An Investigation by High Definition Mineralogy into

FORTY-TWO MINERAL SAND SAMPLES FROM CAROLINA, USA

prepared for

SOUTH CAROLINA DEPARTMENT OF NATURAL RESOURCES

Project 16225-001 – Final Report
December 12, 2017

NOTES

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Executive Summary

Forty-two (42) mineral sand samples were submitted to the Advanced Mineralogy Facility at SGS Canada Inc., by Mr. Scott Howard from the South Carolina Department of Natural Resources, for mineralogical analysis. The purpose of this test program was to determine the overall mineral assemblage of the samples, with emphasis on the REE minerals (REM) occurrence. The testwork was conducted with QEMSCAN technology (Quantitative Evaluation of Materials by Scanning Electron Microscopy), X-ray diffraction (XRD) analysis, geochemical analyses, and electron probe micro analyses.

Sample Preparation

- Each sample was first screened to remove coarse shells and organic material.
- A 20g aliquot was obtained by riffling for ICP-MS analysis (ICM90A) for major and trace elements.
- A 20g subsample was also riffled from the following samples SC_VC-14, SC_VC-20, SC_VC-28, NC_VC-25, and NC_VC-34, for qualitative XRD.
- Subsequently, each sample was screened at 212 µm to generate a +212 and a -212 µm fraction. One randomly oriented and one transverse graphite-impregnated polished section was prepared from each fraction (total of four per sample). These sections were carbon coated and submitted for QEMSCAN analysis using the Particle Mineral Analysis mode of operation.
- The remainder of each fraction from samples GA_VC-3, SC_VC-15, SC_VC-29, NC_VC-27, and NC_VC-37 was submitted for heavy liquid separation at 2.9 SG. The heavy product (Sink) from each fraction was then combined and one PS was prepared for a PMA analysis using the QEMSCAN.

X-Ray Diffraction (XRD) Results

XRD analysis shows that the samples consist of major amounts of quartz, minor to trace amounts of apatite, plagioclase, K-feldspars, calcite, ilmenite, epidote, amphibole, garnet, and zircon.

QEMSCAN Samples

The samples have been divided into three groups including GA (N=7); SC (N=19), and NC (N=16).

Modal Mineralogy

Table I illustrates the minimum (Min), maximum (Max) and average (Avg) mineral mass for the three sample groups. Rare Earth Minerals (REM) occur in trace amounts and include mainly monazite and rare synchysite/bastnaesite. Other minerals of interest (indicators) include zircon, apatite, Fe-oxides, rutile, and ilmenite.

Table I: Min, Max and Avg Mineral Mass for the GA, SC, and NC Groups

Sample Group	GA_VC-1			SC_VC-7			NC_VC-6		
Mineral	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**	**Min**	**Max**	**Ave**
Monazite	0.00	0.02	0.01	0.00	0.02	0.00	0.00	0.04	0.01
Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00
Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zircon	0.01	0.10	0.04	0.00	0.17	0.08	0.02	0.19	0.08
Apatite	0.34	1.81	1.18	0.01	3.78	1.17	0.04	2.68	0.89
Fe-Oxides	0.00	0.00	0.00	0.00	1.72	0.34	0.00	0.04	0.01
Rutile	0.03	0.19	0.10	0.02	0.37	0.12	0.02	0.27	0.14
Ilmenite	0.06	0.73	0.36	0.06	1.16	0.47	0.04	0.99	0.40
Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00
Fe-Sulphides	0.00	0.08	0.02	0.00	1.06	0.09	0.00	0.39	0.09
Quartz	77.01	93.91	87.23	64.74	94.36	77.77	21.04	91.46	78.00
Plagioclase	0.69	6.07	2.67	0.30	11.23	2.73	0.95	5.93	2.75
K-Feldspar	1.55	6.63	3.31	0.25	10.42	3.41	1.48	8.40	3.58
Biotite	0.01	0.07	0.02	0.01	0.16	0.06	0.00	0.52	0.12
Muscovite	0.00	0.15	0.05	0.00	0.45	0.06	0.00	0.09	0.02
Clays	0.02	0.21	0.09	0.01	1.57	0.17	0.00	0.27	0.12
Chlorite	0.01	0.05	0.03	0.02	0.10	0.06	0.00	0.42	0.08
Amphibole	0.14	0.77	0.46	0.08	1.41	0.57	0.01	1.49	0.38
Epidote	0.14	0.94	0.40	0.08	1.14	0.38	0.01	0.49	0.21
Grossular	0.00	0.05	0.03	0.00	0.52	0.11	0.00	0.24	0.08
Titanite	0.00	0.02	0.01	0.00	0.02	0.00	0.00	0.03	0.01
Other Silicates	0.00	0.06	0.02	0.00	0.07	0.02	0.01	0.16	0.05
Calcite	1.38	11.30	3.85	0.79	28.48	12.03	0.01	74.00	12.66
Ankerite	0.02	0.10	0.07	0.01	1.60	0.31	0.00	0.78	0.20
Dolomite	0.00	0.09	0.02	0.00	0.07	0.01	0.00	0.22	0.05
Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Gypsum/Anhydrite	0.00	0.03	0.01	0.00	0.04	0.00	0.00	0.19	0.02
Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.02	0.01	0.00	0.02	0.00	0.00	0.17	0.04

Monazite Liberation and Textural Features

The liberation and association of monazite is shown in Figure III. The liberation values are erratic due to low mass of the monazite in the samples and low particle statistics. Liberation ranges from nil to 100%.

The mass of monazite from each sample from the three groups is added to illustrate the roundness of the mineral (Figure IV). Monazite is sub-rounded (58%) and rounded/well rounded (42%) in the GA group, sub-rounded (53%) to angular (33%) and less rounded/well rounded (12%) in the SC group, and sub-rounded (37%) to angular/very angular (34%) and rounded/well-rounded (29%) in the NC group.

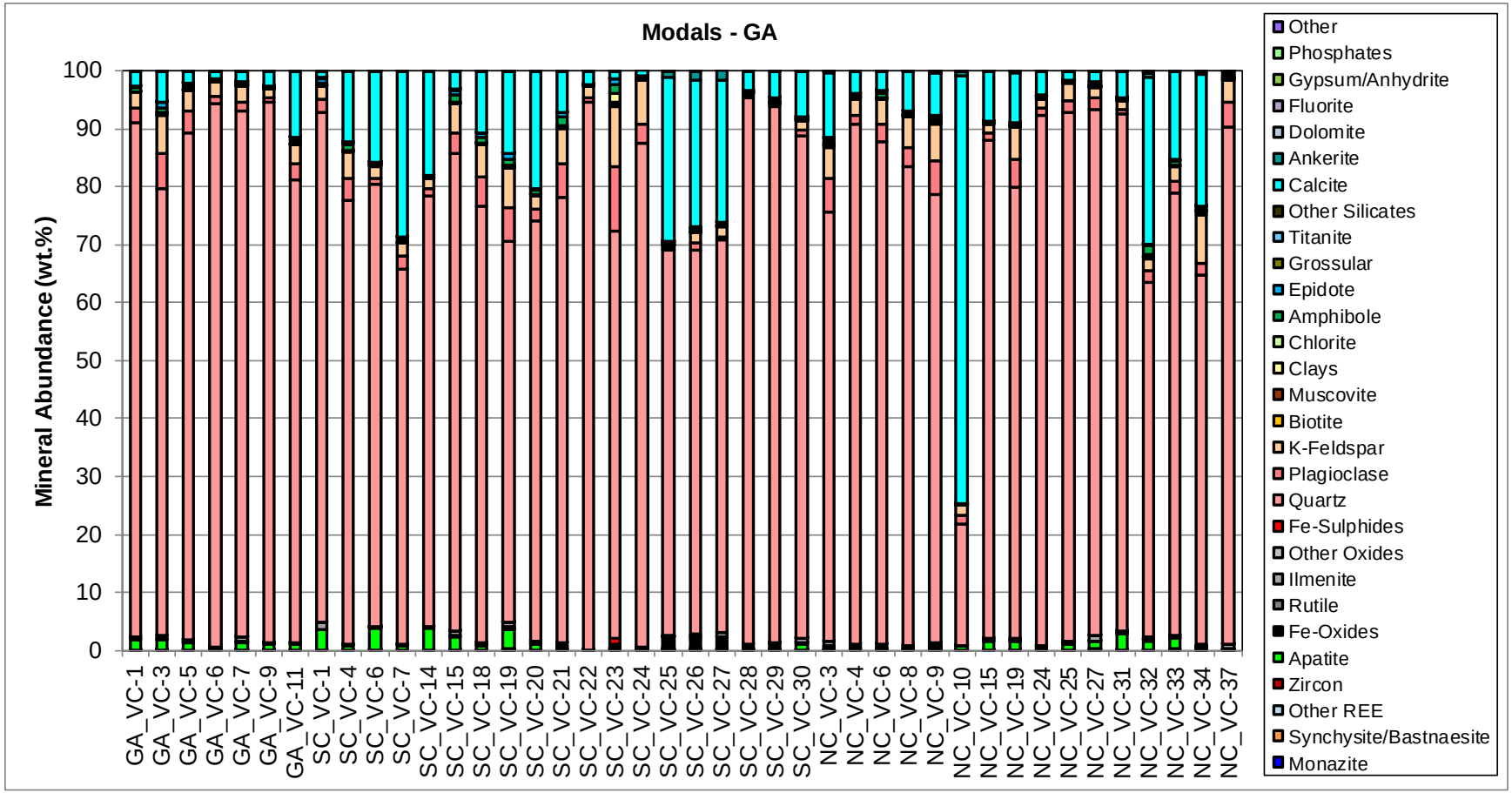


Figure I: Mineral Distributions (Mass%) for the GA, SC and NC Groups

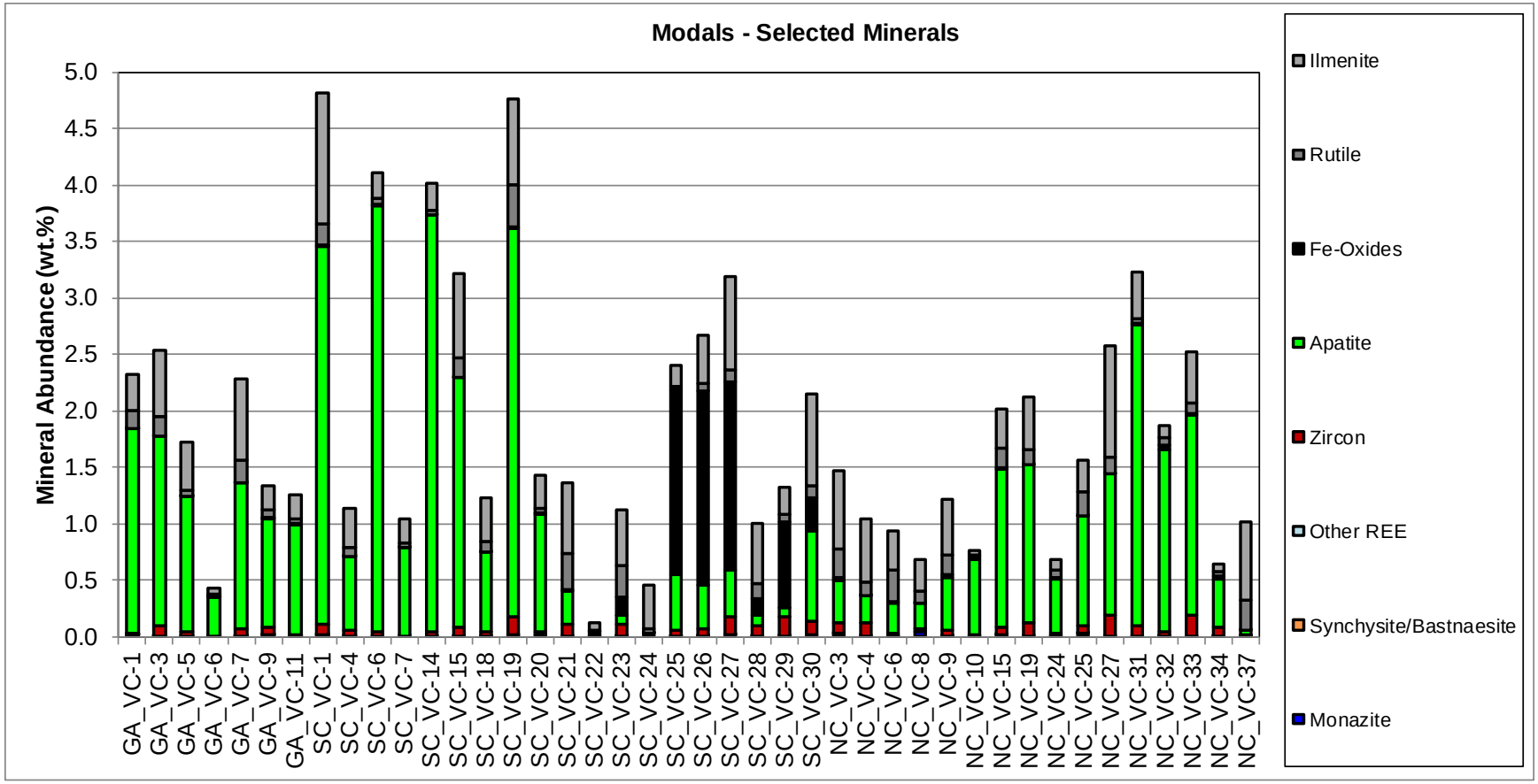
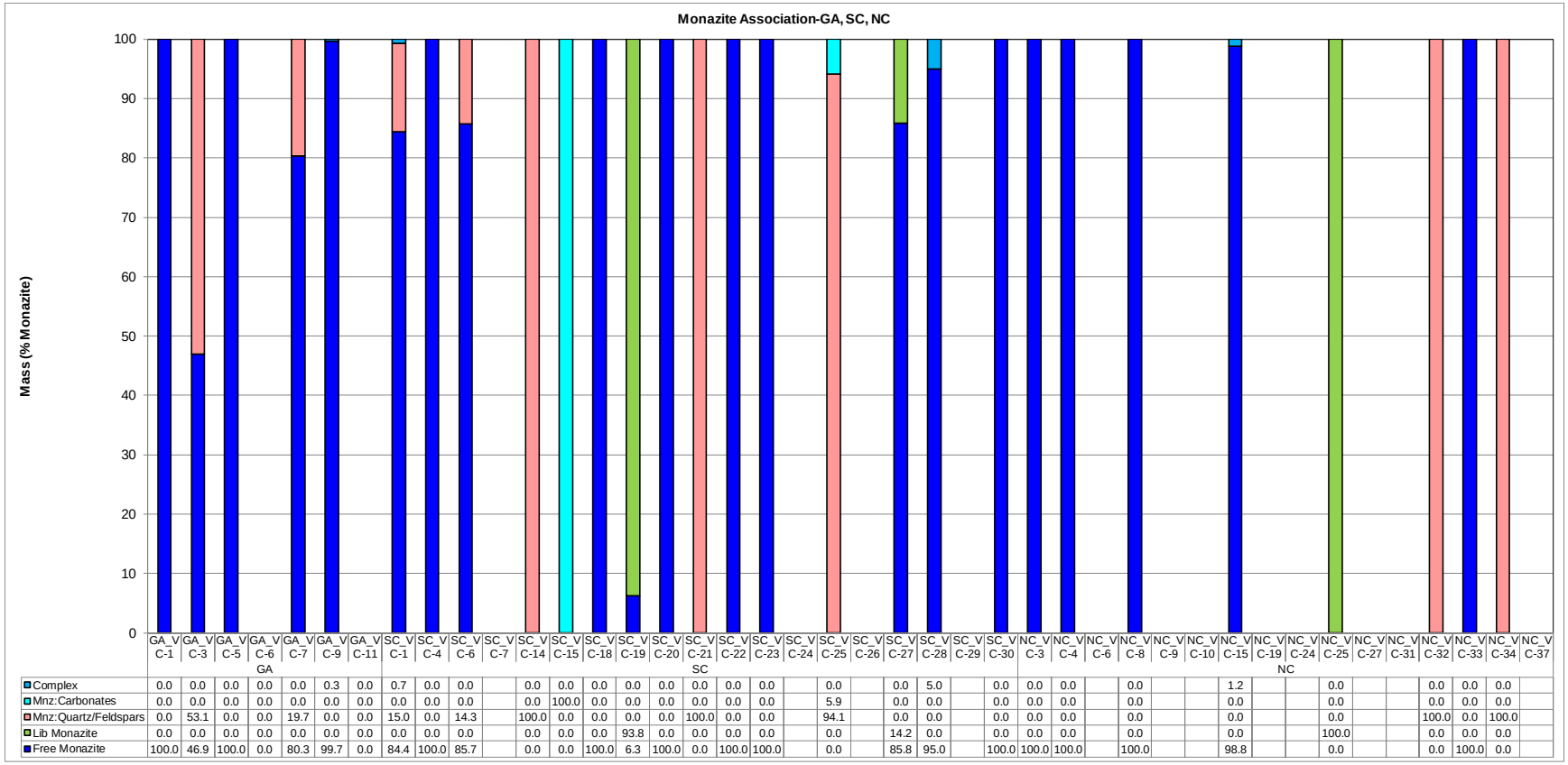
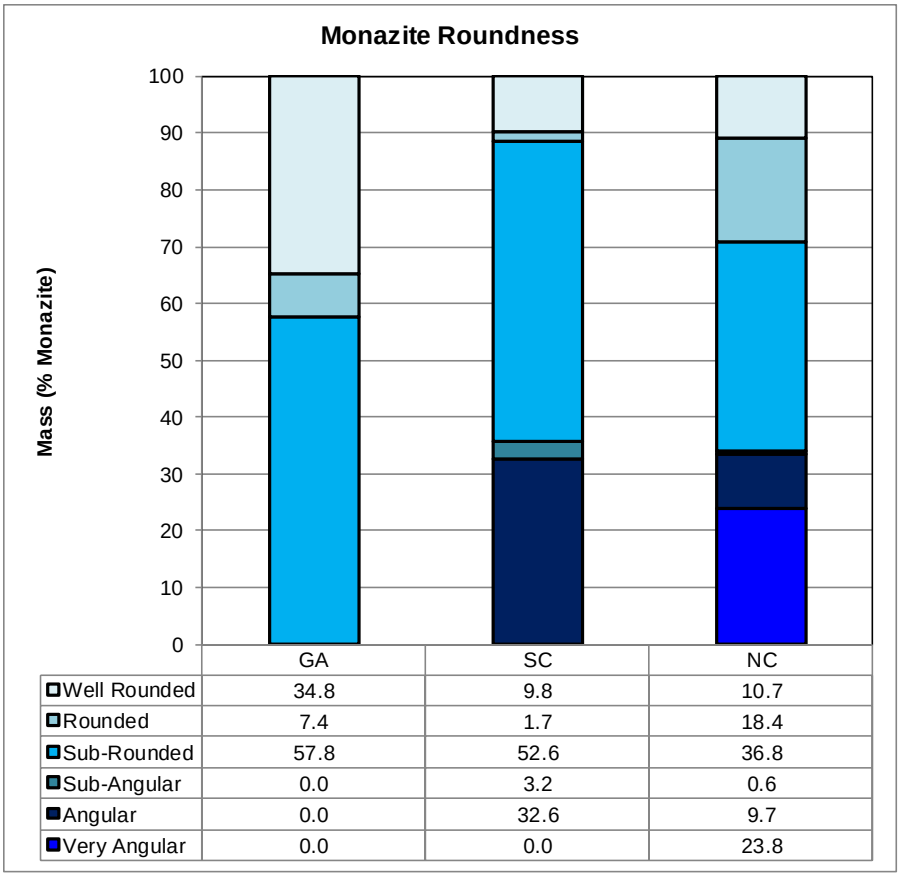


Figure II: Selected Mineral Distributions (Mass%) for the GA, SC and NC Groups



	GA_V C-1	GA_V C-3	GA_V C-5	GA_V C-6	GA_V C-7	GA_V C-9	GA_V C-11	SC_V C-1	SC_V C-4	SC_V C-6	SC_V C-7	SC_V C-14	SC_V C-15	SC_V C-18	SC_V C-19	SC_V C-20	SC_V C-21	SC_V C-22	SC_V C-23	SC_V C-24	SC_V C-25	SC_V C-26	SC_V C-27	SC_V C-28	SC_V C-29	SC_V C-30	NC_V C-3	NC_V C-4	NC_V C-6	NC_V C-8	NC_V C-9	NC_V C-10	NC_V C-15	NC_V C-19	NC_V C-24	NC_V C-25	NC_V C-27	NC_V C-31	NC_V C-32	NC_V C-33	NC_V C-34	NC_V C-37
	GA							SC																			NC																
Complex	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.7	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0		0.0	5.0		0.0	0.0	0.0		0.0			1.2			0.0			0.0	0.0	0.0	
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0		5.9		0.0	0.0		0.0	0.0	0.0		0.0			0.0			0.0			0.0	0.0	0.0	
Mnz:Quartz/Feldspars	0.0	53.1	0.0	0.0	19.7	0.0	0.0	15.0	0.0	14.3		100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0		94.1		0.0	0.0		0.0	0.0	0.0		0.0			0.0			0.0			100.0	0.0	100.0	
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	93.8	0.0	0.0	0.0	0.0		0.0		14.2	0.0		0.0	0.0	0.0		0.0			0.0			100.0			0.0	0.0	0.0	
Free Monazite	100.0	46.9	100.0	0.0	80.3	99.7	0.0	84.4	100.0	85.7		0.0	0.0	100.0	6.3	100.0	0.0	100.0	100.0		0.0		85.8	95.0		100.0	100.0	100.0		100.0			98.8			0.0			0.0	100.0	0.0	

Figure III: Liberation and Association of Monazite in the GA, SC and NC Groups



	GA	SC	NC
Well Rounded	34.8	9.8	10.7
Rounded	7.4	1.7	18.4
Sub-Rounded	57.8	52.6	36.8
Sub-Angular	0.0	3.2	0.6
Angular	0.0	32.6	9.7
Very Angular	0.0	0.0	23.8

Figure IV: Monazite Roundness in the GA, SC and NC Groups

Geochemistry

Geochemical analyses indicate that REE are present in very low concentrations in the samples. For example, cerium ranges from 8 ppm to 100 ppm, but it is generally less than 50 ppm in most samples. Other light REE (LREE) are even lower. Yttrium is generally <30 ppm.

Cerium shows a strong correlation with lanthanum, dysprosium, samarium, and neodymium reflecting the main Rare Earth Mineral (REM) monazite. Correlation between cerium and yttrium is good but not as linear as with other REE. Yttrium could be carried by other minerals such as apatite for example. The correlation between cerium and phosphorus is poor and this is attributed to the fact that phosphorus is accounted by mainly apatite and trace monazite. It probably indicates that apatite is not a major cerium carrier.

Chondrite normalized plots (REE+Y) show enriched LREE and depleted HREE with a pronounced negative europium anomaly. The SC group exhibits the highest and lowest REE values.

Mineral Processing

A few fractions from selected samples (Table II) were submitted for heavy liquid separation (HLS) at SG of 2.9 g/cm^3. The Sink product from the HLS ranges from 0.3 wt% to 5.0 wt% of the fraction mass, but most was retained in the Float product as expected due to the high amounts of silicate minerals. The Sink products from the +212 and -212 µm fractions for the NC-VC-27 sample, and those of the NC-VC-37 sample, were combined due to their low mass for the QEMSCAN analysis to determine the mineral distribution.

Table II: Weights and Wt% Distribution Between Sink and Float Fractions for Selected Samples

Sample ID	Initial wt HLS Initial wt/g	Sink 2.9SG wt/g	Sink wt%	Float 2.9SG wt/g	Float wt%
GA_VC-3 -212um	72.76	1.9	*2.6*	70.38	*97.4*
SC_VC-15 -212um	62.27	2.39	*3.8*	59.72	*96.2*
SC_VC-29 +212um	87.89	0.56	*0.6*	87.07	*99.4*
NC_VC-27 +212um	9.81	0.03	*0.3*	9.8	*99.7*
NC_VC-27 -212um	15.38	0.64	*4.2*	14.59	*95.8*
NC_VC-37 +212um	20.6	0.04	*0.4*	10.46	*99.6*
NC_VC-37 -212um	46.68	2.31	*5.0*	44.2	*95.0*

The Sink products consist of various silicates (amphiboles, garnets, epidote), carbonates, ilmenite, rutile Fe-oxides, apatite, and trace amounts of monazite. The distribution of the heavy minerals is shown in Figure V, but the complete results are given in the main body of the report.

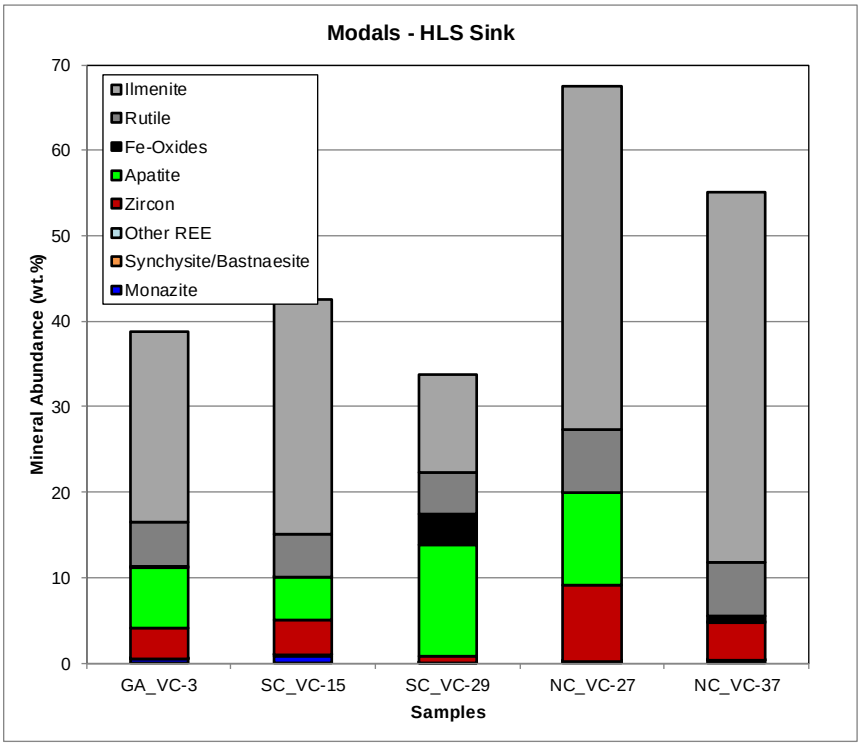


Figure V: Mineral Distribution of Minerals of Interest from the Sink Products of Selected Samples

Mineral Chemistry

The polished sections of the Sink products were used for the EPMA to determine the mineral chemistry of monazite, zircon, rutile, and apatite. The Sinks were chosen because of the higher mineral of interest population (monazite, rutile etc.).

The average concentrations of the major oxides including La_2O_3, Ce_2O_3, Pr_2O_3, Nd_2O_3 and Sm_2O_3 in the monazite analyzed are similar among the samples (Table III). The oxides Y_2O_3, Gd_2O_3, and Dy_2O_3 show slightly wider variations. The ThO_2 ranges from 3.97 wt% to 5.05 wt% and UO_2 from 0.31 wt% to 0.92 wt%. Monazite is rich in Ce_2O_3, La_2O_3, and Nd_2O_3. The Y_2O_3 ranges from 0.99 wt% to 1.98 wt%.

Table III: Average Mineral Chemistry of Monazite from the EPMA

No. Analyses	23	24	11	25	18
Oxide/Sample	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
P_2O_5	29.75	29.56	29.95	28.88	28.99
SiO_2	0.28	0.35	0.15	0.73	0.68
ThO_2	5.05	5.21	3.97	5.65	5.75
UO_2	0.92	0.68	0.65	0.32	0.41
Y_2O_3	1.98	1.50	1.59	0.99	1.60
La_2O_3	13.70	13.82	13.25	14.22	13.56
Ce_2O_3	28.10	28.73	28.41	29.65	28.86
Pr_2O_3	3.16	3.21	3.27	3.27	3.20
Nd_2O_3	11.58	11.82	12.49	11.70	11.86
Sm_2O_3	2.00	1.98	1.96	1.66	1.82
Gd_2O_3	1.53	1.40	1.78	1.03	1.26
Tb_2O_3	0.14	0.12	0.03	0.08	0.10
Dy_2O_3	0.63	0.50	0.62	0.32	0.44
Er_2O_3	0.13	0.11	0.09	0.07	0.10
CaO	1.04	0.97	0.87	0.84	0.82
Total	99.98	99.96	99.08	99.39	99.46

Zircon contains ZrO_2 ranging from 65.84 wt% to 66.24 wt%, HfO_2 from 1.12 wt% to 1.28 wt%, and Y_2O_3 from 0.11 wt% to 0.15 wt% (Table IV

Table IV: Detection Limits and Average Mineral Chemistry in Oxide wt% for Zircon from the EPMA

N	Sample/Oxide	SiO_2	ZrO_2	HfO_2	UO_2	Y_2O_3	La_2O_3	Ce_2O_3	Nd_2O_3	Dy_2O_3	Total
	Detection Limit	0.050	0.130	0.037	0.078	0.040	0.039	0.035	0.079	0.089	
8	GA_VC-3	32.51	66.17	1.26	0.05	0.11	0.01	0.00	0.00	0.01	100.11
8	SC_VC-15	32.47	66.20	1.12	0.03	0.13	0.01	0.01	0.00	0.01	99.97
8	SC_VC-29	32.59	65.84	1.28	0.05	0.15	0.01	0.01	0.01	0.00	99.94
9	NC_VC-27	32.54	65.94	1.14	0.03	0.15	0.01	0.01	0.01	0.01	99.83
8	NC_VC-37	32.38	66.24	1.16	0.03	0.11	0.01	0.02	0.04	0.01	100.00

The average concentrations of P_2O_5 and CaO show minor variations among the apatite, i.e., 2 to 3% amongst the samples (Table V). Rare Earth Elements (La, Ce, and Y) are below the detection limits of the instrument.

Table V: Detection Limits and Average Mineral Chemistry in Oxide wt% for Apatite from the EPMA

N	Sample/Oxide	SiO_2	Y_2O_3	La_2O_3	Ce_2O_3	Nd_2O_3	CaO	P_2O_5	SO_3	F	Cl	Total
	Detection Limit	0.032	0.080	0.089	0.081	0.158	0.054	0.068	0.049	0.062	0.021	
8	GA_VC-3	0.91	0.05	0.02	0.02	0.01	48.93	30.19	2.88	4.31	0.06	85.56
8	SC_VC-15	0.26	0.06	0.06	0.06	0.03	50.29	32.35	2.00	4.08	0.03	87.50
8	SC_VC-29	1.82	0.02	0.02	0.02	0.03	47.25	30.02	1.67	4.07	0.07	83.27
8	NC_VC-27	0.29	0.04	0.03	0.02	0.02	50.24	32.49	2.09	4.14	0.05	87.64

Rutile consists mainly of TiO_2 ranging from 96.66 wt% to 99.14 wt%, minor Nb_2O_5 from 0.30 wt% to 1.36 wt%, and Fe_2O_3 which is below 1 wt% (Table VI).

Table VI: Detection Limits in Oxide wt% and Average Mineral Chemistry for Rutile from the EPMA

No. Analyses	Oxide	Nb_2O_5	Ta_2O_5	SiO_2	TiO_2	SnO_2	Cr_2O_3	Fe_2O_3	Total
	Detection Limit	0.01863	0.02043	0.01508	0.06097	0.02232	0.02103	0.02206	
8	GA_VC-3	1.07	0.09	0.07	96.66	0.01	0.40	0.84	99.14
8	SC_VC-15	1.34	0.13	0.00	97.19	0.02	0.06	0.95	99.69
8	SC_VC-29	0.30	0.01	0.00	99.14	0.00	0.06	0.27	99.80
11	NC_VC-27	1.36	0.02	0.15	96.79	0.01	0.08	0.85	99.26
7	NC_VC-37	0.26	0.01	0.21	98.39	0.00	0.06	0.44	99.38

Introduction

This report describes a mineralogical test program using High Definition Mineralogy, including QEMSCAN technology (Quantitative Evaluation of Materials by Scanning Electron Microscopy), X-ray diffraction (XRD) analysis, geochemical analyses, and electron probe micro analyses on forty-two mineral sand samples. The samples are from South Carolina, and were submitted by Mr. Scott Howard from the South Carolina Department of Natural Resources. The purpose of this test program was to determine the overall mineral assemblage of the samples, with emphasis on the REE minerals (REM) occurrence.

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Report preparation by: Tassos Grammatikopoulos
Reviewed by: Cheryl Mina, and Stephanie Downing

Testwork Summary

1. Sample Receipt and Preparation

Forty-two mineral sand samples (Table 1) were submitted to the Advanced Mineralogy Facility at SGS Canada Inc., Lakefield site by the South Carolina Department of Natural Resources for mineralogical analysis. The project number CALR-16378-001 was assigned to the testwork.

Table 1: Sample Inventory and Identifications

No	Sample ID	No	Sample ID
1	GA_VC-1	22	SC_VC-26
2	GA_VC-3	23	SC_VC-27
3	GA_VC-5	24	SC_VC-28
4	GA_VC-6	25	SC_VC-29
5	GA_VC-7	26	SC_VC-30
6	GA_VC-9	27	NC_VC-3
7	GA_VC-11	28	NC_VC-4
8	SC_VC-1	29	NC_VC-6
9	SC_VC-4	30	NC_VC-8
10	SC_VC-6	31	NC_VC-9
11	SC_VC-7	32	NC_VC-10
12	SC_VC-14	33	NC_VC-15
13	SC_VC-15	34	NC_VC-19
14	SC_VC-18	35	NC_VC-24
15	SC_VC-19	36	NC_VC-25
16	SC_VC-20	37	NC_VC-27
17	SC_VC-21	38	NC_VC-31
18	SC_VC-22	39	NC_VC-32
19	SC_VC-23	40	NC_VC-33
20	SC_VC-24	41	NC_VC-34
21	SC_VC-25	42	NC_VC-37

- Each sample was first coarse screened to remove shells and organic material.
- A 20g aliquot was obtained by riffling for ICP-MS analysis (ICM90A) for major and trace elements.
- A 20g subsample was also riffled from the following samples, SC_VC-14, SC_VC-20, SC_VC-28, NC_VC-25, and NC_VC-34 for qualitative XRD.
- Subsequently each sample was screened at 212 µm to generate a +212 and a -212 µm fraction. One randomly oriented and one transverse graphite-impregnated polished section was prepared from each fraction (total of four per sample). These sections were carbon coated and submitted for QEMSCAN analysis using the Particle Mineral Analysis mode of operation.

- The remainder of each fraction from samples GA_VC-3, SC_VC-15, SC_VC-29, NC_VC-27, and NC_VC-37 was submitted for HLS at 2.9 SG. The heavy product (Sink) from each fraction was then combined and one PS was prepared for a PMA analysis using the QEMSCAN.

The XRD report is presented in Appendix A, the Certificate of Analysis in Appendix B, the QEMSCAN data are presented in Appendix C, and the Terminology used in Appendix D.

2. Operational Modes and Quality Control

2.1. Operational Modes

The mode of QEMSCAN analysis used for this project was the Particle Mineral Analysis (PMA).

The PMA is a two-dimensional mapping analysis aimed at resolving liberation and locking characteristics of a generic set of particles. The PMA mode scans the polished section and provides a statistically robust population of mineral identifications based on the X-ray chemistry of minerals. A pre-defined number of particles are mapped at a point spacing selected to spatially resolve and describe mineral textures and associations. This mode is often selected to characterize feed and concentrate products, as both gangue and value minerals report in statistically abundant quantities to be resolved.

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. Light elements such as lithium, boron, carbon, beryllium, oxygen, and hydrogen also cannot be discriminated by the QEMSCAN analysis.

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 bias may be introduced, especially in the fine fraction, and caution is advised in interpreting the results.

2.2. QEMSCAN Assay Reconciliation for the Mineral Sand Samples

Each polished section for the sample was submitted for mineralogical analyses with QEMSCAN PMA. All data was processed with the iExplorer software version 5.2. A mineral list developed for the analyzed sample is shown in Table 2.

Table 2: Mineral List and Formulas

Mineral	Formula
Amphibole	$(Na,K)Ca_2(Fe,Mg)_5(Al,Si)_8O_{22}(OH)_2$
Anhydrite	$CaSO_4$
Ankerite	$CaFe(CO_3)_2$
Apatite	$Ca_5(PO_4)_3F$
Bastnaesite	$(Ce,La,Nd)(CO_3)F$
Biotite	$K(Mg,Fe)Al_2Si_3AlO_{10}(OH)_2$
Calcite	$CaCO_3$
Chlorite	$Na_{0.5}(Al,Mg)_6(Si,Al)_8O_{18}(OH)_{12}\cdot 5(H_2O)$
Dolomite	$CaMg(CO_3)_2$
Epidote	$Ca_2Fe^{3+}_{2.25}Al_{0.75}(SiO_4)_3(OH)$
Fluorite	CaF_2
Goethite	$\alpha FeO\cdot OH$
Grossular	$Ca_3Al_2(SiO_4)_3$
Gypsum	$Ca(SO_4)\bullet 2(H_2O)$
Hematite	Fe_2O_3
Ilmenite	$FeTiO_3$
Kaolinite	$Al_2Si_2O_5(OH)_4$
K-Feldspar	$KAlSi_3O_8$
Magnetite	Fe_3O_4
Monazite	e.g., Monazite-(Ce): $(Ce,La,Nd,Th)PO_4$
Muscovite	$KAl_2(AlSi_3O_{10})(F,OH)_2$
Plagioclase	$(NaSi,CaAl)AlSi_2O_8$
Pyrite	FeS_2
Quartz	SiO_2
Rutile	TiO_2
Synchysite	$Ca(Ce,Nd,La)(CO_3)_2F$
Titanite	$CaTiSiO_5$
Zircon	$ZrSiO_4$

2.3. QEMSCAN Assay Reconciliation for the Mineral Sands Samples

Each polished section for the sample was submitted for mineralogical analyses with QEMSCAN (PMA). All data was processed with the iExplorer software version 5.2. Key QEMSCAN mineralogical assays have been regressed with the chemical assays (calculated for the head) for the samples, as presented in Table 3 to Table 7, and graphically illustrated in Figure 1. Overall correlation, as measured by R-squared criteria was 0.89.

Table 3: QEMSCAN and Direct Assay Reconciliation for the GA Group Samples

Sample	GA_VC-1			GA_VC-3			GA_VC-5			GA_VC-6		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.56	0.46	0.58	1.42	0.34	1.47	0.81	0.72	0.84	0.41	0.38	0.59
Al (Chemical)	0.74	-	-	1.79	-	-	1.01	-	-	0.42	-	-
Ca (QEMSCAN)	2.12	5.93	1.52	3.60	4.69	3.55	1.85	0.97	2.12	0.84	0.59	2.44
Ca (Chemical)	1.90	-	-	2.70	-	-	1.60	-	-	1.20	-	-
Fe (QEMSCAN)	0.31	0.02	0.35	0.61	0.06	0.64	0.39	0.04	0.50	0.10	0.05	0.40
Fe (Chemical)	0.84	-	-	1.18	-	-	0.80	-	-	0.72	-	-
K (QEMSCAN)	0.35	0.29	0.36	0.86	0.23	0.89	0.45	0.59	0.41	0.33	0.33	0.34
K (Chemical)	0.40	-	-	0.80	-	-	0.50	-	-	0.30	-	-
Mg (QEMSCAN)	0.10	0.03	0.11	0.14	0.04	0.15	0.10	0.04	0.11	0.04	0.03	0.10
Mg (Chemical)	0.13	-	-	0.24	-	-	0.16	-	-	0.08	-	-
Mn (QEMSCAN)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn (Chemical)	0.01	-	-	0.02	-	-	0.01	-	-	0.01	-	-
P (QEMSCAN)	0.34	0.01	0.39	0.31	0.03	0.32	0.22	0.00	0.29	0.06	0.00	0.46
P (Chemical)	0.21	-	-	0.20	-	-	0.16	-	-	0.04	-	-
Ti (QEMSCAN)	0.20	0.00	0.23	0.29	0.01	0.31	0.17	0.00	0.23	0.04	0.01	0.20
Ti (Chemical)	0.17	-	-	0.28	-	-	0.17	-	-	0.04	-	-
Zr (QEMSCAN)	0.01	0.00	0.01	0.04	0.00	0.04	0.02	0.00	0.02	0.00	0.00	0.03
Zr (Chemical)	0.03	-	-	0.05	-	-	0.02	-	-	0.01	-	-

Sample	GA_VC-7			GA_VC-9			GA_VC-11		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.50	0.38	0.65	0.27	0.16	0.75	0.68	0.40	1.19
Al (Chemical)	0.64	-	-	0.48	-	-	0.84	-	-
Ca (QEMSCAN)	1.51	0.85	2.39	1.57	1.00	4.03	5.34	5.15	5.68
Ca (Chemical)	1.60	-	-	2.40	-	-	11.3	-	-
Fe (QEMSCAN)	0.39	0.03	0.88	0.16	0.02	0.75	0.31	0.19	0.54
Fe (Chemical)	0.94	-	-	0.73	-	-	0.69	-	-
K (QEMSCAN)	0.35	0.33	0.39	0.21	0.16	0.44	0.44	0.30	0.71
K (Chemical)	0.30	-	-	0.30	-	-	0.50	-	-
Mg (QEMSCAN)	0.06	0.03	0.10	0.04	0.03	0.08	0.13	0.09	0.18
Mg (Chemical)	0.10	-	-	0.09	-	-	0.21	-	-
Mn (QEMSCAN)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.01	-	-	0.01	-	-
P (QEMSCAN)	0.24	0.01	0.55	0.18	0.00	0.95	0.18	0.00	0.51
P (Chemical)	0.20	-	-	0.16	-	-	0.13	-	-
Ti (QEMSCAN)	0.34	0.00	0.81	0.11	0.02	0.50	0.10	0.02	0.24
Ti (Chemical)	0.24	-	-	0.11	-	-	0.09	-	-
Zr (QEMSCAN)	0.03	0.00	0.06	0.03	0.00	0.15	0.01	0.00	0.02
Zr (Chemical)	0.05	-	-	0.05	-	-	0.01	-	-

Table 4: QEMSCAN and Direct Assay Reconciliation for the SC Group Samples

Sample	SC_VC-1			SC_VC-4			SC_VC-6		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.54	0.53	0.65	0.93	0.49	1.11	0.36	0.29	0.77
Al (Chemical)	0.68	-	-	1.13	-	-	0.33	-	-
Ca (QEMSCAN)	2.21	2.15	2.59	5.67	13.6	2.42	7.90	8.68	2.94
Ca (Chemical)	2.80	-	-	7.90	-	-	14.2	-	-
Fe (QEMSCAN)	0.67	0.25	3.24	0.39	0.15	0.49	0.20	0.08	1.00
Fe (Chemical)	1.04	-	-	0.80	-	-	0.55	-	-
K (QEMSCAN)	0.30	0.30	0.30	0.59	0.32	0.70	0.29	0.27	0.47
K (Chemical)	0.40	-	-	0.60	-	-	0.20	-	-
Mg (QEMSCAN)	0.08	0.06	0.15	0.16	0.11	0.18	0.09	0.08	0.16
Mg (Chemical)	0.08	-	-	0.24	-	-	0.18	-	-
Mn (QEMSCAN)	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.01	-	-	0.01	-	-
P (QEMSCAN)	0.62	0.61	0.69	0.12	0.17	0.10	0.70	0.72	0.54
P (Chemical)	0.30	-	-	0.07	-	-	0.27	-	-
Ti (QEMSCAN)	0.48	0.12	2.70	0.16	0.01	0.22	0.11	0.00	0.77
Ti (Chemical)	0.28	-	-	0.18	-	-	0.08	-	-
Zr (QEMSCAN)	0.04	0.00	0.29	0.02	0.00	0.03	0.02	0.00	0.12
Zr (Chemical)	0.04	-	-	0.04	-	-	0.02	-	-
Sample	**SC_VC-7**			**SC_VC-14**			**SC_VC-15**		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.51	0.28	0.81	0.33	0.27	0.73	0.98	0.49	1.03
Al (Chemical)	0.69	-	-	0.35	-	-	1.23	-	-
Ca (QEMSCAN)	12.0	18.4	3.34	8.85	9.62	4.43	2.76	6.65	2.37
Ca (Chemical)	10.0	-	-	13.6	-	-	2.10	-	-
Fe (QEMSCAN)	0.27	0.18	0.40	0.20	0.08	0.92	0.68	0.13	0.74
Fe (Chemical)	0.65	-	-	0.51	-	-	1.23	-	-
K (QEMSCAN)	0.30	0.15	0.50	0.21	0.17	0.48	0.65	0.30	0.69
K (Chemical)	0.40	-	-	0.20	-	-	0.60	-	-
Mg (QEMSCAN)	0.15	0.16	0.14	0.07	0.06	0.15	0.21	0.13	0.21
Mg (Chemical)	0.20	-	-	0.17	-	-	0.20	-	-
Mn (QEMSCAN)	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00
Mn (Chemical)	0.01	-	-	0.01	-	-	0.03	-	-
P (QEMSCAN)	0.15	0.13	0.17	0.68	0.68	0.69	0.41	0.18	0.43
P (Chemical)	0.17	-	-	0.31	-	-	0.25	-	-
Ti (QEMSCAN)	0.09	0.00	0.20	0.10	0.00	0.70	0.35	0.00	0.38
Ti (Chemical)	0.09	-	-	0.07	-	-	0.43	-	-
Zr (QEMSCAN)	0.00	0.00	0.00	0.02	0.00	0.11	0.03	0.00	0.04
Zr (Chemical)	0.02	-	-	0.02	-	-	0.10	-	-
Sample	**SC_VC-18**			**SC_VC-19**			**SC_VC-20**		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	1.16	0.46	1.27	1.43	0.38	2.11	0.51	0.25	0.97
Al (Chemical)	1.35	-	-	2.53	-	-	0.70	-	-
Ca (QEMSCAN)	5.23	16.2	3.45	7.67	13.2	4.11	8.83	12.5	2.44
Ca (Chemical)	4.50	-	-	8.90	-	-	9.10	-	-
Fe (QEMSCAN)	0.45	0.14	0.50	0.75	0.19	1.11	0.30	0.14	0.58
Fe (Chemical)	0.84	-	-	1.40	-	-	0.86	-	-
K (QEMSCAN)	0.75	0.27	0.82	0.90	0.29	1.29	0.33	0.16	0.63
K (Chemical)	0.70	-	-	0.90	-	-	0.40	-	-
Mg (QEMSCAN)	0.17	0.11	0.18	0.20	0.13	0.25	0.13	0.11	0.16
Mg (Chemical)	0.23	-	-	0.36	-	-	0.19	-	-
Mn (QEMSCAN)	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.03	-	-	0.01	-	-
P (QEMSCAN)	0.13	0.31	0.10	0.64	1.46	0.11	0.20	0.24	0.12
P (Chemical)	0.09	-	-	0.25	-	-	0.10	-	-
Ti (QEMSCAN)	0.17	0.00	0.20	0.47	0.22	0.63	0.12	0.03	0.28
Ti (Chemical)	0.22	-	-	0.35	-	-	0.13	-	-
Zr (QEMSCAN)	0.02	0.01	0.02	0.06	0.00	0.10	0.01	0.00	0.03
Zr (Chemical)	0.05	-	-	0.06	-	-	0.02	-	-

Table 5: QEMSCAN and Direct Assay Reconciliation for the SC Group Samples (cont'd)

Sample	SC_VC-21			SC_VC-22			SC_VC-23			SC_VC-24		
Element	Combined	+212um	-212um	Combined	+212um	-212um	Combined	+212um	-212um	Combined	+212um	-212um
Al (QEMSCAN)	1.34	0.89	1.37	0.31	0.24	1.89	2.65	1.15	3.32	1.13	1.10	1.75
Al (Chemical)	1.67	-	-	0.55	-	-	4.53	-	-	1.06	-	-
Ca (QEMSCAN)	3.80	19.2	2.87	1.04	0.90	4.08	1.61	0.59	2.07	0.78	0.67	3.19
Ca (Chemical)	2.70	-	-	4.20	-	-	1.10	-	-	2.90	-	-
Fe (QEMSCAN)	0.64	0.17	0.67	0.08	0.02	1.44	1.28	0.39	1.68	0.31	0.22	2.11
Fe (Chemical)	1.26	-	-	0.87	-	-	2.31	-	-	0.85	-	-
K (QEMSCAN)	0.81	0.54	0.83	0.27	0.22	1.16	1.37	0.91	1.58	0.94	0.93	1.11
K (Chemical)	0.80	-	-	0.50	-	-	1.30	-	-	0.90	-	-
Mg (QEMSCAN)	0.24	0.12	0.25	0.02	0.01	0.38	0.23	0.06	0.30	0.08	0.06	0.55
Mg (Chemical)	0.25	-	-	0.08	-	-	0.35	-	-	0.08	-	-
Mn (QEMSCAN)	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.01	-	-	0.03	-	-	0.01	-	-
P (QEMSCAN)	0.05	0.37	0.04	0.00	0.00	0.05	0.02	0.00	0.02	0.00	0.00	0.03
P (Chemical)	0.05	-	-	0.01	-	-	0.02	-	-	0.03	-	-
Ti (QEMSCAN)	0.40	0.01	0.42	0.03	0.00	0.68	0.32	0.20	0.37	0.14	0.09	1.19
Ti (Chemical)	0.31	-	-	0.02	-	-	0.36	-	-	0.08	-	-
Zr (QEMSCAN)	0.05	0.00	0.05	0.01	0.01	0.19	0.05	0.02	0.06	0.01	0.00	0.23
Zr (Chemical)	0.06	-	-	0.01	-	-	0.03	-	-	0.01	-	-

Sample	SC_VC-25			SC_VC-26			SC_VC-27		
Element	Combined	+212um	-212um	Combined	+212um	-212um	Combined	+212um	-212um
Al (QEMSCAN)	0.17	0.15	0.38	0.39	0.26	0.72	0.29	0.22	0.43
Al (Chemical)	0.35	-	-	0.56	-	-	0.48	-	-
Ca (QEMSCAN)	11.8	11.3	16.0	10.8	11.7	8.33	10.4	11.6	8.16
Ca (Chemical)	11.0	-	-	8.50	-	-	8.40	-	-
Fe (QEMSCAN)	1.67	1.15	6.14	1.84	2.07	1.23	1.85	1.44	2.66
Fe (Chemical)	2.20	-	-	1.80	-	-	2.44	-	-
K (QEMSCAN)	0.07	0.06	0.21	0.24	0.13	0.53	0.25	0.22	0.29
K (Chemical)	0.20	-	-	0.30	-	-	0.30	-	-
Mg (QEMSCAN)	0.13	0.12	0.25	0.18	0.19	0.16	0.13	0.13	0.14
Mg (Chemical)	0.27	-	-	0.29	-	-	0.29	-	-
Mn (QEMSCAN)	0.03	0.02	0.11	0.04	0.05	0.02	0.04	0.05	0.03
Mn (Chemical)	0.02	-	-	0.01	-	-	0.02	-	-
P (QEMSCAN)	0.09	0.08	0.21	0.07	0.05	0.11	0.08	0.03	0.18
P (Chemical)	0.25	-	-	0.14	-	-	0.12	-	-
Ti (QEMSCAN)	0.08	0.01	0.65	0.18	0.00	0.63	0.33	0.01	0.96
Ti (Chemical)	0.09	-	-	0.16	-	-	0.31	-	-
Zr (QEMSCAN)	0.02	0.01	0.16	0.03	0.01	0.10	0.07	0.00	0.19
Zr (Chemical)	0.02	-	-	0.04	-	-	0.07	-	-

Sample	SC_VC-28			SC_VC-29			SC_VC-30		
Element	Combined	+212um	-212um	Combined	+212um	-212um	Combined	+212um	-212um
Al (QEMSCAN)	0.11	0.05	0.71	0.15	0.09	0.83	0.33	0.20	0.88
Al (Chemical)	0.32	-	-	0.42	-	-	0.64	-	-
Ca (QEMSCAN)	1.49	1.17	4.41	2.09	1.61	7.89	3.59	3.45	4.19
Ca (Chemical)	1.30	-	-	2.70	-	-	5.00	-	-
Fe (QEMSCAN)	0.34	0.08	2.80	0.76	0.61	2.64	0.64	0.42	1.59
Fe (Chemical)	0.81	-	-	1.12	-	-	1.15	-	-
K (QEMSCAN)	0.07	0.04	0.35	0.04	0.00	0.47	0.22	0.15	0.55
K (Chemical)	0.20	-	-	0.20	-	-	0.30	-	-
Mg (QEMSCAN)	0.03	0.01	0.18	0.03	0.02	0.22	0.08	0.06	0.17
Mg (Chemical)	0.08	-	-	0.11	-	-	0.19	-	-
Mn (QEMSCAN)	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.01
Mn (Chemical)	0.01	-	-	0.02	-	-	0.02	-	-
P (QEMSCAN)	0.02	0.00	0.19	0.02	0.00	0.17	0.15	0.13	0.22
P (Chemical)	0.04	-	-	0.19	-	-	0.09	-	-
Ti (QEMSCAN)	0.25	0.01	2.46	0.11	0.00	1.43	0.32	0.08	1.36
Ti (Chemical)	0.15	-	-	0.15	-	-	0.26	-	-
Zr (QEMSCAN)	0.04	0.00	0.43	0.07	0.01	0.87	0.06	0.00	0.29
Zr (Chemical)	0.05	-	-	0.07	-	-	0.06	-	-

Table 6: QEMSCAN and Direct Assay Reconciliation for the NC Group Samples

Sample	NC_VC-3			NC_VC-4			NC_VC-6		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	1.24	0.50	1.37	0.52	0.20	0.78	0.80	0.23	0.92
Al (Chemical)	1.47	-	-	0.66	-	-	1.08	-	-
Ca (QEMSCAN)	5.30	15.6	3.46	1.86	2.75	1.14	1.86	3.32	1.54
Ca (Chemical)	7.60	-	-	2.10	-	-	2.20	-	-
Fe (QEMSCAN)	0.64	0.41	0.68	0.33	0.14	0.49	0.42	0.08	0.50
Fe (Chemical)	1.21	-	-	1.00	-	-	1.16	-	-
K (QEMSCAN)	0.71	0.36	0.77	0.39	0.15	0.59	0.53	0.23	0.60
K (Chemical)	0.60	-	-	0.40	-	-	0.50	-	-
Mg (QEMSCAN)	0.20	0.38	0.16	0.08	0.07	0.09	0.15	0.03	0.17
Mg (Chemical)	0.37	-	-	0.16	-	-	0.23	-	-
Mn (QEMSCAN)	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.01	-	-	0.02	-	-
P (QEMSCAN)	0.07	0.00	0.09	0.05	0.05	0.04	0.05	0.05	0.05
P (Chemical)	0.06	-	-	0.05	-	-	0.04	-	-
Ti (QEMSCAN)	0.38	0.03	0.44	0.25	0.06	0.40	0.28	0.01	0.34
Ti (Chemical)	0.28	-	-	0.20	-	-	0.32	-	-
Zr (QEMSCAN)	0.04	0.00	0.05	0.05	0.00	0.09	0.01	0.00	0.02
Zr (Chemical)	0.06	-	-	0.05	-	-	0.05	-	-
Sample	**NC_VC-8**			**NC_VC-9**			**NC_VC-10**		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.95	0.52	1.21	1.33	0.97	1.35	0.34	0.13	0.55
Al (Chemical)	1.58	-	-	1.88	-	-	0.48	-	-
Ca (QEMSCAN)	3.18	3.42	3.04	3.79	10.8	3.49	30.2	36.1	24.0
Ca (Chemical)	5.40	-	-	3.30	-	-	28.2	-	-
Fe (QEMSCAN)	0.35	0.11	0.50	0.46	0.32	0.47	0.17	0.12	0.23
Fe (Chemical)	1.18	-	-	1.29	-	-	0.35	-	-
K (QEMSCAN)	0.68	0.44	0.83	0.82	0.57	0.83	0.23	0.14	0.31
K (Chemical)	0.50	-	-	0.80	-	-	0.30	-	-
Mg (QEMSCAN)	0.08	0.04	0.10	0.14	0.16	0.14	0.03	0.02	0.04
Mg (Chemical)	0.35	-	-	0.33	-	-	0.51	-	-
Mn (QEMSCAN)	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.02
Mn (Chemical)	0.01	-	-	0.02	-	-	0.01	-	-
P (QEMSCAN)	0.05	0.00	0.07	0.09	0.01	0.09	0.12	0.07	0.18
P (Chemical)	0.05	-	-	0.09	-	-	0.12	-	-
Ti (QEMSCAN)	0.15	0.01	0.24	0.26	0.04	0.27	0.03	0.00	0.05
Ti (Chemical)	0.18	-	-	0.27	-	-	0.05	-	-
Zr (QEMSCAN)	0.01	0.00	0.02	0.02	0.00	0.02	0.00	0.00	0.01
Zr (Chemical)	0.03	-	-	0.05	-	-	0.02	-	-
Sample	**NC_VC-15**			**NC_VC-19**			**NC_VC-24**		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.33	0.25	0.64	1.11	0.20	1.57	0.36	0.14	0.72
Al (Chemical)	0.38	-	-	1.35	-	-	0.45	-	-
Ca (QEMSCAN)	4.14	4.44	2.96	4.56	2.34	5.68	2.06	2.37	1.54
Ca (Chemical)	5.70	-	-	4.70	-	-	7.50	-	-
Fe (QEMSCAN)	0.22	0.15	0.52	0.32	0.04	0.46	0.09	0.03	0.20
Fe (Chemical)	0.79	-	-	0.93	-	-	0.56	-	-
K (QEMSCAN)	0.22	0.16	0.43	0.71	0.15	0.99	0.21	0.07	0.46
K (Chemical)	0.20	-	-	0.60	-	-	0.30	-	-
Mg (QEMSCAN)	0.05	0.05	0.04	0.07	0.02	0.10	0.02	0.02	0.03
Mg (Chemical)	0.15	-	-	0.24	-	-	0.10	-	-
Mn (QEMSCAN)	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00
Mn (Chemical)	0.01	-	-	0.01	-	-	0.01	-	-
P (QEMSCAN)	0.26	0.24	0.33	0.26	0.10	0.34	0.09	0.04	0.17
P (Chemical)	0.15	-	-	0.17	-	-	0.10	-	-
Ti (QEMSCAN)	0.22	0.11	0.66	0.23	0.05	0.32	0.07	0.00	0.19
Ti (Chemical)	0.13	-	-	0.23	-	-	0.09	-	-
Zr (QEMSCAN)	0.03	0.00	0.14	0.05	0.00	0.08	0.01	0.00	0.03
Zr (Chemical)	0.04	-	-	0.04	-	-	0.03	-	-

Table 7: QEMSCAN and Direct Assay Reconciliation for the NC Group Samples (cont'd)

Sample	NC_VC-25			NC_VC-27			NC_VC-31			NC_VC-32		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.55	0.16	0.69	0.46	0.20	0.65	0.29	0.18	0.60	0.57	0.27	1.31
Al (Chemical)	0.68	-	-	0.66	-	-	0.44	-	-	0.98	-	-
Ca (QEMSCAN)	1.28	1.68	1.14	1.57	1.31	1.76	3.02	3.37	2.07	12.4	14.5	7.33
Ca (Chemical)	2.20	-	-	4.60	-	-	5.30	-	-	13.8	-	-
Fe (QEMSCAN)	0.16	0.02	0.21	0.50	0.03	0.85	0.22	0.06	0.69	0.80	0.63	1.21
Fe (Chemical)	0.79	-	-	0.91	-	-	0.78	-	-	1.45	-	-
K (QEMSCAN)	0.38	0.10	0.47	0.24	0.15	0.30	0.19	0.14	0.33	0.36	0.19	0.78
K (Chemical)	0.40	-	-	0.30	-	-	0.20	-	-	0.40	-	-
Mg (QEMSCAN)	0.02	0.01	0.03	0.03	0.00	0.05	0.05	0.05	0.05	0.52	0.52	0.52
Mg (Chemical)	0.09	-	-	0.10	-	-	0.13	-	-	0.55	-	-
Mn (QEMSCAN)	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.03	0.01
Mn (Chemical)	0.01	-	-	0.02	-	-	0.01	-	-	0.02	-	-
P (QEMSCAN)	0.18	0.11	0.21	0.23	0.10	0.33	0.50	0.53	0.41	0.30	0.31	0.27
P (Chemical)	0.17	-	-	0.21	-	-	0.25	-	-	0.23	-	-
Ti (QEMSCAN)	0.22	0.00	0.29	0.40	0.01	0.69	0.16	0.00	0.59	0.08	0.01	0.25
Ti (Chemical)	0.23	-	-	0.44	-	-	0.19	-	-	0.11	-	-
Zr (QEMSCAN)	0.03	0.01	0.04	0.08	0.00	0.14	0.04	0.01	0.13	0.02	0.00	0.06
Zr (Chemical)	0.05	-	-	0.11	-	-	0.05	-	-	0.02	-	-

Sample	NC_VC-33			NC_VC-34			NC_VC-37		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.56	0.35	0.92	1.19	0.10	3.14	0.92	0.52	1.12
Al (Chemical)	0.61	-	-	1.73	-	-	1.25	-	-
Ca (QEMSCAN)	7.01	9.05	3.51	9.57	12.8	3.79	0.61	0.22	0.80
Ca (Chemical)	8.30	-	-	18.0	-	-	0.40	-	-
Fe (QEMSCAN)	0.36	0.18	0.65	0.43	0.20	0.84	0.47	0.01	0.69
Fe (Chemical)	0.90	-	-	1.33	-	-	1.31	-	-
K (QEMSCAN)	0.37	0.27	0.56	1.13	0.07	3.04	0.49	0.36	0.55
K (Chemical)	0.30	-	-	0.50	-	-	0.60	-	-
Mg (QEMSCAN)	0.16	0.19	0.11	0.20	0.13	0.32	0.11	0.02	0.16
Mg (Chemical)	0.27	-	-	0.45	-	-	0.15	-	-
Mn (QEMSCAN)	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Mn (Chemical)	0.01	-	-	0.01	-	-	0.03	-	-
P (QEMSCAN)	0.33	0.33	0.33	0.08	0.11	0.02	0.01	0.00	0.01
P (Chemical)	0.21	-	-	0.12	-	-	0.01	-	-
Ti (QEMSCAN)	0.21	0.02	0.54	0.05	0.01	0.12	0.38	0.01	0.56
Ti (Chemical)	0.20	-	-	0.13	-	-	0.50	-	-
Zr (QEMSCAN)	0.08	0.00	0.21	0.03	0.00	0.10	0.01	0.00	0.01
Zr (Chemical)	0.04	-	-	0.01	-	-	0.07	-	-

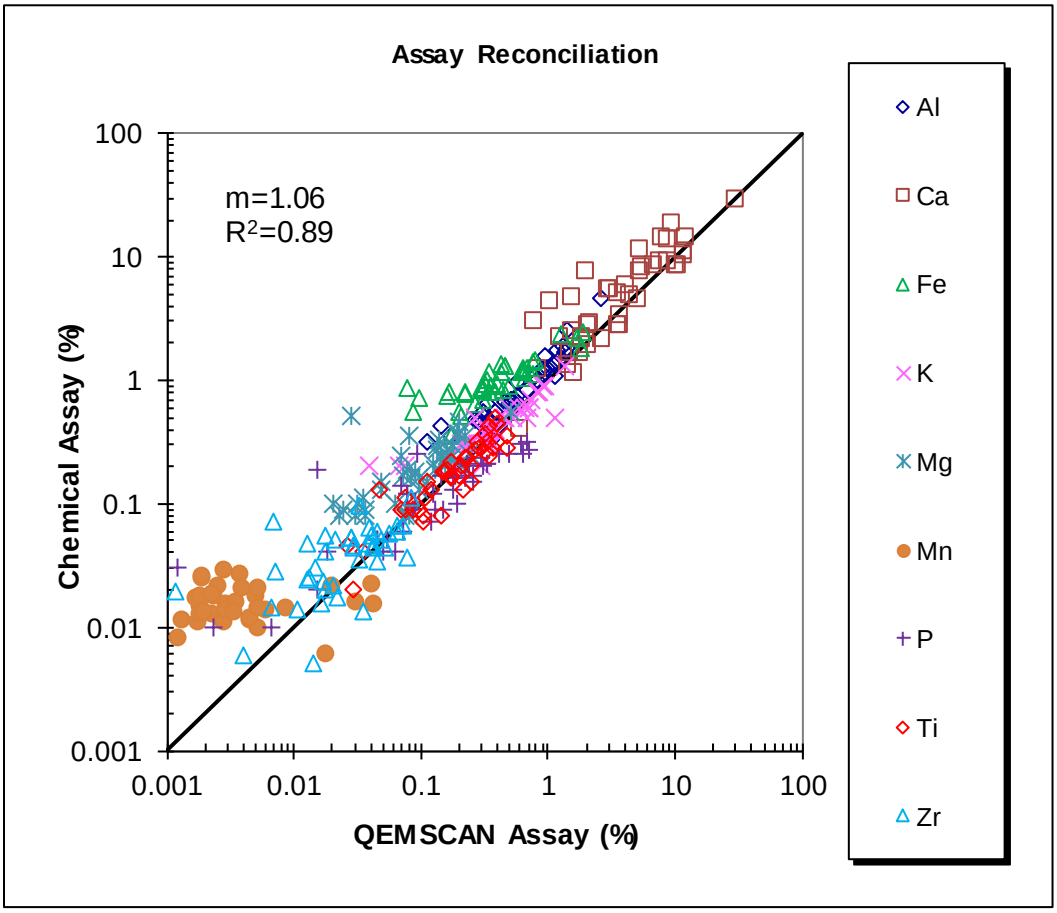


Figure 1: QEMSCAN Calculated and Direct Chemical Assay Reconciliation

3. X-Ray Diffraction (XRD) Analysis

XRD analysis was conducted on the following samples, SC_VC-14, SC_VC-20, SC_VC-28, NC_VC-25, and NC_VC-34 for qualitative XRD. The summary of XRD results are given in Table 8 and the complete report in Appendix A. These results are in agreement with the QEMSCAN analysis.

