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Ministry of Energy, Mines & Petroleum Resources
Mining & Minerals Division
BC Geological Survey

Assessment Report
Title Page and Summary

TYPE OF REPORT [type of survey(s)]: TECHNICAL EXPLORATION

TOTAL COST: $402,976.00

AUTHOR(S): SCOTT JONES P.ENG **SIGNATURE(S):**

NOTICE OF WORK PERMIT NUMBER(S)/DATE(S): MX-13-131 **YEAR OF WORK:** 2015

STATEMENT OF WORK - CASH PAYMENTS EVENT NUMBER(S)/DATE(S): EVENT #5611758; JULY 25, 2016

PROPERTY NAME: ALEY

CLAIM NAME(S) (on which the work was done): 516635, 520262, 520263, 842363, 520172

COMMODITIES SOUGHT: NIOBIUM

MINERAL INVENTORY MINFILE NUMBER(S), IF KNOWN:

MINING DIVISION: OMINECA **NTS/BCGS:** NTS: 094B.041 AND 094B.042 BCGS 094B042

LATITUDE: 56 ° 27 '10 " **LONGITUDE:** 123 ° 44 '13 " (at centre of work)

OWNER(S):
1) TASEKO MINES LTD. THROUGH ITS OWNERSHIP OF ALEY CORPORATION 2)

MAILING ADDRESS:
15TH FLOOR - 1040 WEST GEORGIA STREET
VANCOUVER B.C., V6E 4H1

OPERATOR(S) [who paid for the work]:
1) ALEY CORPORATION 2)

MAILING ADDRESS:
15TH FLOOR - 1040 WEST GEORGIA STREET
VANCOUVER B.C., V6E 4H1

PROPERTY GEOLOGY KEYWORDS (lithology, age, stratigraphy, structure, alteration, mineralization, size and attitude):
CARBONATITE DEPOSIT, MINERALIZATION AGE: MISSISSIPPIAN, ALTERATION TYPE: CHLORITIC, FENITIC, CARBONA
CLASSIFICATION: MAGMATIC, HYDROTHERMAL, INDUSTRIAL METAL. CHARACTER: DISSEMINATED, LAYERED, POD
LITHOLOGY: RAUHAUGITE, DOLOMITE CARBONATITE, SOVITE, CALCITE CARBONATITE, CARBONATITE, AMPHIBOLI
ALTERED SEDIMENT/SEDIMENTARY, DOLOMITE, SHALE, QUARTZITE

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS: 35632, 34176, 33237, 32798, 30113, 28733, AND 27991

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TYPE OF WORK IN THIS REPORT	EXTENT OF WORK (IN METRIC UNITS)	ON WHICH CLAIMS	PROJECT COSTS APPORTIONED (incl. support)
GEOLOGICAL (scale, area)			
Ground, mapping			
Photo interpretation			
GEOPHYSICAL (line-kilometres)			
Ground			
Magnetic			
Electromagnetic			
Induced Polarization			
Radiometric			
Seismic			
Other			
Airborne			
GEOCHEMICAL (number of samples analysed for...)			
Soil			
Silt			
Rock			
Other			
DRILLING (total metres; number of holes, size)			
Core			
Non-core			
RELATED TECHNICAL			
Sampling/assaying		516635	138589
Petrographic			
Mineralographic			
Metallurgic		516635	166668
PROSPECTING (scale, area)			
PREPARATORY / PHYSICAL			
Line/grid (kilometres)			
Topographic/Photogrammetric (scale, area)			
Legal surveys (scale, area)			
Road, local access (kilometres)/trail		520172	24520
Trench (metres)			
Underground dev. (metres)			
Other		842363,516635,520262,520263	73,199
		TOTAL COST:	402976.00

Assessment Report on the Technical Work Performed on the Aley Niobium Property in 2015

Located in the Omineca Mining District
British Columbia, Canada

NTS: 94B.041 & 94B.042

Located at approximately
56° 27' N Latitude
123° 44' W Longitude
UTM NAD 83, Zone 10

Owner: Aley Corporation
Operator: Taseko Mines Limited through its wholly owned subsidiary, Aley Corporation

Title Numbers:
516635, 520262, 520263, 842363, 520172, 1031172, 1031167, 1031170, 1031162, 1031164, and 1031166

Author:
Scott Jones, P. Eng.
September, 2016

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1.0) SUMMARY

The Aley property (hereafter the "Property") is held by Aley Corporation, itself a wholly-owned subsidiary of Taseko Mines Limited ("Taseko"). The Property is located within the Omineca Mining District in north-eastern British Columbia and comprises 111 contiguous mineral claims and a mining lease covering a total area of approximately 47, 122 hectares. It is close to the Ospika Arm of Williston Lake in the headwaters of the Ospika River as shown in Figure 1, centered at 56° 27' N and 123° 44' W, NTS map sheets 94B.041 and 94B.042.

The work program upon which this report is based was implemented between January 1 and December 15, 2015 and falls into the category of "technical exploration and development work". Aley Corporation was the operator of the work described in this report.

The work with respect to which assessment has been claimed comprises:

i. Maintenance and repairs to the exploration road.
ii. Environmental baseline sampling.
iii. Metallurgical test work and reporting.
iv. Analysis of rock samples to determine the acid rock drainage and metal leaching potential of the waste rock and processing products.

The locations of the various aspects of work completed in 2015 are shown in Figure 2.

2.0) LOCATION AND ACCESS

The Property is located in the Omineca Mining District in northeastern BC and comprises a contiguous group of mineral claims centered at 56°27'N and 123°44'W, approximately 150 km northeast of the town of Mackenzie, BC (Figure 1). The property derives its name from Aley Creek, one of the major tributaries of the Ospika River which drains the northern portions of the claims. No other named topographic features on NTS topographic sheet 94B/05 (1:50,000 scale) occur in the property.

Figure 1: Property Location Map

The center of the deposit is situated approximately 20 km northeast of the head of the Ospika Arm of Williston Lake and around 30 km northeast of CANFOR's Ospika Camp site, which contains a well-maintained airstrip.

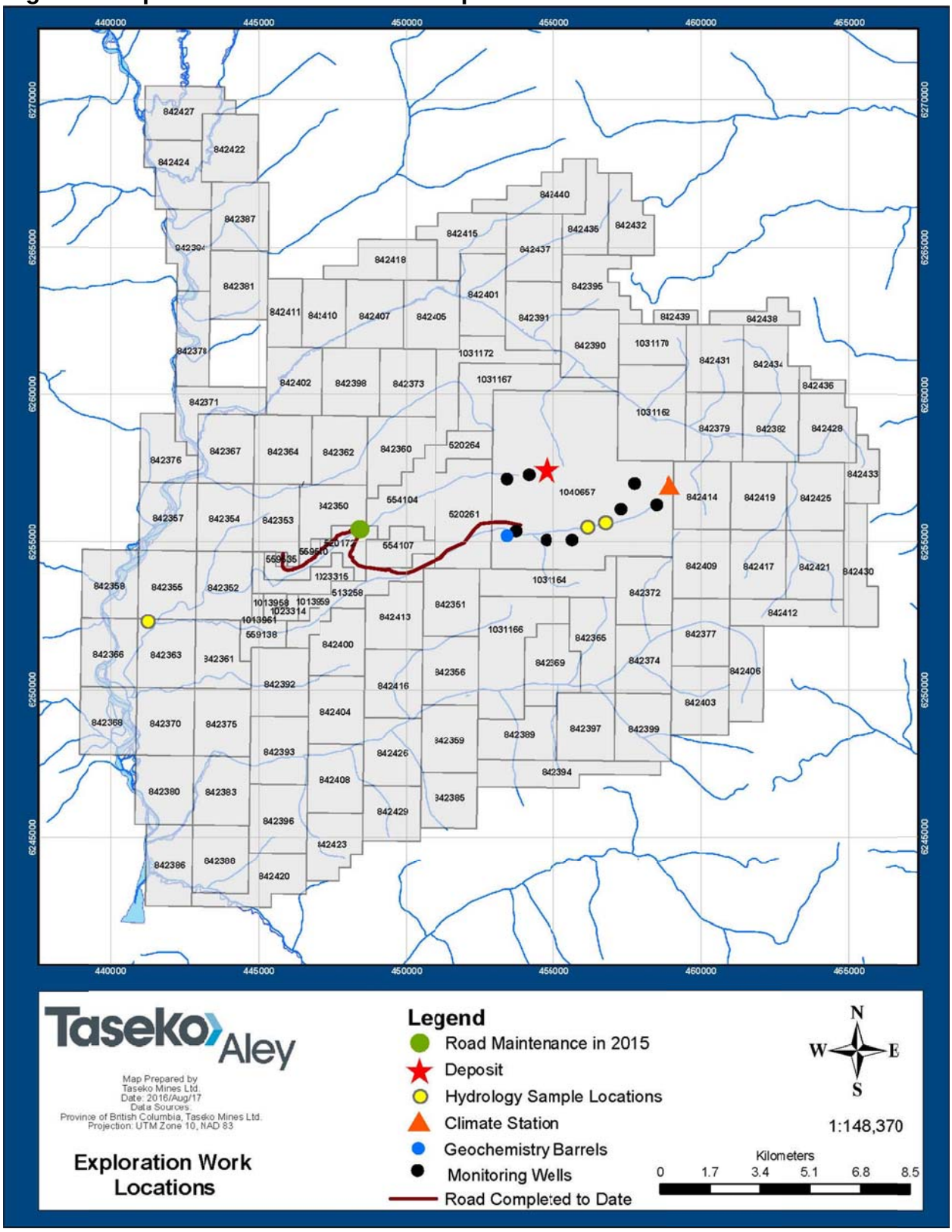
The Ospika Camp site may also be accessed from Mackenzie via logging roads which skirt the western margin of Williston Lake, around its northernmost tip, passing the Tsay Keh Dene community, and down along the eastern shore line where the exploration camp is located. The total road distance from Prince George to site is approximately 600 kilometers.

Barge access to the Opsika site from Mackenzie (approximately 90 km to the south on Williston Lake) is also available.

During the 2015 exploration season, helicopter service provided support for purposes of access and equipment transport. Operations were based principally from the Ospika airstrip.

Recently-constructed logging roads under the operation of Canfor extend approximately 30 km beyond the Ospika Camp towards the property. During the 2012 field season, construction of the 11-km exploration access road designed to link a section of the Canfor logging road (4000 Road) and the Aley deposit area had advanced to the 5.6 km mark, roughly halfway into the Aley deposit area. Maintenance of this portion of the road was undertaken in 2015.

Figure 2: Exploration Work Location Map



3.0) PHYSIOGRAPHY AND CLIMATE

Elevations range from 1,300 m in the valleys to the west and south of the claim blocks to 2,233 m on the ridge to the very east of the deposit known as the Saddle Zone. Topography primarily consists of steep mountainous terrain with U to V-shaped glacial valleys. Small creeks drain several peaks with all drainage on the property flowing into the Ospika River. Drainage flows are seasonal and dependent on meltwater, rainfall and winter freezing. Avalanche trains are evident on some of the steeper slopes.

Boreal forest covers the area below the tree line (~1600 m) while much of the central part of the claims lie above this tree line, which are dominated by alpine shrubs and grasses. The higher elevations are commonly covered with sparse grass, broken scree, and occasional outcrops.

The region is subject to an extreme range of weather conditions throughout the year. Summers are short, from June to late September, and are variably dry to wet with local storms. In such local conditions, heavy rainfall or even snow may occur at any time during the season. Humidity ranges from very dry to humid. Autumn is short with the rapid onset of snowstorms and heavy rains starting in late September, which effectively ends the field season. Snow stays on the ground from October through early June and may remain all year in shaded patches on the peaks in the property.

4.0) CLAIMS

Taseko, through its wholly owned subsidiary Aley Corporation, is the 100% owner of the Aley mining lease and mineral claims. Aley Corporation was the operator of the program described in this report. In 2015, work was conducted prior to the issuance of the lease on 5 of the 115 pre-lease mineral claims which constituted the whole Aley property (Figure 3). In Table 1 a summary of the mineral claims on which work was completed is presented, and Table 2 lists the claims to which the 2015 assessment work was applied.

Figure 3: Aley Mineral Claims

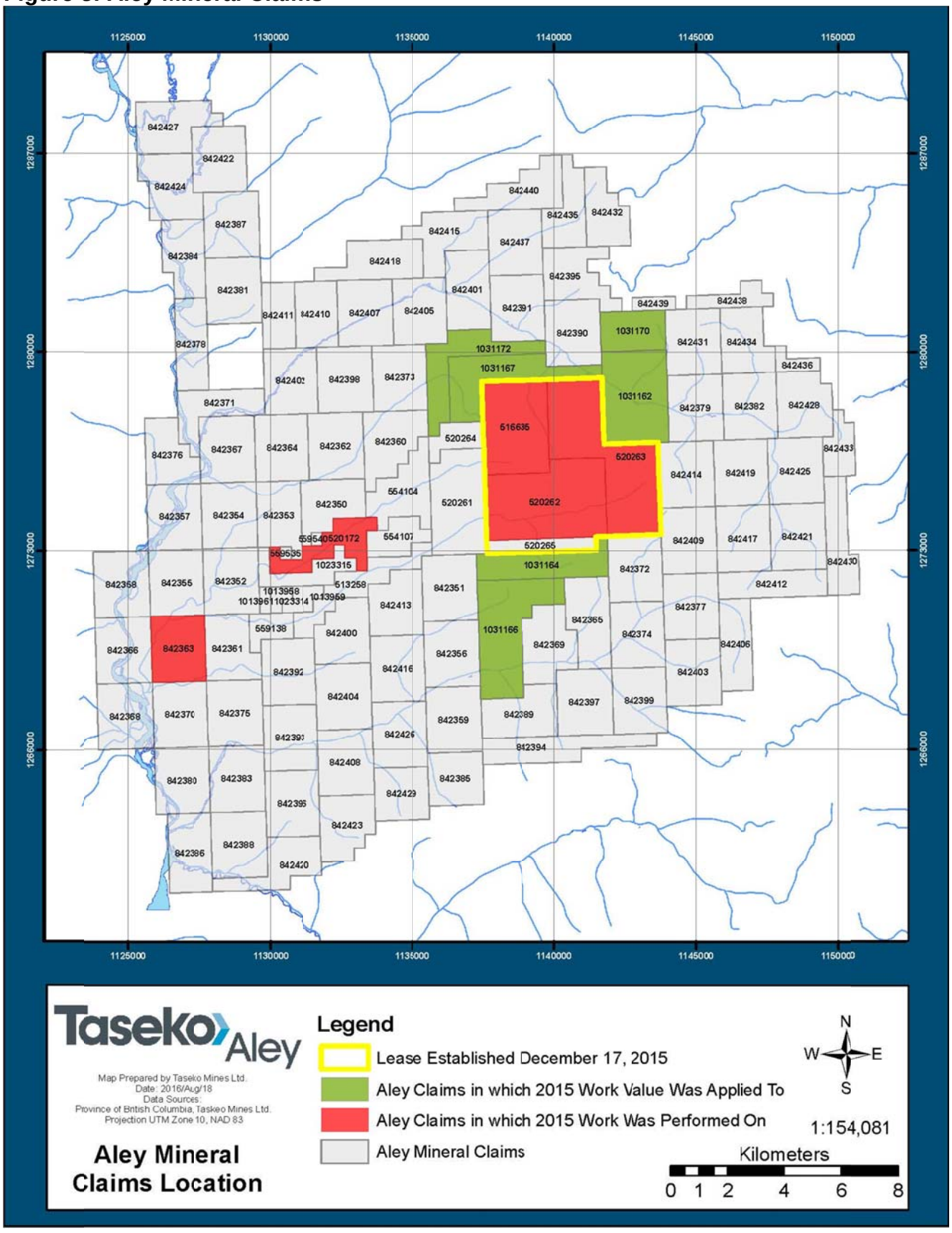


Table 1: Mineral Claims upon which Work was Undertaken in 2015

Title Number	Claim Name	Owner	Issue Date	Good to Date	Status	Area (ha)
842363	ALEY 54	200960 (100%)	2011/jan/04	2025/oct/24	GOOD	448
520172	ALEY 10	200960 (100%)	2005/sep/19	2025/oct/24	GOOD	340
516635		200960 (100%)	2005/sep/21	2021/jan/31; Good *(Converted to lease 1040657 on December 17, 2015)*		3162
520262		200960 (100%)				
520263		200960 (100%)				

Table 2: Mineral Claims to which 2015 Work is to be Applied

Title Number	Issue Date	Good To Date	Status	Area (ha)
1031172	2014/sep/26	2024/dec/24	GOOD	464
1031167	2014/sep/26	2024/dec/24	GOOD	572
1031170	2014/sep/26	2024/dec/24	GOOD	321
1031162	2014/sep/26	2024/dec/24	GOOD	750
1031164	2014/sep/26	2024/dec/24	GOOD	447
1031166	2014/sep/26	2024/dec/24	GOOD	806

5.0) EXPLORATION HISTORY

Cominco Ltd. (1985-1986)

Cominco Ltd. acquired the Aley property subsequent to an initiative in 1980 that was originally focused on the follow-up of regional base metals anomalies to the north of the Property. At that time, no other claims existed in the region. K.R. Pride followed the stratigraphy southeast from these anomalies and in so doing encountered what he suspected to be a carbonatite complex. Samples collected by Pride showed evidence of carbonatite including the presence of pyrochlore. In 1982, P.C. LeCouteur of Cominco visited the property to further collect samples and to assess the possible extent of the carbonatite body. In October 1982, claims Aley 1 through Aley 4 (80 units in total) were staked in order to cover the carbonatite complex. Additional staking in 1986 added the claims Aley 5 through Aley 7 (32 units) and a final claim, Aley 8 (20 units), was added in March 1986.

Field work commenced during the 1983 summer season and this periodic ground work continued yearly until 1986. In addition, metallurgical studies were also carried out from 1983 to 1985. No exploration work was undertaken from September 1986 to September 2004, when Aley Corporation acquired control of the mineral claims from Teck-Cominco.

Work performed by Cominco included:

i. The construction of 20-km bulldozer access trail from the Ospika barge landing site to the Aley camp (1984), now partially superseded by the recent logging roads and CANFOR's Ospika Camp.
ii. The development of approximately 28 km of caterpillar trails to drill sites accessible by means of 4x4 Land Cruiser from a small camp located near the centre of the carbonatite plug.
iii. The preparation of orthophotographic base maps (1983).
iv. Magnetometer surveys at both reconnaissance and detailed local grid scale (17 line-kilometers); scintillometer reconnaissance surveys.
v. Geological mapping at a scale of 1:5,000 over claims Aley 1-7, and at a 1:500 scale in the case of exploration trenching.
vi. Soil sampling on contour lines and along road banks.
vii. Rock chip sampling of outcrops, talus, road cuts with outcrop/sub-crop, and all trenches (5-m contiguous samples).
viii. Diamond drilling in two campaigns totaling 3,046 m over 19 holes in two areas of interest, namely the Saddle and Central Zones. NQ core was drilled in 1985 and BQ in 1986. All cores were stored on site and sample preparation work was undertaken in the field.
ix. An environmental baseline study was initiated during the 1985 and 1986 field seasons by Norelco.
x. Metallurgical testing was conducted using gravity separation on a 4 ton bulk sample in 1983 and 1984. Some flotation test work was carried out until 1991 with varying success.
xi. Mineralogical studies were conducted on samples throughout programs.

Cominco compiled reports for each field season outlining the work carried out and the results achieved. In these reports, Cominco provided preliminary estimates for the resource based on in-house analysis, suggesting 15 million tonnes in the Saddle Zone and 15 to 20 million tonnes in the Central Zone. The details of these estimates and the grade assumed have not been recovered from the Cominco files.

Aley Corporation. (2004-2006)

Following the acquisition of control of the mineral claims by Aley Corporation in 2004, exploration efforts concentrated on trench sampling for metallurgical test materials, confirmation of locations of the previously drilled holes and review of the property's geology. Trenches were dug by means of drilling and blasting in the vicinity of the previous Cominco trenches cut in 1985 and 1986. The purpose of these trenches was twofold; to acquire materials suitable for metallurgical testwork and to confirm the assay results from Cominco's samples during the 1980's. Samples were collected from trenches in the Central Zone near the location of CZ-85-6, CZ-85-6A and CZ-85-8, and in the Saddle Zone at SZ-84-4. A total of 912 kg of samples for assaying and metallurgical test purposes were collected from the trenches. During the same period, all the major mineralized zones which were identified by Cominco in their previous work were visited and old drill sites were located using GPS. The GPS-based ground checks were carried out to validate the previous mapping and survey work which utilized conventional compass mapping procedures. In this manner, identification of possible systematic errors from Cominco's previous work was effectively carried out. Aley Corporation eventually reported a "reasonable positive correlation" between its own survey work and that of Cominco's.

In 2006, compilation and geological review of previous drilling and trenching data were completed by Dave Thomas of AMEC. The objective of the exercise was to evaluate the Aley mineralization and subsequently, to plan for the 2006 field program. The 2006 drilling program was postponed to 2007.

Aley conducted another series of metallurgical test work in 2006. About 1,200 kg of samples were collected from the same trenches in the Saddle and Central Zone areas. The test work was conducted by PRA laboratories in Vancouver. In the same year, preliminary wildlife and environmental surveys were also carried out in collaboration with the Tsay Keh Dene Band.

Taseko Mines Ltd. (2007)

In 2007, Taseko drilled eleven (11) holes with an aggregate length of 1,369 m. All of the holes were drilled at Aley's "Saddle Zone" area. The program which involved drilling NQ2 and BTW-sized core was aimed at confirming the previous 1985-1986 exploration findings of Cominco and to establish a better understanding of the deposit's geology and orebody geometry. Likewise, the activity provided sufficient sample materials to conduct additional metallurgical test work.

Unlike in 1985 and 1986 when access to the property was through cat-trails, material and personnel movements in 2007 were all helicopter-supported. All project personnel were accommodated at Canfor's Ospika camp, situated on the lower northern flank of the Ospika arm

of Williston Lake. Drill core logging, splitting and sampling were also undertaken in this same site utilizing Canfor's renovated outbuildings.

A total of 388 drill core samples combined with 22 duplicate, 11 blank and 23 standard samples were sent to the laboratory for assay purposes.

All drill core samples from the Ospika site were shipped to PRA Laboratories in Vancouver, BC for preparation and thence to IPL for the chemical analysis. Duplicates for quality control were forwarded to Global Discovery Labs (Teck Cominco) for XRF analysis. The remaining sawn core splits were placed in core boxes and initially kept in a secure storage at the Ospika Camp (inside a locked trailer under the care of a watchman). These were later transferred in 2008 to a permanent storage facility at the Gibraltar Mine, a Taseko-owned and operated mine near William's Lake, BC.

Taseko Mines Ltd. (2009/2010)

In 2009 a five-week academically-oriented mapping campaign was conducted on the Aley property by Duncan F. McLeish and Dr. Stephen T. Johnston of the University of Victoria and, Mitch G. Mihalynuk of the MEMPR. This work was part of a bigger program which was intended to gain better understanding of the tectonic and structural controls as well as of the timing of emplacement of the carbonatites in the Canadian Cordillera. At the request of Taseko, Duncan McLeish went back again to the site in 2010 for a 2-week follow-up mapping program. He was joined in the field by Anton Chakhmouradian and Ryan Kressal from the University of Manitoba. The 2010 exercise was aimed at acquiring structural and petrographic information that would be the basis for Taseko's exploration target definition during its summer program for that same year.

A total of 88 samples from rock outcrops and drill cores from the 2007 drilling campaign were submitted for whole-rock analysis as part of a geochemical characterization exercise. The geochemical results as well as the additional information obtained from drill core logging were valuable inputs in the interpretation and better understanding of the Aley deposit's mineralization and configuration. Consequently, the advances in the geologic studies during the year served as vital factors in programming the drill holes in 2010 as well as in the succeeding years.

Taseko's diamond drilling program in 2010 involved the completion of 23 holes (2010-012 to 2010-034) with an aggregate length of 4,460 m, all within Aley's "Central Zone" area. The objective of the drill program was to confirm the 1985-1986 exploration findings of Cominco in the Central Zone. Aside from collecting more geological information to better understand the nature of the deposit, the drilling program also aimed at collecting more materials for additional metallurgical test work.

A total of 1,312 NQ-size drill core split samples (in addition to 75 duplicate, 75 standard reference and 25 blank samples) were sent to Inspectorate Laboratories of Richmond, BC. for chemical analysis.

Taseko Mines Ltd. (2011)

Taseko completed a drilling program comprising 65 exploration holes (2011-035 to 2011-099), 3 geo-mechanical holes (GM11-01 to GM11-03) and 2 geotechnical holes (GTF-4 and GTF-5) with an aggregate length of 17,136 m during the field season in 2011. Most of the holes were drilled within the Central Zone area and the primary objectives were to better define the continuity and extent of the ore zones and obtain more detailed sub-surface geological and structural information. Aside from obtaining geotechnical information for the earlier-conceived mine infrastructure sites, GTF-4 and GTF-5 holes were drilled to also define the extent of the mineralized carbonatite body to the south of the Central Zone.

The additional data gathered subsequently served as basis for the geologic modeling and resource estimation process as well for the initial pit engineering studies. Most of the holes were drilled along similar NE orientation (Azimuth 20º to 60º) with dips ranging from -45 º to -55 º. Five of the holes were drilled along a SW orientation (Azimuth 201º to 208 º) and with steeper dips ranging from -60 º to -72 º. Including the previously drilled 2010 holes, the over-all drill hole density after the completion of the 2011 program was already within 50 m hole to hole spacing, at its closest.

A geological model of the Aley Central Zone was completed in 2011 using all the 2010 and 2011 drilling results. This 3D model was based on the establishment of a simplified 3-lithofacies classification which was derived after detailed analyses of the drill hole geology and the associated assay results. The model demonstrates near-surface Nb mineralization at Aley of significant grade within an area of approximately 1,400 m (E-W) by 500m (N-S) and, to a depth below surface in the order of 250m. Although mineralization appears to taper off along the northern and western sections of the deposit, the eastern and southern extents of the deposit remain open, beyond which further mineralization has potential to occur.

On March 29, 2012 Taseko released an updated NI43-101-compliant mineral resource for the Aley property. This resource was prepared for Taseko by Ronald G. Simpson of Geosim Services Inc., and may be found at www.sedar.com. . The estimation was based on drilling data collected up to 2011 and includes results of 7,017 drill core assays. The in-pit mineral resource published on March 29, 2012 is presented in Table 3 below:

Table 3: Aley Resource Estimate

Resource Category	Cut-off Grade (Nb_2O_5 %)	Tonnes (000's)	% Nb_2O_5
Measured	0.20	112,651	0.41
Indicated	0.20	173,169	0.35
Inferred	0.20	144,216	0.32
TOTAL Measured+Indicated:	0.20	285,820	0.37

Taseko Mines Ltd. (2012)

The 2012 exploration program comprised drilling, test pitting and road construction. Field work was conducted between June 24 and October 11, 2012. The 2012 drill program comprised geotechnical, geo-mechanical, exploration-condemnation and water monitoring holes. While all geotechnical holes were drilled within the proposed tailings storage facility (TSF), truck shop and mill plant areas, the geomechanical component of the program occurred within the Central Zone. Only 2 exploration holes were drilled during the course of 2012 and were situated approximately 600m SE of the deposit area. The exploration holes served the purpose of condemnation between the main deposit area and the proposed mine infrastructure sites. Downstream of the proposed TSF area, relatively short holes for groundwater monitoring work were completed.

Taseko Mines Ltd. (2013-2014)

Work in 2013 and 2014 was focused on metallurgical test work to produce a saleable product, design of infrastructure required to operate and process ore from an open pit mine, and continuing baseline environmental studies.

On October 30, 2014 Taseko published a NI43-101 technical report for the Aley property, establishing a mineral reserve. The report, "Technical Report on Mineral Reserves at the Aley Project, British Columbia, Canada", may be found at www.sedar.com. The reserve supported in the technical report is presented in Table 4 below.

Table 4: Aley Reserve Estimate

Reserve Category	Tonnes (000's)	% Nb_2O_5
Proven	44,272	0.52
Probable	39,543	0.48
TOTAL Proven and Probable	83,815	0.50

Note the reserves are stated at a cut-off grade of 0.30% Nb_2O_5 and are contained within the resources stated in Table 3.

