An Investigation by High Definition Mineralogy into

THE MINERALOGICAL CHARACTERISTICS OF ONE COMPOSITE SPODUMENE RICH SAMPLE FROM THE M^C^AVOY PEGMATITE, TORP LAKE PROJECT, NUNAVUT

prepared for

NORTH ARROW MINERALS INC.

Project 12518-001, MI5045-SEP10 – Final Report
March 17, 2011

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Executive Summary

The mineralogical examination of the sample was carried out with X-ray diffraction (XRD), QEMSCAN™ and whole rock analyses by XRF and AA. A summary of the results is presented below.

Modal Mineralogy

The results from the XRD and QEMSCAN™ are in close agreement.

XRD Analysis

The Li Combined head sample consists of major amounts of spodumene and quartz and minor plagioclase.

QEMSCAN™ Analysis

Li Combined Sample (Unsized)

The sample consists of spodumene (54.6%), quartz (42.1%) and Na-Feldspar (2.2%). Trace amounts (<1%) of microcline, muscovite, sulphides, Ta-Nb-minerals, spessartine, biotite, amphibole, amblygonite, calcite, Fe oxides are also present.

Li Combined Sample (Sized)

The sample consists of spodumene (51.9%), quartz (42.8%) and Na-Feldspar (4.0%). Trace amounts (<1%) of microcline, muscovite, sulphides, Ta-Nb-minerals, spessartine, biotite, amphibole, amblygonite, calcite, Fe oxides are also present.

Note that minor differences in the modal abundance of the two main minerals are expected.

Grain Size Distribution

In the Li Combined sample the d_{50} (mid point in the size distribution) is for Na-Feldspar 69 μm, quartz 127 μm, spodumene 158 μm, and the Particle (all minerals) 157 μm.

Elemental Deportment

Spodumene carries most of the Li (99.4 wt%), while amblygonite carries trace amounts.

Liberation and Association of Spodumene

Free and liberated spodumene accounts for 98.6% (91.2% is free). All other associations occur in trace amounts (<1.0 wt%).

Liberation is very high in all four fractions and drops slightly in the -75 μm fraction. It ranges from 98.9%

in the +425 µm to 98.7% in the -425/+212 µm and 98.4% in the -212/+75 µm, while liberation is slightly lower at 97.7% in the -75 µm.

Free and liberated spodumene occurs throughout all the size classes. Middling particles occur throughout all the size classes in trace amounts (<1.0 wt%).

Liberation and Association of Albite/Quartz

Free and liberated albite/quartz account for 98.1% (97.1% is free). Middling particles of albite/quartz with spodumene account for 1.6% in the sample.

Liberation is very high in all four fractions and ranges from 95.7% in the +425 µm to 97.9% in the -425/+212 µm, 98.5% in the -212/+75 µm, and 99.3% in the -75 µm.

Mineral Release of Spodumene and Albite/Quartz

Liberation in spodumene ranges from 98.9% to 98.7% to 98.4% to 97.7% for 611 µm, 300 µm, 126 µm and 15 µm, respectively. Liberation of feldspars/quartz (combined) ranges from 95.7% to 97.9% to 98.5% to 99.3% for the same size range.

Grade and Recovery of Spodumene

Grades and recoveries of spodumene are similar across the size fractions as expected from the liberation values. Li grades, for the sample at K_{80} of 425 µm, between 3.6% and 3.5%, for recoveries of 98% and 99%, respectively, are expected.

Introduction

This summary report describes a mineralogical test program using High Definition Mineralogy, including the QEMSCAN^{TM} technology (Quantitative Evaluation of Materials by Scanning Electron Microscopy), conducted on one composite sample, referred to as Li Combined sample, submitted by North Arrow Minerals Inc. The purpose of this test program was to determine the overall mineral assemblage and textural characteristics of the sample with emphasis on the liberation/association of spodumene.

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Testwork Summary

1. Sample Receipt and Preparation

Six Li-bearing samples, named 914553, 914555, 914557, 914559, 914561 and 914563 from the McAvoy pegmatite of the Torp Lake Project, Nunavut, were submitted to the mineralogy department at SGS Canada Inc., Lakefield site, by North Arrow Minerals Inc and were assigned the project number 12518-001 and the LIMS number MI5045-SEP10. The six Li-bearing samples were blended to make a Li Combined sample (Table 1).

Table 1: Sample ID and Weights

Sample ID	Initial Weight wt/g
914553	1535.1
914555	1524.7
914557	2387.8
914559	1988.7
914561	1802.8
914563	1702.6
Li Combined Head	4856.3

A small portion of the Li Combined Head sample (unsized) was micro-riffled and subsequent aliquots were submitted for whole rock analyses (WRA) by X-ray fluorescence (XRF) for major elements, Rb (XRF) and Li (SA fusion by Atomic Absorption), and semi-quantitative X-Ray Diffraction (XRD) analysis. These were submitted for quality control purposes. Additional alliquits were also taken for polished section preparation for the QEMSCAN analysis. A total of two graphite-impregnated polished sections were prepared. The graphite impregnated polished sections were submitted for mineralogical analyses using QEMSCAN^{TM} technology.

An additional 500 grams were riffled from the Li Combined Head sample (refer to as sized thereafter) and screened at 212 µm. The sample was screened to avoid generating additional fine-grained material. The +212 portion material was further stage ground to a K_{80} of 425 µm. Then, the -212 µm portion and the stage ground portion were re-combined and screened. Table 2 presented the mass distribution from the screen fraction analysis. Based on the wt% distribution, the sample was combined into four size fractions for QEMSCAN^{TM} analysis and included: +425 µm, -425/+212 µm, -212/+75 µm and -75 µm. In addition, a micro-riffled sub-sample of each of the four size fractions was submitted for whole rock analyses by XRF (including SiO_2, Al_2O_3, Fe_2O_3, MgO and CaO), Rb (XRF) and Li (SA fusion by AA) for data validation and reconciliation purposes. The results are presented in the assay reconciliation portion of this report, and the Certificate of Chemical Analysis is appended. A total of seven graphite-impregnated polished sections included two from each of the first three coarse fractions and one from the finer fraction were prepared. The graphite impregnated polished sections were submitted for mineralogical analyses using QEMSCAN^{TM} technology and the Particle Mineral Analysis (PMA) mode. Electron microprobe analyses were also carried on the spodumene to determine the elemental impurities.

Table 2: Summary of the Screen Analysis (in wt%)

Sample ID	Initial Weight wt/g	+425 µm	-425/+212 µm	-212/+150 µm	-150/+106 µm	-106/+75 µm	-75/+53 µm	-53/+38 µm	-38/+25 µm	-25/+20 µm	-20 µm
Li Combined Sample	472.6	23.4	39.5	5.2	5.1	3.9	11.1	2.8	2.9	0.7	5.4

The certificate of analysis is presented in Appendix A, the XRD results in Appendix B, the additional QEMSCAN^{TM} data in Appendix C and the modes of QEMSCAN^{TM} operation in Appendix D.

2. Operational Modes and Quality Control

2.1. Operational Modes

The Particle Mineral Analysis (PMA) mode of QEMSCAN^{TM} analysis was used for this project. A full description of this and other methods is appended. The PMA is a two-dimensional mapping analysis aimed at resolving liberation and locking characteristics of a generic set of particles. A pre-defined number of particles are mapped at a point spacing selected in order to spatially resolve and describe mineral textures and associations. This mode is often selected to characterize concentrate products, as both gangue and value minerals report in statistically abundant quantities to be resolved.

The PMA scans the entire polished section and provides a statistically robust population of mineral identifications based on X-ray chemistry of minerals. It should be noted that the energy dispersive X-ray characteristics for magnetite and hematite are nearly identical and that these two minerals cannot reliably be distinguished by QEMSCAN™. Note that Li cannot not detected by conventional instruments, including QEMSCAN^{TM}. Li minerals are identified using X-ray diffraction analysis (XRD) and they are identified based on the chemistry of major elements (i.e., Al, Si) in order to calibrate the SIP for the QEMSCAN^{TM} analysis.

2.2. X-Ray Diffraction Analysis

Semi-quantitative XRD analysis was performed on a sub-sample of the Li Combined sample (unsized) for QEMSCAN^{TM} set up and quality control purposes. These results are summarized in Table 3 and Table 4, and the complete XRD report with diffraction patterns is presented in Appendix B. The XRD results are consistent with QEMSCAN^{TM} data.

The sample consists of major amounts of spodumene and quartz and minor plagioclase.

Table 3: Summary of XRD Analysis

Crystalline Mineral Assemblage (relative proportions based on peak height)

Sample	Major (>30% Wt)	Moderate (10% -30% Wt)	Minor (2% -10% Wt)	Trace (<2% Wt)
Li Combined Sample	spodumene, quartz	-	plagioclase	-

** tentative identification due to low concentrations, diffraction line overlap or poor crystallinity*

Table 4: Summary of Semi-Quantitative XRD Analysis

Mineral	Li Combined Sample (wt %)
Quartz	39.9
Albite	4.5
Spodumene	55.6
TOTAL	100.0

2.3. QEMSCAN™ Operational Statistics and Assay Reconciliation

All data were processed with the iExplorer software version 4.2 SR1. A mineral list developed for the analyzed samples is shown in Table 5.

Table 5. Mineral List and Formulas

Mineral	Mineral Formula
Na-Feldspar	$(NaSi,CaAl)AlSi_2O_8$
Quartz	SiO_2
Microcline	$KAlSi_3O_8$
Spodumene	$LiAlSi_2O_6$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Spessartine	$Mn_3Al_2Si_3O_{12}$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Amphibole	$(Na,K)Ca_2(Fe,Mg)_5(Al,Si)_8O_{22}(OH)_2$
Amblygonite	$LiAlFPO_4$
Calcite	$CaCO_3$

2.3.1. Li Combined Sample (Unsized)

Key QEMSCAN™ mineralogical assays have been regressed with the chemical assays for Li Combined sample, as presented in Table 6 and Figure 1, respectively. Overall correlation, as measured by R-squared criteria is 1.00, with a slope of 0.98. R-squared values above 0.98 and slopes between 0.97 and 1.03 are considered acceptable.

Table 6: QEMSCAN™ and Direct Assay Reconciliation - Li Combined Sample (Unsized)

	Li Combined Sample (Unsized)
	-600/+3um
Al (QEMSCAN)	9.7
Al (Chemical)	8.6
Fe (QEMSCAN)	0.2
Fe (Chemical)	0.3
K (QEMSCAN)	0.1
K (Chemical)	0.1
Li (QEMSCAN)	2.3
Li (Chemical)	1.9
Na (QEMSCAN)	0.2
Na (Chemical)	0.4
P (QEMSCAN)	0.0
P (Chemical)	0.1
Si (QEMSCAN)	35.3
Si (Chemical)	35.9

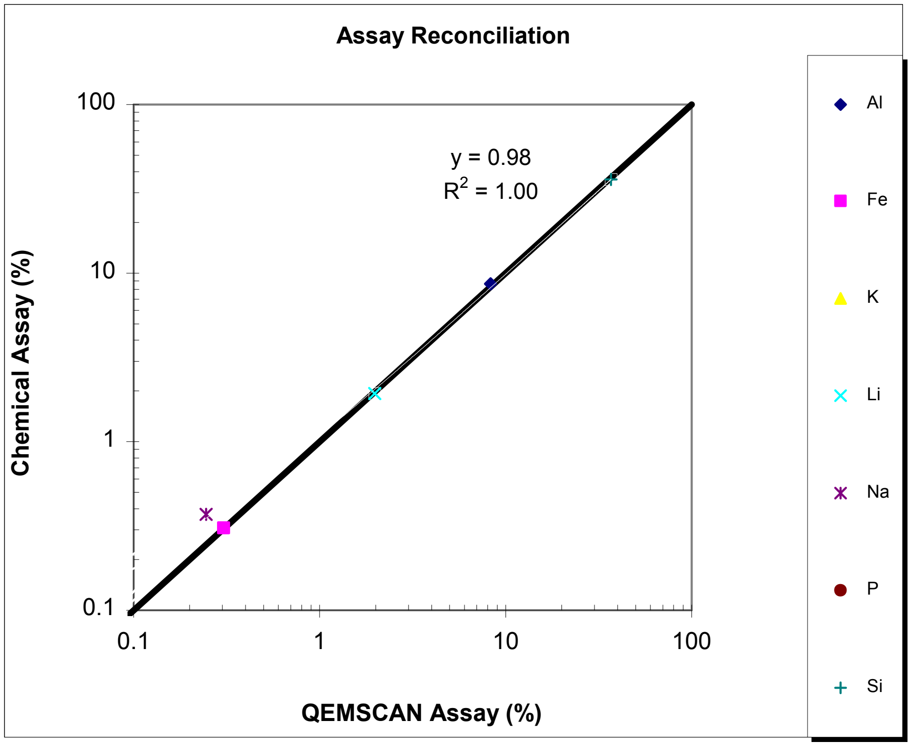


Figure 1: QEMSCAN™ and Direct Assay Reconciliation - Li Combined Sample (Unsized)

2.3.2. Li Combined Sample (Sized)

Key QEMSCAN™ mineralogical assays have been regressed with the chemical assays for Li Combined sample (sized), as presented in Table 7 and Figure 2, respectively. Overall correlation, as measured by R-squared criteria is 1.00, with a slope of 0.98. R-squared values above 0.98 and slopes between 0.97 and 1.03 are considered acceptable.