The samples consist of major amounts of quartz, minor to trace amounts of apatite, plagioclase, K-feldspars, calcite, ilmenite, epidote, amphibole, garnet, and zircon.

Table 8: XRD Results

Sample ID	Major	Moderate	Minor	Trace
SC_VC-14 -212um Rep	quartz	-	apatite, plagioclase, potassium-feldspar, calcite	*ilmenite, *epidote, *amphibole
SC_VC-20 -212um	quartz	-	plagioclase, potassium-feldspar, calcite	*ilmenite, *epidote, *amphibole, *apatite
SC_VC-28 -212um	quartz	-	ilmenite, potassium-feldspar, plagioclase, calcite	*apatite, *ilmenite, *amphibole, *epidote, *hematite, *garnet, *zircon
NC_VC-25 +212um Rep	quartz	-	calcite	*apatite, *plagioclase, *hematite, *calcite, *potassium-feldspar
NC_VC-34	quartz	-	plagioclase, potassium-feldspar	*apatite, *amphibole

4. Mineralogical Data for the Mineral Sands Samples

The mineralogical characteristics of the samples are presented per group to include GA, SC and NC group samples.

4.1. Modal Mineralogy

The mineral distributions (in wt%) of the GA, SC and NC group samples are given in Table 9 to Table 13: Modal Mineralogy of the NC Group Samples (cont'd), and graphically illustrated in Figure 2 to Figure 6. The samples consist mainly of quartz, plagioclase, and K-feldspars. Rare Earth Minerals (REM) include

mainly monazite. Potential mineral indicators include zircon, apatite, Fe-oxides, ilmenite, rutile and apatite.

Table 9: Modal Mineralogy of the GA Group Samples

Survey		CALR-16225-001 / MI5017-SEP17						
Project		South Carolina Department of Natural Resources						
Sample		GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Calculated ESD Particle Size		118	83	130	275	182	250	188
Mineral Mass (%)	Monazite	0.01	0.00	0.00	0.00	0.00	0.02	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.02	0.10	0.04	0.01	0.07	0.07	0.02
	Apatite	1.81	1.68	1.19	0.34	1.30	0.96	0.98
	Fe-Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Rutile	0.16	0.18	0.06	0.03	0.19	0.07	0.04
	Ilmenite	0.32	0.58	0.43	0.06	0.73	0.21	0.22
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.08	0.03	0.01	0.01	0.00	0.01
	Quartz	88.7	77.0	87.4	93.9	90.6	93.2	79.8
	Plagioclase	2.45	6.07	3.88	1.18	1.68	0.69	2.77
	K-Feldspar	2.71	6.63	3.54	2.62	2.73	1.55	3.40
	Biotite	0.02	0.07	0.01	0.01	0.01	0.01	0.01
	Muscovite	0.03	0.15	0.02	0.00	0.02	0.06	0.06
	Clays	0.08	0.21	0.10	0.02	0.12	0.06	0.06
	Chlorite	0.01	0.03	0.05	0.02	0.02	0.03	0.04
	Amphibole	0.61	0.77	0.55	0.19	0.29	0.14	0.68
	Epidote	0.37	0.94	0.48	0.14	0.25	0.18	0.42
	Grossular	0.00	0.05	0.04	0.01	0.05	0.03	0.03
	Titanite	0.01	0.01	0.02	0.00	0.00	0.00	0.00
	Other Silicates	0.00	0.06	0.01	0.02	0.00	0.01	0.06
	Calcite	2.55	5.15	2.06	1.38	1.81	2.69	11.3
	Ankerite	0.07	0.09	0.08	0.02	0.06	0.02	0.10
	Dolomite	0.02	0.09	0.02	0.00	0.03	0.00	0.01
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.03	0.00	0.01	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.02	0.00	0.01	0.00	0.00	0.00
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	81	21	61	0	27	94	0
	Synchysite/Bastnaesite	20	17	0	0	12	0	14
	Other REE	10	22	0	0	0	10	10
	Zircon	50	42	38	69	80	66	65
	Apatite	94	87	94	125	120	114	114
	Fe-Oxides	13	12	18	19	15	15	18
	Rutile	61	39	41	50	62	52	35
	Ilmenite	70	53	82	78	108	86	90
	Other Oxides	0	0	8	16	8	10	8
	Fe-Sulphides	12	13	12	21	15	14	14
	Quartz	114	86	128	273	181	255	200
	Plagioclase	84	47	68	113	91	70	83
	K-Feldspar	89	63	95	218	136	130	122
	Biotite	23	23	19	38	23	34	23
	Muscovite	31	23	17	15	36	46	37
	Clays	47	28	31	35	48	63	53
	Chlorite	13	15	18	19	20	19	16
	Amphibole	65	41	50	51	50	45	46
	Epidote	54	38	57	58	79	70	79
	Grossular	33	29	33	45	52	41	38
	Titanite	24	34	54	42	26	17	31
	Other Silicates	11	15	10	25	13	15	24
	Calcite	133	54	64	108	102	111	100
	Ankerite	27	22	31	26	26	28	31
	Dolomite	34	59	51	51	43	26	59
	Fluorite	25	11	17	32	0	16	18
	Gypsum/Anhydrite	25	115	25	162	12	18	17
	Phosphates	0	14	29	11	8	8	0
	Other	10	9	9	14	11	14	11

Table 10: Modal Mineralogy of the SC Group Samples

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Calculated ESD Particle Size		244	129	247	148	233	125	115	93	173	108
Mineral Mass (%)	Monazite	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.10	0.04	0.04	0.00	0.04	0.07	0.04	0.15	0.03	0.11
	Apatite	3.35	0.66	3.78	0.79	3.69	2.21	0.71	3.44	1.05	0.29
	Fe-Oxides	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
	Rutile	0.19	0.08	0.06	0.03	0.04	0.17	0.09	0.37	0.04	0.33
	Ilmenite	1.16	0.35	0.22	0.21	0.24	0.75	0.38	0.77	0.30	0.62
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.02	0.00	0.02	0.00	0.00	0.01	0.14	0.00	0.01
	Quartz	88.1	76.5	76.4	64.7	74.3	82.4	75.5	65.7	72.6	76.8
	Plagioclase	2.08	3.84	0.88	2.30	1.44	3.59	4.84	5.70	2.05	5.75
	K-Feldspar	2.37	4.44	2.21	2.19	1.59	5.03	5.74	6.87	2.39	6.05
	Biotite	0.01	0.03	0.02	0.02	0.02	0.05	0.07	0.16	0.07	0.07
	Muscovite	0.00	0.13	0.01	0.02	0.01	0.04	0.05	0.11	0.05	0.29
	Clays	0.12	0.15	0.08	0.06	0.02	0.19	0.13	0.31	0.03	0.12
	Chlorite	0.06	0.06	0.05	0.09	0.04	0.07	0.05	0.05	0.08	0.07
	Amphibole	0.43	0.89	0.39	0.70	0.31	1.22	0.92	1.01	0.58	1.41
	Epidote	0.68	0.39	0.13	0.15	0.11	0.88	0.63	0.87	0.25	0.78
	Grossular	0.28	0.03	0.04	0.00	0.02	0.08	0.02	0.08	0.02	0.03
	Titanite	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.02	0.00	0.02
	Other Silicates	0.05	0.02	0.01	0.02	0.01	0.01	0.01	0.05	0.00	0.02
	Calcite	0.97	12.3	15.6	28.5	17.9	3.12	10.7	14.0	20.3	7.11
	Ankerite	0.07	0.11	0.11	0.18	0.20	0.10	0.09	0.13	0.11	0.06
	Dolomite	0.00	0.01	0.00	0.00	0.00	0.01	0.02	0.07	0.00	0.01
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	66	38	41	0	17	40	37	38	114	32
	Synchysite/Bastnaesite	24	0	0	0	0	21	0	46	0	0
	Other REE	0	0	0	0	14	0	0	14	0	0
	Zircon	84	55	107	27	91	68	62	43	55	64
	Apatite	251	116	226	121	185	96	109	229	160	80
	Fe-Oxides	17	16	21	24	19	20	19	21	21	14
	Rutile	83	48	75	43	72	65	55	59	58	69
	Ilmenite	129	68	95	77	111	82	70	66	106	68
	Other Oxides	8	0	8	16	11	11	11	21	14	14
	Fe-Sulphides	19	16	15	15	15	12	17	16	17	14
	Quartz	240	130	249	146	233	121	113	89	166	107
	Plagioclase	133	82	99	97	137	84	77	40	94	78
	K-Feldspar	177	98	205	109	149	103	92	54	107	88
	Biotite	25	26	29	24	39	31	28	31	42	34
	Muscovite	20	48	25	34	32	26	32	18	42	57
	Clays	64	64	74	75	47	54	59	27	66	50
	Chlorite	36	17	21	20	20	17	17	17	19	19
	Amphibole	96	59	62	47	57	66	53	43	55	57
	Epidote	117	47	76	58	70	67	55	38	61	49
	Grossular	58	35	37	16	47	39	34	41	34	27
	Titanite	26	23	20	26	104	62	31	32	28	38
	Other Silicates	43	15	17	17	20	13	13	17	13	16
	Calcite	149	105	152	120	154	93	87	102	157	80
	Ankerite	29	33	30	30	37	30	29	30	33	28
	Dolomite	34	35	34	0	46	38	67	36	16	27
	Fluorite	0	16	15	25	21	26	0	24	21	14
	Gypsum/Anhydrite	14	0	10	14	21	21	0	65	0	26
	Phosphates	8	14	13	0	0	0	0	0	11	0
	Other	12	13	11	14	14	11	11	11	16	11

Table 11: Modal Mineralogy of the SC Group Samples (cont'd)

Survey		CALR-16225-001 / MI5017-SEP17								
Project		South Carolina Department of Natural Resources								
Sample		SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Calculated ESD Particle Size		396	67	283	248	164	158	289	334	233
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.03	0.11	0.02	0.05	0.08	0.15	0.10	0.17	0.13
	Apatite	0.01	0.08	0.01	0.49	0.37	0.41	0.10	0.08	0.79
	Fe-Oxides	0.00	0.16	0.00	1.64	1.72	1.67	0.14	0.77	0.30
	Rutile	0.02	0.28	0.03	0.03	0.06	0.11	0.13	0.06	0.11
	Ilmenite	0.06	0.49	0.39	0.18	0.43	0.83	0.53	0.24	0.82
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.00	1.06	0.00	0.26	0.12	0.00	0.00	0.05	0.03
	Quartz	94.4	70.1	87.0	66.3	66.2	67.6	94.3	92.4	86.6
	Plagioclase	0.77	11.2	3.37	0.44	1.44	0.52	0.30	0.34	0.93
	K-Feldspar	2.08	10.4	7.42	0.31	1.56	1.71	0.49	0.25	1.63
	Biotite	0.01	0.15	0.02	0.10	0.12	0.12	0.03	0.06	0.07
	Muscovite	0.02	0.45	0.02	0.00	0.01	0.01	0.00	0.00	0.00
	Clays	0.02	1.57	0.01	0.21	0.02	0.04	0.02	0.02	0.04
	Chlorite	0.02	0.10	0.03	0.09	0.07	0.04	0.04	0.04	0.10
	Amphibole	0.10	1.29	0.53	0.19	0.34	0.20	0.12	0.08	0.22
	Epidote	0.10	1.14	0.37	0.09	0.13	0.20	0.08	0.18	0.09
	Grossular	0.02	0.07	0.00	0.19	0.27	0.11	0.11	0.52	0.25
	Titanite	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.00	0.03	0.01	0.02	0.07	0.02	0.01	0.04	0.01
	Calcite	2.30	1.18	0.79	28.2	25.4	24.7	3.41	4.54	7.69
	Ankerite	0.07	0.02	0.01	1.17	1.60	1.54	0.05	0.13	0.19
	Dolomite	0.01	0.05	0.00	0.00	0.02	0.00	0.00	0.01	0.01
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.04	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.02	0.00
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	51	21	0	41	0	82	54	0	77
	Synchysite/Bastnaesite	0	29	0	24	13	21	36	27	0
	Other REE	0	0	0	15	9	14	12	18	0
	Zircon	62	35	128	59	54	72	96	96	85
	Apatite	62	76	92	124	71	82	88	64	117
	Fe-Oxides	16	31	27	54	47	47	53	177	243
	Rutile	51	27	54	63	42	47	81	65	44
	Ilmenite	79	39	162	120	103	93	109	108	115
	Other Oxides	0	0	0	14	0	0	11	11	12
	Fe-Sulphides	26	28	25	27	16	19	15	22	18
	Quartz	405	70	287	257	172	164	293	356	237
	Plagioclase	84	38	151	71	60	66	62	40	73
	K-Feldspar	166	43	205	114	89	151	120	60	124
	Biotite	30	23	29	36	30	40	36	23	39
	Muscovite	25	19	30	16	15	24	18	20	15
	Clays	36	21	50	207	27	47	49	39	33
	Chlorite	19	23	21	21	15	18	21	20	25
	Amphibole	52	37	92	33	26	39	45	35	42
	Epidote	54	34	101	18	19	28	43	16	32
	Grossular	37	22	26	106	63	48	53	91	70
	Titanite	36	23	53	85	39	39	36	39	68
	Other Silicates	16	15	16	13	12	17	25	13	17
	Calcite	163	53	121	126	87	105	114	86	133
	Ankerite	53	21	29	39	41	41	31	27	34
	Dolomite	30	41	18	24	30	19	38	34	45
	Fluorite	13	0	0	17	12	17	14	12	20
	Gypsum/Anhydrite	15	69	0	16	15	27	14	126	11
	Phosphates	11	0	0	16	14	13	13	12	0
	Other	14	11	14	13	9	31	11	11	19

Table 12: Modal Mineralogy of the NC Group Samples

Survey		CALR-16225-001 / MI5017-SEP17							
Project		South Carolina Department of Natural Resources							
Sample		NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Calculated ESD Particle Size		89	163	116	133	89	90	225	104
Mineral Mass (%)	Monazite	0.02	0.01	0.00	0.04	0.00	0.00	0.02	0.00
	Synchysite/Bastnaesite	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.09	0.11	0.03	0.03	0.05	0.02	0.07	0.12
	Apatite	0.38	0.24	0.27	0.22	0.47	0.66	1.39	1.40
	Fe-Oxides	0.03	0.01	0.01	0.01	0.03	0.02	0.01	0.01
	Rutile	0.25	0.11	0.27	0.10	0.18	0.02	0.18	0.13
	Ilmenite	0.69	0.57	0.36	0.29	0.49	0.04	0.35	0.47
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.19	0.01	0.08	0.20	0.18	0.04	0.00	0.05
	Quartz	73.9	89.6	86.7	82.6	77.3	21.0	86.1	77.7
	Plagioclase	5.93	1.60	3.12	3.31	5.77	1.51	1.05	4.77
	K-Feldspar	5.26	2.93	4.06	5.20	6.31	1.78	1.62	5.56
	Biotite	0.17	0.09	0.17	0.10	0.19	0.02	0.01	0.05
	Muscovite	0.03	0.04	0.01	0.08	0.05	0.00	0.00	0.03
	Clays	0.15	0.03	0.07	0.13	0.20	0.00	0.11	0.11
	Chlorite	0.06	0.08	0.08	0.04	0.09	0.00	0.04	0.04
	Amphibole	0.66	0.30	0.70	0.31	0.43	0.01	0.12	0.15
	Epidote	0.46	0.17	0.43	0.25	0.31	0.01	0.11	0.17
	Grossular	0.05	0.07	0.05	0.07	0.05	0.00	0.20	0.12
	Titanite	0.03	0.00	0.01	0.01	0.02	0.00	0.00	0.03
	Other Silicates	0.11	0.01	0.05	0.04	0.05	0.03	0.02	0.04
	Calcite	11.1	3.99	3.32	6.86	7.40	74.0	8.45	8.57
	Ankerite	0.19	0.02	0.07	0.07	0.08	0.69	0.17	0.23
	Dolomite	0.17	0.02	0.05	0.04	0.22	0.00	0.00	0.19
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.01	0.00	0.02	0.01	0.08	0.00	0.00	0.02
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.04	0.00	0.03	0.04	0.05	0.09	0.01	0.02
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	42	50	0	98	0	0	155	0
	Synchysite/Bastnaesite	27	0	29	0	22	0	21	25
	Other REE	11	0	0	0	14	20	11	0
	Zircon	51	75	50	46	38	32	77	58
	Apatite	64	152	83	70	67	91	145	70
	Fe-Oxides	19	17	30	21	14	24	34	21
	Rutile	38	49	58	45	36	23	159	38
	Ilmenite	78	98	72	72	64	41	132	61
	Other Oxides	0	11	11	11	14	11	11	0
	Fe-Sulphides	16	17	16	17	15	15	17	15
	Quartz	88	162	114	128	90	98	228	114
	Plagioclase	37	79	49	38	40	62	116	53
	K-Feldspar	55	121	74	62	65	96	183	62
	Biotite	36	51	30	28	46	20	34	20
	Muscovite	14	35	14	22	15	15	17	17
	Clays	22	40	26	19	26	19	127	30
	Chlorite	17	19	18	16	21	11	23	29
	Amphibole	39	50	51	33	40	17	42	31
	Epidote	19	61	31	26	22	14	52	24
	Grossular	37	78	38	49	40	0	55	75
	Titanite	39	33	30	25	37	22	43	46
	Other Silicates	15	17	13	12	12	13	19	13
	Calcite	75	120	65	80	57	77	129	57
	Ankerite	22	24	22	24	23	22	36	28
	Dolomite	33	41	25	24	32	0	26	26
	Fluorite	19	29	28	11	17	29	17	0
	Gypsum/Anhydrite	46	24	42	26	91	0	29	28
	Phosphates	11	21	0	0	0	0	11	21
	Other	11	12	11	12	11	17	14	11

Table 13: Modal Mineralogy of the NC Group Samples (cont'd)

Survey		CALR-16225-001 / MI5017-SEP17							
Project		South Carolina Department of Natural Resources							
Sample		NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Calculated ESD Particle Size		184	140	158	221	153	168	139	152
Mineral Mass (%)	Monazite	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.03	0.06	0.19	0.09	0.05	0.18	0.08	0.02
	Apatite	0.48	0.98	1.24	2.68	1.61	1.78	0.42	0.04
	Fe-Oxides	0.01	0.00	0.01	0.00	0.04	0.00	0.02	0.01
	Rutile	0.07	0.21	0.14	0.05	0.07	0.09	0.04	0.26
	Ilmenite	0.09	0.29	0.99	0.41	0.10	0.46	0.08	0.70
	Other Oxides	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.01	0.00	0.01	0.39	0.02	0.31	0.01
	Quartz	91.5	91.3	90.7	89.2	61.3	76.3	63.7	89.2
	Plagioclase	1.31	2.02	1.98	0.95	2.04	2.03	2.14	4.41
	K-Feldspar	1.67	2.98	1.87	1.48	1.81	2.68	8.40	3.68
	Biotite	0.02	0.00	0.00	0.01	0.38	0.02	0.52	0.14
	Muscovite	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.09
	Clays	0.27	0.12	0.14	0.04	0.07	0.12	0.14	0.18
	Chlorite	0.02	0.05	0.02	0.12	0.42	0.13	0.05	0.10
	Amphibole	0.07	0.09	0.15	0.14	1.49	0.56	0.47	0.48
	Epidote	0.08	0.10	0.28	0.05	0.21	0.14	0.17	0.49
	Grossular	0.09	0.07	0.24	0.12	0.02	0.05	0.03	0.06
	Titanite	0.00	0.02	0.01	0.00	0.01	0.03	0.00	0.00
	Other Silicates	0.02	0.01	0.02	0.01	0.16	0.03	0.10	0.06
	Calcite	4.23	1.59	1.85	4.48	28.7	15.2	22.8	0.01
	Ankerite	0.05	0.07	0.15	0.13	0.78	0.20	0.33	0.00
	Dolomite	0.01	0.01	0.00	0.00	0.07	0.01	0.04	0.04
	Fluorite	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.01	0.19	0.00	0.02	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.01	0.01	0.01	0.01	0.09	0.02	0.17	0.01
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	0	86	0	0	32	65	32	0
	Synchysite/Bastnaesite	15	0	0	0	26	0	30	19
	Other REE	0	17	21	14	11	0	22	14
	Zircon	66	50	69	67	84	90	130	44
	Apatite	81	87	101	177	123	134	111	80
	Fe-Oxides	24	19	18	16	29	16	21	15
	Rutile	50	64	54	47	43	54	20	48
	Ilmenite	81	76	92	95	65	83	52	90
	Other Oxides	11	14	21	16	0	11	16	11
	Fe-Sulphides	16	13	15	19	18	16	21	16
	Quartz	184	137	155	219	151	166	124	147
	Plagioclase	74	92	86	100	33	82	34	98
	K-Feldspar	113	116	121	147	45	127	31	98
	Biotite	22	20	23	30	17	24	18	64
	Muscovite	16	12	18	15	13	15	13	26
	Clays	199	92	67	42	26	57	16	57
	Chlorite	20	32	19	40	22	23	19	25
	Amphibole	37	60	64	41	33	43	32	67
	Epidote	45	55	70	51	15	40	14	64
	Grossular	60	52	46	50	32	38	31	22
	Titanite	32	36	34	21	15	89	13	50
	Other Silicates	13	14	19	19	13	19	13	35
	Calcite	105	76	93	129	115	131	126	33
	Ankerite	26	29	41	32	54	30	29	11
	Dolomite	27	21	33	22	27	27	25	66
	Fluorite	14	19	21	25	21	19	17	0
	Gypsum/Anhydrite	15	44	25	59	69	24	29	0
	Phosphates	11	23	11	11	14	11	0	0
	Other	13	13	15	19	12	15	12	12

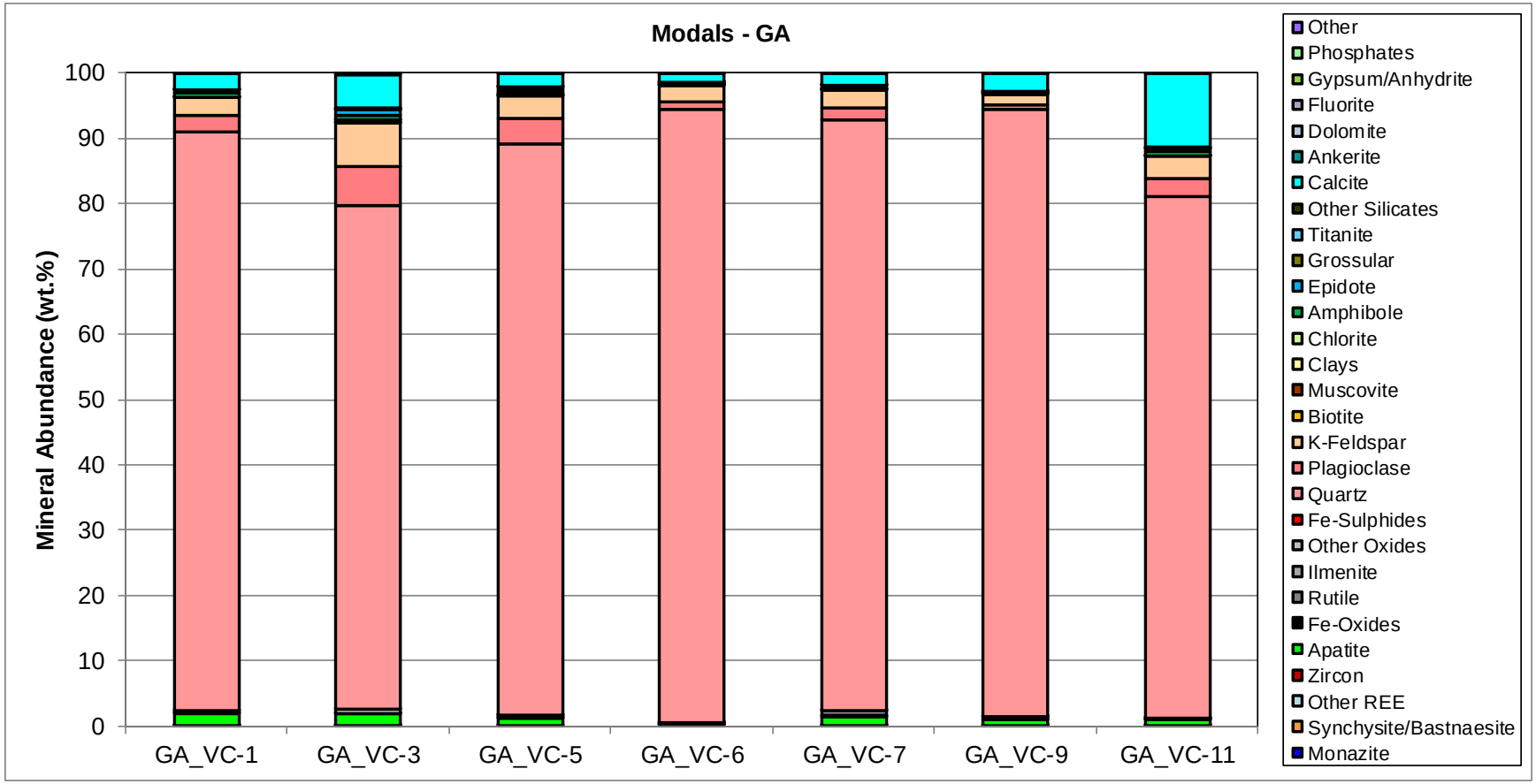


Figure 2: Modal Mineralogy Illustration for the GA Group Samples

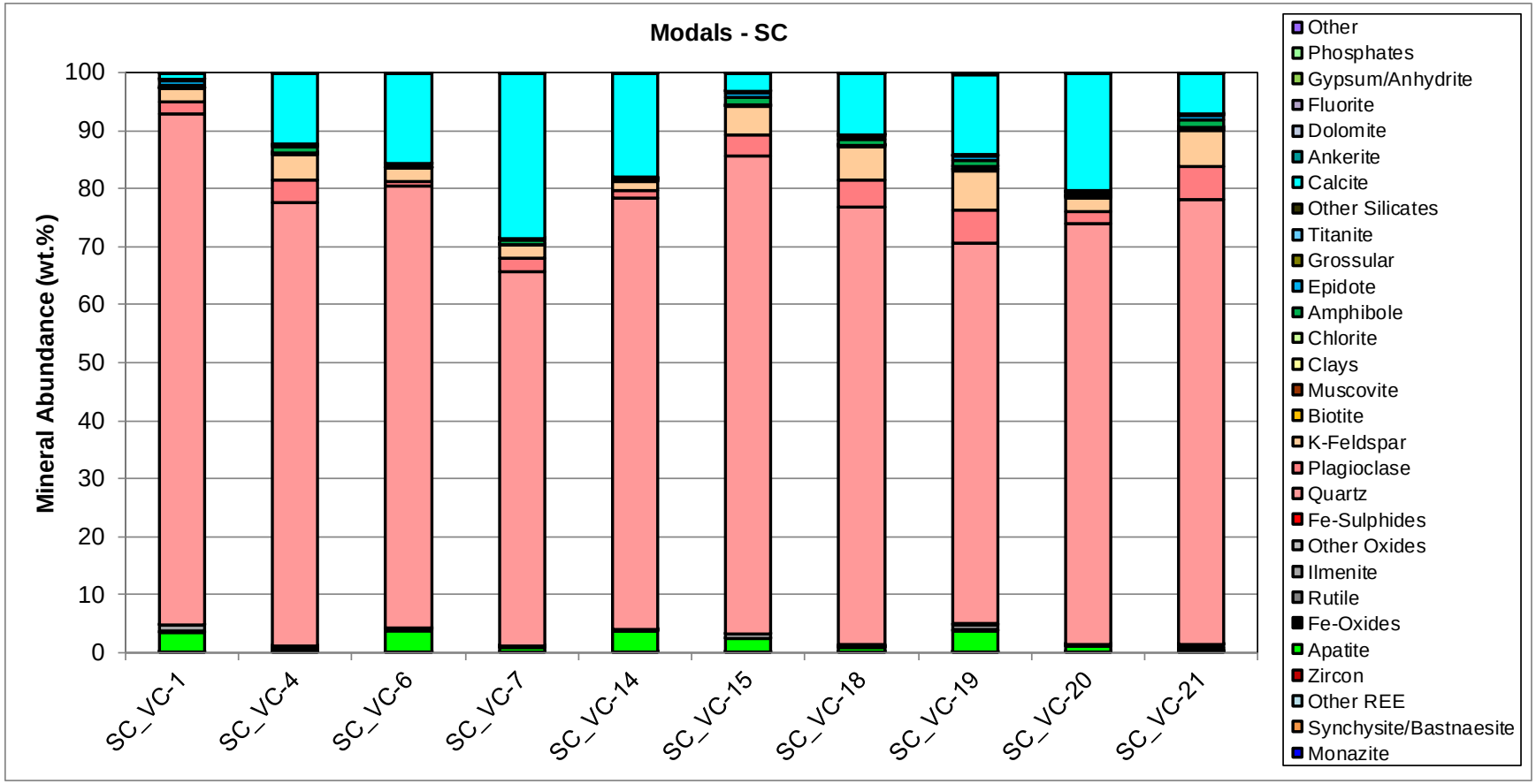


Figure 3: Modal Mineralogy Illustration for the SC Group Samples

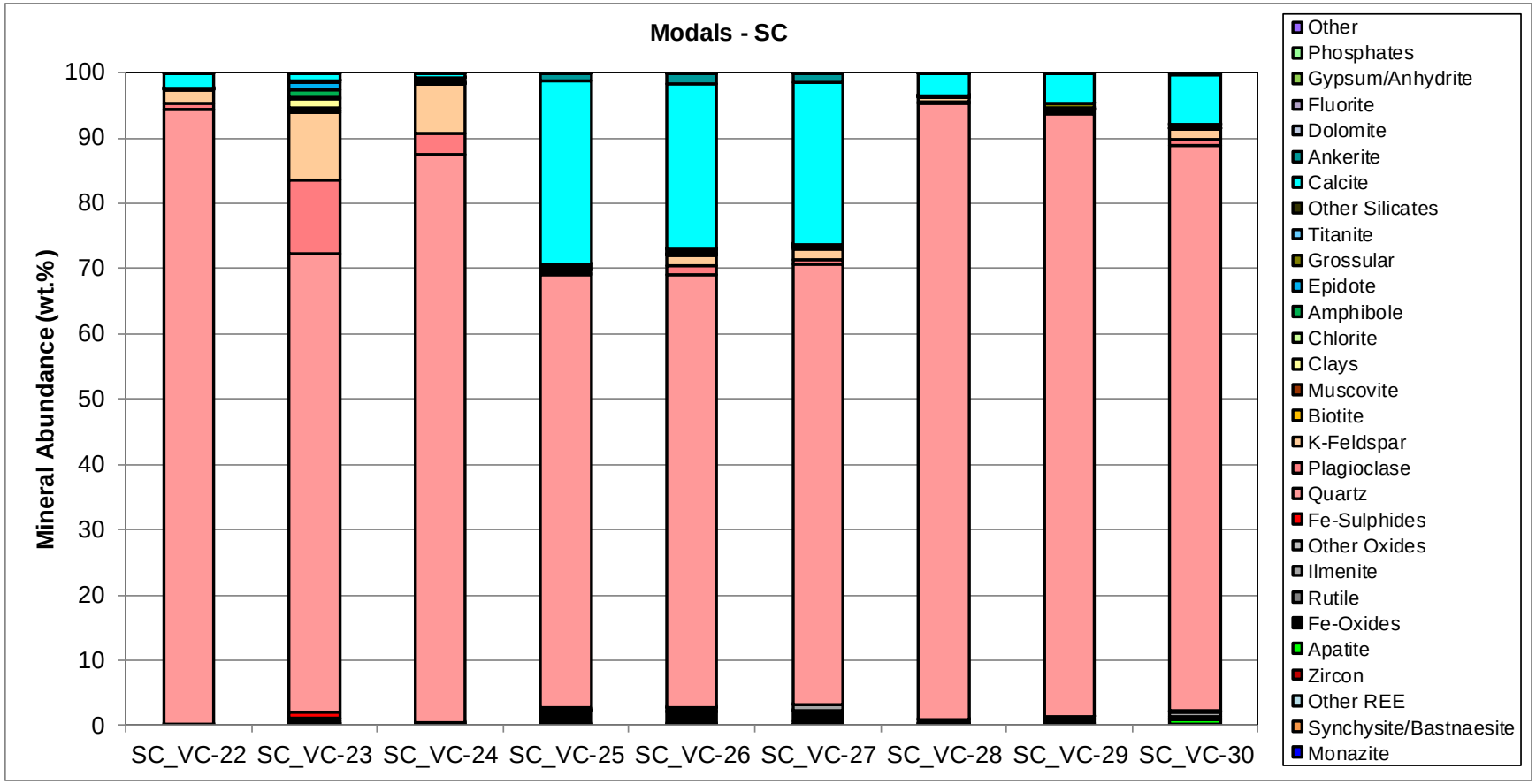


Figure 4: Modal Mineralogy Illustration for the SC Group Samples (cont'd)

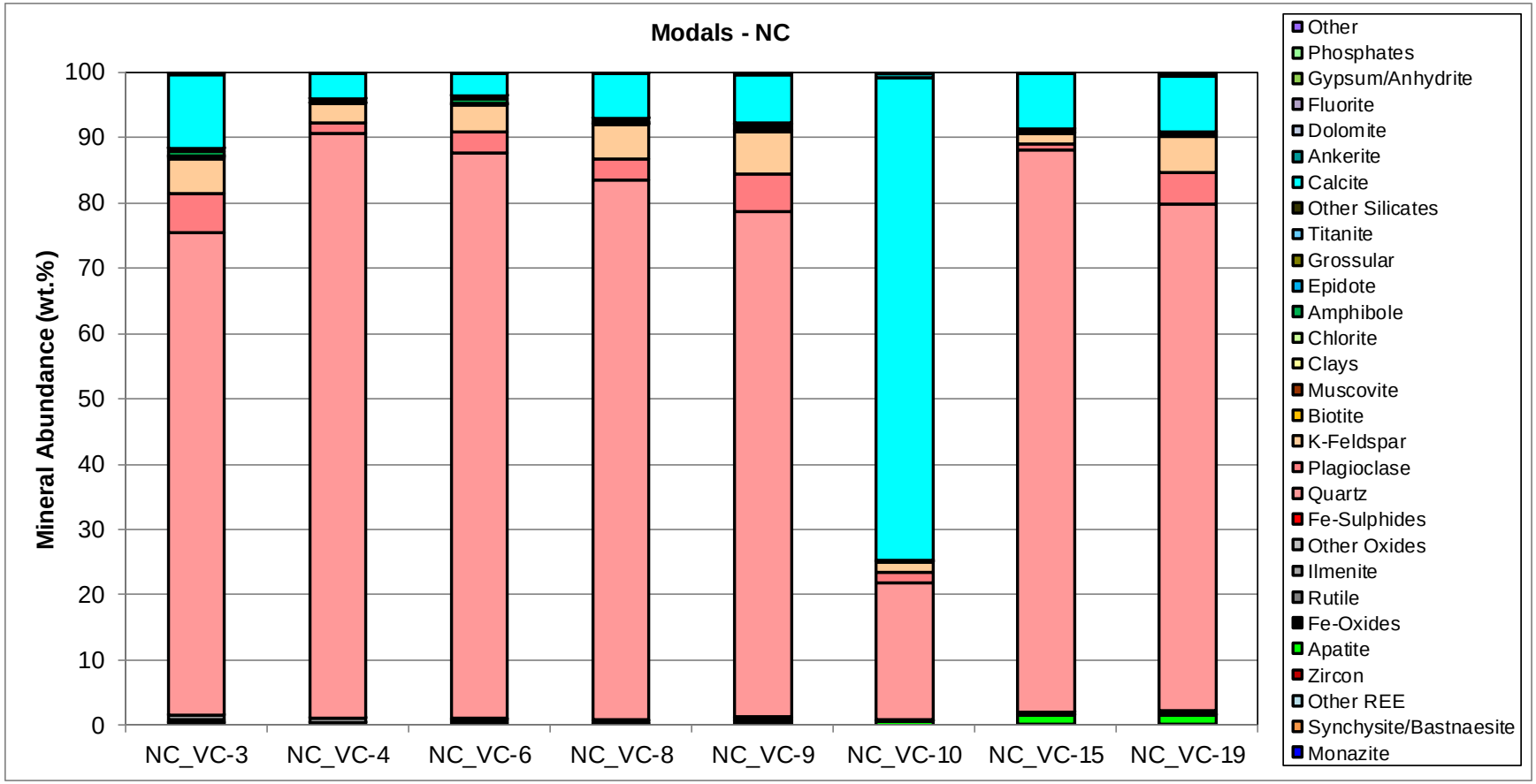


Figure 5: Modal Mineralogy Illustration for the NC Group Samples

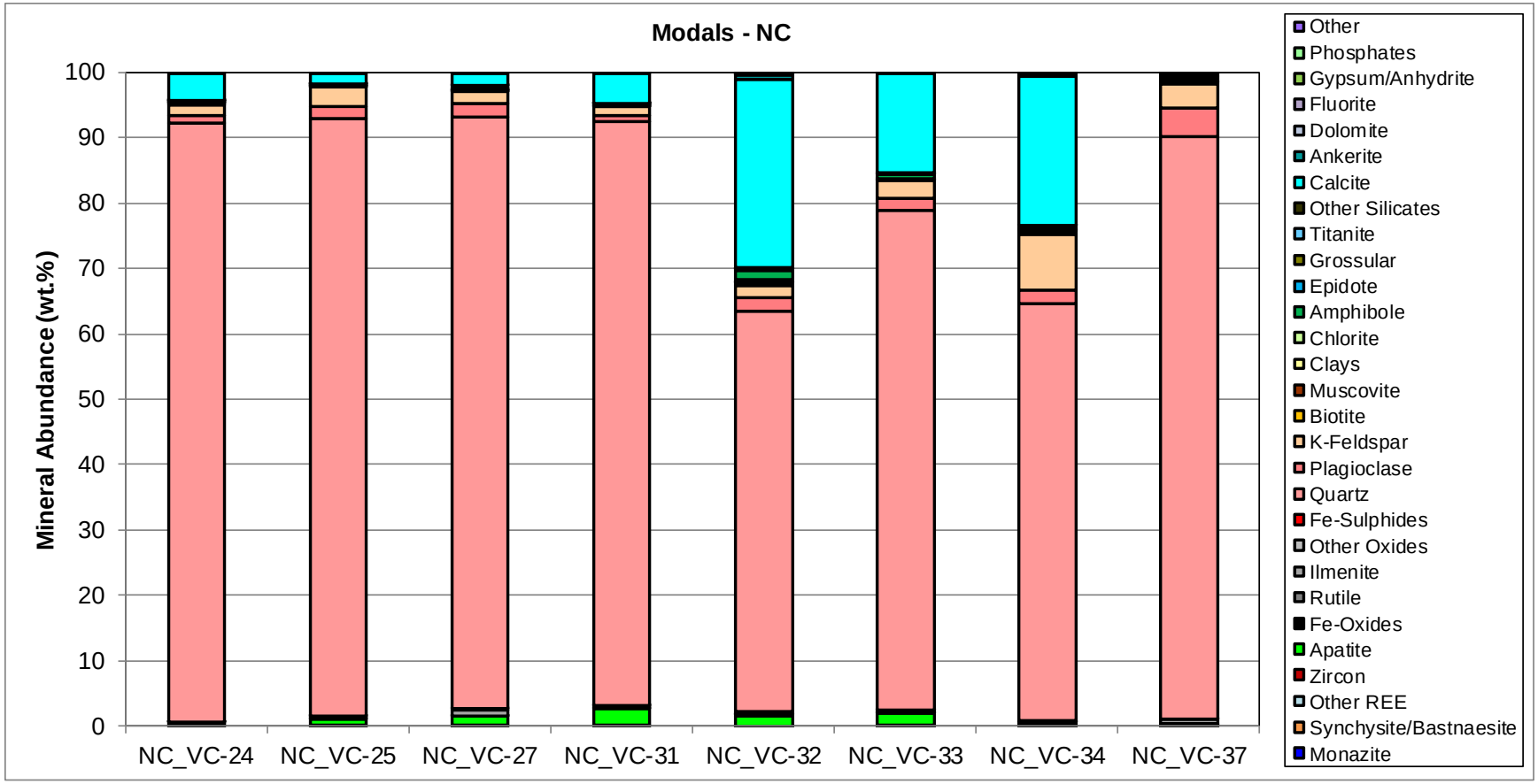


Figure 6: Modal Mineralogy Illustration for the NC Group Samples

4.2. Cumulative Grain Size Distribution

The cumulative grain size distribution graphs for selected minerals are given in Appendix C.

The D_{50} (midpoint by mass from the cumulative grain size distribution, in µm) for the main minerals is presented in Table 14. The D_{50} ranges widely for all the minerals. However, it is noted that the grain size is greatly affected by the mass of the minerals (i.e., number of particles) in each sample. An example of a cumulative grain size is shown in Figure 7.

Table 14: The D_{50} for Selected Minerals for the Samples

Sample	D50										
	Monazite	Zircon	Apatite	Rutile	Other Oxides	Fe-Sulphides	Quartz/ Feldspars	Micas/ Clays	Other Silicates	Carbonates	Particle
GA_VC-1	-	108	118	87	89	18	142	55	86	223	142
GA_VC-3	54	52	110	71	65	17	110	52	60	77	108
GA_VC-5	-	52	124	69	102	16	158	46	86	86	157
GA_VC-6	-	175	153	52	110	32	354	30	61	153	351
GA_VC-7	42	134	156	93	145	21	220	64	97	146	215
GA_VC-9	117	87	140	74	111	20	368	73	76	161	352
GA_VC-11	-	110	142	43	104	19	264	62	92	142	236
SC_VC-1	104	112	283	133	164	25	305	65	169	185	303
SC_VC-4	-	66	150	81	92	21	160	72	74	149	159
SC_VC-6	-	146	308	136	129	19	323	56	93	199	304
SC_VC-7	-	33	180	-	82	20	181	36	58	163	178
SC_VC-14	-	129	240	127	137	20	296	33	99	212	279
SC_VC-15	-	99	135	108	101	13	151	54	93	123	150
SC_VC-18	-	87	168	104	82	25	142	54	77	118	140
SC_VC-19	-	58	340	122	95	20	128	37	55	162	140
SC_VC-20	-	72	224	112	136	21	203	51	74	218	208
SC_VC-21	-	95	114	121	93	18	136	89	83	105	134
SC_VC-22	-	58	129	74	105	47	540	38	76	313	535
SC_VC-23	-	44	-	34	46	46	114	28	45	80	118
SC_VC-24	-	160	-	64	243	-	360	36	155	357	354
SC_VC-25	-	272	188	181	69	35	379	171	44	197	319
SC_VC-26	-	91	123	104	56	22	253	28	41	125	208
SC_VC-27	160	119	106	53	71	24	212	46	42	146	195
SC_VC-28	-	121	133	117	137	20	389	39	71	155	380
SC_VC-29	-	155	107	150	-	30	523	28	90	137	500
SC_VC-30	105	112	197	59	167	25	333	34	61	170	319
NC_VC-3	55	74	105	54	108	19	117	34	42	113	116
NC_VC-4	-	98	256	85	132	20	197	42	82	150	197
NC_VC-6	-	-	118	98	102	19	145	28	63	108	143
NC_VC-8	-	54	94	101	95	22	166	30	40	117	165
NC_VC-9	-	50	88	61	81	20	119	56	52	81	117
NC_VC-10	-	-	172	30	48	21	142	24	17	144	147
NC_VC-15	-	101	225	229	138	25	296	217	73	176	281
NC_VC-19	-	66	96	57	74	19	133	46	55	74	126
NC_VC-24		144	154	82	99	22	229	-	57	162	225
NC_VC-25	-	81	129	76	112	17	166	95	67	102	165
NC_VC-27	-	95	148	88	111	15	188	78	96	116	185
NC_VC-31	-	92	257	74	117	24	274	59	59	200	274
NC_VC-32	-	141	158	122	77	24	222	24	38	188	229
NC_VC-33	-	128	185	84	104	19	206	37	53	174	206
NC_VC-34	-	-	205	27	65	28	223	20	31	221	221
NC_VC-37	-	-	-	61	115	21	180	88	103	78	179
Average	**91**	**102**	**166**	**90**	**105**	**23**	**232**	**55**	**71**	**155**	**225**
Minimum	42	33	88	27	46	13	110	20	17	74	108
Maximum	160	272	340	229	243	47	540	217	169	357	535

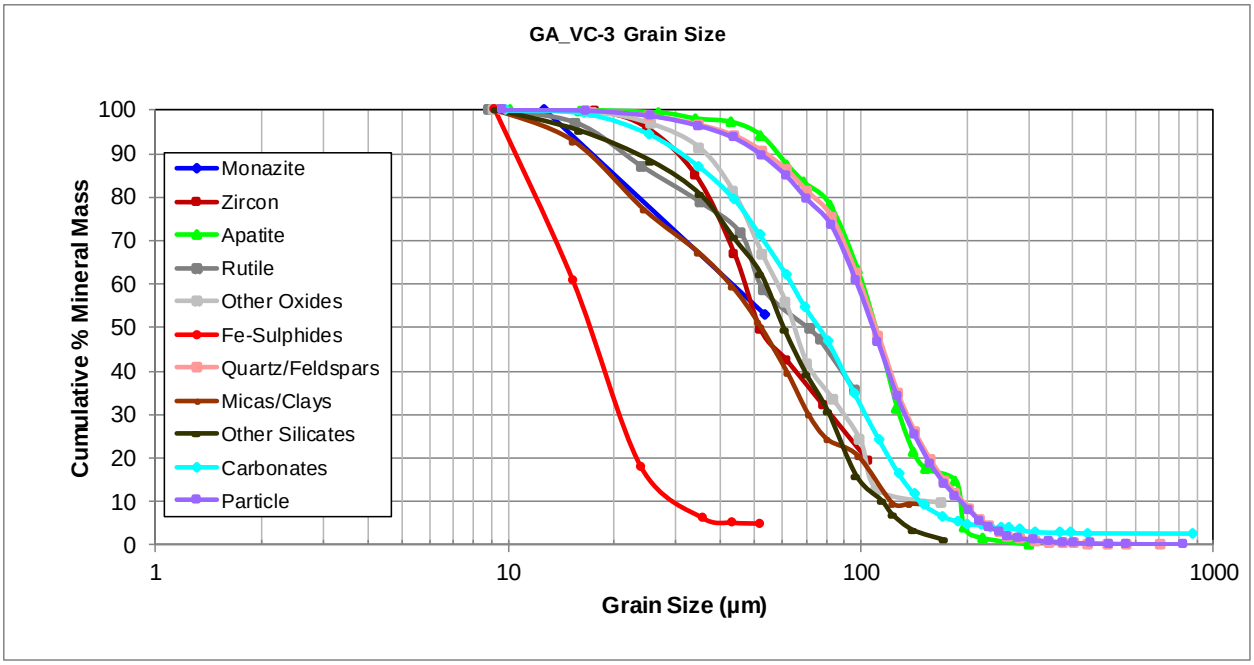


Figure 7: Cumulative Grain Size Distribution Curves for Selected Minerals for the GA_VC-3 Sample

4.3. Liberation and Association of Monazite, Zircon, Apatite

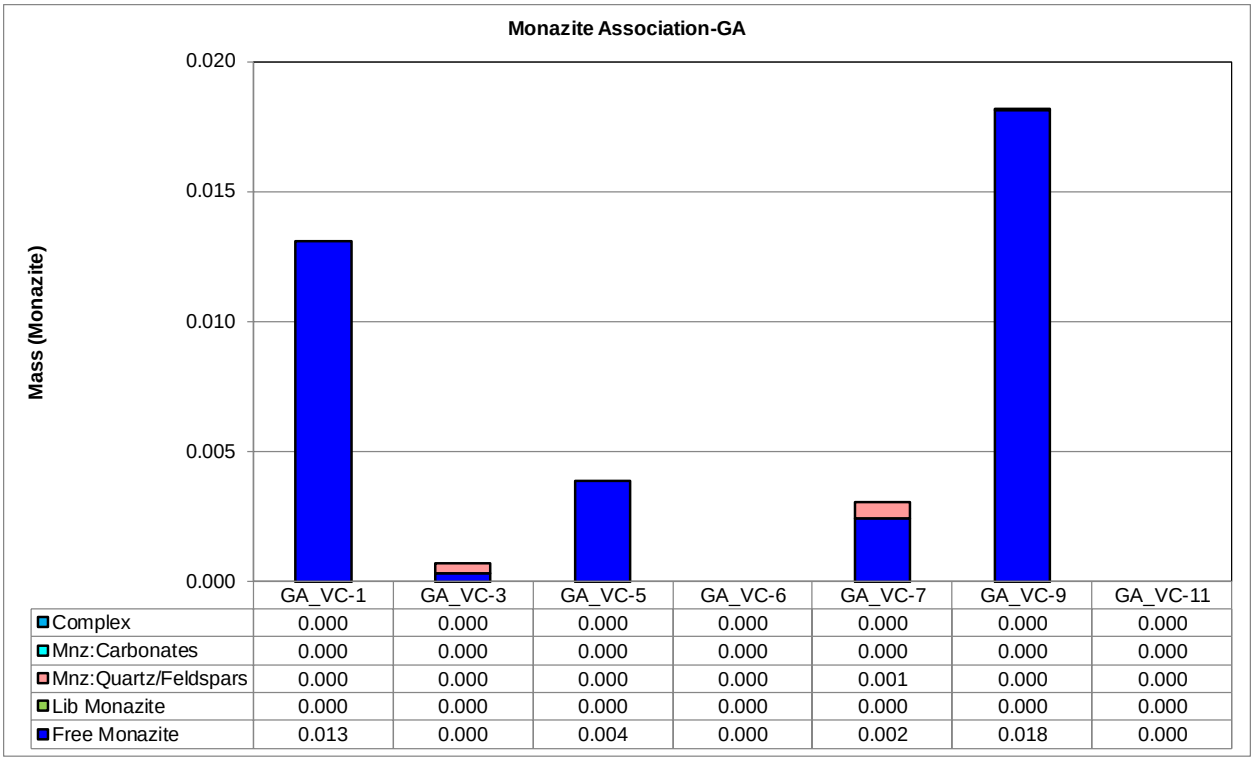
4.3.1. Liberation and Association of Monazite

Free and liberated monazite ranges from 47% to 100% in the GA group samples. The remainder occurs as middling particles with quartz/feldspars (20% to 53%) (Figure 8 and Figure 9).

Free and liberated monazite ranges from nil to 100% in the SC group samples. The remainder occurs as middling particles with quartz/feldspars (nil to 100%, carbonates nil to 100%, and complex particles (nil to 5%) as shown in Figure 10 and Figure 11.

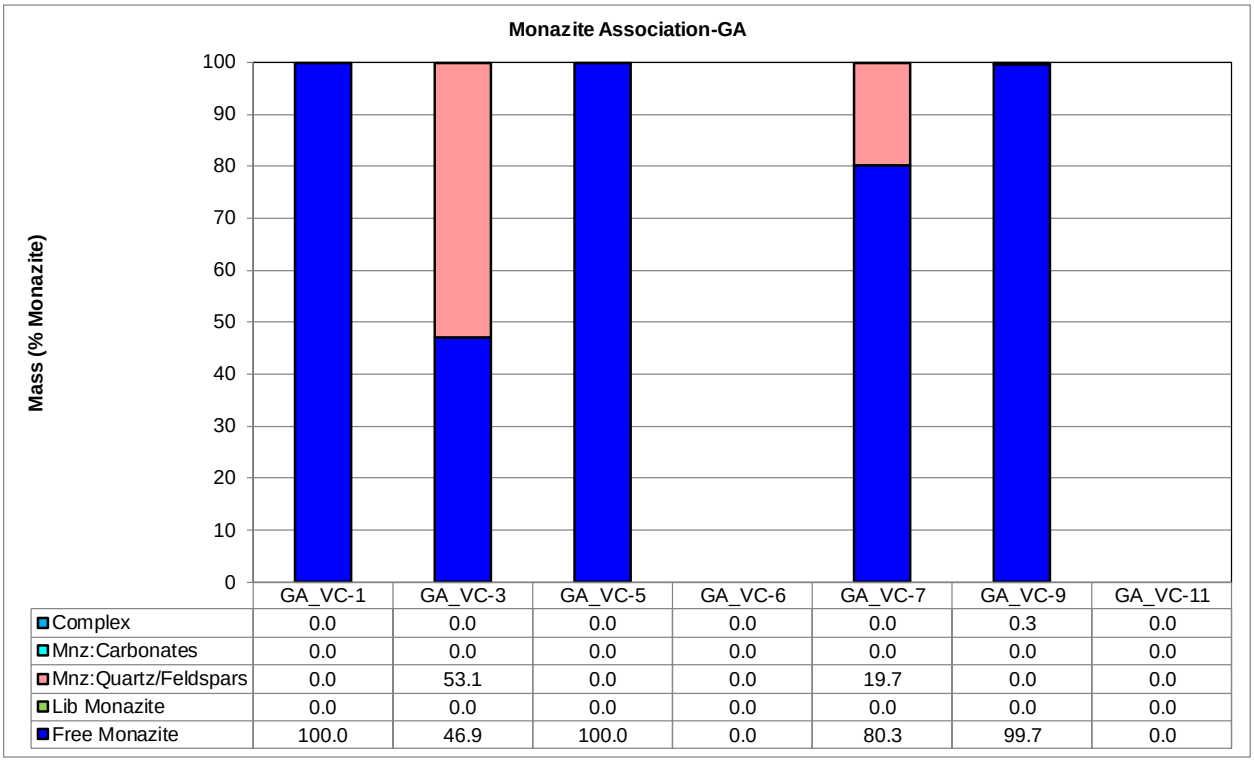
Free and liberated monazite ranges from nil to 100% in the NC group samples. The remainder occurs as middling particles with quartz/feldspars (nil to 100%) and complex particles nil to <1% (Figure 12 and Figure 13).

Image grids and particle maps for each group of samples are presented in Figure 14 to Figure 18.