Historic assessment credit filings have been summarized in Table 5 below.

Table 5: Historic Assessment Work

Report No.	Year	Author	Historic Claim Names	Type of Work
35632	2014	Yelland, Greg	Aley 10, 520261, 520262, Aley 12, Aley 13, Aley 53, Aley 54, Aley 63	Physical, Geological, Geochemical
34176	2013	Crozier, Jeremy	520262, 520263	Drilling, Physical, Geochemical
33237	2011	Crozier, Jeremy	520262	Drilling, Geochemical
32798	2011	Crozier, Jeremy	520262	Drilling, Geochemical
30113	2008	Crozier, Jeremy; Chung, Crystal J	516635, 520262	Drilling
28733	2006	Nethery, Bryan T	Aley 9, 520261, 516635, Aley 10	Physical, Geological, Geochemical
27991	2005	Hardy, J; Lyons, E.M; Nethery, Bryan T	Aley 9-10, 520261, 516635	Geological, Geochemical

6.0) REGIONAL GEOLOGY

The Aley region lies within the Western Foreland belt of the Rocky Mountains and is characterized by Early to Middle Paleozoic deep water carbonates and shales (McLeish, 2011; Figures 4a and 4b). These rock units slope to off-shelf deep water strata, defining the paleo-geographic Kechika Trough. In the Aley region, the north-south trending, 50 km wide trough is bound to the west by the Northern Rocky Mountain Trench (NRMT), which is host to an Eocene dextral strike-slip fault interpreted to have accommodated >400 km of dextral strike-slip displacement; and to the east by a facies boundary defined by the western limit of shallow water carbonates of the Macdonald Platform. North of 59 degrees N Latitude, the Kechika Trough widens into the Selwyn Basin. The trough terminates immediately south of the Aley region, where the facies boundary marking the east margin of the trough curves around to the west, and is truncated against the NRMT fault. Strata on the western side of the NRMT are: (1) lithologically similar Paleozoic continental margin sediments, (2) assigned to the Kechika formation, and (3) form part of the Cassiar terrane, a continental block of uncertain paleogeographic affinity

The Aley Creek area lies near the eastern limit of Paleozoic volcanism and coarse clastic sedimentation in the Foreland Belt. The Lady Laurier volcanics and westerly-derived Earn Group conglomerates, exposed to the immediate north and west of the Aley carbonatite, have been cited as evidence for tectonism in the mid-Paleozoic. Synmagmatic contractional deformation structures in continental margin strata that is host to the Aley carbonatite, suggesting that this activity was (1) at least in part the result of convergence along the parent margin and (2) associated with carbonatite emplacement (McLeish, 2011).

Figure 4A: Regional Geology

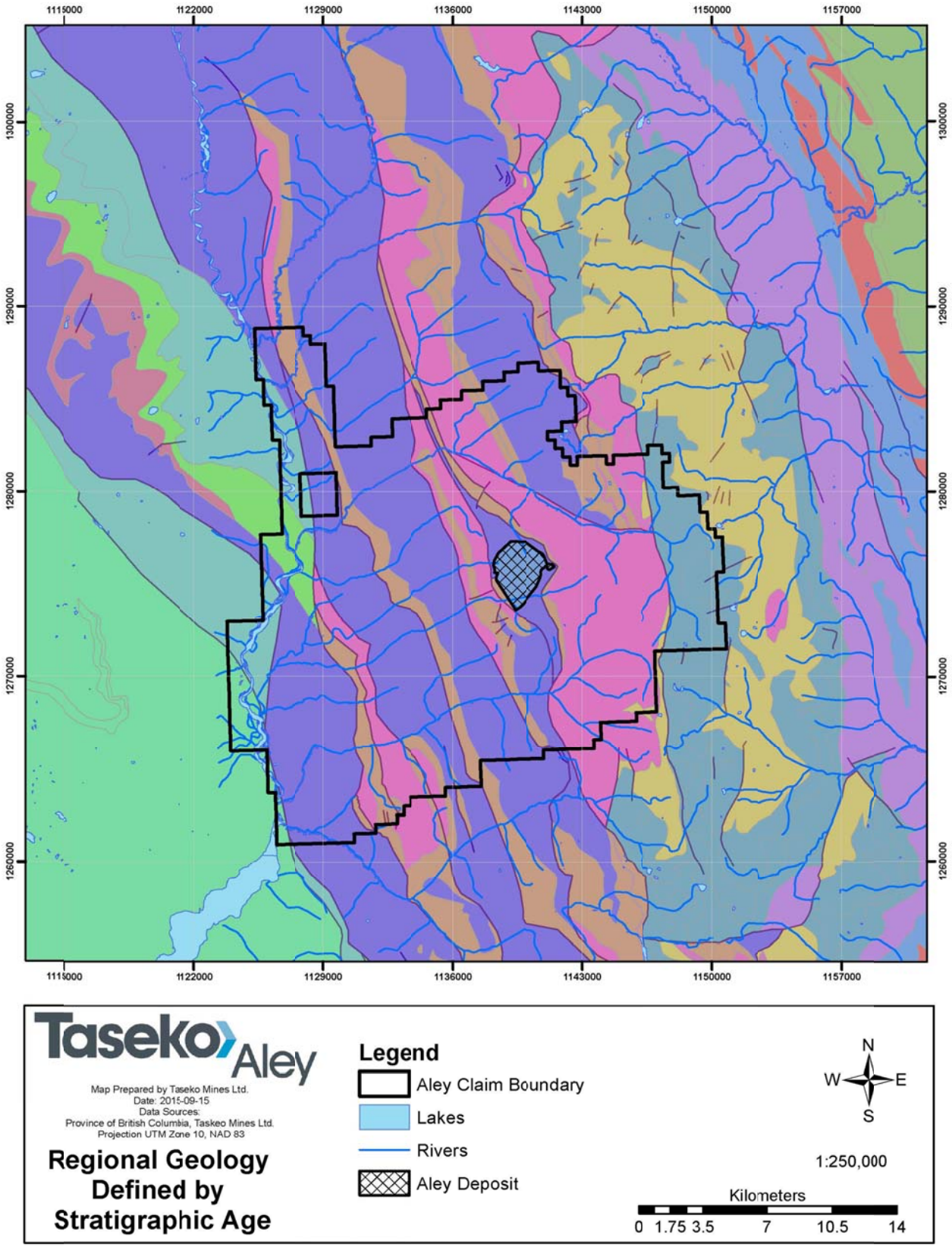


Figure 4B: Regional Geology Legend

7.0) PROPERTY GEOLOGY

The Aley Carbonatite complex intrudes Cambrian to Ordovician sedimentary rocks of the Kechika (limestone), Skoki (dolomite to volcaniclastics) and Road River Group formations (clastic sedimentary rocks). The intrusion is ovoid in plan view with a diameter of approximately 2 km and surrounded by a fenite aureole up to 500 m thick that has previously been mapped as "amphibolite" (Pride, Cominco Ltd., 1987) and "syenite" (Mäder, 1986). The complex is predominantly composed of dolomite carbonatite (CD) with minor calcite carbonatite (CC). Texturally, relationships suggest that CD is metasomatic in origin while CC is interpreted to be primary. Three calcite carbonatite intrusions are identifiable within the drill holes, each with an associated cumulate phase. In approximate order of intersection, from top to bottom of the drill holes, these are (Chakhmouradian et al, 2010 and Kressall, 2011):

Primary Phases:

I. Magnetite-Apatite-Columbite Cumulate (CM) & Phlogopite-Magnetite Calcite Carbonatite (CC)

Heavy mineral cumulate separates (CM) are composed of densely packed magnetite (35-50 vol. %), apatite (25-35 vol. %), columbite (5 vol. %), phlogopite (0-15 vol. %) and zircon (up to 1.5 vol. %). Zircon is only identifiable by shortwave ultra-violet light (fluoresces yellow). Interstitial carbonate is predominantly calcite (up to approximately 10 vol. %). Fine- to medium-grained (up to ~5 mm diameter grains) magnetite is anhedral with a globular appearance. Phlogopite is fine-grained (<1 mm) and pinkish-brown in colour. Columbite can rarely be distinguished from magnetite due to its similar black colour and sub-metallic luster.

Phlogopite-magnetite-phyric CC, closely associated with CM, occurs at similar shallow depths. A sharp contact between CM and CC in some drillholes suggests an evolutionary relationship between CM and CC. The unit is composed of calcite (65-75 vol. %), magnetite (5-25 vol. %), phlogopite (0-10 vol. %), apatite (7.5 to 15 vol. %), columbite (observed up to 2 vol. %) and zircon (trace). Magnetite is typically fine-grained (<1 mm) and has similar globular appearance as magnetite within CM. Phlogopite is typically fine-grained, pinkish-brown and occurs as disseminations. Large (up to 3 cm in diameter) brecciated massive magnetite occurs more rarely within CC (presumably fractured cumulate). Columbite is recognized by its black submetallic luster, hexagonal to octahedral shape in cross-section in core and is distinguished from magnetite by being non-magnetic. Magnetite and apatite are commonly concentrated in laminae within laminated CC.

II: Phoscorite (PH)

Phoscorite is composed of magnetite, apatite, olivine, interstitial calcite and abundant baddeleyite (ZrO_2). The unit is medium- to coarse-grained, with magnetite crystals as large as 1 cm in diameter, and can be differentiated from the mineralized CM by the subhedral to euhedral shape of magnetite, presence of olivine and absence of zircon.

Rounded olivine crystals are commonly serpentinized, and are recognizable by their greenish-brown colour and very low hardness.

A niobate-barren phlogopite-magnetite-phyric CC also occurs in association with the phoscorite. Similarly, observed sharp contacts (e.g. at 2010-22-184.3 m) between CC and PH suggests a fractionation relationship between the two units. CC related to PH differs from CC related to CM by absence of zircon and columbite and the subhedral to euhedral shape of magnetite crystals.

III: Silicocarbonatite (CS)

CS refers to cumulates and calcitic carbonatites bearing blue sodic-amphibole. Fine- to medium-grained blue amphibole occurs as euhedral prismatic crystals with bipyramid terminations within massive porphyritic and cumulate CS with magnetite, apatite, phlogopite and abundant zircon (0-5 vol. % locally). In laminated CS, the amphibole commonly forms blue 1-5 cm bands. A currently unidentified green mineral with the same crystal form as the blue amphibole is commonly observed within the CS, sometimes occurring within the core of the blue amphibole. Magnetite occurs as fine- to coarse-grained (up to 1 cm in diameter) subhedral to euhedral crystals. Black phlogopite commonly occurs as coarse-grained (up to 1 cm) or locally pegmatitic euhdedral crystals. The unit appears to be a layered intrusion ranging from a magnetite-apatite-sodic amphibole cumulate devoid of calcite to an increased proportion of calcite in porphyritic layers, to an aphyric white calcite carbonatite (composed entirely of calcite). Early observations suggest that zircon may concentrate locally to specific CS phases. Black to pink octahedral pyrochlore has been observed within CS.

Metasomatic Phases:

IV: Dolomite carbonatite (CD)

CD is the most abundant and texturally variable lithology. The unit dominantly consists of dolomite (75-99%), apatite (1-20%), pyrite (1-5%), calcite (0-5%) and niobates (0-2%). Interpretation is that most, if not all CD is secondary after CM, CC, PH and CS. Dolomitization is closely related to lamination of the complex, with laminated CD being the most abundant lithology in the complex. The lamination is generally defined by concentrated apatite laminae. Massive CD on the other hand tends to contain very little apatite. Partial chloritization and silicification of CD (up to 25 vol. %) suggest low grade metamorphism of the complex. Relict textures of the other lithologies (CM, CC, PH and CS) are observed within bands of the dolomite carbonatite. These include pseudomorphs after phenocrysts and cumulate minerals. Phlogopite is replaced dominantly by chlorite and dolomite, but also pyrite, silica, muscovite and monazite. Coarse-grained (up to 1 cm) chloritized phlogopite within CD is commonly associated with silicocarbonatite. Back-scatter electron imaging indicates that dark-grey submetallic pseudomorphs after magnetite are dominantly composed of dolomite with rutile inclusions occurring along cleavage planes. Pyrite commonly aggregates along the rim of the pseudomorphs.

Fersmite occurs as anhedral, octahedral and hexagonal polycrystalline pseudomorph up to 4 mm in diameter after columbite and pyrochlore concentrating within zircon-bearing apatite laminae. Fersmite is rarely recognizable within hand sample, but where visible it has a pale-yellow to pink colour and grainy texture. Two varieties of fersmite pseudomorphs are recognized at Aley: 1) Ti-enriched acicular yellow fersmite; and 2) subplatey lamellar Th-rich fersmite embedded in Th-poor fersmite. The two varieties of fersmite are only distinguishable using microscopic methods. Monazite also occurs in some pseudomorphs with fersmite, but is only identifiable by microscopic methods. Within the oxidized zone, fersmite needles are disaggregated and redispersed. Nb-mineralization within CD generally reflects associated primary mineralization. The most fersmite-rich CD is observed in the vicinity of CM and associated CC, whereas the least mineralized CD is observed in the vicinity of PH. Some fersmite is observed locally in CD associated with CS.

Although pyrite is observed within all lithologies, it is most abundant within dolomite carbonatite occurring as stringers, laminae, massive aggregates and to lesser extent as euhedral cubic disseminations. The greatest concentration of pyrite occurs with dolomitized CM bands.

The least common textural variety of CD is brecciated and matrix-supported. This was observed in drill cores associated with localized fault zones that are dominated by rubble and gouge. No Nb-mineralization has been observed yet within these brecciated fault zones.

Fault zones are generally about 10 to 15 meters wide but these become wider as they extend to the surface. Faults are generally traceable between adjacent drillholes but displacement appears to be minor maintaining the CM-PH-CS sequence. Faults are likely associated with localized slumping of the complex. Some bands of sheared breccia within the dolomite carbonatite suggest that some ductile deformation must have followed brittle deformation.

V: Fenite (AM and AMX)

The fenite aureole has previously been referred to as a syenite (Mäder, 1986) and an amphibolite (Assessment report 16484). The fenite is texturally variable, ranging from dark- to greyish green in colour and composed of variable proportions of albite, quartz, arvedsonite, aegirine, calcite, apatite and accessory lorenzenite and rare-earth carbonates (Mäder, 1986). A fenitized conglomerate also occurs along the margins of the complex containing rounded clasts of amphibole-rich quartz syenite, metasomatized sedimentary rocks and quartzite.

Centimetre- to metre-scale fenite blocks also occur within the core of the complex (AMX). A fenite-block rich horizon is most commonly observed in the drillholes occurring between CM and PH or CS (when PH is not present). Aphyric to magnetite-phlogopite-phyric calcite carbonatite commonly occurs in contact with the fenite clast and as crosscutting veinlets. Black phlogopite rims (1-2 cm thick) occur between calcite and

dark-green fenite core. Dolomitized fenite clasts are greyish purple in colour and contain abundant pyrite disseminated within the matrix.

The so-called ampibolite occurs in two phases. One is the massive amphibole-rich rock and the other a coarse breccia dominated by rounded amphibole-rich quartz syenite mixed with rounded clasts of amphibole-metasomatised Paleozoic sedimentary rocks, particularly pure early Cambrian quartzite that occurs some 1-km below the present surface. Pride (Pride, 1984) proposed that the amphibolite resulted from the Mg and Fe metasomatisation process associated with the emplacement of the carbonatite. This “fenitisation” overprinted the breccias of sedimentary rocks and the process brought into question the earlier assumption that the amphibolite was an indeed an intrusive rock.

Mäder (1986) observed that the rock had syenitic textures with original Na-amphiboles and the unusual petrochemistry that lead to quartz and albite dominance. This he termed quartz-albite syenite in order to distinguish it from the more common nepheline syenite normally associated with carbonatites. The rock in question had undergone extensive metasomatism that overprinted much of the original quartz-albite-arfvedsonite magmatic textures. Mader suggested that the metasomatism replaced albite and some arfvedsonite with aegirine and that quartz increased and sometimes recrystallized to form larger grains while residual albite reformed into finer grained albite aggregates.

The breccia comprises up to 30% xenoliths of quartzite and igneous rocks such as micro-syenite and albitite. Metasomatic reactions formed rims around the sedimentary clastics showing pervasive adsorption and formation of recrystallized quartz, albite, and secondary aegirine. Micro-syenite clasts are much less common. These also show reaction rims with similar mineralogy observed in the massive metasomatised syenite and in the sedimentary clasts.

8.0) 2015 EXPLORATION ROAD MAINTENANCE

8.1) Work Performed

The exploration road that was constructed in 2012 was surveyed in 2015 to determine whether maintenance work was required. The exploration road maintenance was carried out by Chu Cho Industries from September 17-20 2015. Equipment utilized was a Caterpillar 330 excavator. The work involved firstly clearing the area of overhanging dangerous trees to allowed safe access to the areas of the road that had slumped. Once the site was safe to work in, the rest of the work focused on clearing of the slumped material, remediating ditches and installing further erosion controls ahead of the winter season.

8.2) Raw Data

No raw data was produced from this work.

8.3) Interpretation of Results and Analysis

There are no results to analyze or interpret as part of this work. A brief report by Chu Cho Enterprises on this work is included in Appendix 1.

8.4) Conclusions

It was concluded that an inspection of the exploration road should once again take place in early spring of 2016 and any further remediation work should be carried out in the summer months of 2016.

8.5) Cost Statements

Table 6: Chu Cho Enterprises Costs

Service	Equipment	Hours/Items	Rate	Subtotal	Total
Management	Supervisor	56 hrs	$80	$4,480	$4,480
Construction	Pick- up Truck	9 days	$250	$2,250	$2,250
Labour	Travel Time	16.5 hrs	$50	$825	$825
Labour	Faller	44 hrs	$80	$3,520	$3,520
Labour	Labourer	34 hrs	$65	$2,210	$2,210
Construction	ATV	4 days	$250	$1,000	$1,000
Construction	Power Saw	4 days	$60	$240	$240
Construction	Tractor + Operator	12 hrs	$100 $65	$1,980	$1,980
Construction	Excavator + Operator	24 hrs	$196 $65	$6,265	$6,265
Labour	Living out Allowance	11 days	$150	$1,650	$1,650
Construction	Hay Bales	10	$10	$100	$100
Total				**$24,520**	**$24,520**

9.0) 2014 BASELINE ENVIRONMENTAL SAMPLING PROGRAM

9.1) Work Performed

Work was conducted by Knight Piesold Ltd from July 8 to July 11, 2015 and included:

- Data download and maintenance at the meteorological station
- Flow measurements, data download, and maintenance at the hydrology stations
- Data download at the groundwater monitoring wells
- Sampling of geochemistry waste rock barrels.

The project's meteorological station was visited on July 10, 2015. The station was inspected and determined to be in working condition. The station's mast was lowered and data verification was completed on the instruments to check their condition. The data from the station's datalogger was downloaded, checked and then re-initialized by a program re-set. The contents of the Pluvio2 precipitation gauge were emptied and a mixture of methanol/propylene glycol was added to the collection bucket to prevent freezing during the winter.

Low flow discharge measurements were conducted at three hydrology stations, H3, H5, and H7 on July 9, 2015. At each station two area-velocity discharge measurements were completed, dataloggers were downloaded, and maintenance performed on the equipment.

Eight groundwater monitoring wells were visited and water level transducers downloaded and manual water levels taken.

Samples were taken from 5 ARD barrels and sent for analysis.

9.2) Raw Data

Due to the large number of data points, all of the raw data associated with this program is included in the electronic file directory labeled "2015 Baseline Data", submitted with this report.

9.3) Interpretation of Results and Analysis

The focus of the 2015 program was data collection and station maintenance. As a result, no detailed analysis was completed.

Further investigation is required to reach any conclusions. Continued hydrometric data collection will help to improve the quality of the current data set.

9.4) Conclusions

This program is part of a larger multi-year data collection program. Further investigation is required before being able to provide firm conclusions. The field report associated with the 2015 site work is included in Appendix 2.

9.5) Cost Statements

Table 7: Tsayta Aviation Costs

Category	Service	Items	Rate	Subtotal	Total
Hydrology	Air transport	11.3 hrs	$1,191	$13,462	$13,462

Table 8: Yellowhead Helicopter Costs

Category	Service	Items	Rate	Subtotal	Total
Hydrology	Helicopter	10.1 hrs	$1,400	$14,140	$14,140
Hydrology	Fuel	1,616 ltrs	$2.18	$3,523	$3,523
Hydrology	Expenses	misc		$1,614	$1,614
Total				**$19,277**	**$19,277**

Table 9: Knight Piesold Costs

Category	Service	Items	Rate	Subtotal	Total
Hydrology, well monitoring, climate station	field work and QA/QC	94 man hrs	$207	$19,525	$19,525
Hydrology	Disbursements			$5,530	$5,530
Total				**$25,050**	**$25,050**

Table 10: VEP Communications Costs

Category	Service	Items	Rate	Subtotal	Total
Hydrology	Logistics	11.5 Months	$500	$5,750	$5,750
Total				**$5,750**	**$5,750**

Table 11: Avison Management Costs

Category	Service	Items	Rate	Subtotal	Total
Hydrology	Bear Guard	47.5 hrs	$80	$3,800	$3,800
Hydrology	Truck Rental	76 Km	$0.65	$49	$49
Total				**$3,849**	**$3,849**

Table 12: Finlay River Outfitters Costs

Category	Service	Items	Rate	Subtotal	Total
Hydrology	Breakfasts	12 people	$25	$300	$300
Hydrology	Lunches	14 people	$20	$280	$280
Hydrology	Dinners	12 people	$35	$420	$420
Hydrology	Accommodation	12 people	$70	$840	$840
Total				**$1,840**	**$1,840**

Table 13: Chucho Environmental Costs

Category	Service	Items	Rate	Subtotal	Total
Hydrology	Environmental Technician	41 hrs	$60	$2,460	$2,460
Hydrology	Mileage	280 Km	$0.95	$266	$266
Total				**$2,726**	**$2,726**

10.0) 2015 METALLURGICAL TEST WORK

10.1) Work Performed

In 2015, Metallurgical costs were incurred in three main categories as outlined below.

The first category of work was the completion of the formal report on mineral processing and hydrometallurgical test programs to date by SGS Laboratories. SGS also provided storage of the excess feed blend samples and products related to metallurgical test programs

The second category of work was the completion of pyrometallurgical conversion of leach residue from the SGS test work into a ferro-niobium alloy. This work was contracted to XPS in order to conduct individual tests as directed by Taseko employees. This work was conducted at the laboratory scale and included roasting and crucible conversions.

The third category of work was the commencement of two desktop studies intended to identify optimization opportunities related to the hydrometallurgical and pyrometallurgical process stages. The hydrometallurgical aspect of this work was contracted to Edouard Asselin, while Great Lakes Metallurgy performed the pyrometallurgical evaluation.

All work was completed on samples taken from the deposit area.

10.2) Raw Data

Data from the work conducted by SGS Laboratories is contained in a series of 4 reports as issued by SGS which covers the multi-year span of the program. It should be noted that this work details the development of a unique processing method for niobium ores that is considered proprietary at this time and the reports are therefore confidential.

Data from XPS confirmed that further improvements in product quality were possible and provided sufficient information to undertake the subsequent hydrometallurgical and pyrometallurgical desktop studies. The data is provided in the report, “XPS 2015 Reports Redacted” provided in Appendix 3.

The work completed by Great Lakes Metallurgy and Edouard Asselin involves a review of existing data and did not generate any data in and of itself

10.3) Interpretation of Results and Analysis

Analysis from the information obtained from individual tests during the SGS Laboratories metallurgical test work provided a process route, which was ultimately verified at their facilities with a laboratory scale locked cycle test program. Locked cycle product was successfully leached to produce an acceptable feed to a known pyrometallurgical conversion technique.

Assessment of results from the XPS data indicated that further improvements in product quality were possible and provided sufficient information to undertake the subsequent hydrometallurgical and pyrometallurgical desktop studies.

Preliminary desktop assessments from Great Lakes Metallurgy and Edouard Asselin, confirmed that the opportunity for improved product quality and lower costs was technically possible. Reports were not finalized in 2015 and will be considered confidential and proprietary when complete.

10.4) Conclusions

As a result of the work conducted by XPS, Edouard Asselin, and Great Lakes Metallurgy, an opportunity for improved product quality and lower costs was identified as technically possible. Further analysis and verification continued into 2016.

10.5) Cost Statements

Table 14: SGS Laboratories Costs

Category	Service	Items	Rate	Subtotal	Total
Metallurgical Tests	Assay Report	ls	-	$606	$606
Metallurgical Tests	Sample Storage			$7,095	$7,095
Metallurgical Tests	Report	ls		$123,531	$123,531
Total				**$131,232**	**$131,232**

Table 15: XPS Costs

Category	Service	Items	Rate	Subtotal	Total
Metallurgical Tests	Smelter Tests	1 Batch Test	$15,500	$15,500	$15,500
Metallurgical Tests	Report	ls	$9,000	$9,000	$9,000
Disbursements	Misc			$151	$151
Total				**$24,651**	**$24,651**

Table 16: Edouard Asselin Costs

Category	Service	Items	Rate	Subtotal	Total
Labour	Consulting Services	33 hrs	$145	$4,785	$4,785
Total				**$4,785**	**$4,785**

Table 17: Great Lakes Metallurgy Costs

Category	Service	Items	Rate	Subtotal	Total
Labour	Consulting Services	40 hrs	$150	$6,000	$6,000

11.0) 2015 GEOCHEMICAL CHARACTERIZATION

11.1) Work Performed

In 2015, kinetic testing of materials from the proposed mine was continued in order to assess the potential for acid rock drainage and metal leaching (ARD/ML). Tests were maintained throughout 2015 by Maxxam Analytics, complete with regular periodic sampling and assaying. Given the alkaline nature of the deposit some of the assay requirements to assess the performance of these tests fall outside of the expertise of standard assay laboratories. As such samples from these tests were sent for assay analysis at labs with specialization in a variety of techniques. These specialized assays were conducted by ALS Canada, Maxxam, and the Saskatchewan Research Council.

11.2) Raw Data

All of the 2015 raw data associated with the kinetic test work component is included in the electronic file directory labeled “2015 Geochem Data”, submitted with this report.

11.3) Interpretation of Results and Analysis

Kinetic tests can require multiple years’ worth of data collection and interpretation before results can be considered final and conclusions drawn in the form of site source terms. As such, analysis of the data continues indicating that the samples are depleting, but no final conclusions or source terms can be determined at this time from the 2015 work.

There are no reports or conclusions related to the 2015 kinetic test work. This work was focused on continuing data collection as part of a multi-year program to be incorporated in a final report when the test work is complete.

11.4) Conclusions

Information obtained with regards to the ARD/ML kinetic tests and analysis continues to inform potential site water quality and site water management strategies. This is as a direct result of the information obtained from the work conducted at ALS Canada, Maxxam, and the Saskatchewan Research Council.

11.5) Cost Statements

Table 18: Maxxam Costs

Category	Service	Items	Rate	Subtotal	Total
Humidity Cell Assays	Waste Rock Humidity Cell Assaying	N/A	-	$79,212	$79,212

Table 19: Saskatchewan Research Council (SRC) Costs

Category	Service	Items	Rate	Subtotal	Total
Humidity Cell Assays	Waste Rock Humidity Cell Assaying	N/A	-	$20,558	$20,558

Table 20: ALS Canada Costs

Category	Service	Items	Rate	Subtotal	Total
Humidity Cell Assays	Assays	77 analysis	$16.17	$1,245	$1,245

Table 21: SRK Consulting Costs

Category	Service	Items	Rate	Subtotal	Administration	Total
Humidity Cell Assays	Assays and data compilation	245 hrs	$151/hr	$36,972	$1847	$38,819
Total		245 hrs		**$36,972**	**$1847**	**$38,819**

12.0) TOTAL COSTS

The total cost of work carried out in 2015 includes:

1) Road maintenance total of $24,520
2) Environmental Baseline Studies total of $73,199
3) Metallurgical test work total of $166,668
4) Geochemical characterization total of $138,589

The total cost of all technical work carried out in 2015 is $402,976. Of that total, $402,886.82 is being applied against the Aley claims and $89.18 is being credited to the Aley Corporation PAC account.

