	0	0	0	6	0	27
Goethite	-2	-4	0	21	17	0	-17
Hematite	0	0	2	-2	3	8	-4

The quantitative results shown in the table above have been normalised to 100%, and it should be noted that the values shown represent the relative proportion of the crystalline material in the sample. Totals greater or smaller than 100% are due to rounding errors.

Negative results in the table indicate normally a larger than usual uncertainty in regard to the quantity of the phase reported; for some of the minor and trace phases it might also indicate an uncertainty in regard of the phase itself, or both. Some additional comments will be made under the mineralogical overview and, where appropriate, under the sample specific comments.

4.1 General and Mineralogical Overview

A short general and mineralogical overview is provided below:

- The mineralogical assemblages show significant variation between samples; however quartz, iron oxides and traces of 'Clay Mineral' are common to all.
- Malachite is present in all samples with the exception of 'MH0142'. It is poorly crystalline in all samples except in 'MH0206' where crystallinity is good and 'MH0141' in which it is reasonably crystalline. Slight alteration is possibly present in some of the samples.
- The cerussite found in samples 'MH0154' and 'MH0193' is well crystalline with slight alteration apparent.
- Poorly crystalline atacamite was only found in sample 'MH0189'.
- Well crystalline hemimorphite, $Zn_4Si_2O_7(OH)_2{\cdot}H_2O$, has been identified in quantifiable amounts in sample 'MH0193'.
- Caledonite, $Cu_2Pb_5(SO_4)_3CO_3(OH)_6$, was identified in sample 'MH0154'. It is very poorly crystalline and the pattern shows signs of alteration or compositional variation.
- Osarizawaite, a mineral from the alunite group with idealised approximate formula of $Pb(Al_2Cu)(SO_4)_2(OH)_6$ has also been found in just one sample, 'MH0142'. It is reasonably crystalline.
- Brochantite $Cu_4SO_4(OH)_6$ has been found in samples 'MH0189' and 'MH0206'. It is well crystalline and shows little variation in both samples.
- Three samples 'MH0134', 'MH0141' and 'MH0142' appear to contain very poorly crystalline material with ordering insufficient for identification. No mineral could be associated with these 'humps'.
- Goethite is very poorly crystalline.
- 'Clay Mineral', is the general heading under which varying amounts of vermiculite, zeolite and smectite have been grouped.
- Some amorphous material appears to be present in all samples.