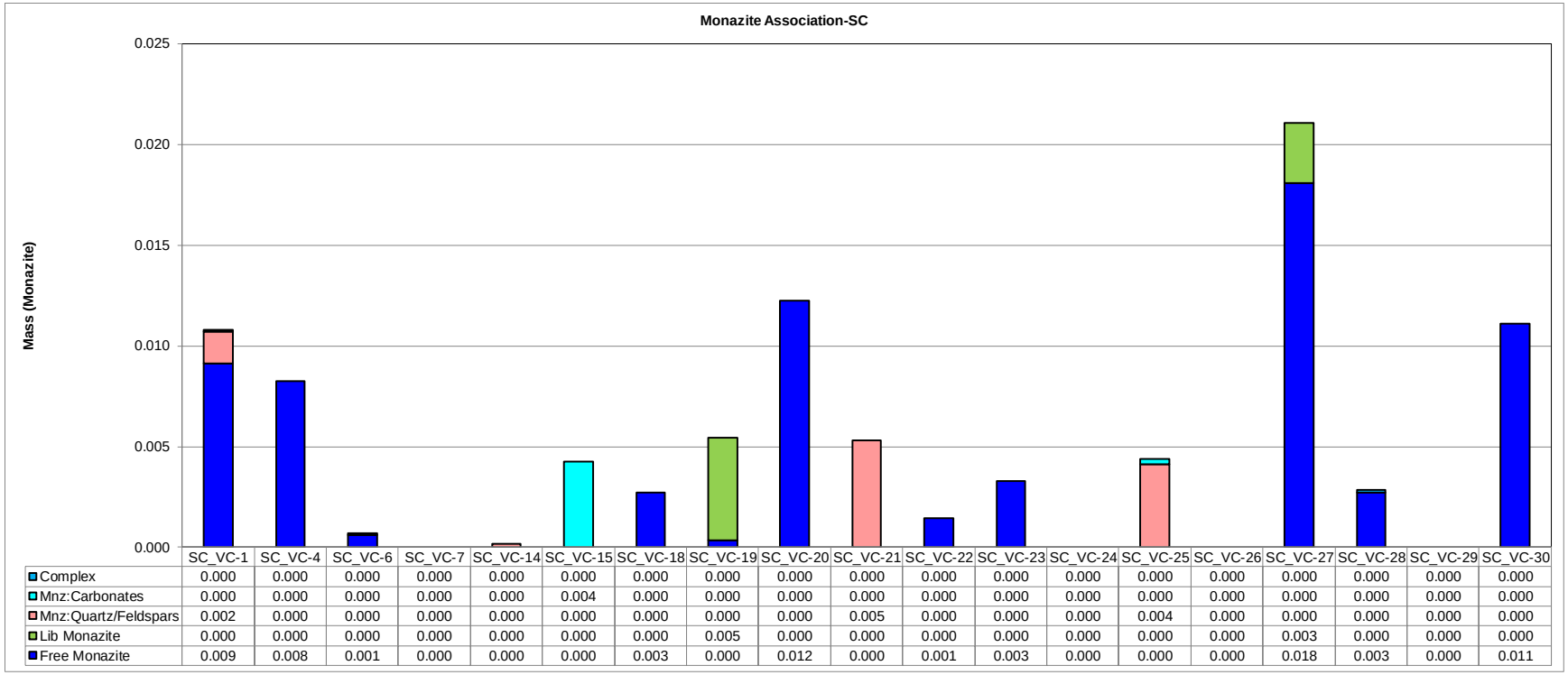
	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Free Monazite	0.013	0.000	0.004	0.000	0.002	0.018	0.000

Figure 8: Liberation and Association of Monazite (Mass) for the GA Group Samples



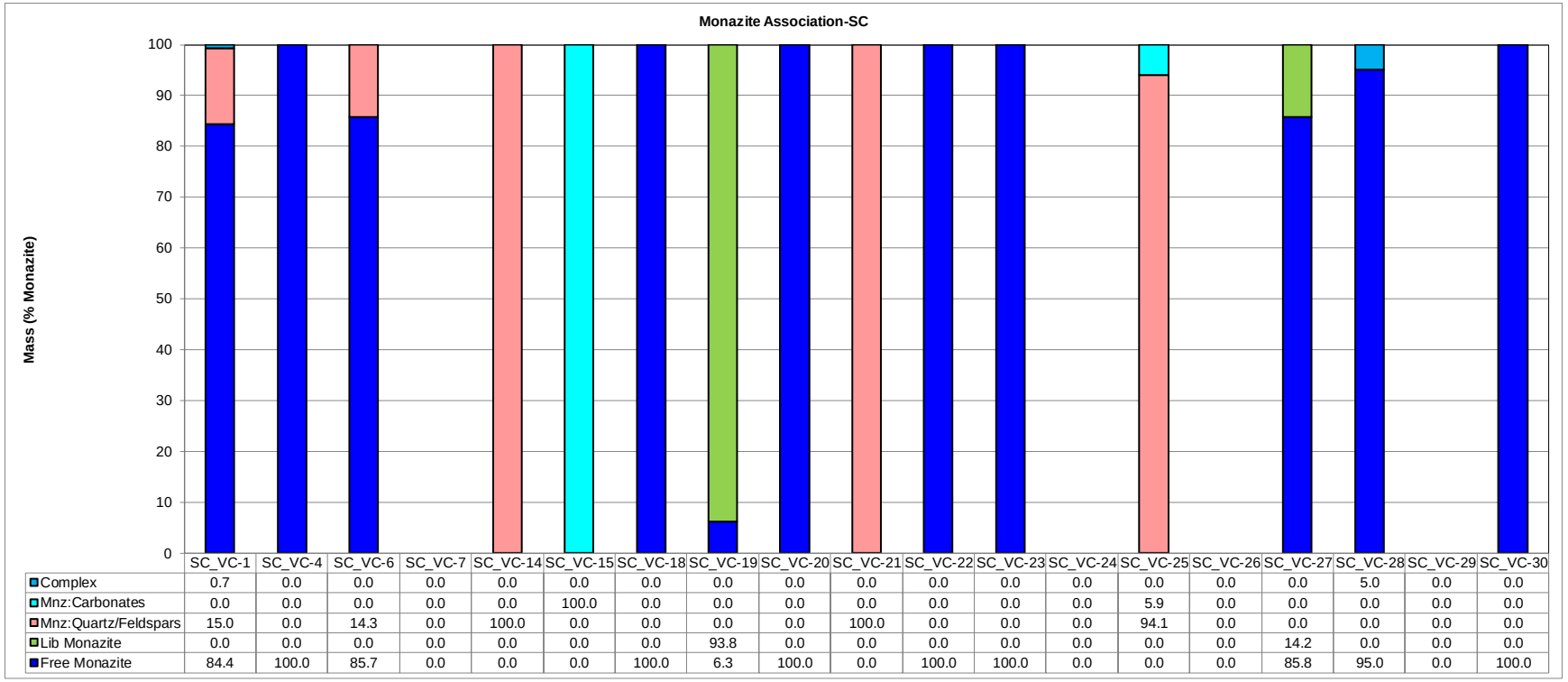
	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mnz:Quartz/Feldspars	0.0	53.1	0.0	0.0	19.7	0.0	0.0
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Free Monazite	100.0	46.9	100.0	0.0	80.3	99.7	0.0

Figure 9: Liberation and Association of Monazite (Norm Mass%) for the GA Group Samples



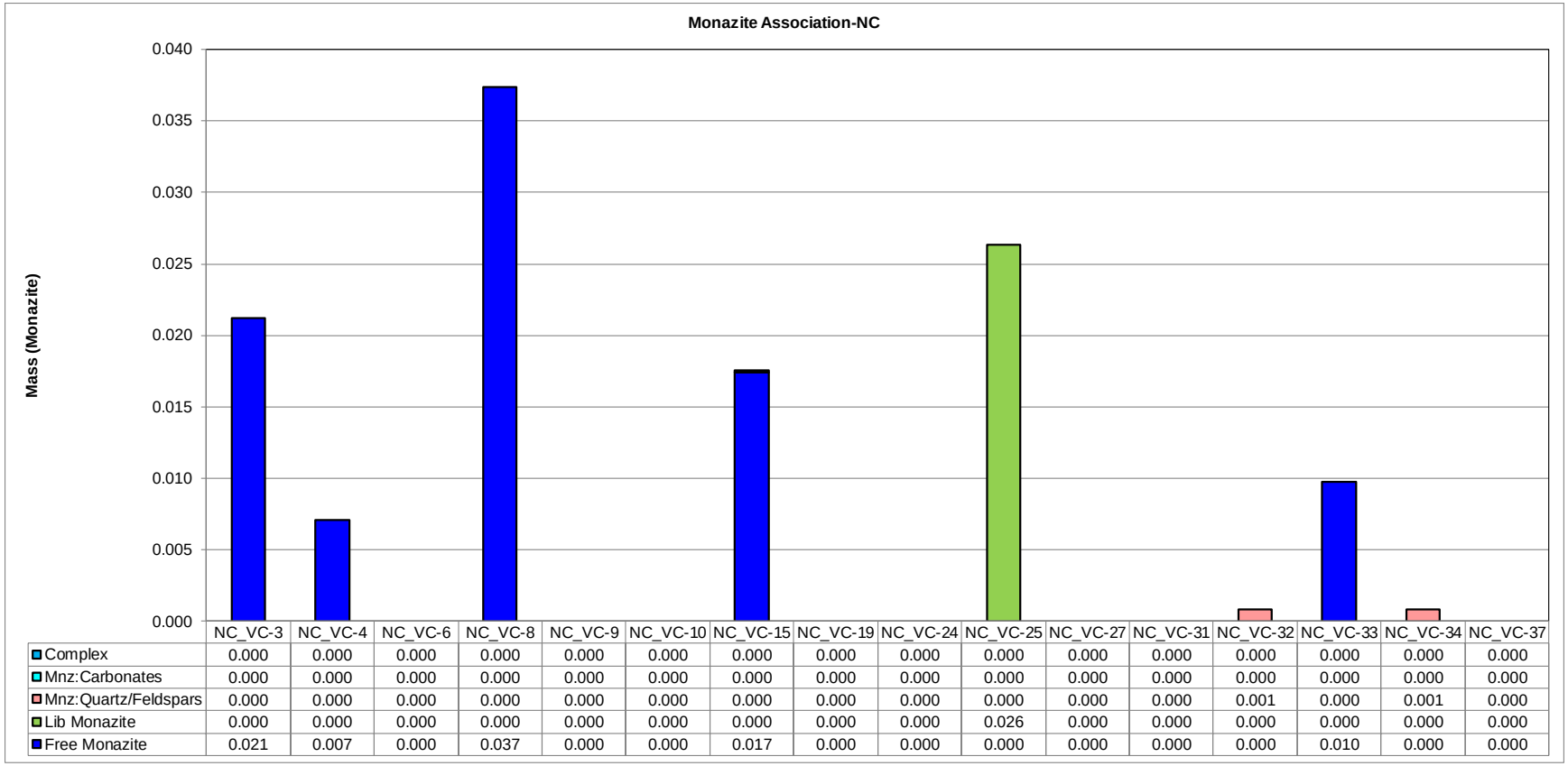
	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000
Free Monazite	0.009	0.008	0.001	0.000	0.000	0.000	0.003	0.000	0.012	0.000	0.001	0.003	0.000	0.000	0.000	0.018	0.003	0.000	0.011

Figure 10: Liberation and Association of Monazite (Mass) for the SC Group Samples



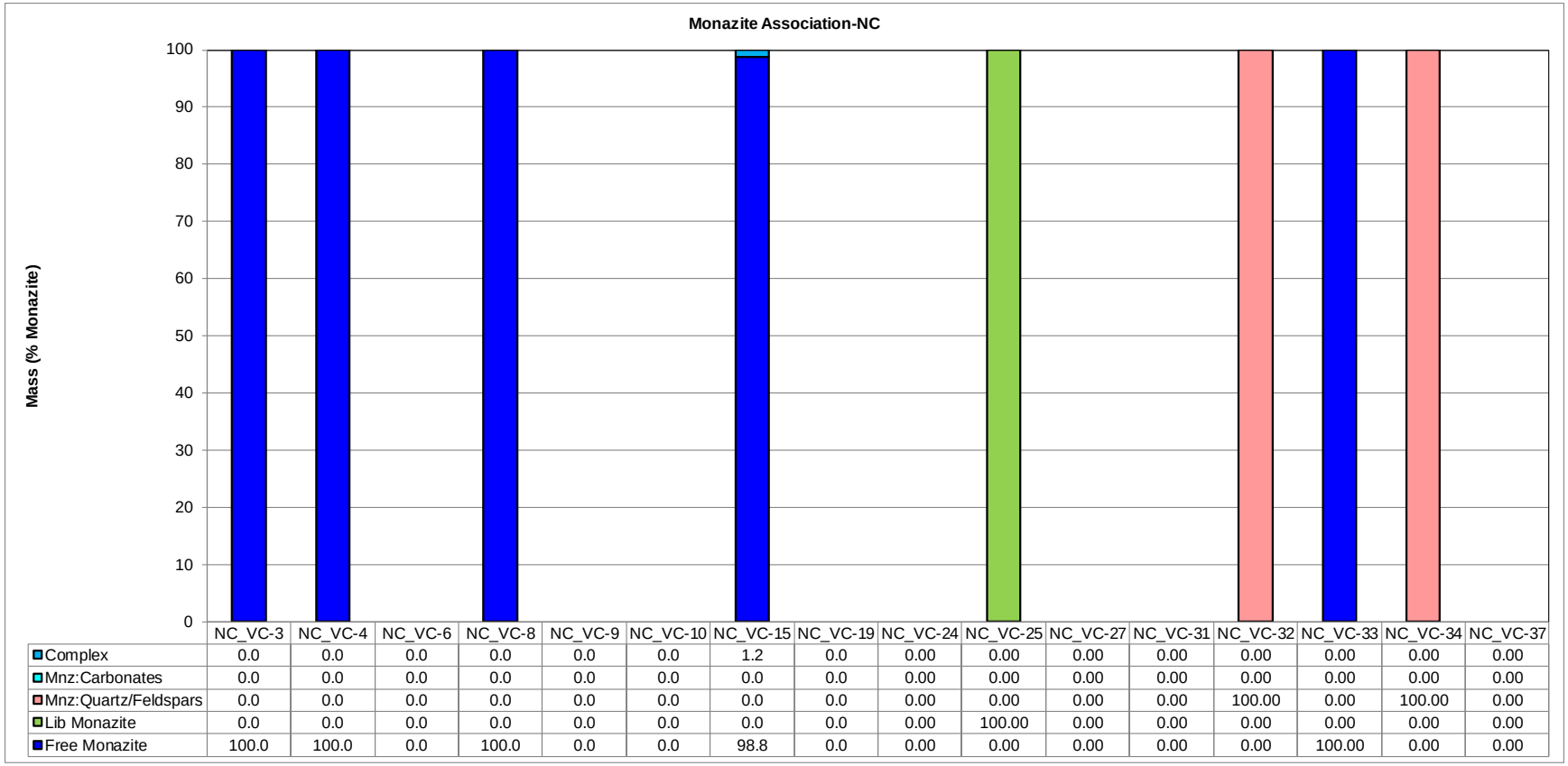
	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0
Mnz:Quartz/Feldspars	15.0	0.0	14.3	0.0	100.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	94.1	0.0	0.0	0.0	0.0	0.0
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	93.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.2	0.0	0.0	0.0
Free Monazite	84.4	100.0	85.7	0.0	0.0	0.0	100.0	6.3	100.0	0.0	100.0	100.0	0.0	0.0	0.0	85.8	95.0	0.0	100.0

Figure 11: Liberation and Association of Monazite (Norm Mass%) for the SC Group Samples



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.026	0.000	0.000	0.000	0.000	0.000	0.000
Free Monazite	0.021	0.007	0.000	0.037	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000

Figure 12: Liberation and Association of Monazite (Mass) for the NC Group Samples



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mnz:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.00	100.00	0.00	100.00	0.00
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Free Monazite	100.0	100.0	0.0	100.0	0.0	0.0	98.8	0.0	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00

Figure 13: Liberation and Association of Monazite (Norm Mass%) for the NC Group Samples

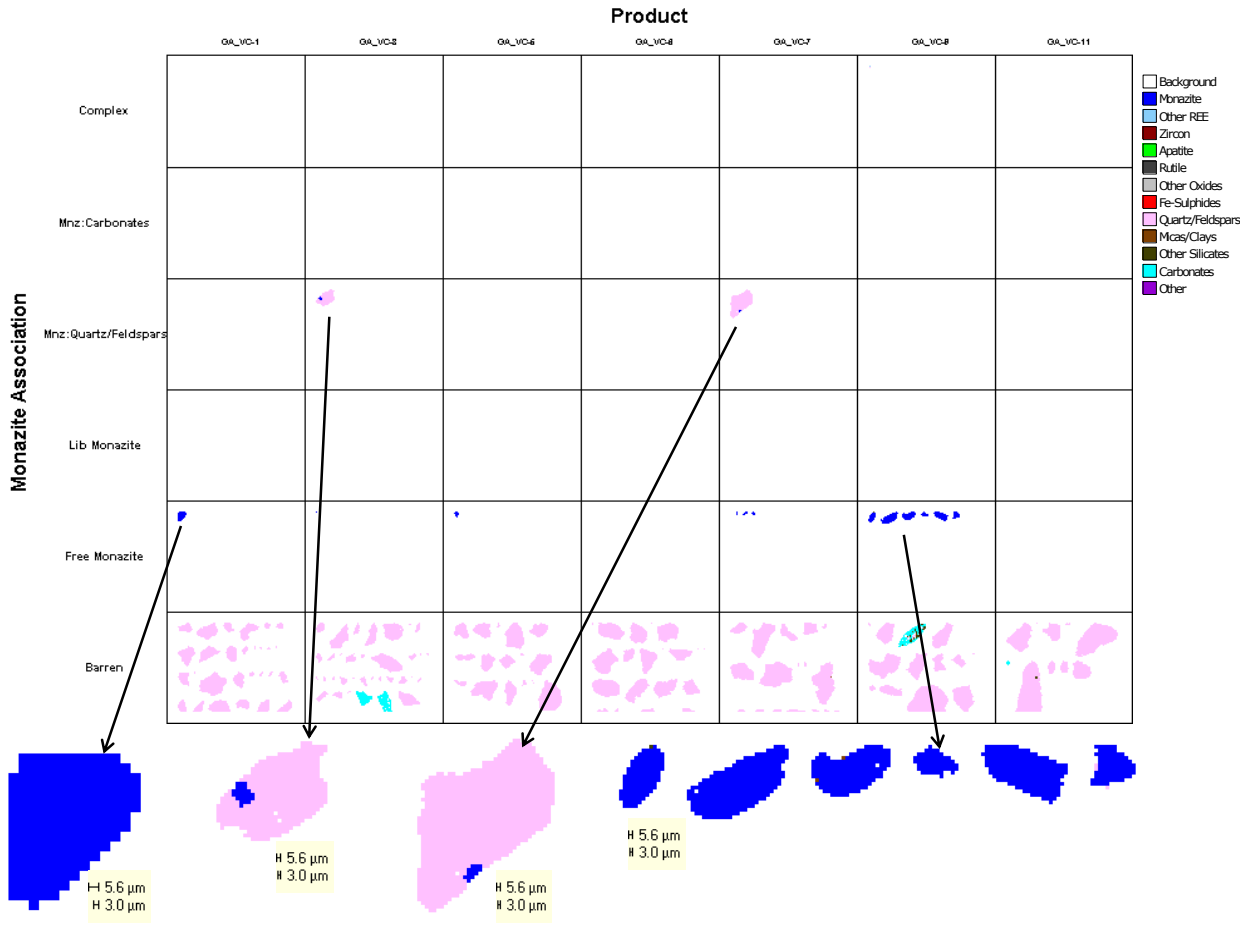


Figure 14: Image Grid and Particle Maps of Monazite Liberation and Association for the GA Group Samples

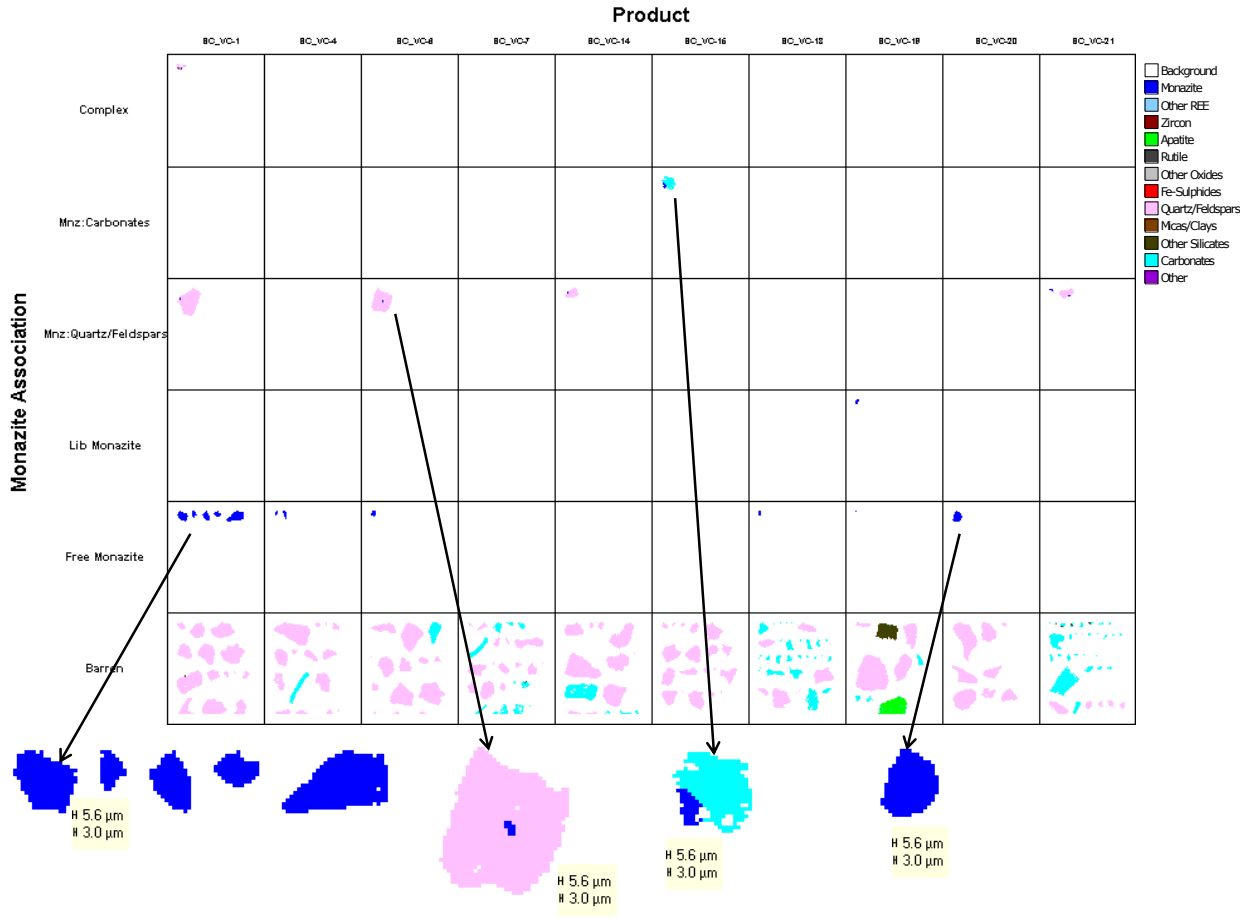


Figure 15: Image Grid and Particle Maps of Monazite Liberation and Association for the SC Group Samples

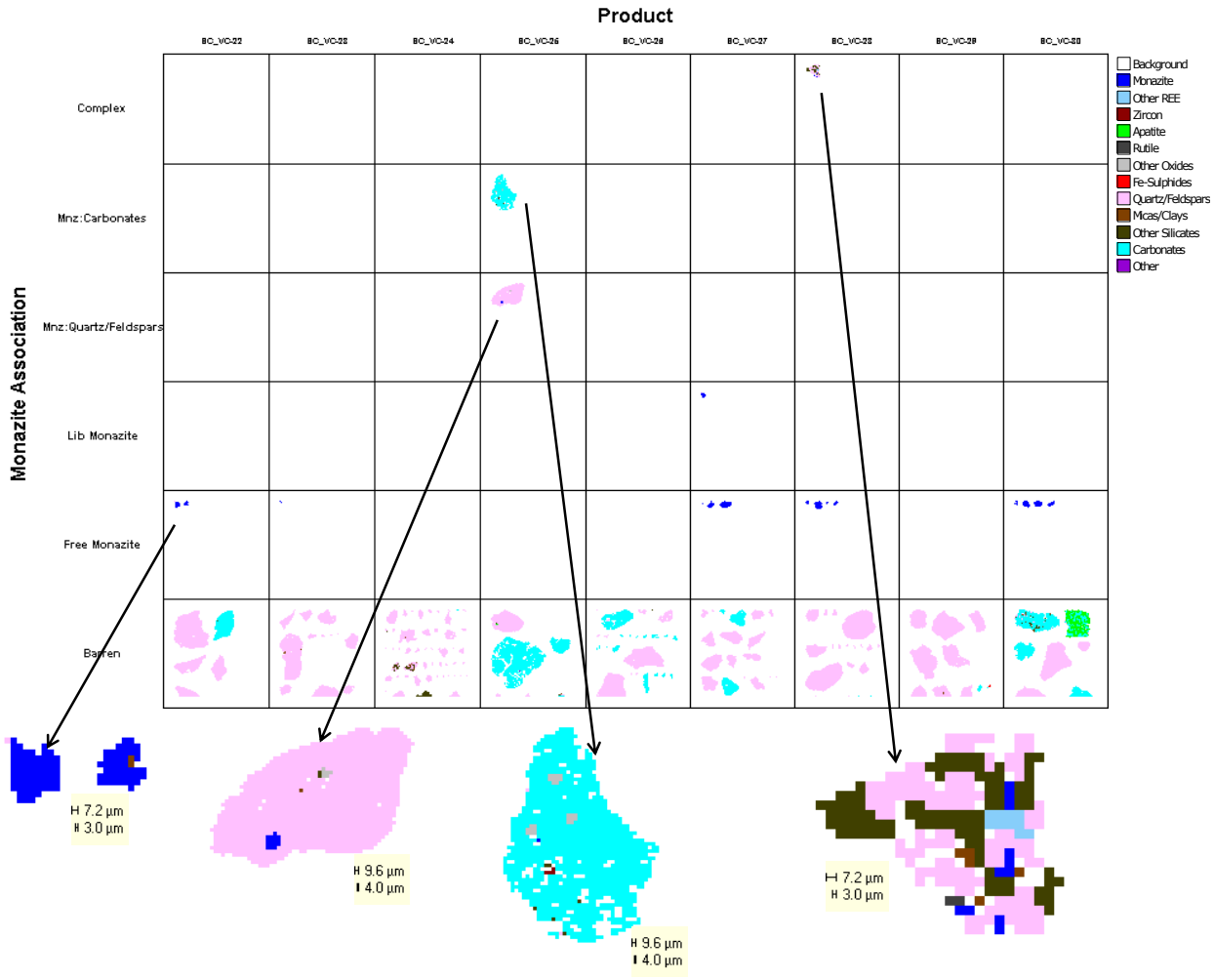


Figure 16: Image Grid and Particle Maps of Monazite Liberation and Association for the SC Group Samples (cont'd)

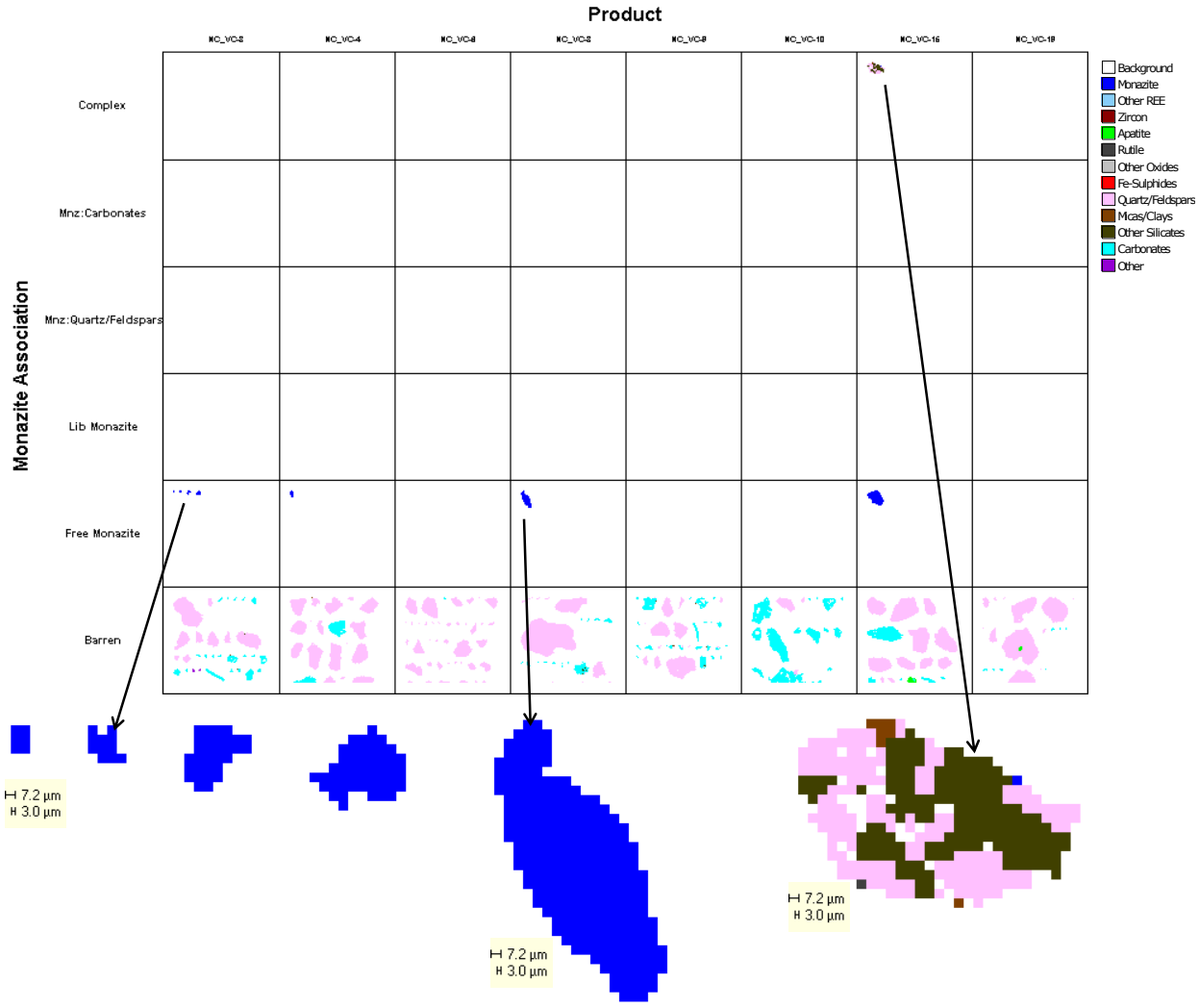


Figure 17: Image Grid and Particle Maps of Monazite Liberation and Association for the NC Group Samples

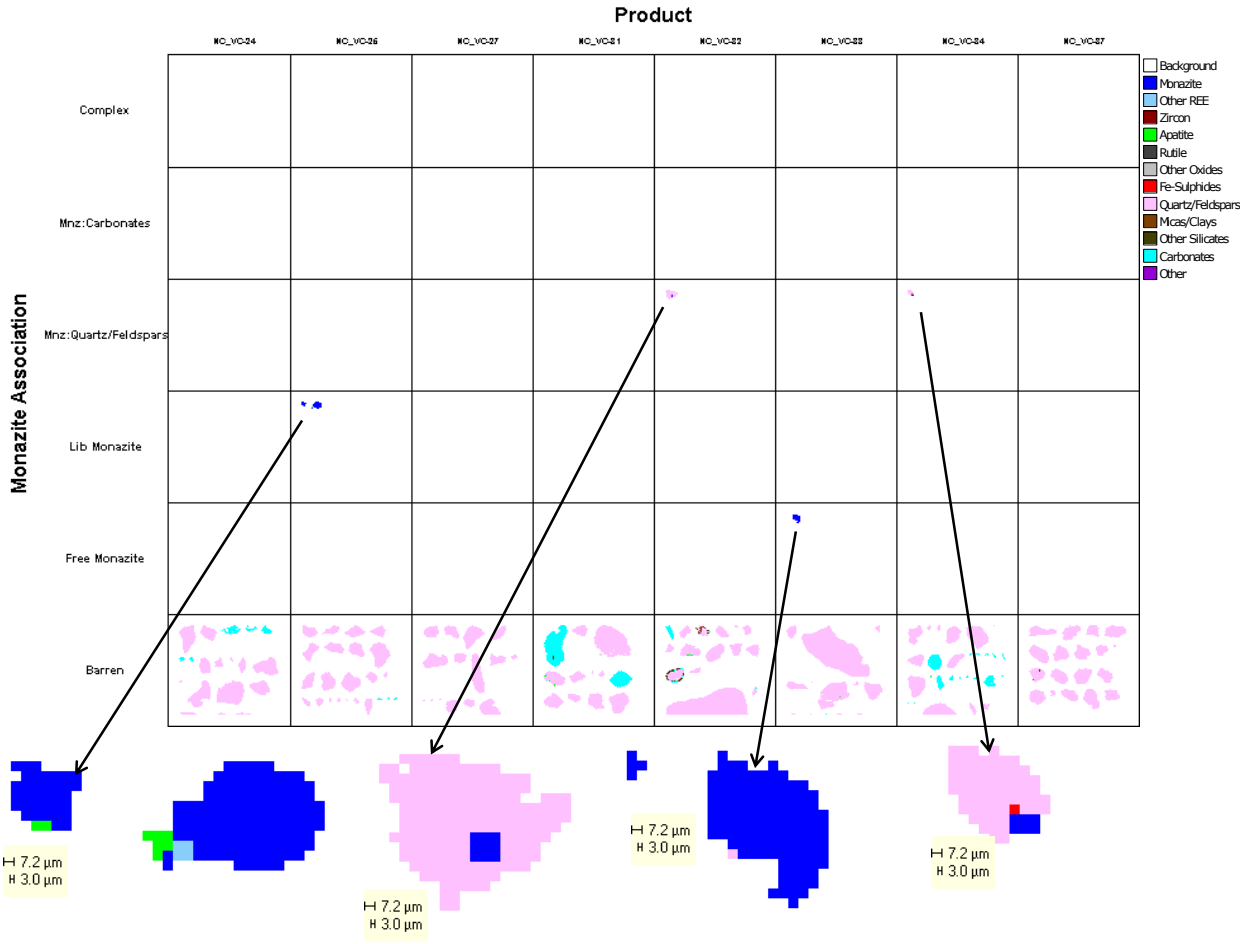


Figure 18: Image Grid and Particle Maps of Monazite Liberation and Association for the NC Group Samples (cont'd)

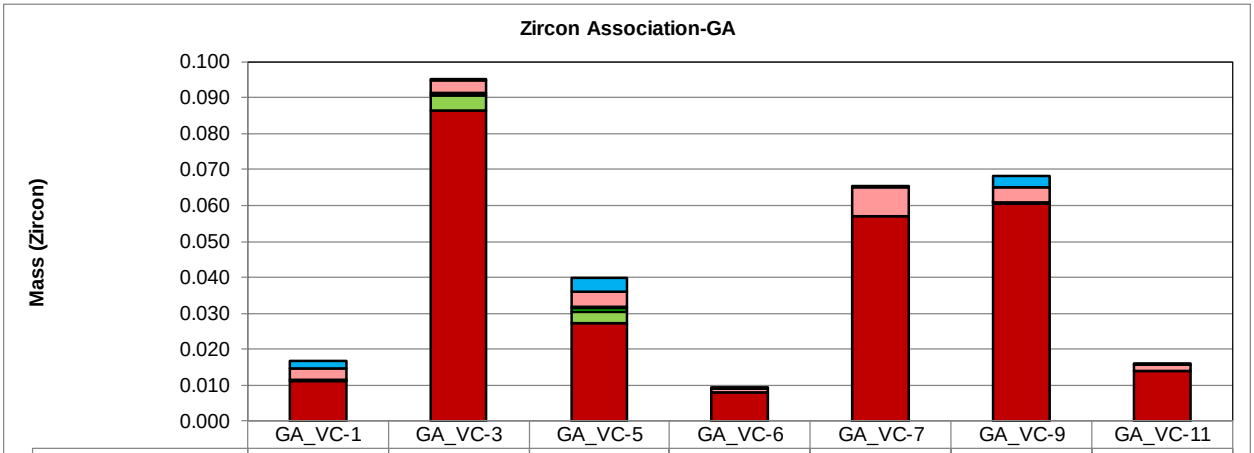
4.3.2. Liberation and Association of Zircon

Free and liberated zircon ranges from 66% to 95% in the SC group samples. The remainder occurs as middling particles with quartz/feldspars (ca. 4% to 19%), apatite (nil to 2%), and complex particles (nil to 13%) as shown in Figure 19 and Figure 20.

Free and liberated zircon ranges from nil to ca.100% in the NC group samples. The remainder occurs as middling particles with quartz/feldspars (nil to 84%), apatite (nil to 3%), various silicates (nil to 1%), carbonates (nil to 9%), and complex particles (nil to 25%) as shown in Figure 21 and Figure 22.

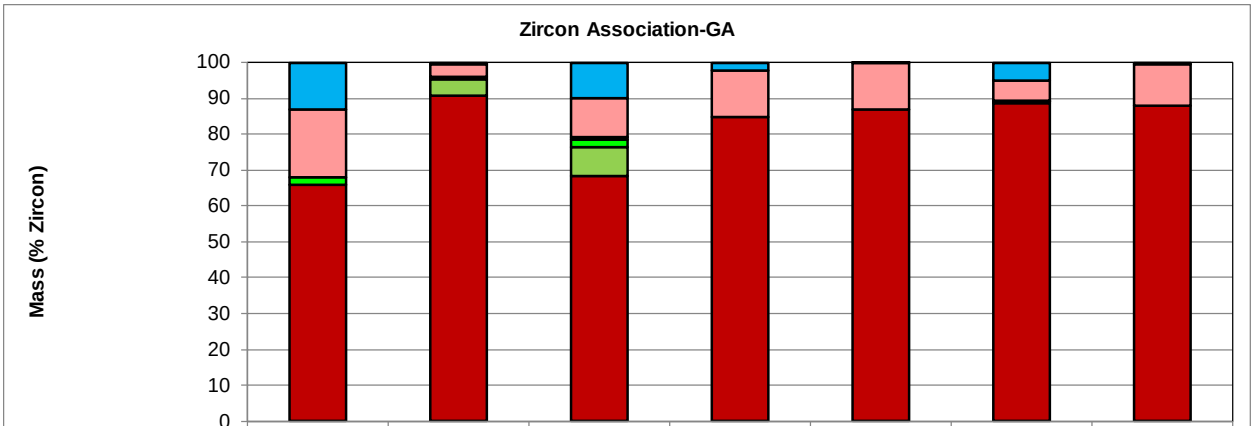
Free and liberated zircon ranges from 69% to ca. 100% in the NC group samples. The remainder occurs as middling particles with quartz/feldspars (nil to 40%), apatite (nil to 1%), micas/clays (nil to 6%), carbonates (nil to 4%), and complex particles (nil to 8%) as shown in Figure 23 and Figure 24.

Image grids and particle maps for each group of samples are presented in Figure 25 to Figure 29.



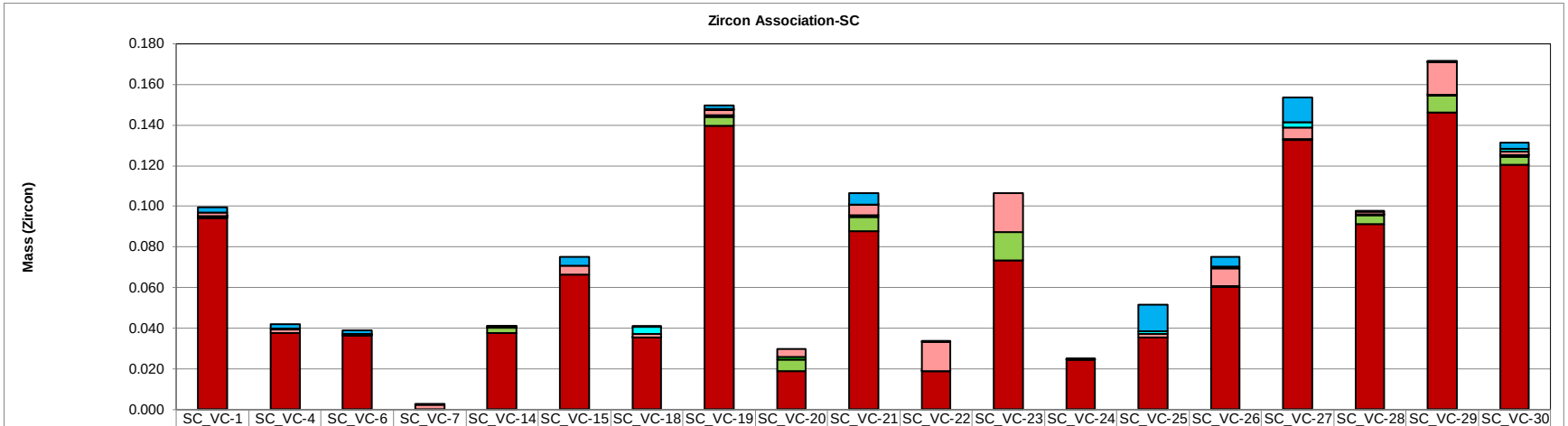
	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.002	0.001	0.004	0.000	0.000	0.003	0.000
Zrn:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.003	0.003	0.004	0.001	0.008	0.004	0.002
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.000	0.001	0.001	0.000	0.000	0.000	0.000
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Zircon	0.000	0.004	0.003	0.000	0.000	0.000	0.000
Free Zircon	0.011	0.086	0.027	0.008	0.057	0.061	0.014

Figure 19: Liberation and Association of Zircon (Mass) for the GA Group Samples



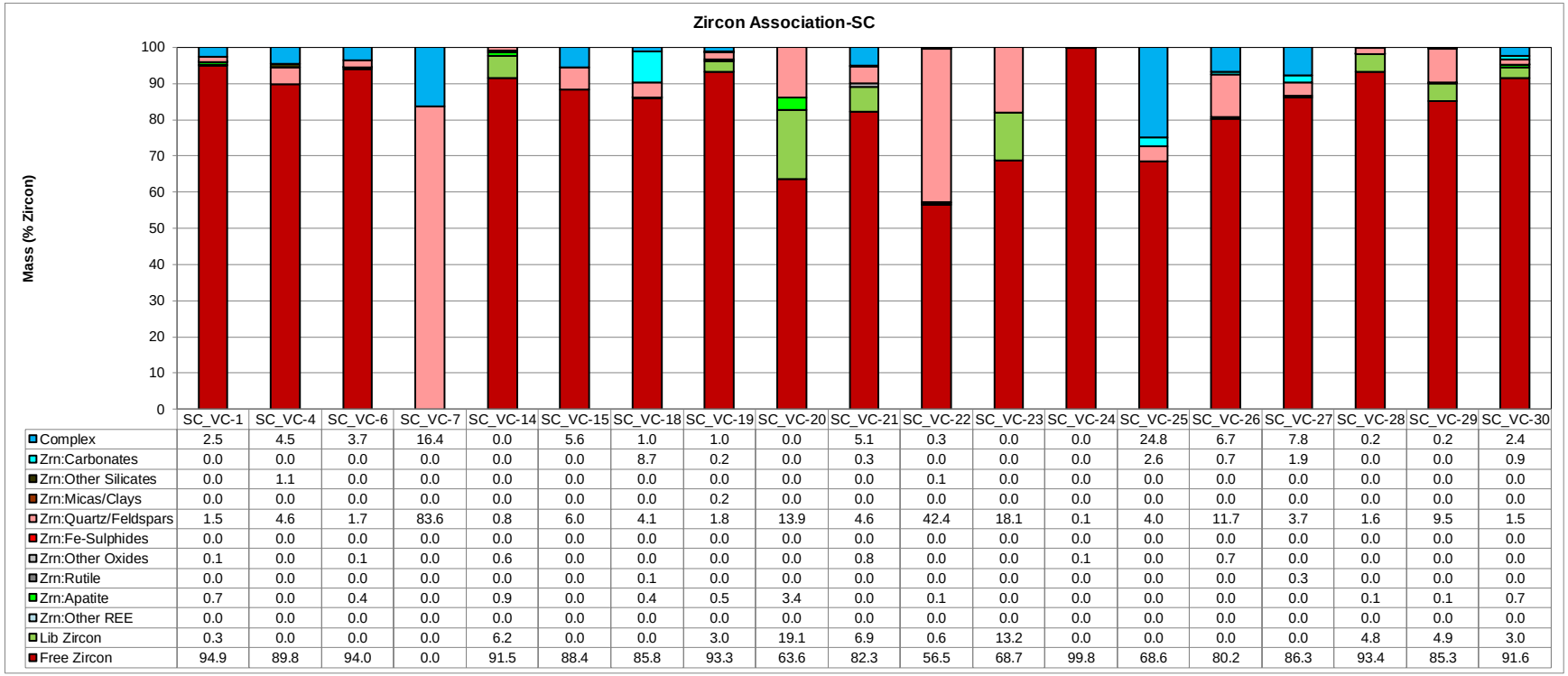
	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	13.2	0.6	9.8	2.1	0.3	5.0	0.7
Zrn:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	19.0	3.5	11.0	13.1	12.7	5.8	11.6
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Apatite	1.8	0.7	2.2	0.0	0.0	0.2	0.0
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Lib Zircon	0.0	4.4	8.0	0.0	0.0	0.2	0.0
Free Zircon	66.0	90.8	68.4	84.8	87.0	88.7	87.8

Figure 20: Liberation and Association of Zircon (Norm Mass%) for the GA Group Samples



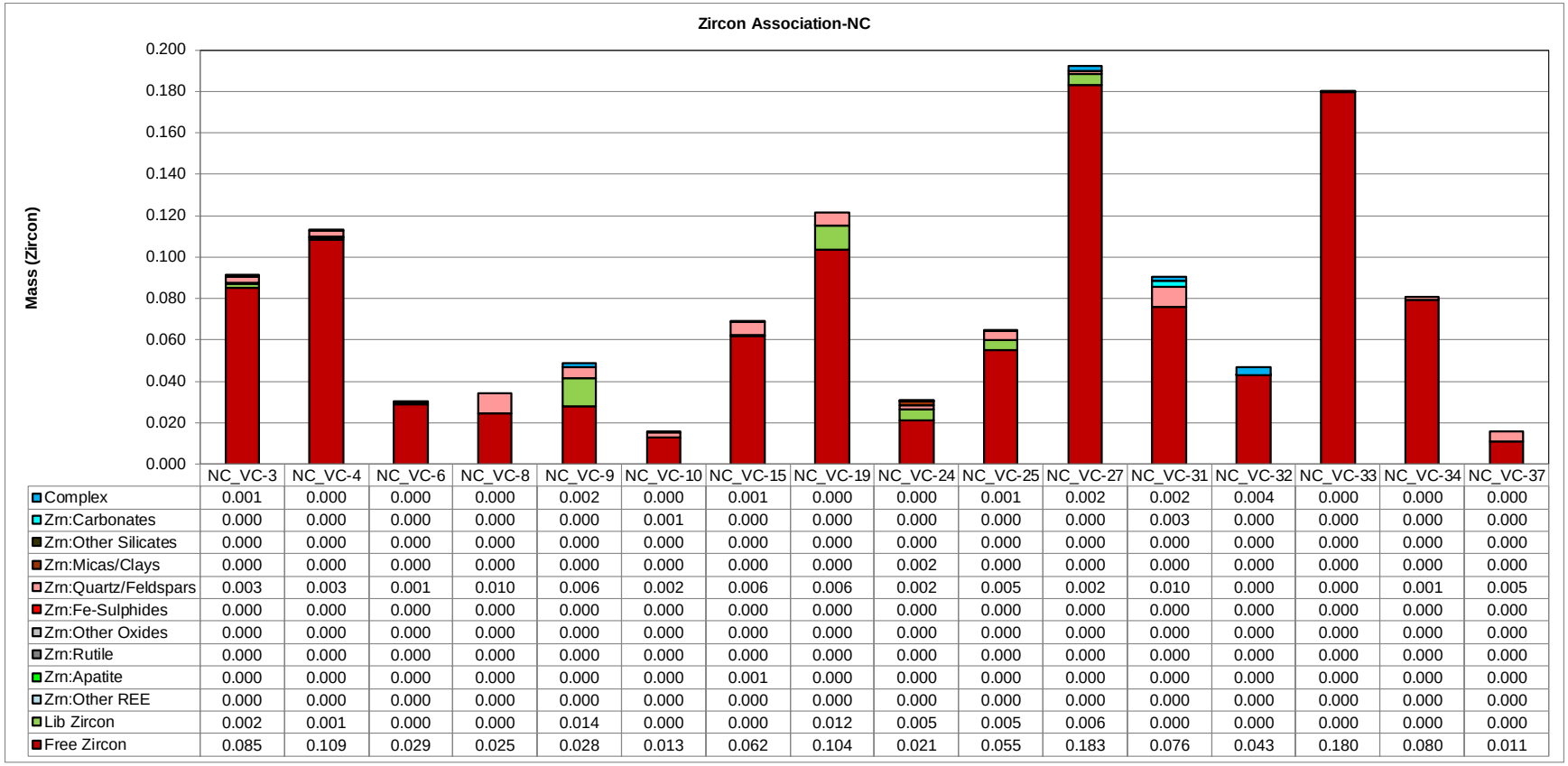
	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.003	0.002	0.001	0.000	0.000	0.004	0.000	0.002	0.000	0.005	0.000	0.000	0.000	0.013	0.005	0.012	0.000	0.000	0.003
Zrn:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003	0.000	0.000	0.001
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.001	0.002	0.001	0.002	0.000	0.005	0.002	0.003	0.004	0.005	0.014	0.019	0.000	0.002	0.009	0.006	0.002	0.016	0.002
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Zircon	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.004	0.006	0.007	0.000	0.014	0.000	0.000	0.000	0.000	0.005	0.008	0.004
Free Zircon	0.094	0.038	0.036	0.000	0.038	0.066	0.035	0.140	0.019	0.088	0.019	0.073	0.025	0.035	0.060	0.132	0.091	0.146	0.120

Figure 21: Liberation and Association of Zircon (Mass) for the SC Group Samples



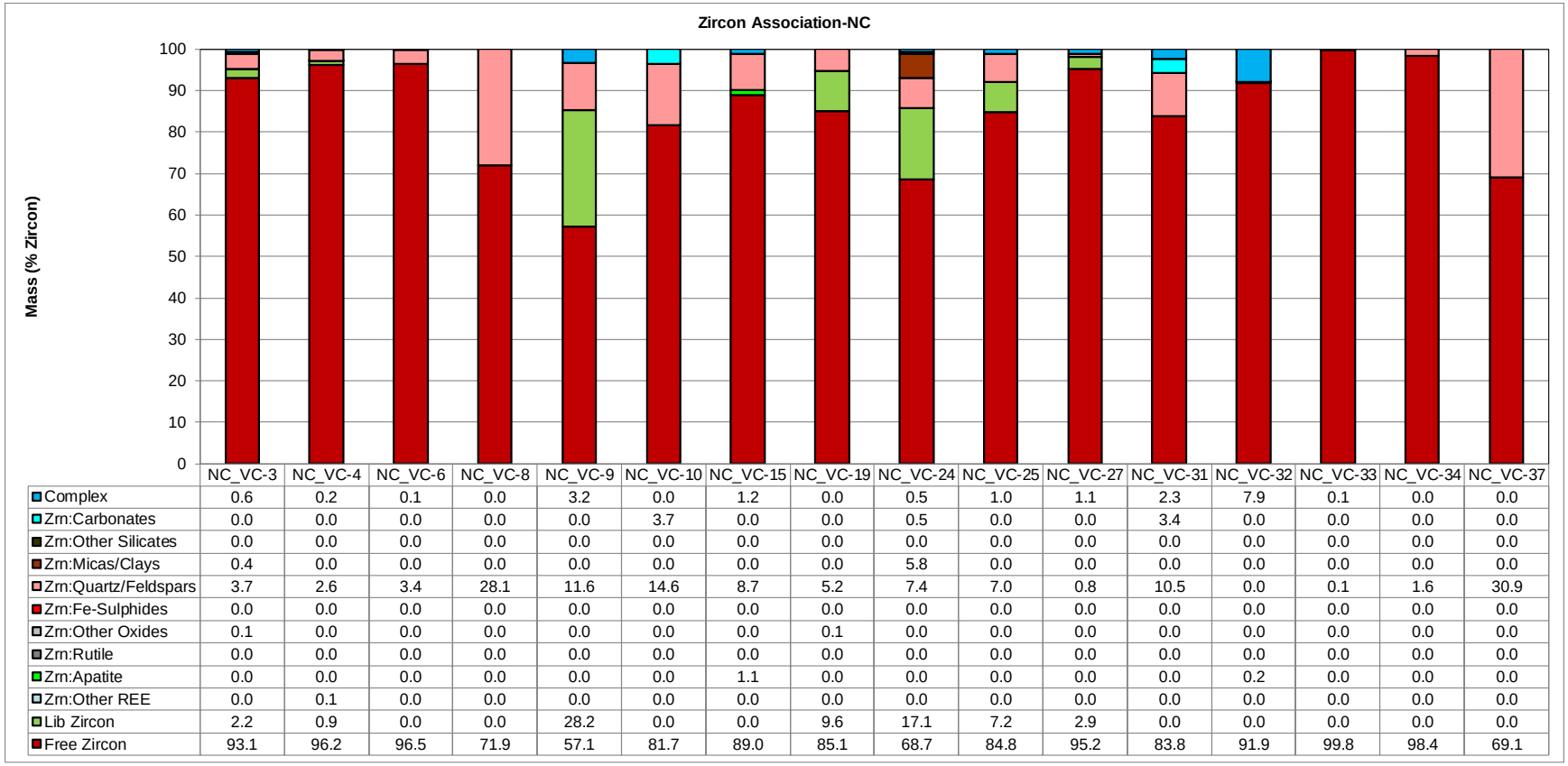
	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	2.5	4.5	3.7	16.4	0.0	5.6	1.0	1.0	0.0	5.1	0.3	0.0	0.0	24.8	6.7	7.8	0.2	0.2	2.4
Zrn:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.2	0.0	0.3	0.0	0.0	0.0	2.6	0.7	1.9	0.0	0.0	0.9
Zrn:Other Silicates	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	1.5	4.6	1.7	83.6	0.8	6.0	4.1	1.8	13.9	4.6	42.4	18.1	0.1	4.0	11.7	3.7	1.6	9.5	1.5
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.1	0.0	0.1	0.0	0.6	0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.1	0.0	0.7	0.0	0.0	0.0	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
Zrn:Apatite	0.7	0.0	0.4	0.0	0.9	0.0	0.4	0.5	3.4	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.7
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Zircon	0.3	0.0	0.0	0.0	6.2	0.0	0.0	3.0	19.1	6.9	0.6	13.2	0.0	0.0	0.0	0.0	4.8	4.9	3.0
Free Zircon	94.9	89.8	94.0	0.0	91.5	88.4	85.8	93.3	63.6	82.3	56.5	68.7	99.8	68.6	80.2	86.3	93.4	85.3	91.6

Figure 22: Liberation and Association of Zircon (Norm Mass%) for the SC Group Samples



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.001	0.000	0.000	0.000	0.002	0.000	0.001	0.000	0.000	0.001	0.002	0.002	0.004	0.000	0.000	0.000
Zrn:Carbonates	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.003	0.003	0.001	0.010	0.006	0.002	0.006	0.006	0.002	0.005	0.002	0.010	0.000	0.000	0.001	0.005
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Zircon	0.002	0.001	0.000	0.000	0.014	0.000	0.000	0.012	0.005	0.005	0.006	0.000	0.000	0.000	0.000	0.000
Free Zircon	0.085	0.109	0.029	0.025	0.028	0.013	0.062	0.104	0.021	0.055	0.183	0.076	0.043	0.180	0.080	0.011

Figure 23: Liberation and Association of Zircon (Mass) for the NC Group Samples



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.6	0.2	0.1	0.0	3.2	0.0	1.2	0.0	0.5	1.0	1.1	2.3	7.9	0.1	0.0	0.0
Zrn:Carbonates	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0	0.5	0.0	0.0	3.4	0.0	0.0	0.0	0.0
Zrn:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Micas/Clays	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	3.7	2.6	3.4	28.1	11.6	14.6	8.7	5.2	7.4	7.0	0.8	10.5	0.0	0.1	1.6	30.9
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Zrn:Other REE	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Zircon	2.2	0.9	0.0	0.0	28.2	0.0	0.0	9.6	17.1	7.2	2.9	0.0	0.0	0.0	0.0	0.0
Free Zircon	93.1	96.2	96.5	71.9	57.1	81.7	89.0	85.1	68.7	84.8	95.2	83.8	91.9	99.8	98.4	69.1

Figure 24: Liberation and Association of Zircon (Norm Mass%) for the NC Group Samples

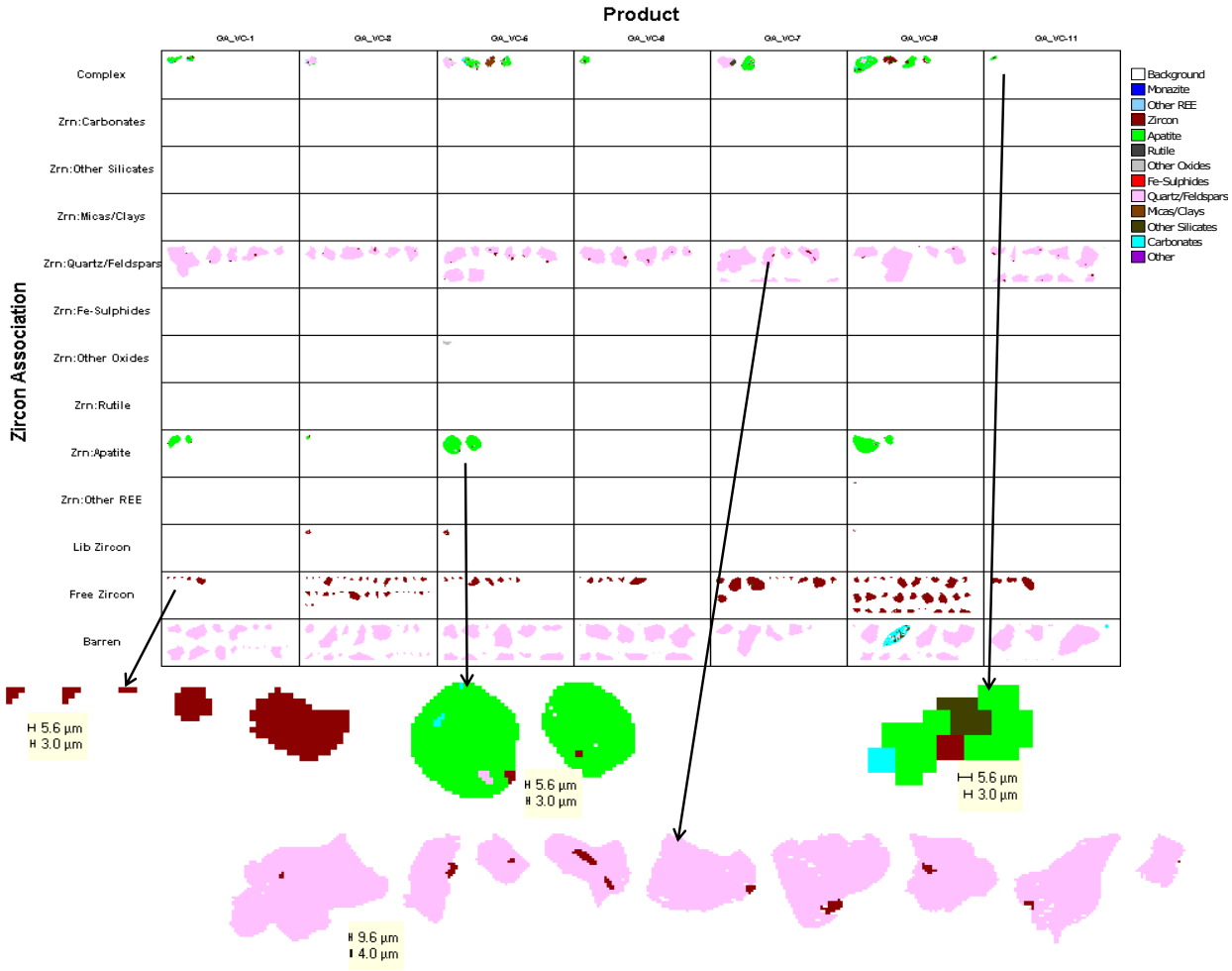


Figure 25: Image Grid and Particle Maps of Zircon Liberation and Association for the GA Group Samples