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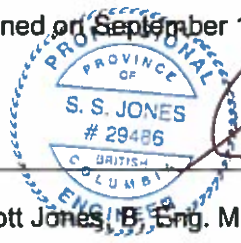
STATEMENT OF AUTHOR'S QUALIFICATIONS

I, Scott Jones, hereby state:

1. That I prepared this report in my capacity as Vice-President, Engineering of Taseko Mines Ltd., with offices located at 15th Floor, 1040 W. Georgia St. Vancouver, BC, V6E 4H8.
2. That I am a graduate of McGill University (B.Eng. Mining, 1985) and have been employed by Taseko Mines Ltd. Since 2006.
3. That I have the relevant education and experience to act as a qualified person in the reporting of the work carried out in 2015 on the Aley property as described in this report.
4. That the accompanying Statements of Costs in Sections 8.5, 9.5, 10.5, and 11.5 are an accurate statement of expenditures on the project.

Signed on September 1, 2016



Scott Jones, B. Eng. Mining. P.Eng.

APPENDIX 1

Aley Exploration Road Maintenance Report

CHU CHO INDUSTRIES L.P.	**Project Title:**		**Site Visit #**
	Alley Road Maintenance		
	Site Visit By:	**Site Visit Date:**	2
	Jon Kostyshyn	Sept 17,2015	

Site Location:	**Weather During Site Visit:**
0+000 - 4+000	Approximately 8 C and Overcast
Owner's Representative:	**Were Photographs Taken During Visit:**
Taseko	Yes

Parts of Construction Looked at During Site Visit:

Erosion Control, Danger Tree Assessment, Water Control, Access to site

Engineering Comments:

General Observations:

- A site visit in July confirmed that some road maintenance was needed on the Alley Road

Maintenance Requirements: <Discussed with Taseko>

- Danger Tree Assessment and removal from 0+000 to 4+000
- Clean out ditches that have accumulated silt and debris
- Replace Hay bale ditch blocks were required
- Reestablish drainage patterns across creek
- Tighten up tension cracks were required

Overview:

- All maintenance requirements. were completed from Sept 17-20. There was a significant amount of danger trees removed along the right of way in order to allow crews and equipment to safely access the site. Ditches were reestablished as equipment moved in along the right of way. Once the excavator reached the creek logs were placed to help minimize impact on stream banks and the stream channel. Once across crews worked on cleaning out existing water bars, reestablishing a small ditch line through the area that had sloughed. Not all material could be removed as there was no way of trucking it out and it putting it on the low side was not a option. Any material removed from ditches or water bars was heaped up to help increase the berm and water bar size. Hay bales were either added to existing working sedimentation blocks or replaced. It was noted that during the period of Sept 22 to 24 it did not stop raining and a extremely large amount of water was deposited. The site was visited again on Sept 28, and it was evident that water was flowing in the right direction and that all erosion control measures were working.

Approx 1.5km on the 4000Rd (Before)

Approx 1.5km on the 4000Rd (After)

Large Catch Basin above creek (Befor)

Large Catch Basin above creek (After)

Water Bar and Ditch block (Befor)

Replaced Ditch Block that worked well during excessive rain as you can see the high water mark were water was filtered (After)

APPENDIX 2

Aley Project 2015 Knight Piesold Site Visit Summary

MEMORANDUM

To:	Mr. Tom Broddy	Date:	December 23, 2015
Copy To:	Jessica Mackie, Ben Green	File No.:	VA101-314/20-A.01
From:	Ben Green	Cont. No.:	VA15-03064
Re:	Aley Project Environmental Field Program – July 8 to July 11, 2015		

Introduction

This memorandum summarizes the fieldwork tasks that were undertaken during the visit to the Aley Project site by Dan Maddalena of Knight Piesold Ltd. (KP) from July 8 to July 11, 2015. The objectives of KP's site visit are summarized below:

- Download data from the meteorological station and perform necessary maintenance.
- Reform current meter stage discharge measurements at the three hydrology stations (H3, H5, and H7).
- Download the water level transducer data at all monitoring wells.
- Download the vibrating wire piezometer data and replace the batteries.
- Water sampling and maintenance for the on-site geochemistry waste rock barrels.

A quality assurance and quality control (QA/QC) review was completed on all field data prior to being uploaded to KP's web-based data management system, FULCRUM. This uploaded data should be used to supplement the information included in this memo, should further resolution be required.

The helicopter pilot during the site visit was Monica of Yellowhead Helicopters. Dan was assisted by a bear guard (Jarl) and First Nations assistant (Stephan).

Meteorological Station

The project's meteorological station was visited on July 10, 2015. The station was inspected and determined to be in working condition. The station's mast was lowered and data verification was completed on the instruments to check their condition (see photos 1 to 4, Attachment 1). The data from the station's datalogger was downloaded, checked and then re-initialized by a program re-set. The contents of the Pluvio2 precipitation gauge were emptied and a mixture of methanol/propylene glycol was added to the collection bucket to prevent freezing during the winter.

Upon review of the meteorological data, it was confirmed by Campbell Scientific that the 12V deep cell battery at the station had been damaged (possibly by a lightning strike) and was not able to sufficiently recharge through the solar panel during the winter months when the solar panel is often covered by snow. Typically, when a 12 V deep cell battery is connected to a solar panel, it will function for many years without interruption. KP recommends its replacement be a high priority as continuous climate data collection will not be possible during winter with the existing battery.

Hydrology Stations

Low flow discharge measurements were conducted at three hydrology stations on July 9, 2015. Descriptions and observations of each site visit are provided below:

Station H3 (photos 5 to 8, Attachment 1):

Station H3 is located on Steve Creek upstream of the mineral deposit. Two area-velocity discharge measurements were completed. The water level transducer was inspected to ensure the winterization equipment was in good condition. The datalogger was downloaded and the battery and solar panel were inspected for damage. No maintenance was required after the inspection.

Station H5 (photos 9 and 10, Attachment 1):

Station H5 is located on Steve Creek downstream of confluence with Al Creek. Two area-velocity discharge measurements were completed. The water level transducer was inspected to ensure winterization equipment was in good condition. The battery box for the neon system had become unfastened from the tree causing the wires to be pulled out of the neon logger box. The battery box was fastened back to the tree and the cables were re-secured inside the neon logger box. The data from September 2015 was downloaded from the logger.

Station H7 (photos 11 and to 12, Attachment 1):

Station H7 is located on Steve Creek upstream of the Skoki formation. The station was damaged by an animal and the pressure transducer had been removed from the site. A replacement pressure transducer should be installed during the next site visit. All data from the data logger were downloaded and two area-velocity discharge measurements were completed.

Groundwater Level and Transducer Download

The monitoring well sites that were visited are summarized in the table below.

Well	Date	Water Level Measured	Download Water Level Transducer	Comments
MW11-05 D	2015/07/08	Yes	Yes	
MW11-05S	2015/07/08	Yes	Yes	
MW11-04S	2015/07/08	Yes	Yes	
MW11-04D	2015/07/08	Yes	Yes	
MW11-01A	2015/07/08	Yes	Yes	
MW11-01B	2015/07/08	No	No	Artesian plug ceased in well
MW11-02A	2015/07/09	No	No	Artesian plug ceased in well
MW11-02B	2015/07/09	No	No	Artesian plug ceased in well
MW12-08D	2015/07/09	Yes	Yes	
MW12-08S	2015/07/09	Yes	Yes	
MW12-07S	2015/07/09	Yes	Yes	
MW12-7D	2015/07/09	Yes	Yes	
MW11-03D	2015/07/09	Yes	Yes	
MW11-03S	2015/07/09	Yes	Yes	
MW11-06	2015/07/10	Yes	Yes	

The water level data have been added to the summary water level plots attached to this memo.

Geochemistry Barrel Sampling

All five ARD barrels were sampled on July 10, 2015. Samples were successfully filtered, preserved, and sent to ALS and SRC laboratories for analysis. The collection buckets were inspected for damage and any debris inside the barrels was removed (photos 11 and 12, Attachment 1). *In situ* and analytical results of these samples were provided to SRK Consulting for analysis.

Vibrating Wire Piezometers

The data from the vibrating wire piezometers was not downloaded due to accessibility issues and incorrect site coordinates. The water level plots for these monitoring drill holes were not updated.

Conclusions and Recommendations

The following objectives were completed during the July 2015 site visit:

- Data download and maintenance at the meteorological station.
- Flow measurements, data download, and maintenance at the hydrology stations.
- Data download at the groundwater monitoring wells.
- Sampling of all geochemistry waste rock barrels and maintenance.

KP Recommends the following tasks for the next site visit in 2016:

- Replace damaged 12V deep cell battery from meteorological station and re-initialize logger program after battery replacement.
- Drill drain holes in geochemistry water collection buckets to prevent water backing up into the tubing in buckets BT-01 and BT-05.
- Re-install pressure transducer at hydrology station H7.
- Re-initiate the use of satellite telemetry at the ALEY metrological station to remotely monitor the functionality of the station. An upgrade may be required to the telemetry on the station to better accommodate the communication.
- Provide additional protection for the wires on the dataloggers to prevent damage from animals.

We trust that this memo meets your current needs and expectations. Please do not hesitate to contact the undersigned should you have any questions or concerns.

Prepared: _____
For: Ben Green, MSc., P.Geo. – Senior Hydrogeologist

Reviewed: _____
For: Jessica Mackie, EP – Senior Environmental Scientist

Approval that this document adheres to Knight Piésold Quality Systems: [ ]

Attachments:
Attachment 1 – Photo Report
Attachment 2 – Groundwater Level Plots

PHOTO 1 ALEY Climate Station, July 2015

PHOTO 2 ALEY Climate Station - Rain Gauge Before Winterization, July 2015

PHOTO 3 ALEY Climate Station sensor verification, July 2015

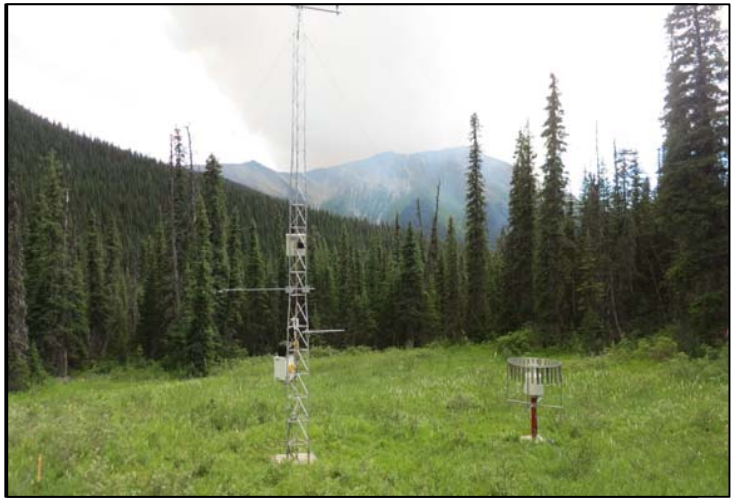


PHOTO 4 ALEY Climate Station looking southwest, July 2015

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VA101-00314/20
VA15-03064
September 1, 2015

PHOTO 5 H3 - Hydrology Site, July 2015

PHOTO 6 H3 - Hydrology Site, July 2015

PHOTO 7 H3 - Hydrology Site, July 2015

PHOTO 8 H3 - Hydrology Site, July 2015

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PHOTO 9 H5 Hydrology Site - Animal damage, July 2015

PHOTO 10 H5 Hydrology Site, July 2015

PHOTO 11 H7 - Hydrology Site - Animal damage, July 2015

PHOTO 12 H7 - Hydrology Site - stage discharge measurement, July 2015

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PHOTO 9 Monitoring well MW11-04, July 2015

PHOTO 10 Monitoring well MW11-05, July 2015

PHOTO 11 Geochemistry barrel (BT-01), July 2015

PHOTO 12 Geochemistry barrels, July 2015

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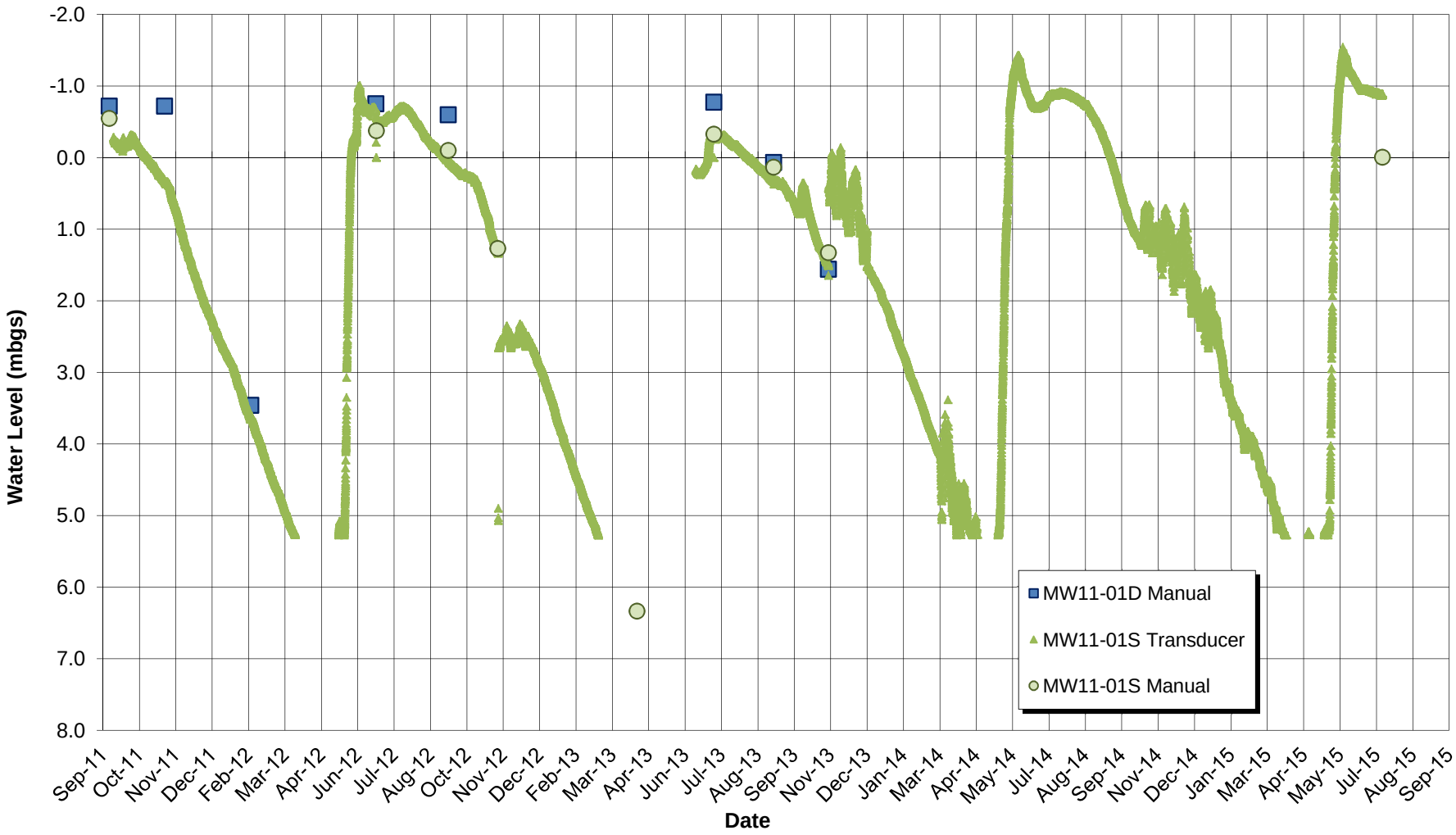

NOTES:

1. GROUND ELEVATION IS 1447 masl (BASED ON HAND HELD GPS).
2. MW11-01D SCREENED INTERVAL FROM 13.3 TO 17.4 mbgs.
3. MW11-01S SCREENED INTERVAL FROM 3.1 TO 6.1 mbgs.
4. MANUAL WATER LEVEL MEASUREMENTS NOT TAKEN AT MW11-01S ON FEBRUARY 10, 2012 AND AT MW11-01D ON NOVEMBER 8, 2012 AND APRIL 10, 2013 BECAUSE THE WEL WAS FROZEN.
5. MW11-01S WATER LEVEL DECREASED BELOW INSTALLATION DEPTH OF TRANSDUCER (5.35 mbgs) FROM MARCH 26, 2012 TO MAY 19, 2012 AND FEBRUARY 23, 2013 TO JUNE 13, 2013.
6. WATER LEVELS AT MW11-01S WERE NOT RECORDED FROM NOVEMBER 7, 2012 TO JUNE 10, 2013 AS A RESULT OF TRANSDUCER ERROR.
7. MW11-01D MANUAL MEASUREMENTS RECORDED AS FLOWING ARTESIAN BUT ACTUAL ARTESIAN PRESSURE NOT MEASURED ON SEPTEMBER 7, 2011; NOVEMBER 7, 2011; JUNE 27, 2012; AND JULY 3, 2013. FLOWING ARTESIAN MEASUREMENTS PLOTTED AS TOP OF STICK UP (0.78 mags).

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	22DEC`15	ISSUED WITH VA15-03064	JMQ	MBG

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MW11-01D/S
WATER LEVELS

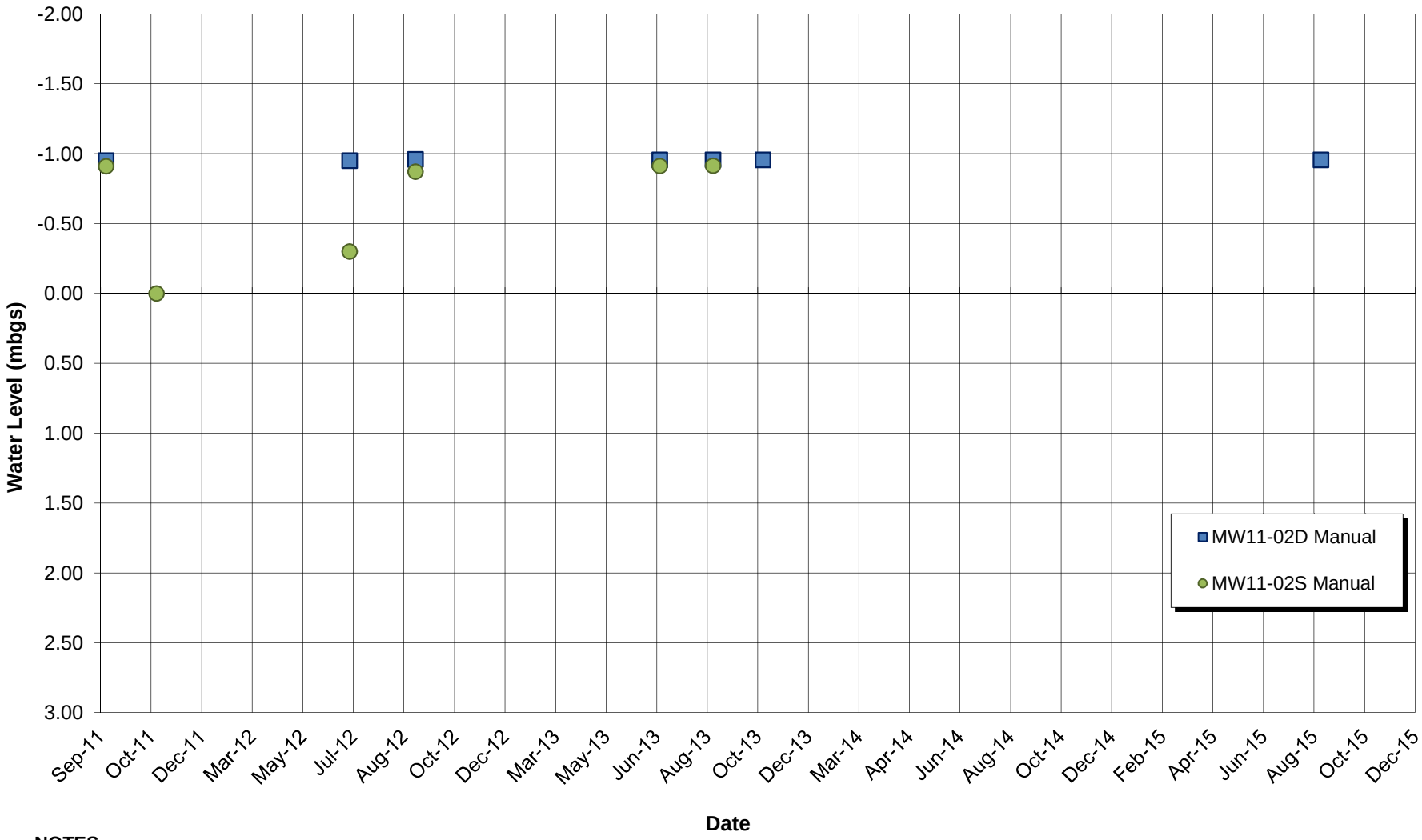
Knight Piésold CONSULTING

P/A NO. VA101-314/20

REF. NO. VA15-03064

FIGURE 1

REV A



NOTES:

1. GROUND ELEVATION IS 1405 masl (BASED ON HAND HELD GPS).
2. MW11-02D SCREENED INTERVAL FROM 28.4 TO 31.4 mbgs.
3. MW11-02S SCREENED INTERVAL FROM 10.4 TO 13.5 mbgs.
4. MW11-02D/S MANUAL MEASUREMENTS RECORDED AS FLOWING ARTESIAN BUT ACTUAL ARTESIAN PRESSURE NOT MEASURED. FLOWING ARTESIAN MEASUREMENTS PLOTTED AS TOP OF STICK UP (0.96 mags AND 0.91 mags RESPECTIVELY).

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	23DEC`15	ISSUED WITH VA15-03064	JMQ	MBG

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MW11-02D/S
WATER LEVELS

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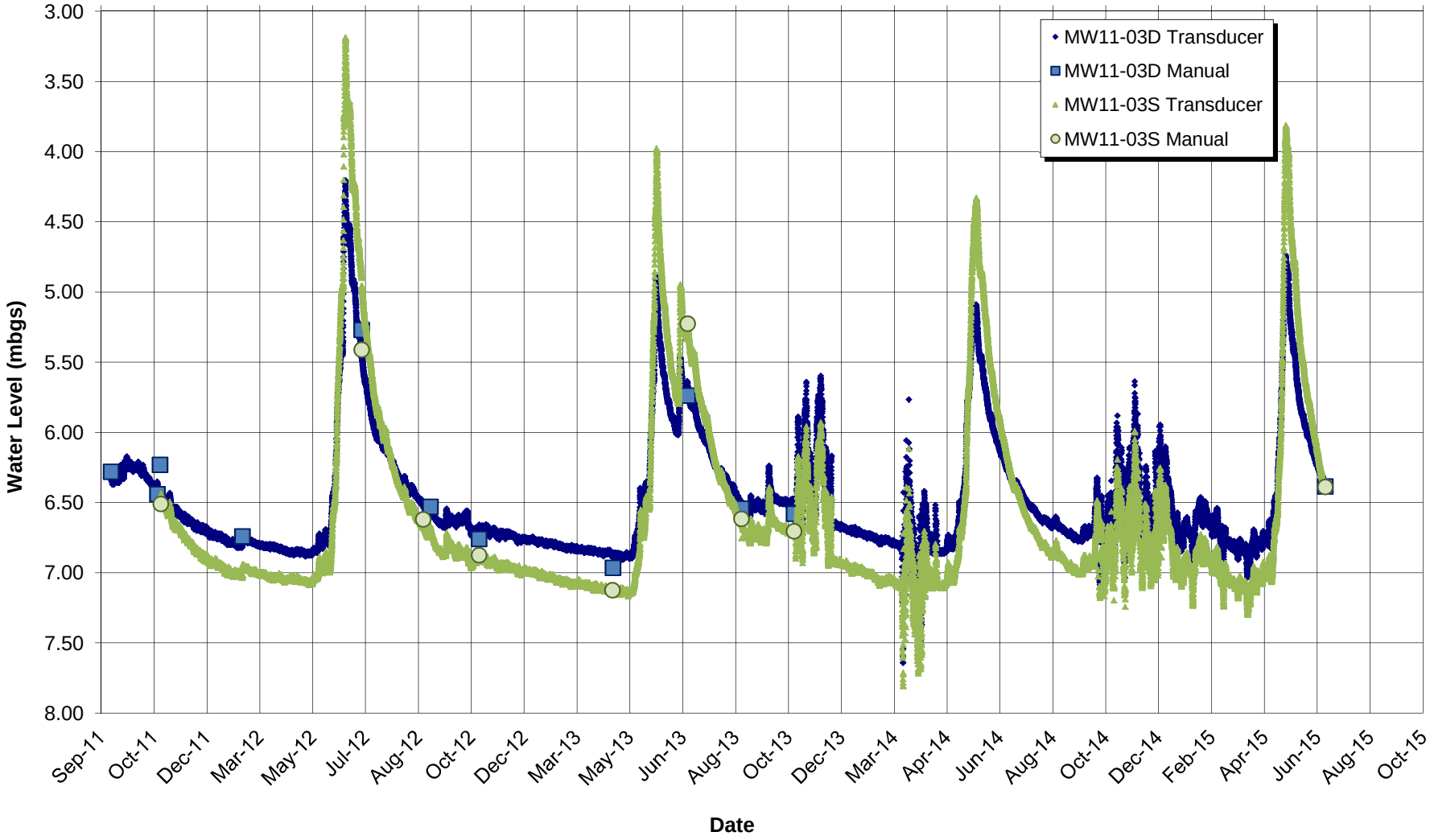
P/A NO. VA101-314/20

REF. NO. VA15-03064

FIGURE 2

REV A



NOTES:

1. GROUND ELEVATION IS 1363 masl (BASED ON HAND HELD GPS).
2. MW11-03D SCREENED INTERVAL FROM 29.9 TO 32.9 mbgs.
3. MW11-03S SCREENED INTERVAL FROM 8.2 TO 11.3 mbgs.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	22DEC'15	ISSUED WITH VA15-03064	JMQ	BMG

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ALEY PROJECT

MW11-03D/S
WATER LEVELS

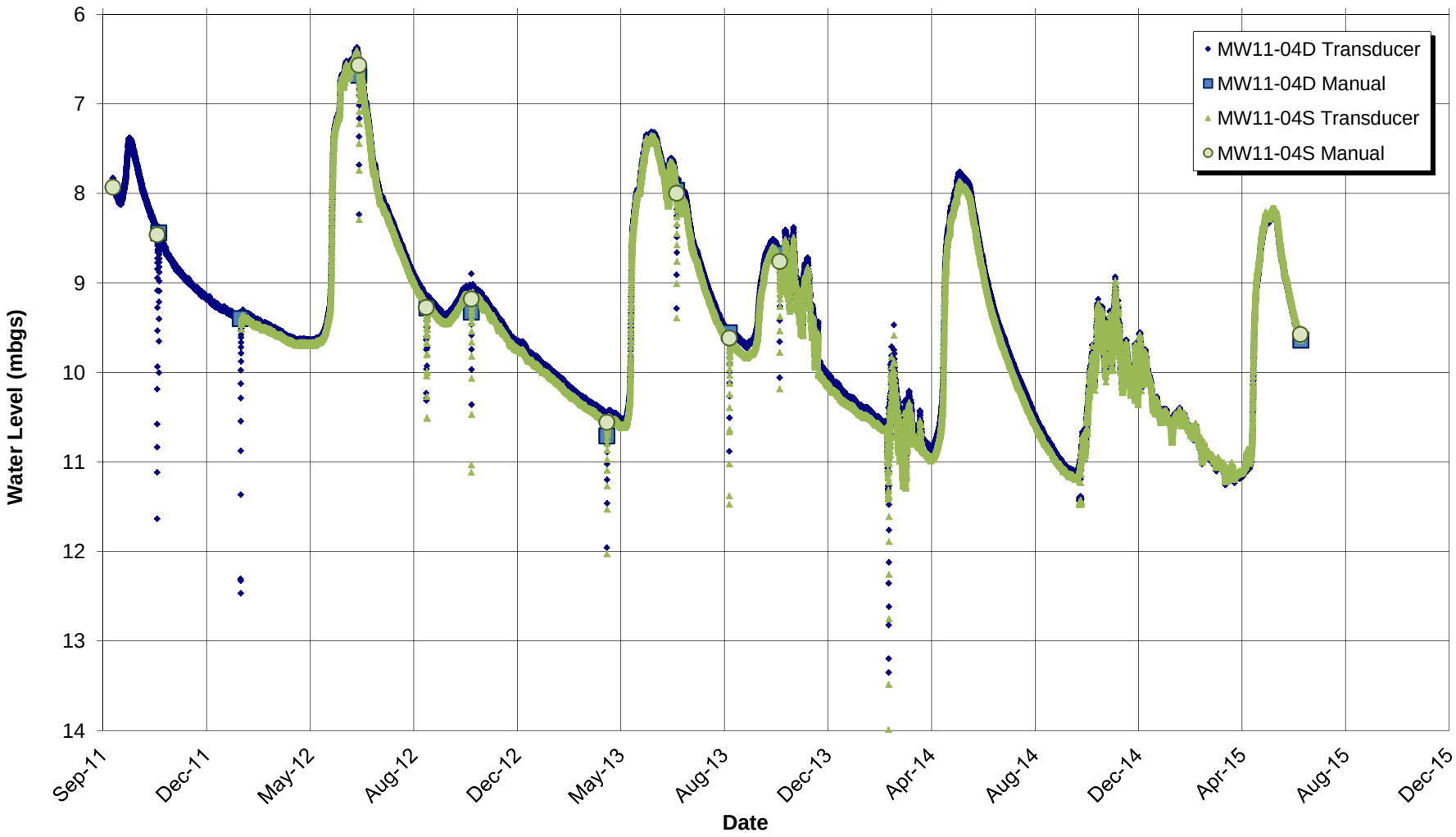
Knight Piésold CONSULTING

P/A NO. VA101-314/20

REF. NO. VA15-03064

FIGURE 3

REV A



NOTES:

1. GROUND ELEVATION IS 1625 masl (BASED ON HAND HELD GPS).
2. MW11-04D SCREENED INTERVAL FROM 22.6 TO 25.6 mbgs and MW11-04S SCREENED INTERVAL FROM 16.8 TO 19.8 mbgs.
3. MW11-04D MANUAL WATER LEVEL MEASUREMENTS ON NOVEMBER 6, 2012 AND APRIL 14, 2013 WERE OBTAINED DURING SAMPLING (PURGING) OF MW11-04S, WHICH MAY HAVE AFFECTED THE WATER LEVEL AT MW11-04D.
4. NOISE IN DATA ON NOVEMBER 3, 2011; FEBRUARY 9, 2012; JUNE 27, 2012; SEPTEMBER 12, 2012; NOVEMBER 6, 2012; APRIL 14, 2013; JULY 5, 2013; SEPTEMBER 5, 2013; AND NOVEMBER 3, 2013; MARCH 11, 2014 IS RECOVERY FROM GROUNDWATER SAMPLING AT SITE.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	22DEC'15	ISSUED WITH VA15-03064	JMQ	MBG

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ALEY PROJECT

MW11-04D/S
WATER LEVELS

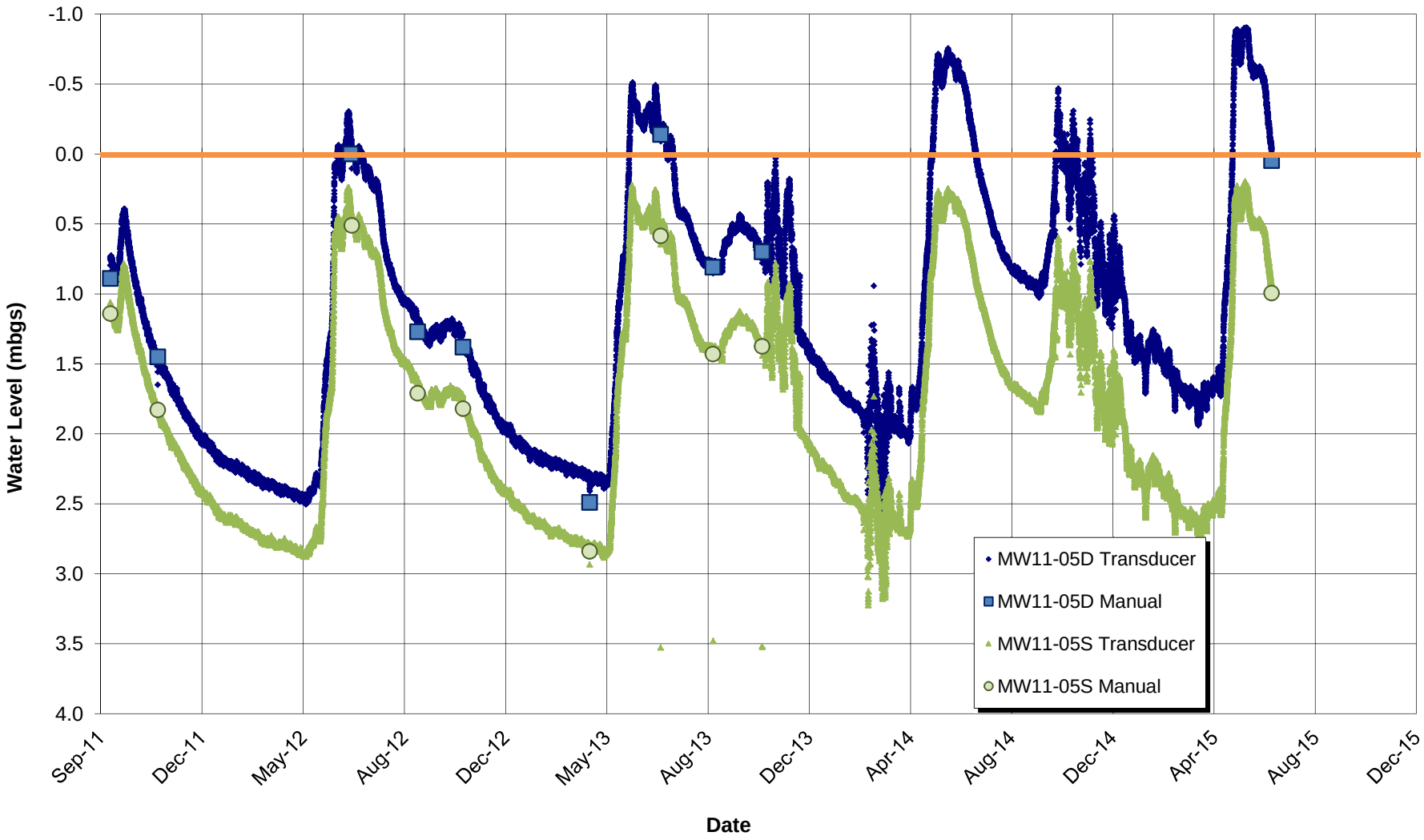
Knight Piésold CONSULTING

P/A NO. VA101-314/20

REF. NO. VA15-03064

FIGURE 4

REV A



NOTES:

1. GROUND ELEVATION IS 1636 masl (BASED ON HAND HELD GPS).
2. MW11-05D SCREENED INTERVAL FROM 35.6 TO 38.7 mbgs.
3. MW11-05S SCREENED INTERVAL FROM 7.9 TO 10.9 mbgs.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	22DEC'15	ISSUED WITH VA15-03064	JAS	MBG

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MW11-05D/S
WATER LEVELS

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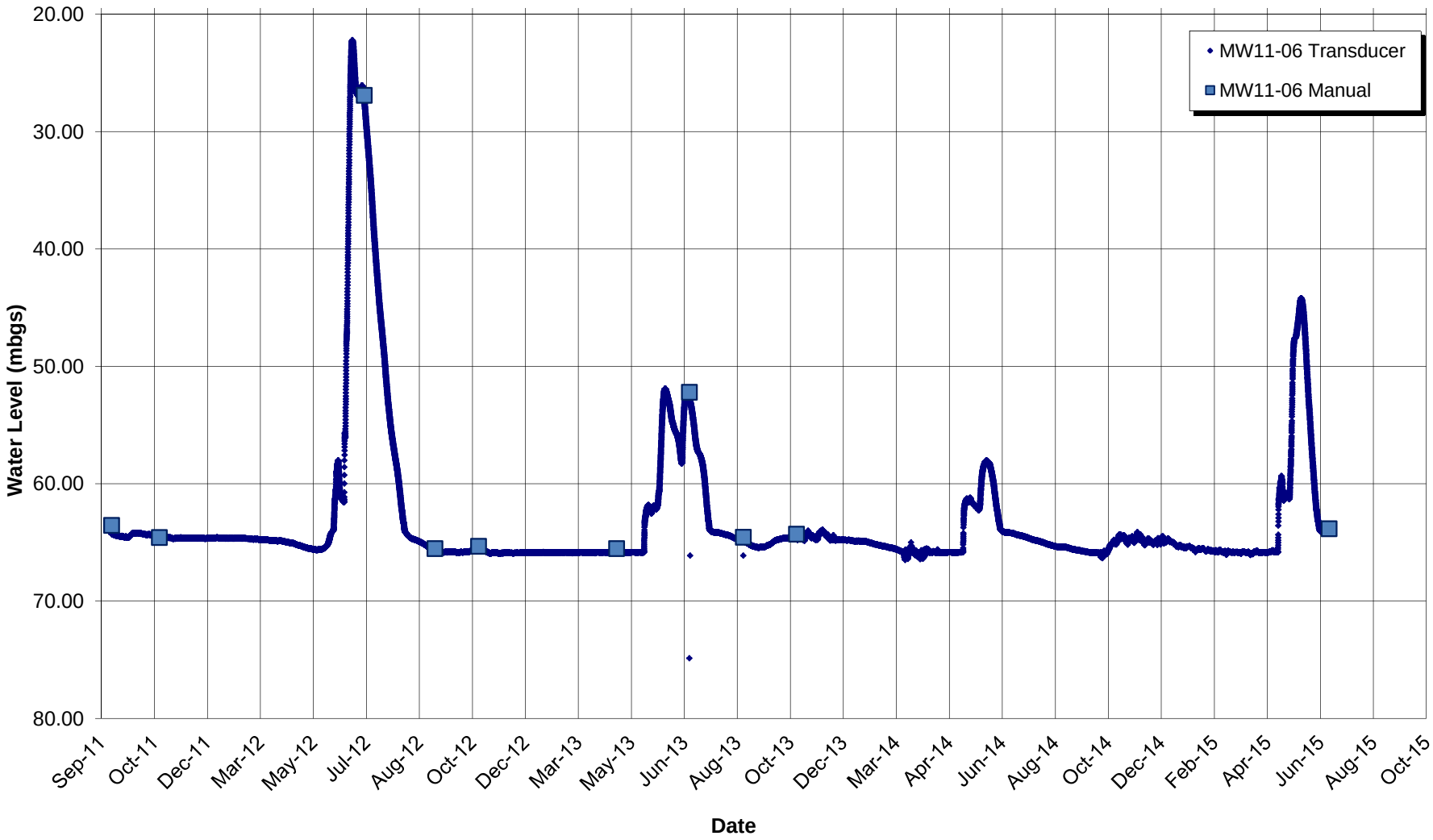
P/A NO. VA101-314/20

REF. NO. VA15-03064

FIGURE 5

REV A



NOTES:
1. GROUND ELEVATION IS 1435 masl (BASED ON HAND HELD GPS).
2. SCREENED INTERVAL FROM 63.8 TO 72.4 mbgs.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	22DEC'15	ISSUED WITH VA15-03064	JMQ	MBG

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ALEY PROJECT

MW11-06
WATER LEVELS

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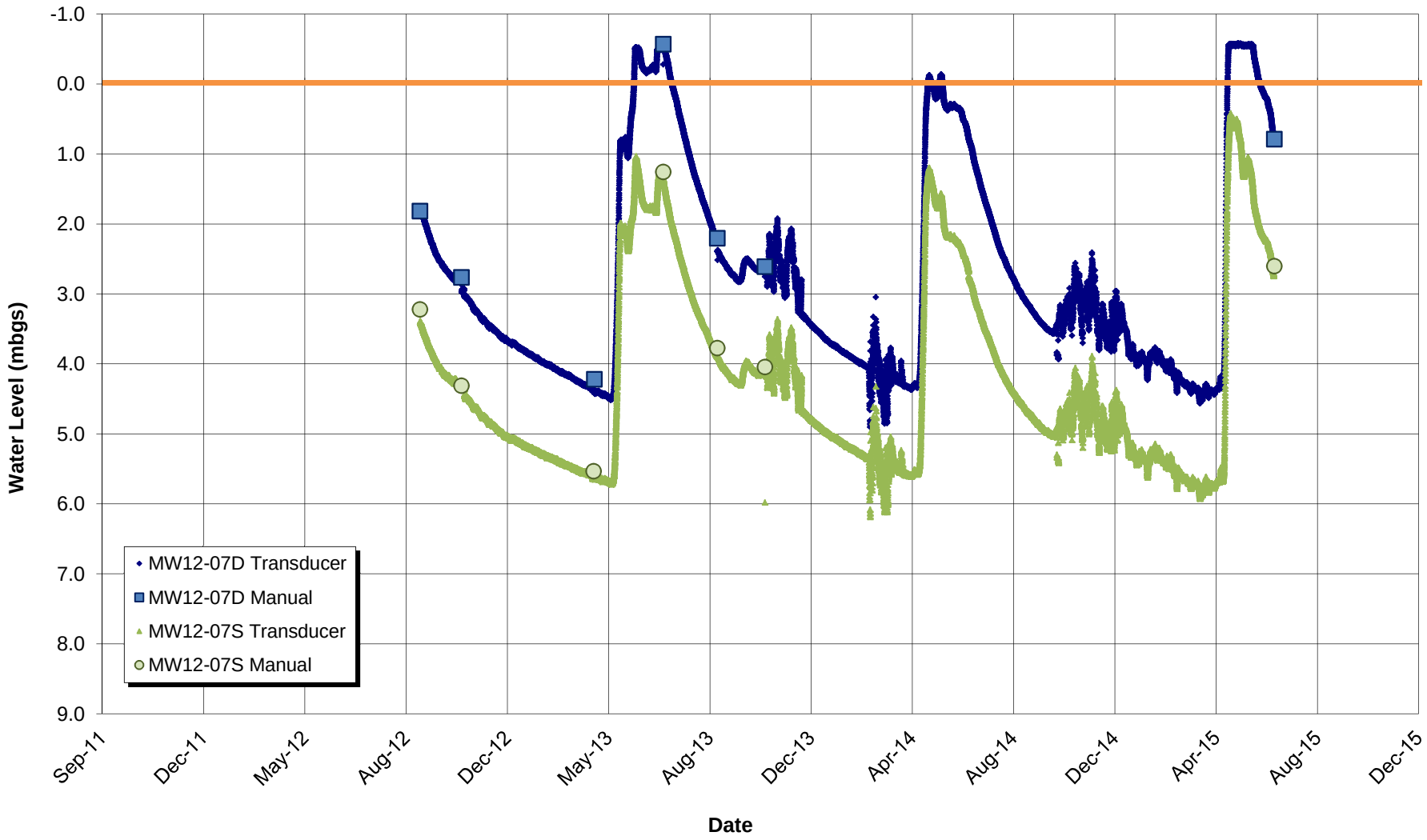
P/A NO. VA101-314/20

REF. NO. VA15-03064

FIGURE 6

REV A



NOTES:

1. GROUND ELEVATION IS 1290 masl (BASED ON HAND HELD GPS).
2. MW12-07D SCREENED INTERVAL FROM 27.5 TO 30.6 mbgs.
3. MW12-07S SCREENED INTERVAL FROM 14.9 TO 18 mbgs.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	22DEC15	ISSUED WITH VA15-03064	JMQ	MBG

ALEY CORPORATION

ALEY PROJECT

MW12-07D/S
WATER LEVELS

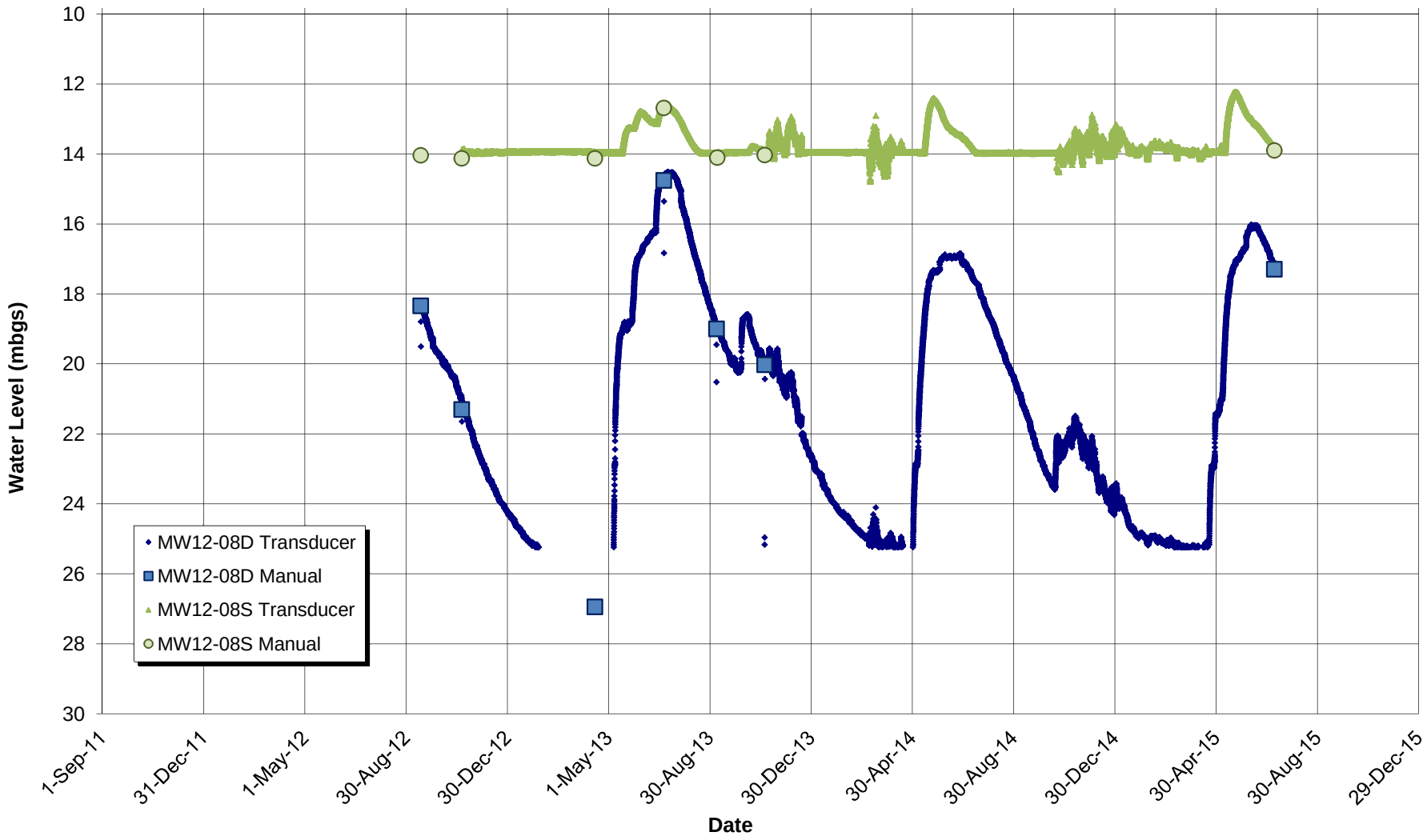
Knight Piésold CONSULTING

P/A NO. VA101-314/20

REF. NO. VA15-03064

FIGURE 7

REV A



NOTES:

1. GROUND ELEVATION IS 1340 masl (BASED ON HAND HELD GPS).
2. MW12-08D SCREENED INTERVAL FROM 33.5 TO 36.6 mbgs.
3. MW12-08S SCREENED INTERVAL FROM 11.6 TO 14.6 mbgs.
4. WATER LEVEL AT MW12-08D DECREASED BELOW INSTALLATION DEPTH OF TRANSDUCER (25.39 mbgs) FROM FEBRUARY 2, 2013 TO MAY 4, 2013.
5. TRANSDUCER DATA AT MW12-08S INDICATES THAT WELL IS DRY FROM NOVEMBER 5, 2012 TO MAY 17, 2013 AND FROM AUGUST 10, 2013 TO OCTOBER 16, 2013.

REV	DATE	DESCRIPTION	PREP'D	RVW'D
A	22DEC`15	ISSUED WITH VA15-03064	JAS	MBG

ALEY CORPORATION

ALEY PROJECT

MW12-08D/S
WATER LEVELS

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P/A NO. VA101-314/20

REF. NO. VA15-03064

FIGURE 8

REV A

APPENDIX 3

XPS 2015 Reports Redacted

XPS Consulting & Testwork Services

Memo

Issued to:	*Julia Gartley*
Copy to:	*Mika Muinonen*
From:	*Arthur Barnes*
Issued On:	26 February 2015
Project Name:	*Taseko FeNb conversion*
Project Code:	*3014815.00*
Subject	***Results of Latest Conversion Test***

1. Summary

The most recent conversion test on a small amount of calcined Taseko concentrate yielded an excellent button and a very well fused slag compared to previous runs. A Niton portable XRF reported the grade of the metal button as 63.7% Nb; and 32.7% Fe, with 0.63% Zr. Based on the assumed grade the recovery of Nb exceeded 91%. Prior to crushing the slag for chemical analysis XPS recommended examination of the slag using a scanning electron microscope (SEM) to identify whether the residual Nb was (a) dissolved in the slag, (b) entrained as metal prills or (c) remained as unreacted feed, as this would provide useful information going forward.

The microscopic examination confirmed that the slag itself is niobium free and that niobium not reporting to the metal button is in the form of partially reacted feed material and some very small prills close to the crucible walls. The largest prill identified was 400 micron in diameter representing a mass of approximately 0.3mg. Other prills were much smaller. The EXD point assays on the prill reported similar Nb grades as the Niton on the button.

Clearly the additional preheating has resulted in a far more fluid slag, and the images show well formed crystals of pure corundum (Al_2O_3) confirming that temperatures in the melt comfortably exceeded 2000°C for the most part.

Both modes of niobium loss would not be significant in a commercial operation. The current method of crucible preheating and the use of MgO crucibles will be continued.

2. Images

A portion of slag about 12 mm long, with a fracture face almost perpendicular to the button was selected for light polishing to ensure prills were not pulled from the surface. This resulted in some 3-D relief of the surfaces, and some loss of accuracy on the EDX analyses, but did allow retention of the macro structure. Metallic particles show as bright spots, while the darker the phase, the lower the atomic mass of the substance- The first 3 images at minimum magnification (10x) show the sample in its correct orientation relative to the crucible and metal button

Figure 1(a): Left side of slag. The metal button was collected from the area at the bottom of the image, in black. Tiny prills are visible on the extreme left. Figure 1(b): Central portion, overlapping both (a) and (c). A small metal prill can be seen in the lower right.

Figure 1 (c) Right side of slag

These areas were further examined at 54x, 500x and 1000x magnification to resolve small details not visible at lower magnification.

The macro images are however very illustrative of the overall structure, showing the bottom portion to be dense and uniform texture, while the upper zone is porous with many needles. The sides show signs of chilling and rapid solidification.

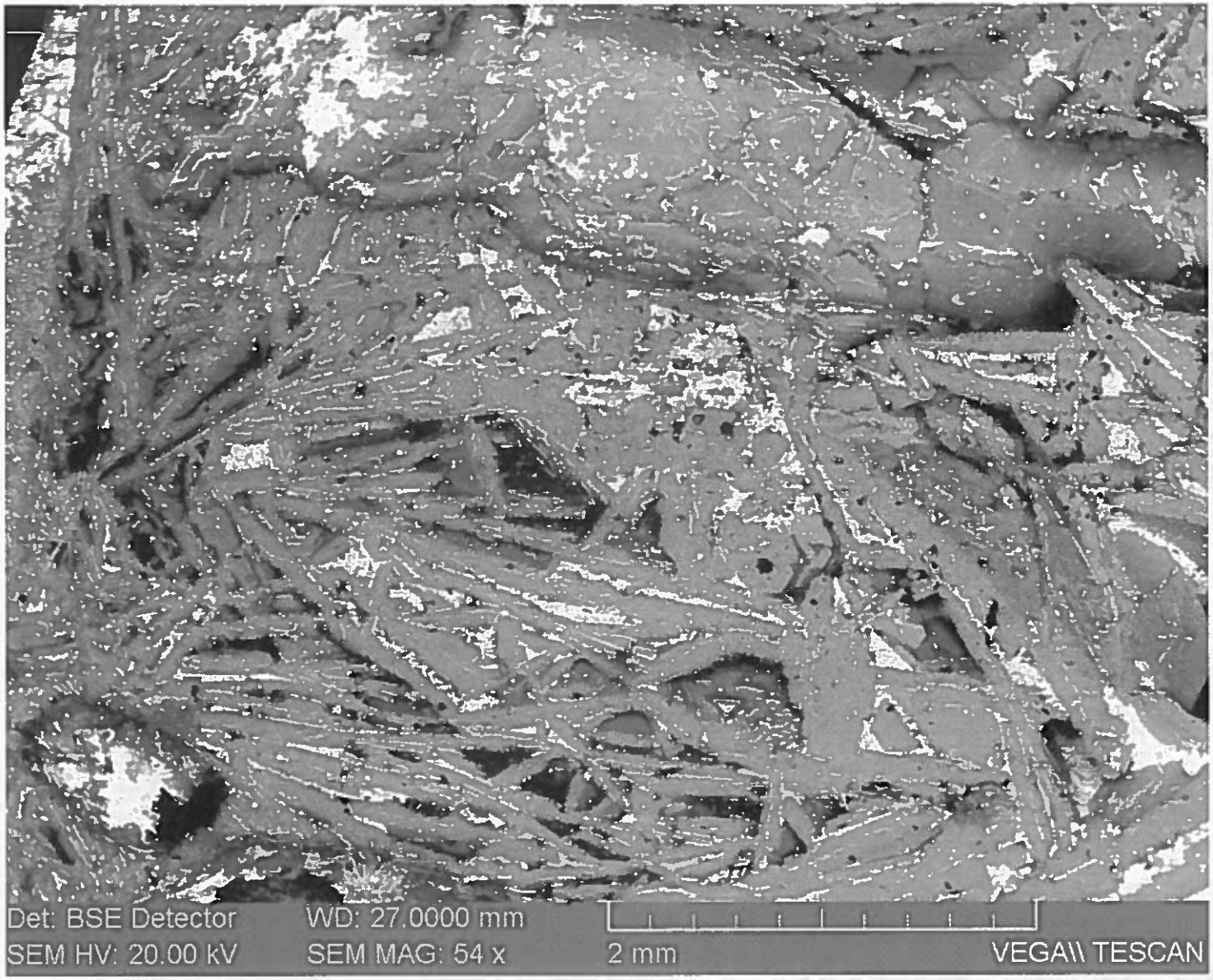


Figure 2: Shows a higher magnification view of the central portion. Note that these images are all rotated approximately 90⁰ to the macro images

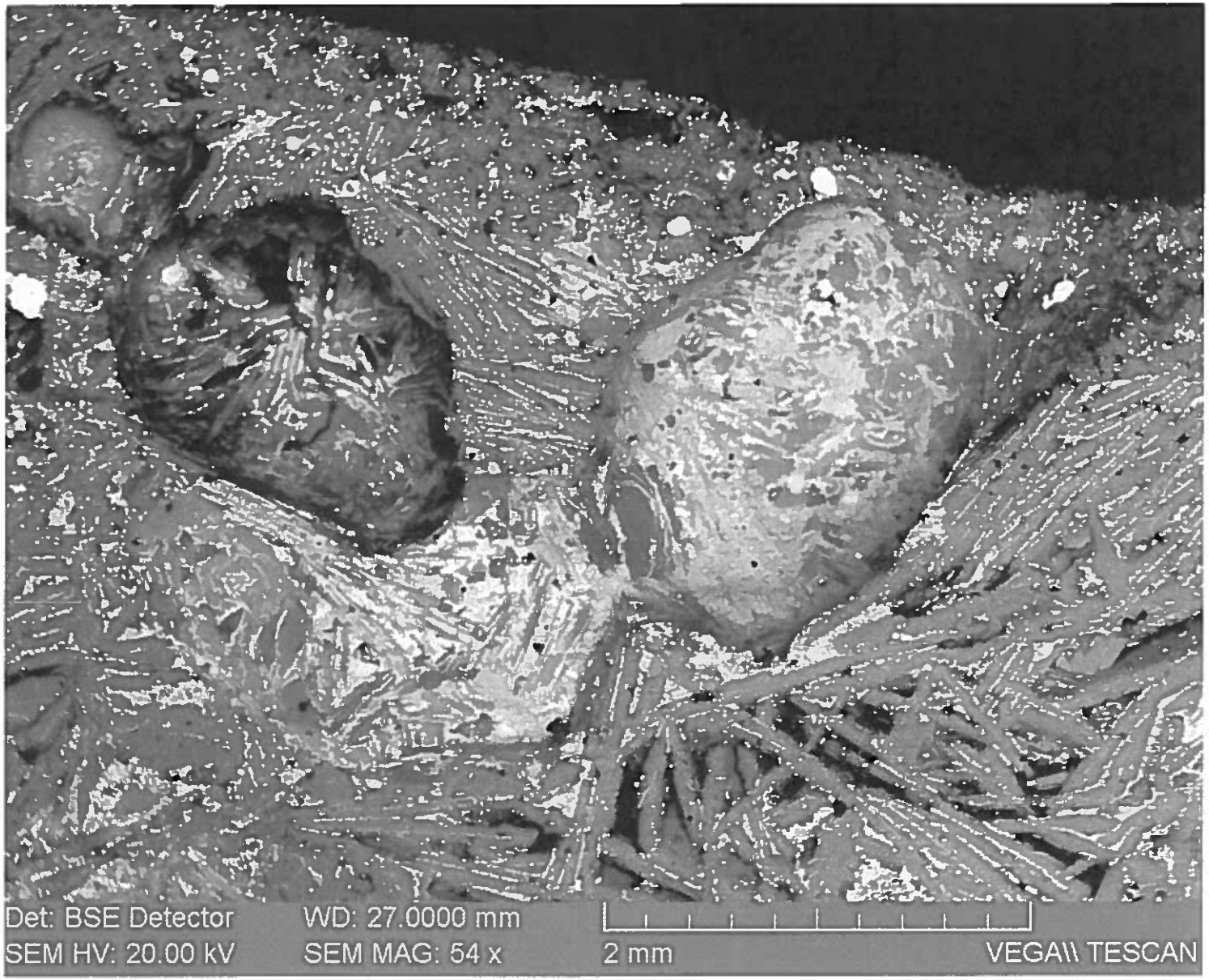


Figure 3: Closer view of side zone (Again rotated relative to the original orientation). The small bright prills in the chill zone are visible.