Table 7: QEMSCAN™ and Direct Assay Reconciliation - Li Combined Sample (Sized)

	Li Combined Sample				
	Combined	+425um	-425/+212um	-212/+75um	-75um
Al (QEMSCAN)	8.1	10.1	8.3	7.6	6.2
Al (Chemical)	8.8	10.2	8.8	8.0	7.8
Fe (QEMSCAN)	0.3	0.2	0.2	0.2	0.5
Fe (Chemical)	0.3	0.2	0.3	0.3	0.5
K (QEMSCAN)	0.1	0.0	0.1	0.1	0.1
K (Chemical)	0.1	0.1	0.1	0.1	0.2
Li (QEMSCAN)	1.9	2.5	1.9	1.7	1.3
Li (Chemical)	2.0	2.4	2.0	1.8	1.6
Na (QEMSCAN)	0.4	0.2	0.4	0.4	0.6
Na (Chemical)	0.4	0.2	0.4	0.4	0.6
P (QEMSCAN)	0.1	0.0	0.0	0.0	0.1
P (Chemical)	0.1	0.0	0.1	0.1	0.1
Si (QEMSCAN)	37.0	34.9	37.0	37.7	38.7
Si (Chemical)	36.3	34.8	36.5	37.2	37.0

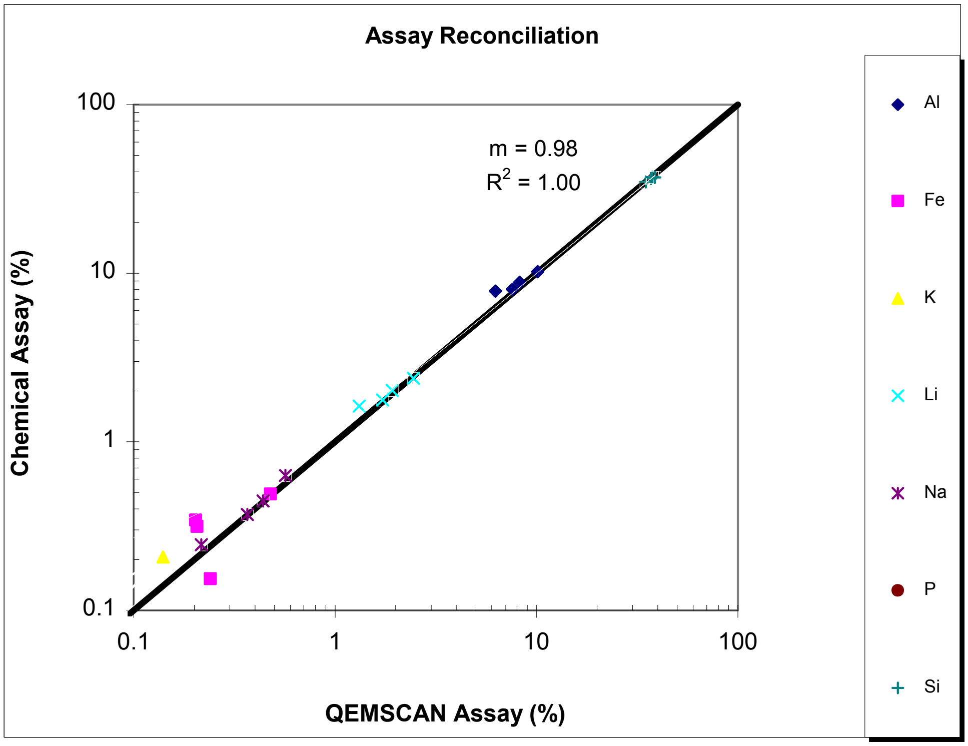


Figure 2: QEMSCAN™ and Direct Assay Reconciliation - Li Combined Sample (Sized)

3. Mineralogical Analyses of the Li Combined Sample (Unsized)

3.1. Modal Abundance and Grain Size

The results of the bulk modal analysis of the Li Combined sample (unsized) are presented in Table 8 and are graphically shown in Figure 3. Representative particle maps, sorted based on the size spodumene are presented in Figure 4 and Figure 5.

The sample consists of spodumene (54.6%), quartz (42.1%) and Na-Feldspar (2.2%). Trace amounts (<1%) of microcline, muscovite, sulphides, Ta-Nb-minerals, spessartine, biotite, amphibole, amblygonite, calcite, and Fe oxides are also present.

Table 8: Modal Analysis of the Li Combined Sample (Unsized)

Survey		**North Arrow Minerals Inc.**
Project		**12518-001 / MI5045-SEP10**
Sample		**Li Combined Sample (Unsized)**
Fraction		**-600/+3um**
Mass Size Distribution (%)		100.0
Particle Size		509
		Sample
Mineral Mass (%)	Na-Feldspar	1.8
	Quartz	32.7
	Microcline	0.0
	Spodumene	64.0
	Muscovite	1.1
	Sulphides	0.0
	Ta-Nb-minerals	0.0
	Spessartine	0.0
	Biotite	0.0
	Amphibole	0.0
	Amblygonite	0.2
	Calcite	0.0
	Fe Oxide	0.0
	Other	0.1
	Total	100.0
Mean Grain Size by Frequency (μm)	Na-Feldspar	165
	Quartz	367
	Microcline	39
	Spodumene	487
	Muscovite	284
	Sulphides	0
	Ta-Nb-minerals	47
	Spessartine	35
	Biotite	30
	Amphibole	31
	Amblygonite	256
	Calcite	0
	Fe Oxide	38
	Other	77

Note: The size of the minerals as shown in the tables is calculated statistically from the length of all the horizontal intercepts through each particle. It uses an assumption of random sectioning of spherical particles having uniform size, to obtain an estimate of the stereologically-corrected grain size in microns. The size calculation is a statistical property, which means that it is only valid when applied to a population of particles, and its accuracy increases as the population size increases. The accuracy of the size calculation is extremely low if applied to just a single cross-section.

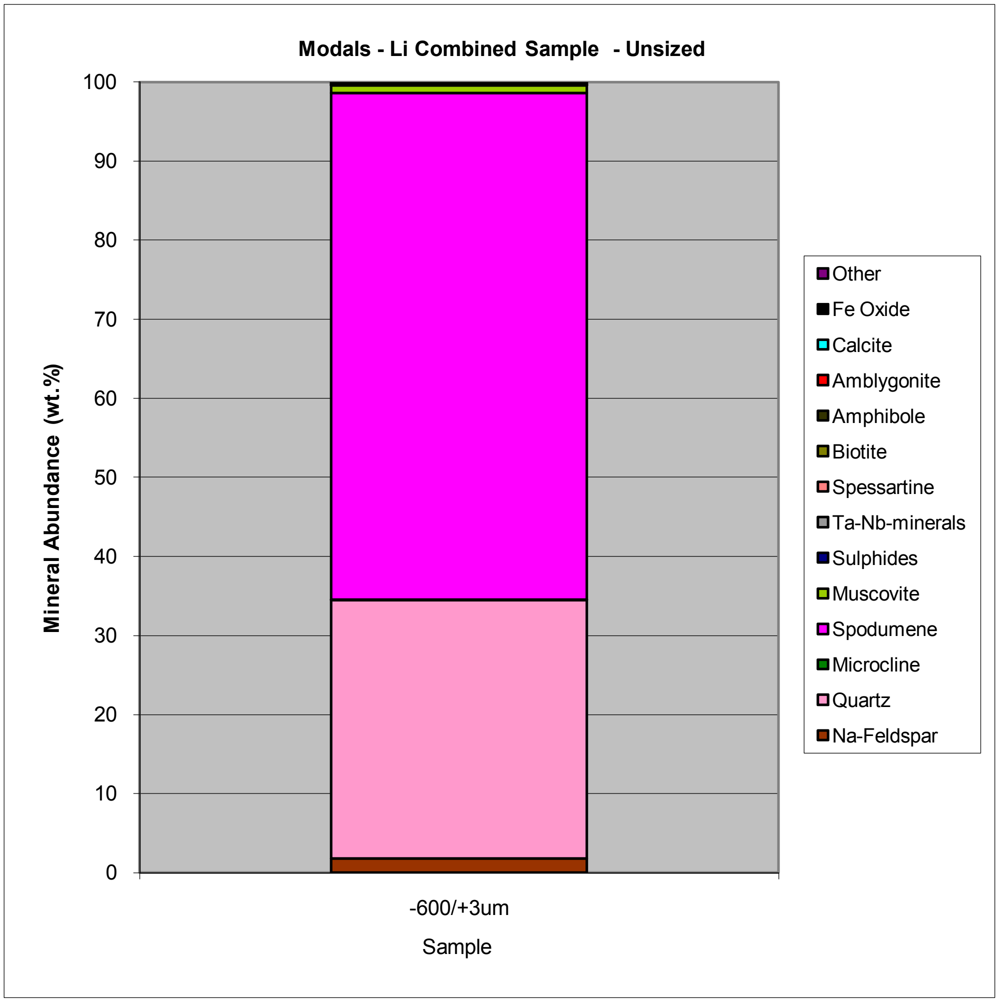
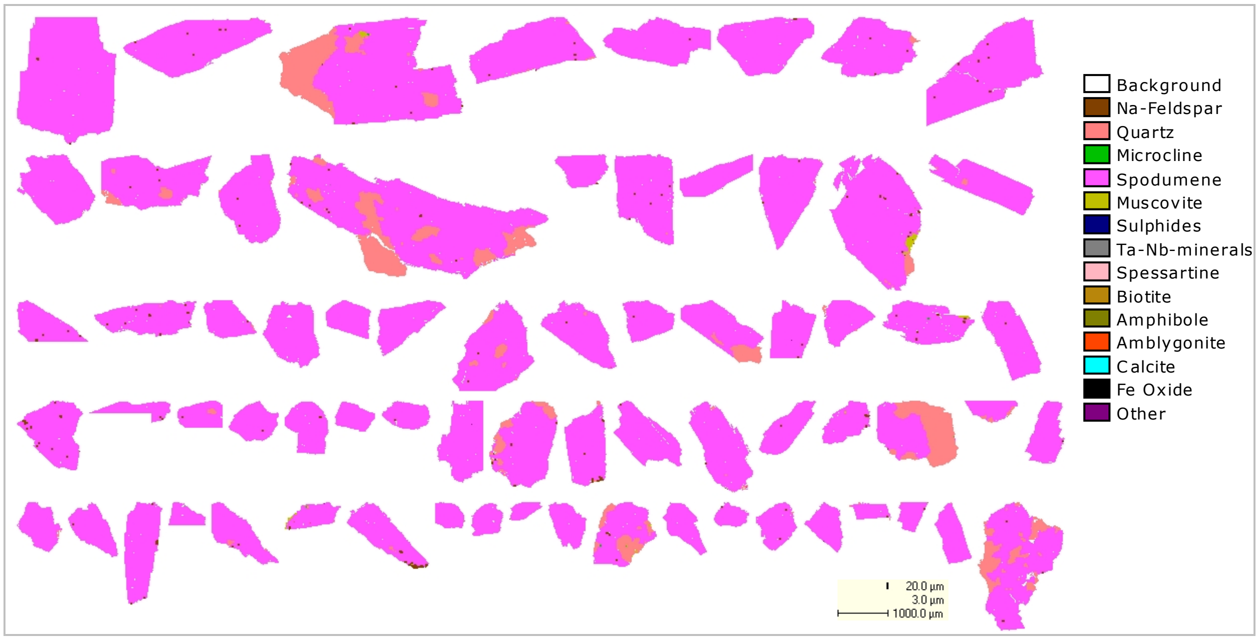


Figure 3: Mineral Distribution Profile of the Li Combined Sample (Unsized)



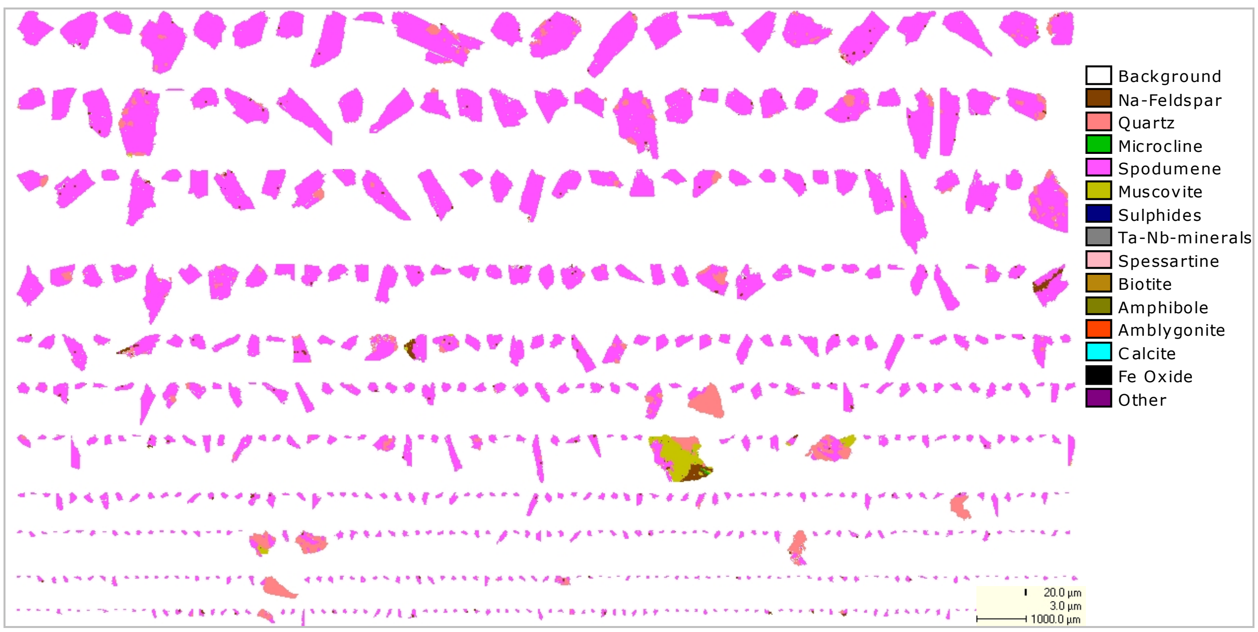
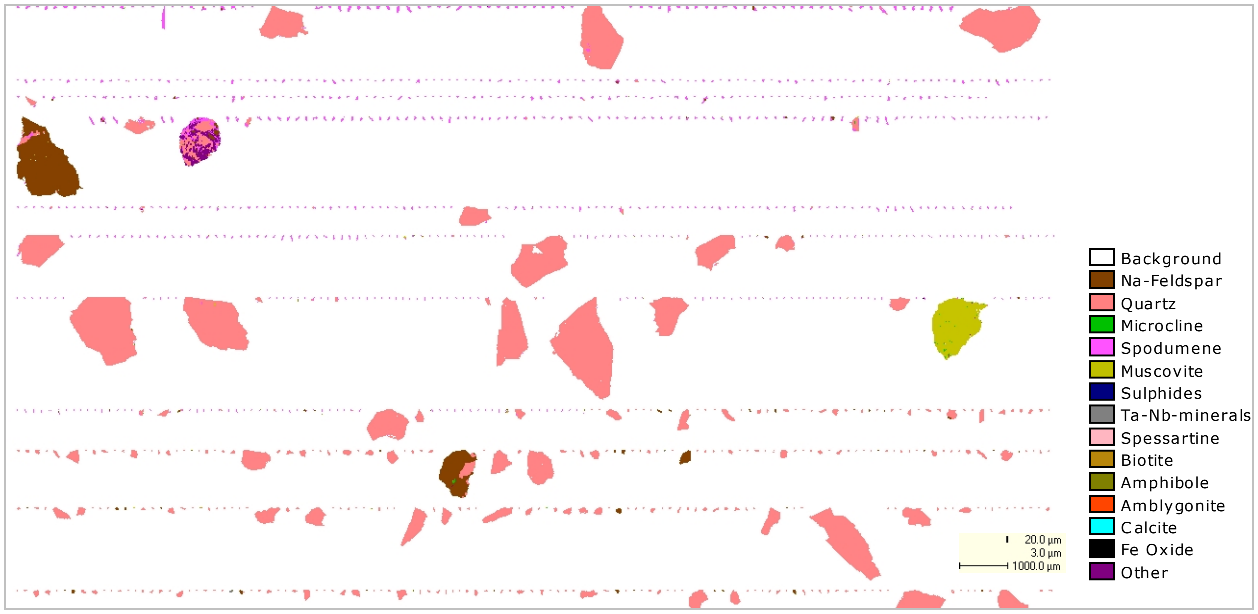