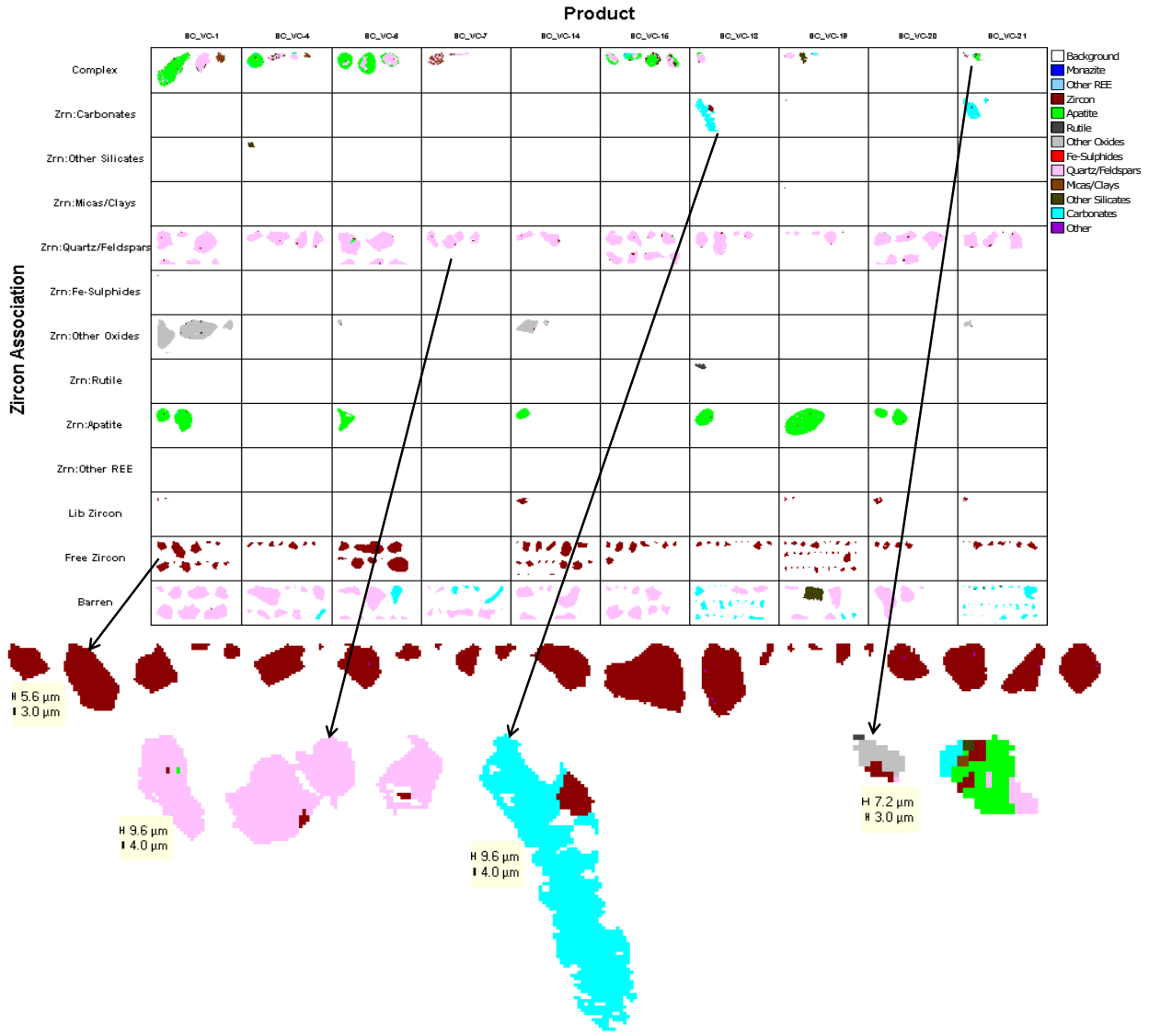


Figure 26: Image Grid and Particle Maps of Zircon Liberation and Association for the SC Group Samples

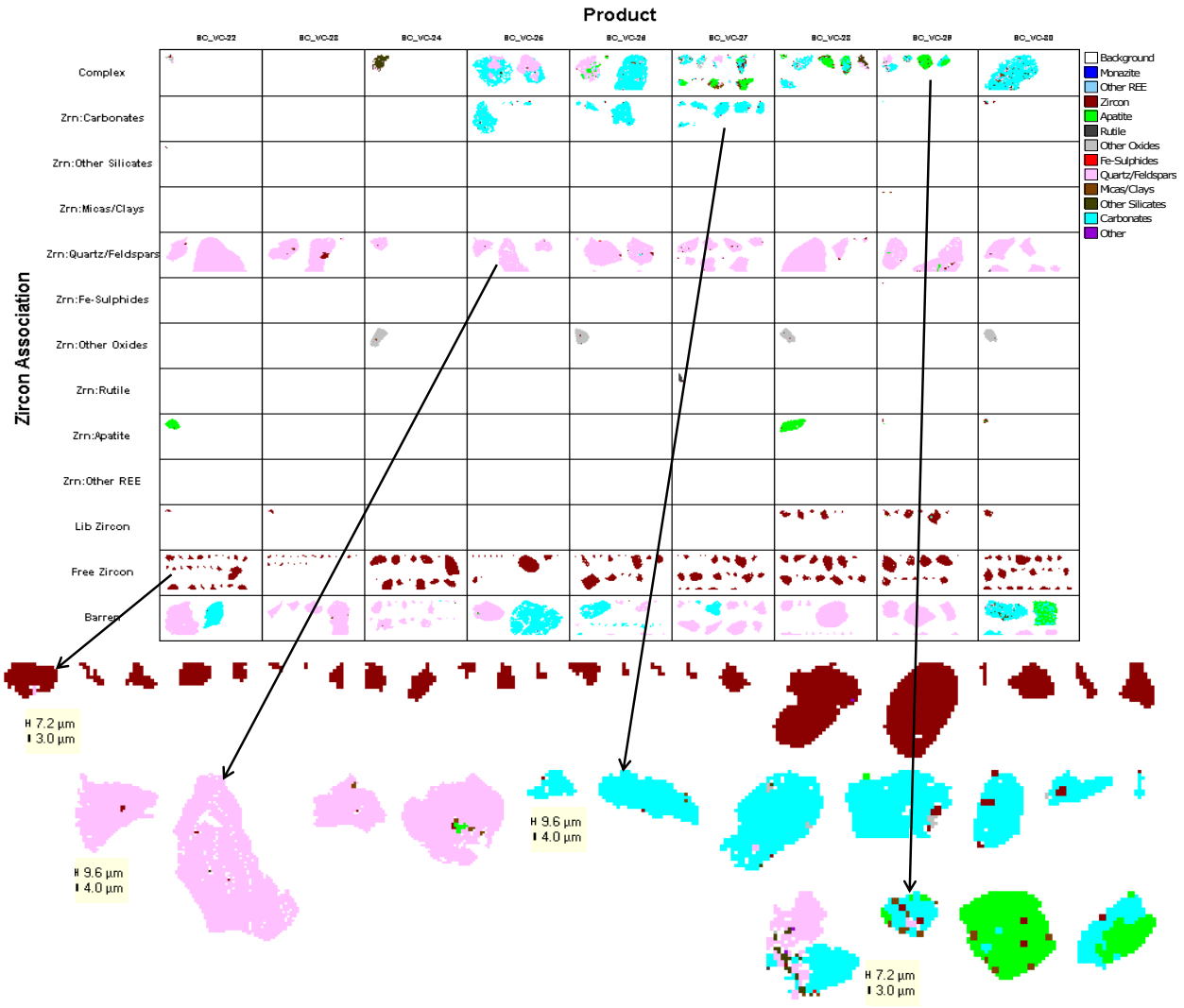


Figure 27: Image Grid and Particle Maps of Zircon Liberation and Association for the SC Group Samples (cont'd)

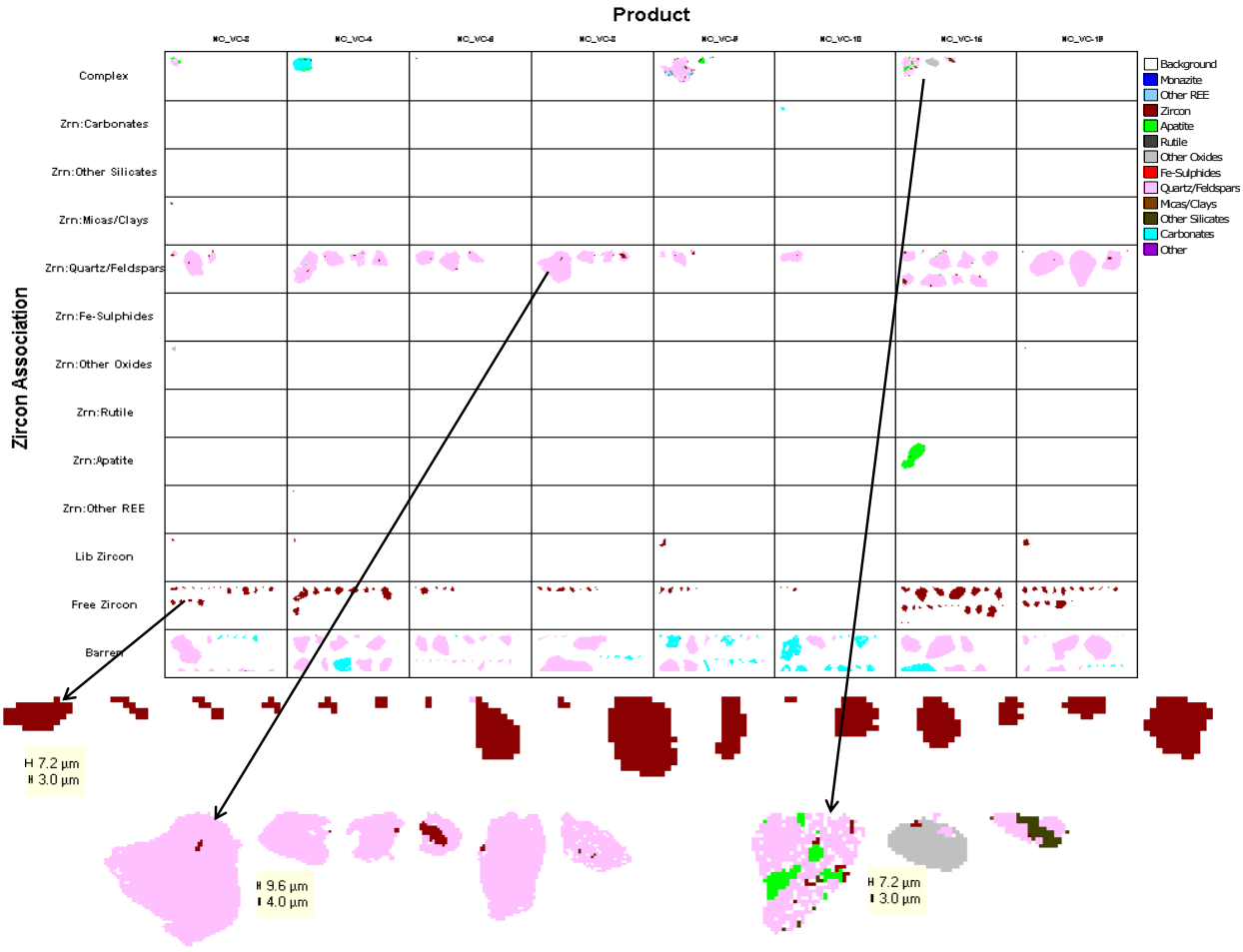


Figure 28: Image Grid and Particle Maps of Zircon Liberation and Association for the NC Group Samples

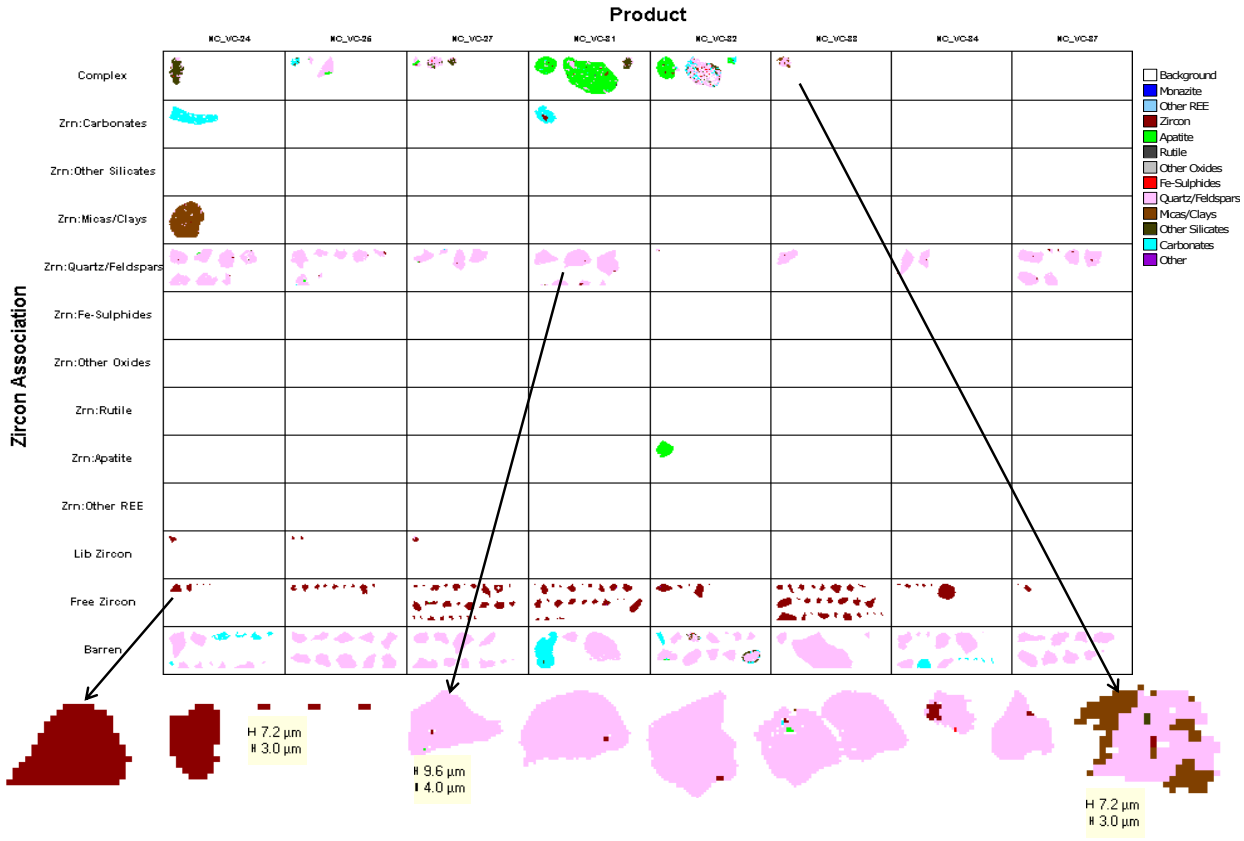


Figure 29: Image Grid and Particle Maps of Zircon Liberation and Association for the NC Group Samples (cont'd)

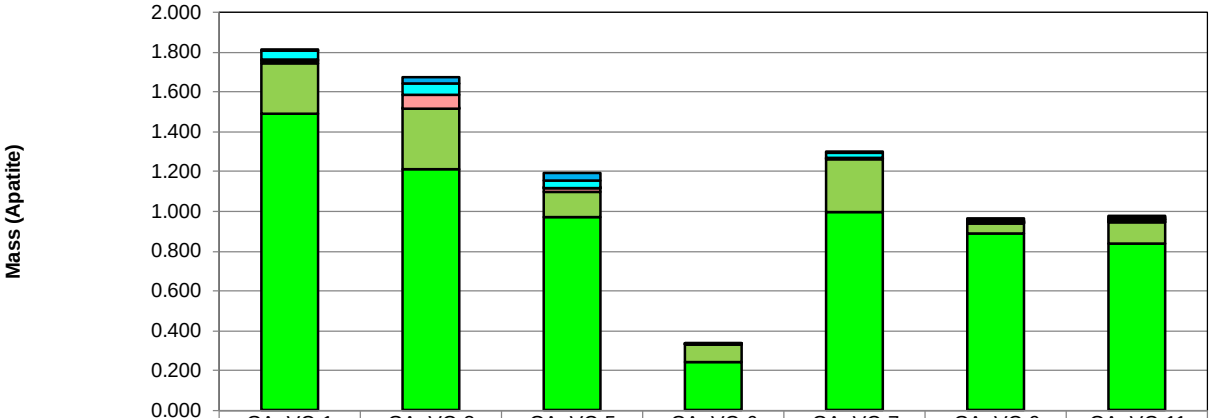
4.3.3. Liberation and Association of Apatite

Free and liberated apatite ranges from 90% to 98% in the SC group samples. The remainder occurs as middling particles with quartz/feldspars (nil to 4%, carbonates nil to 3% and complex particles nil to 3% (Figure 30 and Figure 31).

Free and liberated apatite ranges from 36% to ca. 100% in the NC group. The remainder occurs as middling particles with quartz/feldspars (nil to 25%), carbonates (nil to 54%) and complex particles nil to 11% (Figure 32 and Figure 33).

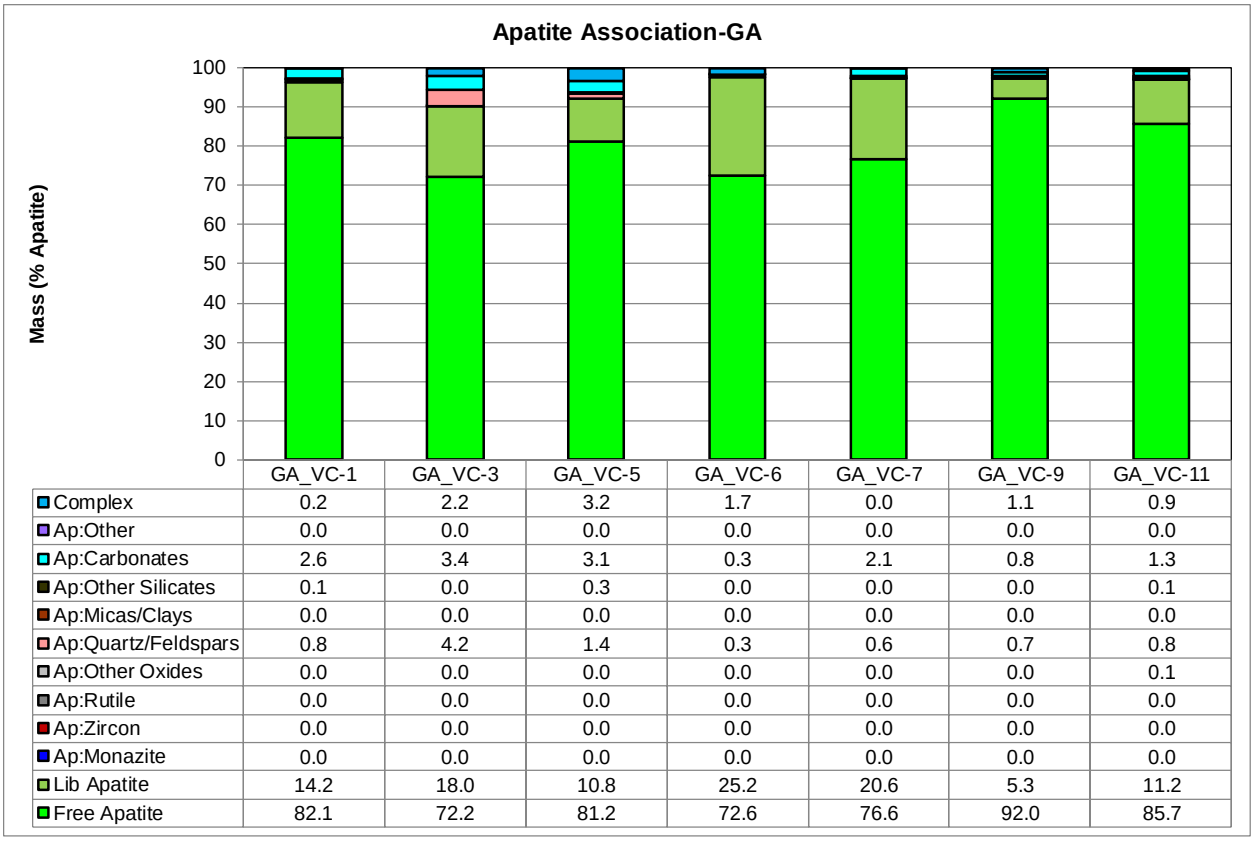
Free and liberated apatite ranges from 61% to 92% in the NC group. The remainder occurs as middling particles with quartz/feldspars (<1% to 16%), carbonates (nil to 34%) and complex particles nil to 5% (Figure 34 and Figure 35).

Image grids and particle maps for each group of samples are presented in Figure 36 to Figure 40.



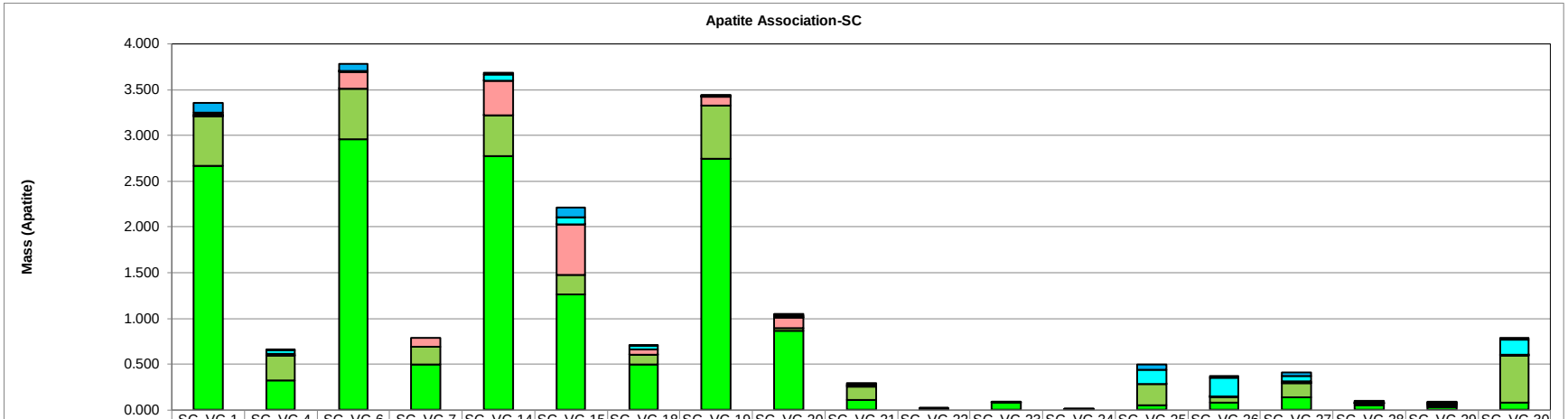
	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.003	0.038	0.039	0.006	0.000	0.011	0.009
Ap:Other	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Carbonates	0.047	0.057	0.037	0.001	0.027	0.008	0.012
Ap:Other Silicates	0.002	0.000	0.003	0.000	0.000	0.000	0.001
Ap:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Quartz/Feldspars	0.014	0.070	0.016	0.001	0.008	0.007	0.007
Ap:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Ap:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Zircon	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Apatite	0.258	0.302	0.129	0.085	0.267	0.051	0.109
Free Apatite	1.489	1.211	0.969	0.244	0.995	0.886	0.838

Figure 30: Liberation and Association of Apatite (Mass) for the GA Group Samples



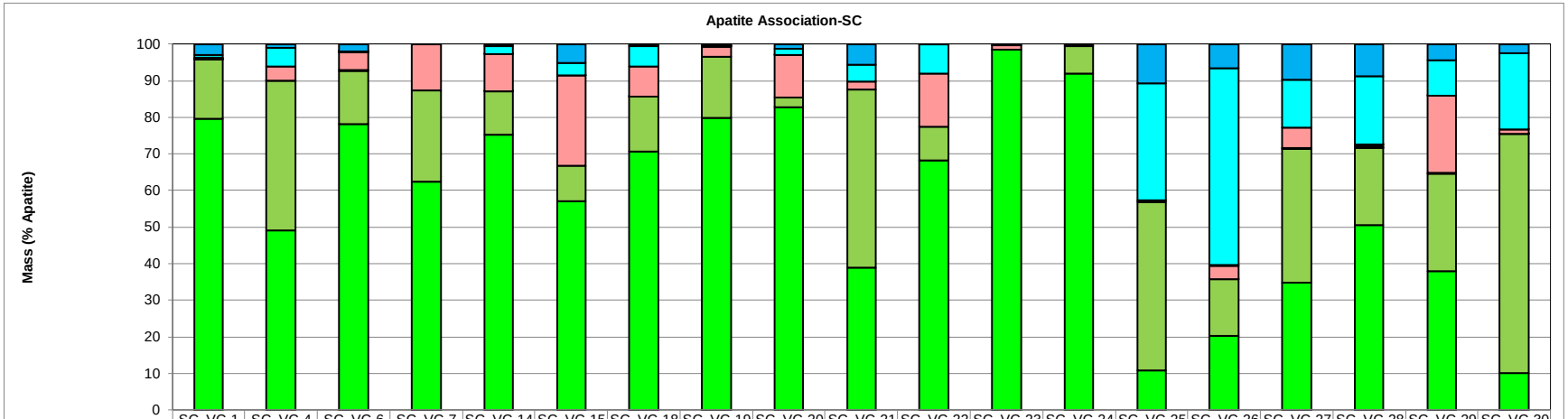
	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.2	2.2	3.2	1.7	0.0	1.1	0.9
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Carbonates	2.6	3.4	3.1	0.3	2.1	0.8	1.3
Ap:Other Silicates	0.1	0.0	0.3	0.0	0.0	0.0	0.1
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Quartz/Feldspars	0.8	4.2	1.4	0.3	0.6	0.7	0.8
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Apatite	14.2	18.0	10.8	25.2	20.6	5.3	11.2
Free Apatite	82.1	72.2	81.2	72.6	76.6	92.0	85.7

Figure 31: Liberation and Association of Apatite (Norm Mass%) for the GA Group Samples



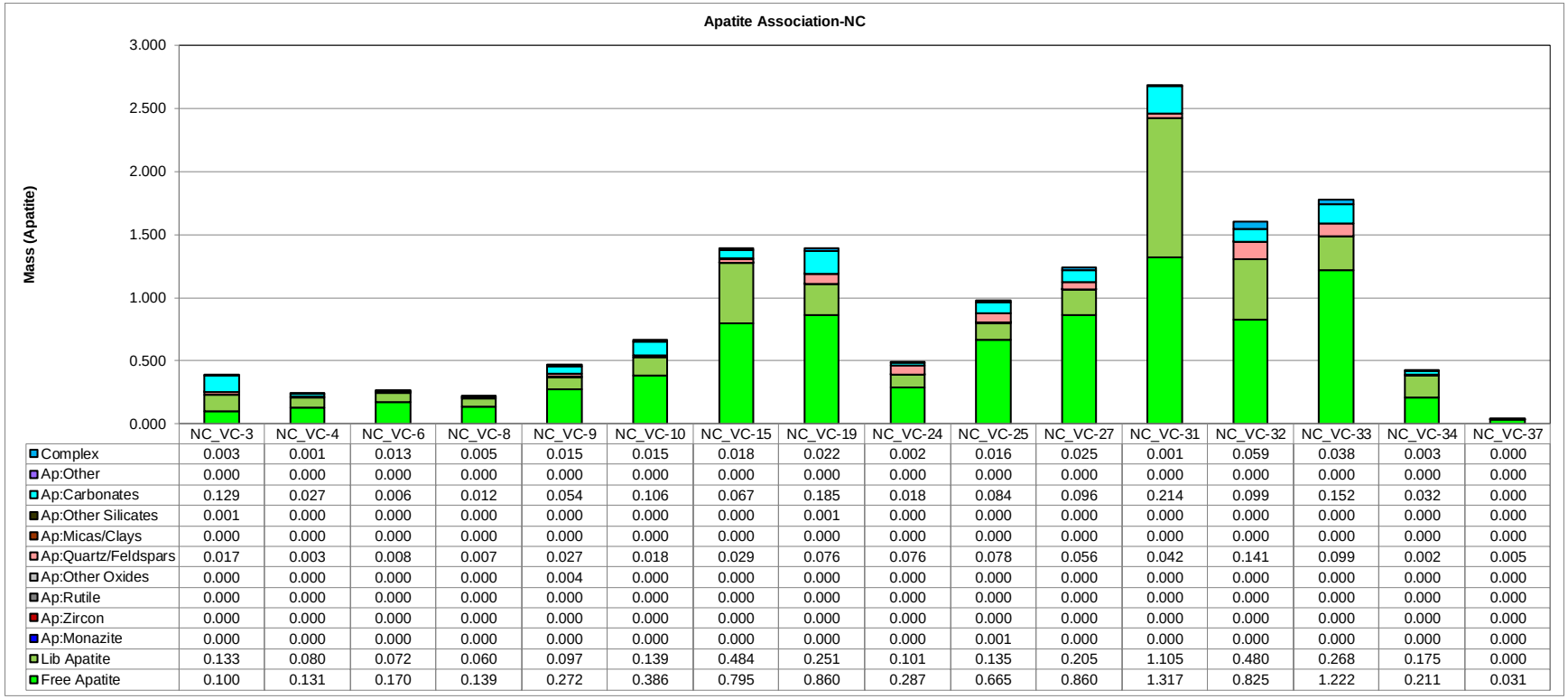
	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.101	0.006	0.075	0.000	0.022	0.111	0.004	0.015	0.014	0.017	0.000	0.000	0.000	0.052	0.024	0.040	0.008	0.004	0.019
Ap:Other	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Carbonates	0.018	0.034	0.010	0.000	0.075	0.076	0.039	0.006	0.017	0.013	0.001	0.000	0.000	0.158	0.201	0.055	0.018	0.008	0.165
Ap:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Ap:Quartz/Feldspars	0.018	0.025	0.185	0.099	0.375	0.549	0.059	0.097	0.120	0.006	0.002	0.001	0.000	0.002	0.013	0.022	0.001	0.017	0.010
Ap:Other Oxides	0.001	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Zircon	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Apatite	0.546	0.270	0.552	0.196	0.446	0.213	0.105	0.574	0.029	0.143	0.001	0.000	0.000	0.228	0.058	0.151	0.020	0.022	0.515
Free Apatite	2.668	0.321	2.957	0.493	2.773	1.265	0.502	2.749	0.865	0.114	0.008	0.080	0.006	0.053	0.076	0.143	0.049	0.032	0.080

Figure 32: Liberation and Association of Apatite (Mass) for the SC Group Samples



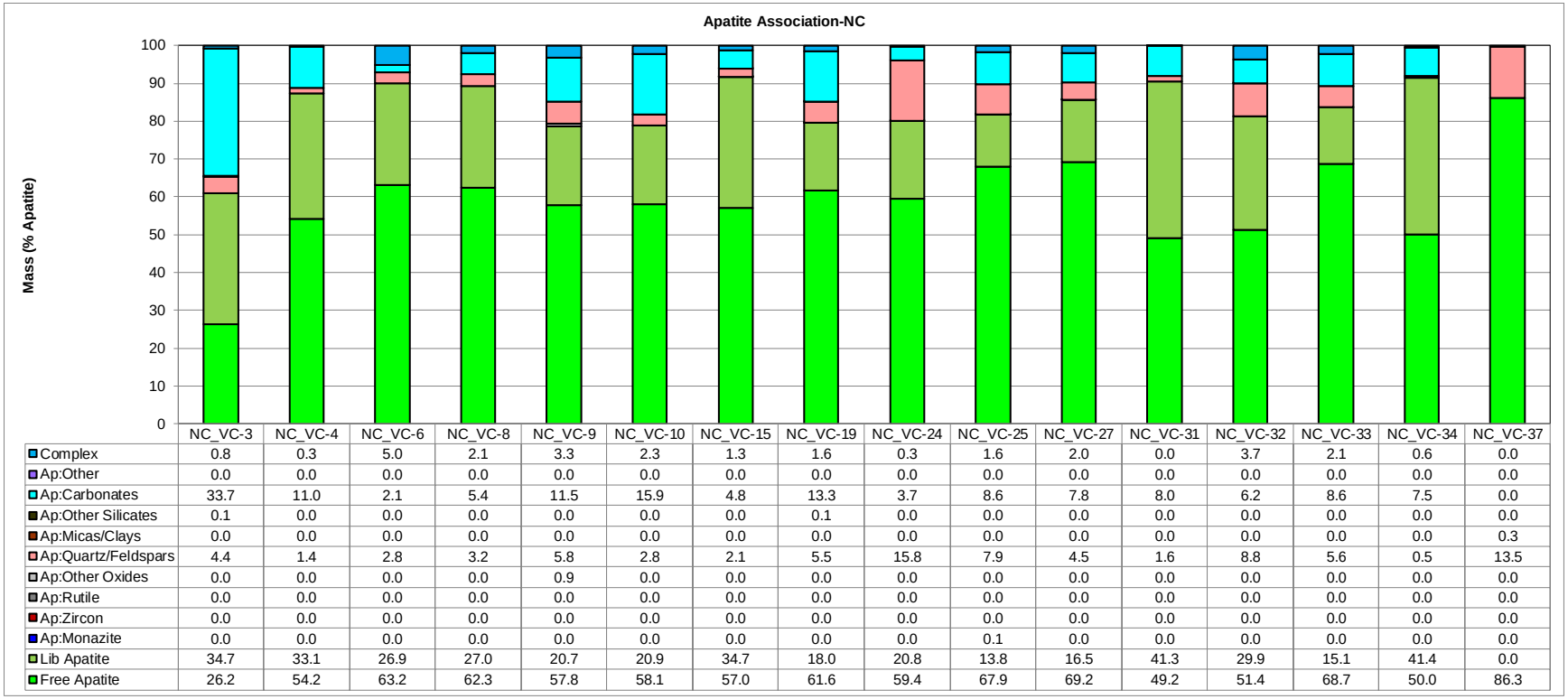
	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	3.0	0.9	2.0	0.0	0.6	5.0	0.6	0.4	1.3	5.7	0.0	0.4	0.4	10.6	6.5	9.6	8.7	4.3	2.3
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Carbonates	0.5	5.2	0.3	0.0	2.0	3.4	5.5	0.2	1.6	4.5	7.9	0.0	0.0	32.0	53.8	13.3	18.7	9.8	20.9
Ap:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0
Ap:Quartz/Feldspars	0.5	3.7	4.9	12.6	10.2	24.8	8.3	2.8	11.5	2.2	14.6	1.0	0.1	0.4	3.6	5.5	0.5	21.0	1.3
Ap:Other Oxides	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Apatite	16.3	41.1	14.6	24.9	12.1	9.6	14.8	16.7	2.8	48.6	9.1	0.0	7.5	46.1	15.5	36.7	21.1	26.7	65.3
Free Apatite	79.6	49.0	78.1	62.5	75.1	57.2	70.7	79.9	82.7	39.0	68.2	98.6	92.0	10.8	20.3	34.8	50.6	38.0	10.1

Figure 33: Liberation and Association of Apatite (Norm Mass%) for the SC Group Samples



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.003	0.001	0.013	0.005	0.015	0.015	0.018	0.022	0.002	0.016	0.025	0.001	0.059	0.038	0.003	0.000
Ap:Other	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Carbonates	0.129	0.027	0.006	0.012	0.054	0.106	0.067	0.185	0.018	0.084	0.096	0.214	0.099	0.152	0.032	0.000
Ap:Other Silicates	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Quartz/Feldspars	0.017	0.003	0.008	0.007	0.027	0.018	0.029	0.076	0.076	0.078	0.056	0.042	0.141	0.099	0.002	0.005
Ap:Other Oxides	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Zircon	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ap:Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
Lib Apatite	0.133	0.080	0.072	0.060	0.097	0.139	0.484	0.251	0.101	0.135	0.205	1.105	0.480	0.268	0.175	0.000
Free Apatite	0.100	0.131	0.170	0.139	0.272	0.386	0.795	0.860	0.287	0.665	0.860	1.317	0.825	1.222	0.211	0.031

Figure 34: Liberation and Association of Apatite (Mass) for the NC Group Samples



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.8	0.3	5.0	2.1	3.3	2.3	1.3	1.6	0.3	1.6	2.0	0.0	3.7	2.1	0.6	0.0
Ap: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	0.0	0.0	0.0	0.0
Ap:Carbonates	33.7	11.0	2.1	5.4	11.5	15.9	4.8	13.3	3.7	8.6	7.8	8.0	6.2	8.6	7.5	0.0
Ap:Other Silicates	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Ap:Quartz/Feldspars	4.4	1.4	2.8	3.2	5.8	2.8	2.1	5.5	15.8	7.9	4.5	1.6	8.8	5.6	0.5	13.5
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Lib Apatite	34.7	33.1	26.9	27.0	20.7	20.9	34.7	18.0	20.8	13.8	16.5	41.3	29.9	15.1	41.4	0.0
Free Apatite	26.2	54.2	63.2	62.3	57.8	58.1	57.0	61.6	59.4	67.9	69.2	49.2	51.4	68.7	50.0	86.3

Figure 35: Liberation and Association of Apatite (Norm Mass%) for the NC Group Samples

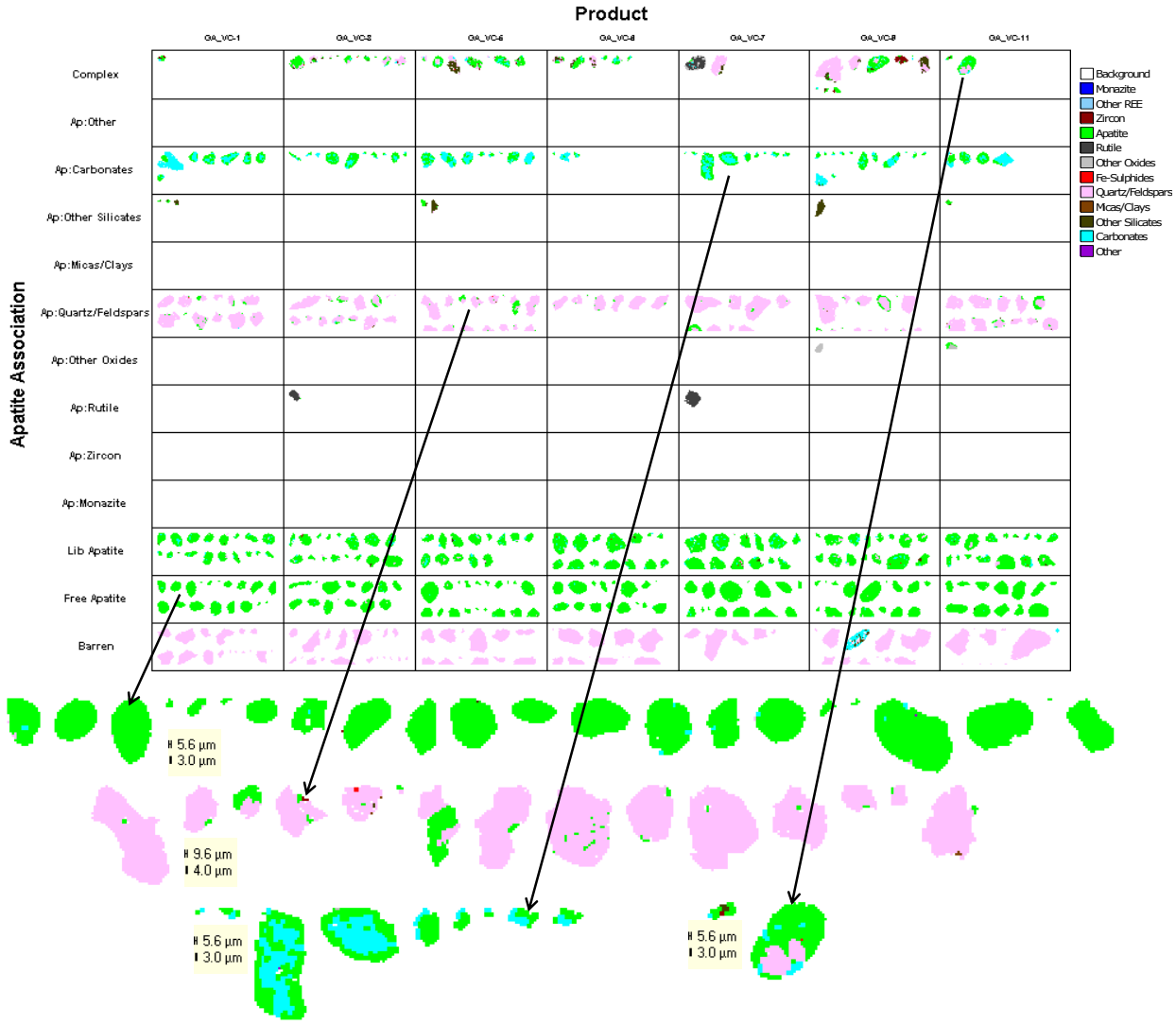


Figure 36: Image Grid and Particle Maps of Apatite Liberation and Association for the GA Group Samples

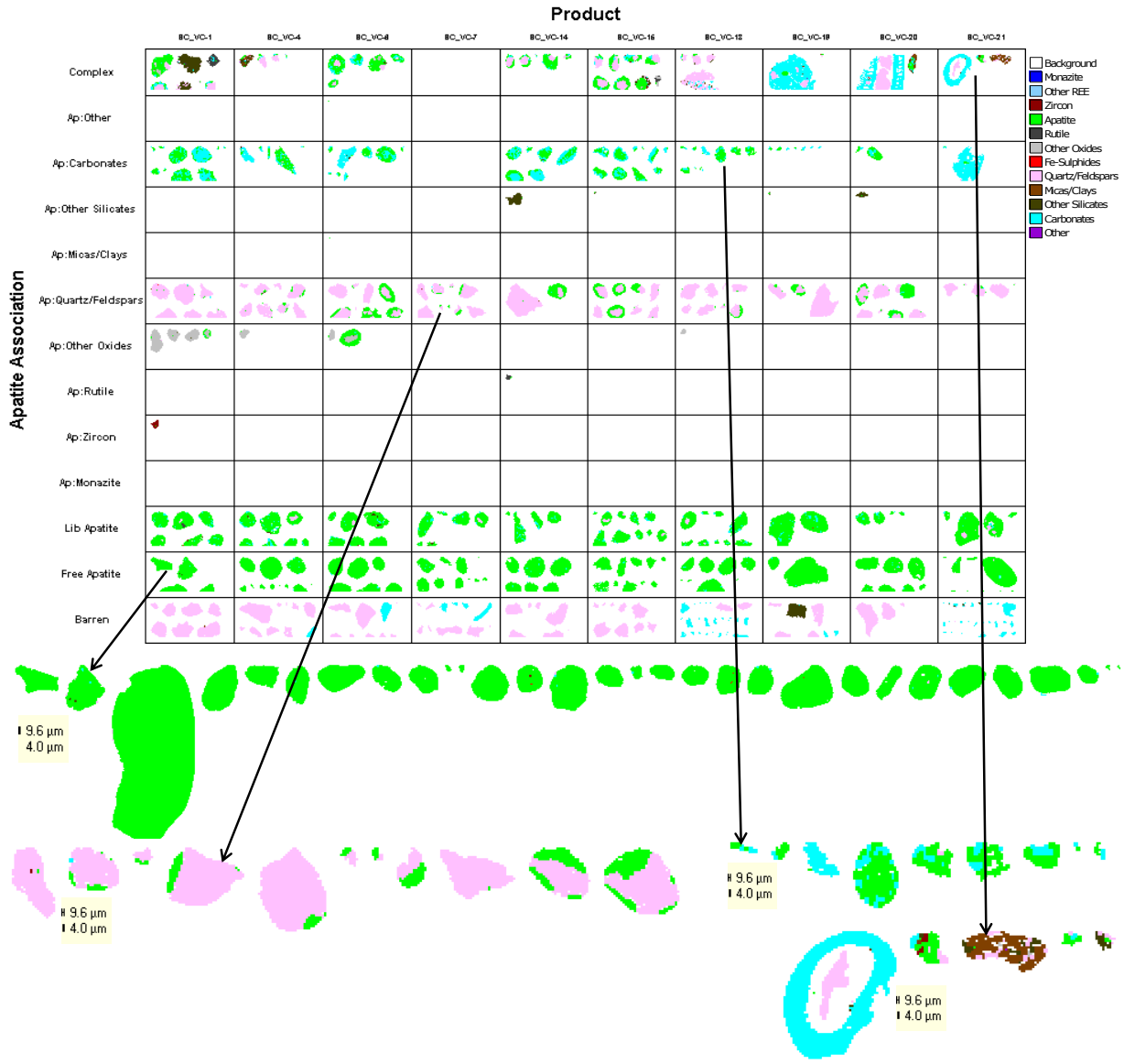


Figure 37: Image Grid and Particle Maps of Apatite Liberation and Association for the SC Group Samples

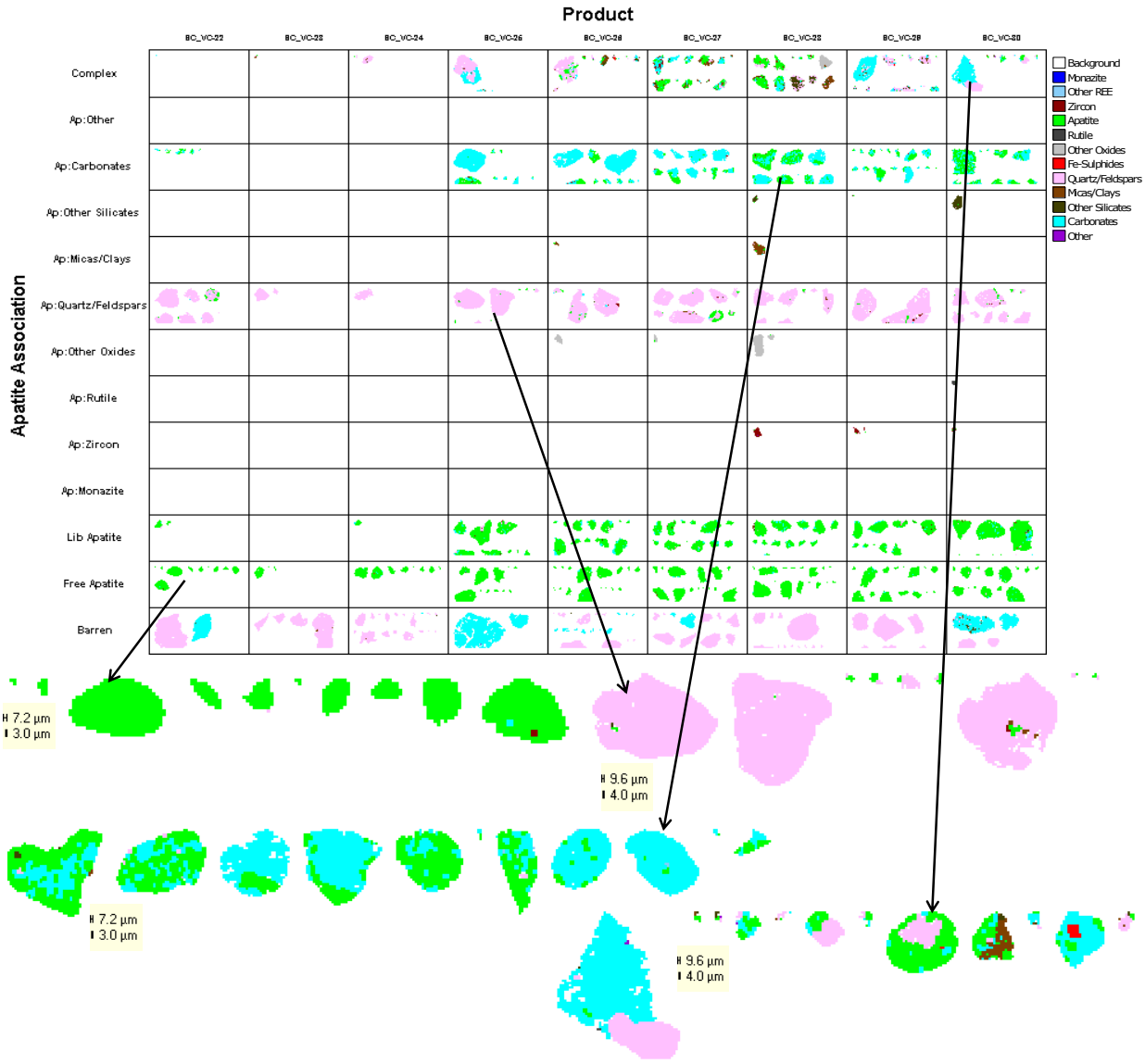


Figure 38: Image Grid and Particle Maps of Apatite Liberation and Association for the SC Group Samples (cont'd)

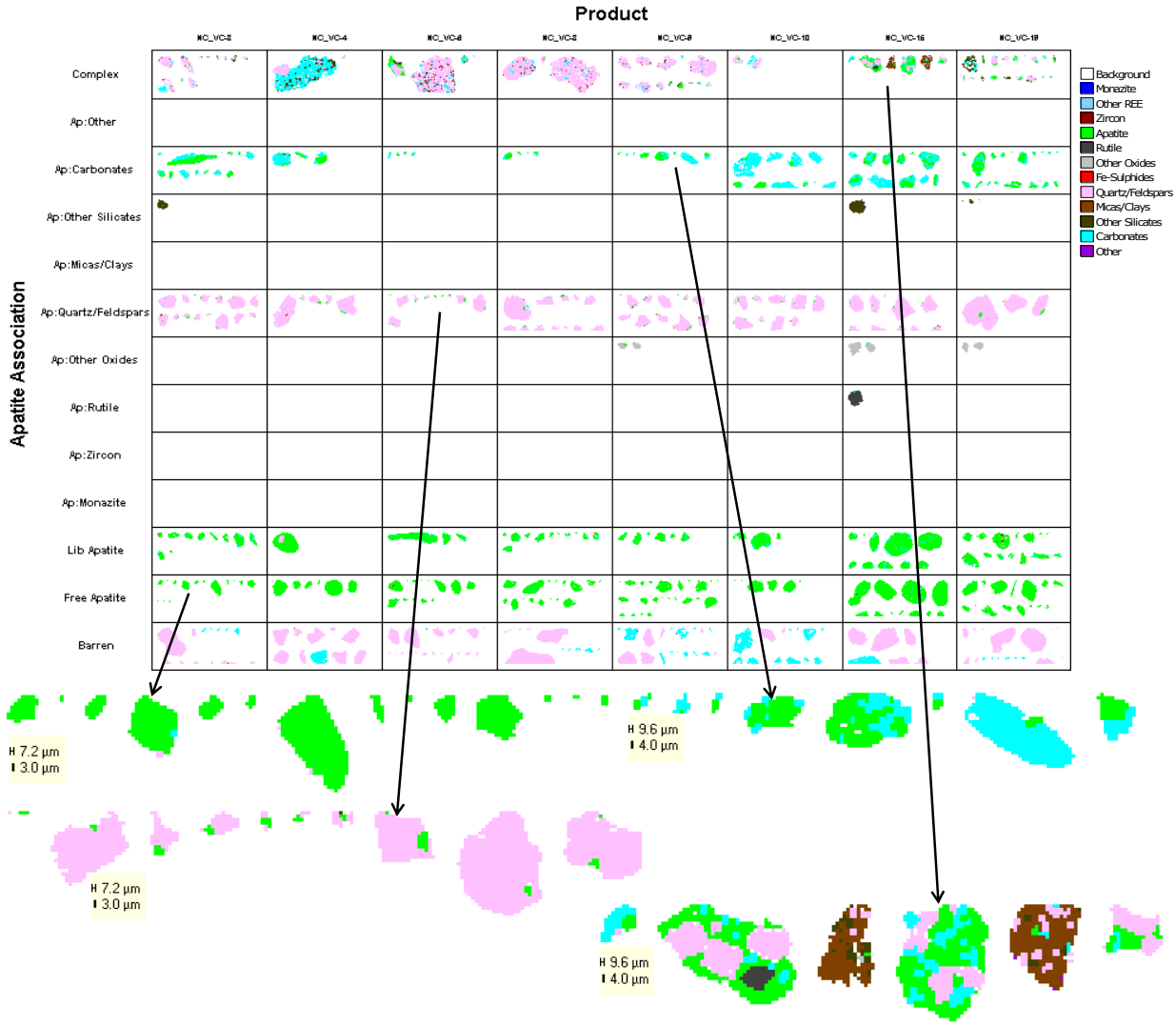


Figure 39: Image Grid and Particle Maps of Apatite Liberation and Association for the NC Group Samples

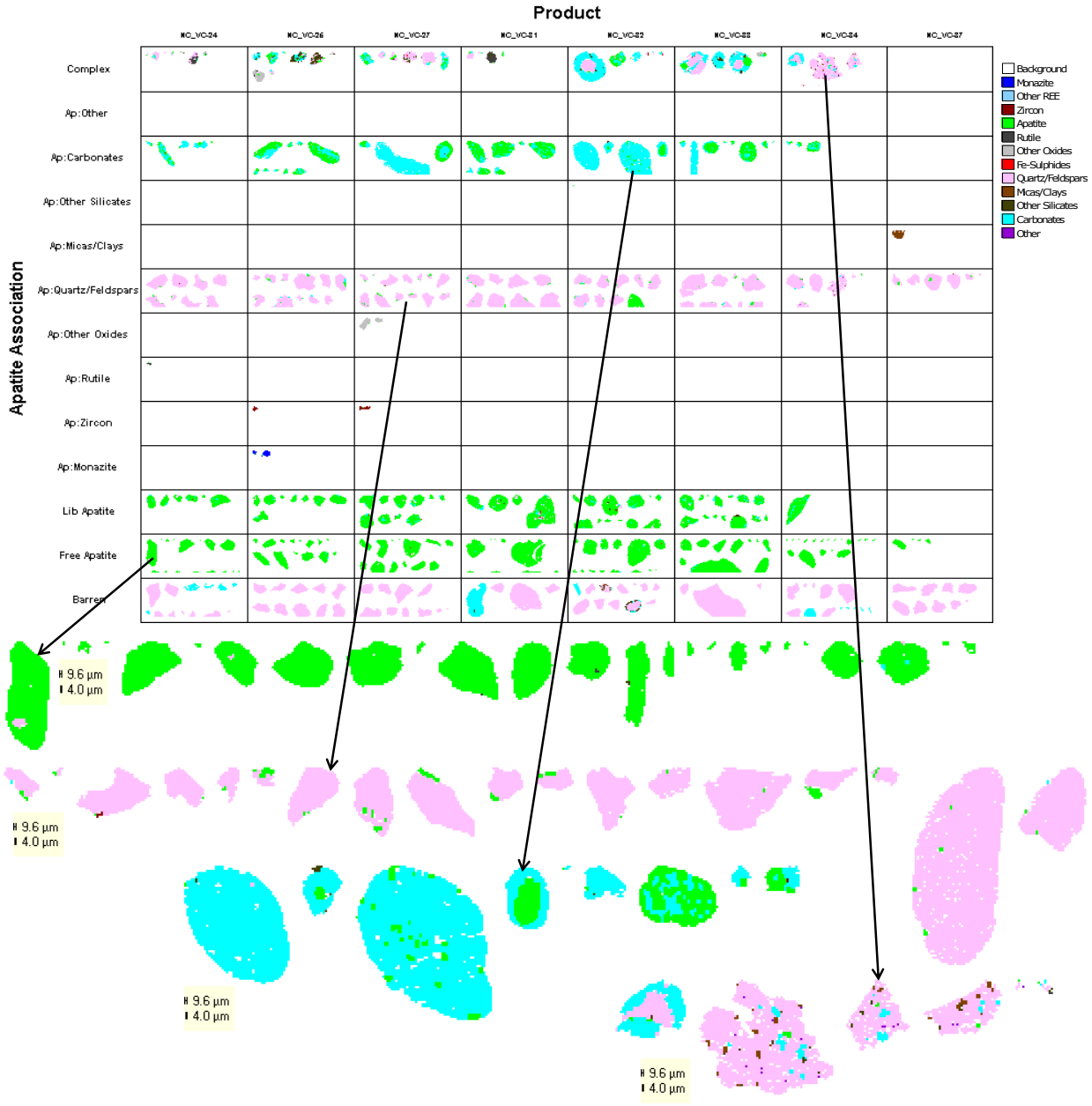


Figure 40: Image Grid and Particle Maps of Apatite Liberation and Association for the NC Group Samples (cont'd)

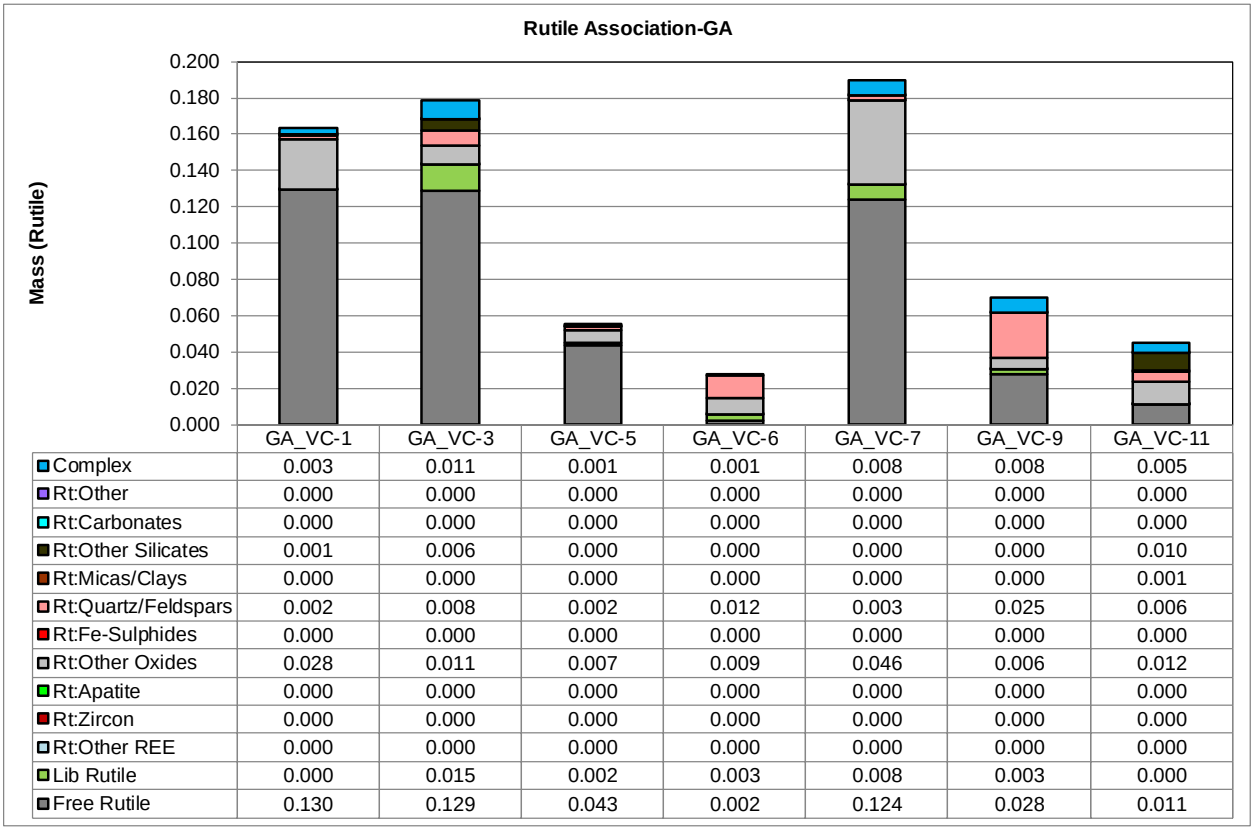
4.3.4. Liberation and Association of Rutile

Free and liberated rutile ranges from 20% to 82% in the SC group samples. The remainder occurs as middling particles with other oxides (6% to 33%), quartz/feldspars (1% to 43%), micas/clays (nil to 1%), other silicates (nil to 21%), and complex particles (20% to 82%) as shown in Figure 41 to Figure 42.