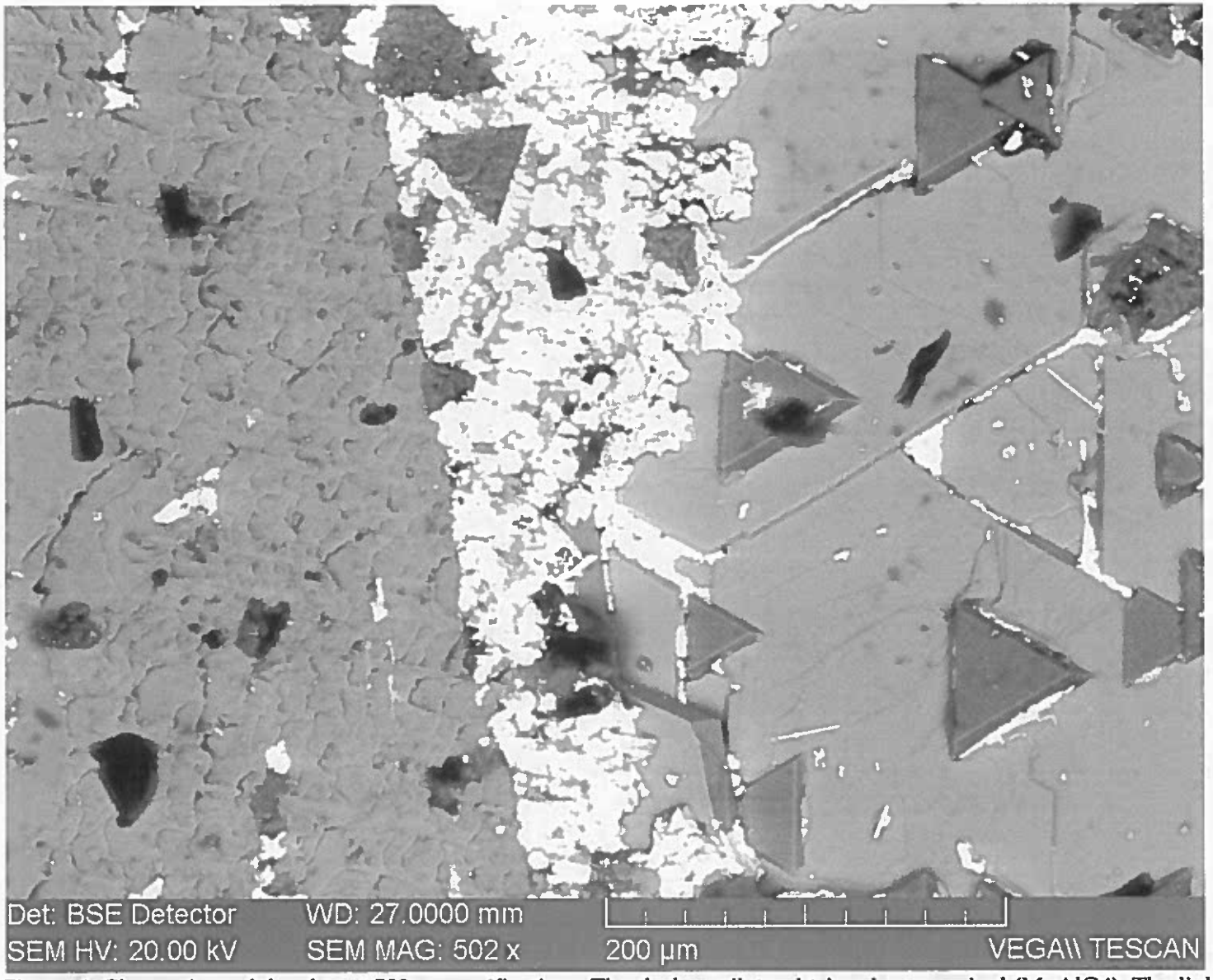


Figure 4: Closer view of the slag at 500x magnification. The dark equilateral triangles are spinel (MgAlO4). The lighter grey prisms are Al2O3. The lighter material in the middle is partially reacted feed material.

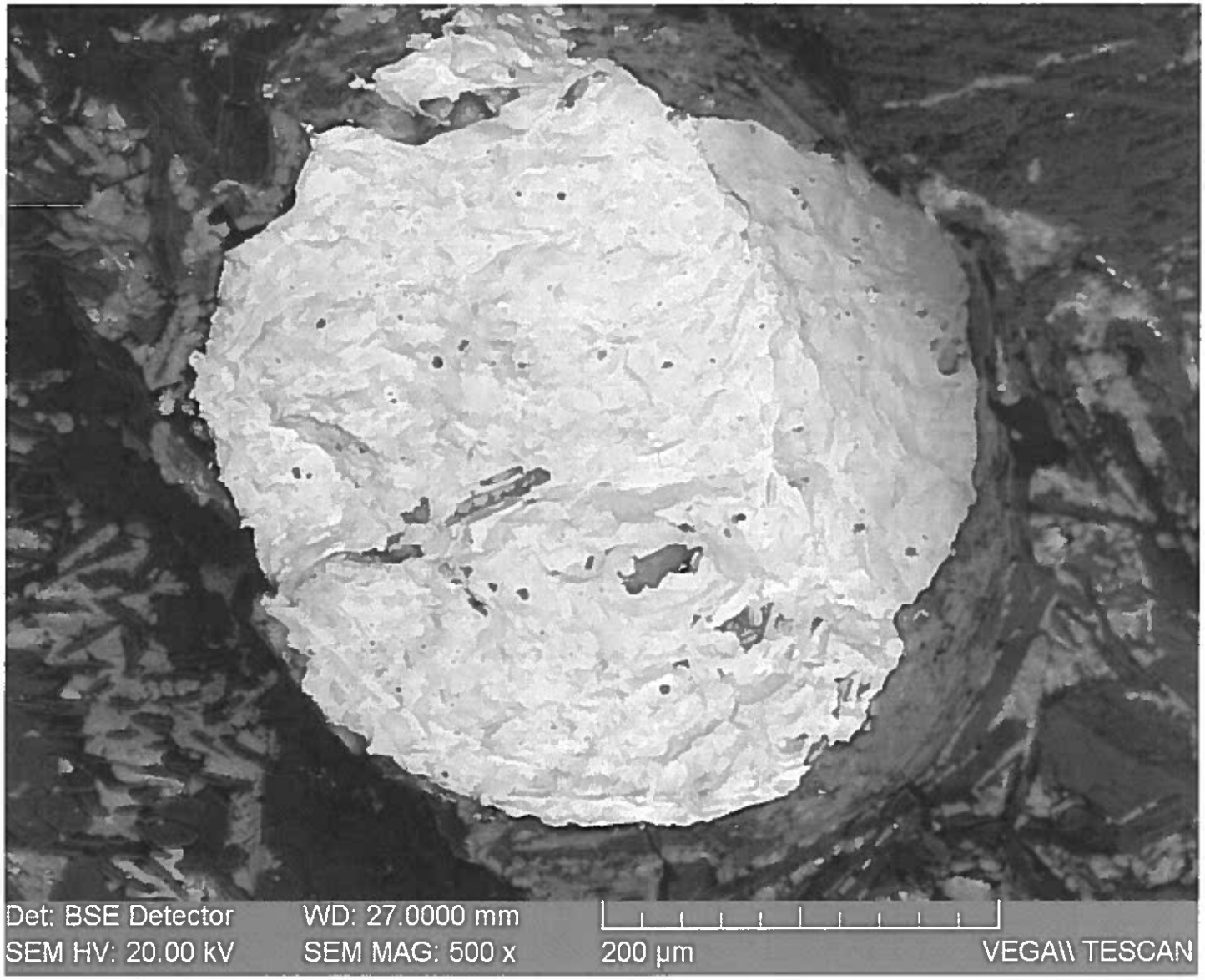


Figure 5: A closer view of the prill.

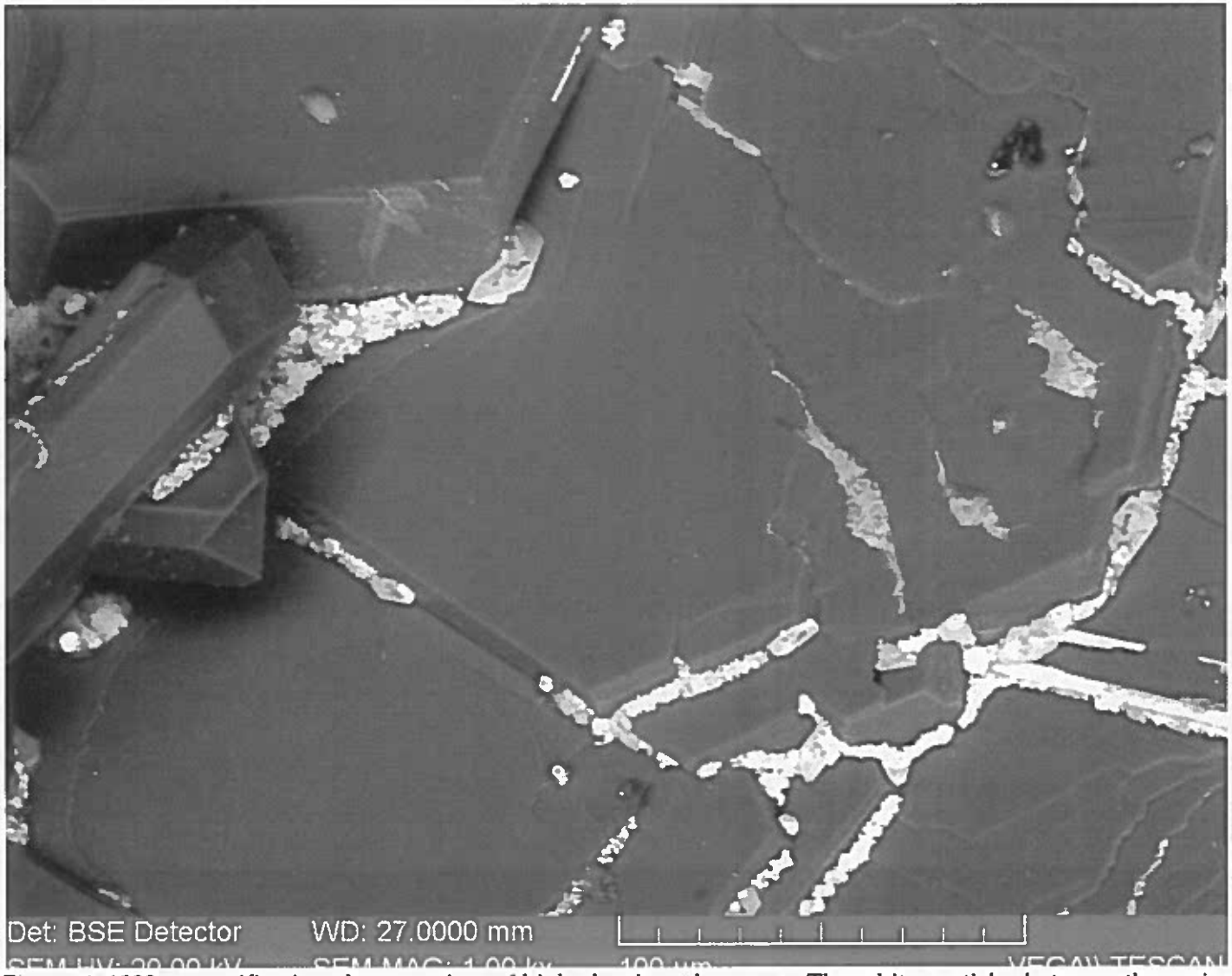
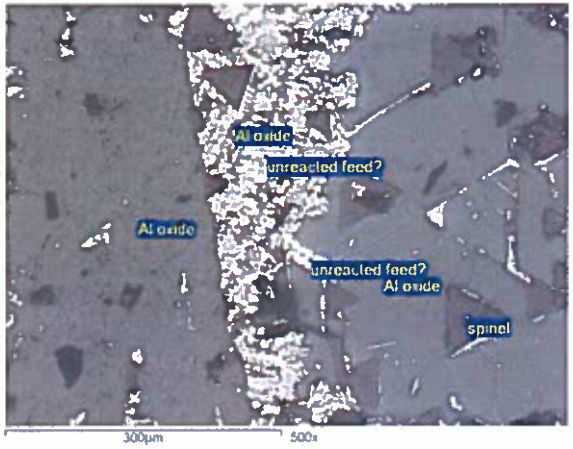


Figure 6: 1000x magnification close up view of high alumina slag zone. The white particles between the grains are partially reacted feed. The darker grey areas are pure corundum.

3. Results

Specific areas were chosen for X-ray analysis using the built in energy-dispersive x-ray analyser built into the Vega Tescan SEM used for this investigation. While the results are not as accurate or as quantitative as would be achieved using the Microprobe, results are quicker and cheaper to obtain, and do not require the extensive polishing needed for quality probe work. Elements below Atomic number 10 are not suited to x-ray analysis. Oxygen values were calculated by the software to obtain a total of 100%,. Results of point probes are tabled below for the relevant images:

Point	O	Mg	Al	Si	Ca	Ti	Zr	Nb
spinel	50.31	14.21	32.78				1.47	0
Alumina	50.47	2.12	36.54		4.54	4.87	1.46	0
Alumina	52.02	1.49	39.83		4.28	2.38		0
Unreacted	44.85	0.41	3.69	1.81	7.25	11.38	14.61	12.32
Unrected	41.06	0.69	3.31	0.53	5.43	18.24	21.92	8.52
Alumina	49.60	2.22	29.2	3.62	6.89	6.51	1.17	0

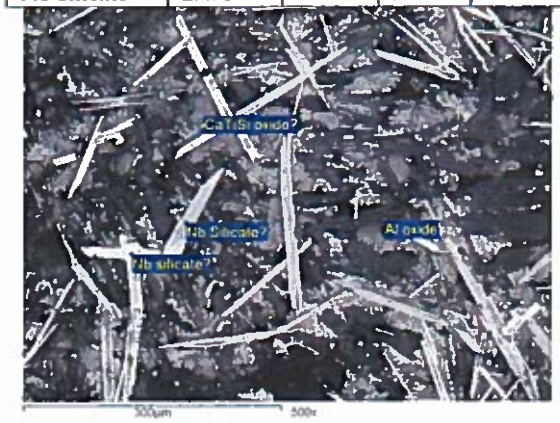


For the prill:

Spectrum	Si	Fe	Ni	Nb
FeNb	4.04	28.45	1.13	66.39
FeNb	6.23	38.06	1.30	54.42

For the needles

Spectrum	O	Mg	Al	Si	Ca	Ti	Fe	Zr	Nb
Al oxide	61.39	3.52	21.15	4.76		9.19			
CaTiSi oxide	47.79	1.16	7.15	1.53	4.39	25.07		8.34	4.56
Nb Silicate	32.63		2.15	6.72	1.58	0.51	1.36		53.30
Nb silicate	29.98		2.40	6.88	1.60	0.88	0.86		55.60



4. Conclusions and Recommendations

The technique allows visual and chemical confirmation of the success of the testwork and eliminates issues related to the physical separation of slag and metal.

Niobium losses are the result of the small scale of the tests and the very rapid cooling occurring with the small melt quantities. The recipes used for the aluminothermic reduction are correct for obtaining the required Nb grade of alloy.

More accurate quantitative information can be obtained by electron probe micro analysis (Microprobe) techniques as originally proposed, with faster turnaround times than are currently achieved through conventional chemical analyses and provide much more precise information.

XPS recommend the use of these techniques in further work

Arthur Barnes
Principal Consultant
Extractive Metallurgy
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+1 705 699 3400 x3483

Memo

Issued to:	Julia Gartley
Copy to:	Mika Muinonen
From:	*Arthur Barnes, Elizabeth Whiteman*
Issued On:	27 March 2015
Project Name:	Taseko, FeNb 2015 Conversion Tests
Project Code:	*3014815.00*
Subject	**QEMSCAN and EPMA Analysis of FeNb Alloy and Slag**

1. Overview/Summary

Difficulties with reconciliation of chemical assays with metal recoveries for converted Aley products led to examination of the metal and slag under the scanning electron microscope (SEM) and a brief report on the value of microscopy. This report recommended taking the study to the next level and combining Quantitative SEM work (QEMSCAN) with electron probe microanalysis (EPMA or "Microprobe") techniques to obtain specific point assays for identified species and a quantitative assessment of the amount of each species to provide a calculated grade and recovery result

A phase and compositional study was completed on the FeNb alloy button and slag generated from the conversion test #2 conducted at XPS recently. This study defined and quantified the phases present in the two components by generating a false coloured phase map of each by QEMSCAN. The compositions of these phases were quantified by EPMA (electron probe microanalysis). The following memo presents the phase compositions, the mass of each present in each component, a calculated assay of elements of interest and both SEM and false colour images.

Based on the micro analysis/ QEMSCAN data combination presented here, the following overall grades and recoveries are calculated: Note that a key assumption made is that the surfaces examined are representative of the macro specimen. Because the full cross section of the alloy and half of the cross section of the slag was examined, this assumption is regarded as being sound.

TABLE 1: Overall Metallurgical results

Species	Total Mass	Nb grade	Nb mass	Nb Recovery
Alloy button	32.4	61.46	19.9	78
Alloy prills	4.55	74.7	3.4	18.8
Slag	58.95	1.7	1.0	3.2
Total	95.9	65.9 (in metal)	25.2	100

The overall Nb recovery (or conversion efficiency) to metal, including the metallic prills is 96.8% at a grade of 65.9% Nb
The recovery to the primary metal button is 78% at a grade of 61.5% Nb

77% of the Nb identified in the slag is in the form of metallics including the 84% Nb grade NbSi alloy prills which alone accounted for almost 40% of the Nb in "slag".

2. EPMA Compositional Analysis

Quantitative compositional analysis was completed using a Cameca SX-100 Electron Microprobe. Electron Probe Micro Analysis (EPMA) produces higher beam currents and increased beam stability, coupled with higher resolution wavelength dispersive spectrometry (WDS). These features allow for improved detection limits and accuracy of the resulting analysis. Peak to background settings and data collection times were chosen to maximise the detection limits.

Resulting detailed compositional data was input into the QEMSCAN software in order to refine the final assay and elemental deportment calculations.

Table 1 shows the compositions of the phases as quantified by EPMA. Metallic phases are named based on the Fe:Nb ratio.

Compositional data shows the main slag phase, Ca Corundum, contains 0.32% Nb in solution. The CaAlTiZrSi phase and the Nb-rich phase are thought to be unreacted feed. These phases were difficult to obtain consistent compositional information and have been grouped with an average composition applied.

Some metallic phases are present in the slag. These phases are consistent with metalics identified in the alloy button. The NbSi alloy was only found in the slag and not in the alloy button. This phase shows some very minor variation in trace element composition depending on the prill size it occurs in and whether there is association with other FeNb phases.

Table 1 EPMA Compositional Data

Slag Phases

Comment	Mg	Al	Si	Ca	Ti	Cr	Fe	Co	Ni	Cu	Zr	Nb	P	O	Total	n=
Nb-rich CaAlTiZr	0.48	2.32	0.75	8.41	15.44	-0.02	-0.01	-0.03	-0.01	-0.04	16.44	12.49	-0.05	25.82	82.02	7
CaAlTiZrSi	1.58	6.50	0.22	3.24	32.83	0.10	0.00	-0.02	0.01	-0.02	14.60	4.44	-0.02	36.59	100.05	5
Ca Corundum	1.06	41.24	0.16	5.13	2.77	-0.05	0.00	-0.01	0.00	0.00	0.88	0.32	0.00	41.88	93.38	20
AlMg Spinel	15.47	36.91	0.02	0.04	2.05	0.04	0.01	-0.01	0.01	0.00	0.03	0.02	0.00	44.46	99.04	6
Detection Limit (%)	*0.022*	*0.030*	*0.034*	*0.019*	*0.022*	*0.024*	*0.043*	*0.046*	*0.047*	*0.058*	*0.093*	*0.084*	*0.041*			

	Si	S	Cr	Fe	Co	Ni	Cu	Zr	Nb	P	Ti	Total	n=
FeNb0.1	7.47	0.00	0.04	9.06	0.03	0.43	0.01	-0.10	84.12	0.49	0.01	101.55	5
FeNb0.3-0.4	3.50	0.00	0.19	26.96	0.06	0.76	0.07	-0.10	68.58	0.07	0.03	100.12	19
FeNb0.7-1.0	5.61	0.00	0.40	40.39	0.10	0.64	0.04	-0.09	53.75	0.00	0.00	100.85	2
NbSi Small Prills	12.44	0.00	0.04	3.15	-0.01	0.02	0.00	-0.12	84.98	-0.01	0.03	100.53	8
NbSi Big Prill	12.28	0.00	0.03	3.78	0.01	0.15	0.00	-0.12	84.05	0.25	0.01	100.44	5
Detection Limit (%)	*0.027*	*0.003*	*0.027*	*0.056*	*0.059*	*0.063*	*0.076*	*0.058*	*0.080*	*0.047*	*0.026*		

FeNb Alloy Phases

	Si	S	Cr	Fe	Co	Ni	Cu	Zr	Nb	P	Ti	Total	n=
FeNb0.1	5.21	0.00	0.01	8.48	0.03	0.66	0.02	-0.07	83.33	2.19	0.32	100.18	14
FeNb0.3-0.4	3.70	0.00	0.07	23.31	0.07	1.02	0.06	-0.08	70.42	0.94	0.42	99.93	22
FeNb0.7-1.0	5.96	0.00	0.19	41.56	0.12	0.92	0.03	-0.08	51.14	0.04	0.27	100.15	20
FeNb0.5-0.6	2.57	0.00	0.10	31.36	0.09	1.55	0.13	-0.10	63.22	0.09	0.62	99.65	19
Detection Limit (%)	*0.028*	*0.000*	*0.026*	*0.056*	*0.058*	*0.062*	*0.076*	*0.059*	*0.081*	*0.046*	*0.025*		

Values highlighted in grey are below the detection limit; oxygen is a calculated value; n= indicates number of analysis points

3. QEMSCAN Analysis

QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy) is an automated system that produces particle maps (colour coded by mineral) through the collection of rapidly acquired X-rays. The maps and corresponding data files quantify the modal mineralogy, texture, grain size, elemental deportment and liberation of samples analysed. IN this case, the slag and alloy components were analysed by the Field Image measurement mode with a measurement resolution of 5µm. This means an x-ray analysis was taken every 5µm and the phase map generated. The slag and Alloy samples were cut and mounted in spoxy resin and polished for QEMSCAN analysis.

3.1 Calculated Assay

Table 2 shows the elemental assay calculated from the phases quantified by QEMSCAN and compositional data from the EPMA analysis. The Nb and Fe grades are consistent with those obtained using the Niton portable XRF where the grades were reported as 63.7%Nb and 32.7% Fe. The QEMSCAN calculated Zr grade is much lower than the reported 0.63% by the handheld XRF.

Table 2 Estimated Assay of Alloy and Slag base don EPMA Compositions

	Alloy	Slag
Al	0.07	29.95
Ca	0.01	4.25
Fe	31.24	1.13
Mg	0.00	1.95
Nb	61.46	7.03
Ni	0.93	0.04
P	0.56	0.05
Si	4.99	0.70
Ti	0.36	5.53
Zr	0.05	3.09

3.2 Mineralogy

Table 3 and Figures 1 and 2 show the mineralogy of the alloy and slag components. Note that this mineralogy is representative of the surface measured only and may not accurately represent the entire sample.

Table 3 QEMSCAN Mineralogy

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	10.06	1.33
Fe/Nb Ratio 0.3-0.4	37.12	2.45
Fe/Nb Ratio 0.5-0.6	0.78	0.21
Fe/Nb Ratio 0.7-1.0	51.77	0.73
NbSi	0.00	2.47
Total Metallics	*99.73*	*7.18*
Zr Oxide	0.05	0.11
Al2O3	0.04	0.38
Al Oxide Low Ca	0.10	63.94
CaAl	0.00	0.00
AlMg Spinel	0.00	7.35
CaAlTiZrSi	0.06	12.15
Nb-bearing (Ca,Al,Ti,Zr)	0.00	8.89
Other	0.00	0.00
Total	*100.00*	*100.00*

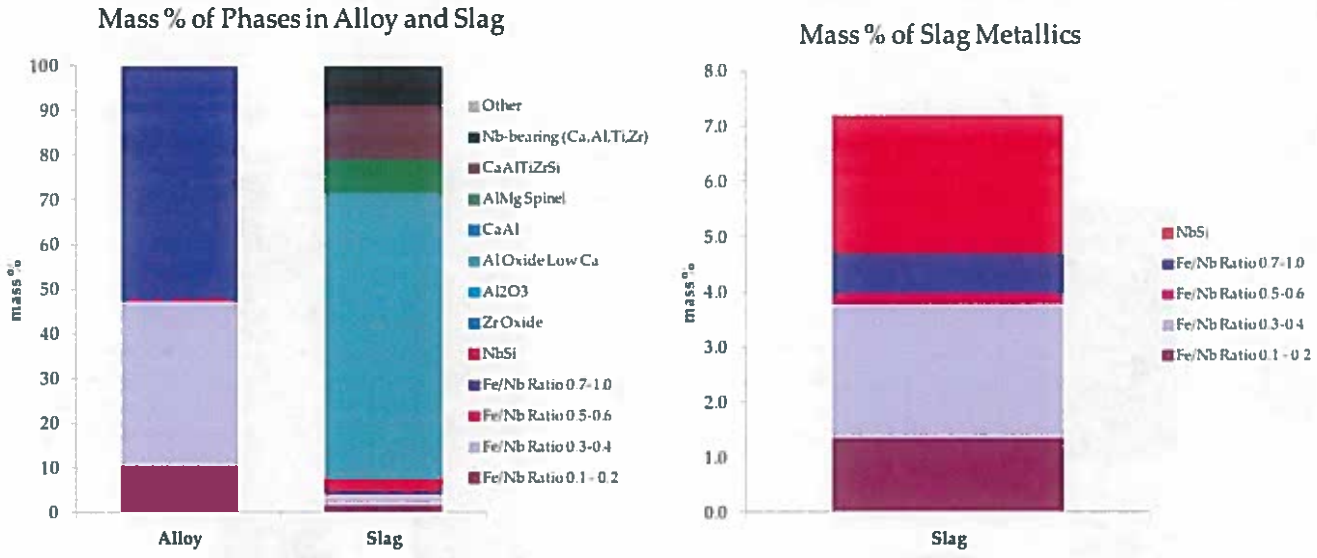

Figure 1: Mass percent of phases identified by QEMSCAN for the Alloy and Slag. Trace metallic phases are highlighted on the right.