Figure 4. Particle Maps of the Li Combined Sample (Unsized)



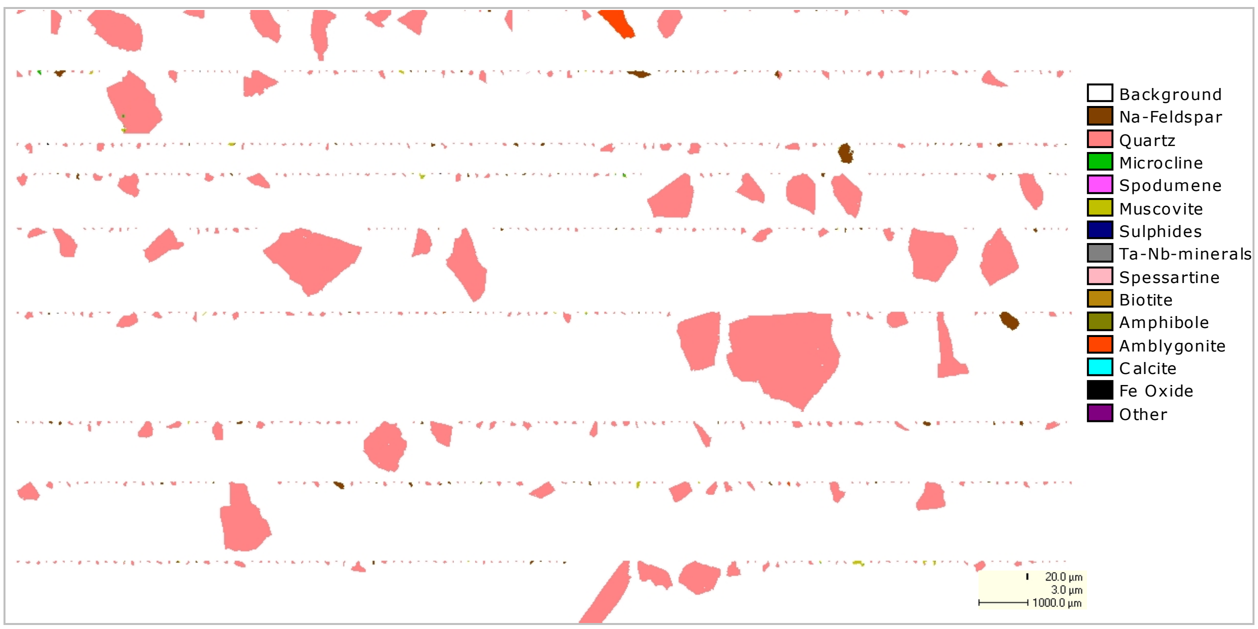


Figure 5. Particle Maps of the Li Combined Sample (Unsized)

4. Mineralogical Analyses of the Li Combined Sample (Sized)

4.1. Modal Abundance and Grain Size

The results of the bulk modal analysis of the Li Combined sample (sized) are presented in Table 9 and are graphically shown in Figure 6.

The sample consists of spodumene (51.9%), quartz (42.8%) and Na-Feldspar (4.0%). Trace amounts (<1%) of microcline, muscovite, sulphides, Ta-Nb-minerals, spessartine, biotite, amphibole, amblygonite, calcite, and Fe oxides are also present. Note that trace amounts of minerals such as amblygonite, Ta-Nb etc. are tentatively identified and additional work is necessary to determine their occurrence.

Most of the spodumene mass occurs in the -425/+212 µm fraction at 21.0% (of the sample), followed by 15.9% in the +425 µm, 8.2% in the -75 µm and 6.7% in the -212/+75 µm.

Note that minor differences are expected in the modal mineral abundance between the unsized and sized sample due to the large size variation of particle size in the unsized sample.

Table 9: Modal Analysis of the Li Combined Sample (Sized)

Survey		**North Arrow Minerals Inc.**								
Project		**12518-001 / MI5045-SEP10**								
Sample		**Li Combined Sample**								
Fraction		**Combined**	**+425um**		**-425/+212um**		**-212/+75um**		**-75um**	
Mass Size Distribution (%)			23.4		39.5		14.2		22.9	
Particle Size		50	271		137		64		17	
		Sample	**Sample**	**Fraction**	**Sample**	**Fraction**	**Sample**	**Fraction**	**Sample**	**Fraction**
Mineral Mass (%)	Na-Feldspar	4.0	0.4	1.7	1.5	3.7	0.7	4.6	1.4	6.3
	Quartz	42.8	6.9	29.7	16.7	42.2	6.6	46.6	12.5	54.6
	Microcline	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.2
	Spodumene	51.9	15.9	68.1	21.0	53.3	6.7	47.4	8.2	35.8
	Muscovite	0.7	0.1	0.3	0.2	0.5	0.1	0.9	0.3	1.3
	Sulphides	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4
	Ta-Nb-minerals	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
	Spessartine	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	Biotite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Amphibole	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.4
	Amblygonite	0.2	0.0	0.2	0.1	0.1	0.0	0.2	0.1	0.4
	Calcite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fe Oxide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
	Total	100.0	23.4	100.0	39.5	100.0	14.2	100.0	22.9	100.0
Mean Grain Size by Frequency (µm)	Na-Feldspar		101		85		47		14	
	Quartz		234		140		68		16	
	Microcline		20		22		16		7	
	Spodumene		253		122		59		18	
	Muscovite		60		47		33		10	
	Sulphides		14		0		7		22	
	Ta-Nb-minerals		14		20		14		6	
	Spessartine		14		10		8		6	
	Biotite		14		10		9		4	
	Amphibole		15		10		9		5	
	Amblygonite		190		105		55		10	
	Calcite		0		17		7		4	
	Fe Oxide		0		25		18		7	
	Other		15		12		15		6	

Note: The size of the minerals as shown in the tables is calculated statistically from the length of all the horizontal intercepts through each particle. It uses an assumption of random sectioning of spherical particles having uniform size, to obtain an estimate of the stereologically-corrected grain size in microns. The size calculation is a statistical property, which means that it is only valid when applied to a population of particles, and its accuracy increases as the population size increases. The accuracy of the size calculation is extremely low if applied to just a single cross-section.

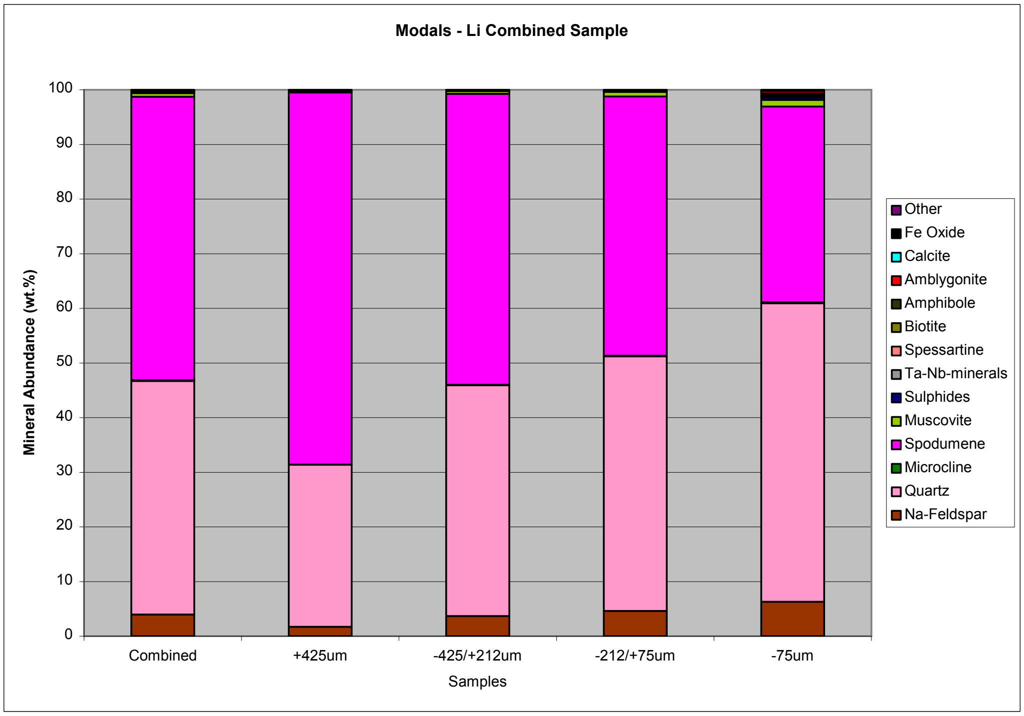


Figure 6: Mineral Distribution Profile of the Li Combined Sample (Sized)

4.2. Grain Size Distribution

Figure 7 illustrates the cumulative grain size distribution of the main mineral phases for the Li Combined sample (sized). The curve referred to as "Particle" reflects all the measured minerals in the sample. The d_{50} (mid point in the size distribution) for:

- Na-Feldspar is 69 µm,
- Quartz is 127 µm,
- Spodumene is 158 µm, and
- the Particle curve includes all the mineral phases and follows a similar trend. About 50% of all particles are greater than 157 µm.

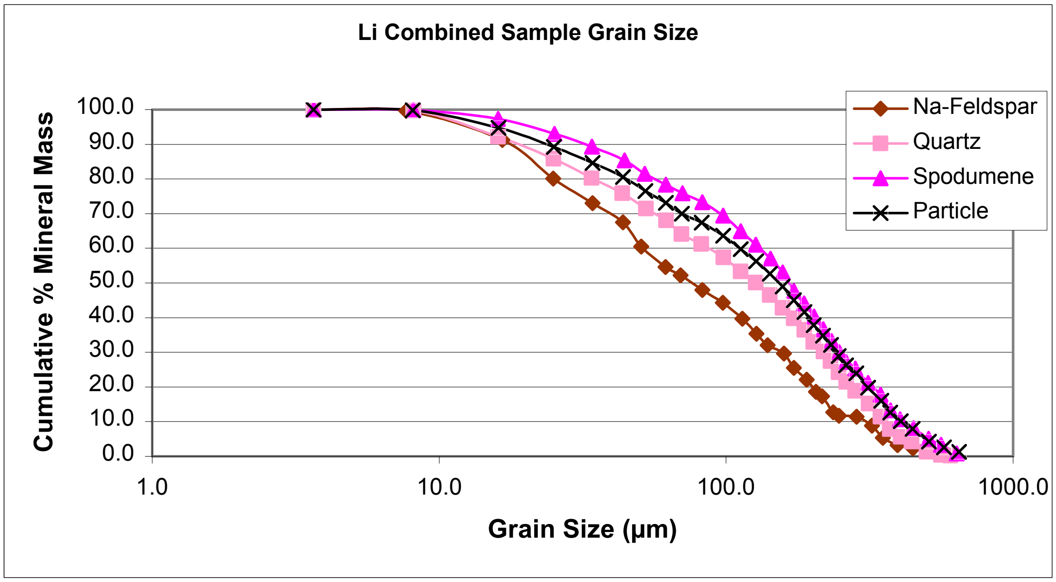


Figure 7: Cumulative Average Grain Size Distribution of Main Minerals in the Li Combined Sample (Sized)

4.3. Electron Microprobe Analyses of Spodumene

Electron microprobe analyses of spodumene were carried out at Laboratoire de Microanalyse - Universite Laval, Quebec, Canada, using a CAMECA SX-100 electron microprobe. The scope was to determine the composition of the mineral. The results are shown in Table 10. Note that Li is a light element and cannot be quantified by the electron microprobe. The Li_2O content shown in the table is by difference. Spodumene is clean of major element impurities and particular of Fe and Mn. Note that the levels of Fe and Mn are very close to the detection limits of the probe so the impurities are very low.