Free and liberated rutile ranges from 37% to 89% in the NC group samples. The remainder occurs as middling particles with apatite (nil to 3%), other oxides (nil to 17%), quartz/feldspars (nil to 11%), other silicates (nil to 28%), carbonates (nil to 11%) and complex particles (nil to 27%) as shown in Figure 43 to Figure 44.

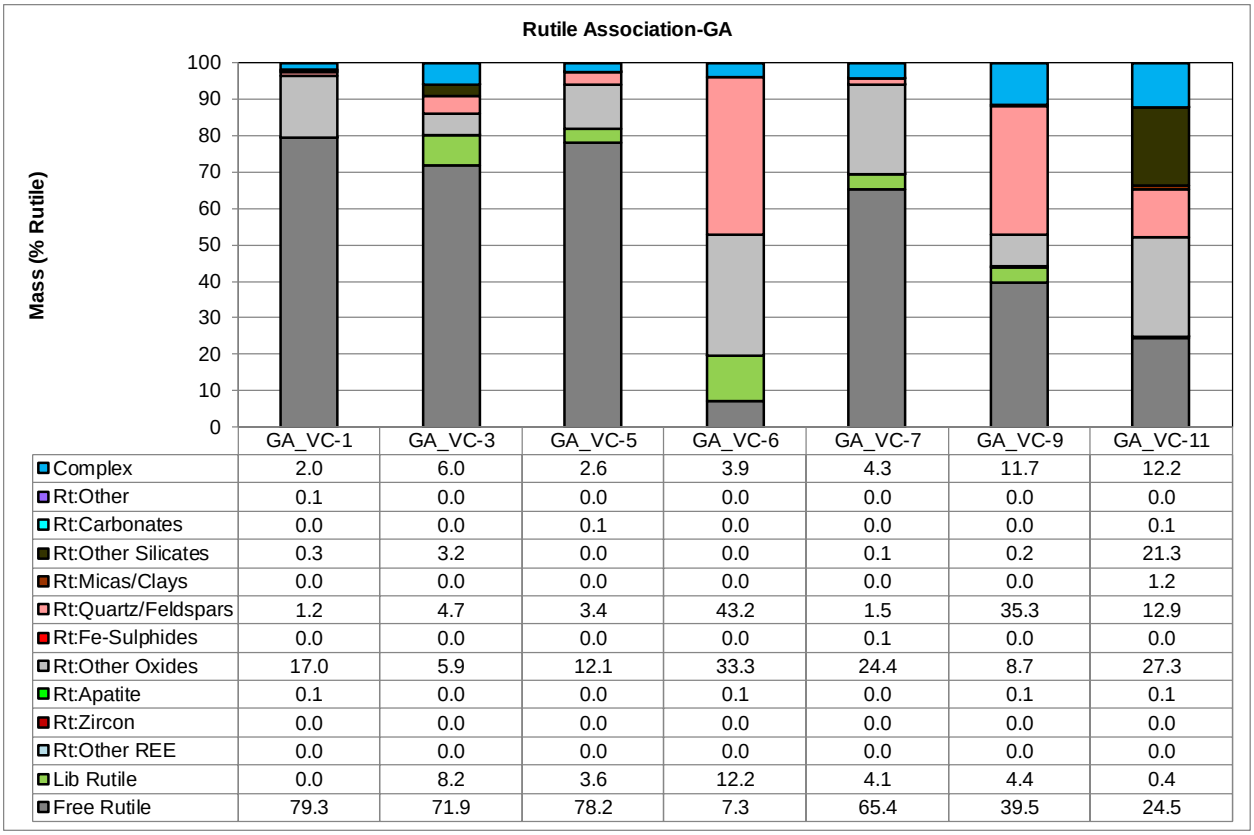
Free and liberated rutile ranges from 22% to 98% in the NC group. The remainder occurs as middling particles with other oxides (nil to 61%), Fe-sulphides (nil to 9%), quartz/feldspars (nil to 18%), micas/clays (nil to 1%), other silicates (nil to 31%), carbonates (nil to 4%) and complex particles (nil to 37%) as shown in Figure 45 to Figure 46.

Image grids and particle maps for each group of samples are presented in Figure 47 to Figure 51.



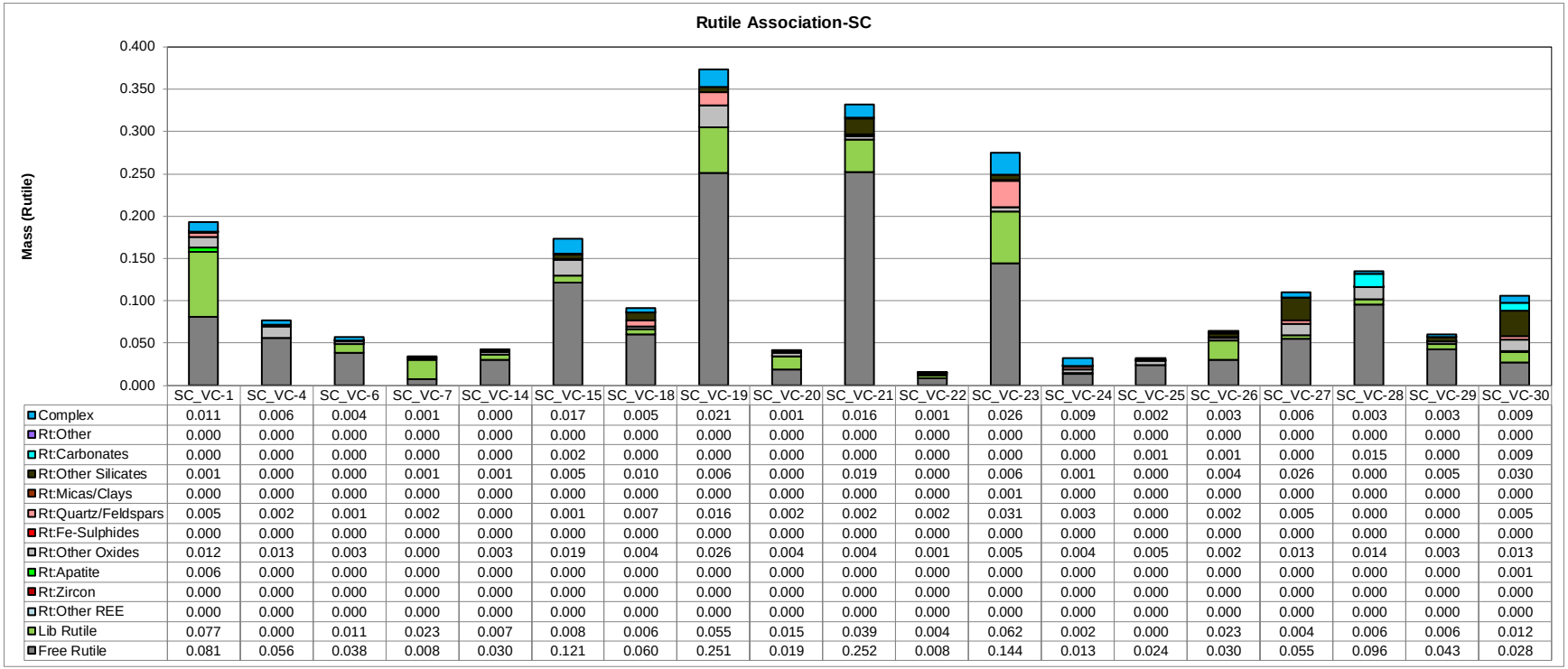
	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.003	0.011	0.001	0.001	0.008	0.008	0.005
Rt:Other	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Other Silicates	0.001	0.006	0.000	0.000	0.000	0.000	0.010
Rt:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Rt:Quartz/Feldspars	0.002	0.008	0.002	0.012	0.003	0.025	0.006
Rt:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Other Oxides	0.028	0.011	0.007	0.009	0.046	0.006	0.012
Rt:Apatite	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Zircon	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Rutile	0.000	0.015	0.002	0.003	0.008	0.003	0.000
Free Rutile	0.130	0.129	0.043	0.002	0.124	0.028	0.011

Figure 41: Liberation and Association of Rutile (Mass) for the GA Group Samples



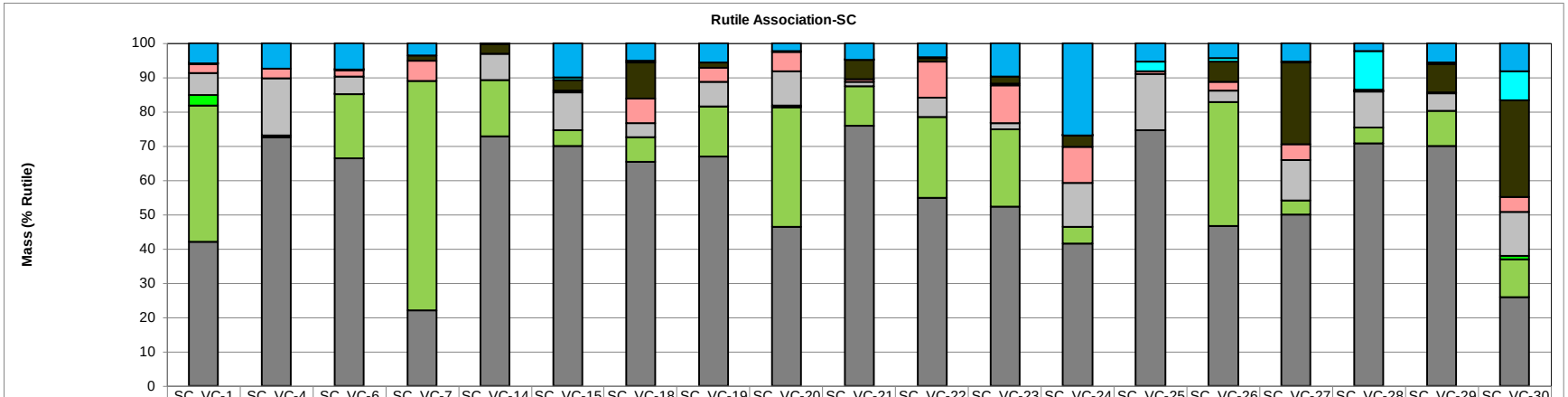
	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	2.0	6.0	2.6	3.9	4.3	11.7	12.2
Rt:Other	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Rt:Other Silicates	0.3	3.2	0.0	0.0	0.1	0.2	21.3
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Rt:Quartz/Feldspars	1.2	4.7	3.4	43.2	1.5	35.3	12.9
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Rt:Other Oxides	17.0	5.9	12.1	33.3	24.4	8.7	27.3
Rt:Apatite	0.1	0.0	0.0	0.1	0.0	0.1	0.1
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	0.0	8.2	3.6	12.2	4.1	4.4	0.4
Free Rutile	79.3	71.9	78.2	7.3	65.4	39.5	24.5

Figure 42: Liberation and Association of Rutile (Mass%) for the GA Group Samples



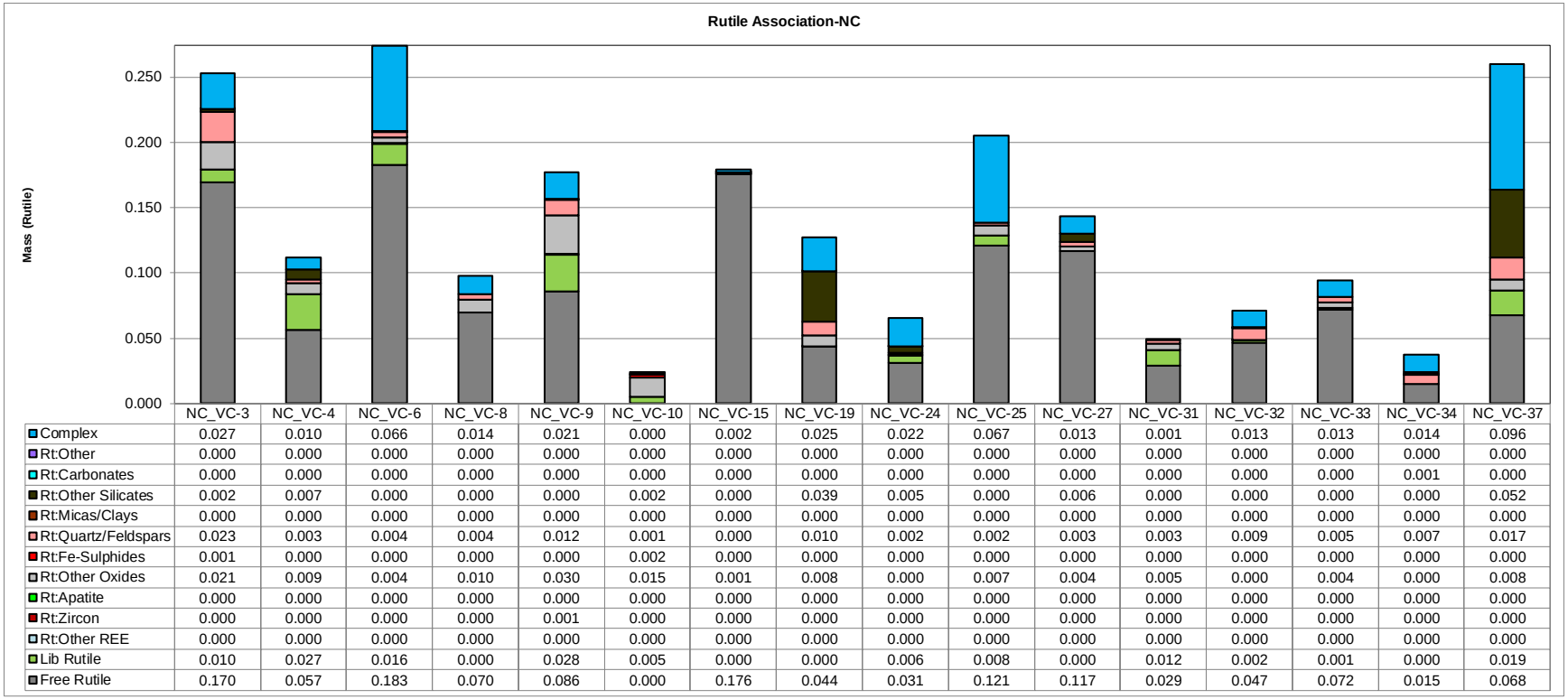
	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.011	0.006	0.004	0.001	0.000	0.017	0.005	0.021	0.001	0.016	0.001	0.026	0.009	0.002	0.003	0.006	0.003	0.003	0.009
Rt:Other	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Carbonates	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.015	0.000	0.009
Rt:Other Silicates	0.001	0.000	0.000	0.001	0.001	0.005	0.010	0.006	0.000	0.019	0.000	0.006	0.001	0.000	0.004	0.026	0.000	0.005	0.030
Rt:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Quartz/Feldspars	0.005	0.002	0.001	0.002	0.000	0.001	0.007	0.016	0.002	0.002	0.002	0.031	0.003	0.000	0.002	0.005	0.000	0.000	0.005
Rt:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Other Oxides	0.012	0.013	0.003	0.000	0.003	0.019	0.004	0.026	0.004	0.004	0.001	0.005	0.004	0.005	0.002	0.013	0.014	0.003	0.013
Rt:Apatite	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Rt:Zircon	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Rutile	0.077	0.000	0.011	0.023	0.007	0.008	0.006	0.055	0.015	0.039	0.004	0.062	0.002	0.000	0.023	0.004	0.006	0.006	0.012
Free Rutile	0.081	0.056	0.038	0.008	0.030	0.121	0.060	0.251	0.019	0.252	0.008	0.144	0.013	0.024	0.030	0.055	0.096	0.043	0.028

Figure 43: Liberation and Association of Rutile (Mass) for the SC Group Samples



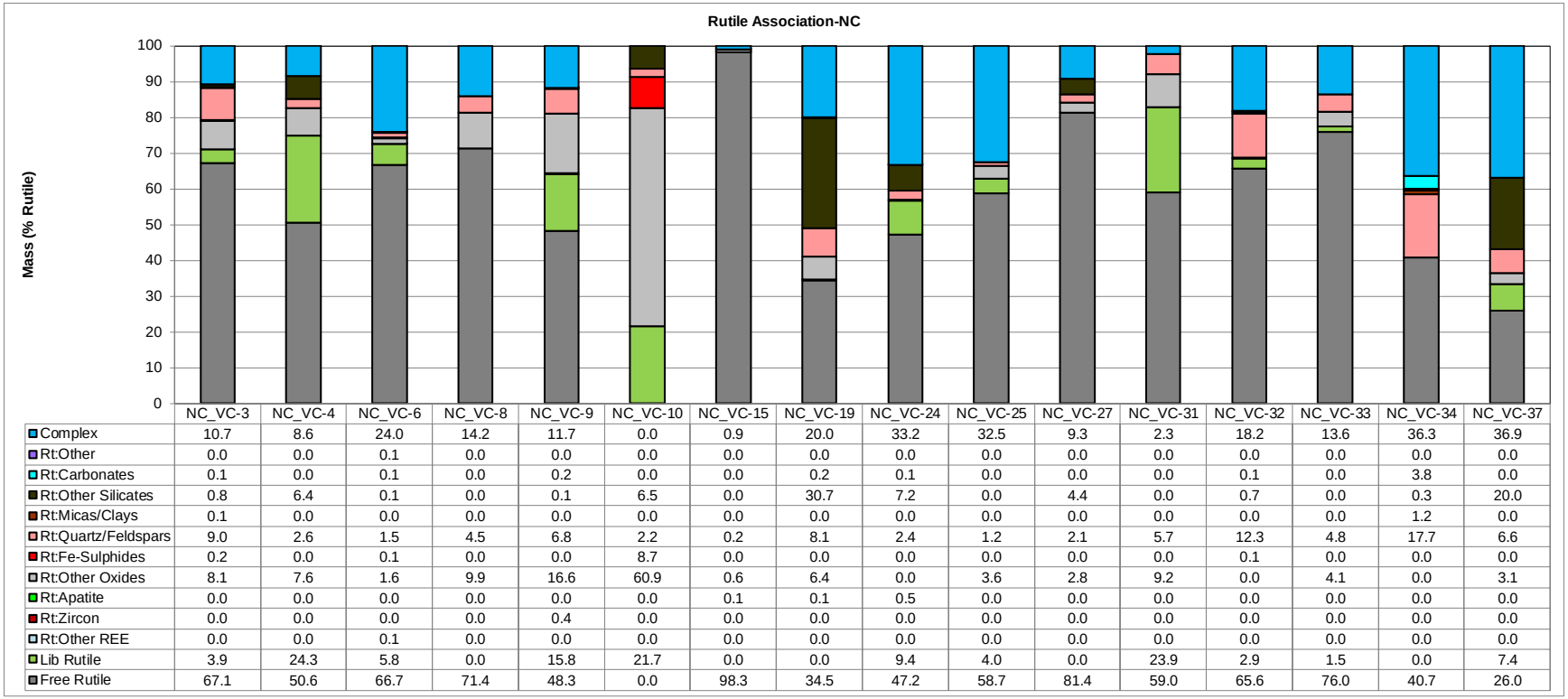
	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	5.8	7.3	7.7	3.6	0.3	9.9	5.1	5.5	2.4	4.8	4.1	9.6	26.9	5.3	4.2	5.4	2.3	5.7	8.1
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	2.8	1.1	0.2	11.3	0.3	8.5
Rt:Other Silicates	0.3	0.0	0.2	1.6	2.7	3.0	10.5	1.7	0.0	5.7	1.0	2.3	3.2	0.0	5.9	23.8	0.3	8.2	28.2
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	2.7	2.8	1.7	5.7	0.1	0.4	7.2	4.2	5.8	0.6	10.4	11.2	10.5	0.7	2.5	4.6	0.2	0.2	4.4
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Rt:Other Oxides	6.3	16.8	5.3	0.0	7.6	11.0	4.1	6.9	10.0	1.3	5.7	1.8	12.8	16.4	3.5	11.9	10.3	5.2	12.7
Rt:Apatite	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	39.9	0.0	18.7	66.8	16.4	4.6	7.1	14.6	34.8	11.7	23.7	22.5	5.0	0.0	36.0	4.0	4.6	10.1	11.1
Free Rutile	42.0	72.7	66.4	22.3	72.8	70.2	65.6	67.1	46.4	75.8	54.8	52.3	41.6	74.8	46.9	50.1	70.9	70.1	25.9

Figure 44: Liberation and Association of Rutile (Mass%) for the SC Group Samples



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.027	0.010	0.066	0.014	0.021	0.000	0.002	0.025	0.022	0.067	0.013	0.001	0.013	0.013	0.014	0.096
Rt:Other	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Rt:Other Silicates	0.002	0.007	0.000	0.000	0.000	0.002	0.000	0.039	0.005	0.000	0.006	0.000	0.000	0.000	0.000	0.052
Rt:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Quartz/Feldspars	0.023	0.003	0.004	0.004	0.012	0.001	0.000	0.010	0.002	0.002	0.003	0.003	0.009	0.005	0.007	0.017
Rt:Fe-Sulphides	0.001	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Other Oxides	0.021	0.009	0.004	0.010	0.030	0.015	0.001	0.008	0.000	0.007	0.004	0.005	0.000	0.004	0.000	0.008
Rt:Apatite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Zircon	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Rt:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Rutile	0.010	0.027	0.016	0.000	0.028	0.005	0.000	0.000	0.006	0.008	0.000	0.012	0.002	0.001	0.000	0.019
Free Rutile	0.170	0.057	0.183	0.070	0.086	0.000	0.176	0.044	0.031	0.121	0.117	0.029	0.047	0.072	0.015	0.068

Figure 45: Liberation and Association of Rutile (Mass) for the NC Group Samples



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	10.7	8.6	24.0	14.2	11.7	0.0	0.9	20.0	33.2	32.5	9.3	2.3	18.2	13.6	36.3	36.9
Rt:Other	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.1	0.0	0.1	0.0	0.2	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.1	0.0	3.8	0.0
Rt:Other Silicates	0.8	6.4	0.1	0.0	0.1	6.5	0.0	30.7	7.2	0.0	4.4	0.0	0.7	0.0	0.3	20.0
Rt:Micas/Clays	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0
Rt:Quartz/Feldspars	9.0	2.6	1.5	4.5	6.8	2.2	0.2	8.1	2.4	1.2	2.1	5.7	12.3	4.8	17.7	6.6
Rt:Fe-Sulphides	0.2	0.0	0.1	0.0	0.0	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Rt:Other Oxides	8.1	7.6	1.6	9.9	16.6	60.9	0.6	6.4	0.0	3.6	2.8	9.2	0.0	4.1	0.0	3.1
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	3.9	24.3	5.8	0.0	15.8	21.7	0.0	0.0	9.4	4.0	0.0	23.9	2.9	1.5	0.0	7.4
Free Rutile	67.1	50.6	66.7	71.4	48.3	0.0	98.3	34.5	47.2	58.7	81.4	59.0	65.6	76.0	40.7	26.0

Figure 46: Liberation and Association of Rutile (Mass%) for the NC Group Samples

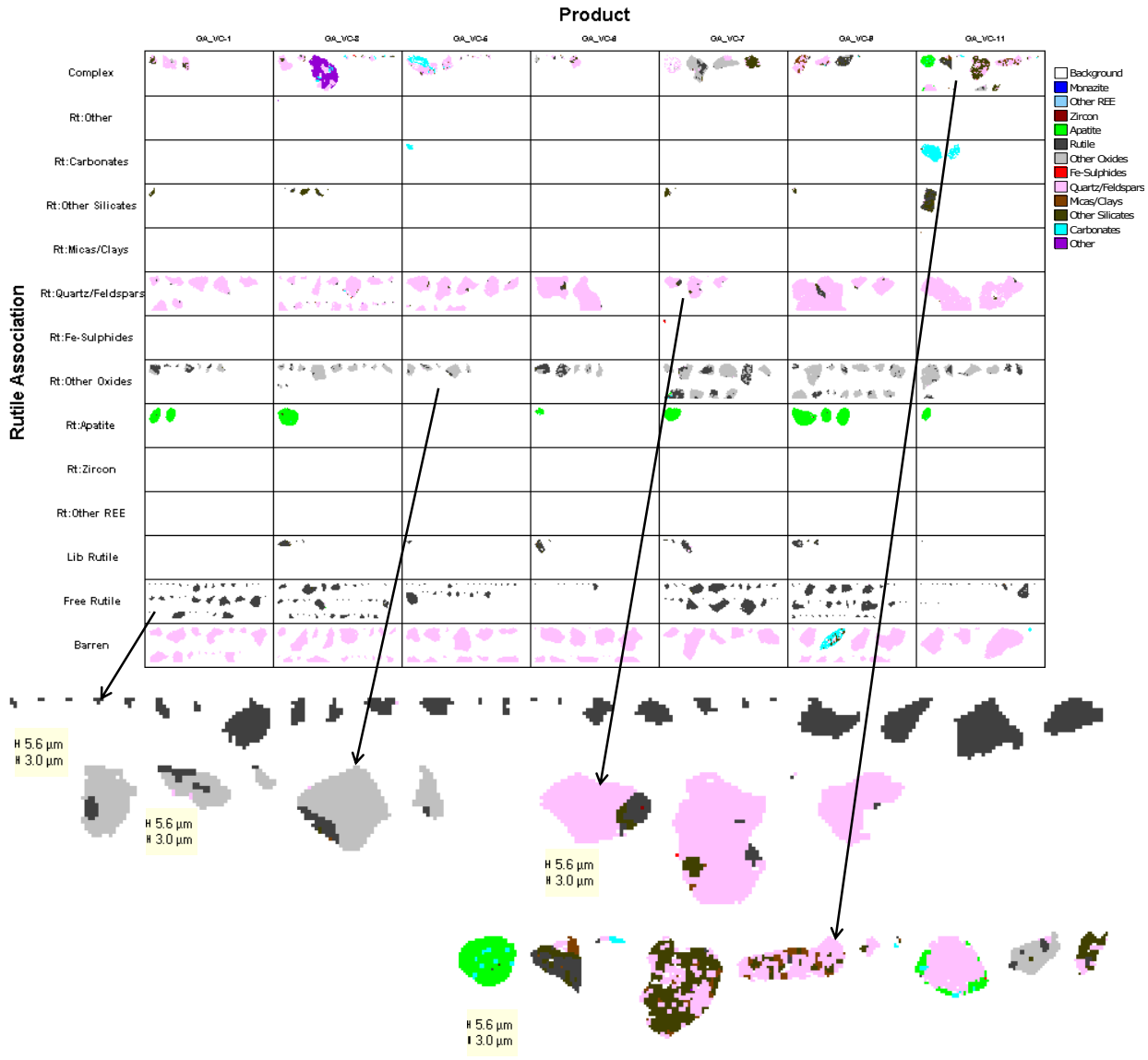


Figure 47: Image Grid and Particle Maps of Rutile Liberation and Association for the GA Group Samples

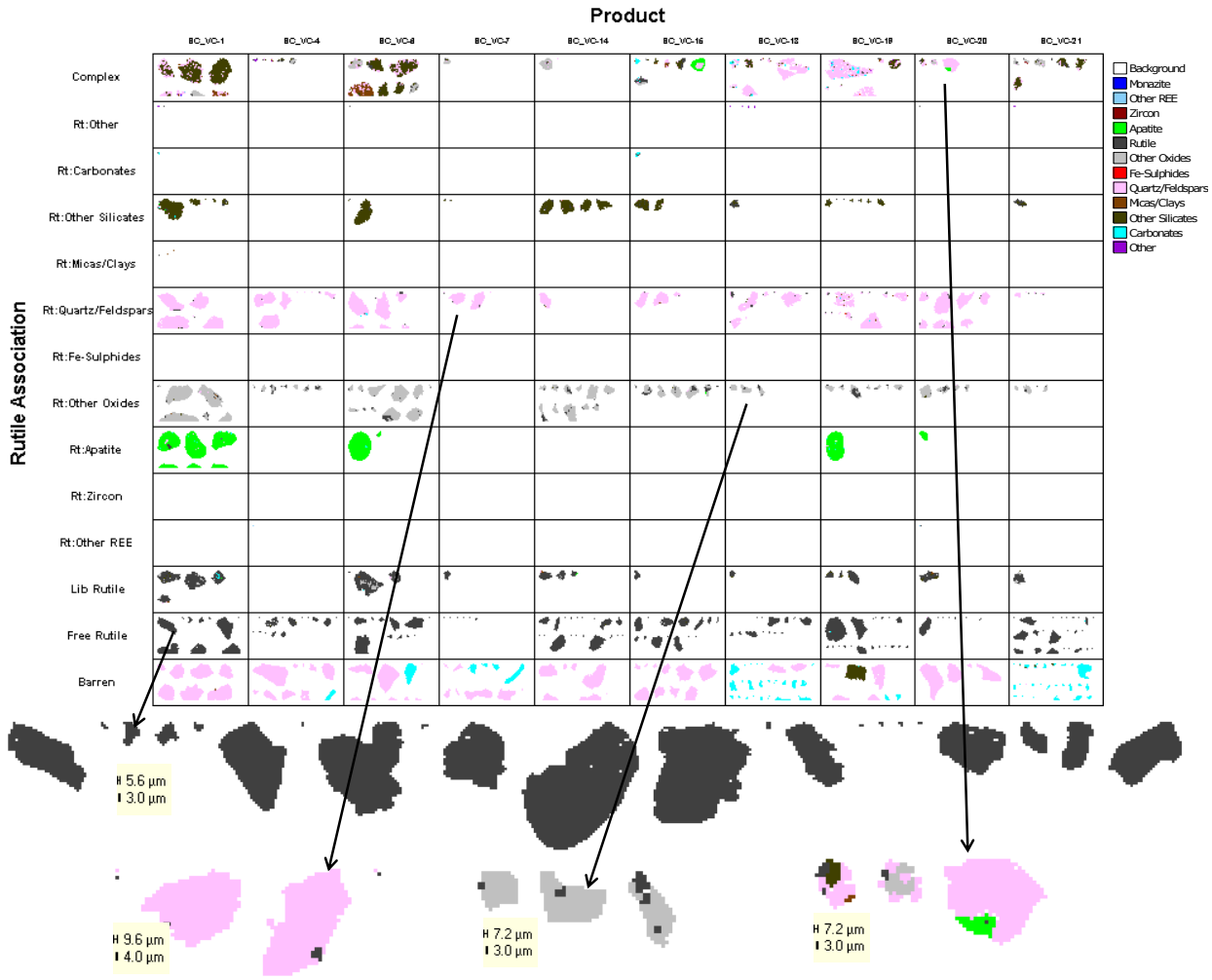


Figure 48: Image Grid and Particle Maps of Rutile Liberation and Association for the SC Group Samples

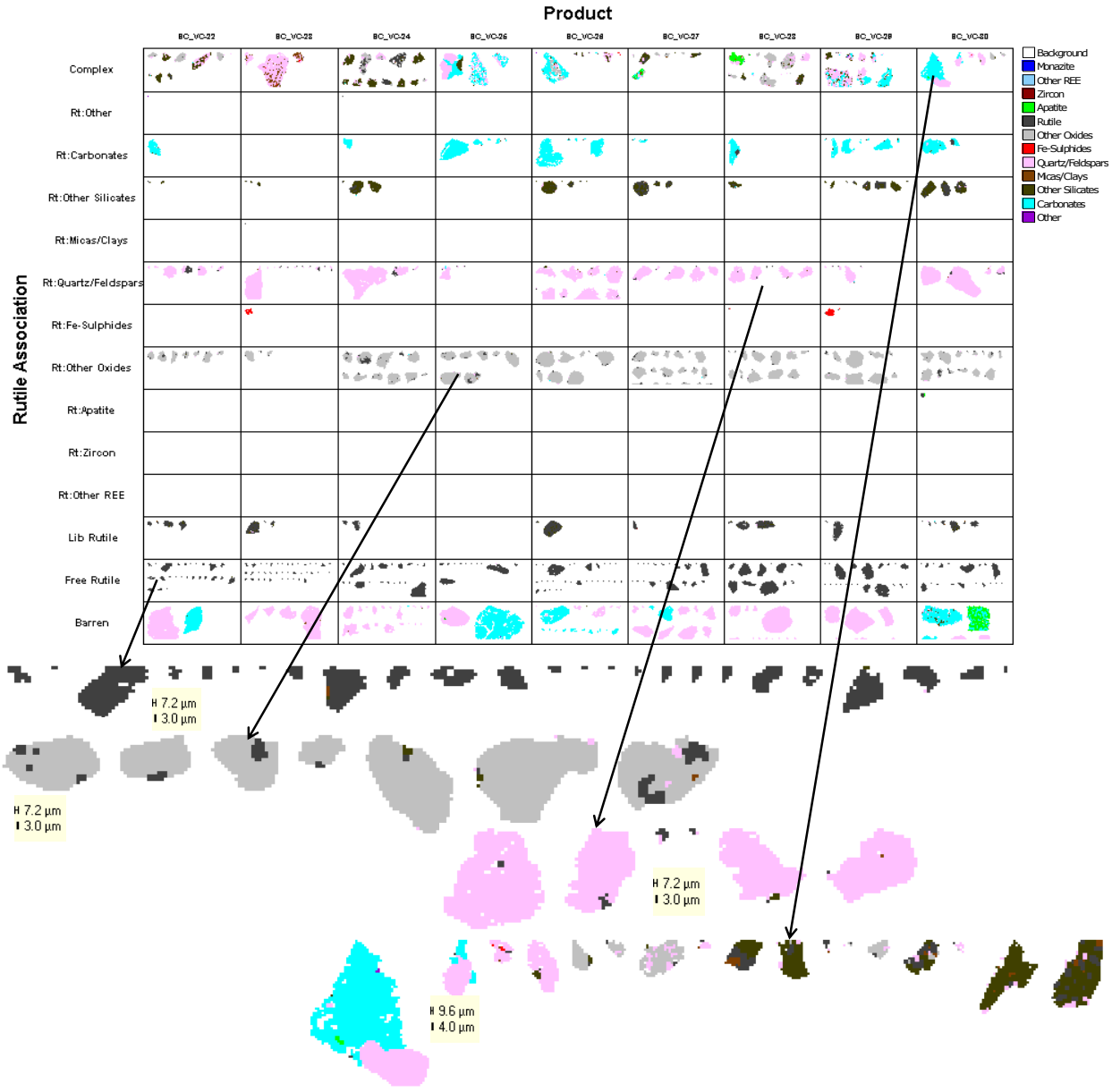


Figure 49: Image Grid and Particle Maps of Rutile Liberation and Association for the SC Group Samples (cont'd)

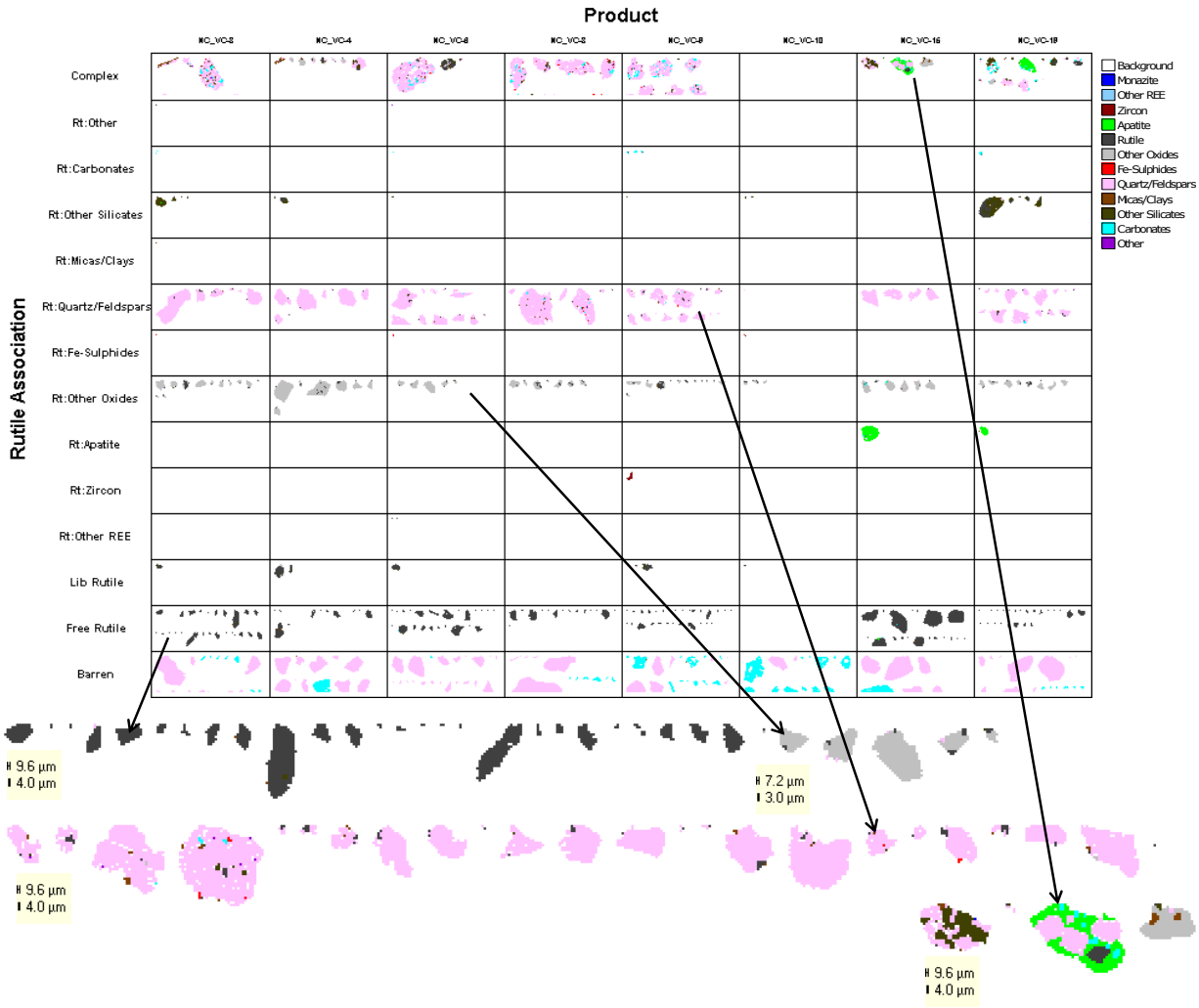


Figure 50: Image Grid and Particle Maps of Rutile Liberation and Association for the NC Group Samples

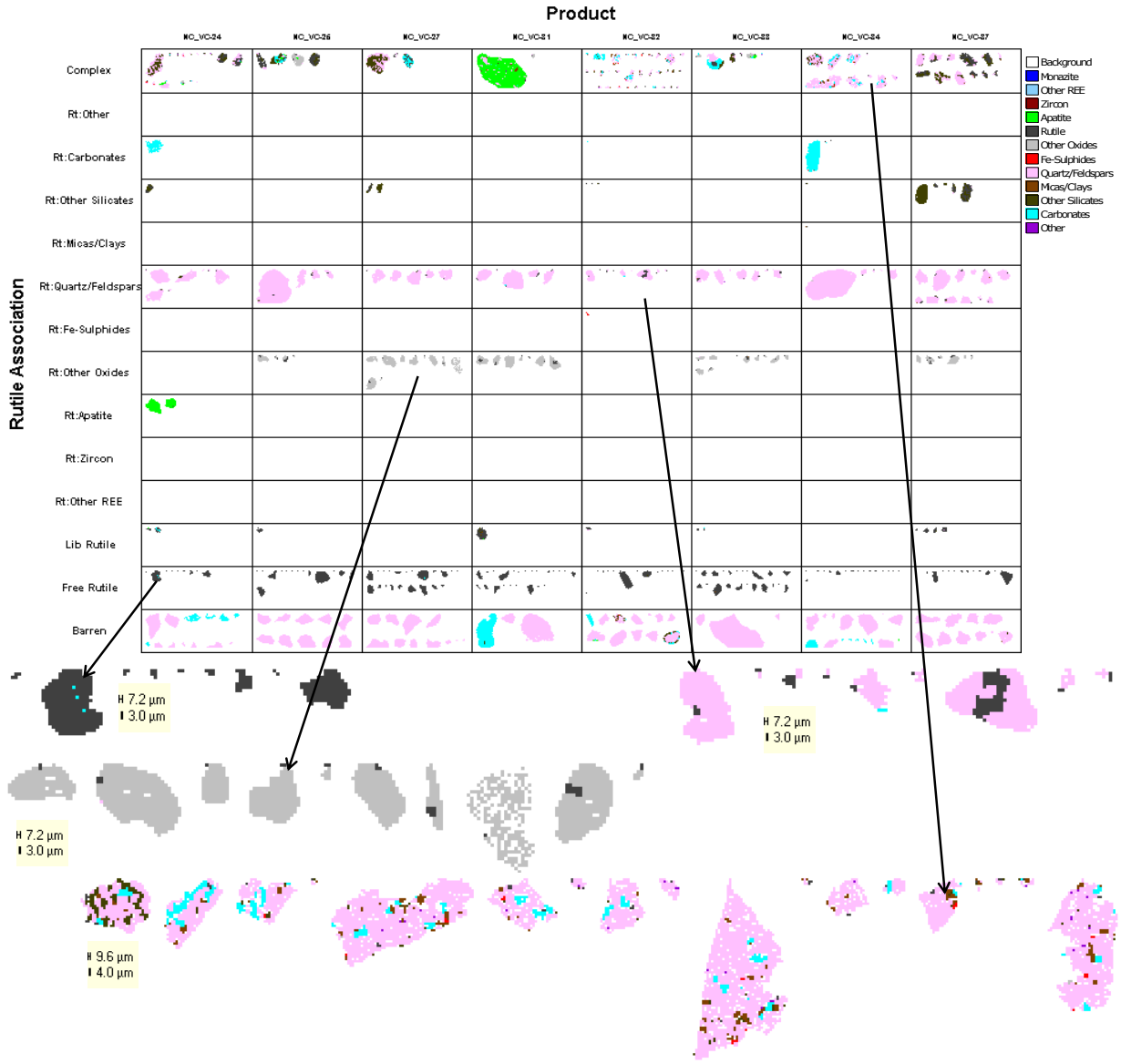


Figure 51: Image Grid and particle Maps of Rutile Liberation and Association for the NC Group Samples (cont'd)

4.4. Roundness of Minerals

The values indicative of the roundness of the various minerals is based on its cross-section (2D). The lower the number, the more rounded the particle. It is calculated by perimeter^2/area. For a perfect circle, the value will be 4π (about 12.6) and for a square 16. An illustration of the particle classification using this shape factor is shown in Figure 52.

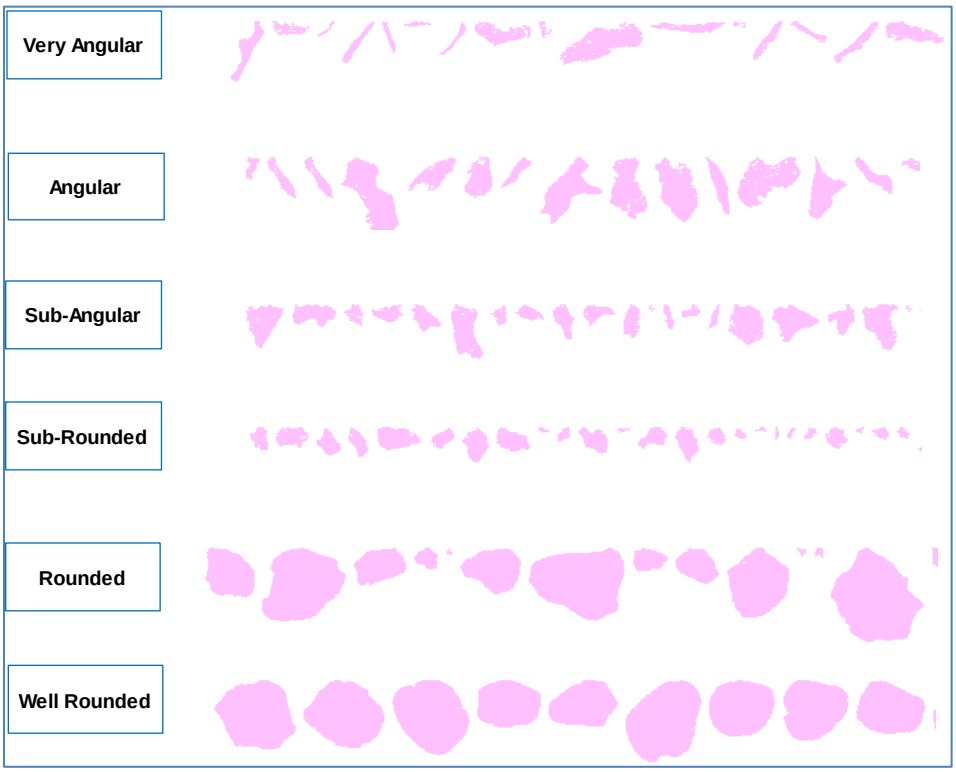
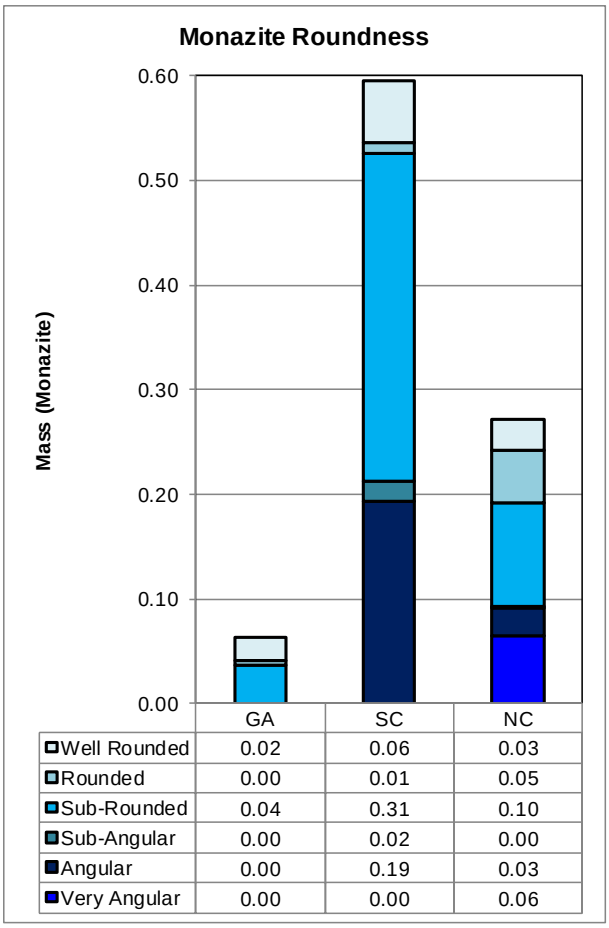


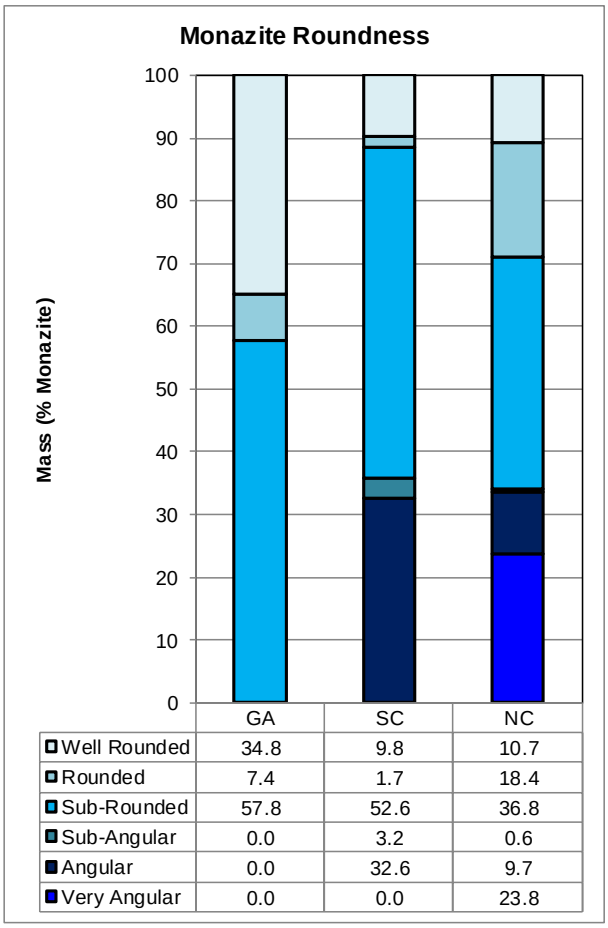
Figure 52: Shape Factor Illustration of Particles

4.5. Roundness of Monazite

Monazite is sub-rounded (58%) and rounded/well rounded (42%) in the GA group samples, sub-rounded (53%) to angular (33%) and less rounded/well rounded (12%) in the SC group, and sub-rounded (37%) to angular/very angular (34%) and rounded/well-rounded (29%) in the NC group (Figure 53). An image grid for each group of samples, illustrating the monazite roundness, is presented in Figure 54 to Figure 56.



	GA	SC	NC
Well Rounded	0.02	0.06	0.03
Rounded	0.00	0.01	0.05
Sub-Rounded	0.04	0.31	0.10
Sub-Angular	0.00	0.02	0.00
Angular	0.00	0.19	0.03
Very Angular	0.00	0.00	0.06



	GA	SC	NC
Well Rounded	34.8	9.8	10.7
Rounded	7.4	1.7	18.4
Sub-Rounded	57.8	52.6	36.8
Sub-Angular	0.0	3.2	0.6
Angular	0.0	32.6	9.7
Very Angular	0.0	0.0	23.8

Figure 53: Monazite Roundness for the GA, SC and NC Samples (Mass and Norm Mass%)

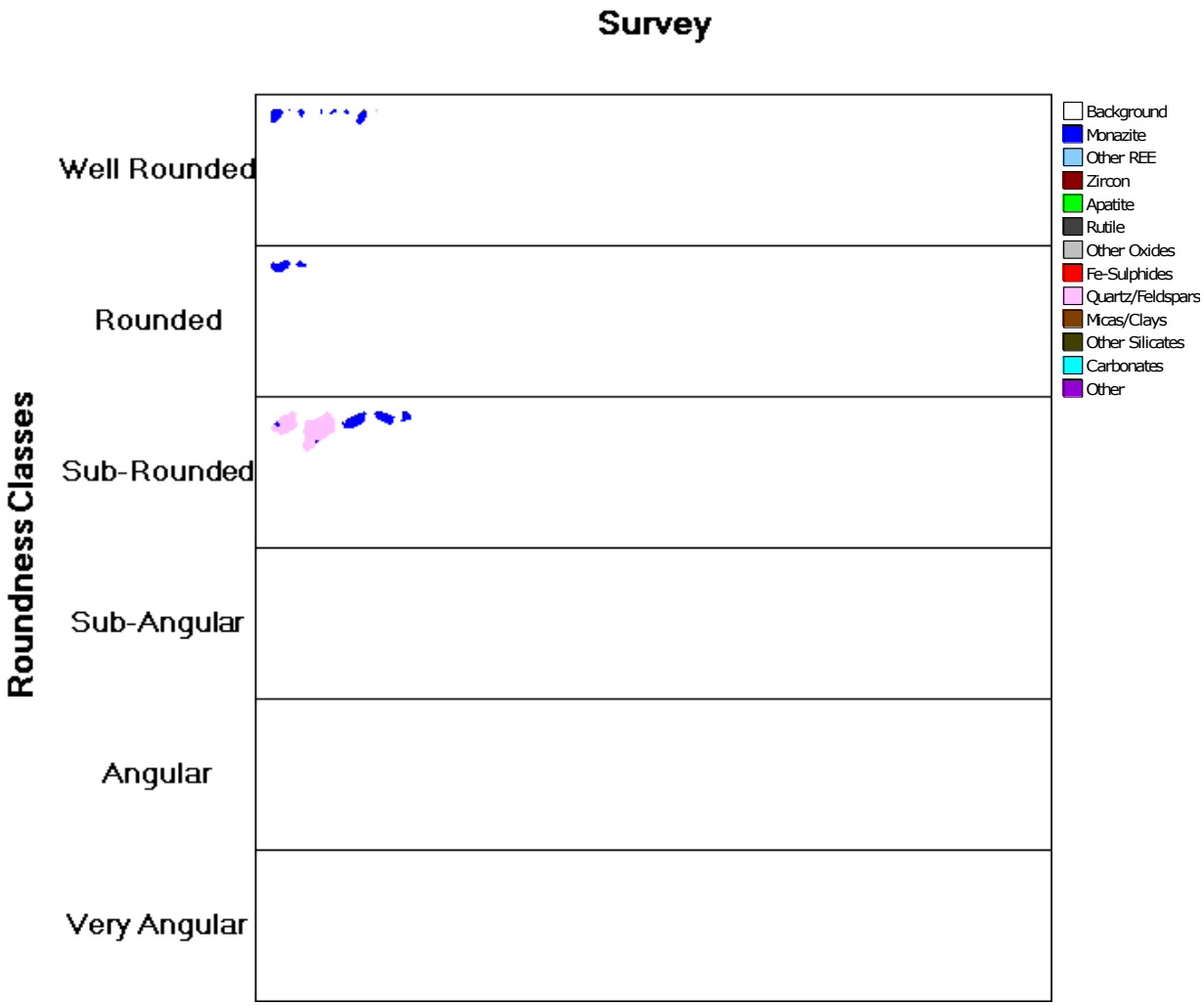


Figure 54: Image Grid of Monazite Roundness for the GA Group Samples

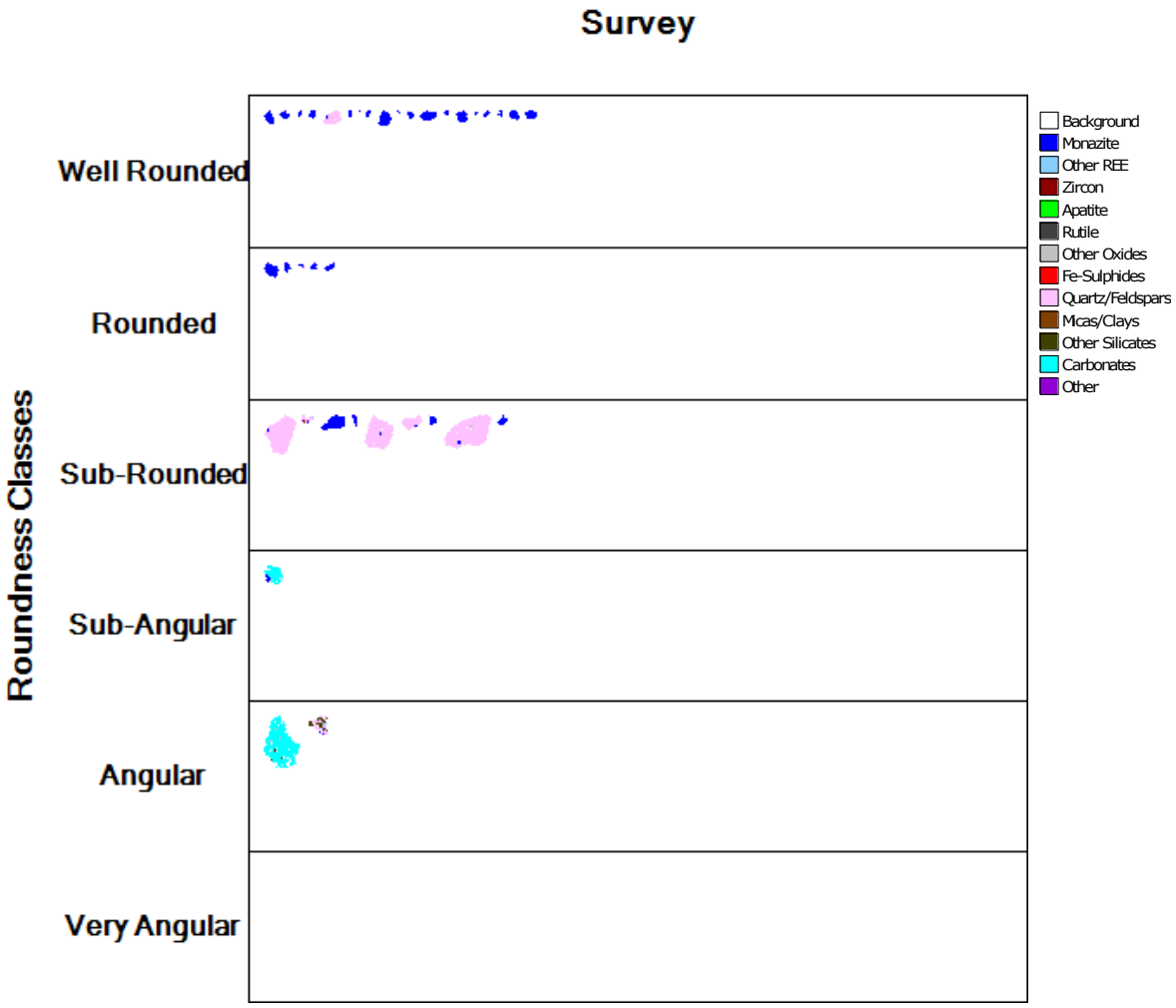


Figure 55: Image Grid of Monazite Roundness for the SC Group

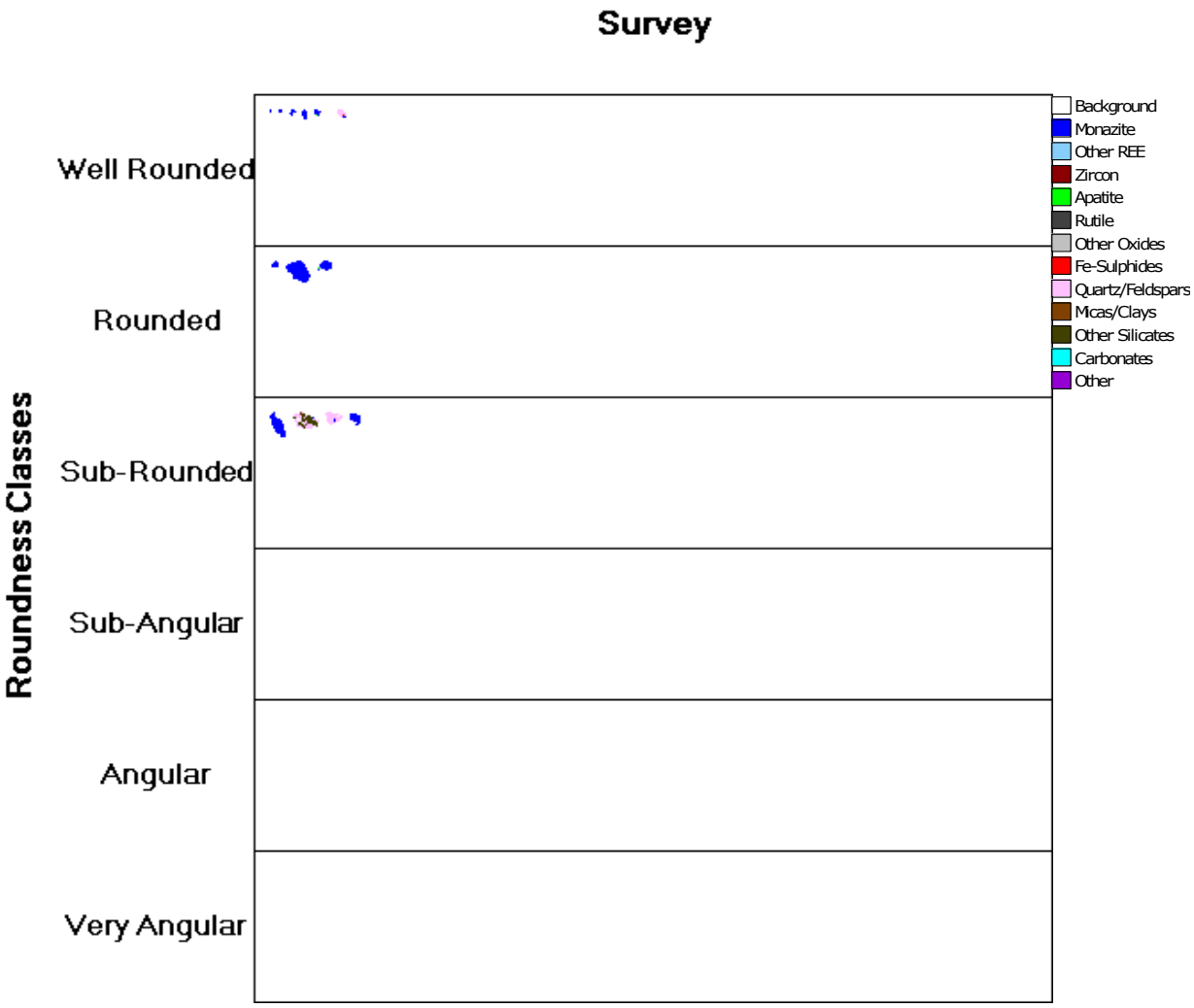
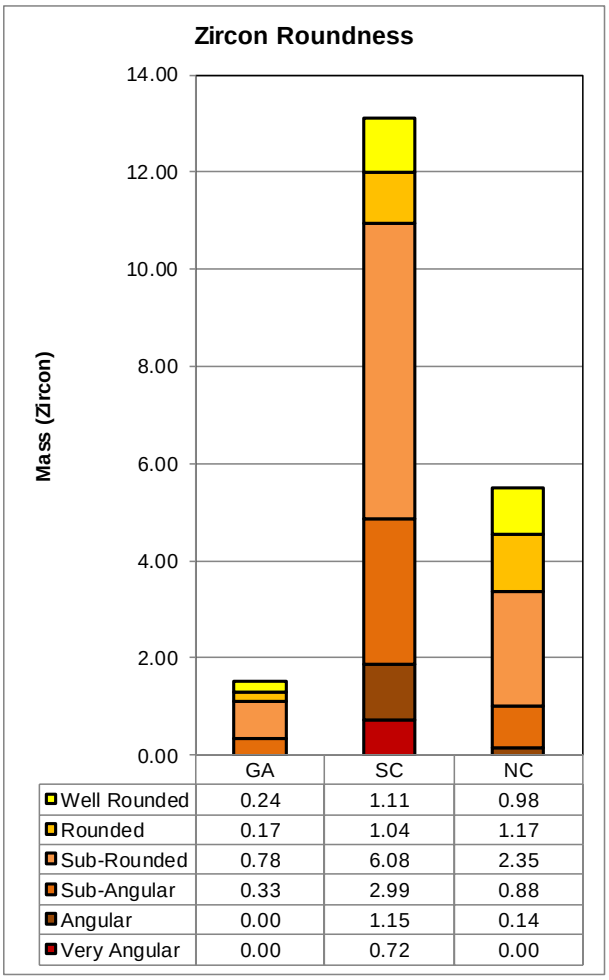


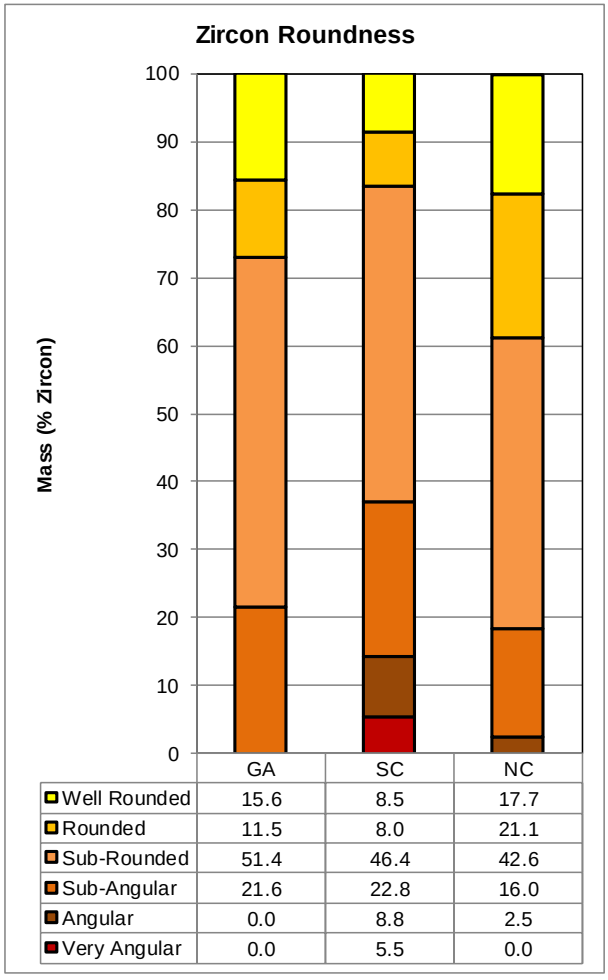
Figure 56: Image Grid of Monazite Roundness for the NC Group

4.6. Roundness of Zircon

Zircon is sub-angular (22%), sub-rounded (51%), and rounded/well rounded (27%) in the GA group samples, angular/very angular (14%), sub-angular (23%), sub-rounded (46%), and rounded/well rounded (16%) in the SC group, angular/very angular (<3%), sub-angular (16%), sub-rounded (43%), and rounded/well rounded (39%) in the NC group (Figure 57). An image grid for each group of samples, illustrating the zircon roundness, is presented in Figure 58 to Figure 60.