3.3 Elemental Deportment

Based on the mineralogy and the EPMA compositions, the deportment of elements to the various phases can be quantified. For these samples, Fe, Nb and P deportments are shown. Deportment data essentially describes the distribution of the element through the various

phases in the sample. Deportment data shown as mass will sum to the grade of the element in the sample.

Fe deportment is shown in Table 4 and Figure 2 as both mass and mass percent of Fe in each sample. Nb deportment is shown in Table 5 and Figure 3 as both mass and mass percent of Nb in each sample. P deportment is shown in Table 6 and Figure 4 as both mass and mass percent of P in each sample.

Table 4. Fe Deportment

QEMSCAN Fe Deportment (mass Fe)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	0.85	0.11
Fe/Nb Ratio 0.3-0.4	8.65	0.57
Fe/Nb Ratio 0.5-0.6	0.24	0.06
Fe/Nb Ratio 0.7-1.0	21.49	0.30
NbSi	0.00	0.08
	31.24	*1.13*

QEMSCAN Fe Deportment (mass % Fe)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	2.73	10.00
Fe/Nb Ratio 0.3-0.4	27.70	50.62
Fe/Nb Ratio 0.5-0.6	0.78	5.74
Fe/Nb Ratio 0.7-1.0	68.79	26.78
NbSi	0.00	6.86
	100.00	*100.00*

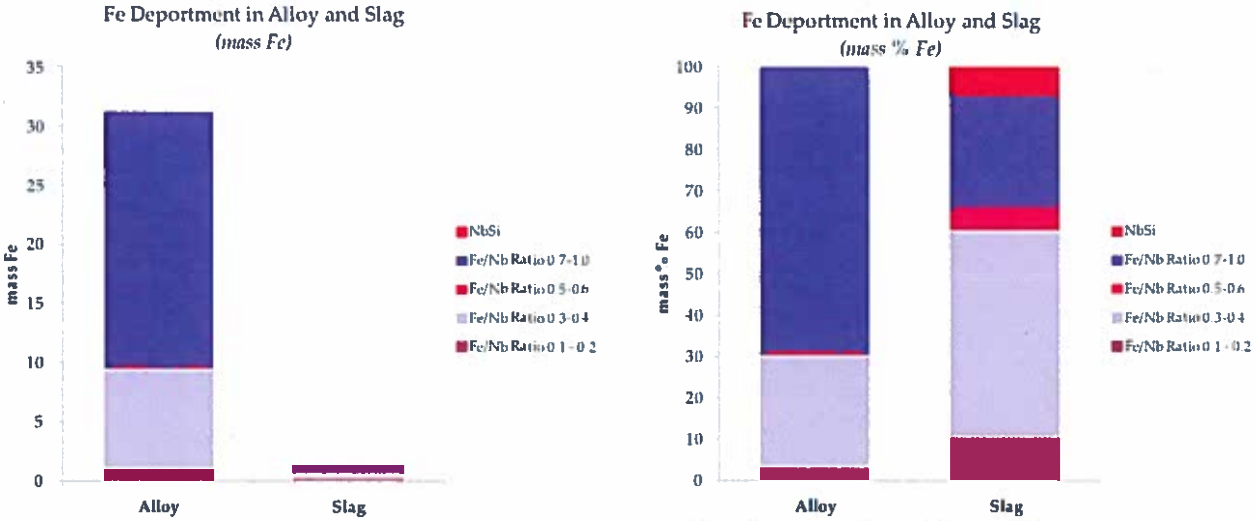

Figure 2: QEMSCAN calculated Fe deportment for the alloy and slag as both mass Fe and mass % Fe in each sample.

Table 5. Nb Deportment

QEMSCAN Nb Deportment (mass Nb)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	8.38	1.11
Fe/Nb Ratio 0.3-0.4	26.14	1.72
Fe/Nb Ratio 0.5-0.6	0.49	0.13
Fe/Nb Ratio 0.7-1.0	26.44	0.37
NbSi	0.00	2.09
Total Nb in Metallics	*61.46*	*5.42*
Al Oxide Low Ca	0.00	0.20
CaAlTiZrSi	0.00	0.31
Nb-bearing (Ca,Al,Ti,Zr)	0.00	1.11
	61.46	*7.03*

QEMSCAN Nb Deportment (mass % Nb)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	13.64	15.74
Fe/Nb Ratio 0.3-0.4	42.53	24.51
Fe/Nb Ratio 0.5-0.6	0.80	1.85
Fe/Nb Ratio 0.7-1.0	43.02	5.28
NbSi	0.00	29.68
Total Nb in Metallics	*99.99*	*77.06*
Al Oxide Low Ca	0.00	2.82
CaAlTiZrSi	0.00	4.34
Nb-bearing (Ca,Al,Ti,Z	0.00	15.78
	100.00	*100.00*

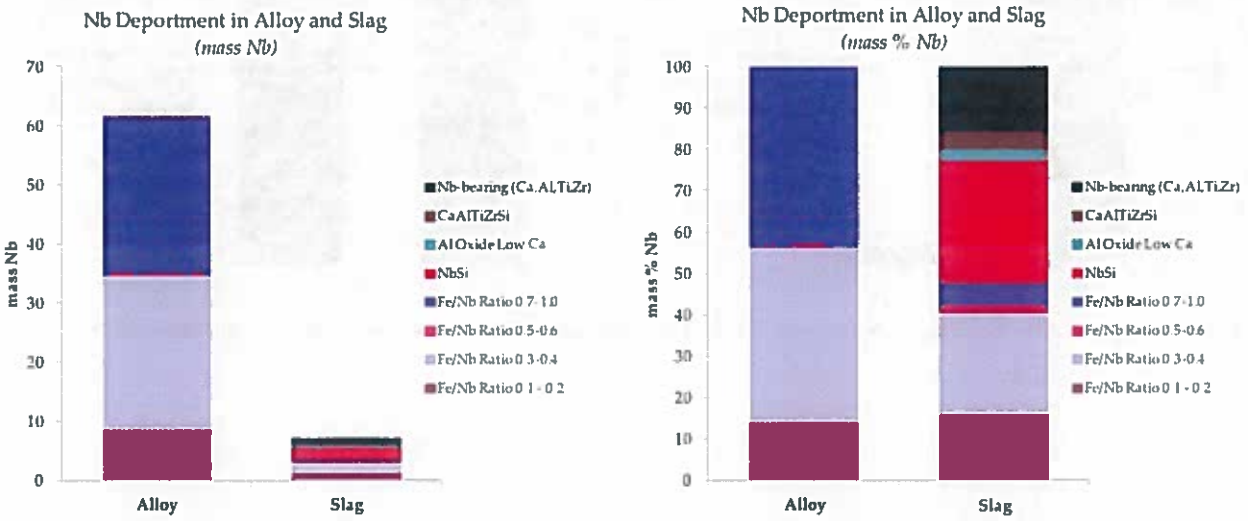

Figure 3: QEMSCAN calculated Nb deportment for the alloy and slag as both mass Nb and mass % Nb in each sample.

This data shows that in the slag phase, 77.1% of Nb in the slag occurs in prills of NbSi or NbSi/FeNb mix.

Table 6. P Deportment

QEMSCAN P Deportment (mass P)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	0.21	0.03
Fe/Nb Ratio 0.3-0.4	0.35	0.02
Fe/Nb Ratio 0.5-0.6	0.00	0.00
	0.56	*0.05*

QEMSCAN P Deportment (mass % P)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	38.00	54.96
Fe/Nb Ratio 0.3-0.4	61.87	44.68
Fe/Nb Ratio 0.5-0.6	0.12	0.36
	100.00	*100.00*

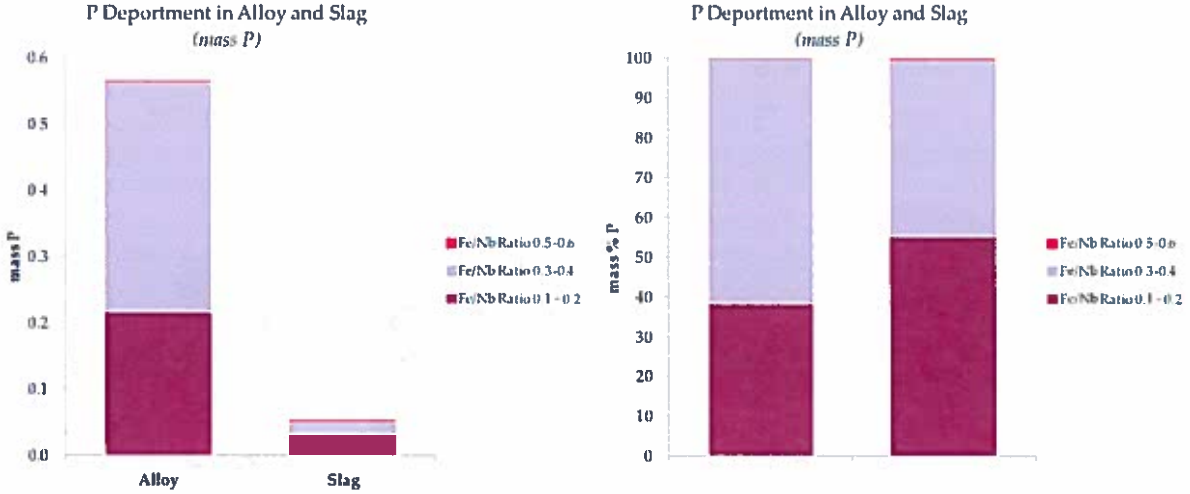

Figure 4: QEMSCAN calculated P deportment for the alloy and slag as both mass P and mass % P in each sample.

4. Images

4.1 Slag

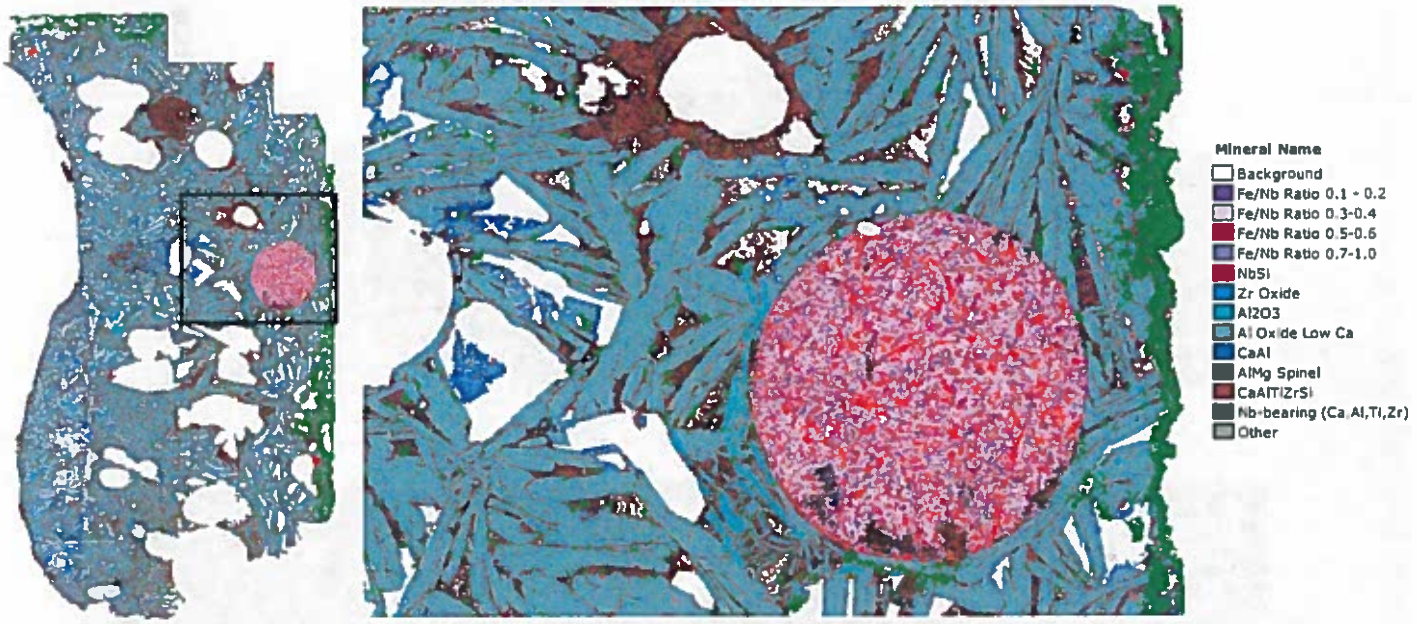

Figure 5: QEMSCAN false colour phase map of the slag. Image on the right shows the slag is mostly large Ca corundum crystals with grains of unreacted feed trapped between them. A large prill of mixed FeNb and NbSi alloy phases is present as are smaller prills of only NbSi alloy.

The slag phase is compared to the SEM images originally taken in February. The orientation shows similar structure however in the polished surface, a large prill of FeNb and NbSi alloy was exposed. It is likely that approximately 2mm of material was removed from the original surface to obtain the polished surface.

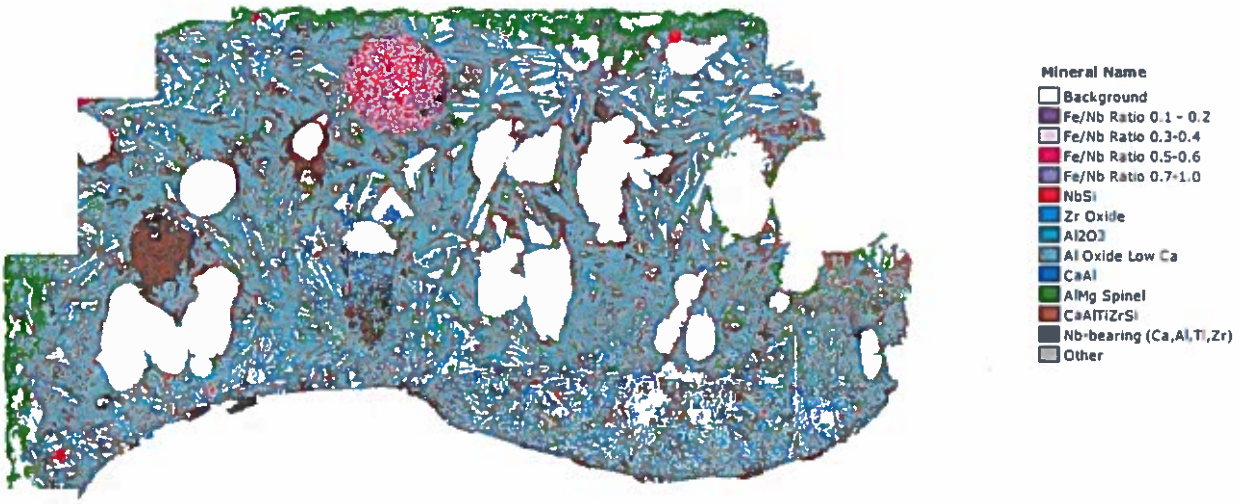

Figure 6: Comparison of the slag surface originally analysed and the new polished surface which the quantitative data is based on.

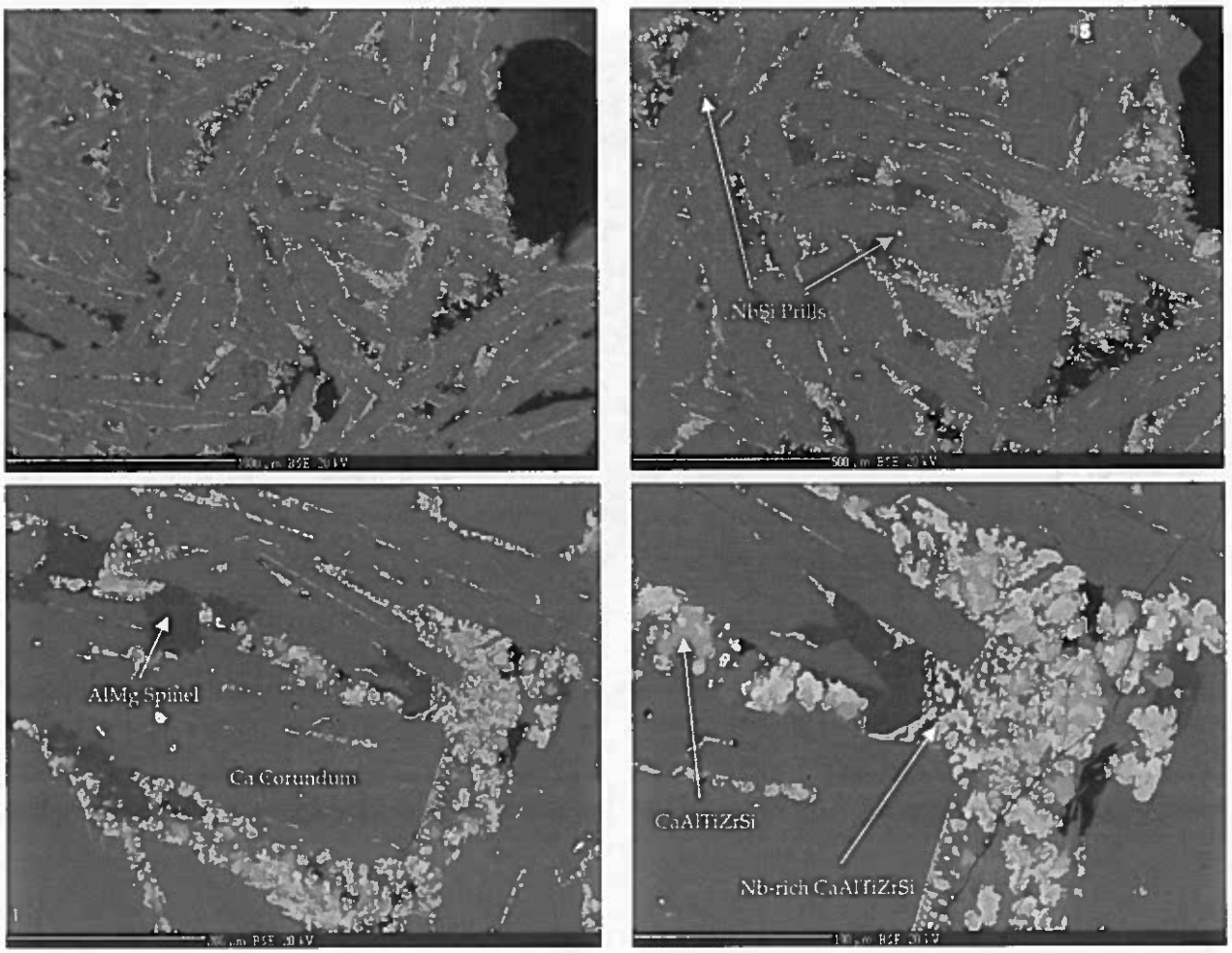

Figure 7: High resolution SEM images of the polished slag surface in increasing magnification showing the Ca corundum crystals with unreacted feed material trapped between them. The complexity of the trapped feed material is visible and shows why a consistent composition could not be obtained for each of the phases.

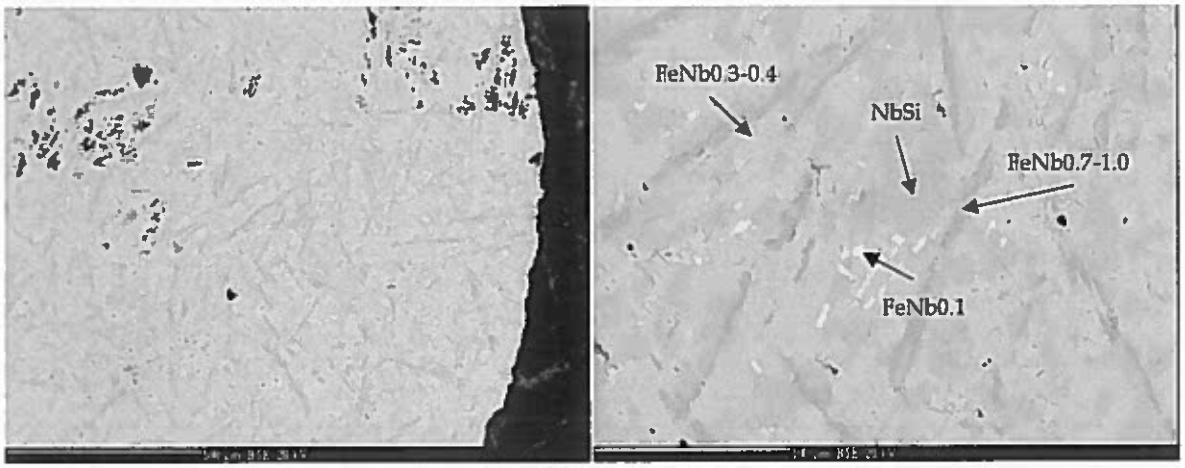

Figure 8: Large prill in the slag showing the various FeNb and NbSi alloy phases with increased magnification.

4.2 FeNb Alloy

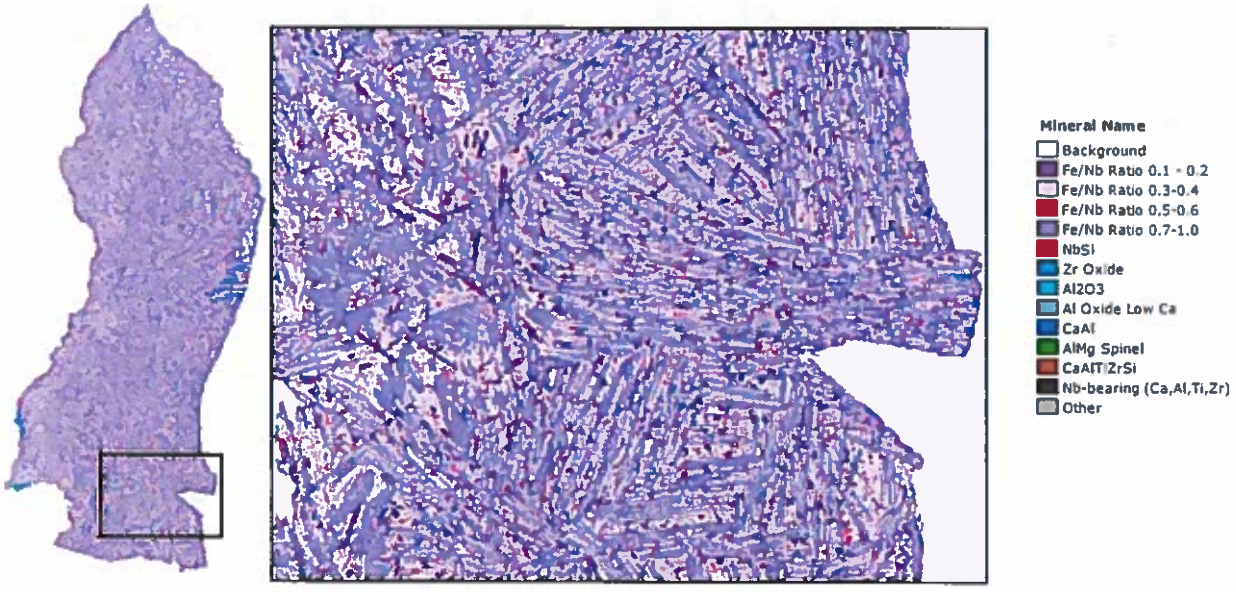

Figure 9: QEMSCAN false colour phase map of the FeNb Alloy. Image on the right shows the alloy is 4 different crystallisations of FeNb. Individual grains can clearly be identified based on the direction of the growth of the crystals.

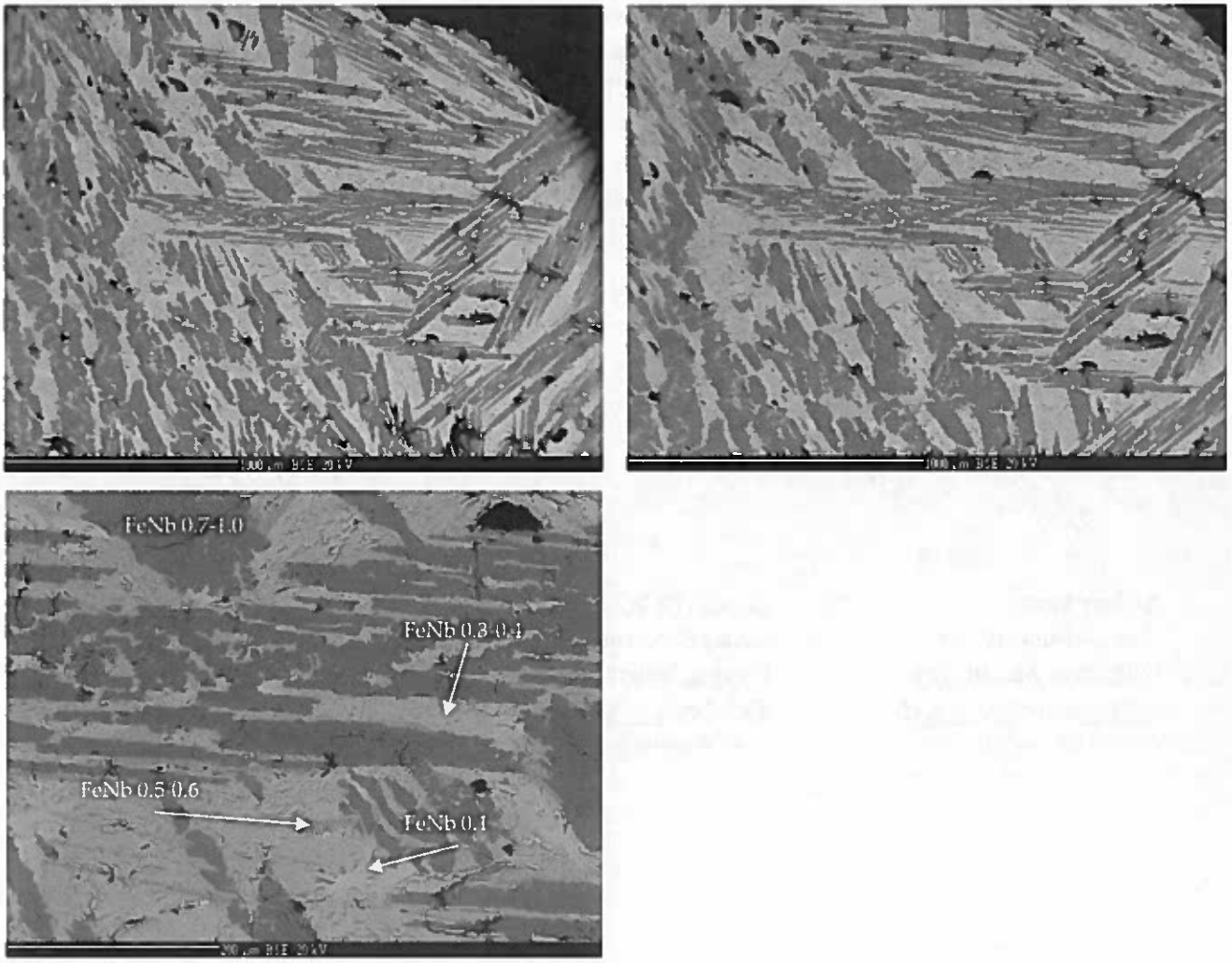

Figure 10: High resolution SEM images of the polished alloy surface in increasing magnification showing the various FeNb crystals.