Table 10: Electron Microprobe Analyses of Spodumene

Analysis / wt%	MnO	FeO	K2O	CaO	Na2O	MgO	Al2O3	SiO2	Li2O*	Total
#1	0.02	0.00	0.00	0.00	0.10	0.01	27.84	66.34	5.68	100.00
#2	0.03	0.01	0.00	0.00	0.09	0.00	27.90	67.39	4.58	100.00
#3	0.00	0.00	0.00	0.00	0.08	0.00	27.79	66.23	5.90	100.00
#4	0.03	0.01	0.00	0.00	0.10	0.02	27.95	67.70	4.19	100.00
#5	0.02	0.07	0.00	0.00	0.08	0.01	27.63	65.85	6.34	100.00
#6	0.01	0.00	0.00	0.00	0.10	0.00	27.72	65.85	6.31	100.00
#7	0.00	0.01	0.00	0.00	0.10	0.01	27.83	66.32	5.73	100.00
#8	0.00	0.01	0.00	0.00	0.12	0.00	27.69	65.97	6.21	100.00
#9	0.01	0.00	0.00	0.00	0.11	0.01	27.84	66.78	5.25	100.00
#10	0.01	0.00	0.00	0.00	0.10	0.00	27.90	65.63	6.37	100.00
#11	0.02	0.02	0.00	0.00	0.07	0.00	27.74	65.86	6.29	100.00
#12	0.01	0.03	0.00	0.00	0.12	0.00	27.95	65.58	6.31	100.00
#13	0.12	0.02	0.00	0.00	0.08	0.01	27.75	65.28	6.74	100.00
#14	0.00	0.00	0.00	0.00	0.11	0.01	27.95	66.74	5.18	100.00
#15	0.03	0.00	0.00	0.00	0.10	0.00	27.69	65.42	6.76	100.00
#16	0.01	0.02	0.00	0.00	0.07	0.01	27.67	65.62	6.59	100.00
#17	0.00	0.02	0.00	0.01	0.11	0.01	27.60	65.32	6.93	100.00
#18	0.02	0.00	0.00	0.00	0.11	0.01	27.77	65.95	6.14	100.00
#19	0.00	0.02	0.00	0.00	0.09	0.00	27.63	65.75	6.50	100.00
#20	0.01	0.02	0.00	0.00	0.10	0.00	27.82	67.04	5.00	100.00
#21	0.01	0.06	0.00	0.00	0.10	0.00	27.67	65.86	6.30	100.00
#22	0.01	0.01	0.00	0.00	0.11	0.01	27.75	65.35	6.75	100.00
#23	0.00	0.00	0.00	0.00	0.12	0.01	27.69	65.70	6.47	100.00
#24	0.01	0.02	0.00	0.00	0.07	0.01	27.83	66.49	5.58	100.00
#25	0.04	0.05	0.00	0.00	0.08	0.00	27.71	65.15	6.96	100.00
#26	0.01	0.00	0.00	0.03	0.17	0.01	27.51	65.92	6.36	100.00
#27	0.00	0.00	0.00	0.00	0.10	0.00	27.67	65.46	6.76	100.00
#28	0.02	0.02	0.00	0.00	0.09	0.01	27.65	67.24	4.97	100.00
#29	0.00	0.02	0.00	0.00	0.12	0.02	27.74	66.34	5.75	100.00
#30	0.00	0.02	0.00	0.00	0.12	0.00	27.68	65.94	6.24	100.00
#31	0.00	0.04	0.00	0.00	0.08	0.02	27.81	66.73	5.32	100.00
#32	0.01	0.00	0.00	0.00	0.14	0.00	27.63	64.85	7.37	100.00
#33	0.01	0.00	0.00	0.00	0.11	0.00	27.77	66.68	5.42	100.00
Average	**0.01**	***0.02***	***0.00***	***0.00***	**0.10**	***0.01***	**27.75**	**66.07**	**6.04**	
Std.Dev.	0.02	0.02	0.00	0.01	0.02	0.01	0.11	0.68	0.74	

Detection limits (in wt%) were for MnO 0.014, FeO 0.017, K_2O 0.005, CaO 0.006, Na_2O 0.008, MgO 0.008, Al_2O_3 0.012 and SiO_2 0.017.
Li_2O: by difference*

4.3.1. Li Deportment

The normalized elemental deportment of lithium for the Li Combined sample is graphically presented in Figure 8. The Li values used for this calculation are based on theoretical compositions of amblygonite and the probe analysis of spodumene.

In the Li Combined sample (sized), spodumene accounts for the majority of the lithium (99.4 wt%), followed by trace amounts of amblygonite.

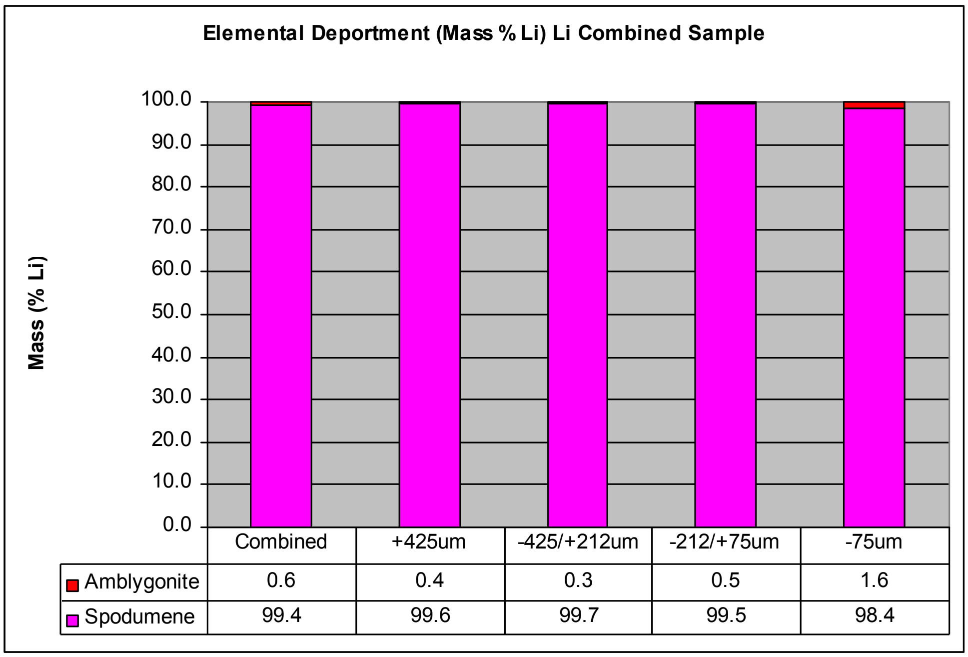


Figure 8. Elemental Li Deportment for the Li Combined Sample (Sized)

4.4. Liberation and Association

The liberation and association characteristics of spodumene were examined. For the purposes of this analysis, particle liberation is defined based on 2D particle area percent. Particles are classified in the following groups (in descending order) based on mineral-of-interest area percent: free (=95% surface exposure) and liberated (≥80%) (Figure 9). The non-liberated grains have been classified according to association characteristics, where binary association groups refer to particle area percent greater than or equal to 95% of the two minerals or mineral groups. The complex groups refer to particles with ternary, quaternary and greater mineral associations including the mineral of interest.

Liberation classes were defined as the following;

- **Free:** A mineral with > 95% surface exposure
- **Liberated:** A mineral with ≥ 80% but < 95%surface exposure
- **Middlings (Mids):** A mineral with ≥ 50% but < 80% surface exposure
- **Sub-middlings (Sub-Mids):** A mineral with ≥ 20% but < 50% surface exposure
- **Locked:** A mineral with < 20% surface exposure

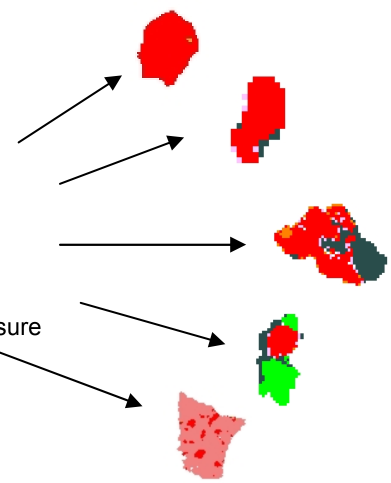


Figure 9. Terminology - Liberation and Association

Association classes were defined as the following:

- Barren – A particle that has 0% of Spodumene
- Free Spodumene - A particle that has > 95% of Spodumene
- Lib Spodumene - A particle that has > 80% of Spodumene
- Binary Spd:Na-Feldspar- A particle that has ≥ 95 area% of Spodumene + Na-Feldspar
- Binary Spd:Quartz- A particle that has ≥ 95 area% of Spodumene + Quartz
- Binary Spd:Microcline - A particle that has ≥ 95 area% of Spodumene + Microcline
- Binary Spd:Muscovite - A particle that has ≥ 95 area% of Spodumene + Muscovite
- Binary Spd:Ta-Nb minerals - A particle that has ≥ 95 area% of Spodumene + Ta-Nb minerals
- Binary Spd:Other - A particle that has ≥ 95 area% of Spodumene + Other
- Complex: Any combination of the above definitions has been defined as a complex particle.

4.5. Spodumene Liberation and Association

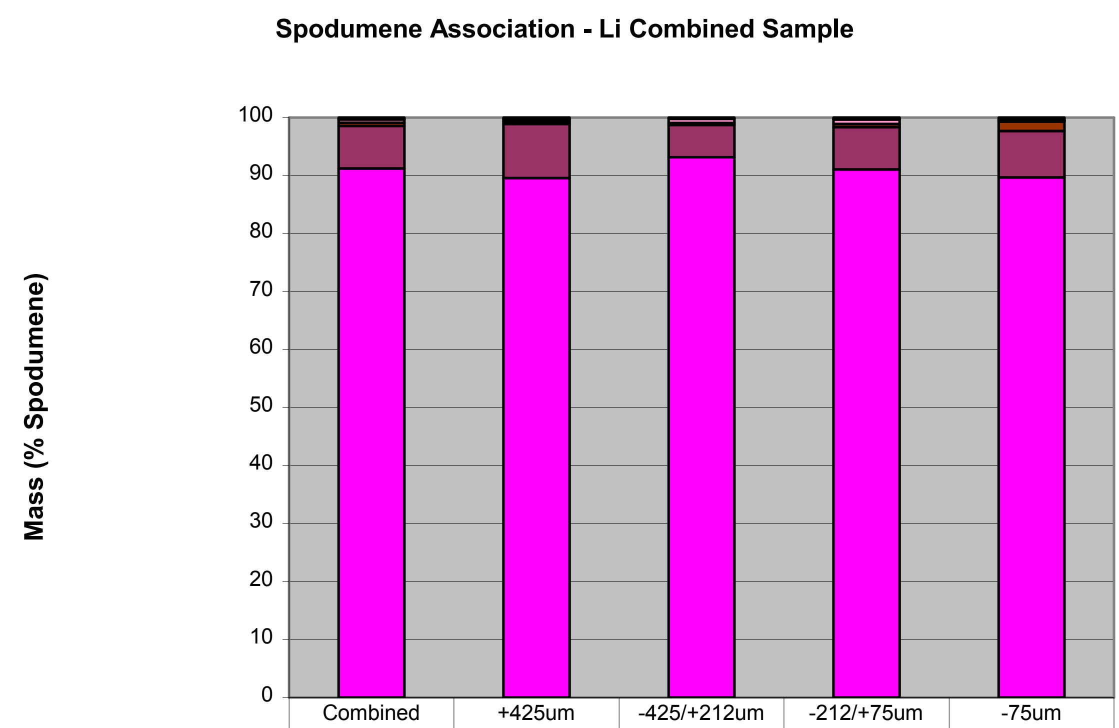
Liberation and association data for spodumene are given in Table 11 and graphically presented in Figure 10. An image grid of the association and additional particle maps of spodumene are given in Figure 11.

Free and liberated spodumene accounts for 98.6% (91.2% is free). All other associations occur in trace amounts (<1.0 wt%).

Liberation is very high in all four fractions and drops slightly in the -75 µm fraction. It ranges from 98.9% in the +425 µm to 98.7% in the -425/+212 µm and 98.4% in the -212/+75 µm, and 97.7% in the -75 µm.

Table 11. Normalized Liberation Mass of Spodumene of the Li Combined Sample (Sized)

Mineral Name	Combined	+425um	-425/+212um	-212/+75um	-75um
Free Spodumene	91.2	89.6	93.2	91.1	89.7
Lib Spodumene	7.3	9.3	5.6	7.3	8.0
Spd:Na-Feldspar	0.6	0.4	0.3	0.5	1.6
Spd:Quartz	0.5	0.4	0.7	0.8	0.2
Spd:Microcline	0.0	0.0	0.0	0.0	0.0
Spd:Muscovite	0.0	0.0	0.0	0.0	0.0
Spd:Ta-Nb minerals	0.0	0.0	0.0	0.0	0.0
Spd:Other	0.0	0.0	0.0	0.0	0.1
Complex Spd	0.3	0.3	0.2	0.3	0.4
Total	100.0	100.0	100.0	100.0	100.0



	Combined	+425um	-425/+212um	-212/+75um	-75um
Complex Spd	0.3	0.3	0.2	0.3	0.4
Spd:Other	0.0	0.0	0.0	0.0	0.1
Spd:Ta-Nb minerals	0.0	0.0	0.0	0.0	0.0
Spd:Muscovite	0.0	0.0	0.0	0.0	0.0
Spd:Microcline	0.0	0.0	0.0	0.0	0.0
Spd:Quartz	0.5	0.4	0.7	0.8	0.2
Spd:Na-Feldspar	0.6	0.4	0.3	0.5	1.6
Lib Spodumene	7.3	9.3	5.6	7.3	8.0
Free Spodumene	91.2	89.6	93.2	91.1	89.7

Figure 10. Spodumene Liberation and Association Profile of the Li Combined Sample (Sized)