	GA	SC	NC
Well Rounded	0.24	1.11	0.98
Rounded	0.17	1.04	1.17
Sub-Rounded	0.78	6.08	2.35
Sub-Angular	0.33	2.99	0.88
Angular	0.00	1.15	0.14
Very Angular	0.00	0.72	0.00



	GA	SC	NC
Well Rounded	15.6	8.5	17.7
Rounded	11.5	8.0	21.1
Sub-Rounded	51.4	46.4	42.6
Sub-Angular	21.6	22.8	16.0
Angular	0.0	8.8	2.5
Very Angular	0.0	5.5	0.0

Figure 57: Zircon Roundness for the GA, SC and NC Samples (Mass and Norm Mass%)

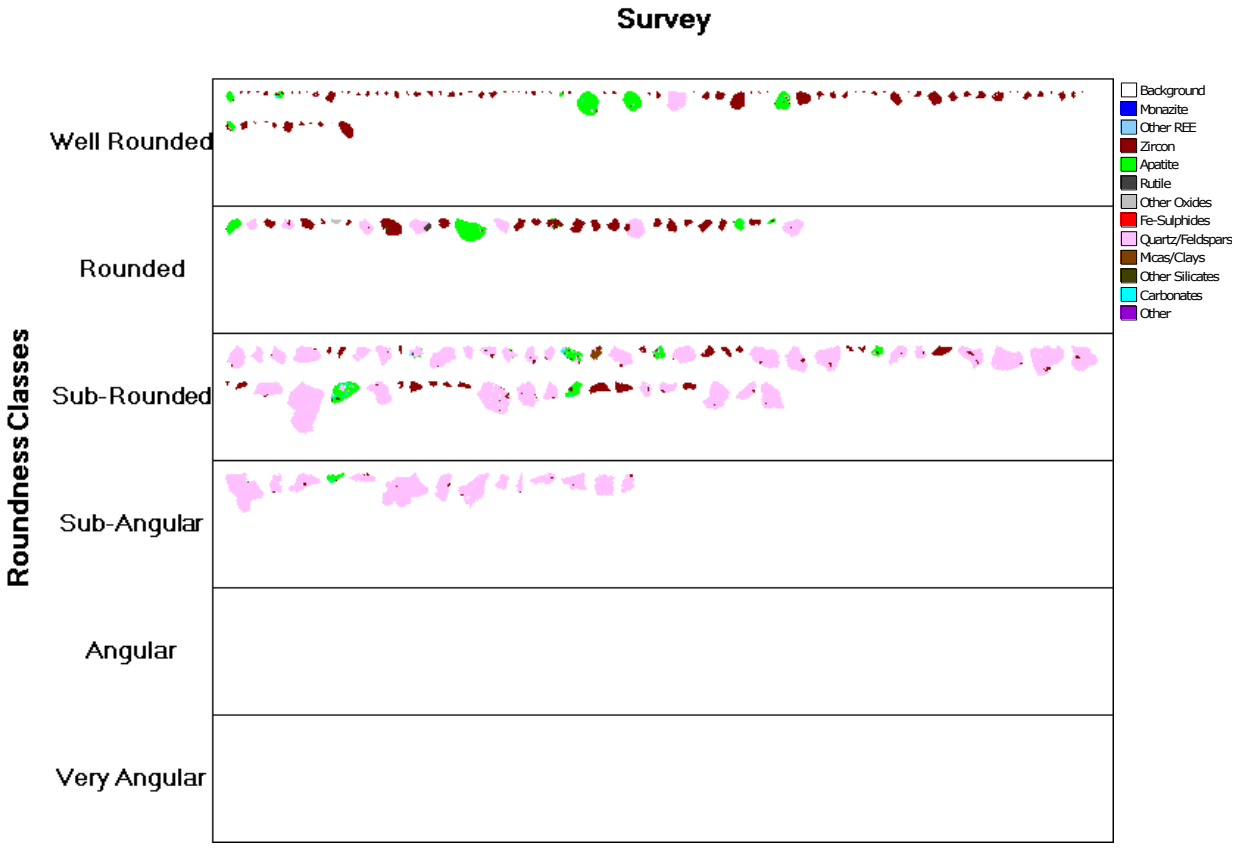


Figure 58: Image Grid of Zircon Roundness for the GA Group

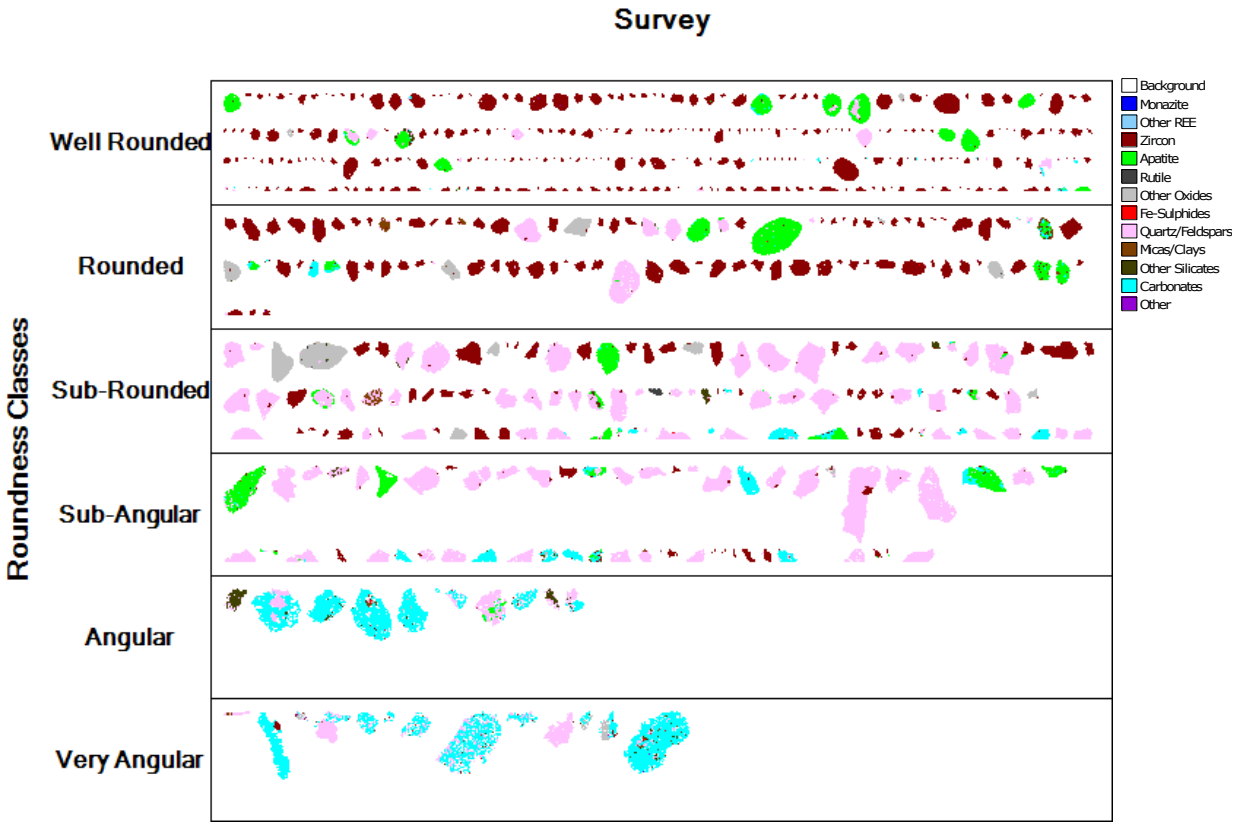


Figure 59: Image Grid of Zircon Roundness for the SC Group

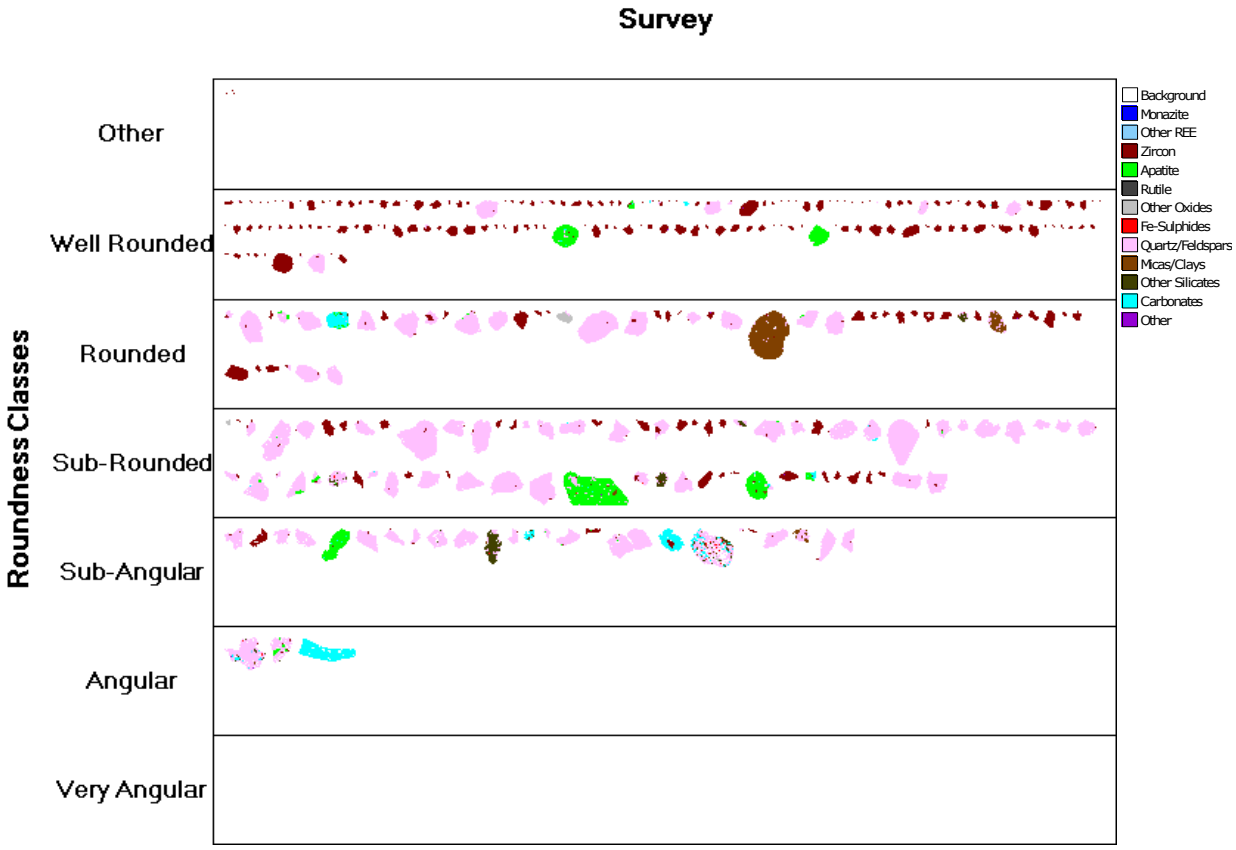
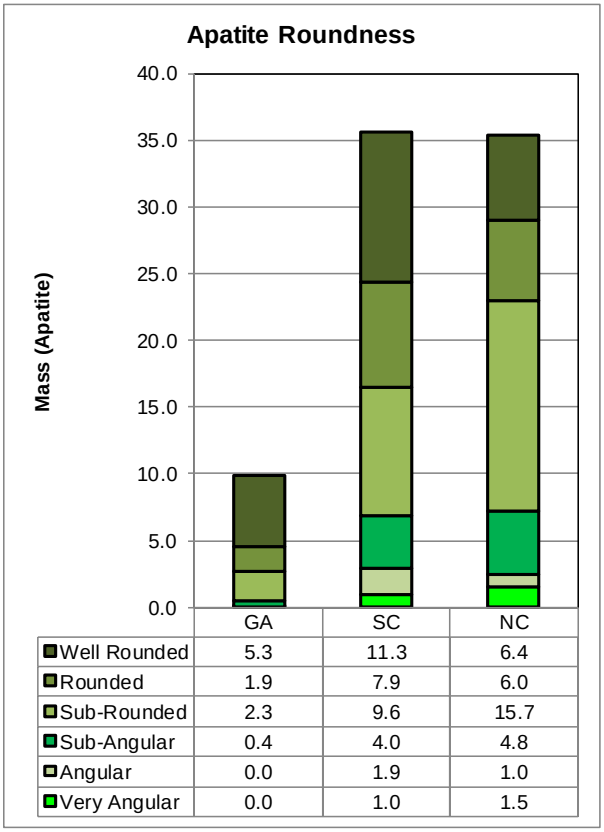


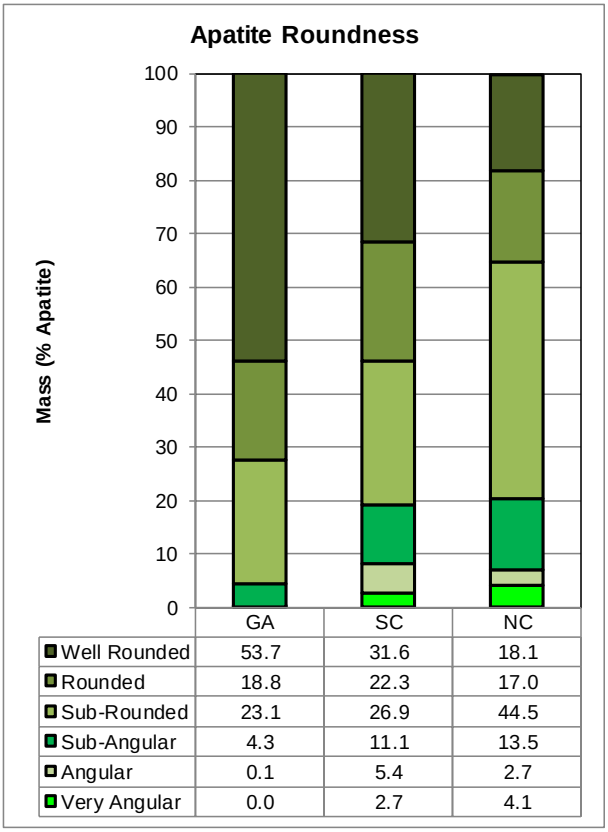
Figure 60: Image Grid of Zircon Roundness for the NC Group

4.7. Roundness of Apatite

Apatite is mainly rounded/well rounded (73%), sub-rounded (23%), and sub-angular (4%) in the GA group samples, is mainly rounded/well rounded (54%), sub-rounded (27%), and sub-angular (11%), and angular/very angular (8%) in the SC group, is mainly rounded/well rounded (35%), sub-rounded (45%), and sub-angular (14%), and angular/very angular (7%) in the NC group (Figure 61). An image grid for each group of samples, illustrating the apatite roundness, is presented in Figure 62 to Figure 64.



	GA	SC	NC
Well Rounded	5.3	11.3	6.4
Rounded	1.9	7.9	6.0
Sub-Rounded	2.3	9.6	15.7
Sub-Angular	0.4	4.0	4.8
Angular	0.0	1.9	1.0
Very Angular	0.0	1.0	1.5



	GA	SC	NC
Well Rounded	53.7	31.6	18.1
Rounded	18.8	22.3	17.0
Sub-Rounded	23.1	26.9	44.5
Sub-Angular	4.3	11.1	13.5
Angular	0.1	5.4	2.7
Very Angular	0.0	2.7	4.1

Figure 61: Apatite Roundness for the GA, SC and NC Samples (Mass and Norm Mass%)

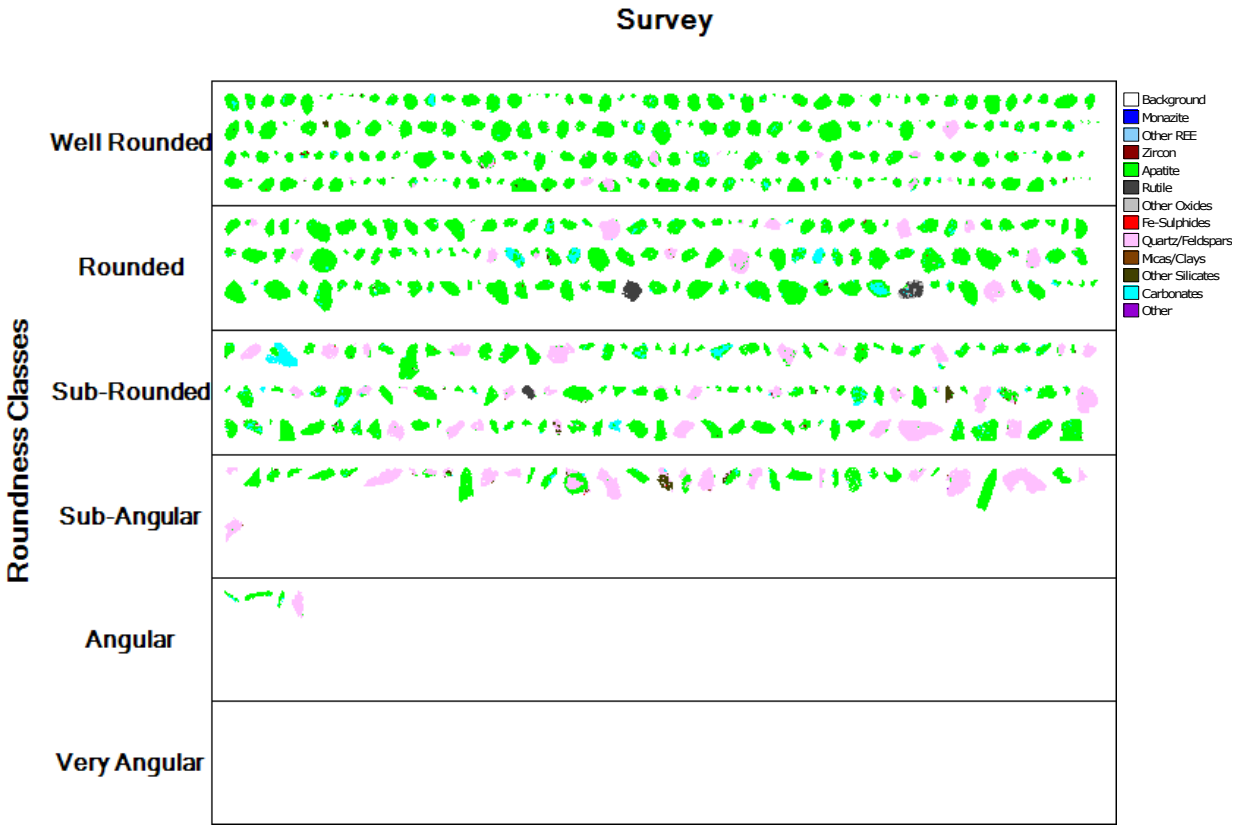


Figure 62: Image Grid of Apatite Roundness for the GA Group

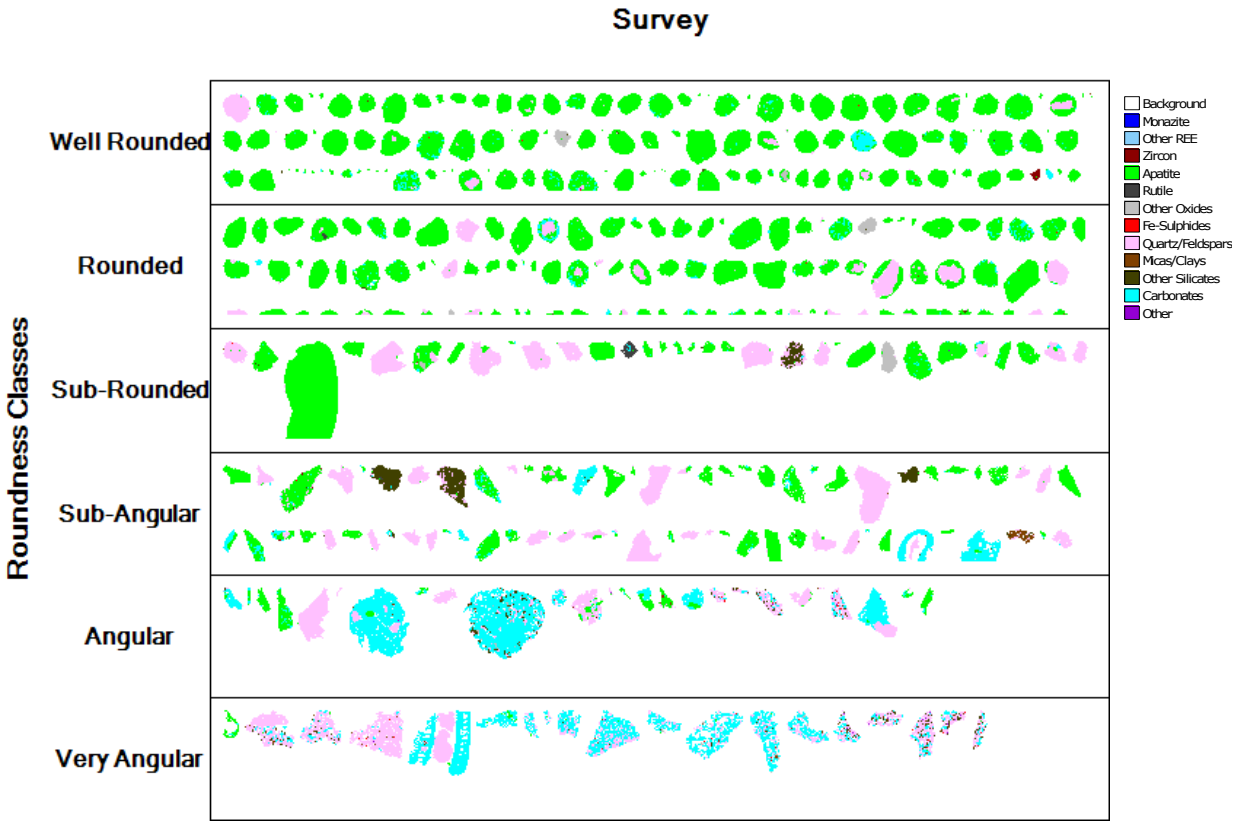


Figure 63: Image Grid of Apatite Roundness for the SC Group

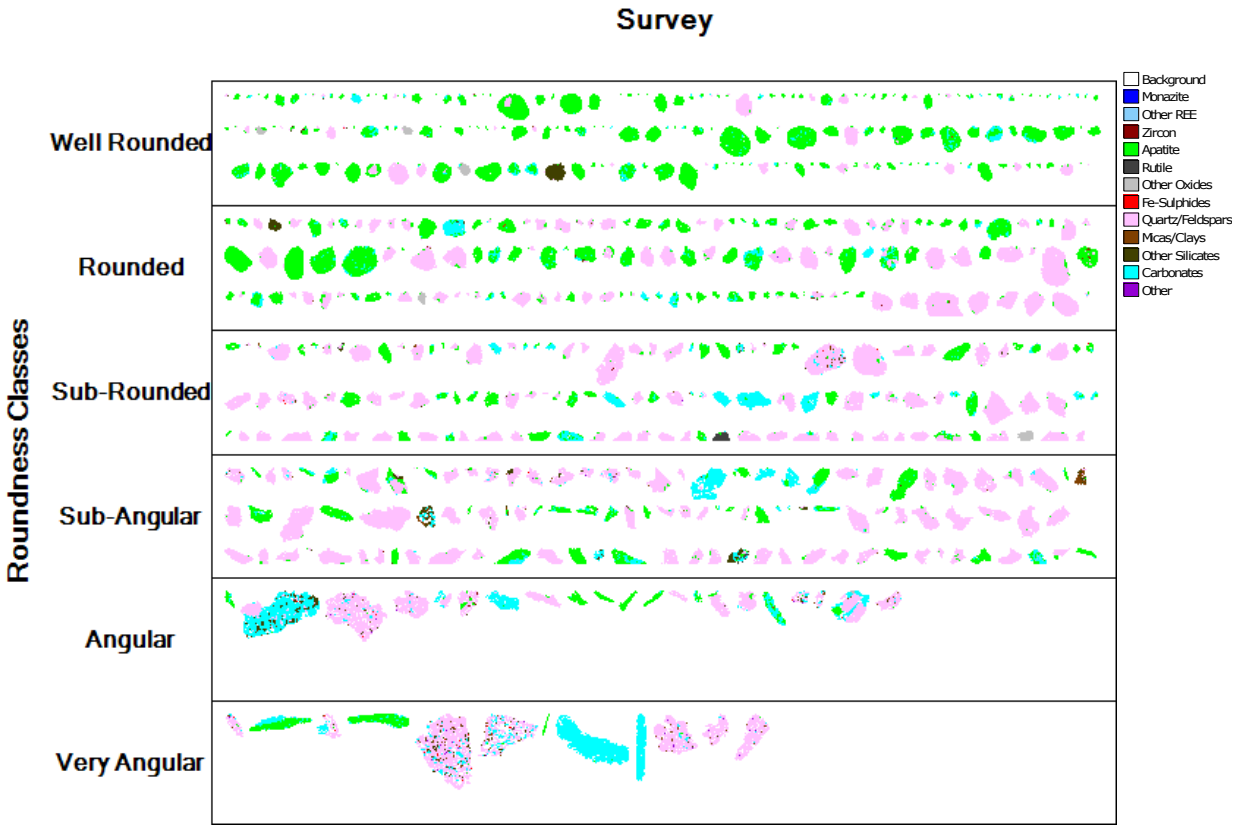
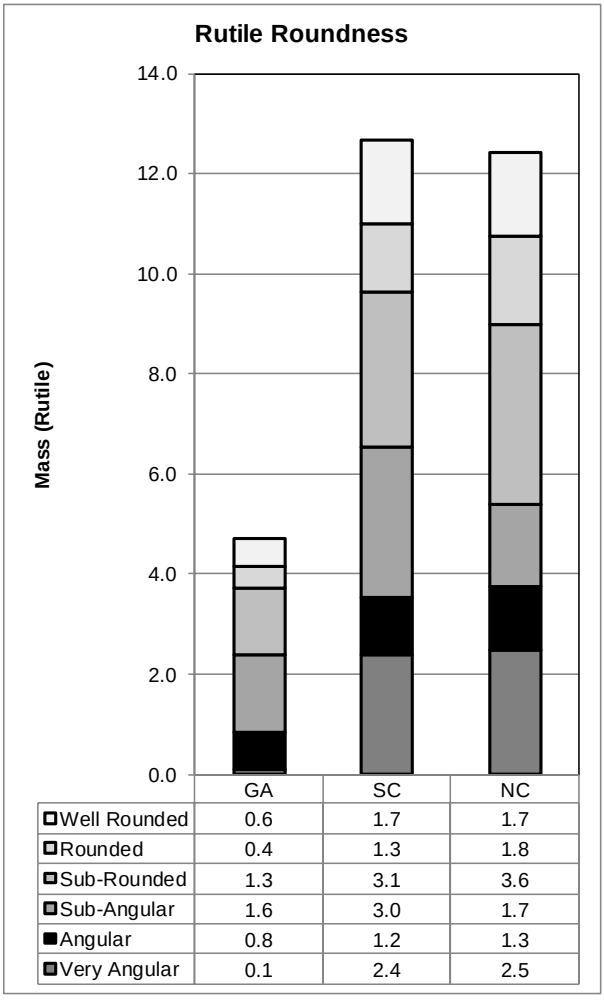


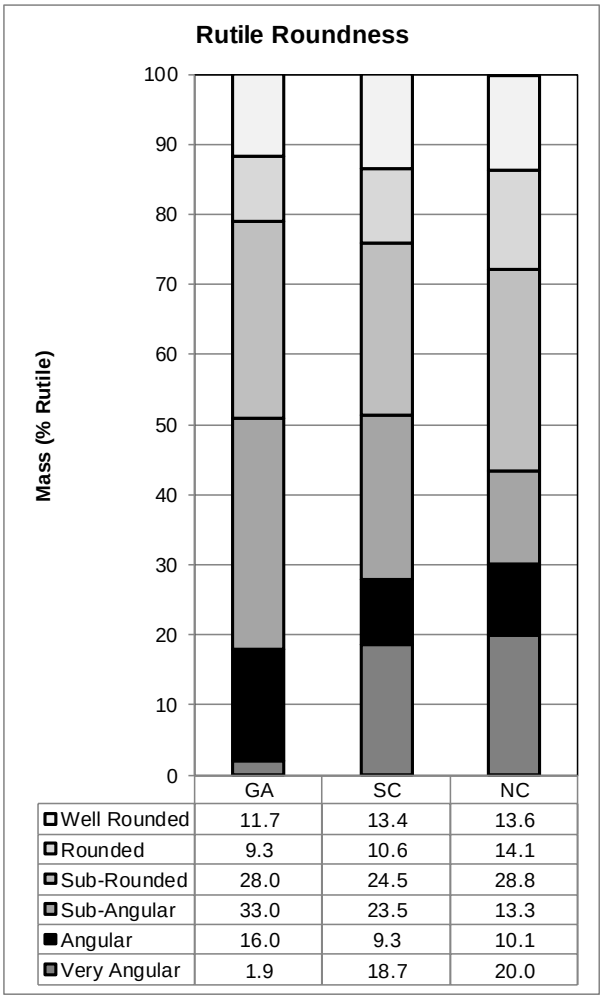
Figure 64: Image Grid of Apatite Roundness for the NC Group

4.8. Roundness of Rutile

Rutile is rounded/well rounded (21%), sub-rounded (28%), sub-angular (33%) and angular/very angular (18%) in the GA group samples; is rounded/well rounded (24%), sub-rounded (25%), sub-angular (23%) and angular/very angular (28%) in the SC group; is rounded/well rounded (28%), sub-rounded (29%), sub-angular (13%) and angular/very angular (30%) in the NC group (Figure 65). An image grid for each group of samples, illustrating the rutile roundness, is presented in Figure 66 to Figure 68.



	GA	SC	NC
Well Rounded	0.6	1.7	1.7
Rounded	0.4	1.3	1.8
Sub-Rounded	1.3	3.1	3.6
Sub-Angular	1.6	3.0	1.7
Angular	0.8	1.2	1.3
Very Angular	0.1	2.4	2.5



	GA	SC	NC
Well Rounded	11.7	13.4	13.6
Rounded	9.3	10.6	14.1
Sub-Rounded	28.0	24.5	28.8
Sub-Angular	33.0	23.5	13.3
Angular	16.0	9.3	10.1
Very Angular	1.9	18.7	20.0

Figure 65: Rutile Roundness for the GA, SC and NC Samples (Mass and Norm Mass%)

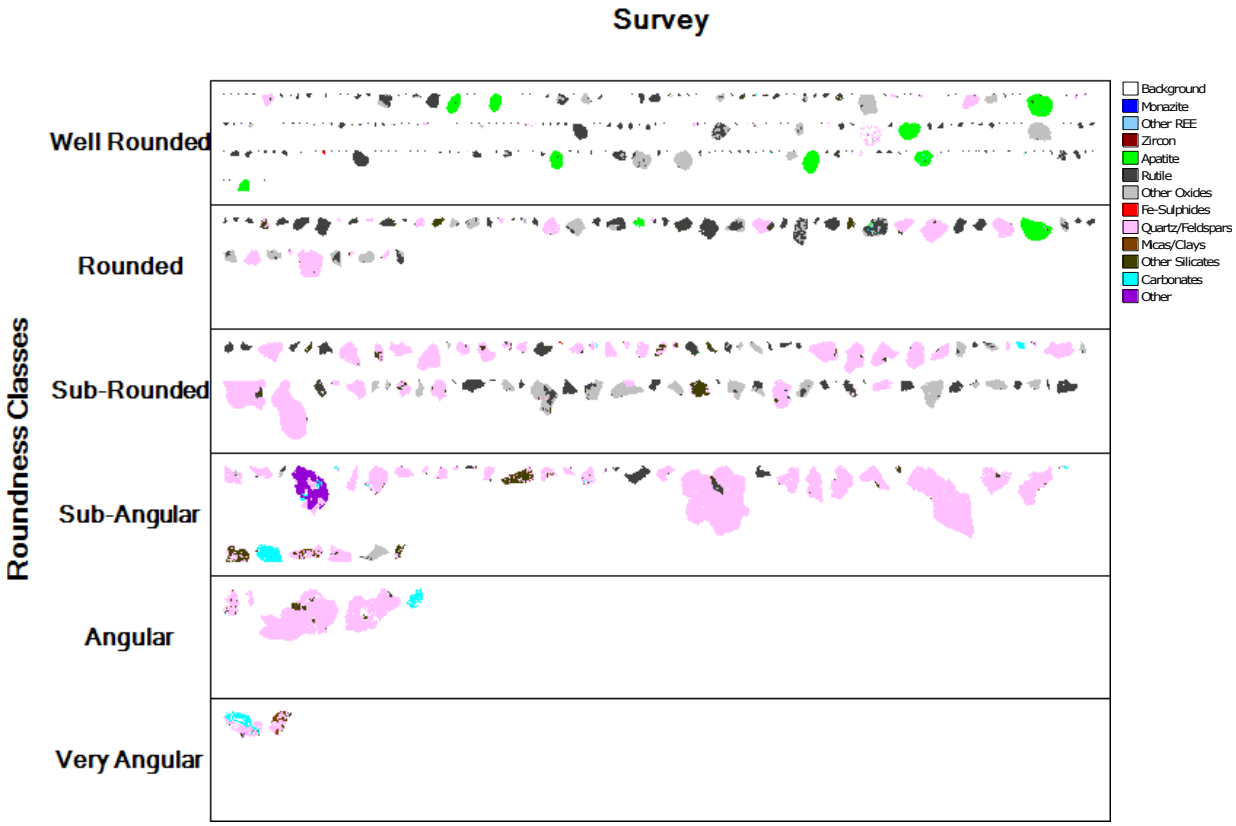


Figure 66: Image Grid of Rutile Roundness for the GA Group

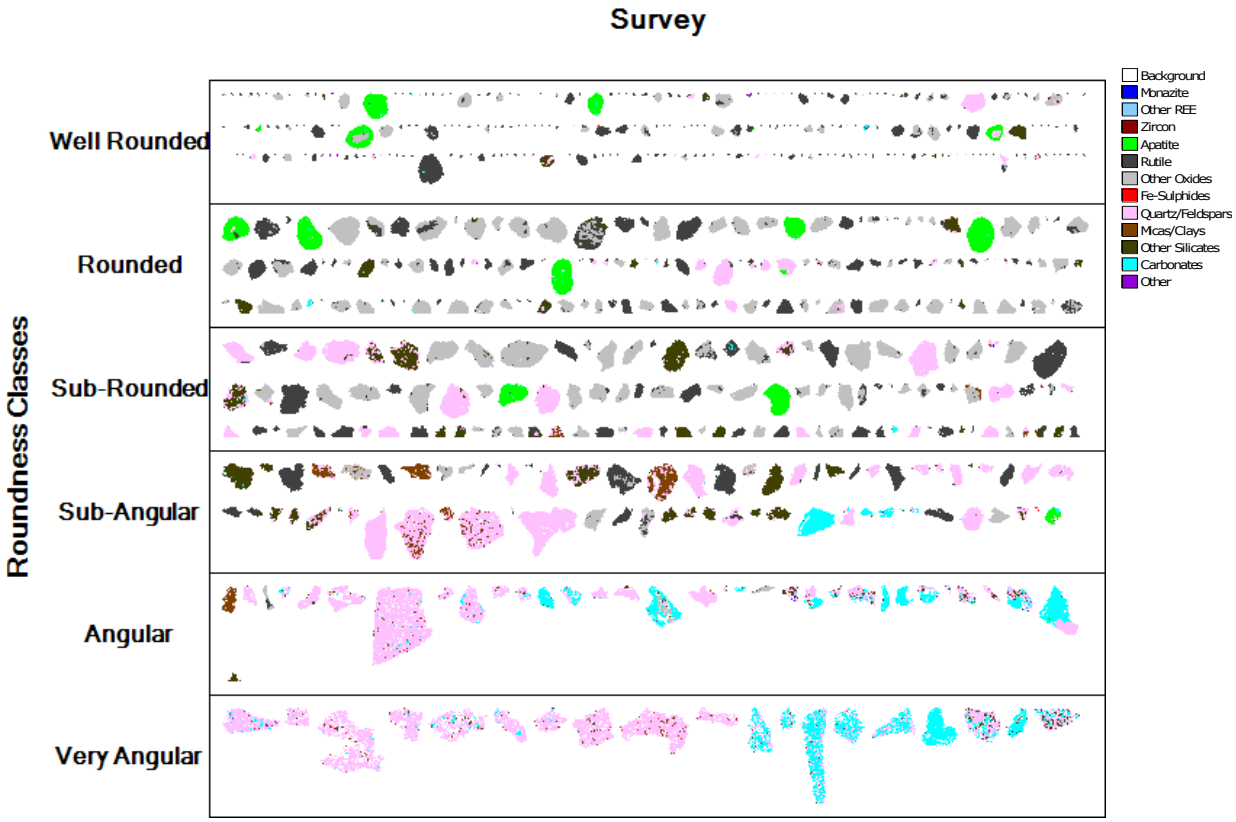


Figure 67: Image Grid of Rutile Roundness for the SC Group

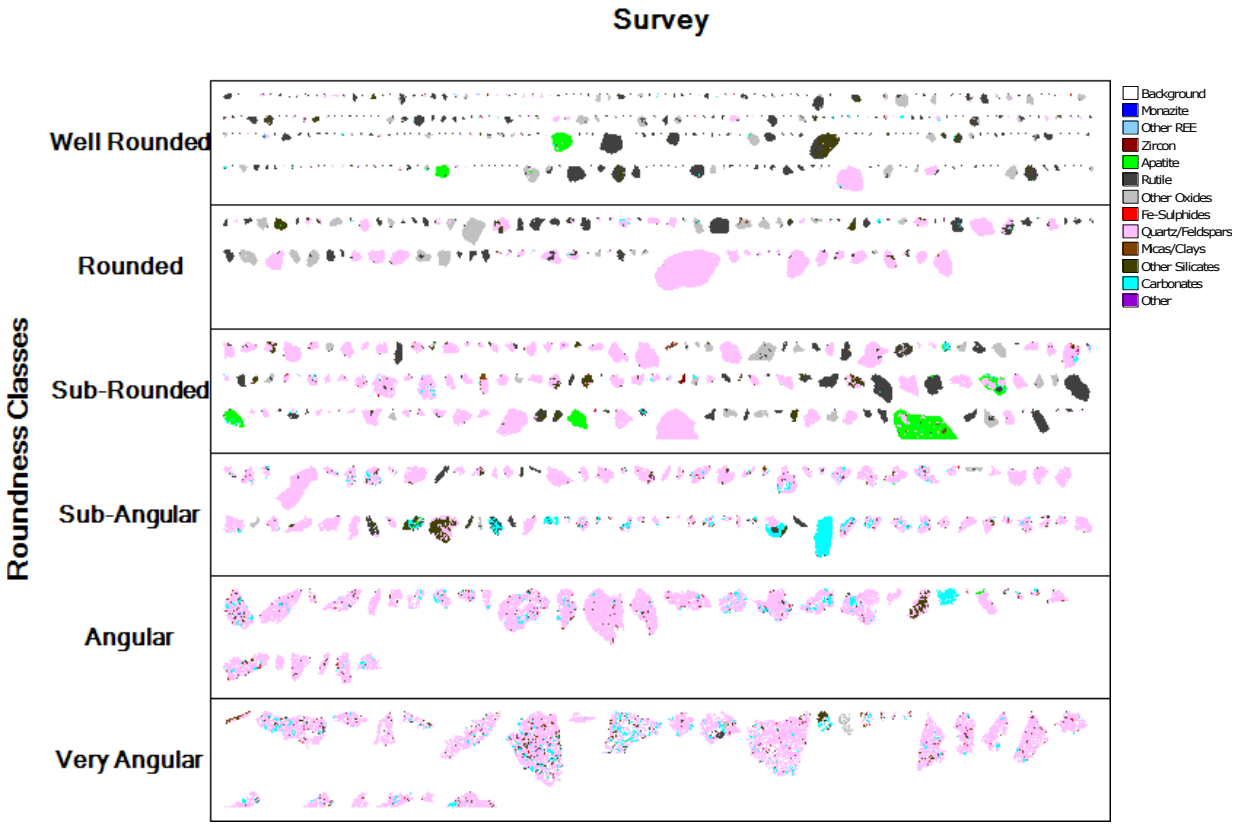


Figure 68: Image Grid of Rutile Roundness for the NC Group

5. Major and Trace Element Geochemistry Analysis

Figure 69 explores the bivariant correlations between Fe, Mg, Al, Ti, Ca, K, and Zr. The elements Ca, Ti, and Zr show a scatter against Al, while Fe, Mn, and Mg show very weak positive correlations. K shows a strong positive correlation with Al indicating the presence of feldspars.

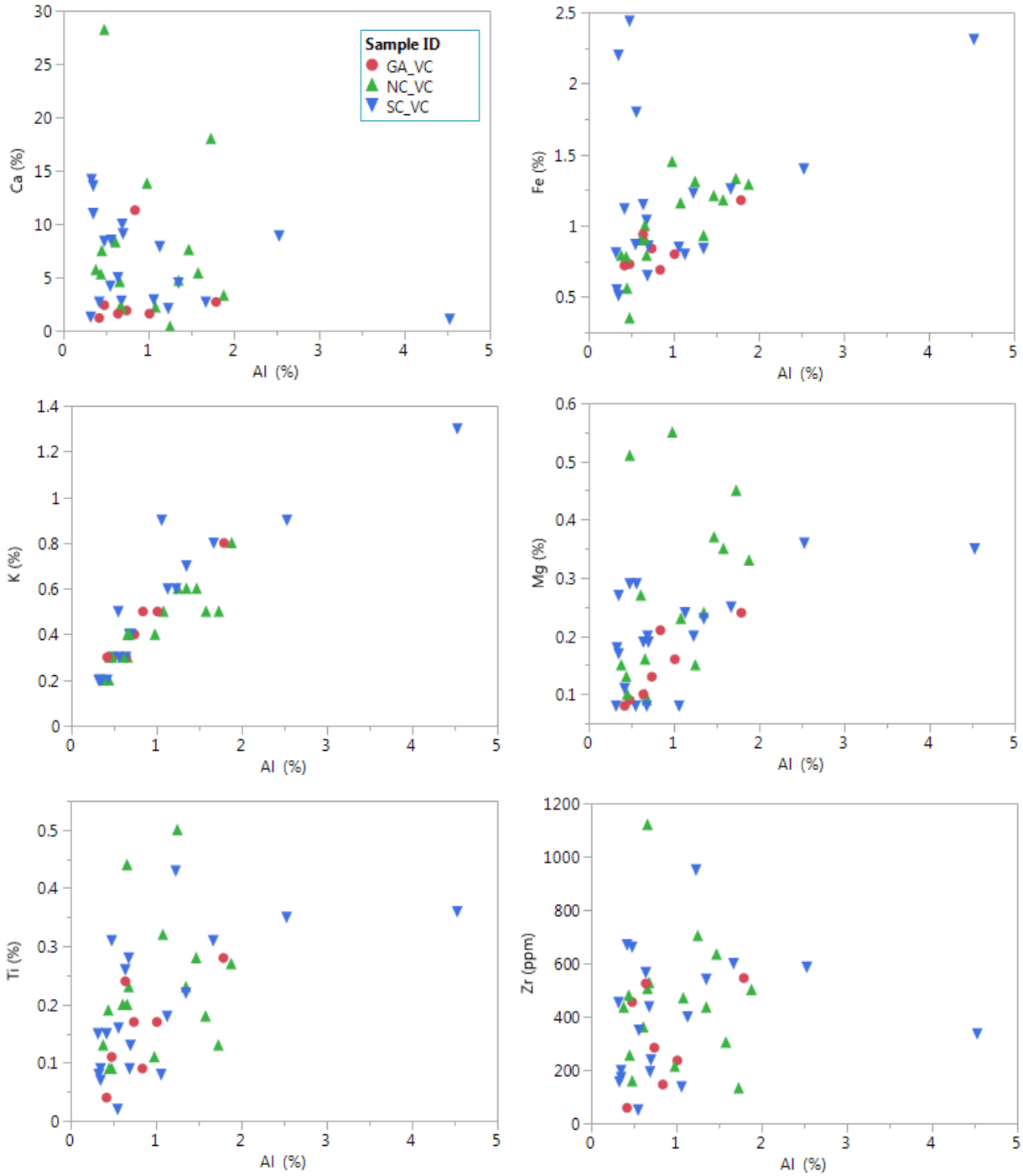


Figure 69: Principal Component Analysis for the Geochemical Data for the Mineral Sands Samples

Table 15 shows the REE concentrations, total REE, LREE, and HREE and the ratio between LREE (Ce-Eu) and HREE (Gd-Y); this is graphically illustrated in Figure 70. The TREE+Y values range from 24 ppm to 156 ppm and average 99 ppm in the GA group samples, from 38 ppm to 263 and average 102 ppm in the SC group, and from 28 ppm to 105 ppm and average 74 ppm in the NC group.

Table 15: REE Concentrations in the Samples

Sample ID	Total REE+Y	LREE (Ce-Eu)	HREE (Gd-Y)	LREE/HREE
GA_VC-1	88.6	62.0	26.5	2.3
GA_VC-3	156.1	115.1	41.0	2.8
GA_VC-5	98.2	74.6	23.6	3.2
GA_VC-6	23.7	17.4	6.3	2.8
GA_VC-7	135.4	101.1	34.2	3.0
GA_VC-9	126.0	94.8	31.2	3.0
GA_VC-11	62.3	47.8	14.5	3.3
SC_VC-1	131.3	98.8	32.5	3.0
SC_VC-4	96.7	78.4	18.3	4.3
SC_VC-6	75.9	56.2	19.7	2.9
SC_VC-7	85.7	66.7	19.0	3.5
SC_VC-14	83.4	59.5	23.9	2.5
SC_VC-15	209.5	164.9	44.6	3.7
SC_VC-18	141.2	115.2	26.0	4.4
SC_VC-19	263.0	213.5	49.5	4.3
SC_VC-20	75.0	59.3	15.7	3.8
SC_VC-21	151.6	121.2	30.4	4.0
SC_VC-22	38.5	31.9	6.6	4.8
SC_VC-23	146.7	116.9	29.8	3.9
SC_VC-24	39.3	32.6	6.7	4.8
SC_VC-25	56.5	41.8	14.7	2.8
SC_VC-26	69.1	54.1	15.0	3.6
SC_VC-27	70.6	53.7	16.9	3.2
SC_VC-28	46.7	36.9	9.7	3.8
SC_VC-29	68.1	52.2	15.9	3.3
SC_VC-30	85.9	69.2	16.7	4.1
NC_VC-3	105.3	85.1	20.2	4.2
NC_VC-4	77.4	63.6	13.8	4.6
NC_VC-6	93.6	73.3	20.3	3.6
NC_VC-8	70.9	55.8	15.1	3.7
NC_VC-9	94.1	73.6	20.5	3.6
NC_VC-10	28.4	20.0	8.4	2.4
NC_VC-15	57.0	43.6	13.5	3.2
NC_VC-19	86.6	63.7	22.9	2.8
NC_VC-24	44.6	33.4	11.2	3.0
NC_VC-25	66.3	48.8	17.5	2.8
NC_VC-27	79.3	56.8	22.5	2.5
NC_VC-31	62.0	44.2	17.8	2.5
NC_VC-32	97.0	75.0	22.0	3.4
NC_VC-33	87.5	66.2	21.3	3.1
NC_VC-34	67.3	52.9	14.4	3.7
NC_VC-37	67.2	51.0	16.2	3.1

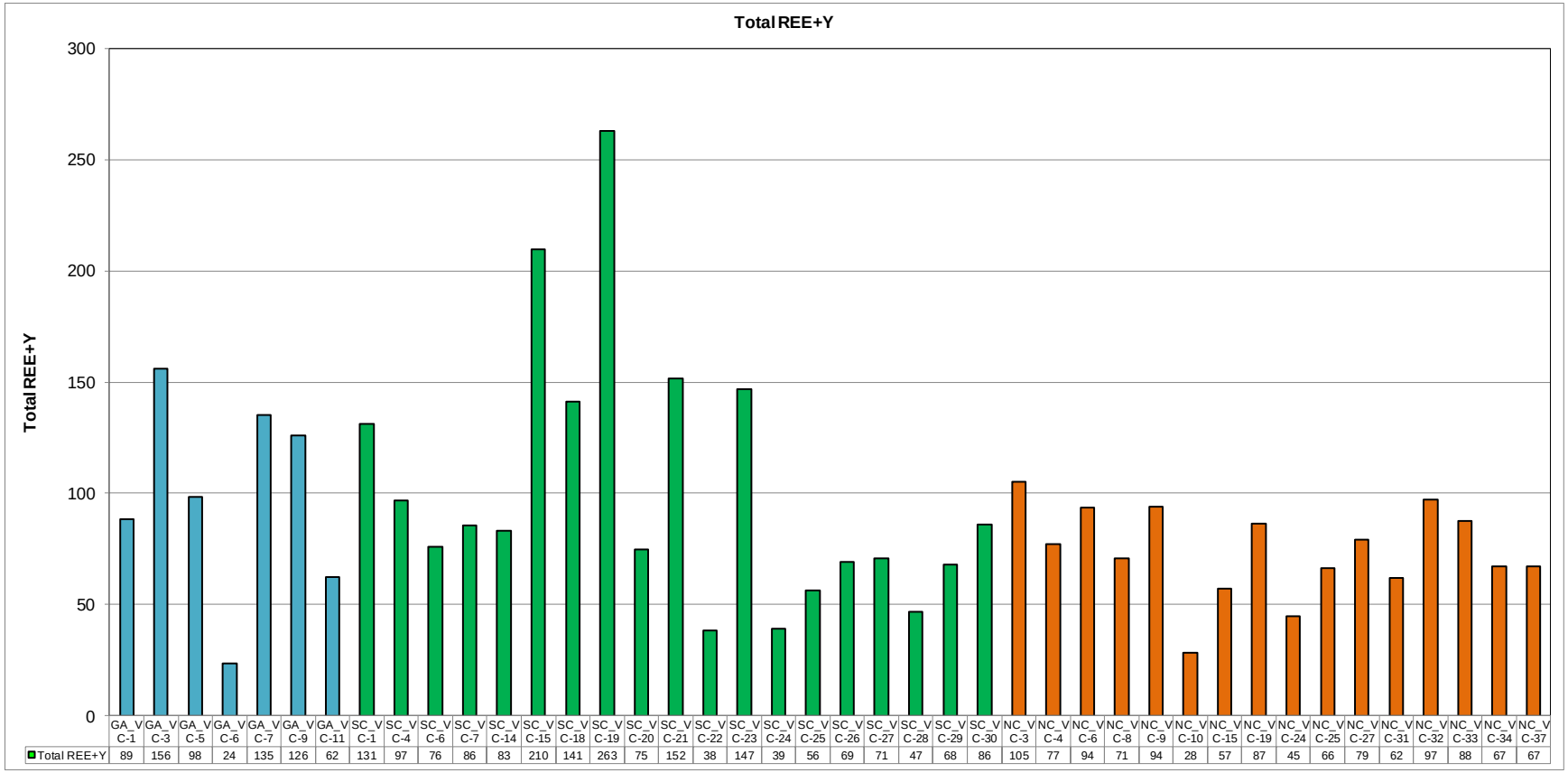


Figure 70: Total REE+Y in the VA, SC and NC Groups

Binary diagrams showing the correlations between the Ce (X-axis), La, Dy, Sm, Nd, Y, and P (Figure 71). Cerium shows a strong positive correlation with La, Dy, Sm, and Nd reflecting the main Rare Earth Mineral (REM) monazite. Correlation between cerium and yttrium is good but not as linear as with other REE. Yttrium could be carried by other minerals such as apatite for example. Correlation between cerium and phosphorus is poor and this is attributed to the fact that phosphorus is accounted by apatite and monazite. It probably indicates that apatite is not a major cerium carrier.

Cerium shows only a very weak positive correlation with barium (Figure 72). On the other hand, zirconium (Zr) and hafnium (Hf) illustrate a strong positive correlation as it would be expected as hafnium occurs in the matrix of zircon.