5. Conclusions and Recommendations

The combination of QEMSCAN and EPMA provides a level of understanding of the metal and slag structure not possible from chemical analysis and microscopy alone.

The detailed phase and element deportments provide invaluable information to assist in optimising techniques and informing the project team on predicted large scale performance in key areas, such as phosphorous deportment.

The results clearly indicate that the reduction reactions are extremely rapid, and are completed, whereas the complete slag fusion was not completed and full -metal separation did not occur before the melt solidified. Longer hold times at elevated temperature should assist in further improving slag metal separation

The blend recipe used is shown to be correct, but the structure of the slag hints at the possibility of improving blending of the ingredients for the next run.

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Memo

Issued to:	Julia Gartley
Copy to:	Mika Muinonen
From:	*Arthur Barnes, Elizabeth Whiteman*
Issued On:	01 June 2015
Project Name:	Taseko, FeNb 2015 Conversion Tests #3
Project Code:	*3014815.00*
Subject	**QEMSCAN and EPMA Analysis of FeNb Alloy and Slag #3**

1. Overview/Summary

Following from the success of the QEMSCAN and EPMA analysis of the alloy and slag of the second FeNb test, the mineralogical characterisation was completed on the third conversion test slag, alloy and refractory.

A phase and compositional study was completed on the FeNb alloy button and slag generated from the conversion test #3 conducted at XPS recently. The crucible containing the slag and alloy was cut in half and ground to a smooth finish on the cut face. The complete half piece was studied rather that cutting smaller pieces. This study defined and quantified the phases present in the three components (slag, alloy and crucible) by generating a false coloured phase map of each by QEMSCAN. The compositions of these phases were quantified by EPMA (electron probe microanalysis) on smaller pieces mounted in polished sections. The following memo presents the phase compositions, the mass of each present in each component, a calculated assay of elements of interest and both SEM and false colour images.

Based on the micro analysis/ QEMSCAN data combination presented here, the following overall grades and recoveries are calculated in Table 1. Note that a key assumption made is that the surfaces examined are representative of the macro specimen. Because the full cross section of the alloy and slag was examined, this assumption is regarded as being sound.

2. Traditional Mass Balance calculations

For this run a recipe of 76 g of calcined concentrate was blended

As mentioned in the introduction, instead of attempting to separate slag, refractory, metal button and visible prills the complete refractory crucible, metal and slag were sectioned using a diamond saw, and one half polished and examined as described..

Figure 1: Optical image of remaining half.

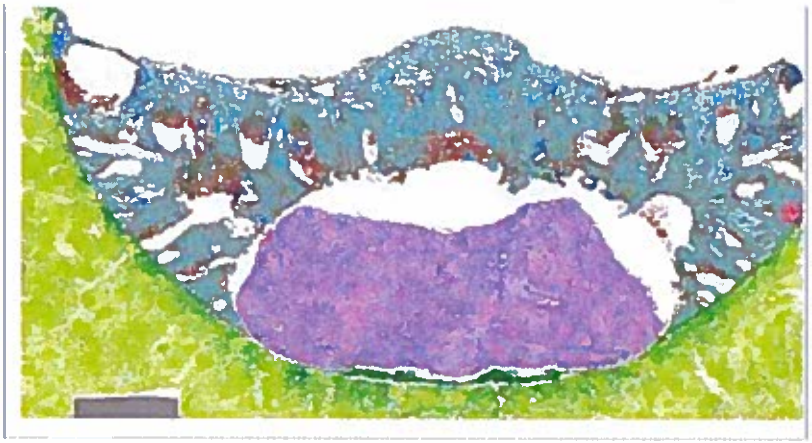

Figure 2: Corresponding QEMSCAN Image (Mirror portion) Showing areas examined

Mass Balance

Note: The mass balance below is based on the analyses of the surface area examined, but the masses calculated from the mass of the half button recovered from the portion not examined plus the estimated mass lost by cutting. (The half button weighed 16.6 g and 4 g was lost during cutting.

Table 1. Overall Metallurgical Results

OUT

Used crucible	192.7	91.2			3.3			0
slag	67.5	1.2	1.8	0.0	19.7	0.3	2.9	3.5
Button	38	0	23.2	12.0	0.0	1.9	0.0	0.7
Prills	5.5	0	4.1	1.5	0.0	0.44	0.00	0.00
Loss	0	0	0	0	0	0	0	0
Total Out	303.7	92.4	29.2	13.5	23.0	2.7	2.9	4.2
Accountability	100.0	91.2	100.0	100.1	93.3	101.3	83.2	106.2
Metal Recovery			93.8%	100.1%		101.3%		
Metal Grade			62.9%					

The overall Nb recovery (or conversion efficiency) to metal, including the metallic prills is 93.8% at a grade of 62.9% Nb.

The mass of metal entrained in prills was only half of the previous run, so the yield of Nb to primary metal was higher. In all other respects this run duplicated and confirmed the results of the previous test

3. EPMA Compositional Analysis

Quantitative compositional analysis was completed using a Cameca SX-100 Electron Microprobe. Electron Probe Micro Analysis (EPMA) produces higher beam currents and increased beam stability, coupled with higher resolution wavelength dispersive spectrometry (WDS). These features allow for improved detection limits and accuracy of the resulting analysis. Peak to background settings and data collection times were chosen to maximise the detection limits.

Resulting detailed compositional data was input into the QEMSCAN software in order to refine the final assay and elemental deportment calculations.

Table 2 shows the compositions of the phases as quantified by EPMA. Metallic phases are named based on the Fe:Nb ratio.

In the previous sample, Nb was identified in solution in the slag. This sample does not show any Nb in solution.

Some metallic phases are present in the slag. Large prills consist of phases that are consistent with metallics identified in the alloy button. Smaller metallics are NbSi alloy and are only found

in the slag and not in the alloy button. This phase shows some very minor variation in trace element composition depending on the prill size it occurs in and whether there is association with other FeNb phases.

Table 2 EPMA Compositional Data

FeNb Alloy

Comment	Si	P	S	Ti	Cr	Mn	Fe	Ni	Zr	Nb	Total
FeNb 0 1	6.49	1.84	0.00	0.34	0.00	0.02	8.29	0.04	-0.10	83.08	100.00
FeNb 0.3-0.4	3.29	1.17	0.00	0.67	0.04	0.19	25.43	0.08	-0.10	69.24	100.00
FeNb 0.5-0.6	3.63	0.10	0.00	0.54	0.05	0.23	32.46	0.07	-0.11	63.03	100.00
FeNb 0.7-1.0	6.56	0.06	0.00	0.33	0.08	0.30	42.38	0.05	-0.10	50.35	100.00
FeNb <0 1	-0.27	-0.04	0.00	0.65	0.01	0.06	4.42	0.04	-0.14	95.26	100.00
Detection Limit (%)	*0.03*	*0.036*	*0.014*	*0.022*	*0.024*	*0.044*	*0.046*	*0.051*	*0.083*	*0.073*	

Slag Phases

Comment	Si	P	S	Ti	Cr	Mn	Fe	Ni	Zr	Nb	Mg	Al	Ca	Na	K	O	Total
CaAlTiZrSi	0.04	0.00	-	4.43	-0.04	0.05	0.01	0.00	1.43	0.01	1.73	40.83	5.28	0.05	0.01	43.08	96.89
Ca Corundum	0.03	-0.01	-	2.20	-0.11	0.02	0.03	0.00	0.58	-0.01	1.23	42.00	4.71	0.02	0.00	41.71	92.41
AlMg Spinel	0.01	0.00	-	2.80	0.00	0.40	0.02	0.00	0.02	-0.01	16.11	36.07	0.06	0.02	0.00	44.73	100.23
MgO Refractory	0.02	0.00	-	1.23	0.02	0.07	0.54	0.01	0.23	0.00	56.32	2.28	0.03	0.01	0.00	40.22	100.98
Ca Binder	0.09	0.00	-	13.88	-0.19	0.02	0.17	0.01	7.99	8.64	8.82	0.93	17.35	0.15	0.02	27.99	85.86
AlMg Spinel Infiltration	0.03	0.00	-	1.32	0.02	0.02	0.09	0.01	0.06	0.03	18.13	35.42	0.02	0.00	0.00	44.43	99.55
Detection Limit (%)	*0.03*	*0.036*	*0.014*	*0.022*	*0.024*	*0.044*	*0.046*	*0.051*	*0.083*	*0.073*	*0.027*	*0.031*	*0.018*	*0.033*	*0.02*		

Highlighted values are below the detection limit: oxygen is a calculated value

Slag Metallics

Comment	Si	P	S	Ti	Cr	Mn	Fe	Ni	Zr	Nb	Total
FeNb 0.5-0.6 in prill	6.56	0.13	0.00	0.03	0.22	0.59	33.72	0.28	-0.09	58.39	99.83
FeNb 0 1 in prill	7.72	0.49	-0.06	0.03	0.02	0.07	7.87	0.17	-0.10	83.20	99.41
FeNb 0 7-1 0 in prill	5.68	0.04	0.00	0.03	0.27	0.71	39.37	0.32	-0.11	53.01	99.32
Nb5i	13.10	-0.03	0.00	0.07	0.02	0.03	2.15	0.02	-0.12	83.62	98.87
Detection Limit (%)	*0.03*	*0.036*	*0.014*	*0.022*	*0.024*	*0.044*	*0.046*	*0.051*	*0.083*	*0.073*	

4. QEMSCAN Analysis

QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy) is an automated system that produces particle maps (colour coded by mineral) through the collection of rapidly acquired X-rays. The maps and corresponding data files quantify the modal mineralogy, texture, grain size, elemental deportment and liberation of samples analysed. In this case, the slag, alloy and crucible components were analysed by the Field Image measurement mode with a measurement resolution of 15µm. This means an x-ray analysis was taken every 15µm and the phase map generated.

4.1 Calculated Assay

Table 3 shows the elemental assay calculated from the phases quantified by QEMSCAN and compositional data from the EPMA analysis. The Nb and Fe grades are consistent with the previous sample.

Table 3 Estimated Assay of Alloy and Slag based on EPMA Compositions

					Previous Sample	
		Alloy	Crucible	Slag	*Alloy 1*	*Slag 1*
Elemental Mass (%)	Al	0.03	4.50	31.30	*0.13*	*30.58*
	Ca	0.01	0.22	4.32	*0.01*	*4.14*
	Fe	31.46	0.11	0.49	*31.20*	*1.09*
	Mg	0.00	53.85	2.20	*0.00*	*1.91*
	Nb	**61.15**	**0.24**	**4.46**	***61.39***	***6.81***
	Si	5.13	0.23	0.68	*4.98*	*0.72*

4.2 Mineralogy

Table 4 and Figures 1 and 2 show the mineralogy of the alloy, slag and crucible components. This mineralogy is based on a cross section through half of the cooled slag, crucible and alloy button. This surface measured is believed to be more representative of the sample than the sections taken in the previous sample. The CaAlTiZrSi crystals identified in-between the slag blades may be overestimated in this sample due to x-ray identification anomalies from measuring an uneven surface. This phase is identified in holes where the slag has cooled around the alloy and the alloy has then drained away.

The slag in the previous sample shows more metallic in the slag however that sample was taken to specifically characterise a large prill. The size of the prill compared to the smaller sectioned surface will vary the mass proportion of the phases.

Table 4. QEMSCAN Mineralogy

						Previous Sample	
		Section	Alloy	Crucible	Slag	*Alloy 1*	*Slag 1*
Mineral Mass(%)	Fe/Nb Ratio 0.1 - 0.2	**6.64**	15.65	0.01	0.68	*10.06*	*1.33*
	Fe/Nb Ratio 0.3-0.4	**9.30**	22.14	0.06	0.66	*37.12*	*2.45*
	Fe/Nb Ratio 0.5-0.6	**2.49**	5.94	0.05	0.13	*0.78*	*0.21*
	Fe/Nb Ratio 0.7-1.0	**22.95**	55.66	0.18	0.39	*51.77*	*0.73*
	NbSi	**0.87**	0.38	0.00	2.00	*0.00*	*2.47*
	Total Metallics	***42.24***	*99.77*	*0.31*	*3.86*	*99.73*	*7.18*
	Zr Oxide	**0.04**	0.00	0.02	0.11	*0.05*	*0.11*
	Al2O3	**0.07**	0.00	0.00	0.20	*0.04*	*0.38*
	Al Oxide Low Ca	**22.24**	0.03	0.47	63.71	*0.10*	*63.94*
	CaAl	**1.32**	0.01	0.31	3.46	*0.00*	*0.00*
	AlMg Spinel	**5.34**	0.01	11.56	7.08	*0.00*	*7.35*
	CaAlTiZrSi	**6.71**	0.17	0.30	18.44	*0.06*	*12.15*
	Nb-bearing (Ca,Al,Ti,Zr)	**0.98**	0.02	0.35	2.48	*0.00*	*8.89*
	MgO	**20.62**	0.00	85.88	0.01	-	-
	CaSi Binder	**0.43**	0.00	0.80	0.64	-	-
	Other	**0.00**	0.00	0.00	0.00	*0.00*	*0.00*
	Total	***100.00***	*100.00*	*100.00*	*100.00*	*100.00*	*100.00*

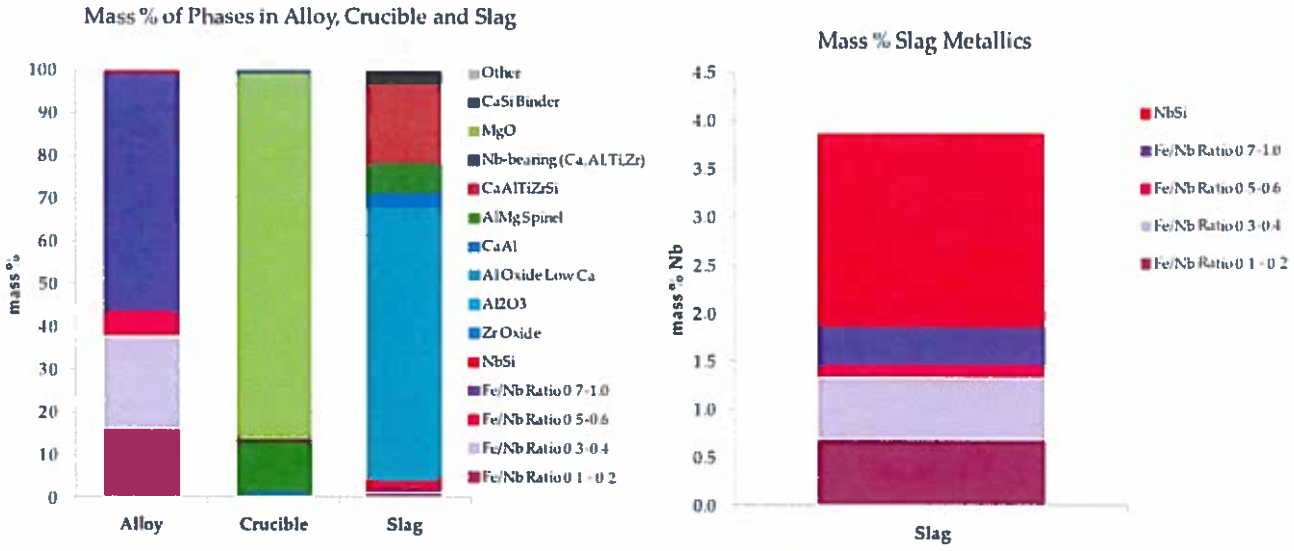

Figure 1: Mass percent of phases identified by QEMSCAN for the Alloy, Crucible and Slag. Trace metallic phases in the slag are highlighted on the right.

4.3 Elemental Deportment

Based on the mineralogy and the EPMA compositions, the deportment of elements to the various phases can be quantified. For these samples, Fe and Nb deportments are shown. Deportment data essentially describes the distribution of the element through the various phases in the sample. Deportment data shown as mass will sum to the grade of the element in the sample.

Fe deportment is shown in Table 5 and Figure 2 as both mass and mass percent of Fe in each sample. Nb deportment is shown in Table 6 and Figure 3 as both mass and mass percent of Nb in each sample.

Table 5. Fe Deportment

QEMSCAN Fe Deportment (mass Fe)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	1.33	0.06
Fe/Nb Ratio 0.3-0.4	5.16	0.15
Fe/Nb Ratio 0.5-0.6	1.86	0.04
Fe/Nb Ratio 0.7-1.0	23.10	0.16
NbSi	0.01	0.06
	31.46	*0.48*

QEMSCAN Fe Deportment (mass % Fe)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	4.22	12.14
Fe/Nb Ratio 0.3-0.4	16.41	32.55
Fe/Nb Ratio 0.5-0.6	5.92	8.44
Fe/Nb Ratio 0.7-1.0	73.41	33.70
NbSi	0.04	13.17
	100.00	*100.00*

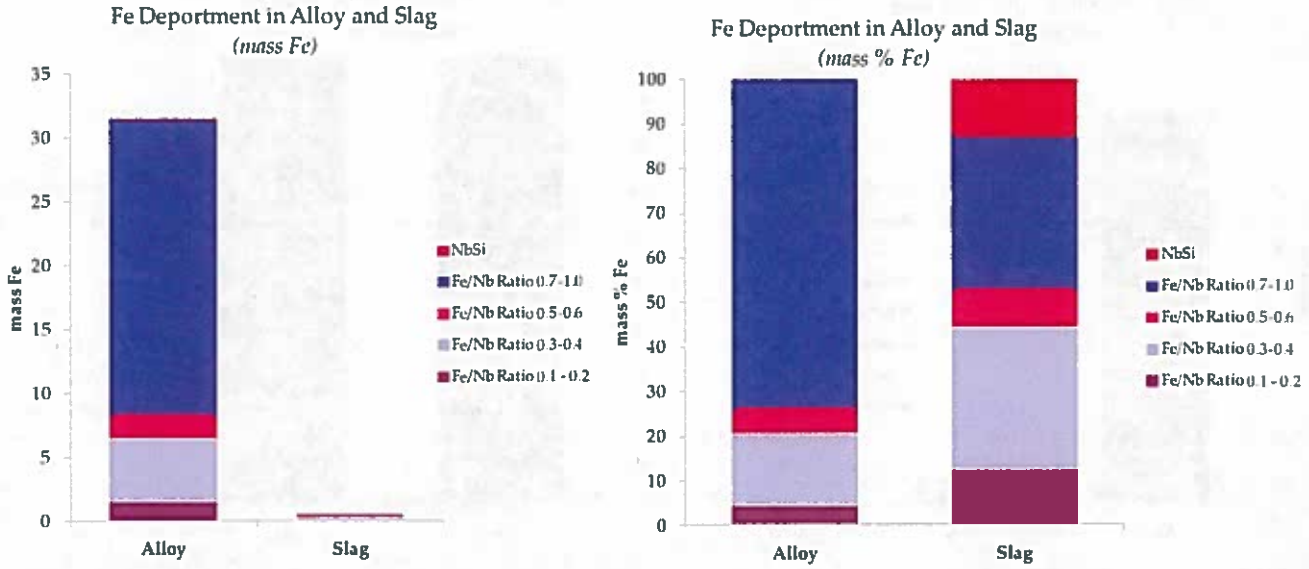

Figure 2: QEMSCAN calculated Fe deportment for the alloy and slag as both mass Fe and mass % Fe in each sample.

Table 6. Nb Deportment

QEMSCAN Nb Deportment (mass Nb)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	13.04	0.57
Fe/Nb Ratio 0.3-0.4	15.59	0.47
Fe/Nb Ratio 0.5-0.6	3.76	0.08
Fe/Nb Ratio 0.7-1.0	28.42	0.20
NbSi	0.32	1.69
Total Nb in Metallics	*61.14*	*3.01*
Al Oxide Low Ca	0.00	0.20
CaAlTiZrSi	0.01	0.79
Nb-bearing (Ca,Al,Ti,Zr)	0.00	0.31
	61.14	*4.30*

QEMSCAN Nb Deportment (mass % Nb)

	Alloy	Slag
Fe/Nb Ratio 0.1 - 0.2	21.33	13.20
Fe/Nb Ratio 0.3-0.4	25.50	10.88
Fe/Nb Ratio 0.5-0.6	6.14	1.88
Fe/Nb Ratio 0.7-1.0	46.49	4.59
NbSi	0.52	39.32
Total Nb in Metallics	*99.99*	*69.88*
Al Oxide Low Ca	0.00	4.59
CaAlTiZrSi	0.01	18.32
Nb-bearing (Ca,Al,Ti,Zr)	0.00	7.21
	100.00	*100.00*

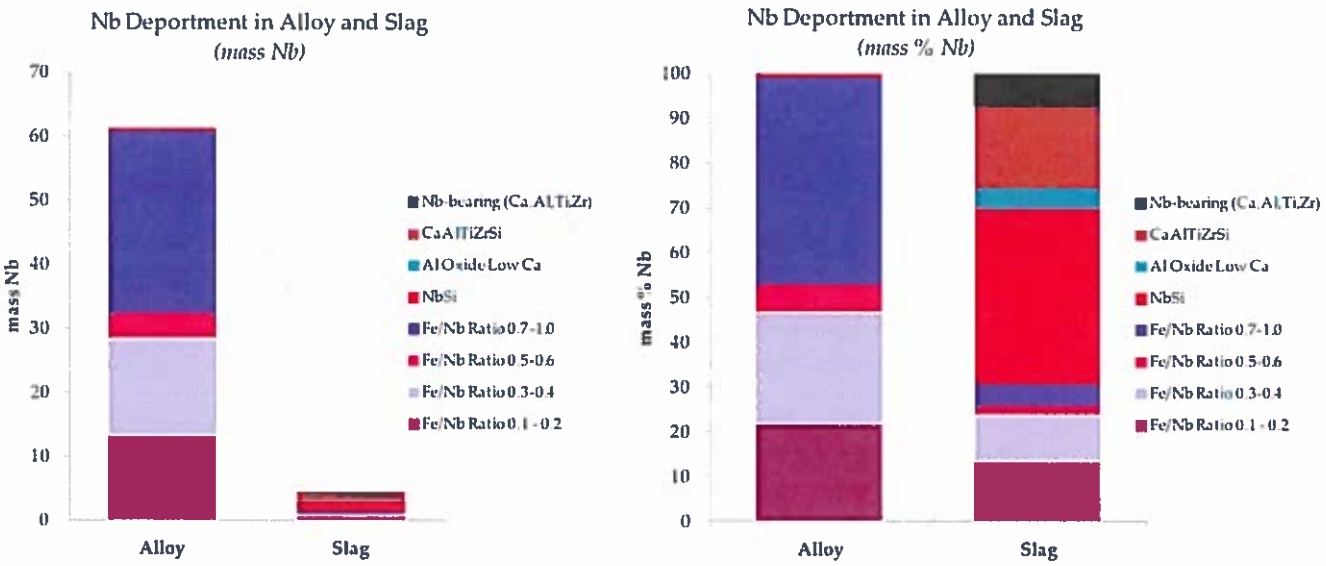

Figure 3: QEMSCAN calculated Nb deportment for the alloy and slag as both mass Nb and mass % Nb in each sample.

This data shows that in the slag phase, 69.9% of Nb in the slag occurs in prills of NbSi or NbSi/FeNb mix. This is lower than the previous sample however due to the likely overestimated CaAlTiZrSi phase; the deportment is likely to be similar between the samples.

5. Images

5.1 Full Specimen

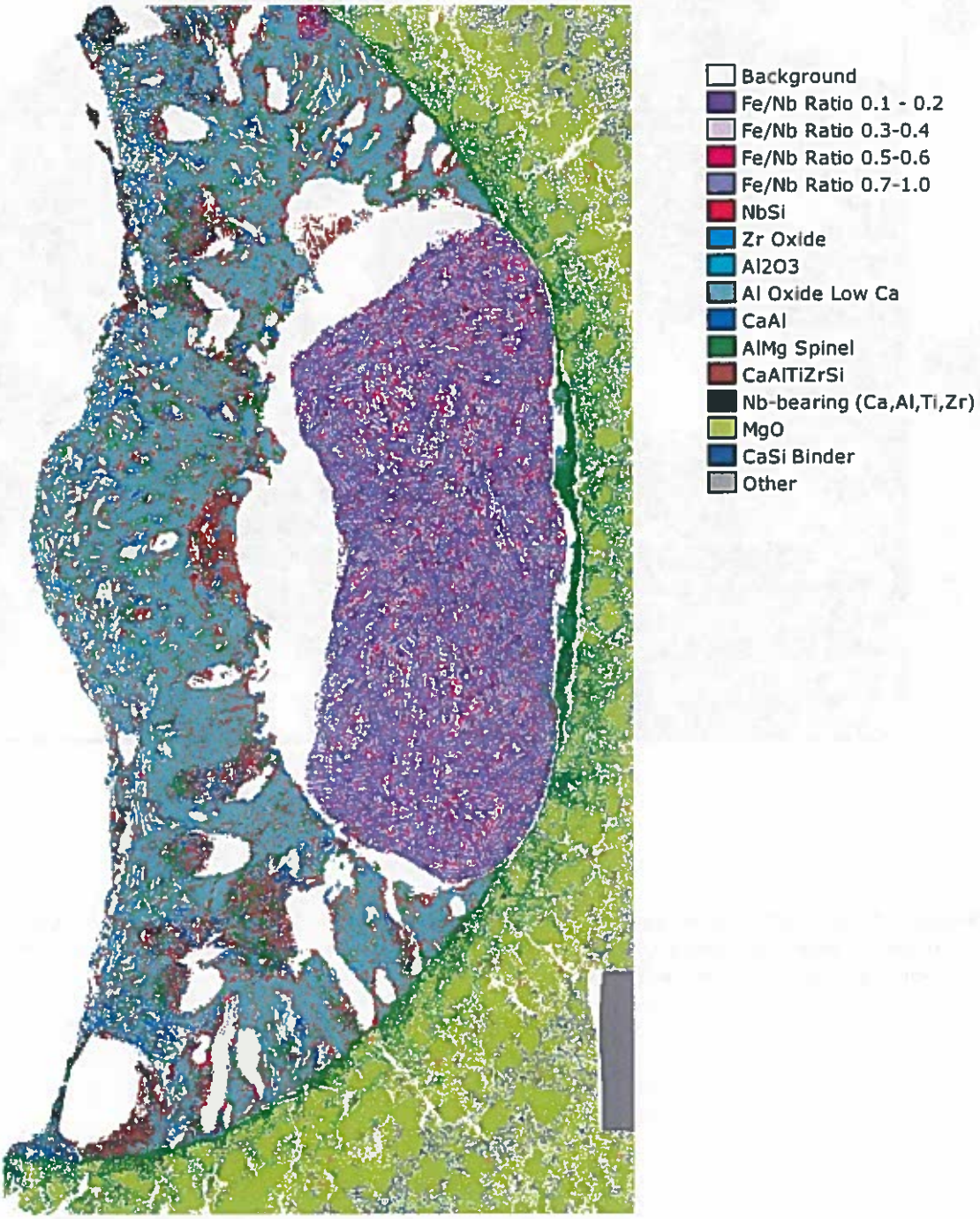

Figure 4: QEMSCAN false colour phase map of the full specimen measured. The grey lower right of the image is Cu tape used for conductivity of the sample during measurement and has not been included in the overall modal abundance of phases.