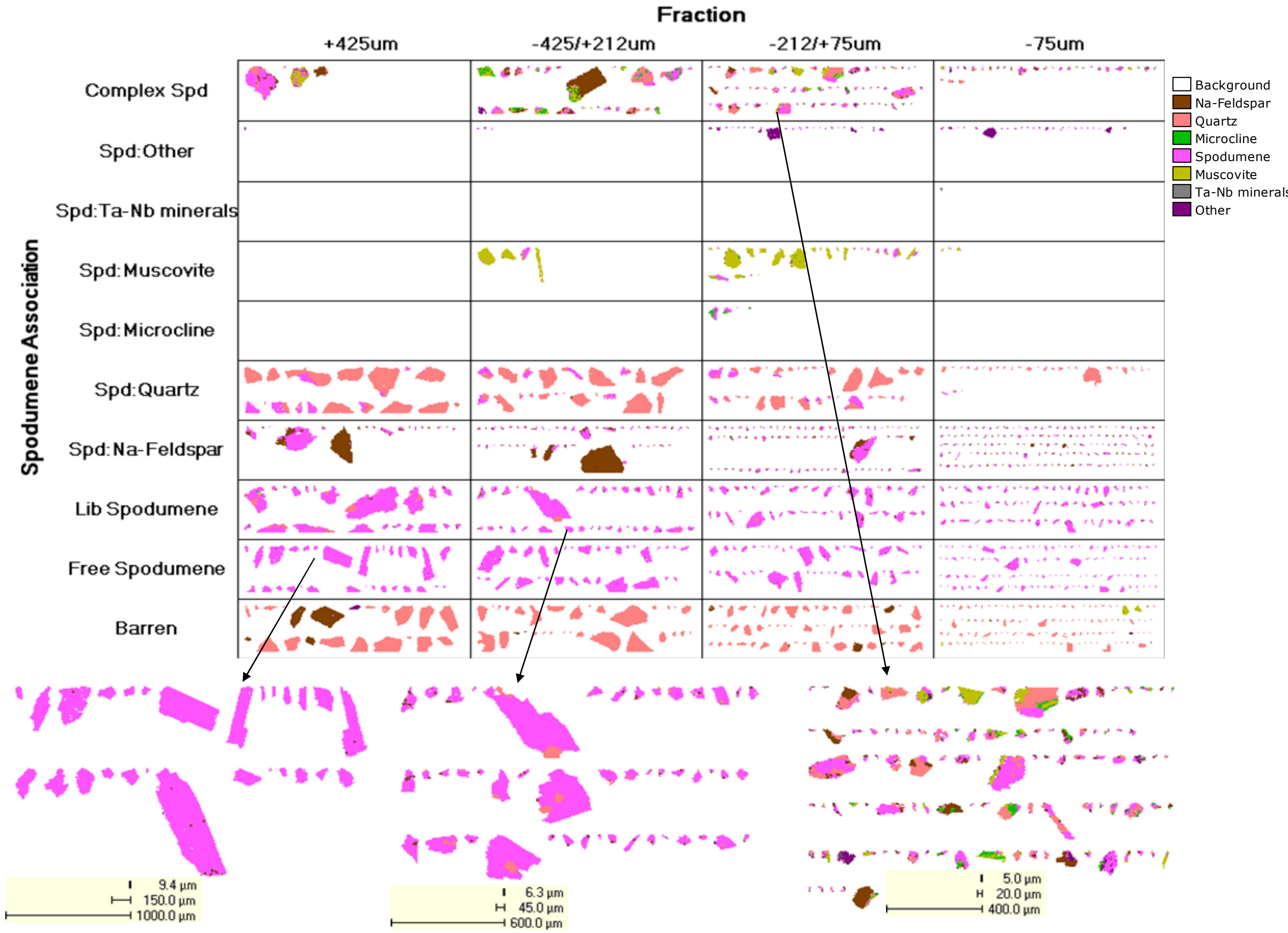
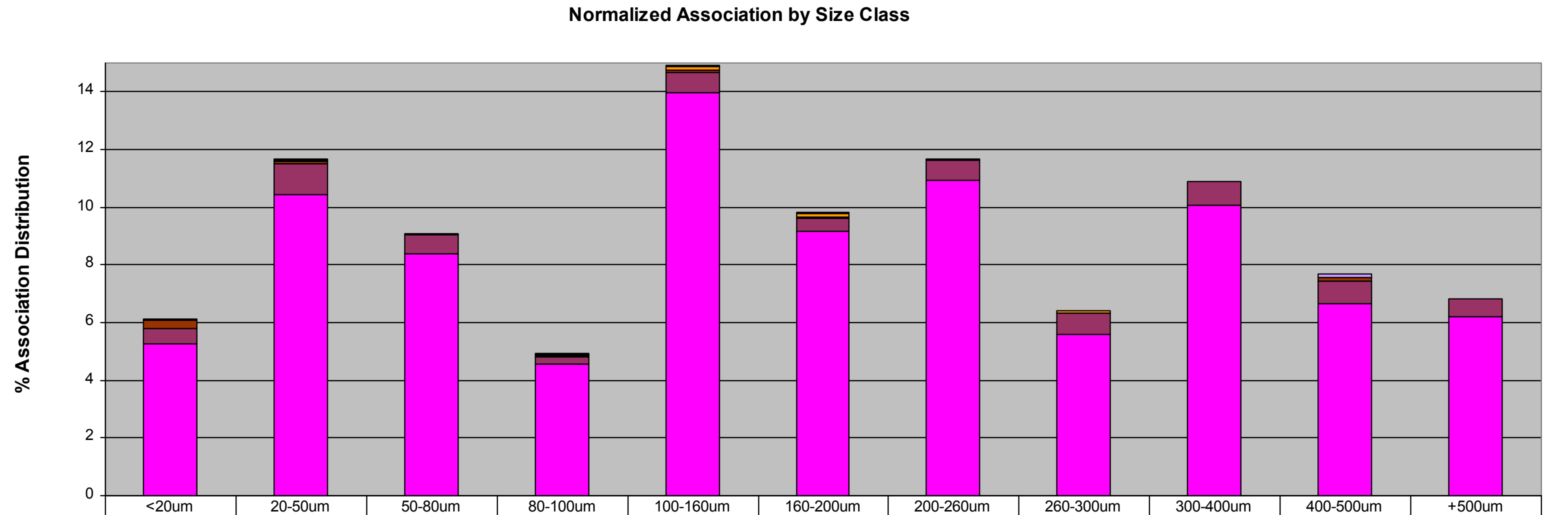


Figure 11. Image Grid Based on Liberation and Association of Spodumene of the Li Combined Sample (Sized)

The liberation and association (by size class) of spodumene is presented in Figure 12. Free and liberated spodumene occurs throughout all the size classes. Middling particles occur throughout all the size classes at minor but varied amounts.



	<20um	20-50um	50-80um	80-100um	100-160um	160-200um	200-260um	260-300um	300-400um	400-500um	+500um
Complex Spd	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Spd:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spd:Ta-Nb minerals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spd:Muscovite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spd:Microcline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spd:Quartz	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.0	0.0
Spd:Na-Feldspar	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Lib Spodumene	0.5	1.1	0.6	0.2	0.7	0.4	0.7	0.7	0.8	0.8	0.6
Free Spodumene	5.3	10.4	8.4	4.6	14.0	9.2	10.9	5.6	10.0	6.7	6.2

Figure 12. Spodumene Liberation by Size Characteristics of the Li Combined Sample (Sized)

4.6. Albite/Quartz Liberation and Association

The two main gangue minerals in the sample are albite (Na-feldspar) and quartz/. These were combined in order to calculate their liberation and association.

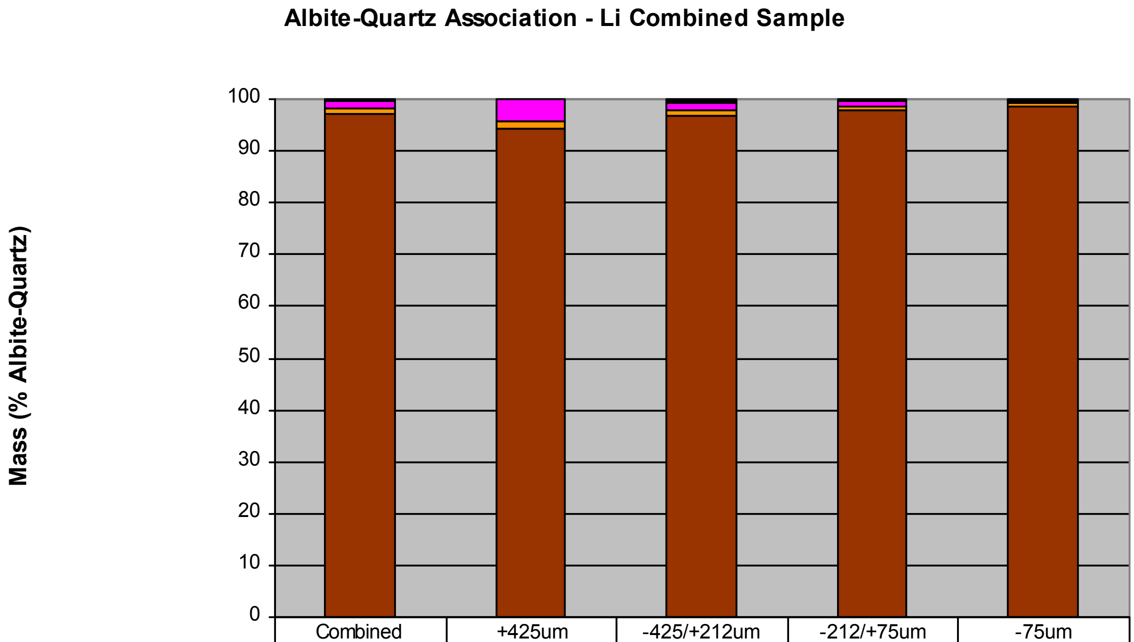
Liberation and association data for albite/quartz (combined) are given in Table 12 and graphically presented in Figure 13. An image grid of the association and additional particle maps of feldspars/quartz are given in Figure 14.

Free and liberated albite/quartz accounts for 98.1% (97.1% is free). Middling particles of albite/quartz with spodumene account for 1.6% in the sample, and decrease with decreasing size from 4.3% to 0.5%. All other associations are negligible.

Liberation is very high in all four fractions and ranges from 95.7% in the +425 μm to 97.9% in the -425/+212 μm, 98.5% in the -212/+75 μm, and 99.3% in the -75 μm.

Table 12. Normalized Liberation Mass of Albite/Quartz of the Li Combined Sample (Sized)

Mineral Name	Combined	+425um	-425/+212um	-212/+75um	-75um
Free Albite/Quartz	97.1	94.1	96.9	97.8	98.5
Lib Albite/Quartz	1.0	1.6	1.0	0.8	0.8
Ab/Qz:Spodumene	1.6	4.3	1.6	1.2	0.5
Ab/Qz:Microcline	0.0	0.0	0.1	0.1	0.0
Ab/Qz:Muscovite	0.1	0.0	0.3	0.0	0.0
Ab/Qz:Ta-Nb minerals	0.0	0.0	0.0	0.0	0.0
Ab/Qz:Other	0.0	0.0	0.0	0.0	0.1
Complex Ab/Qz	0.2	0.0	0.2	0.2	0.1
Total	100.0	100.0	100.0	100.0	100.0



	Combined	+425um	-425/+212um	-212/+75um	-75um
Complex Ab/Qz	0.2	0.0	0.2	0.2	0.1
Ab/Qz:Other	0.0	0.0	0.0	0.0	0.1
Ab/Qz:Ta-Nb minerals	0.0	0.0	0.0	0.0	0.0
Ab/Qz:Muscovite	0.1	0.0	0.3	0.0	0.0
Ab/Qz:Microcline	0.0	0.0	0.1	0.1	0.0
Ab/Qz:Spodumene	1.6	4.3	1.6	1.2	0.5
Lib Albite/Quartz	1.0	1.6	1.0	0.8	0.8
Free Albite/Quartz	97.1	94.1	96.9	97.8	98.5

Figure 13. Albite/Quartz Liberation and Association Profile of the Li Combined Sample (Sized)

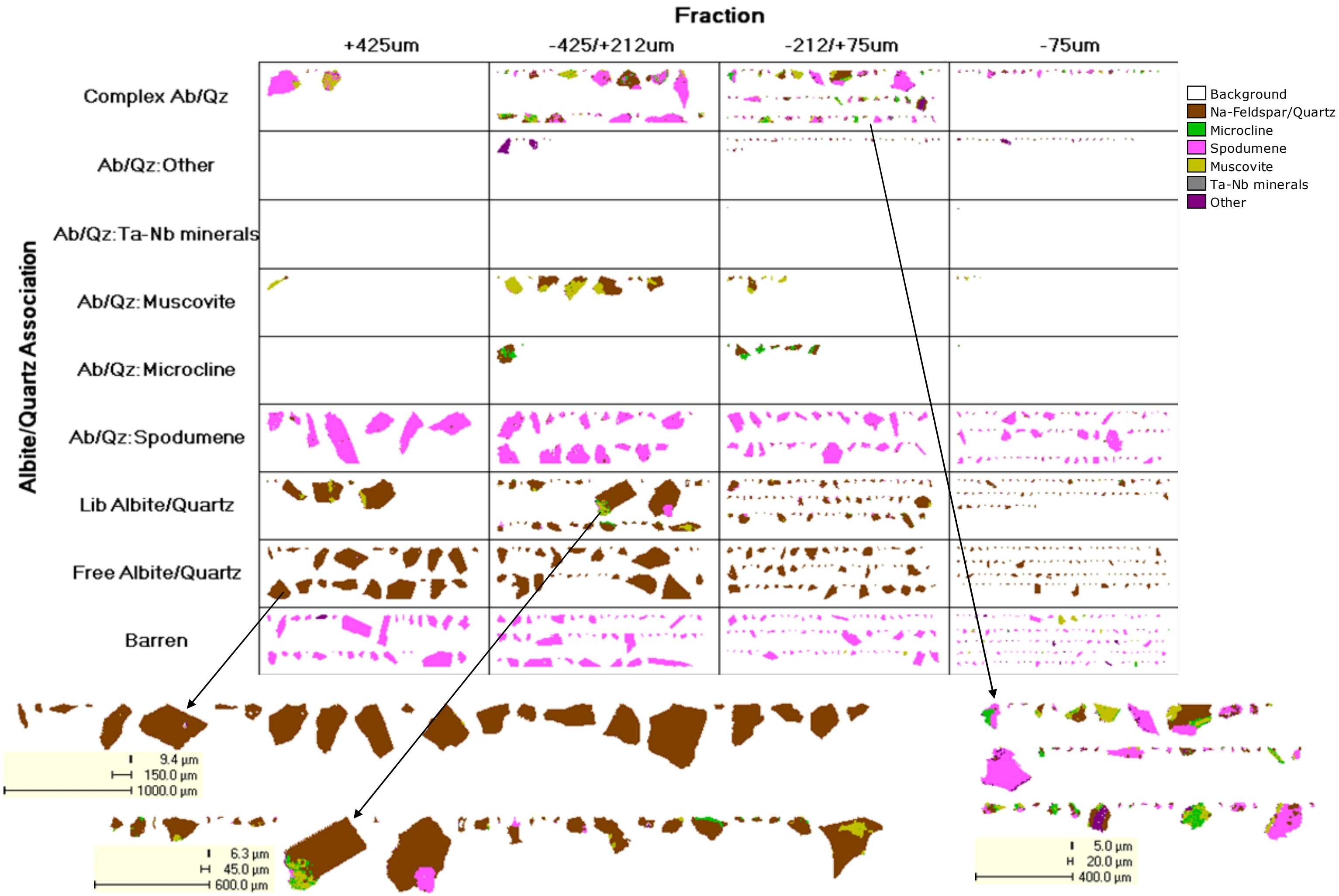


Figure 14. Image Grid Based on Liberation and Association of Albite/Quartz of the Li Combined Sample (Sized)

4.7. Determinative Mineralogy

4.7.1. Mineral Release Curves

Mineral release curves are used to predict the amount of liberated mineral of interest at varying size distributions. This can be an indicator of optimum grind targets for metallurgical processes in order to achieve the most liberation for the least amount of grind energy. The variation between value and gangue mineral release curves may sometimes be used to enhance separation.