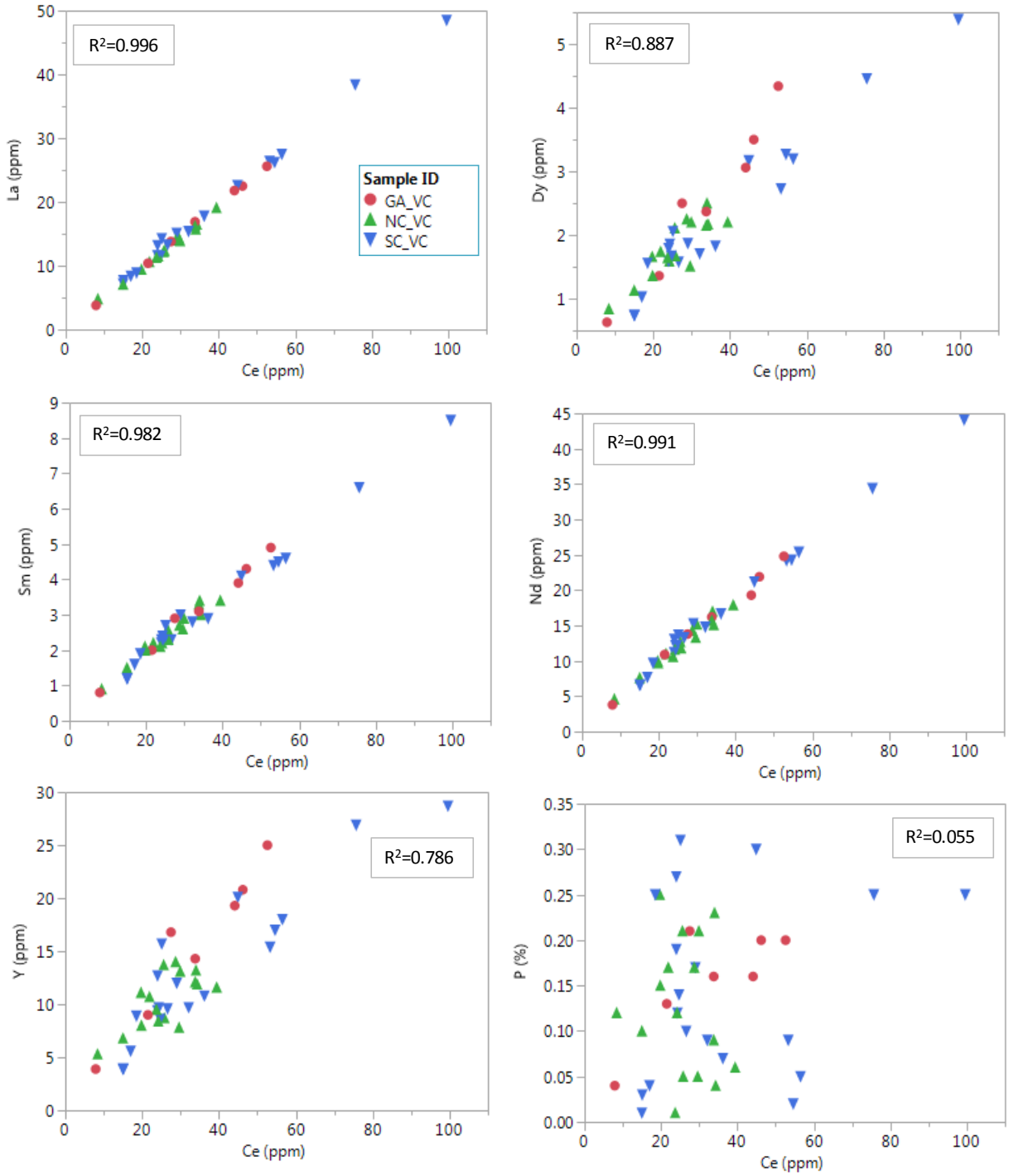


Figure 71: Plots of Ce vs. La, Dy, Sm, Nd, Y, and P for the Samples

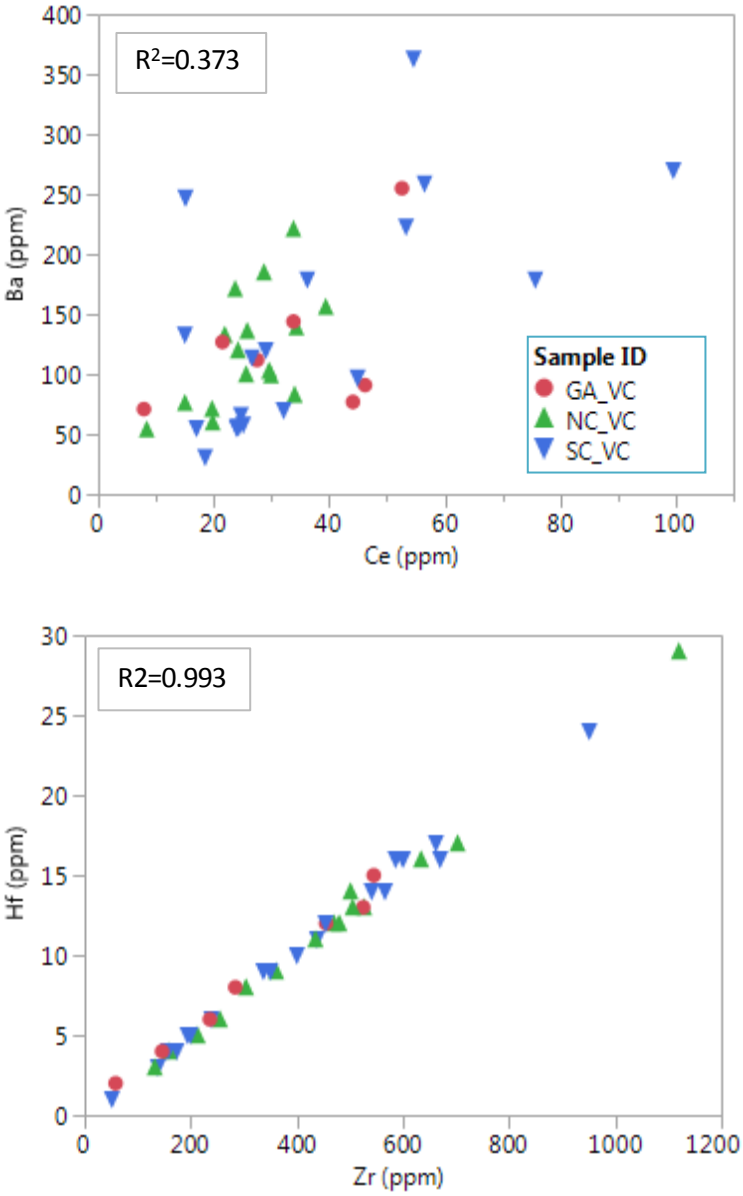


Figure 72: Plots of Ba vs. Ce and Hf vs. Zr for the Samples

Chondrite normalized plots (REE+Y) are shown for all the samples in Figure 73. All the samples show enriched LREE and depleted HREE with a pronounced negative europium anomaly. The SC group exhibits the highest and lowest REE values.

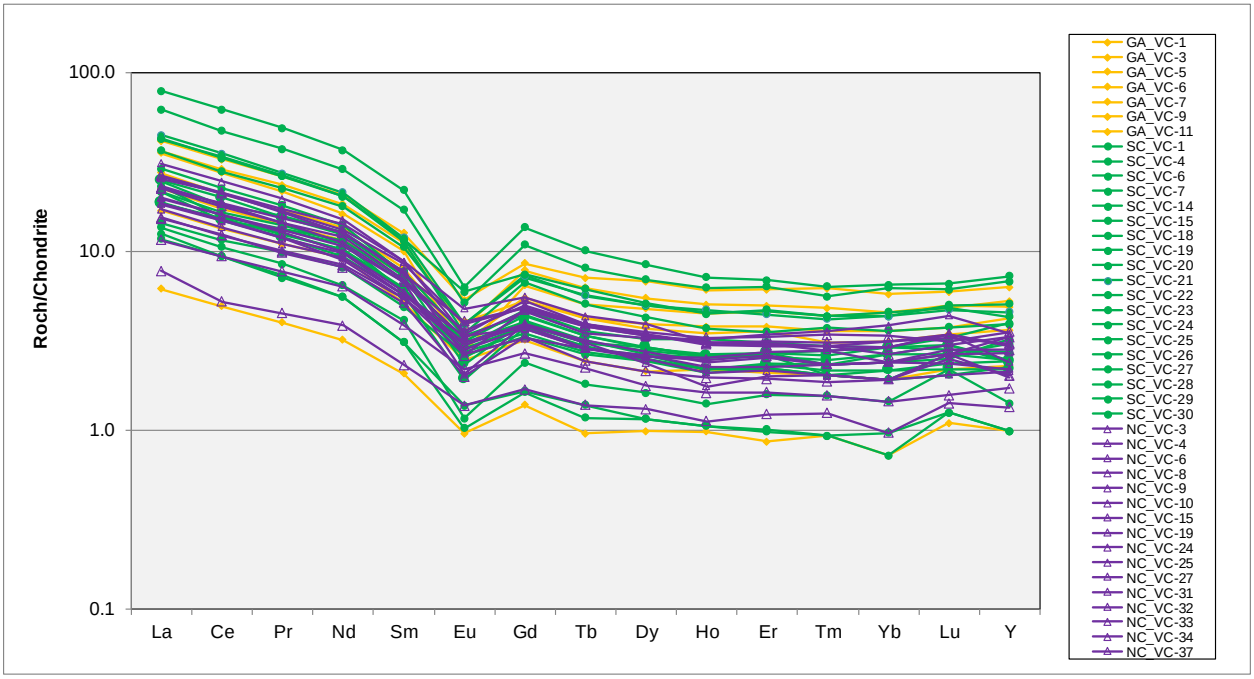


Figure 73: Primitive Mantle-Normalized Spider Diagram for the Mineral Sands Samples

Primitive mantle composition is from Hofmann (1988)

5.1. Geochemistry Data Analysis

For all the following computations and graphical presentations, the JMP software was employed. To graphically illustrate the interrelations between the geochemical data, a Principal Components Analysis (PCA) was undertaken following a centred log-ratio transformation, which was annotated with the Zone abbreviations as per previous graphs. The first principal component, PC-1, explains 65.6% of the total variability in the data set. PC1 is opposing Ca, Sr, to Mg, Rb, K, Fe and Ce, La, Y, Zr, Ti. The PC-2 is opposing Ca, and Sr to Cr, Zr, and Ti. The analysis does not differentiate the sands well indicating that they are rather homogenous. On the other hand, Cr (probably chromites or Cr-bearing Fe-oxides), Zr due to zircon, Ti due to rutile, Ca and Sr (strontianite? Or Sr-bearing apatite), Ce-La-Y, Rb and K due to feldspars and micas might indicate a different provenance of these minerals.

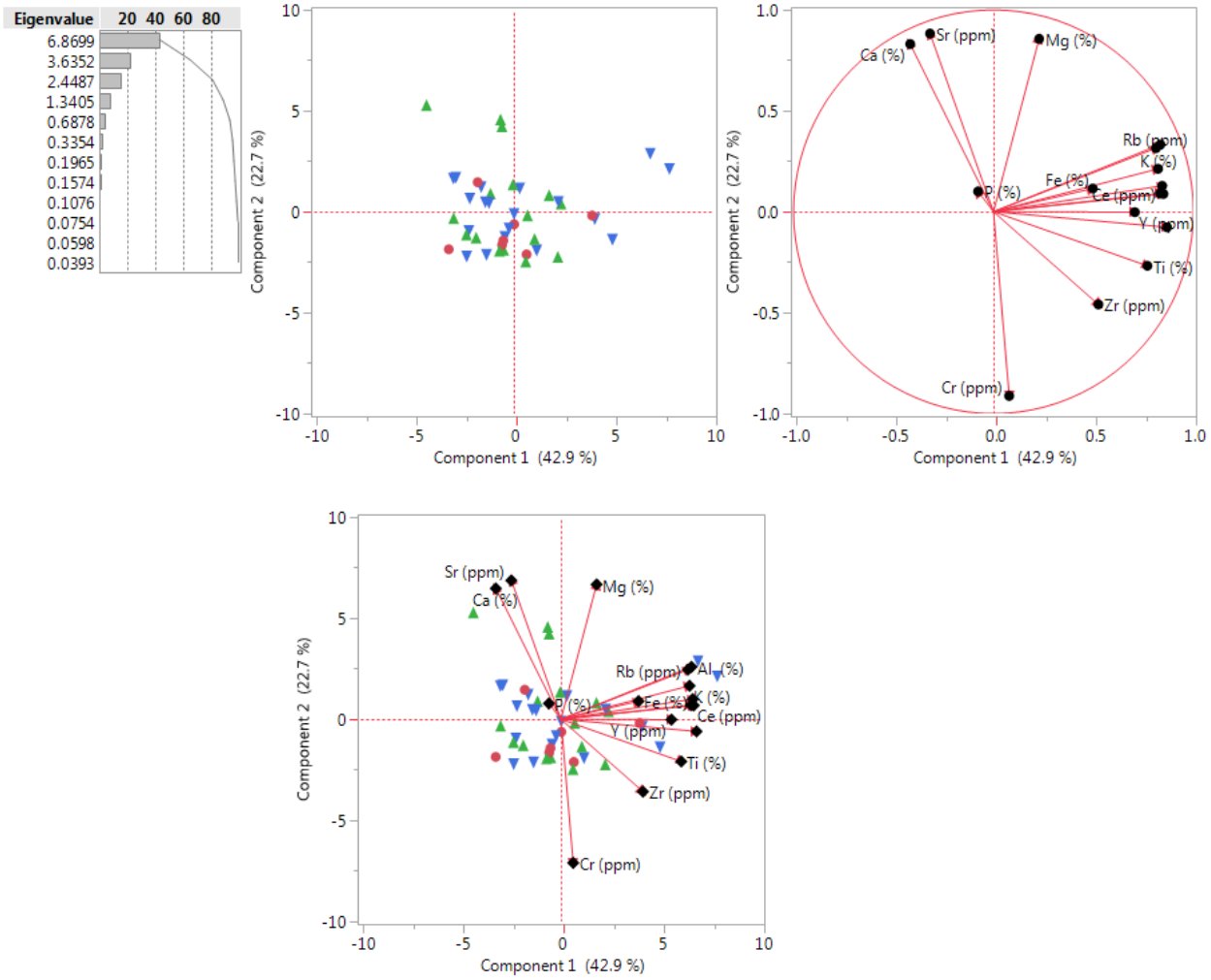


Figure 74: Principal Component Analysis for the Geochemical Data for the Mineral Sands Samples

The correlation matrix (Table 16) contains two sets of coefficients that can be further selected which has been common practice amongst applied geochemists.

Table 16: Correlation Coefficients for the Geochemical Data for the Samples

	Ce (ppm)	La (ppm)	Y (ppm)	Al (%)	Ba (ppm)	Ca (%)	Cr (ppm)	Fe (%)	K (%)	Mg (%)	Mn (ppm)	P (%)	Rb (ppm)	Sr (ppm)	Ti (%)	Zr (ppm)
Ce (ppm)	1.0000	0.9978	0.8866	0.5858	0.6108	-0.2329	-0.0803	0.2754	0.5646	0.2082	0.7297	0.2353	0.5505	-0.1299	0.5714	0.4630
La (ppm)	0.9978	1.0000	0.8962	0.5661	0.5991	-0.2179	-0.0926	0.2415	0.5505	0.1898	0.7112	0.2603	0.5307	-0.1225	0.5542	0.4508
Y (ppm)	0.8866	0.8962	1.0000	0.4063	0.4334	-0.2146	-0.0037	0.1437	0.3598	0.0744	0.6275	0.5371	0.3537	-0.1206	0.5255	0.4539
Al (%)	0.5858	0.5661	0.4063	1.0000	0.8723	-0.1662	-0.2065	0.4670	0.9020	0.4454	0.5885	-0.2658	0.9749	-0.0738	0.4781	0.1227
Ba (ppm)	0.6108	0.5991	0.4334	0.8723	1.0000	-0.3325	-0.0165	0.2475	0.9796	0.1995	0.5573	-0.3185	0.9182	-0.2421	0.4713	0.1766
Ca (%)	-0.2329	-0.2179	-0.2146	-0.1662	-0.3325	1.0000	-0.8151	-0.1206	-0.2611	0.6295	-0.3420	0.2532	-0.1894	0.9293	-0.4091	-0.4194
Cr (ppm)	-0.0803	-0.0926	-0.0037	-0.2065	-0.0165	-0.8151	1.0000	0.0443	-0.0664	-0.7051	0.1547	-0.1531	-0.1576	-0.8231	0.2459	0.3423
Fe (%)	0.2754	0.2415	0.1437	0.4670	0.2475	-0.1206	0.0443	1.0000	0.3328	0.4004	0.6344	-0.0919	0.4184	-0.0704	0.4196	0.2230
K (%)	0.5646	0.5505	0.3598	0.9020	0.9796	-0.2611	-0.0664	0.3328	1.0000	0.2923	0.5574	-0.3736	0.9511	-0.1782	0.4297	0.0956
Mg (%)	0.2082	0.1898	0.0744	0.4454	0.1995	0.6295	-0.7051	0.4004	0.2923	1.0000	0.2236	-0.0175	0.4075	0.7071	0.0725	-0.1300
Mn (ppm)	0.7297	0.7112	0.6275	0.5885	0.5573	-0.3420	0.1547	0.6344	0.5574	0.2236	1.0000	0.0643	0.5397	-0.2370	0.8443	0.6454
P (%)	0.2353	0.2603	0.5371	-0.2658	-0.3185	0.2532	-0.1531	-0.0919	-0.3736	-0.0175	0.0643	1.0000	-0.3385	0.2899	-0.0334	0.1009
Rb (ppm)	0.5505	0.5307	0.3537	0.9749	0.9182	-0.1894	-0.1576	0.4184	0.9511	0.4075	0.5397	-0.3385	1.0000	-0.0929	0.4160	0.0535
Sr (ppm)	-0.1299	-0.1225	-0.1206	-0.0738	-0.2421	0.9293	-0.8231	-0.0704	-0.1782	0.7071	-0.2370	0.2899	-0.0929	1.0000	-0.3877	-0.4332
Ti (%)	0.5714	0.5542	0.5255	0.4781	0.4713	-0.4091	0.2459	0.4196	0.4297	0.0725	0.8443	-0.0334	0.4160	-0.3877	1.0000	0.8352
Zr (ppm)	0.4630	0.4508	0.4539	0.1227	0.1766	-0.4194	0.3423	0.2230	0.0956	-0.1300	0.6454	0.1009	0.0535	-0.4332	0.8352	1.0000

6. Mineral Processing

A few fractions from selected samples (Table 17) were submitted for heavy liquid separation (HLS) at SG of 2.9 g/cm^3. The Sink product from the HLS ranges from 0.3 wt% to 5.0 wt%. Most of the mass is in the Float product as expected due to the high amounts of silicate minerals.

Table 17: Weights and Wt% Distribution Between Sink and Float Products for Selected Samples

Sample ID	Initial wt HLS Initial wt/g	Sink 2.9SG wt/g	Sink wt%	Float 2.9SG wt/g	Float wt%
GA_VC-3 -212um	72.76	1.9	*2.6*	70.38	*97.4*
SC_VC-15 -212um	62.27	2.39	*3.8*	59.72	*96.2*
SC_VC-29 +212um	87.89	0.56	*0.6*	87.07	*99.4*
NC_VC-27 +212um	9.81	0.03	*0.3*	9.8	*99.7*
NC_VC-27 -212um	15.38	0.64	*4.2*	14.59	*95.8*
NC_VC-37 +212um	20.6	0.04	*0.4*	10.46	*99.6*
NC_VC-37 -212um	46.68	2.31	*5.0*	44.2	*95.0*

One graphite impregnated polished section was prepared from each of the fractions and analyzed with the QEMSCAN. The Sink products from the +212 and -212 µm fraction of the NC-VC-27, and those of the NC-VC-37 sample were combined due to their low mass. The results are given in Table 18 and graphically presented in Figure 75 and Figure 76. The Sink products consist of various silicates (amphiboles, garnets, epidote, carbonates), ilmenite, rutile Fe-oxides, apatite, and trace amounts of monazite.

Table 18: Mineral Mass (wt%) Distribution in the Sink Products

Survey		CALR-16225-001 / MI5017-SEP17				
Project		South Carolina Department of Natural Resources				
Sample		GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Fraction		HLS Sink	HLS Sink	HLS Sink	HLS Sink	HLS Sink
Calculated ESD Particle Size		58	90	330	107	96
Mineral Mass (%)	Monazite	0.54	0.86	0.03	0.19	0.32
	Synchysite/Bastnaesite	0.00	0.01	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00
	Zircon	3.59	4.15	0.74	8.98	4.33
	Apatite	7.07	4.97	13.0	10.7	0.29
	Fe-Oxides	0.05	0.03	3.55	0.14	0.55
	Rutile	5.16	5.11	4.86	7.34	6.32
	Ilmenite	22.3	27.4	11.5	40.1	43.3
	Other Oxides	0.00	0.00	0.02	0.01	0.00
	Fe-Sulphides	0.08	0.02	0.26	0.02	0.05
	Quartz	7.64	3.10	3.34	3.30	4.72
	Plagioclase	2.88	2.39	7.45	2.63	3.16
	K-Feldspar	0.93	0.16	0.03	0.04	0.54
	Biotite	0.07	0.04	0.18	0.01	0.21
	Muscovite	0.22	0.08	0.01	0.01	0.22
	Clays	3.97	4.39	7.55	3.52	2.20
	Chlorite	0.21	0.37	5.51	1.12	1.16
	Amphibole	12.1	19.5	1.46	1.99	15.5
	Epidote	23.1	23.4	2.72	5.83	10.8
	Grossular	1.07	1.73	33.5	11.3	2.75
	Titanite	0.51	0.58	0.05	0.50	0.55
	Other Silicates	0.24	0.20	0.03	0.18	2.37
	Calcite	7.46	1.23	0.14	0.83	0.06
	Ankerite	0.52	0.23	4.01	1.20	0.12
	Dolomite	0.20	0.03	0.00	0.00	0.57
	Fluorite	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00
	Other	0.02	0.01	0.01	0.02	0.01
	Total	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	50	69	39	73	82
	Synchysite/Bastnaesite	17	18	19	19	14
	Other REE	14	12	32	15	13
	Zircon	49	74	105	89	83
	Apatite	78	112	211	118	82
	Fe-Oxides	20	16	164	21	46
	Rutile	48	63	185	70	62
	Ilmenite	56	77	140	96	87
	Other Oxides	0	11	18	14	11
	Fe-Sulphides	16	21	85	16	66
	Quartz	32	27	38	30	37
	Plagioclase	29	31	41	30	39
	K-Feldspar	31	34	28	24	33
	Biotite	25	16	36	18	22
	Muscovite	27	23	21	14	22
	Clays	49	64	150	64	64
	Chlorite	26	28	45	34	25
	Amphibole	55	80	120	68	74
	Epidote	52	72	71	70	63
	Grossular	33	37	97	59	37
	Titanite	27	29	27	40	38
	Other Silicates	22	24	23	36	38
	Calcite	47	65	62	54	34
	Ankerite	27	25	94	35	14
	Dolomite	45	41	14	36	55
	Fluorite	0	0	0	0	0
	Gypsum/Anhydrite	21	13	14	11	14
	Phosphates	12	14	17	11	11
	Other	11	17	17	11	11

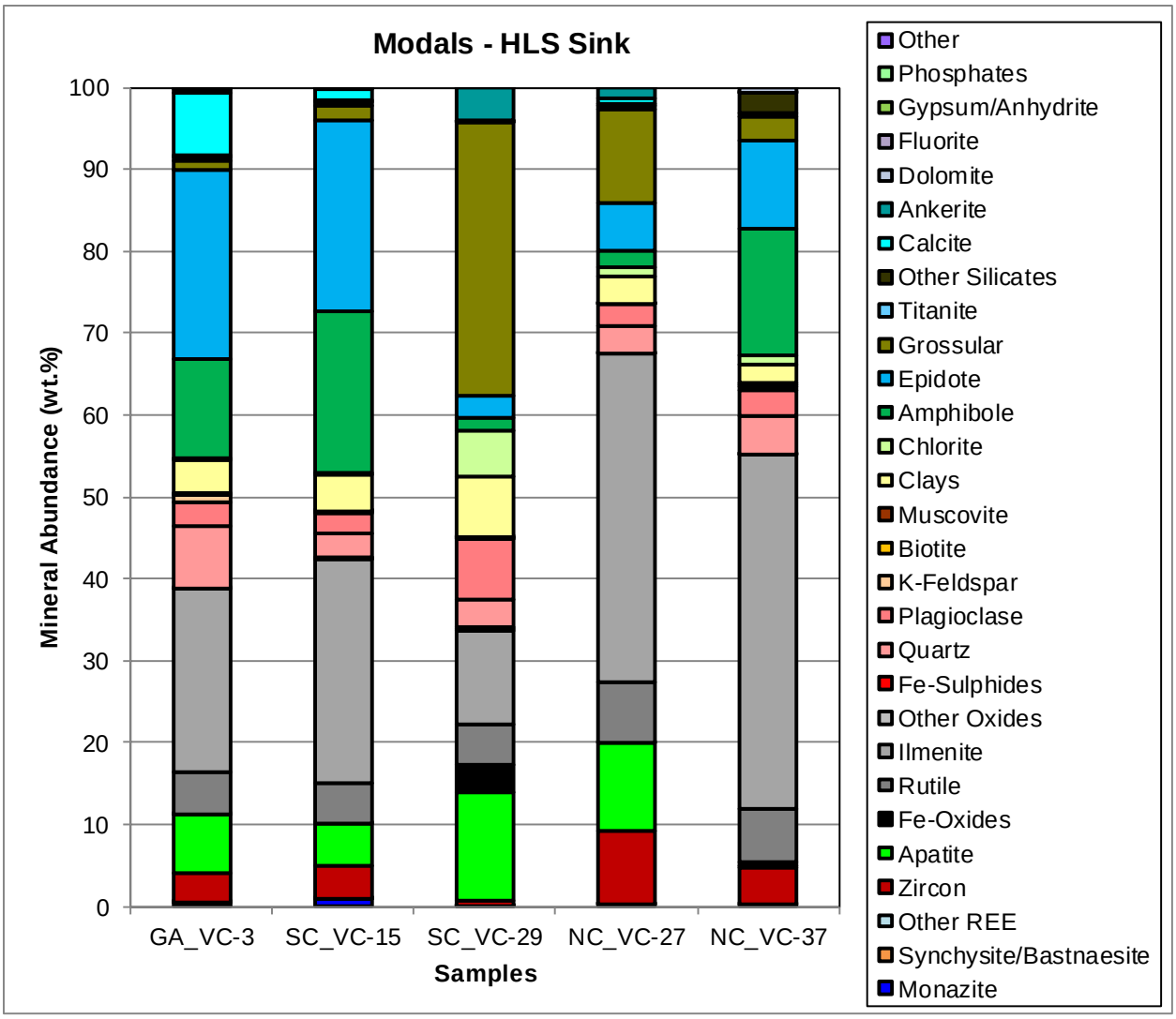


Figure 75: Mineral Distribution of the Sink Products from Selected Samples

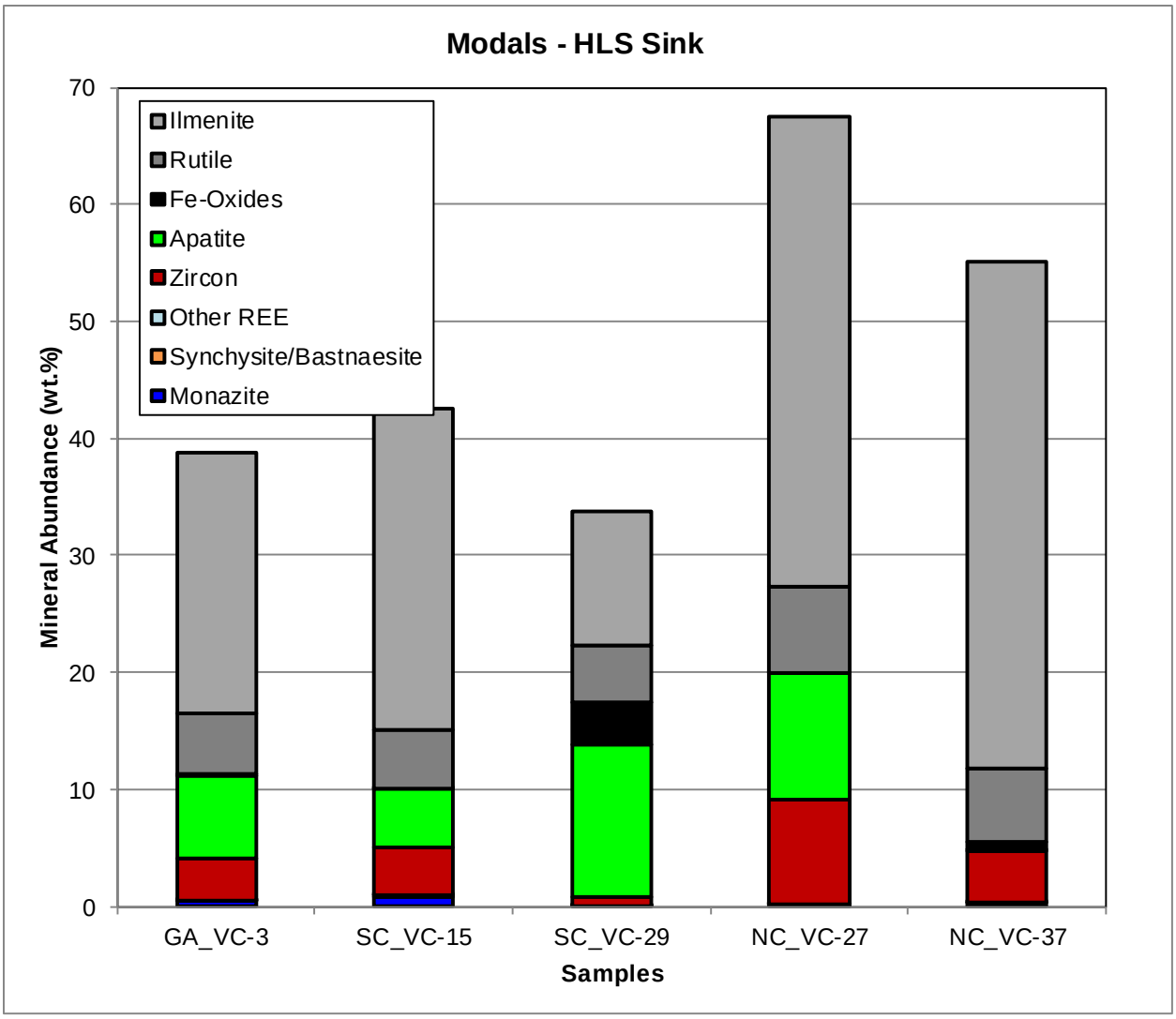
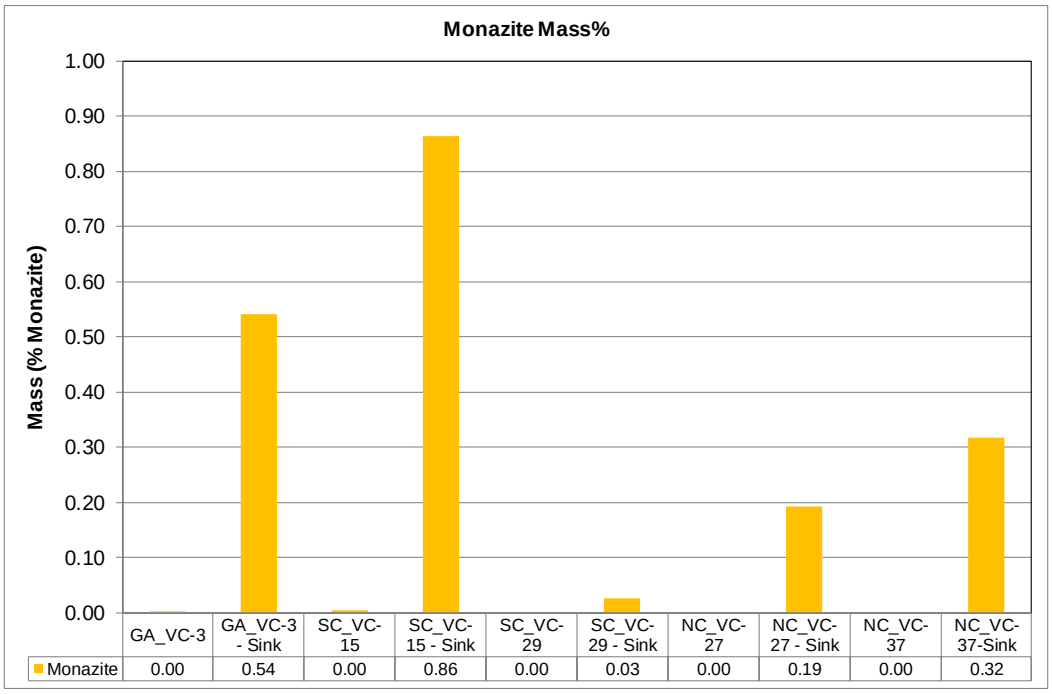
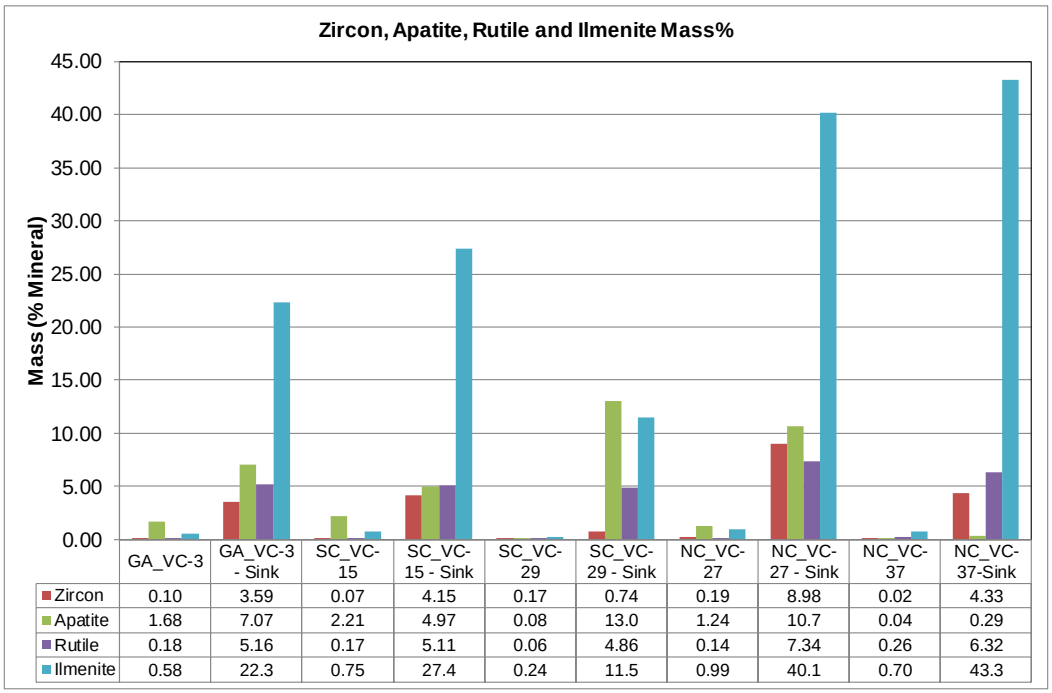


Figure 76: Mineral Distribution of Minerals of Interest from the Sink Products from Selected Samples



	GA_VC-3	GA_VC-3 - Sink	SC_VC-15	SC_VC-15 - Sink	SC_VC-29	SC_VC-29 - Sink	NC_VC-27	NC_VC-27 - Sink	NC_VC-37	NC_VC-37-Sink
Monazite	0.00	0.54	0.00	0.86	0.00	0.03	0.00	0.19	0.00	0.32



	GA_VC-3	GA_VC-3 - Sink	SC_VC-15	SC_VC-15 - Sink	SC_VC-29	SC_VC-29 - Sink	NC_VC-27	NC_VC-27 - Sink	NC_VC-37	NC_VC-37-Sink
Zircon	0.10	3.59	0.07	4.15	0.17	0.74	0.19	8.98	0.02	4.33
Apatite	1.68	7.07	2.21	4.97	0.08	13.0	1.24	10.7	0.04	0.29
Rutile	0.18	5.16	0.17	5.11	0.06	4.86	0.14	7.34	0.26	6.32
Ilmenite	0.58	22.3	0.75	27.4	0.24	11.5	0.99	40.1	0.70	43.3

Figure 77: A Comparison of Mass% between the As-Received Samples and the Sink Products

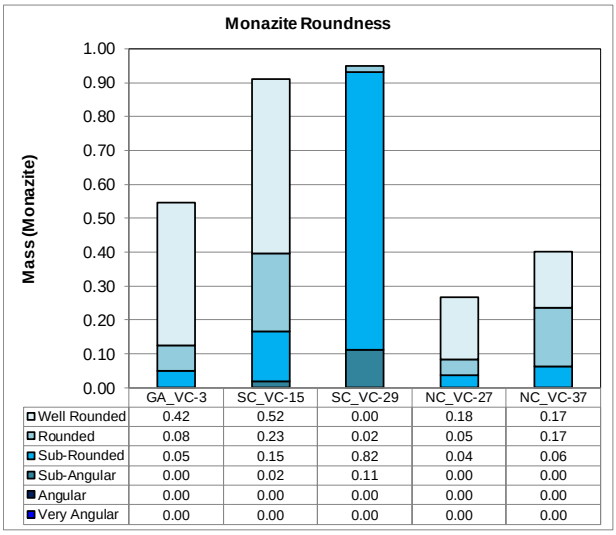
A comparison of the mineral mass between the as-received samples and their equivalent Sink products is given in Table 19. A comparison for monazite, zircon, apatite, rutile, and ilmenite between the as-received and Sink fractions is graphically illustrated in Figure 77. Upgrading of monazite is generally good on a laboratory scale. Recovery is certainly a function of the mineral mass in the as-received samples. Zircon, apatite, rutile, and ilmenite are also upgraded relatively well.

Table 19: Mineral Mass (wt%) of the As-received Samples and Equivalent Sink Products

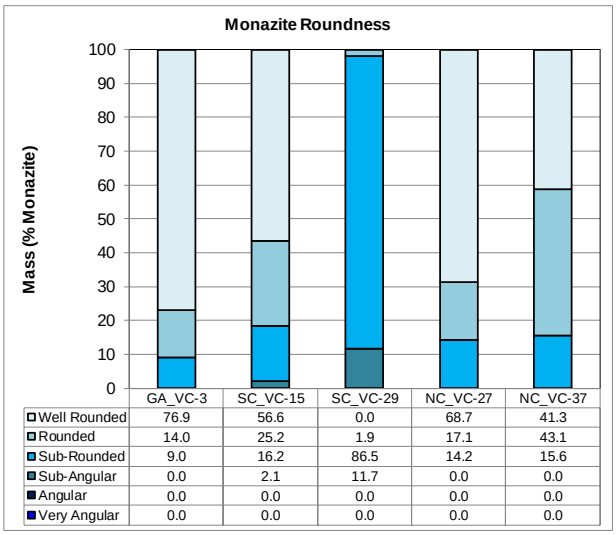
Sample ID	GA_VC-3	GA_VC-3 - Sink	Upgrade Factor	SC_VC-15	SC_VC-15 - Sink	Upgrade Factor	SC_VC-29	SC_VC-29 - Sink	Upgrade Factor	NC_VC-27	NC_VC-27 - Sink	Upgrade Factor	NC_VC-37	NC_VC-37- Sink	Upgrade Factor
Monazite	0.00	0.54	783.1	0.00	0.86	203.1	0.00	0.03	3.0	0.00	0.19	19.0	0.00	0.32	32.0
Synchysite/Bastnaesite	0.00	0.00	11.1	0.00	0.01	24.4	0.00	0.00	4.7	0.00	0.00	n/a	0.00	0.00	0.4
Other REE	0.00	0.00	6.7	0.00	0.00	n/a	0.00	0.00	0.7	0.00	0.00	0.1	0.00	0.00	0.0
Zircon	0.10	3.59	37.6	0.07	4.15	55.4	0.17	0.74	4.3	0.19	8.98	46.7	0.02	4.33	269.4
Apatite	1.68	7.07	4.2	2.21	4.97	2.2	0.08	13.0	157.2	1.24	10.7	8.6	0.04	0.29	8.2
Fe-Oxides	0.00	0.05	18.0	0.01	0.03	3.9	0.77	3.55	4.6	0.01	0.14	22.2	0.01	0.55	103.9
Rutile	0.18	5.16	28.8	0.17	5.11	29.5	0.06	4.86	80.0	0.14	7.34	51.3	0.26	6.32	24.3
Ilmenite	0.58	22.3	38.7	0.75	27.4	36.5	0.24	11.5	49.0	0.99	40.1	40.4	0.70	43.3	61.7
Other Oxides	0.00	0.00	n/a	0.00	0.00	14.6	0.00	0.02	664.7	0.03	0.01	0.3	0.00	0.00	16.5
Fe-Sulphides	0.08	0.08	1.0	0.00	0.02	5.7	0.05	0.26	4.9	0.00	0.02	5.6	0.01	0.05	8.8
Quartz	77.0	7.64	0.1	82.4	3.10	0.0	92.4	3.34	0.0	90.7	3.30	0.0	89.2	4.72	0.1
Plagioclase	6.07	2.88	0.5	3.59	2.39	0.7	0.34	7.45	21.7	1.98	2.63	1.3	4.41	3.16	0.7
K-Feldspar	6.63	0.93	0.1	5.03	0.16	0.0	0.25	0.03	0.1	1.87	0.04	0.0	3.68	0.54	0.1
Biotite	0.07	0.07	1.0	0.05	0.04	0.8	0.06	0.18	3.3	0.00	0.01	2.2	0.14	0.21	1.5
Muscovite	0.15	0.22	1.5	0.04	0.08	1.9	0.00	0.01	7.0	0.00	0.01	1.4	0.09	0.22	2.4
Clays	0.21	3.97	18.9	0.19	4.39	23.3	0.02	7.55	305.1	0.14	3.52	26.0	0.18	2.20	12.0
Chlorite	0.03	0.21	7.1	0.07	0.37	5.6	0.04	5.51	129.3	0.02	1.12	63.2	0.10	1.16	11.8
Amphibole	0.77	12.1	15.7	1.22	19.5	16.1	0.08	1.46	17.3	0.15	1.99	13.3	0.48	15.5	32.1
Epidote	0.94	23.1	24.7	0.88	23.4	26.8	0.18	2.72	15.5	0.28	5.83	20.8	0.49	10.8	21.8
Grossular	0.05	1.07	21.9	0.08	1.73	21.0	0.52	33.5	64.8	0.24	11.3	46.8	0.06	2.75	45.0
Titanite	0.01	0.51	35.1	0.02	0.58	26.1	0.00	0.05	73.8	0.01	0.50	33.4	0.00	0.55	273.5
Other Silicates	0.06	0.24	3.8	0.01	0.20	20.8	0.04	0.03	0.8	0.02	0.18	8.8	0.06	2.37	37.5
Calcite	5.15	7.46	1.4	3.12	1.23	0.4	4.54	0.14	0.0	1.85	0.83	0.4	0.01	0.06	4.6
Ankerite	0.09	0.52	5.7	0.10	0.23	2.4	0.13	4.01	30.7	0.15	1.20	8.0	0.00	0.12	192.1
Dolomite	0.09	0.20	2.2	0.01	0.03	2.8	0.01	0.00	0.0	0.00	0.00	2.6	0.04	0.57	13.8
Fluorite	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	0.0	0.00	0.00	n./a
Gypsum/Anhydrite	0.03	0.00	0.0	0.00	0.00	8.9	0.04	0.00	0.0	0.00	0.00	0.3	0.00	0.00	n/a
Phosphates	0.00	0.00	2.9	0.00	0.00	n/a	0.00	0.00	35.3	0.00	0.00	24.7	0.00	0.00	n/a
Other	0.02	0.02	1.0	0.00	0.01	5.5	0.02	0.01	0.4	0.01	0.02	1.4	0.01	0.01	1.9

6.1. Roundness of Monazite

Monazite ranges in shape in all products but it tends to be mostly sub-rounded to well rounded (Figure 78). An image grid for each group of samples, illustrating the monazite roundness, is presented in Figure 79.



	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Well Rounded	0.42	0.52	0.00	0.18	0.17
Rounded	0.08	0.23	0.02	0.05	0.17
Sub-Rounded	0.05	0.15	0.82	0.04	0.06
Sub-Angular	0.00	0.02	0.11	0.00	0.00
Angular	0.00	0.00	0.00	0.00	0.00
Very Angular	0.00	0.00	0.00	0.00	0.00



	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Well Rounded	76.9	56.6	0.0	68.7	41.3
Rounded	14.0	25.2	1.9	17.1	43.1
Sub-Rounded	9.0	16.2	86.5	14.2	15.6
Sub-Angular	0.0	2.1	11.7	0.0	0.0
Angular	0.0	0.0	0.0	0.0	0.0
Very Angular	0.0	0.0	0.0	0.0	0.0

Figure 78: Monazite Roundness for the for the Sink Fractions from Selected Samples (Mass and Norm Mass%)

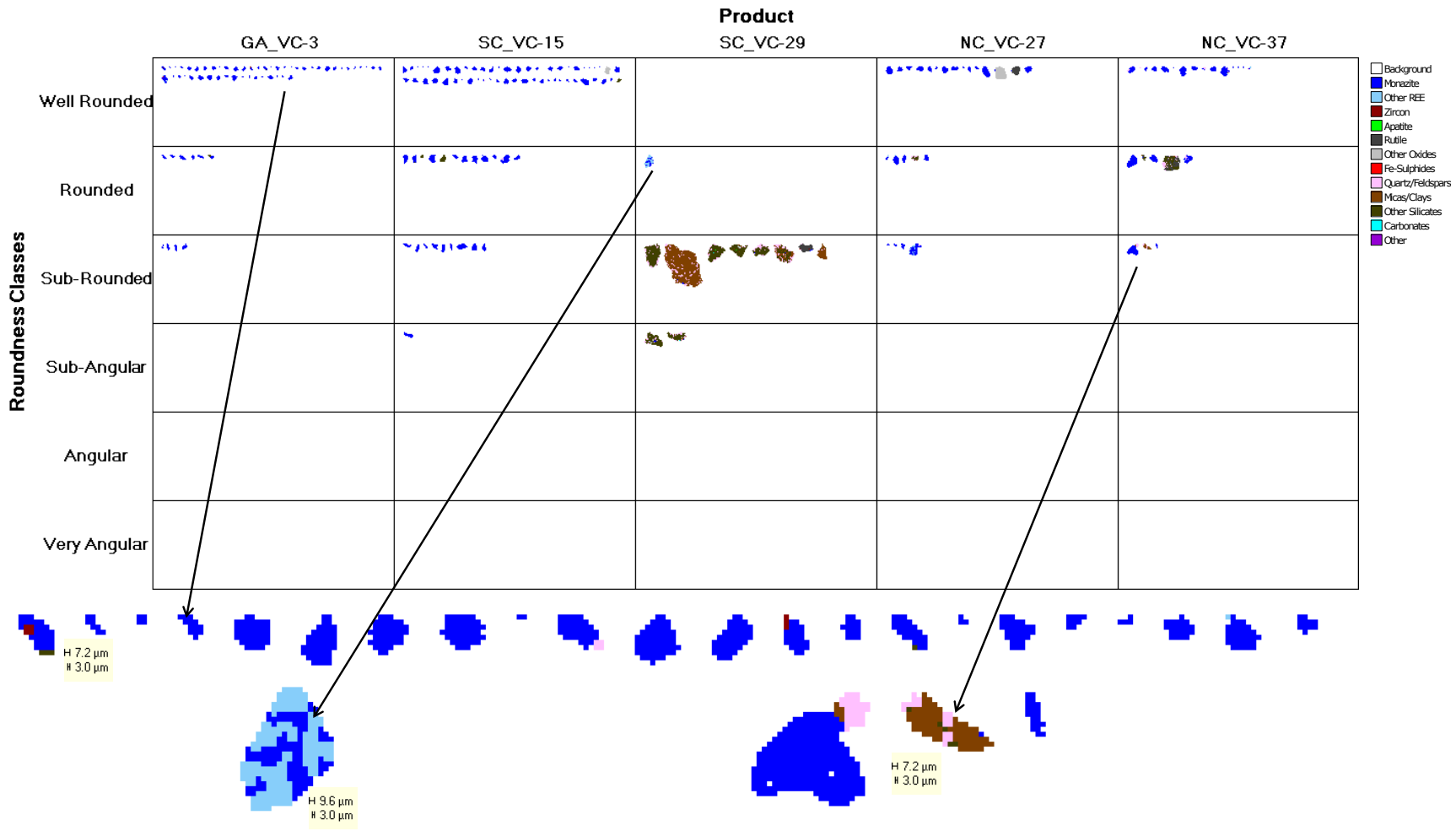
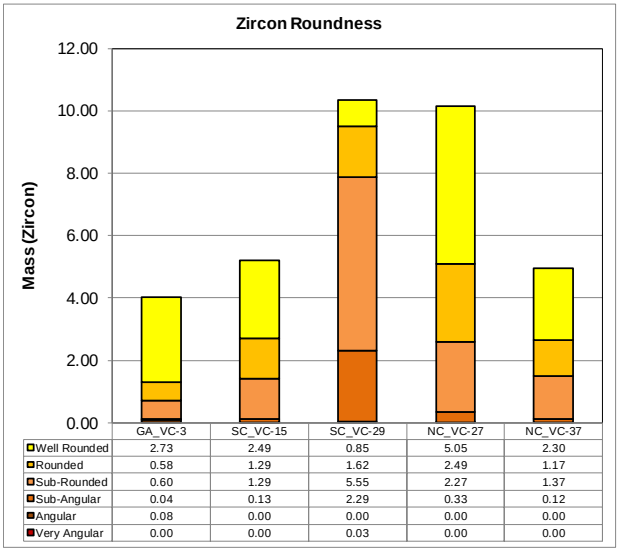


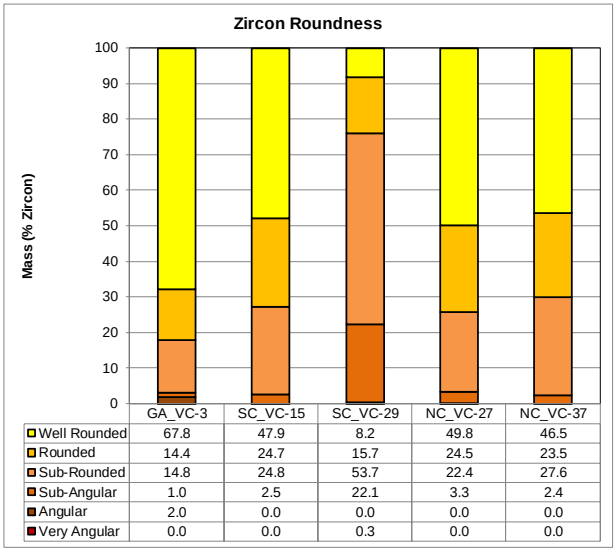
Figure 79: Image Grid of Monazite Roundness for the Sink Products from Selected Samples

6.2. Roundness of Zircon

The shape of the zircon in the Sink products varies among the samples. The NC-VC-27 and -37 samples show similar patterns, the shapes from the SC group samples are considerably different. The most rounded zircon is from the GA sample (Figure 80). An image grid for the samples, illustrating the zircon roundness, is presented in Figure 81.



	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Well Rounded	2.73	2.49	0.85	5.05	2.30
Rounded	0.58	1.29	1.62	2.49	1.17
Sub-Rounded	0.60	1.29	5.55	2.27	1.37
Sub-Angular	0.04	0.13	2.29	0.33	0.12
Angular	0.08	0.00	0.00	0.00	0.00
Very Angular	0.00	0.00	0.03	0.00	0.00



	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Well Rounded	67.8	47.9	8.2	49.8	46.5
Rounded	14.4	24.7	15.7	24.5	23.5
Sub-Rounded	14.8	24.8	53.7	22.4	27.6
Sub-Angular	1.0	2.5	22.1	3.3	2.4
Angular	2.0	0.0	0.0	0.0	0.0
Very Angular	0.0	0.0	0.3	0.0	0.0

Figure 80: Zircon Roundness for the Sink Products from Selected Samples (Mass and Norm Mass%)

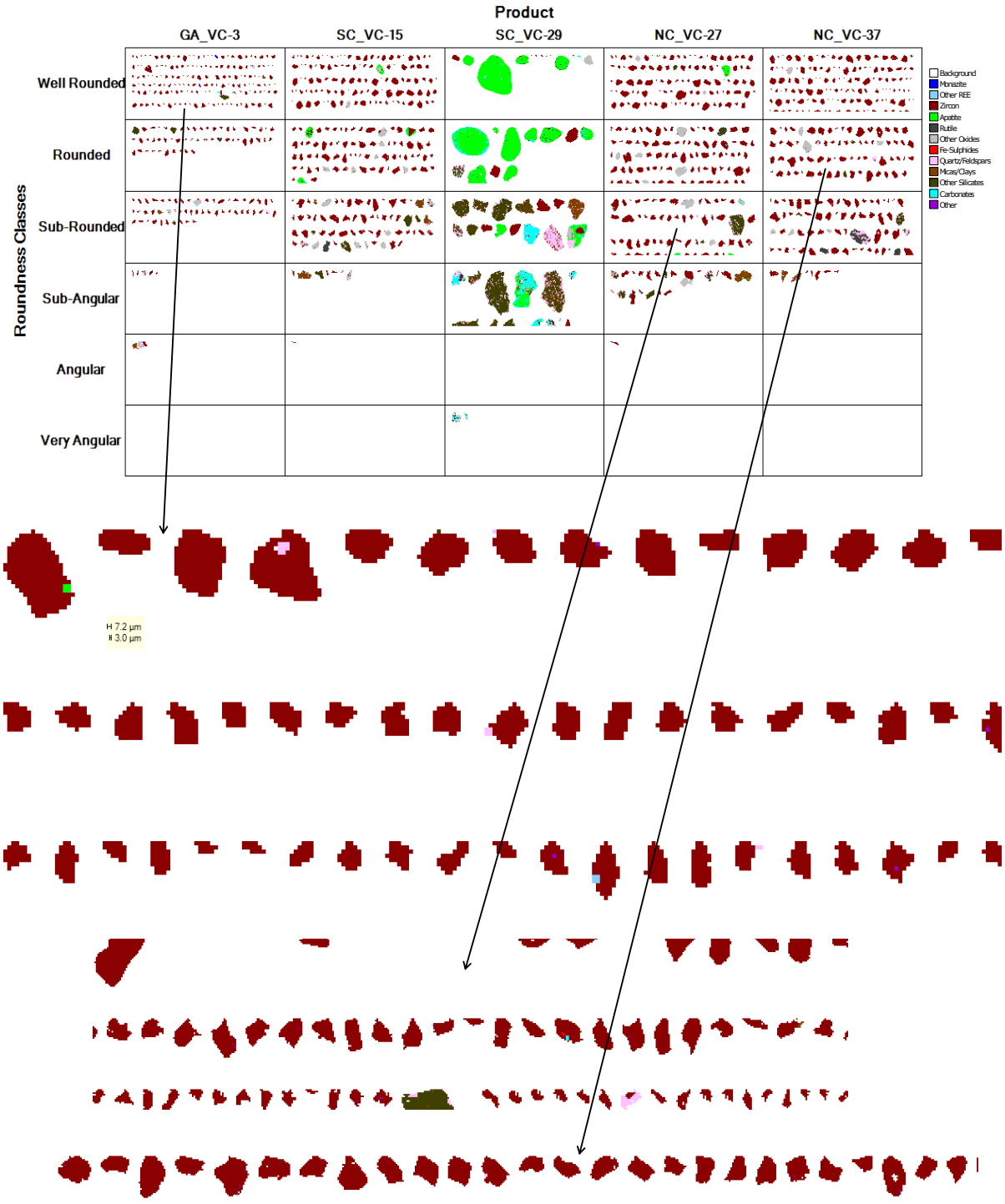


Figure 81: Image Grid of Zircon Roundness for the Sink Products from Selected Samples

6.3. Mineral Chemistry by Electron Probe Micro Analyses (EPMA)

EPMA were conducted on monazite, zircon, rutile, and apatite in the Sink products. The complete results along with representative back scattered electron images are given in Appendix D.

6.3.1. Monazite

The detections limits, average mineral chemistry, and minimum (Min) and maximum (Max) oxide concentrations of monazite from the EPMA are shown in Table 20 to Table 22. The average concentrations of the major oxides including La_2O_3, Ce_2O_3, Pr_2O_3, Nd_2O_3, and Sm_2O_3 in the monazite analyzed are similar among the samples (Figure 82). The Y_2O_3, Gd_2O_3, and Dy_2O_3 show slightly wider variations. The ThO_2 ranges from 3,97 wt% to 5.05 wt% and UO_2 from 0.31 wt% to 0.92 wt%. Monazite is Ce_2O_3, La_2O_3, and Nd_2O_3 rich. The Y_2O_3 ranges from 0.99 wt% to 1.98 wt%. Monazite shows variations in oxide concentrations. For example, ThO_2 ranges from 2.15 wt% to 9.64 wt% in the GA_VC-3, 3.58 wt% to 8.68 wt%, in the SC_VC-29 from 0.70 wt% to 7.76 wt%, in NC_VC-27 from 0.68 wt% to 11.57 wt%, and in NC_VC-37 from 0.81 wt% to 12.19 wt%.