5.2 Slag

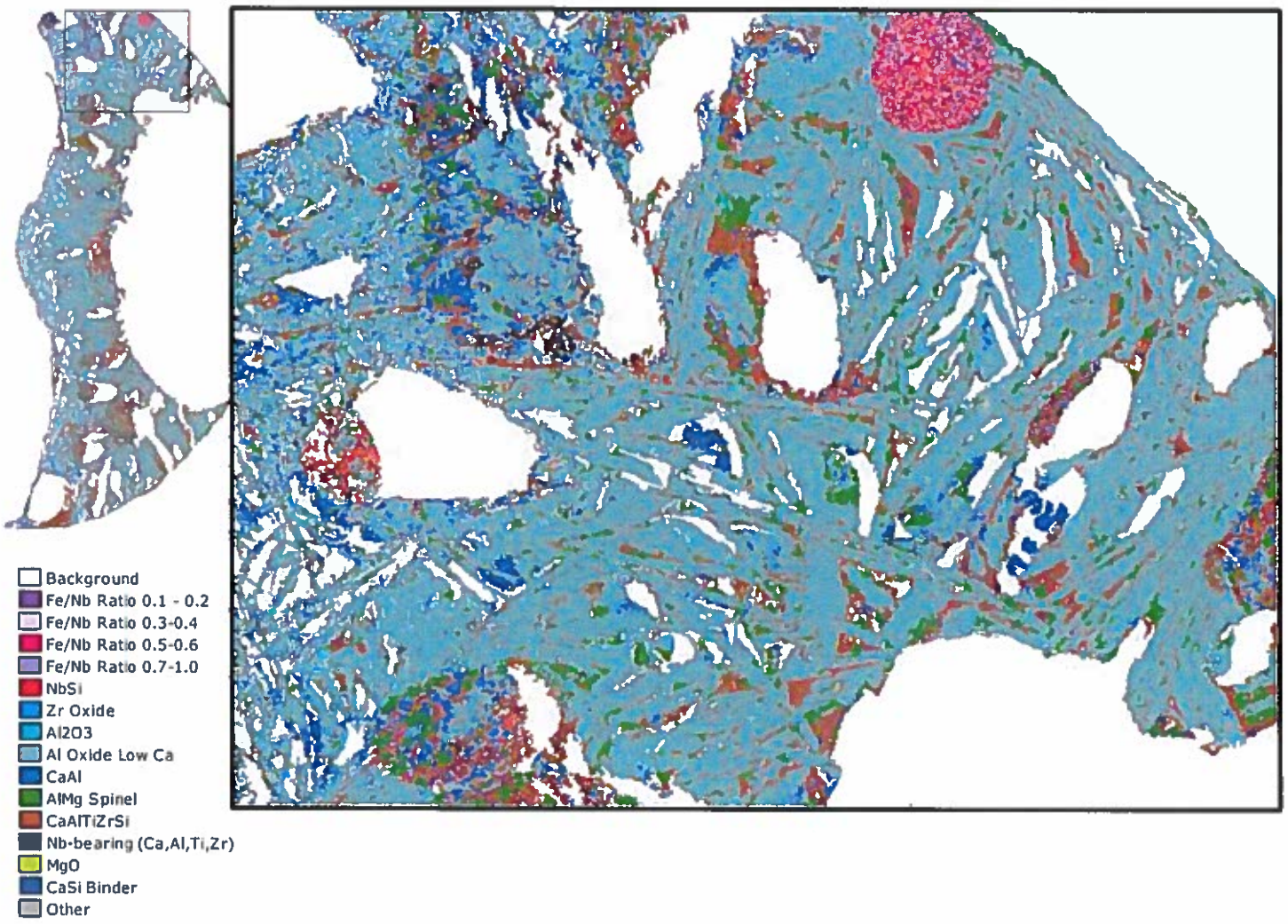

Figure 5: QEMSCAN false colour phase map of the slag. Image on the right shows the slag is mostly large Ca corundum crystals with grains of unreacted feed trapped between them. A large prill of mixed FeNb and NbSi alloy phases is present as are smaller prills of only NbSi alloy.

report Improved feed blending also improved results, confirming the recommendations from the previous work.

The fairly significant interaction between the magnesia crucible and the high alumina slag is noted, as is the amount of $MgAl_2O_4$ spinel formed, and provides some evidence for the slightly inconsistent mass balances obtained in the previous run, where the crucible was not examined.

For small samples such as these, the confidence in the results obtained by QEMSCAN analysis is very much higher than could be obtained by traditional mechanical separation of slag and metal followed by chemical analysis. Valuable additional information on specific element deportment and phase chemistry is an added bonus.

XPS recommend this technique for future work, and suggest that a similar QEMSCAN analysis of the concentrate also be performed to understand elemental associations in the feed material in the future.

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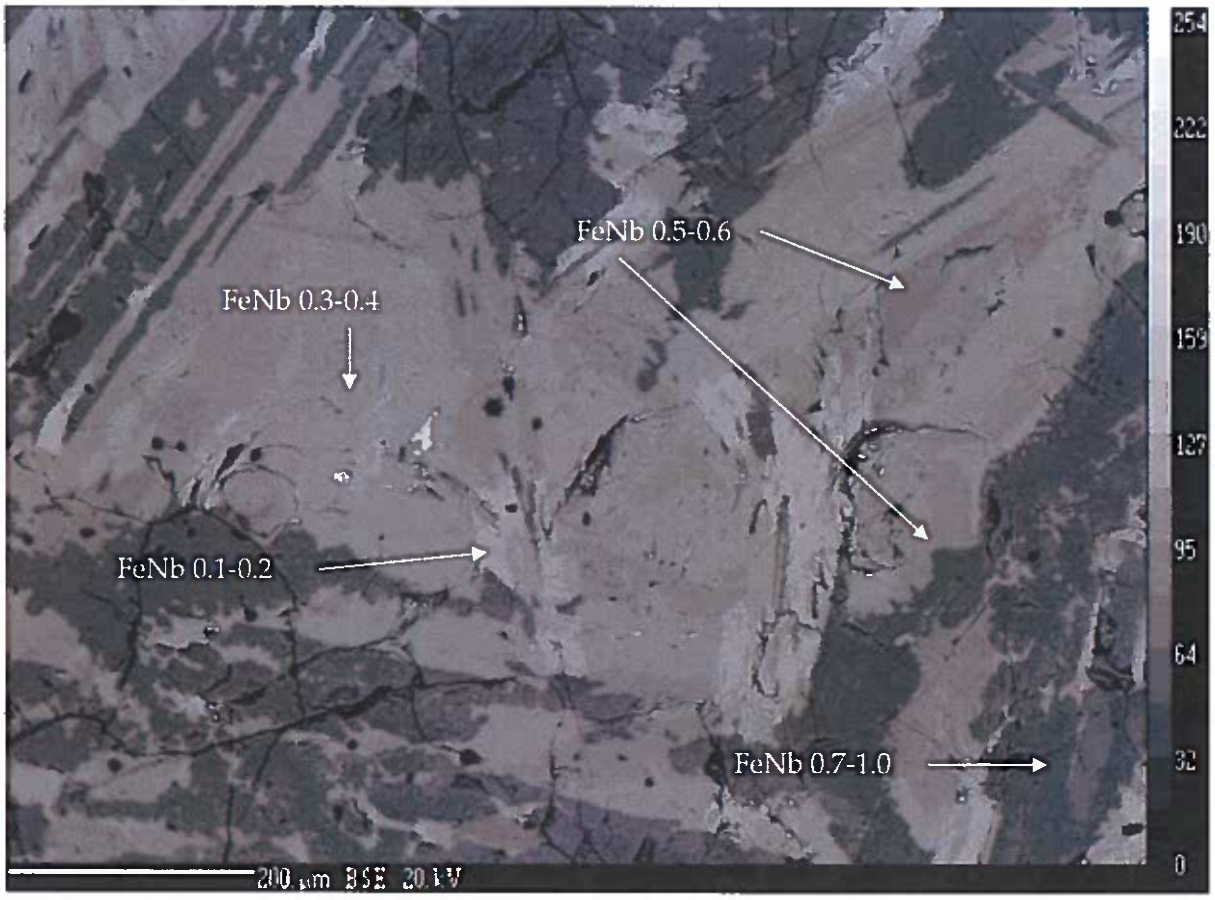


Figure 8: High resolution SEM images of the polished alloy surface.

6. Conclusions and Recommendations

This sample shows mineralogy and calculated assay similar to the first sample analysed by QEMSCAN and EPMA. The differences in the data are not thought to be significant due to the difference in the surface area measured between the samples and the method of preparation.

The alloy and slag phases are consistent in terms of abundance and texture. The mass balance calculations show excellent agreement over all the major elements, indicative of good analytical accuracy.

The results again confirm that the reduction reactions are extremely rapid, compared to the time required for complete slag/ metal separation. The longer hold time above the melting point did indeed assist in further improving slag metal separation, as had been suggested in the previous

5.3 FeNb Alloy

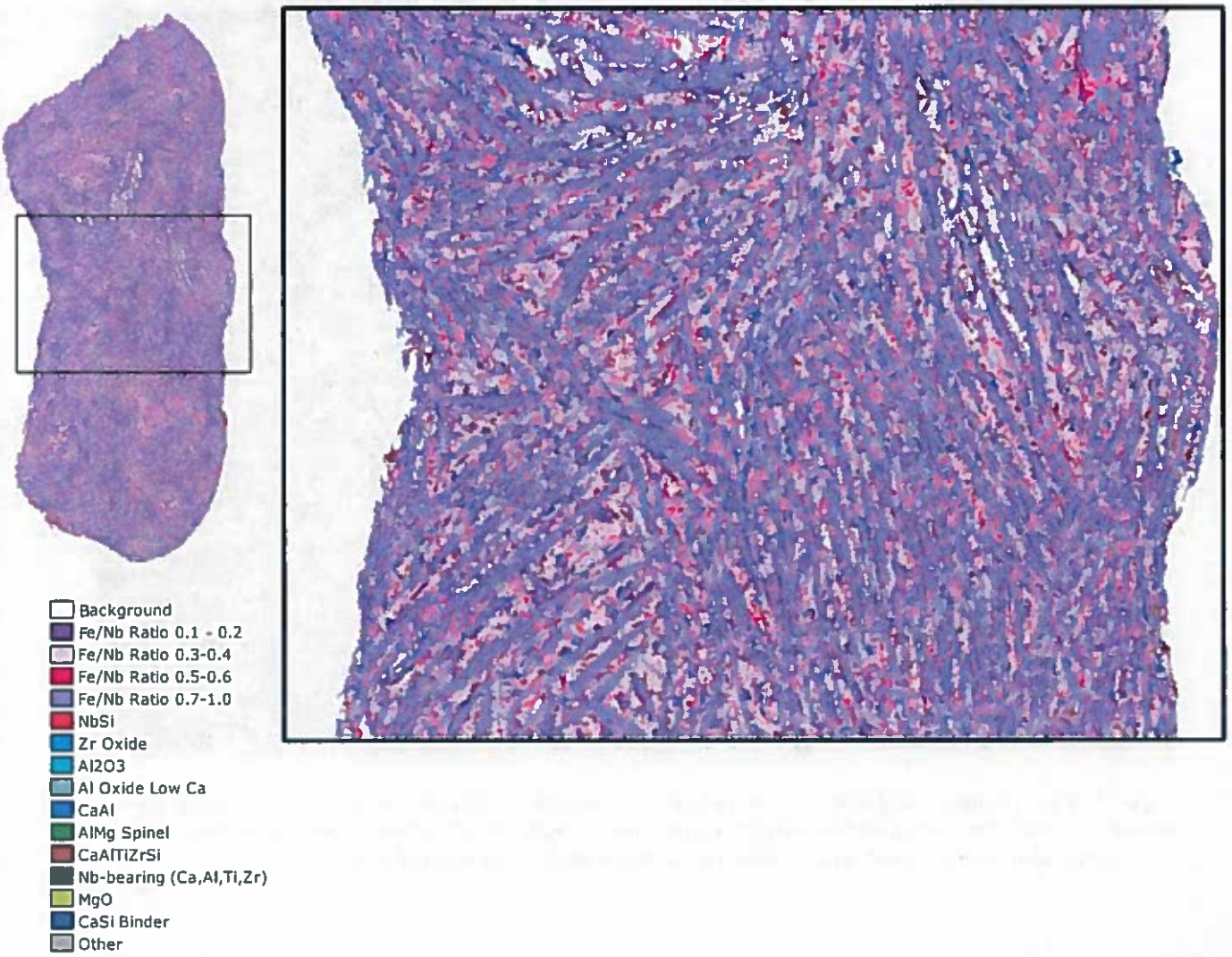


Figure 7: QEMSCAN false colour phase map of the FeNb Alloy. Image on the right shows the alloy is 4 different crystallisations of FeNb. Individual grains can clearly be identified based on the direction of the growth of the crystals.

Figure 6: High resolution SEM image of the polished slag surface in increasing magnification showing the Ca corundum crystals with unreacted feed material trapped between them. The complexity of the trapped feed material is visible and shows why a consistent composition could not be obtained for each of the phases.

XPS Consulting & Testwork Services

Memo Report

Issued to:	Keith Merriam
Copy to:	Mika Muinonen
From:	*Arthur Barnes,*
Issued On:	28 July 2015
Project Name:	Taseko Aley Conversion tests
Project Code:	*3014815.00*
Subject	**Summary of XPS conversion testwork on Aley concentrates**

1. Overview/Summary

In all cases the conversion testwork was performed on very limited quantities of concentrate and the conversion tests were conducted on a smaller scale than optimum for establishing good slag/alloy separation and element recoveries.

Because of the limited quantities of material the initial 2013 work relied heavily on simulation of the conversion process using thermochemical models to guide test conditions and initial laboratory tests were performed using either iron oxides or chrome oxides only to confirm procedures.

Tests conducted at room temperature confirmed that there was insufficient energy to produce a liquid slag and obtain slag/metal separation. Preheating to 800°C resulted in improved separation. The alloy grade in terms of Nb content was deemed to be on target. The high P content of the alloy (1.7-2.0%) was noted as a concern and recommendations revolved around efforts to reduce the P content of the concentrate. Assay techniques for the metallic alloy had to be developed, and turnaround time for results was very long, leading to a very protracted test program.

Further testwork resumed in 2014 once modifications to the concentrator flowsheet had resulted in a substantially lower P content of the concentrate. The 3 runs performed showed P in metal reduced in direct proportion to the reduction in P content in the concentrate, with overall values between 0.22 and 0.85% P in the alloy. Alloy grades were lower than optimum with only 1 of

the 3 runs producing a Nb grade above 60% Nb. Prill losses were still noted as a factor related to the small scale of testing. Issues with reliability of metal assays were observed.

The work in 2015 built on the lessons learned in earlier work, but added microscopic examination of the slag prior to assaying. The first run using additional preheating resulted in a 91% Nb recovery to metal. Microscopic examination of the slag in an SEM confirmed all Nb was either in the form of small metal prills trapped in the slag, or small quantities of unreacted feed. The SEM examinations were replaced by QEMSCAN techniques for the next runs.

The final run in this sequence produced outstanding results: overall Nb recovery to metal of 93.8% at a calculated grade of 62.9% Nb. Minor element deportment is tabled below. P levels were below an overall 0.6% P in the alloy, much more acceptable than the initial results.

Table 1: Run 3 metal Assay by Microprobe

Si	P	S	Ti	Cr	Mn	Fe	Ni	Zr	Nb
5.61	0.58	0.00	0.42	0.05	0.22	32.46	0.05	0.00	60.46

Figure 1: Scale of conversion tests: Crucible, charge, slag and alloy

In all 11 conversion tests on just over 1 kg of total concentrate were performed. The results consistently produced Nb grades of just over 60% and recoveries of 88-93% Nb. The P content of the final alloy was governed by the P content of the concentrate.

The major findings from each sequence of tests are detailed in chronological order in the following sections. Complete (as far as were collected) alloy assays for all the runs are tabulated below.

Table 2: Summary results –alloy assays

Yr		Description	Sample mass (g)	%Nb Recovery without prill	%Nb Recovery with prill	Nb %	Fe %	Al %	P %	Si %	S %	Mn %	Ti %	Zr %	Ca %	Th %	Mg %
13	1	Room temp	92.6	38	n/a	46.4	40.8	2.18	1.47	1.15			0.48	0.075	0.16	0.99	
	2	Room Temp	92.6	29	n/a	41.3	44.8	5.0	1.42	0.95		0.167	1.02	0.177	0.16	1.01	0.02
	3	Preheat to 800 C	92.6	60.8	70.8	55.5	31.9	2.15	1.71	1.72		0.22	0.79	0.178	0.327	0.7	0.02
	4	Preheat 800C	92.6	68.9	86.7	53.9	32.4	3.54	1.83	1.73		0.22	1.75	0.41	0.14	0.7	0.01
	5	Preheat 800C	100	75.0	86.6	63.7	27.1	0.55	2.02	2.16		0.132	0.34	0.049	0.03	0.002	0
14	6	Comp. CL-5-7-8	97.4	59.3	71.1	54.4	29.5	6.35	0.22	2.88		0.188	2.29	0.77	0.15	0.278	0.01
	7	LX-25 residue	100	73.2	77.5	54.3	31.8	1.82	0.76	4.6		0.08	0.34	0.103	0.1		0.02
	8	LX-29 residue	100	84.9	88.9	61.5	29.7	1.37	0.85	3.72	0.82	0.14	0.58	0.086	0		0
15	9	LX-35 residue	90	59.3	78.1	43.1	26.7	19.4		3.28	0.25		1.96		0.23		0
	10	LX-35 residue	76	70.0	87.0	61.46	31.2	0.07	0.56	4.99	0		0.36	0	0.01		0
	11	LX-35 residue	76	79.7	93.8	61.15	31.5	0.07	0.22	5.13	0	0.2	0.04	0	0.01		

Additional assays on sample 8: K= 0.005%; Na= 0.011%; C=0.03%; Pb=0.06%; Ta= 0.16%
Additional assays from microprobe sample 11: Cr=0.05%; Cu= 0.04%; Co= 0.12%; Ni= 0.05%; Zr below detection limit, S=0.00%
Note: All samples from 6-11 were pre-calcined to burn off sulphur and remove all crystal water.

2. Initial work 2013 (Report 13 Aug 2013)

Conversion testwork was performed on a very limited amount of niobium containing concentrate Based on previous experience with attempts to make a high grade ferro-niobium alloy, the aluminothermic test procedure was initially tested using iron oxide and later high grade chromite ore to conserve the very limited amount of concentrate until the procedure had been refined. Thermo-chemical modelling of the process was performed using combinations of FactSage and Pyrosim to determine the optimum test recipes and eliminate unworkable conditions. The results of the models were benchmarked against laboratory scale tests to estimate the heat losses associated with the small sample sizes necessary for the testwork.

After the initial conceptual models and procedural tests were completed, testing of the actual concentrate was performed in 3 sets of two, pending confirmation of the results from each pair of tests before proceeding with the next round. The final test was performed using the best conditions found from the previous 4 tests and resulted in the production of a very high grade ferro-niobium alloy (63.7% Nb) at very high niobium recovery (86.6%)

The key conclusions were:

- The Aley concentrate provided was suited to the production of a marketable grade of ferro-niobium alloy by way of aluminothermic reduction.
- Recoveries exceeding 85% Nb were achievable while producing an alloy grade in excess of 60% Nb providing the reagents were preheated.
- The phosphorous in the concentrate reported to the alloy, which was undesirable from a marketing perspective, but unavoidable using the reduction technique applied. Efforts at reducing the P content should focus on the concentrate.
- Very little of the rare earth content of the concentrate reported to the alloy.
- Very little upgrading of the REE's in the slag occurred as the Fe and Nb removed were replaced by a similar amount of Al.
- The small scale testwork confirmed that the aluminothermic reduction of Aley niobium concentrate was controlled by thermodynamics and thermochemical modelling of various scenarios could therefore be used with confidence.

The report recommended the following going forward:

- Further conversion testwork should proceed using parameters extracted from the successful final run in order to optimise metal yield and grades.
- The use of the XRF to establish preliminary alloy grades should be accepted for intermediate results, rather than hold up testwork pending the expensive, long turnaround microwave assisted fusion/ICP technique.
- Beneficiation testwork and mineral process flowsheet development should focus on phosphorous reduction from the concentrate.
- Mineralogical examination of the concentrate should be used to determine the mode of phosphorous deportment as a matter of some urgency, as 2% P in the ferro-niobium

alloy would render it unsuitable for use in speciality alloys and severely restrict its marketability.

3. Phase 2 work, 2014 (8 Oct 2014)

Conversion tests were performed on 3 leached concentrates produced by the Aley project. In all cases the sample masses were very small, resulting in a substantial portion of the converted alloy being trapped in the slag due to rapid freezing. This results in under-reporting of metal recovery if this "prill" effect is ignored.

In general the 3 samples behaved similarly although the third run on the LX-29 leach residue produced both the highest Nb grade and the highest Nb recovery to alloy(Grade=**61.5%** Nb and recovery, **84.9%-88.9%,** depending on whether the contribution of entrained prills were excluded or included in the calculation.)

In all cases phosphorous substantially reported to the alloy, as was observed in the first set of tests, but efforts to reduce P levels in the concentrate resulted in a generally encouragingly lower P value in the alloy. Silicon reduction remains higher than desirable, with more than half the Si reporting to the alloy and contributes to dilution of the Nb grade of the alloy.

Aluminium utilisation was good considering the small batch sizes involved, and residual Al in the alloy was within the expected range.

Table 3: Summary results for 2nd phase testing

Run #	Description	Sample mass	%Nb Recovery without prill	%Nb Recovery with prill	Nb %	Fe %	Al%	P%	Si%
1	Comp. CL-5-7-8	97.4 g	59.3	71.1	54.4	29.5	6.35	0.22	2.88
2	LX-25 residue	100	73.2	77.5	54.3	31.8	1.82	0.76	4.6
3	LX-29 residue	100	84.9	88.9	61.5	29.7	1.37	0.85	3.72

4. Phase 3 work 2015

4.1 Report 26 February 2015

Conversion tests on a small amount of calcined Taseko concentrate yielded an excellent button and a very well fused slag compared to previous runs. A Niton portable XRF reported the grade of the metal button as 63.7% Nb; and 32.7% Fe. Based on the assumed grade the recovery of Nb exceeded 91%. Prior to crushing the slag for chemical analysis XPS recommended examination of the slag using a scanning electron microscope (SEM) to identify whether the residual Nb was (a) dissolved in the slag, (b) entrained as metal prills or (c) remained as unreacted feed, as this would provide useful information going forward.

The microscopic examination confirmed that the slag itself was niobium free and that niobium not reporting to the metal button was in the form of partially reacted feed material and some very small prills close to the crucible walls. Both modes of niobium loss would not be

significant in a commercial operation. The largest prill identified was 400 micron in diameter representing a mass of approximately 0.3mg. Other prills were much smaller. The EXD point assays on the prill reported similar Nb grades as the Niton on the button.

This confirmed that the additional preheating resulted in a far more fluid slag, and the images showed well-formed crystals of pure corundum (Al_2O_3), confirming that temperatures in the melt comfortably exceeded 2000°C for the most part. The current method of crucible preheating and the use of MgO crucibles will be continued.

The technique allowed visual and chemical confirmation of the success of the testwork and eliminated issues related to the physical separation of slag and metal. Niobium losses were the result of the small scale of the tests and the very rapid cooling occurring with the small melt quantities. The recipes used for the aluminothermic reduction were correct for the targeted Nb grade of alloy. The report recommended electron probe micro analysis (Microprobe) techniques

4.2 Report March 2015

Following the recommendations of the February report a QEMSCAN/ Microprobe analysis of the slag was performed. A phase and compositional study was completed on the FeNb alloy button and slag generated from the conversion test #2. This study defined and quantified the phases present in the two components by QEMSCAN. The compositions of these phases were quantified by EPMA (electron probe microanalysis).

Based on the micro analysis/ QEMSCAN data combination the overall grades and recoveries were calculated on the assumption that the surfaces examined were representative of the macro specimen. Because the full cross section of the alloy and half of the cross section of the slag was examined, this assumption was regarded as being sound.

Table 4: Overall Metallurgical results for Run #2 2015

Species	Total Mass	Nb grade	Nb mass	Nb Recovery
Alloy button	32.4	61.46	19.9	78
Alloy prills	4.55	74.7	3.4	18.8
Slag	58.95	1.7	1.0	3.2
Total	95.9	65.9 (in metal)	25.2	100

The overall Nb recovery (or conversion efficiency) to metal, including the metallic prills is 96.8% at a grade of 65.9% Nb. The recovery to the primary metal button was 78% at a grade of 61.5% Nb 77% of the Nb identified in the slag was in the form of metallics including the 84% Nb grade NbSi alloy prills which alone accounted for almost 40% of the Nb in "slag".

The combination of QEMSCAN and EPMA provided a level of understanding of the metal and slag structure not possible from chemical analysis and microscopy alone. The detailed phase and element deportments provided invaluable information to assist in optimising techniques

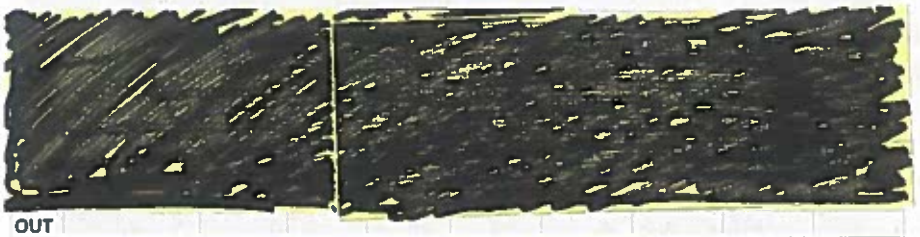
and informing the project team on predicted large scale performance in key areas, such as phosphorous deportment.
The results clearly indicated that the reduction reactions moved rapidly to completion, whereas slag fusion was not completed and full -metal separation did not occur before the melt had solidified. Longer hold times at elevated temperature were expected to assist in further improving slag metal separation. The blend recipe used was shown to be correct, but the structure of the slag hinted at the possibility of improving blending of the ingredients for the next run.

4.3 Report 1 June 2015

A final sample was converted using lessons learned from prior work, including: using only 97% of the theoretical Al requirements, very careful blending of the feed ingredients, maximising preheating, and holding the furnace power on after the conversion reaction had taken place. Following the success of the QEMSCAN and EPMA analysis of the alloy and slag of the second FeNb test, the mineralogical characterisation was completed on slag, alloy and refractory from this this third test.

The crucible containing the slag and alloy was cut in half and ground to a smooth finish on the cut face. The complete half piece was studied rather that cutting smaller pieces. This study defined and quantified the phases present in the three components (slag, alloy and crucible) by QEMSCAN. The compositions of these phases were quantified by EPMA (electron probe microanalysis) on smaller pieces mounted in polished sections. Based on the micro analysis/ QEMSCAN data combination performed, the overall grades and recoveries were calculated in as shown in Table 1. A key assumption was that the surfaces examined were representative of the macro specimen. Because the full cross section of the alloy and slag was examined, this assumption was regarded as being sound.

Table 5. Overall Metallurgical Results



OUT									
	Used crucible	192.7	91.2			3.3			0
	slag	67.5	1.2	1.8	0.0	19.7	0.3	2.9	3.5
	Button	38	0	23.2	12.0	0.0	1.9	0.0	0.7
	Prills	5.5	0	4.1	1.5	0.0	0.44	0.00	0.00
	Loss	0	0	0	0	0	0	0	0
	Total Out	303.7	92.4	29.2	13.5	23.0	2.7	2.9	4.2
	Accountability	100.0	91.2	100.0	100.1	93.3	101.3	83.2	106.2
	Metal Recovery			93.8%	100.1%		101.3%		
	Metal Grade			62.9%					

The overall Nb recovery (or conversion efficiency) to metal, including the metallic prills was calculated at 93.8% at a grade of 62.9% Nb.

The mass of metal entrained in prills was only half of the previous run, so the yield of Nb to primary metal was higher. In all other respects this run duplicated and confirmed the results of the previous test. The results indicated mineralogy and calculated assay similar to the previous sample analysed by QEMSCAN and EPMA. The small differences in the data were due to the differences in the surface area measured between the samples and the method of preparation. The alloy and slag phases were consistent in terms of abundance and texture. The mass balance calculations showed excellent agreement over all the major elements, indicative of good analytical accuracy.

Figure 2: Image of Crucible, metal and slag for Run #3

Figure 3: QEMSCAN image of crucible, metal and alloy

The results confirmed the rapid, reduction reactions compared to the time required for complete slag/ metal separation. The longer hold time above the melting point did indeed assist in further improving slag metal separation, Improved feed blending also improved results,.

Fairly significant interaction between the magnesia crucible and the high alumina slag was noted, as was the amount of $MgAl_2O_4$ spinel formed, and provided some evidence for the slightly inconsistent mass balances obtained in the previous run, where the crucible was not examined.

For small samples such as these, the confidence in the results obtained by QEMSCAN analysis is very much higher than could be obtained by traditional mechanical separation of slag and metal followed by chemical analysis. Valuable additional information on specific element deportment and phase chemistry was seen as an added bonus.

XPS recommended this technique for future work, and suggested a similar QEMSCAN analysis of the concentrate also be performed to understand elemental associations in the feed material in the future.