Note: The size used for the mineral release is the mid-point screen size, which is calculated by the following: Midpoint = square root (top size) x square root (bottom size). For the top size, (e.g., +200 µm) the top size particle (e.g., 340 µm) is identified, then 340 µm will be the top size and 200 the bottom size. Thus, the point for the mineral release at this liberation would be calculated as: square root (340) x square root (200) = 18.4390 x 14.1421 = 260.76. For any midsize, the size fraction µm is used for this calculation. However, for the bottom size, 3 µm is used because that is approximately the beam diameter limitation for the QEMSCAN^{TM}.

Figure 15 illustrates the liberation of spodumene and for feldspars-quartz (combined) for the Li Combined sample (sized). Liberation of spodumene ranges from 98.9% to 98.7% to 98.4% to 97.7% for 611 µm, 300 µm, 126 µm and 15 µm, respectively. The small decrease in the spodumene liberation is attributed to the minor middling particles in the finer grain size classes as shown in Figure 12. Liberation of albite/quartz ranges from 95.7% to 97.9% to 98.5% to 99.3% for 611 µm, 300 µm, 126 µm and 15 µm, respectively.

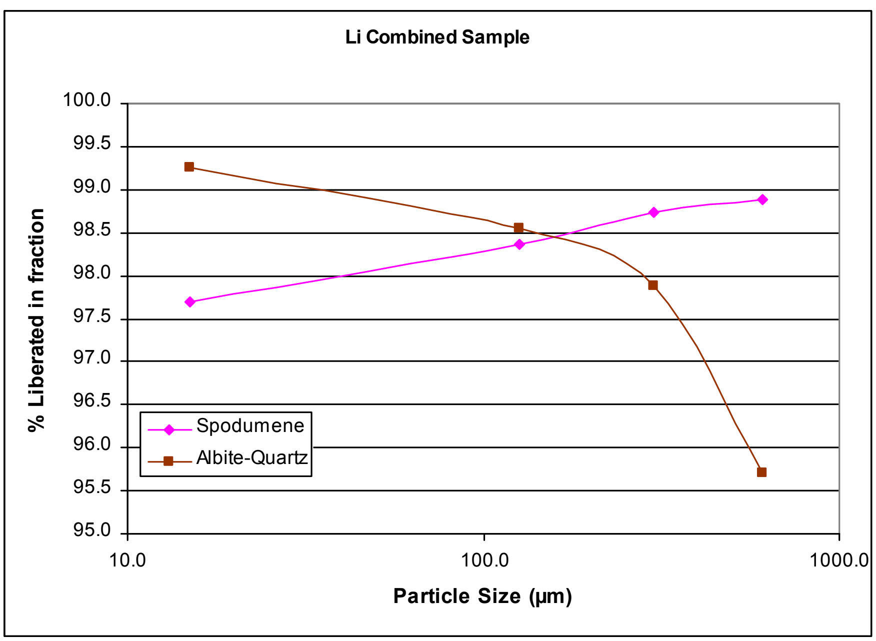


Figure 15. Mineral Release Curve for Spodumene and Albite/Quartz for the Li Combined Sample

(Sized)

4.7.2. Grade – Recovery Curves

Another, more functional, method of presenting liberation is the mineralogically limiting grade-recovery curves, as shown below. They are based on the calculated mass of minerals and the total mass in each liberation category. Thus, the highest grade (>80% spodumene) is contained in the >80% liberated spodumene particles. Then the next category (60-80% liberation) is added and the combined grade is calculated. This is repeated until all spodumene is accounted for. Mineralogically limited grade-recovery analyses provide an indication of the theoretical maximum achievable elemental or mineral grade by recovery, based on individual particle liberation and grade. These results, of course, do not reflect any other recovery factors that could occur in the actual metallurgical process.

Figure 16 illustrates the grade-recovery curves for the sample based on the liberation of spodumene in the Li Combined sample (sized). Grades and recoveries increase are approximately similar as expected from the liberation values. Overall, the grade recovery curve representing the whole sample indicates grades between 99% and 98% for recoveries of 99% to 100%, respectively.

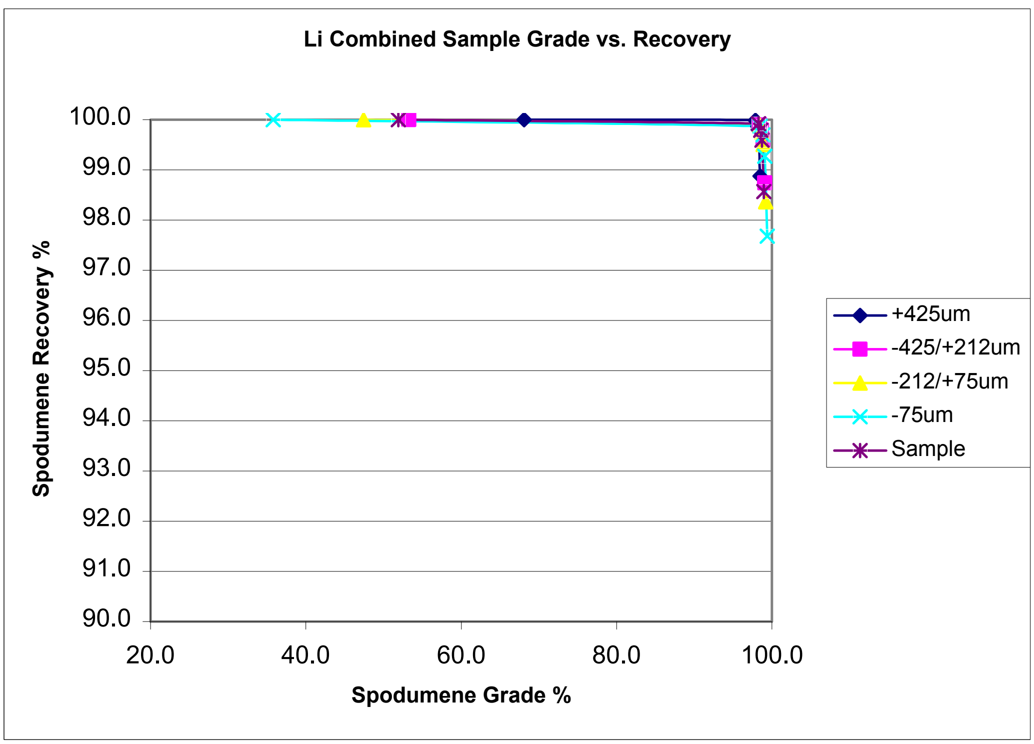


Figure 16. Grade-Recovery Curves for Spodumene of the Li Combined Sample (Sized)

Figure 17 illustrates the grade-recovery curves for the sample based on the liberation and the Li grade. Overall, the grade recovery curve representing the whole sample indicates grades between 3.6% and 3.5% for recoveries of 98% and 99%, respectively.

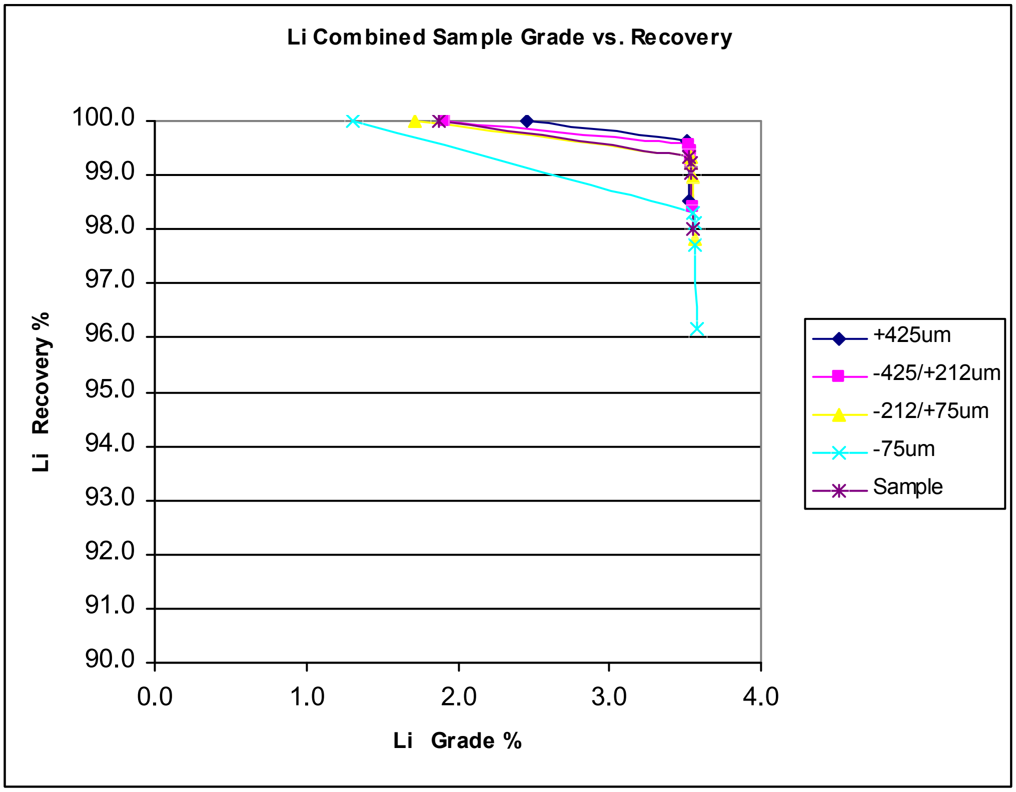


Figure 17. Grade-Recovery Curves for Li of the Li Combined Sample (Sized)

Conclusions and Recommendations

The high definition mineralogical study of the samples identified the following sample characteristics:

Mineral Characteristics

- XRD and QEMSCAN^{TM} (of the sized) analyses indicates that the samples consist of major amounts of spodumene (52-56%) and quartz (40-43%) , followed by Na-Feldspar (4-5%) and trace amounts of microcline, muscovite, sulphides, Ta-Nb-minerals, spessartine, biotite, amphibole, amblygonite, calcite, Fe oxide and other.

Elemental Deportment

- In the Li Combined sample (sized), spodumene carries most of the Li (99.4 wt%), while amblygonite carries the remainder.

Liberation and Association

- In the Li Combined sample (sized), spodumene liberation is at ~99% at K_{80} of 425 µm.
    - Liberation in spodumene ranges from 99% at 611 µm, 300 µm to 98% to 98% for 126 µm and 15 µm, respectively.
- In the Li Combined sample (sized), albite/quartz liberation is at ~98% at K_{80} of 425 µm.
    - Liberation ranges from ~ 97% at 611 µm, to 98% at 300 µm to 99% 126 µm to 99% at15 µm.

Grade and Recovery of Spodumene

- Li grades between 3.6% and 3.5% for recoveries of 98% and 99%, respectively are expected for the Li Combined Sample (sized).

Comments and Recommendations

- The recovery of spodumene (e.g., heavy media, flotation) could occur at K_{80} of 425 µm, based solely on the liberation and association of spodumene. However, metallurgical test work is recommended to determine grades and recoveries of spodumene.
- The main gangue minerals (albite and quartz) are also well liberated and could theoretically be easily removed.
- Spodumene is clean of major element impurities and particular of Fe and Mn. Therefore, a spodumene concentrate should be low in Fe and appears to be of potentially high quality. If these impurities are detected, it possible from gangue entrainment.
- Additional work is recommended to determine the mineralogical characteristics of the pegmatite, e.g., across its length or depth. Mini composite samples or individual samples can be analyzed using one or two size fractions in order to provide a modal distribution of spodumene, and determine its occurrence and approximate liberation/association data.
- Note that the findings in this report are based on what is mineralogically possible, under ideal

separation conditions. For instance, it assumes that it is possible to separate a spodumene grain with a minute attachment of another mineral, from a particle that contains no inclusions or attachments. Practically, this separation might be more complex. Thus, the findings in this report should not be considered as a prediction of recovery performance. Rather, this provides insight into the limitations with respect to mineralogical characteristics.

- It must be noted, that due to the difference in grain size, all size fractions contain particles that are close to the measurement area (~3 μm) and the spacing of the measurement points and therefore can encounter less precision in the measurements. In addition, the X-ray beam can scatter at the edges of particles and can lead to inaccurate analytical results. As the particles become smaller, the edges constitute a larger percentage of the total particle mass. Therefore, some biased might be introduced, especially in the fine fraction, and caution is advised in interpreting the results in this particular fraction

Appendix A – Certificate of Analysis

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LR Internal Dept 14
Attn : Tassos Grammatikopoulos

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Phone: ---, Fax:---

October 13, 2010

Date Rec. : 27 September 2010
LR Report : **CA03065-SEP10**
Project : CALR-12518-001
Client Ref : MI5045-SEP10 North Arrow Minerals

CERTIFICATE OF ANALYSIS

Sample ID	SiO2 %	Al2O3 %	Fe2O3 %	MgO %	CaO %	Na2O %	K2O %	TiO2 %
1: Li Combined Sample	76.9	16.3	0.44	0.05	0.01	0.50	0.14	< 0.01

Sample ID	P2O5 %	MnO %	Cr2O3 %	V2O5 %	LOI %	Sum %	Rb ppm	Li %
1: Li Combined Sample	0.15	0.02	0.06	< 0.01	0.66	95.2	81	1.93

Tom Watt
Project Coordinator

OnLine LIMS

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LR Internal Dept 14
Attn : Tassos

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October 19, 2010

Date Rec. : 07 October 2010
LR Report : **CA02356-OCT10**
Project : CALR-12518-001
Client Ref : MI5045-SEP10 Colonial Metals

CERTIFICATE OF ANALYSIS

Sample ID	SiO2 %	Al2O3 %	Fe2O3 %	MgO %	CaO %	Na2O %	K2O %	TiO2 %
1: Li Combined Sample +425μm	74.4	19.3	0.22	0.07	< 0.01	0.33	0.08	< 0.01
2: Li Combined Sample -425/+212μm	78.1	16.7	0.45	< 0.01	< 0.01	0.50	0.11	< 0.01
3: Li Combined Sample -212/+75μm	79.5	15.2	0.49	< 0.01	0.02	0.60	0.15	< 0.01
4: Li Combined Sample-75μm	79.1	14.8	0.70	0.01	0.07	0.85	0.25	< 0.01
5: Li Combined Sample	76.7	16.5	0.83	0.03	0.01	0.55	0.15	< 0.01

Sample ID	P2O5 %	MnO %	Cr2O3 %	V2O5 %	LOI %	Sum %	Li %	Rb ppm
1: Li Combined Sample +425μm	0.10	0.02	0.02	< 0.01	0.37	95.0	2.38	40
2: Li Combined Sample -425/+212μm	0.15	< 0.01	0.05	< 0.01	0.33	96.5	2.02	51
3: Li Combined Sample -212/+75μm	0.16	< 0.01	0.05	< 0.01	0.69	96.9	1.77	74
4: Li Combined Sample-75μm	0.22	0.02	0.07	< 0.01	0.98	97.1	1.63	---nss
5: Li Combined Sample	0.16	0.03	0.09	< 0.01	0.76	95.8	2.00	---nss

Tom Watt
Project Coordinator

OnLine LIMS

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Appendix B – XRD Analysis

Semi-Quantitative X-Ray Diffraction

Report Prepared for:	*North Arrow Minerals Inc*
Project Number/ LIMS No.	*12518-001/MI5045-SEP10*
Reporting Date:	*October 18, 2010*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time:0.2s, 2θ range: 3-70°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Semi-Quantitative XRD Results
4) Chemical Balance(s)
5) XRD Pattern(s)

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Method Summary

Mineral Identification and Interpretation:

Mineral identification and interpretation involve matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds. Mineral proportions are based on relative peak heights and may be strongly influenced by crystallinity, structural group or preferred orientations. Interpretations and relative proportions should be accompanied by supporting petrographic and geochemical data (Whole Rock Analysis, Inductively Coupled Plasma - Optical Emission Spectroscopy, etc.).

Semi-Quantitative Analysis:

The Semi-Quantitative analysis (RIR method) is performed based on each mineral's relative peak heights and of their respective I/Icor values, which are available from the PDF database. Mineral abundances for the bulk sample (in weight %) are generated by Bruker-EVA Software. These data are reconciled with a bulk chemistry (e.g. whole rock analysis including SiO_2, Al_2O_3, Na_2O, K_2O, CaO, MgO, Fe_2O_3, Cr_2O_3, MnO, TiO_2, P_2O_5, V_2O_5 or other chemical data). A chemical balance table shows the difference between the assay results and elemental concentrations determined by XRD.

Summary of Semi-Quantitative X-ray Diffraction Results

Crystalline Mineral Assemblage (relative proportions based on peak height)

Sample	Major (>30% Wt)	Moderate (10% -30% Wt)	Minor (2% -10% Wt)	Trace (<2% Wt)
Li Combined Sample	spodumene, quartz	-	plagioclase	-

** tentative identification due to low concentrations, diffraction line overlap or poor crystallinity*

Mineral	Composition
Plagioclase	$(NaSi,CaAl)AlSi_2O_8$
Quartz	SiO_2
Spodumene	$LiAlSi_2O_6$

Semi-Quantitative X-ray Diffraction Results

Mineral	Li Combined Sample (wt %)
Quartz	39.9
Albite	4.5
Spodumene	55.6
TOTAL	100.0

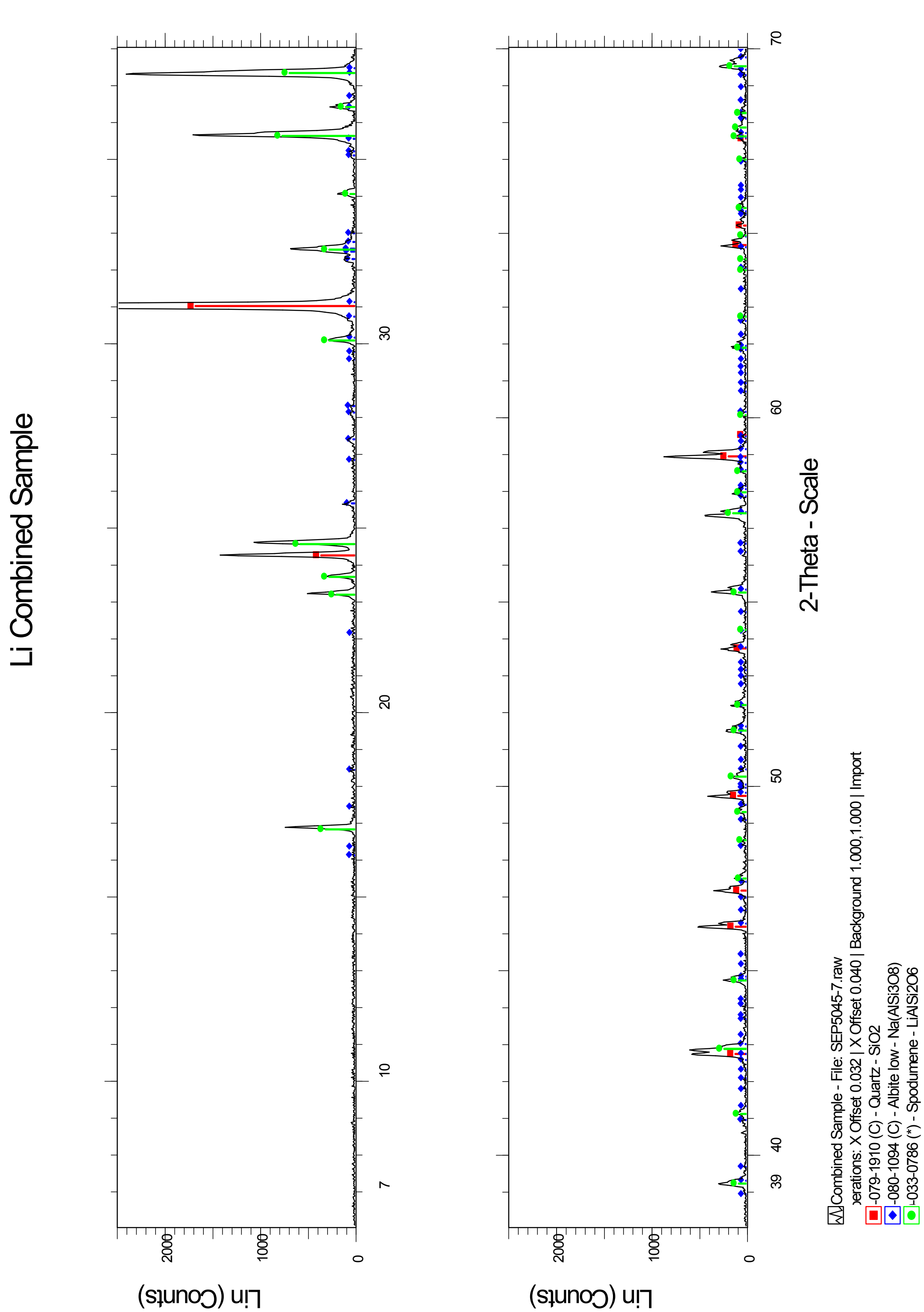
Chemical Balance

Li Combined Sample

Name	Assay[1]	SQD[2]	Delta	Status
Oxygen	49.0	52.1	-3.08	Both
Silicon	35.9	36.9	-0.93	Both
Aluminum	8.63	8.53	0.10	Both
Lithium	1.93	2.07	-0.15	Both
Sodium	0.37	0.40	-0.02	Both
Iron	0.31	-	0.31	XRF
Potassium	0.12	-	0.12	XRF
Phosphorus	0.07	-	0.07	XRF
Chromium	0.04	-	0.04	XRF
Magnesium	0.03	-	0.03	XRF
Manganese	0.02	-	0.02	XRF

1. Values measured by chemical assay.

2. Values calculated based on mineral/compound formulas and quantites identified by semi-quantitative XRD.



Li Combined Sample
Lin (Counts)
2-Theta - Scale
Combined Sample - File: SEP5045-7.raw
›erations: X Offset 0.032 | X Offset 0.040 | Background 1.000,1.000 | Import
-079-1910 (C) - Quartz - SiO2
-080-1094 (C) - Albite low - Na(AlSi3O8)
-033-0786 (*) - Spodumene - LiAlSi2O6

Appendix C – Additional QEMSCAN^{TM} Data

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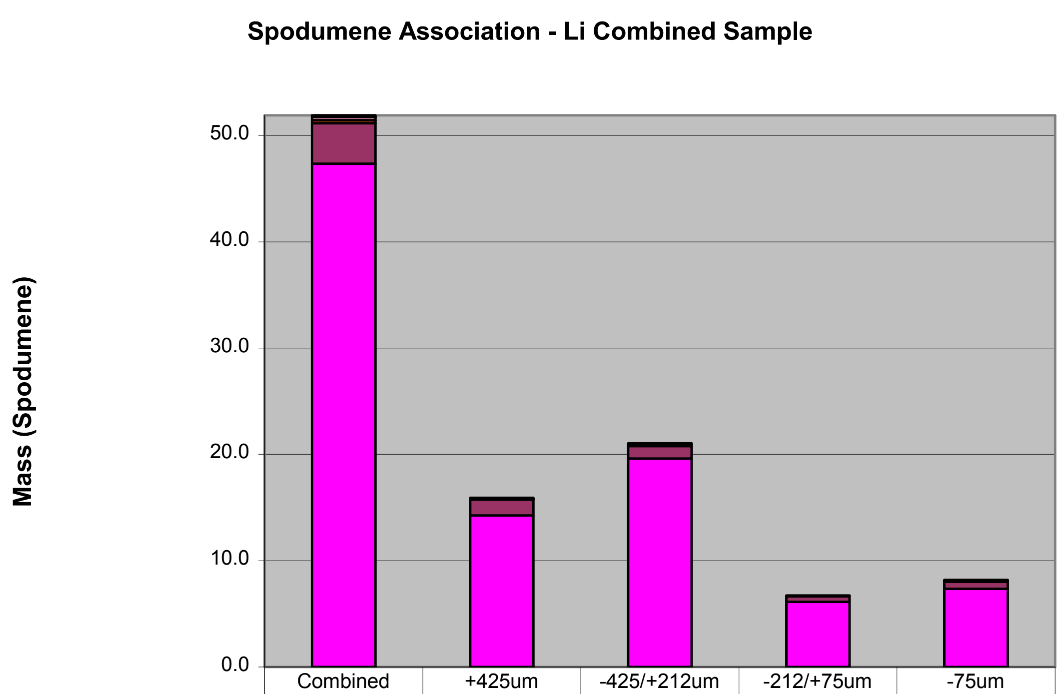
Spodumene Association



	Combined	+425um	-425/+212um	-212/+75um	-75um
Complex Spd	0.1	0.1	0.0	0.0	0.0
Spd:Other	0.0	0.0	0.0	0.0	0.0
Spd:Ta-Nb minerals	0.0	0.0	0.0	0.0	0.0
Spd:Muscovite	0.0	0.0	0.0	0.0	0.0
Spd:Microcline	0.0	0.0	0.0	0.0	0.0
Spd:Quartz	0.3	0.1	0.2	0.1	0.0
Spd:Na-Feldspar	0.3	0.1	0.1	0.0	0.1
Lib Spodumene	3.8	1.5	1.2	0.5	0.7
Free Spodumene	47.4	14.3	19.6	6.1	7.4

Absolute Mass of Spodumene Across Fraction Li Combined Sample

Mineral Name	Combined	+425um	-425/+212um	-212/+75um	-75um
Free Spodumene	47.4	14.3	19.6	6.1	7.4
Lib Spodumene	3.8	1.5	1.2	0.5	0.7
Spd:Na-Feldspar	0.3	0.1	0.1	0.0	0.1
Spd:Quartz	0.3	0.1	0.2	0.1	0.0
Spd:Microcline	0.0	0.0	0.0	0.0	0.0
Spd:Muscovite	0.0	0.0	0.0	0.0	0.0
Spd:Ta-Nb minerals	0.0	0.0	0.0	0.0	0.0
Spd:Other	0.0	0.0	0.0	0.0	0.0
Complex Spd	0.1	0.1	0.0	0.0	0.0
Total	51.9	15.9	21.0	6.7	8.2
Total (% in fraction)	100.0	30.7	40.5	13.0	15.8

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Spodumene Association by Size Class

Absolute Mass of Spodumene

	<20um	20-50um	50-80um	80-100um	100-160um	160-200um	200-260um	260-300um	300-400um	400-500um	+500um	Total
Free Spodumene	2.7	5.4	4.4	2.4	7.2	4.8	5.7	2.9	5.2	3.5	3.2	**47.4**
Lib Spodumene	0.3	0.6	0.3	0.1	0.4	0.2	0.4	0.4	0.4	0.4	0.3	**3.8**
Spd:Na-Feldspar	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	**0.3**
Spd:Quartz	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	**0.3**
Spd:Microcline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Spd:Muscovite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Spd:Ta-Nb minerals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Spd:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Complex Spd	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	**0.1**

Normalized Mass of Spodumene

	<20um	20-50um	50-80um	80-100um	100-160um	160-200um	200-260um	260-300um	300-400um	400-500um	+500um
Free Spodumene	5.3	10.4	8.4	4.6	14.0	9.2	10.9	5.6	10.0	6.7	6.2
Lib Spodumene	0.5	1.1	0.6	0.2	0.7	0.4	0.7	0.7	0.8	0.8	0.6
Spd:Na-Feldspar	0.3	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Spd:Quartz	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.1	0.0	0.0	0.0
Spd:Microcline	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spd:Muscovite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spd:Ta-Nb minerals	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spd:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex Spd	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0

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Mineral Release Curves

Sample	**Li Combined Sample**			
Fraction	**+425um**	**-425/+212um**	**-212/+75um**	**-75um**
Average Particle Size (µm)	610.5	300.2	126.1	15.0
Mineral Mass % 80% Lib				
Spodumene	98.9	98.7	98.4	97.7

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Spodumene Grade vs. Recovery: Li Combined Sample

		Li Combined Sample			
		+425um	**-425/+212um**	**-212/+75um**	**-75um**
Absolute Spd. Elemental Mass	**Spd.>=80**	15.7	20.8	6.6	8.0
	60<=Spd.<80	0.1	0.2	0.1	0.1
	40<=Spd.<60	0.0	0.0	0.0	0.0
	20<=Spd.<40	0.0	0.0	0.0	0.0
	0<Spd.<20	0.0	0.0	0.0	0.0
	Spd.=0	0.0	0.0	0.0	0.0
	Global	15.9	21.0	6.7	8.2
Spd. Grade	**Spd.>=80**	98.5	99.1	99.2	99.4
	60<=Spd.<80	79.1	77.1	78.9	82.1
	40<=Spd.<60	56.9	52.7	55.4	63.3
	20<=Spd.<40	26.7	28.9	33.8	32.3
	0<Spd.<20	0.0	0.1	0.1	0.1
	Spd.=0	0.0	0.0	0.0	0.0

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Cumulative Grain Size Distribution

Fraction	Li Combined Sample							
	Na-Feldspar		Quartz		Spodumene		PSD	
	Size	Mass			Size	Mass	Size	Mass
+600			0.1	0.1	0.9	0.9	1.3	1.3
+540			0.3	0.4	2.4	3.3	1.3	2.6
+480			0.9	1.3	1.8	5.1	1.6	4.3
+420	2.3	2.3	2.9	4.3	3.0	8.1	3.7	7.9
+390	0.9	3.3	1.4	5.6	2.6	10.7	2.2	10.2
+360			2.1	7.8	2.6	13.2	2.5	12.7
+330	2.0	5.3	3.6	11.4	4.5	17.7	3.4	16.1
+300	3.5	8.8	3.8	15.2	3.5	21.2	3.7	19.8
+270	2.6	11.4	3.7	18.9	4.1	25.3	4.1	23.9
+255			2.5	21.4	2.0	27.3	2.3	26.2
+240	0.3	11.7	2.8	24.3	2.7	30.0	2.7	28.9
+225	1.0	12.7	3.2	27.4	3.3	33.3	3.2	32.1
+210	4.6	17.3	2.7	30.2	3.4	36.7	2.7	34.8
+195	1.3	18.6	2.8	33.0	3.7	40.4	3.0	37.9
+180	3.5	22.1	3.5	36.5	3.7	44.1	3.8	41.6
+165	3.4	25.5	3.3	39.8	3.6	47.7	3.4	45.0
+150	4.1	29.6	3.0	42.8	5.3	53.0	4.0	49.0
+135	2.4	32.0	3.7	46.5	4.0	57.0	3.7	52.7
+120	3.3	35.3	3.6	50.1	4.0	61.1	3.6	56.3
+105	4.3	39.6	3.3	53.4	3.8	64.9	3.5	59.8
+90	4.6	44.3	4.0	57.4	4.6	69.4	3.8	63.6
+75	3.7	48.0	3.8	61.2	3.8	73.3	3.8	67.4
+66	4.2	52.2	2.9	64.1	2.6	75.9	2.6	70.0
+57	2.4	54.6	4.0	68.1	2.4	78.3	3.1	73.1
+48	5.9	60.5	3.4	71.4	3.2	81.5	3.4	76.5
+39	7.0	67.5	4.4	75.9	3.9	85.4	4.1	80.6
+30	5.6	73.1	4.4	80.3	4.0	89.3	4.0	84.6
+21	7.1	80.1	5.5	85.8	3.6	93.0	4.6	89.2
+12	11.1	91.3	6.4	92.2	4.3	97.3	5.5	94.8
+4	8.4	99.6	7.5	99.7	2.6	99.9	5.0	99.8
-4	0.4	100.0	0.3	100.0	0.1	100.0	0.2	100.0

Appendix D –QEMSCAN™ Modes of Operation

QEMSCAN^{TM} Operational Modes

QEMSCAN^{TM} is an acronym for Quantitative Evaluation of Materials by Scanning Electron Microscopy, a system which differs from image analysis systems in that it is configured to measure mineralogical variability based on chemistry at the micrometer-scale. QEMSCAN^{TM} utilizes both the back-scattered electron (BSE) signal intensity as well as an Energy Dispersive X-ray Signal (EDS) at each measurement point. It thus makes no simplifications or assumptions of homogeneity based on the BSE intensity, as many mineral phases show BSE overlap. EDS signals are used to assign mineral identities to each measurement point by comparing the EDS spectrum against a mineral species identification program (SIP) or database.

There are three general types of measurement: those using the linear intercept and those based on particle mapping. Bulk mineral analysis (BMA) is performed using the linear intercept method, and is used to provide statistically abundant data for speciation and mineral distribution. Particle mapping modes, including Particle Mineral Analysis (PMA), Specific Mineral Search (SMS) analysis and Trace Mineral Search (TMS) analysis provide information on spatial relationships of minerals, including liberation and association data and provide a visual representation of mineral textures. The particle mapping modes of measurement also allow for advanced analysis of the minerals of interest, including grade vs. recovery relationships and mineral release curves. Specific details of the measurement modes are presented below, while visual examples of these two measurement classes are presented in Figures 1 and 2. The Field Stitch (FS) mode of measurement maps a core sample that has been mounted in the polished section. It collects a chemical spectrum at a set interval within the field of view. Each field of view is then processed offline and a pseudo image of the core sample is produced. This is presented in Figure 3.

Bulk Mineral Analysis, or BMA, is performed by the linear intercept method, in which the electron beam is rastered at a pre-defined point spacing (nominally 3 micrometers, but variable with particle size) along several lines per field, and covering the entire polished section at any given magnification. An example of a BMA measurement image is shown in Figure 1. This measurement provides a robust data set for determination of the bulk mineralogy, with mineral identities and proportions, along with grain size measurements.

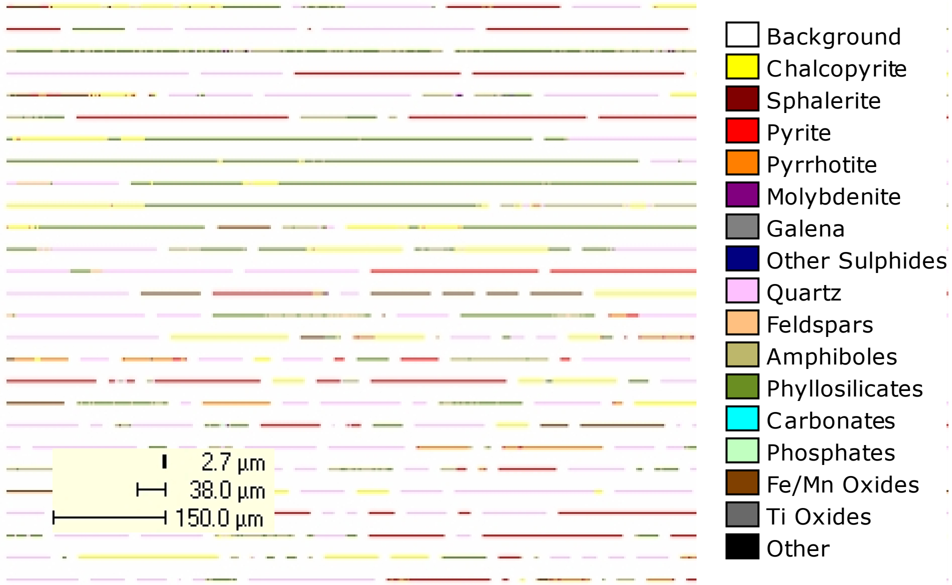

Figure 1. BMA Measurement Mode

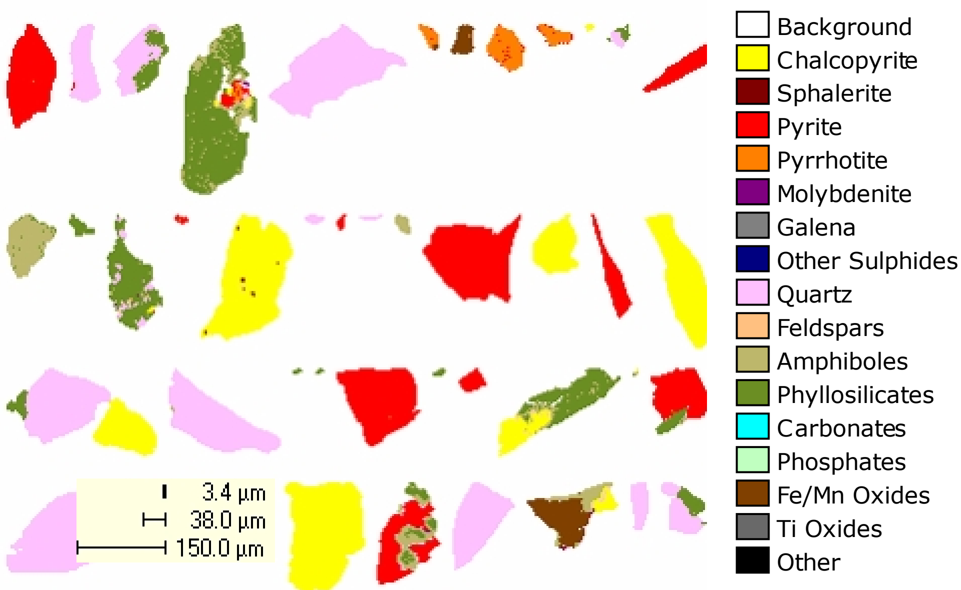

Figure 2. Particle Mapping (PMA, SMS or TMS) Measurement Mode

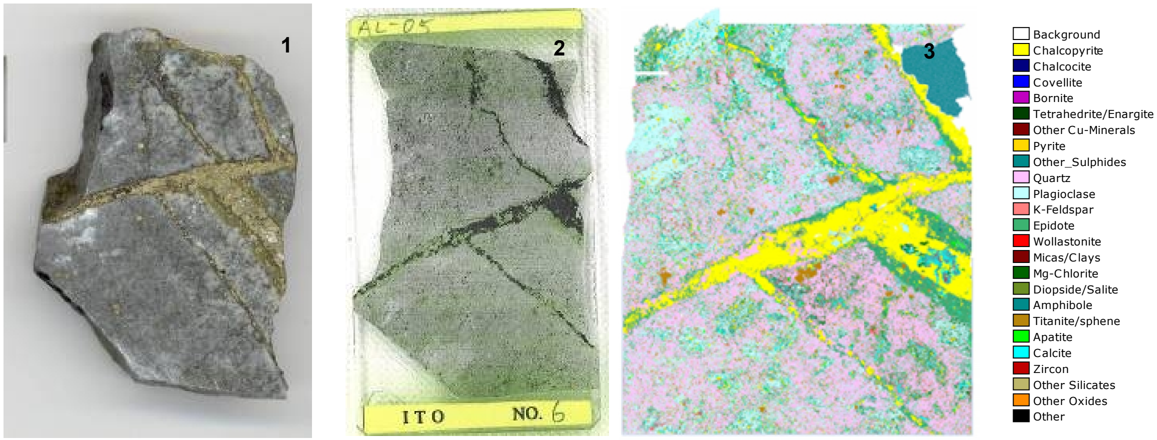

Figure 3. Field Stitch Mode of Measurement Mode; **Image 1:** Selected Core Sample. **Image 2:** Polished Section. **Image 3:** QEMSCANTM Pseudo Image of the Polished Section with Legend/Mineral List.

Particle Mineral Analysis (PMA) is a two-dimensional mapping analysis aimed at resolving liberation and locking characteristics of a generic set of particles. A pre-defined number of particles are mapped at a point spacing selected in order to spatially resolve and describe mineral textures and associations. This mode is often selected to characterize concentrate products, as both gangue and value minerals report in statistically abundant quantities to be resolved.

Specific Mineral Search, or SMS, is a modified Particle Mineral Analysis (PMA) routine. However, in an SMS routine, a phase reports as a low-grade constituent and can be located by thresholding of the back-scattered electron intensity. Any accompanying phases of similar and higher brightness are also mapped. For example, this mode of measurement would be selected in ores of low sulphide grade, searching specifically for particles containing sulphide minerals.

Trace Mineral Search (TMS) is an additional mapping routine, where a phase reports as a trace constituent and can be located by thresholding of the back-scattered electron intensity. The objective of this routine is to reject barren fields and increase analysis efficiency. The outputs are otherwise identical to the SMS routine. This mode of measurement is often used for advanced studies of PGE ore types, or trace minerals of interest such as molybdenite.

It is important to note that with regards to SMS and TMS modes, results pertain only to the target minerals. PMA must be selected if quantitative gangue characterization is required. For example, in some sulphide ores, it may be more efficient to reject barren pyrites in favour of copper-bearing minerals. However, it must be noted that data captured in this manner will not reflect the true characteristics of pyrite, as only the pyrite associated with the copper-bearing minerals will be represented.

The Field Stitch (FS) mode of measurement maps a core sample that has been mounted in the polished section. It collects a chemical spectrum at a set interval within the field of view. Each field of view is then processed offline and a pseudo image of the core sample is produced.