Table 20: Detection limits in Oxide wt% for Monazite from the EPMA

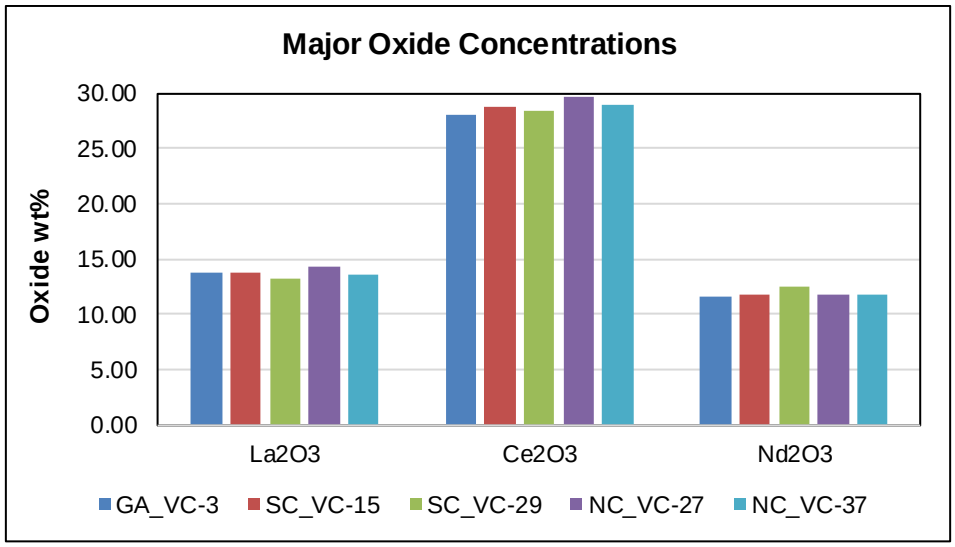
Oxide (wt%)	Detection Limit
P_2O_5	0.041
SiO_2	0.019
ThO_2	0.052
UO_2	0.082
Y_2O_3	0.046
La_2O_3	0.063
Ce_2O_3	0.067
Pr_2O_3	0.090
Nd_2O_3	0.107
Sm_2O_3	0.110
Gd_2O_3	0.112
Tb_2O_3	0.062
Dy_2O_3	0.117
Er_2O_3	0.063
CaO	0.015

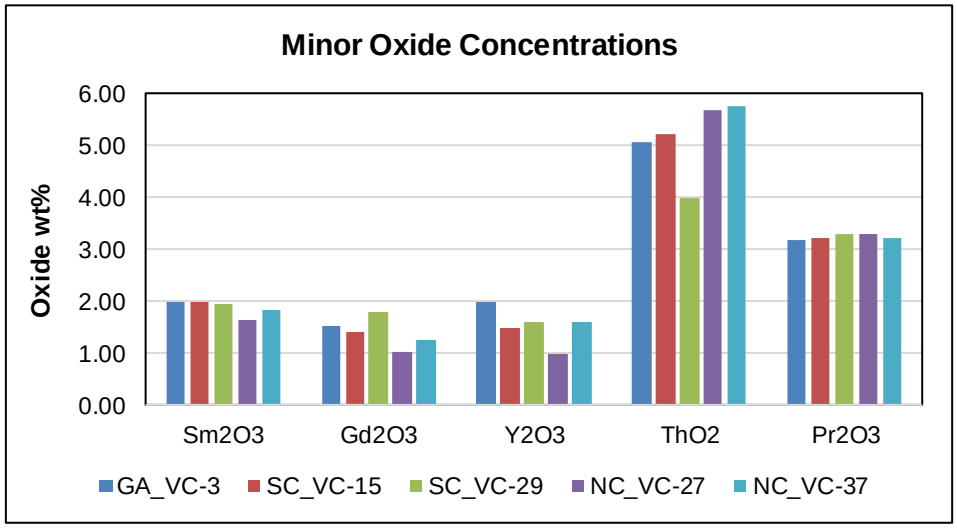
Table 21: Average Mineral Chemistry of Monazite from the EPMA

No. Analyses	23	24	11	25	18
Oxide/Sample	**GA_VC-3**	**SC_VC-15**	**SC_VC-29**	**NC_VC-27**	**NC_VC-37**
P_2O_5	29.75	29.56	29.95	28.88	28.99
SiO_2	0.28	0.35	0.15	0.73	0.68
ThO_2	5.05	5.21	3.97	5.65	5.75
UO_2	0.92	0.68	0.65	0.32	0.41
Y_2O_3	1.98	1.50	1.59	0.99	1.60
La_2O_3	13.70	13.82	13.25	14.22	13.56
Ce_2O_3	28.10	28.73	28.41	29.65	28.86
Pr_2O_3	3.16	3.21	3.27	3.27	3.20
Nd_2O_3	11.58	11.82	12.49	11.70	11.86
Sm_2O_3	2.00	1.98	1.96	1.66	1.82
Gd_2O_3	1.53	1.40	1.78	1.03	1.26
Tb_2O_3	0.14	0.12	0.03	0.08	0.10
Dy_2O_3	0.63	0.50	0.62	0.32	0.44
Er_2O_3	0.13	0.11	0.09	0.07	0.10
CaO	1.04	0.97	0.87	0.84	0.82
Total	99.98	99.96	99.08	99.39	99.46

Table 22: Min, Max and Average Mineral Chemistry of Monazite from the EPMA

Sample ID	Range	P_2O_5	SiO_2	ThO_2	UO_2	Y_2O_3	La_2O_3	Ce_2O_3	Pr_2O_3	Nd_2O_3	Sm_2O_3	Gd_2O_3	Tb_2O_3	Dy_2O_3	Er_2O_3	CaO	Total
GA_VC-3	Min	28.16	0.05	2.15	0.11	0.09	11.99	25.59	2.92	8.79	0.77	0.39	0.00	0.04	0.00	0.34	99.19
	Max	30.36	1.17	9.64	2.89	3.79	19.88	33.78	3.54	13.29	2.38	2.05	0.25	1.05	0.27	1.59	100.66
	Ave	***29.75***	***0.28***	***5.05***	***0.92***	***1.98***	***13.70***	***28.10***	***3.16***	***11.58***	***2.00***	***1.53***	***0.14***	***0.63***	***0.13***	***1.04***	***99.98***
SC_VC-15	Min	28.10	0.06	3.58	0.06	0.15	11.40	23.88	2.82	10.50	1.19	0.56	0.02	0.07	0.00	0.35	99.31
	Max	30.28	1.19	8.68	3.80	3.71	17.69	32.15	3.48	13.27	2.82	2.42	0.27	1.06	0.26	1.86	100.49
	Ave	***29.56***	***0.35***	***5.21***	***0.68***	***1.50***	***13.82***	***28.73***	***3.21***	***11.82***	***1.98***	***1.40***	***0.12***	***0.50***	***0.11***	***0.97***	***99.96***
SC_VC-29	Min	29.63	0.06	0.70	0.06	0.13	10.05	26.06	2.88	11.48	1.65	1.27	0.00	0.26	0.01	0.21	98.06
	Max	30.26	0.39	7.76	1.88	2.89	16.13	33.73	3.52	14.25	2.41	3.07	0.10	1.09	0.16	1.35	100.05
	Ave	***29.95***	***0.15***	***3.97***	***0.65***	***1.59***	***13.25***	***28.41***	***3.27***	***12.49***	***1.96***	***1.78***	***0.03***	***0.62***	***0.09***	***0.87***	***99.08***
NC_VC-27	Min	26.84	0.06	0.69	0.03	0.08	10.88	25.78	2.88	9.26	0.82	0.26	0.00	0.04	0.00	0.17	96.79
	Max	30.40	2.00	11.57	1.83	3.09	19.19	33.84	4.15	15.69	2.49	2.11	0.24	0.96	0.20	1.69	100.17
	Ave	***28.88***	***0.73***	***5.65***	***0.32***	***0.99***	***14.22***	***29.65***	***3.27***	***11.70***	***1.66***	***1.03***	***0.08***	***0.32***	***0.07***	***0.84***	***99.39***
NC_VC-37	Min	27.01	0.10	0.81	0.03	0.12	6.75	19.59	2.61	8.42	0.84	0.32	0.00	0.06	0.00	0.16	98.21
	Max	29.88	2.19	12.19	1.35	5.59	18.17	35.90	4.54	19.28	3.23	3.08	0.32	1.46	0.35	1.59	100.07
	Ave	***28.99***	***0.68***	***5.75***	***0.41***	***1.60***	***13.56***	***28.86***	***3.20***	***11.86***	***1.82***	***1.26***	***0.10***	***0.44***	***0.10***	***0.82***	***99.46***





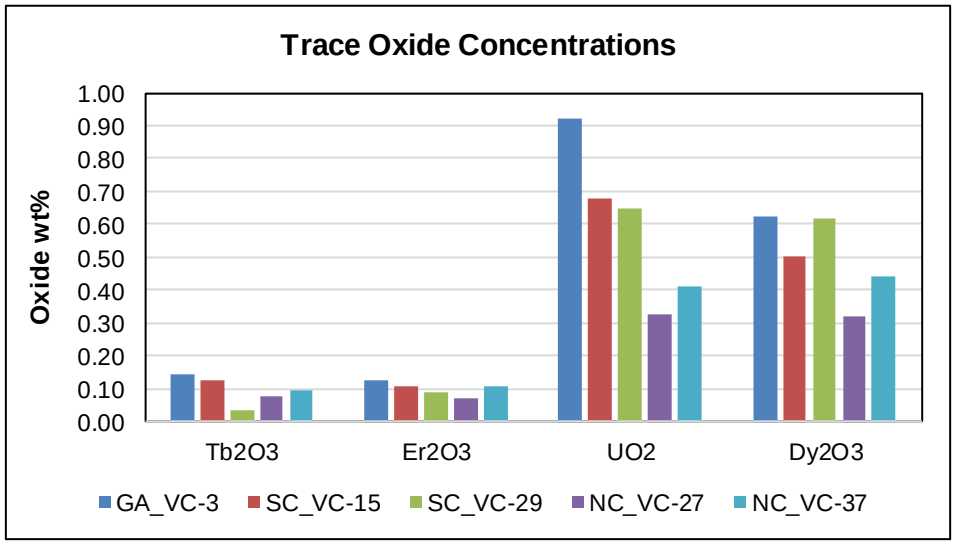


Figure 82: Average Concentrations of Major and Minor Oxides in Monazite from the EPMA

The composition of monazite is expressed as end members monazite (2REEPO4) – cherallite [$CaTh(PO_4)_2$] and huttonite ($2ThSiO_4$) using the classification scheme of Linthout (2007). The graph shows that most of the analyses plot near the monazite apex. It is generally thought that monazite with elevated thorium (Th) concentrations is of igneous origin (e.g., *Schandl E. S. and Gorton, P, 2004: a textural and geochemical guide to the identification of hydrothermal monazite criteria for selection pf samples for dating epigenetic hydrothermal ore deposits, Economic Geology, Vol. 99, pp. 1027-1035*).

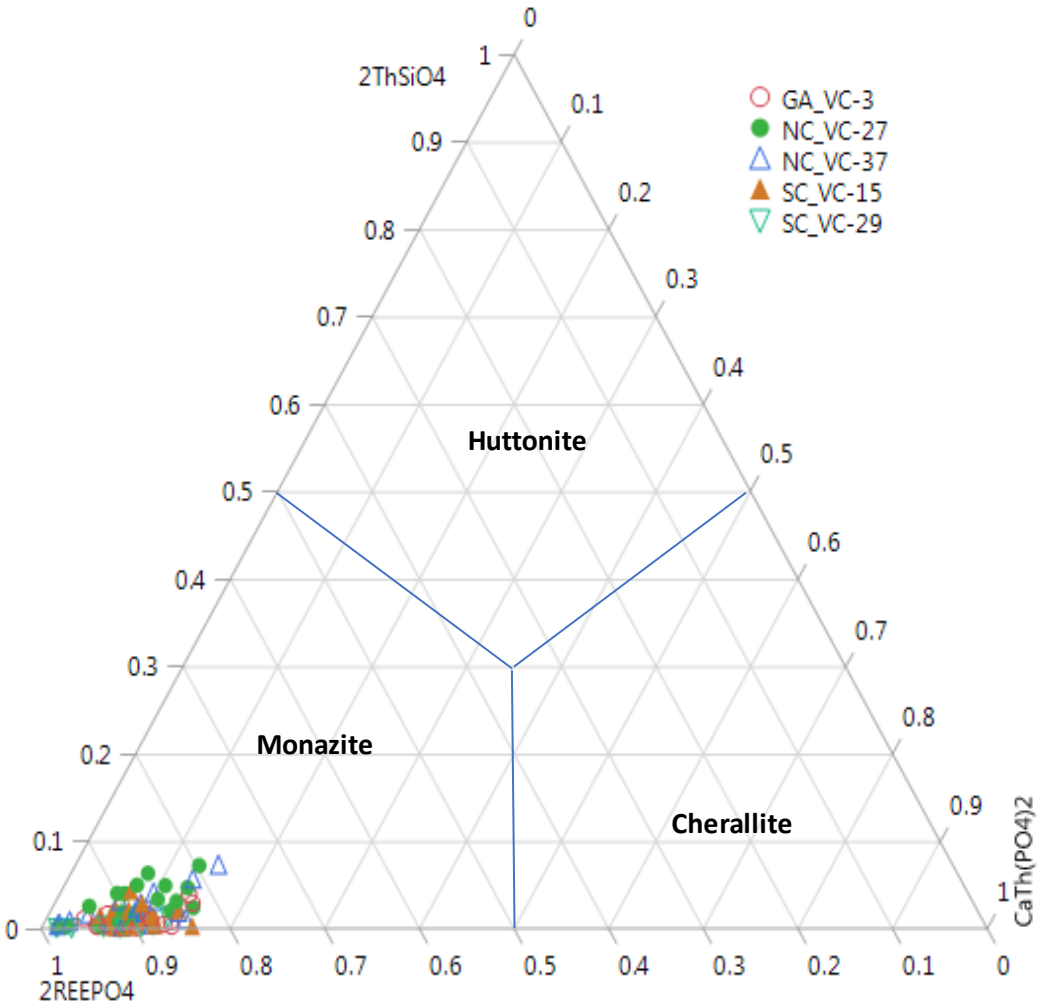


Figure 83: Ternary Plot of Monazite Composition Expressed as Huttonite-Cherallite-Monazite (after Linthout, 2007)

Linthout, K. (2007). Tripartite division of the system $2REEPO_4 – CaTh(PO_4)_2 – 2ThSiO_4$, discreditation of brabantite, and recognition of cherallite as the name for members dominated by $CaTh(PO_4)2$. Can Miner. Vol. 45, pp. 503-508.

Chondrite normalized plots (REE+Y) are shown for the average monazite compositions in Figure 84. Chondrite values are from Hofmann (1988) to be consistent with the whole rock data (above). Monazite displays enriched LREE and a depletion in HREE. Monazite from SC_VC-29 shows a negative Tb anomaly which is not observed in the monazite from the other samples.

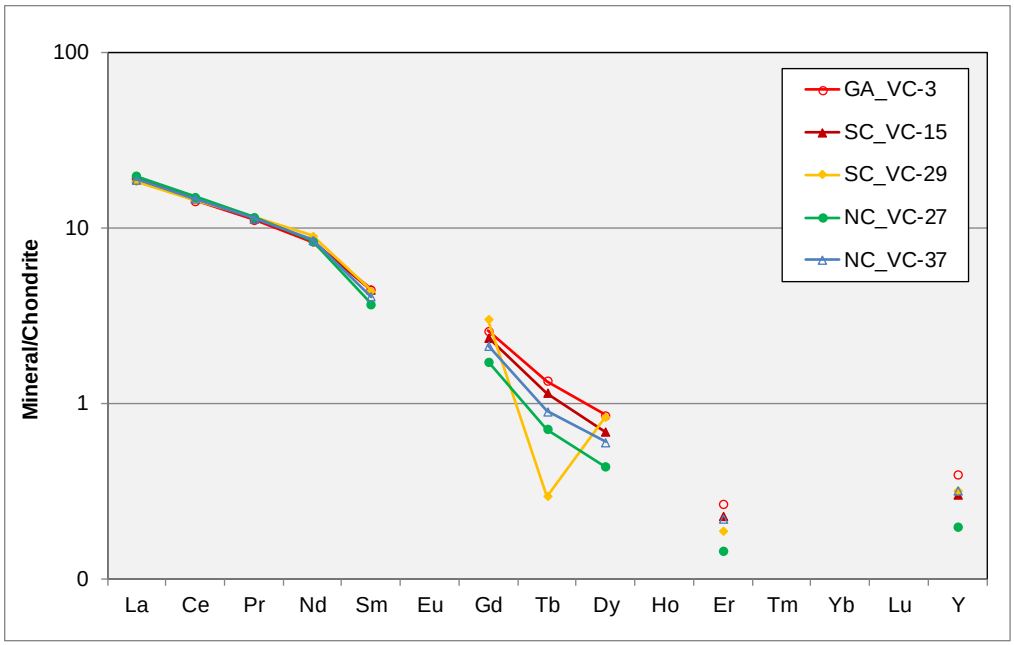


Figure 84: Chondrite Normalized Plots for the Average Monazite Chemistry of the Samples

Primitive mantle composition is from Hofmann (1988)

6.3.2. Zircon

The detections limits and average oxide concentrations from the EPMA of zircon are shown in Table 23. ZrO_2 ranges from 65.84 wt% to 66.24 wt%, HfO_2 ranges from 1.12 wt% to 1.28 wt%. The Y_2O_3 ranges from 0.11 wt% to 0.15 wt%, while other analyzed rare earth elements and uranium are below the detection limits of the instrument. Note that the association of Zr and Hf was observed also in the geochemical data.

Table 23: Detection Limits and Average Mineral Chemistry in Oxide wt% for Zircon from the EPMA

N	Sample/Oxide	SiO_2	ZrO_2	HfO_2	UO_2	Y_2O_3	La_2O_3	Ce_2O_3	Nd_2O_3	Dy_2O_3	Total
	Detection Limit	0.050	0.130	0.037	0.078	0.040	0.039	0.035	0.079	0.089	
8	GA_VC-3	32.51	66.17	1.26	0.05	0.11	0.01	0.00	0.00	0.01	100.11
8	SC_VC-15	32.47	66.20	1.12	0.03	0.13	0.01	0.01	0.00	0.01	99.97
8	SC_VC-29	32.59	65.84	1.28	0.05	0.15	0.01	0.01	0.01	0.00	99.94
9	NC_VC-27	32.54	65.94	1.14	0.03	0.15	0.01	0.01	0.01	0.01	99.83
8	NC_VC-37	32.38	66.24	1.16	0.03	0.11	0.01	0.02	0.04	0.01	100.00

6.3.3. Apatite

The detections limits, and average oxide concentrations for apatite from the EPMA are shown in Table 24. The average concentrations of the major oxides P_2O_5 and CaO varies within 2-3% among the samples. The La_2O_3, Ce_2O_3, and Y_2O_3 are below the detection limit of the instrument. Fluorine ranges from 4.07 wt% to 4.31 wt% among the apatite analyzed.

Table 24: Detection Limits and Average Mineral Chemistry in Oxide wt% for Apatite from the EPMA

N	Sample/Oxide	SiO_2	Y_2O_3	La_2O_3	Ce_2O_3	Nd_2O_3	CaO	P_2O_5	SO_3	F	Cl	Total
	Detection Limit	0.032	0.080	0.089	0.081	0.158	0.054	0.068	0.049	0.062	0.021	
8	GA_VC-3	0.91	0.05	0.02	0.02	0.01	48.93	30.19	2.88	4.31	0.06	85.56
8	SC_VC-15	0.26	0.06	0.06	0.06	0.03	50.29	32.35	2.00	4.08	0.03	87.50
8	SC_VC-29	1.82	0.02	0.02	0.02	0.03	47.25	30.02	1.67	4.07	0.07	83.27
8	NC_VC-27	0.29	0.04	0.03	0.02	0.02	50.24	32.49	2.09	4.14	0.05	87.64

6.3.4. Rutile

The detections limits, average mineral chemistry concentrations from the EPMA of rutile are shown in Table 25. The TiO_2 ranges from 96.66 wt% to 99.14 wt%, and Nb_2O_5 ranges from 0.30 tw% to 1.36 wt%. The Fe_2O_3 is below 1 wt%, and Cr_2O_3 and Ta_2O_5 are present in trace amounts but near the detection limits of the instrument.

Table 25: Detection Limits in Oxide wt% and Average Mineral Chemistry for Rutile from the EPMA

No. Analyses	Oxide	Nb_2O_5	Ta_2O_5	SiO_2	TiO_2	SnO_2	Cr_2O_3	Fe_2O_3	Total
	Detection Limit	0.01863	0.02043	0.01508	0.06097	0.02232	0.02103	0.02206	
8	GA_VC-3	1.07	0.09	0.07	96.66	0.01	0.40	0.84	99.14
8	SC_VC-15	1.34	0.13	0.00	97.19	0.02	0.06	0.95	99.69
8	SC_VC-29	0.30	0.01	0.00	99.14	0.00	0.06	0.27	99.80
11	NC_VC-27	1.36	0.02	0.15	96.79	0.01	0.08	0.85	99.26
7	NC_VC-37	0.26	0.01	0.21	98.39	0.00	0.06	0.44	99.38

Summary Conclusions and Recommendations

Summary

- XRD analysis shows that the samples consist of major amounts of quartz, minor to trace amounts of apatite, plagioclase, K-feldspars, calcite, ilmenite, epidote, amphibole, garnet, and zircon. These results are in agreement with the QEMSCAN analyses. Quartz dominates all three groups of samples.
- The main REM is monazite and occurs in trace amounts. Other minerals of interest (indicators) include zircon, apatite, Fe-oxides, rutile, and ilmenite.
- The liberation and association of monazite is erratic (nil to 100%) due to low mass of the mineral. Therefore, these values are only tentative.
- Monazite is sub-rounded (58%) and rounded/well rounded (42%) in the GA group, sub-rounded (53%) to angular (33%) and less rounded/well rounded (12%) in the SC group, and sub-rounded (37%) to angular/very angular (34%) and rounded/well-rounded (29%) in the NC group. Although based on limited data, the NC monazite seem to be more angular and gradually becoming more rounded in the SC and GA groups. This might reflect the source, provenance, and distance of transportation of the mineral.
- Zircon is more angular in the SC group and similar in the GA and NC groups.
- Apatite is more angular in the NC and SC groups and less in the GA group.
- Geochemical analyses indicate that REE are very low in concentration in the samples. The TREE+Y values range from 24 ppm to 156 ppm and average 99 ppm in the GA group samples, from 38 ppm to 263 and average 102 ppm in the SC group, and from 28 ppm to 105 ppm and average 74 ppm in the NC group.
- Cerium shows a strong correlation with La, Dy, Sm, and Nd reflecting the main Rare Earth Mineral (REM) monazite. Correlation between cerium and yttrium is good but not as linear as with other REE. Yttrium could be carried by other minerals such as apatite for example. Correlation between cerium and phosphorus is poor and this is attributed to the fact that phosphorus is accounted by apatite and monazite. It probably indicates that apatite is not a major cerium carrier.
- Chondrite normalized plots (REE+Y) show that all the samples show enriched LREE and depleted HREE with a pronounced negative europium anomaly.
- Heavy liquid separation (HLS) at SG of 2.9 g/cm^3, conducted on selected fractions and samples, generated small amounts of masses (0.3% to 5.0%) in the heavy Sink products. Although the Sink products are not clean of silicates, an upgrading of the samples shows a good potential to concentrate the heavy minerals (zircon, monazite, and others).

- Mineral chemistry of monazite shows a wide variation and the low thorium concentrations might indicate an igneous rather than a hydrothermal origin. Additional work is required to further evaluate the data.
- The monazite chemistry shows also that a REE concentrate will be radioactive (due to the Th and U) in the matrix of the mineral.

Recommendations and Observations

- The REM are very low in the samples.
- Zircon, rutile, and ilmenite might be potential sources for Zr and Ti, respectively.
- Additional sampling and a WRA analysis is recommended to properly map the mineral sands.
- Gravity separation (i.e., heavy liquid separation or any gravity table) is recommended on laboratory scale prior to any mineralogical analyses. This, coupled with geochemical analyses of the REE and major elements, can provide a mass balance on the REE distribution.

Appendix A – XRD Results

Qualitative X-Ray Diffraction

Report Prepared for:	*South Carolina Department of Natural Resources*
Project Number/ LIMS No.	*16225-001/MI5017-SEP17*
Sample Receipt:	*September 18, 2017*
Sample Analysis:	*October 12, 2017*
Reporting Date:	*October 26, 2017*

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:

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

ACCREDITATION: SGS Minerals Services Lakefield is accredited to the requirements of ISO/IEC 17025 for specific tests as listed on our scope of accreditation, including geochemical, mineralogical and trade mineral tests. To view a list of the accredited methods, please visit the following website and search SGS Canada - Minerals Services - Lakefield: http://palcan.scc.ca/SpecsSearch/GLSearchForm.do.

Method Summary

The Qualitative Mineral Identification By XRD (ME-LR-MIN-MET-MN-D01) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involve matching the diffraction pattern of an unknown test sample 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) and released on software as a database of 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.).

Summary of Qualitative X-ray Diffraction Results

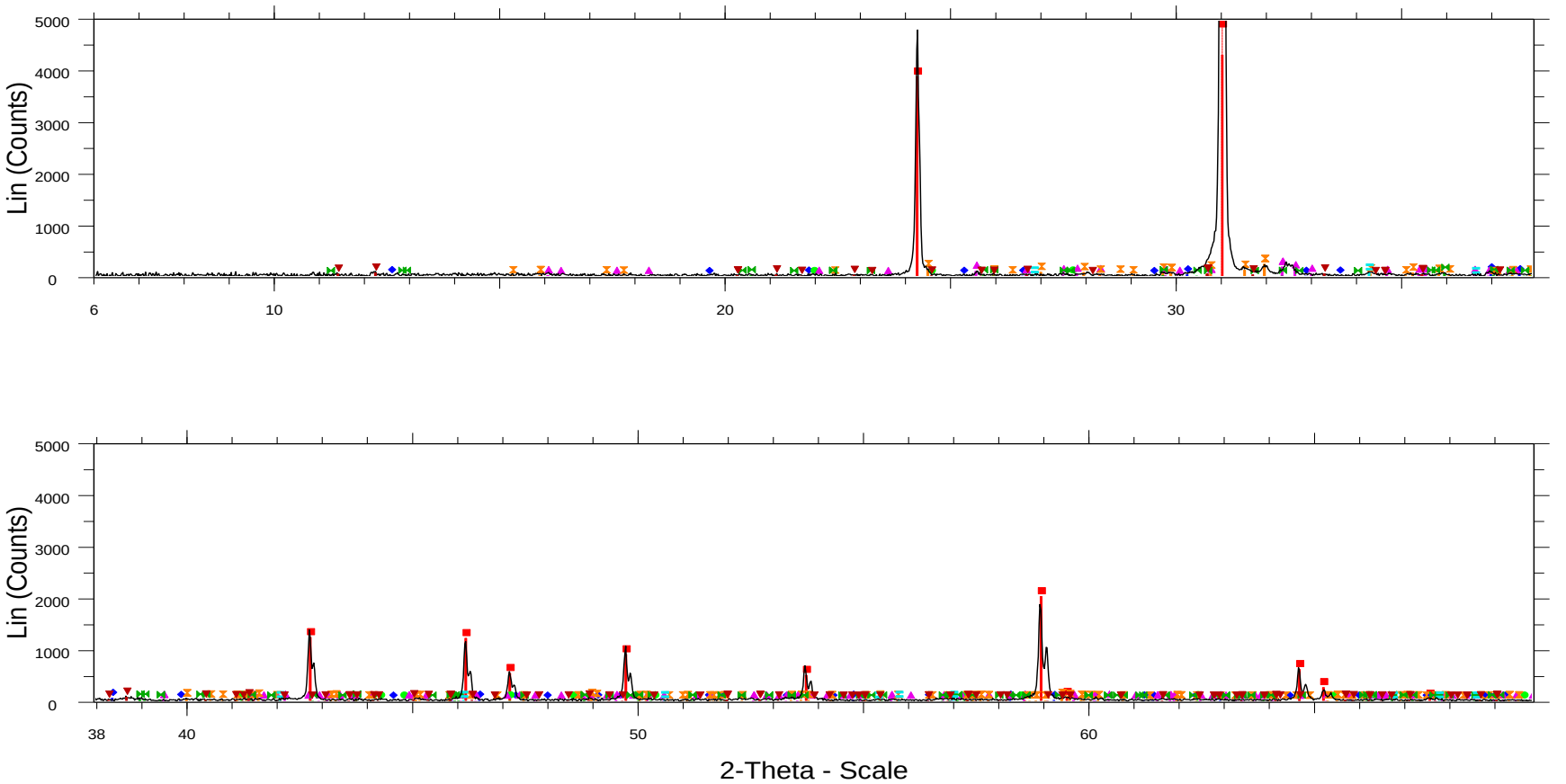
Crystalline Mineral Assemblage (relative proportions based on peak height)

Sample ID	Major	Moderate	Minor	Trace
SC_VC-14 -212um Rep	quartz	-	apatite, plagioclase, potassium-feldspar, calcite	*ilmenite, *epidote, *amphibole
SC_VC-20 -212um	quartz	-	plagioclase, potassium-feldspar, calcite	*ilmenite, *epidote, *amphibole, *apatite
SC_VC-28 -212um	quartz	-	ilmenite, potassium-feldspar, plagioclase, calcite	*apatite, *ilmenite, *amphibole, *epidote, *hematite, *garnet, *zircon
NC_VC-25 +212um Rep	quartz	-	calcite	*apatite, *plagioclase, *hematite, *calcite, *potassium-feldspar
NC_VC-34	quartz	-	plagioclase, potassium-feldspar	*apatite, *amphibole

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

Mineral	Composition
Amphibole	$(Na,K)Ca_2(Fe,Mg)_5(Al,Si)_8O_{22}(OH)_2$
Apatite	$Ca_5(PO_4)_3(F,Cl,OH)$
Calcite	$CaCO_3$
Epidote	$Ca_2(Al,Fe)Al_2O(SiO_4)(Si_2O_7)(OH)$
Garnet	$(Ca,Mg,Mn^{2+})_3(V,Al,Fe^{3+})_2(SiO_4)_3$
Hematite	Fe_2O_3
Ilmenite	$FeTiO_3$
Plagioclase	$(NaSi,CaAl)AlSi_2O_8$
Potassium-Feldspar	$KAlSi_3O_8$
Quartz	SiO_2
Zircon	$ZrSiO_4$

SC_VC-14 -212um Rep



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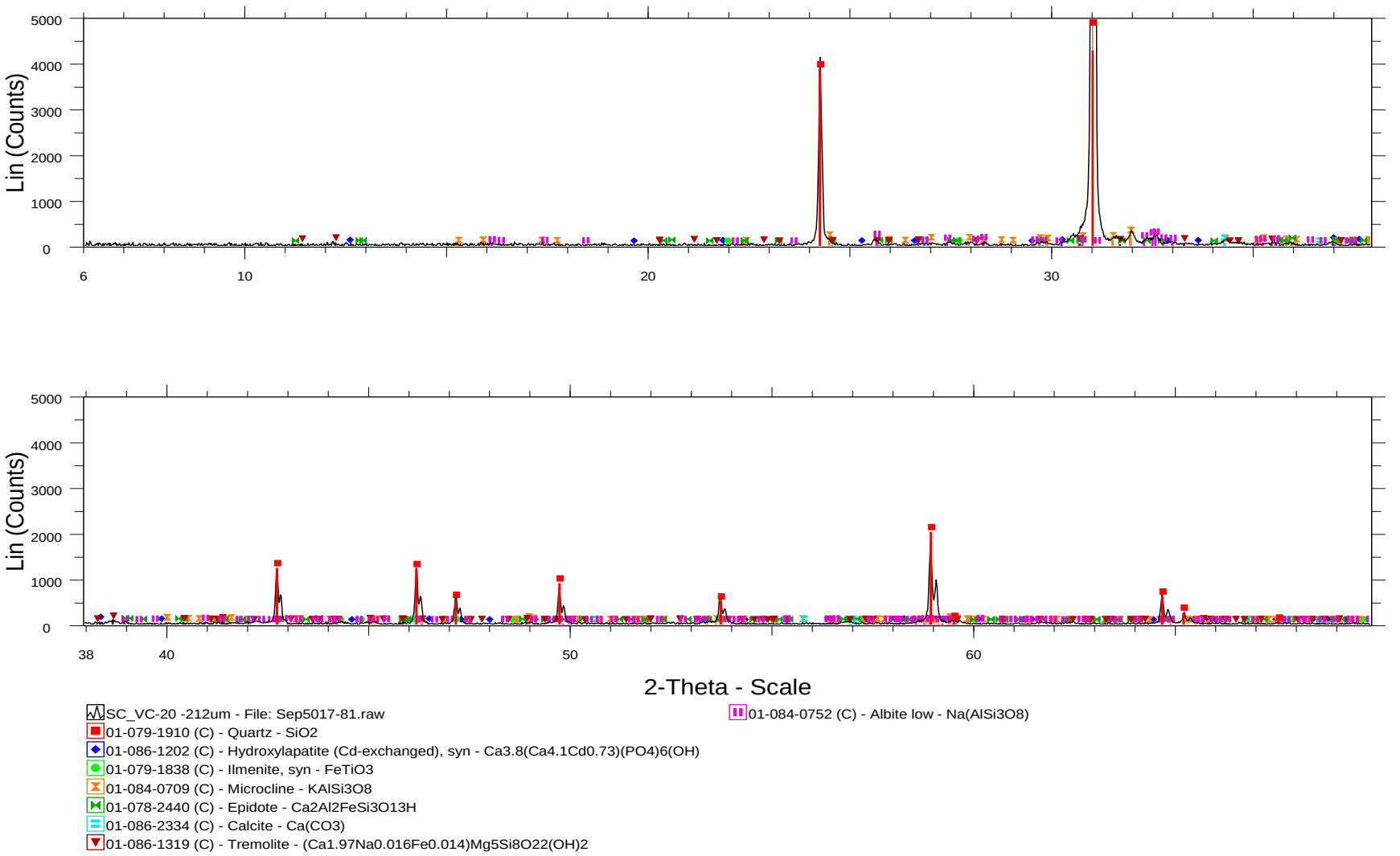
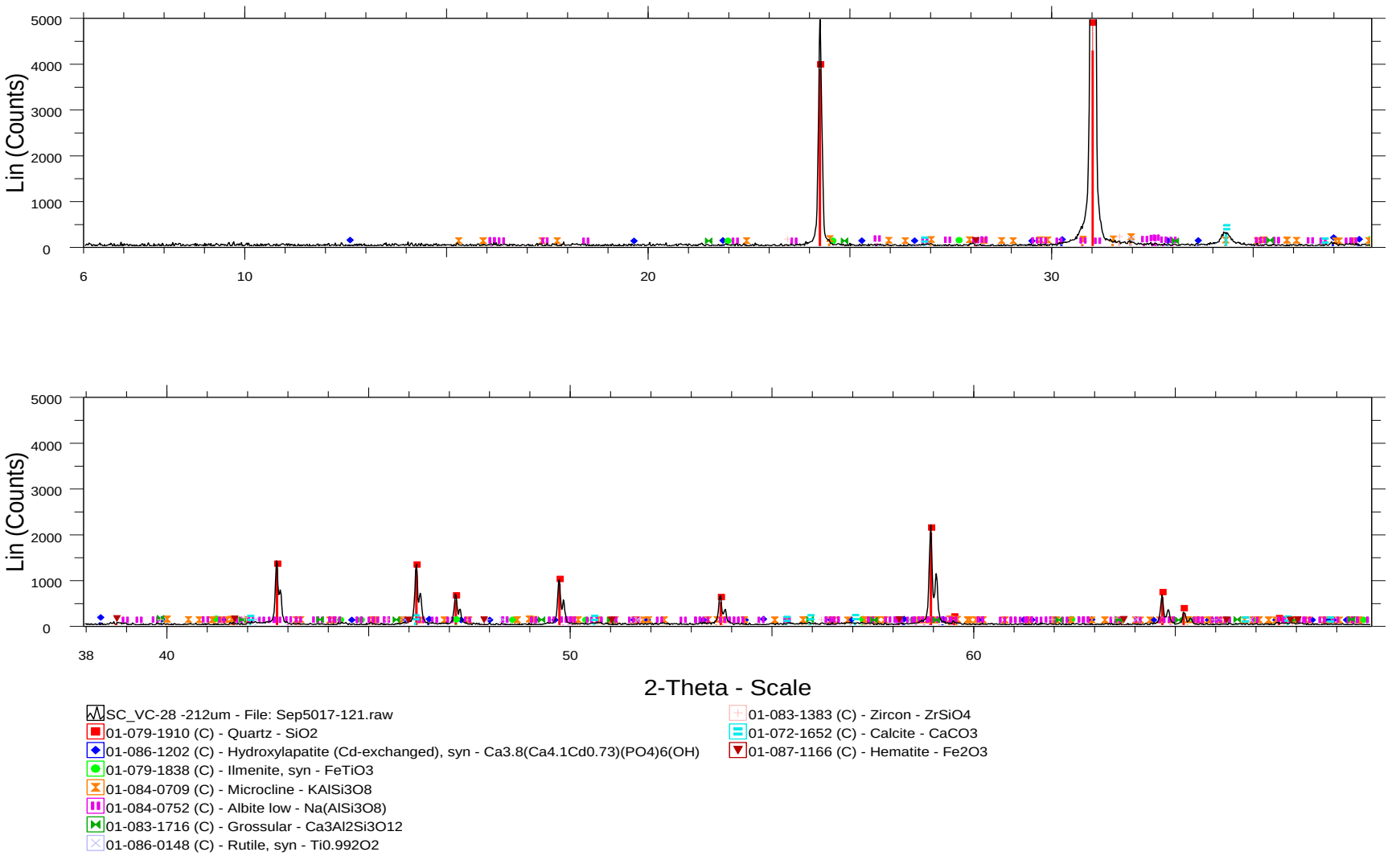
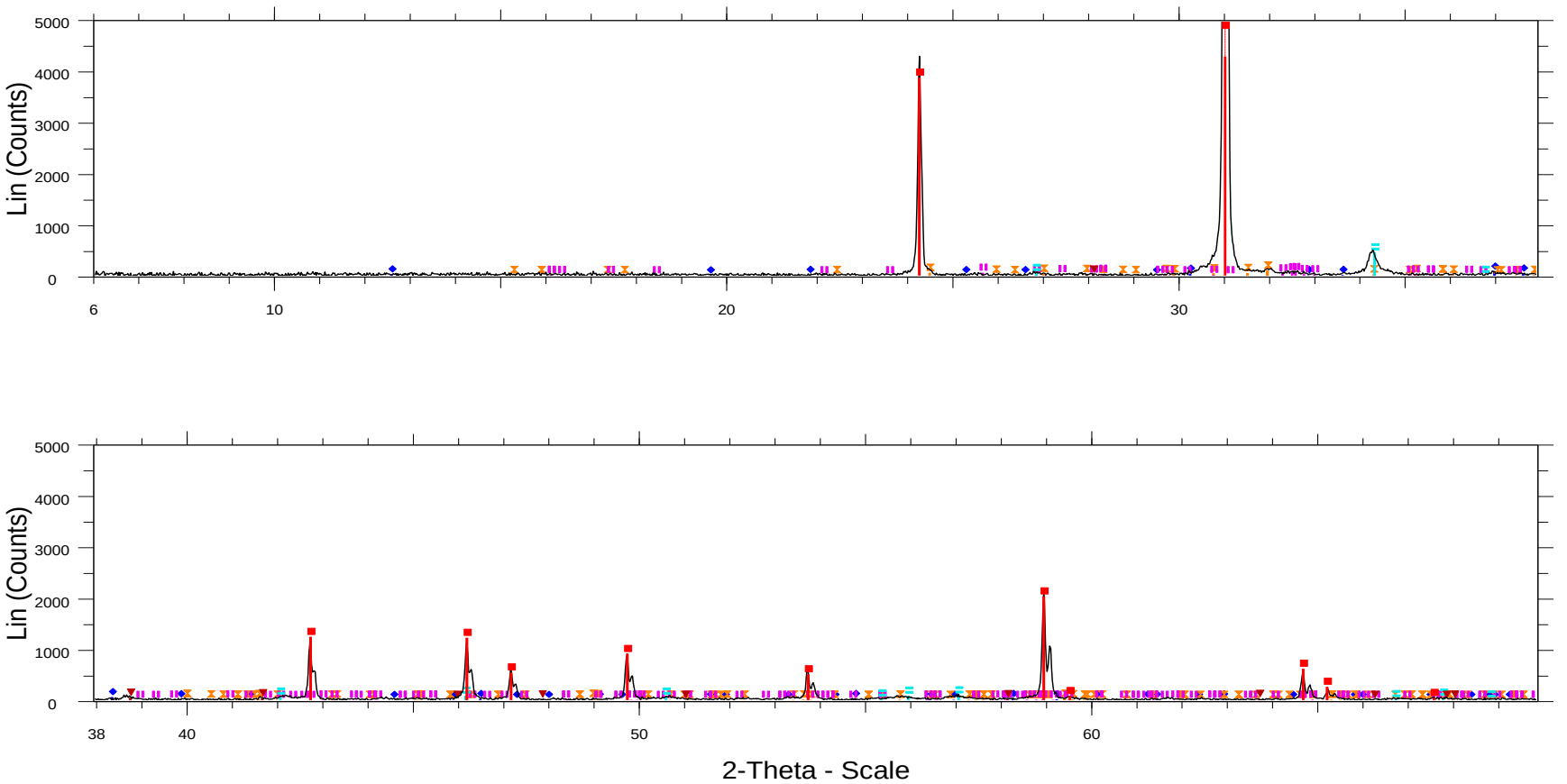


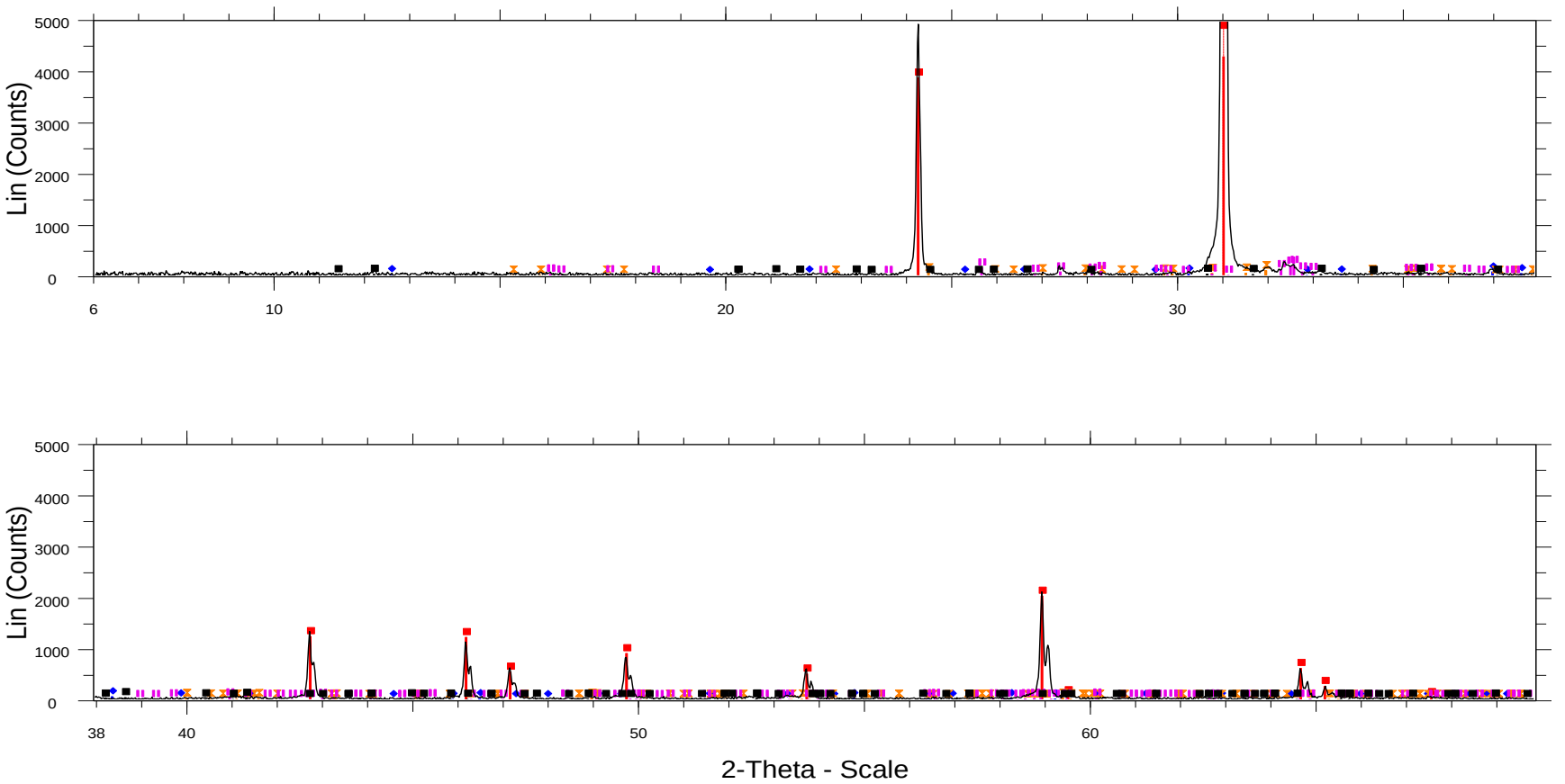
SC_VC-28 -212um



NC_VC-25 +212um Rep



NC_VC-34


Lin (Counts)
5000
4000
3000
2000
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6
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30
Lin (Counts)
5000
4000
3000
2000
1000
0
38
40
50
60
2-Theta - Scale
NC_VC-34 - File: Sep5017-206.raw
01-079-1910 (C) - Quartz - SiO2
01-086-1202 (C) - Hydroxylapatite (Cd-exchanged), syn - Ca3.8(Ca4.1Cd0.73)(PO4)6(OH)1.8
01-084-0709 (C) - Microcline - KAlSi3O8
01-084-0752 (C) - Albite low - Na(AlSi3O8)
01-075-0861 (C) - Tremolite - Na.38K.12Ca1.8Mg5Fe.01Al.24Si7.84O24

Appendix B – Certificate of Analyses

SGS Canada Inc.
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LR Internal Dept 14
Attn : Tassos Grammatikopoulos

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Phone: ---, Fax:---

10-October-2017

Date Rec. : 22 September 2017
LR Report : **CA02708-SEP17**
Project : CALR-16225-001
Client Ref : MI5017-SEP17

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe %	Ga ppm
1: GA_VC-1	< 1	0.74	< 5	112	< 5	< 0.1	1.9	< 0.2	27.5	2.3	712	< 0.1	9	2.50	1.59	0.59	0.84	2
2: GA_VC-3	< 1	1.79	< 5	255	< 5	< 0.1	2.7	< 0.2	52.6	2.9	692	0.3	9	4.34	2.55	0.78	1.18	4

Sample ID	Gd ppm	Ge ppm	Hf ppm	Ho ppm	In ppm	K %	La ppm	Li ppm	Lu ppm	Mg %	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	P %	Pb ppm	Pr ppm
1: GA_VC-1	2.74	< 1	8	0.54	< 0.2	0.4	13.8	< 10	0.24	0.13	142	3	5	13.8	13	0.21	6	3.45
2: GA_VC-3	4.40	1	15	0.87	< 0.2	0.8	25.6	< 10	0.38	0.24	209	4	8	24.8	15	0.20	9	6.40

Sample ID	Rb ppm	Sc ppm	Sb ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm	Th ppm	Ti %	Tl ppm	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm	Zr ppm
1: GA_VC-1	9.0	< 5	0.2	2.9	< 1	142	< 0.5	0.40	3.5	0.17	< 0.5	0.23	2.69	11	1	16.8	1.5	< 10	284
2: GA_VC-3	22.6	< 5	0.2	4.9	< 1	252	0.6	0.67	7.6	0.28	< 0.5	0.40	4.19	21	1	25.0	2.4	13	545

OnLine LIMS

00011596699

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LR Report : **CA02708-SEP17**

Sample ID	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe %	Ga ppm
3: GA_VC-5	< 1	1.01	< 5	144	< 5	< 0.1	1.6	< 0.2	33.8	2.3	563	0.2	8	2.37	1.49	0.45	0.80	2
4: GA_VC-6	< 1	0.42	< 5	71	< 5	< 0.1	1.2	< 0.2	7.9	2.0	764	< 0.1	8	0.63	0.36	0.14	0.72	1
5: GA_VC-7	< 1	0.64	< 5	91	< 5	< 0.1	1.6	0.3	46.2	2.5	772	< 0.1	8	3.50	2.07	0.55	0.94	2
6: GA_VC-9	< 1	0.48	< 5	77	< 5	< 0.1	2.4	< 0.2	44.1	2.0	687	< 0.1	8	3.06	1.92	0.40	0.73	1
7: GA_VC-11	< 1	0.84	< 5	127	< 5	< 0.1	11.3	< 0.2	21.5	2.3	424	< 0.1	7	1.36	0.88	0.36	0.69	2
8: SC_VC-1	< 1	0.68	< 5	97	< 5	< 0.1	2.8	0.2	44.9	2.3	773	< 0.1	8	3.17	1.93	0.57	1.04	2
9: SC_VC-4	< 1	1.13	< 5	179	< 5	< 0.1	7.9	< 0.2	36.2	3.1	353	< 0.1	7	1.83	1.13	0.43	0.80	3
10: SC_VC-6	< 1	0.33	< 5	55	< 5	< 0.1	14.2	< 0.2	24.0	1.9	354	< 0.1	< 5	1.79	1.13	0.45	0.55	< 1

Sample ID	Gd ppm	Ge ppm	Hf ppm	Ho ppm	In ppm	K %	La ppm	Li ppm	Lu ppm	Mg %	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	P %	Pb ppm	Pr ppm
3: GA_VC-5	2.83	< 1	6	0.50	< 0.2	0.5	16.9	< 10	0.22	0.16	122	< 2	5	16.2	14	0.16	6	4.14
4: GA_VC-6	0.71	< 1	2	0.14	< 0.2	0.3	3.8	< 10	0.07	0.08	77	3	1	3.8	14	0.04	< 5	0.97
5: GA_VC-7	4.03	< 1	13	0.72	< 0.2	0.3	22.5	< 10	0.31	0.10	167	3	9	21.9	15	0.20	5	5.69
6: GA_VC-9	3.32	< 1	12	0.64	< 0.2	0.3	21.8	< 10	0.32	0.09	106	3	4	19.3	13	0.16	< 5	5.26
7: GA_VC-11	1.64	< 1	4	0.31	< 0.2	0.5	10.4	< 10	0.14	0.21	112	< 2	3	10.9	15	0.13	< 5	2.66
8: SC_VC-1	3.69	1	11	0.65	< 0.2	0.4	22.6	< 10	0.32	0.08	239	3	8	21.2	20	0.30	6	5.45
9: SC_VC-4	2.23	< 1	10	0.38	< 0.2	0.6	17.8	< 10	0.18	0.24	147	< 2	5	16.7	11	0.07	8	4.38
10: SC_VC-6	2.08	< 1	4	0.37	< 0.2	0.2	13.2	< 10	0.16	0.18	107	< 2	3	13.1	< 10	0.27	< 5	3.18

Sample ID	Rb ppm	Sc ppm	Sb ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm	Th ppm	Ti %	Tl ppm	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm	Zr ppm
3: GA_VC-5	14.3	< 5	0.1	3.1	4	138	< 0.5	0.40	5.6	0.17	< 0.5	0.20	2.73	13	1	14.3	1.3	11	236
4: GA_VC-6	7.5	< 5	0.2	0.8	< 1	92.1	< 0.5	0.09	1.1	0.04	< 0.5	0.06	0.80	7	< 1	3.9	0.3	< 10	58.4
5: GA_VC-7	8.7	< 5	0.2	4.3	< 1	122	0.8	0.59	7.4	0.24	< 0.5	0.31	3.31	13	1	20.8	1.9	< 10	525
6: GA_VC-9	7.0	< 5	0.2	3.9	< 1	168	< 0.5	0.48	7.6	0.11	< 0.5	0.28	2.69	10	1	19.3	1.9	< 10	455
7: GA_VC-11	11.1	< 5	0.2	2.0	< 1	642	< 0.5	0.23	2.3	0.09	< 0.5	0.13	1.74	13	< 1	9.0	0.8	13	146
8: SC_VC-1	8.4	< 5	0.2	4.1	< 1	172	0.7	0.54	7.1	0.28	< 0.5	0.28	3.11	15	1	20.1	1.8	15	438
9: SC_VC-4	13.8	< 5	0.2	2.9	< 1	507	< 0.5	0.32	5.2	0.18	< 0.5	0.18	2.16	15	< 1	10.8	1.2	12	400
10: SC_VC-6	3.8	< 5	0.1	2.3	< 1	814	< 0.5	0.29	2.0	0.08	< 0.5	0.15	2.43	11	< 1	12.7	1.0	< 10	157

SGS Canada Inc.
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LR Report : **CA02708-SEP17**

Sample ID	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe %	Ga ppm
11: SC_VC-7	< 1	0.69	< 5	120	< 5	< 0.1	10.0	0.8	29.0	2.1	420	0.2	5	1.87	1.09	0.49	0.65	2
12: SC_VC-14	< 1	0.35	5	58	< 5	< 0.1	13.6	< 0.2	25.1	1.9	332	< 0.1	< 5	2.06	1.29	0.46	0.51	< 1
13: SC_VC-15	< 1	1.23	< 5	179	< 5	< 0.1	2.1	< 0.2	75.7	3.0	664	< 0.1	9	4.46	2.65	0.75	1.23	3
14: SC_VC-18	< 1	1.35	< 5	223	< 5	< 0.1	4.5	< 0.2	53.3	2.3	437	< 0.1	6	2.73	1.48	0.51	0.84	3
15: SC_VC-19	< 1	2.53	6	270	< 5	0.1	8.9	< 0.2	99.6	3.9	277	0.7	7	5.39	2.88	0.92	1.40	6
16: SC_VC-20	< 1	0.70	8	114	< 5	0.1	9.1	< 0.2	26.6	2.4	533	< 0.1	6	1.58	0.93	0.40	0.86	2
17: SC_VC-21	< 1	1.67	10	259	< 5	0.7	2.7	< 0.2	56.5	3.3	673	0.1	9	3.20	1.85	0.57	1.26	4
18: SC_VC-22	< 1	0.55	8	133	< 5	0.3	4.2	< 0.2	15.0	2.0	718	0.4	8	0.74	0.41	0.15	0.87	1

Sample ID	Gd ppm	Ge ppm	Hf ppm	Ho ppm	In ppm	K %	La ppm	Li ppm	Lu ppm	Mg %	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	P %	Pb ppm	Pr ppm
11: SC_VC-7	2.28	< 1	5	0.37	< 0.2	0.4	15.1	< 10	0.17	0.20	112	< 2	3	15.3	15	0.17	< 5	3.81
12: SC_VC-14	2.41	< 1	5	0.46	< 0.2	0.2	14.3	< 10	0.21	0.17	95	< 2	2	13.7	< 10	0.31	< 5	3.25
13: SC_VC-15	5.59	1	24	0.89	< 0.2	0.6	38.4	< 10	0.39	0.20	283	3	11	34.4	14	0.25	8	9.05
14: SC_VC-18	3.44	< 1	14	0.53	< 0.2	0.7	26.4	< 10	0.24	0.23	172	< 2	6	24.2	12	0.09	8	6.39
15: SC_VC-19	7.02	< 1	16	1.02	< 0.2	0.9	48.5	15	0.42	0.36	260	2	10	44.1	11	0.25	11	11.9
16: SC_VC-20	1.80	< 1	6	0.31	< 0.2	0.4	13.3	< 10	0.15	0.19	132	< 2	4	13.3	11	0.10	5	3.40
17: SC_VC-21	3.78	1	16	0.67	< 0.2	0.8	27.5	< 10	0.30	0.25	246	3	8	25.4	16	0.05	10	6.64
18: SC_VC-22	0.84	< 1	1	0.15	< 0.2	0.5	7.2	< 10	0.08	0.08	107	3	< 1	6.6	14	0.01	6	1.73

Sample ID	Rb ppm	Sc ppm	Sb ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm	Th ppm	Ti %	Tl ppm	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm	Zr ppm
11: SC_VC-7	8.8	< 5	0.2	3.0	< 1	658	< 0.5	0.32	3.1	0.09	< 0.5	0.13	2.21	10	< 1	12.0	0.8	< 10	194
12: SC_VC-14	3.8	< 5	0.2	2.7	< 1	849	< 0.5	0.34	2.0	0.07	< 0.5	0.19	2.76	8	< 1	15.7	1.2	< 10	199
13: SC_VC-15	13.6	< 5	0.2	6.6	< 1	190	0.8	0.76	12.7	0.43	< 0.5	0.36	5.10	23	1	26.9	2.6	15	951
14: SC_VC-18	17.2	< 5	0.3	4.4	< 1	359	0.6	0.48	8.4	0.22	< 0.5	0.24	2.87	15	< 1	15.4	1.5	11	541
15: SC_VC-19	28.2	< 5	0.2	8.5	1	576	0.8	0.95	16.1	0.35	< 0.5	0.41	6.91	32	< 1	28.7	2.7	22	586
16: SC_VC-20	8.6	< 5	0.2	2.3	1	544	< 0.5	0.26	2.9	0.13	< 0.5	0.13	1.52	14	< 1	9.6	0.9	12	239
17: SC_VC-21	20.2	< 5	0.2	4.6	6	252	0.6	0.53	9.6	0.31	< 0.5	0.27	2.64	24	1	18.0	1.8	18	600
18: SC_VC-22	11.0	< 5	0.2	1.2	4	267	< 0.5	0.11	1.6	0.02	< 0.5	0.06	0.64	12	< 1	3.9	0.3	45	51.4

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LR Report : **CA02708-SEP17**

Sample ID	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe %	Ga ppm
19: SC_VC-23	< 1	4.53	10	363	< 5	0.2	1.1	< 0.2	54.6	7.1	478	1.6	12	3.27	1.97	0.87	2.31	11
20: SC_VC-24	< 1	1.06	< 5	247	< 5	< 0.1	2.9	< 0.2	15.1	2.2	762	0.3	8	0.74	0.42	0.20	0.85	2
21: SC_VC-25	< 1	0.35	31	31	< 5	< 0.1	11.0	< 0.2	18.5	2.0	588	< 0.1	6	1.56	0.93	0.38	2.20	1
22: SC_VC-26	< 1	0.56	28	66	< 5	< 0.1	8.5	< 0.2	24.7	2.2	594	0.2	8	1.67	0.97	0.42	1.80	2
23: SC_VC-27	< 1	0.48	48	56	< 5	< 0.1	8.4	< 0.2	24.3	2.6	550	< 0.1	7	1.86	1.13	0.37	2.44	1
24: SC_VC-28	< 1	0.32	< 5	55	< 5	< 0.1	1.3	< 0.2	17.0	1.6	651	< 0.1	7	1.03	0.66	0.17	0.81	< 1
25: SC_VC-29	< 1	0.42	9	56	< 5	< 0.1	2.7	< 0.2	24.0	2.1	706	< 0.1	10	1.59	0.98	0.28	1.12	1
26: SC_VC-30	< 1	0.64	8	70	< 5	< 0.1	5.0	< 0.2	32.1	2.3	713	0.1	8	1.71	1.07	0.34	1.15	2

Sample ID	Gd ppm	Ge ppm	Hf ppm	Ho ppm	In ppm	K %	La ppm	Li ppm	Lu ppm	Mg %	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	P %	Pb ppm	Pr ppm
19: SC_VC-23	3.83	1	9	0.64	< 0.2	1.3	26.2	26	0.31	0.35	268	2	10	24.3	21	0.02	15	6.43
20: SC_VC-24	0.85	< 1	3	0.15	< 0.2	0.9	7.7	< 10	0.08	0.08	125	3	3	6.6	26	0.03	7	1.78
21: SC_VC-25	1.72	< 1	4	0.30	< 0.2	0.2	8.9	< 10	0.13	0.27	153	2	3	9.7	22	0.25	5	2.39
22: SC_VC-26	1.96	< 1	9	0.31	< 0.2	0.3	11.5	< 10	0.14	0.29	149	3	4	12.2	17	0.14	6	2.99
23: SC_VC-27	1.98	< 1	17	0.37	< 0.2	0.3	11.4	< 10	0.19	0.29	215	2	9	12.2	37	0.12	7	3.04
24: SC_VC-28	1.23	1	12	0.20	< 0.2	0.2	8.4	< 10	0.14	0.08	112	3	4	7.7	16	0.04	< 5	2.06
25: SC_VC-29	1.92	1	16	0.31	< 0.2	0.2	11.6	< 10	0.19	0.11	157	3	6	11.2	12	0.19	< 5	2.92
26: SC_VC-30	2.12	< 1	14	0.36	< 0.2	0.3	15.4	< 10	0.17	0.19	171	3	7	14.8	18	0.09	8	3.75

Sample ID	Rb ppm	Sc ppm	Sb ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm	Th ppm	Ti %	Tl ppm	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm	Zr ppm
19: SC_VC-23	45.7	7	0.3	4.5	2	177	0.7	0.58	8.3	0.36	< 0.5	0.28	2.97	57	1	17.0	1.9	39	337
20: SC_VC-24	20.6	< 5	0.2	1.2	< 1	212	< 0.5	0.13	2.4	0.08	< 0.5	0.06	1.52	11	< 1	3.9	0.4	< 10	138
21: SC_VC-25	4.1	< 5	0.7	1.9	< 1	469	< 0.5	0.25	1.7	0.09	< 0.5	0.13	3.88	68	< 1	8.9	0.8	54	173
22: SC_VC-26	7.8	< 5	0.7	2.3	< 1	523	< 0.5	0.27	3.1	0.16	< 0.5	0.14	3.09	50	< 1	8.6	0.9	22	350
23: SC_VC-27	6.1	< 5	0.7	2.4	< 1	451	0.6	0.29	3.5	0.31	< 0.5	0.17	2.20	71	< 1	9.7	1.2	27	662
24: SC_VC-28	4.0	< 5	0.2	1.6	< 1	96.5	< 0.5	0.17	2.9	0.15	< 0.5	0.10	1.30	13	1	5.6	0.6	< 10	454
25: SC_VC-29	4.4	< 5	0.3	2.2	< 1	141	< 0.5	0.28	3.7	0.15	< 0.5	0.15	3.64	30	1	9.4	1.1	19	670
26: SC_VC-30	7.0	< 5	0.3	2.8	< 1	347	< 0.5	0.30	5.1	0.26	< 0.5	0.16	2.73	22	< 1	9.7	1.1	18	566

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Sample ID	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe %	Ga ppm
27: NC_VC-3	< 1	1.47	9	156	< 5	< 0.1	7.6	< 0.2	39.4	2.8	509	0.4	8	2.20	1.27	0.50	1.21	4
28: NC_VC-4	< 1	0.66	< 5	103	< 5	< 0.1	2.1	< 0.2	29.6	2.5	794	< 0.1	8	1.51	0.83	0.30	1.00	2
29: NC_VC-6	< 1	1.08	< 5	139	< 5	< 0.1	2.2	< 0.2	34.3	2.8	791	0.2	11	2.17	1.31	0.38	1.16	3
30: NC_VC-8	< 1	1.58	11	136	< 5	< 0.1	5.4	< 0.2	25.8	2.7	365	0.5	6	1.67	0.94	0.41	1.18	4
31: NC_VC-9	< 1	1.88	6	221	< 5	< 0.1	3.3	< 0.2	33.8	3.0	597	0.7	9	2.15	1.24	0.57	1.29	5
32: NC_VC-10	< 1	0.48	< 5	54	< 5	< 0.1	28.2	0.7	8.4	1.5	118	0.1	< 5	0.84	0.51	0.20	0.35	1
33: NC_VC-15	< 1	0.38	< 5	60	< 5	< 0.1	5.7	< 0.2	19.8	1.7	683	< 0.1	6	1.36	0.81	0.29	0.79	1
34: NC_VC-19	< 1	1.35	< 5	185	< 5	< 0.1	4.7	0.2	28.7	2.2	706	0.5	7	2.25	1.39	0.52	0.93	3

Sample ID	Gd ppm	Ge ppm	Hf ppm	Ho ppm	In ppm	K %	La ppm	Li ppm	Lu ppm	Mg %	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	P %	Pb ppm	Pr ppm
27: NC_VC-3	2.73	< 1	16	0.44	< 0.2	0.6	19.1	13	0.22	0.37	198	3	7	17.9	15	0.06	7	4.77
28: NC_VC-4	2.01	< 1	13	0.25	< 0.2	0.4	14.3	< 10	0.17	0.16	148	3	6	13.3	21	0.05	6	3.48
29: NC_VC-6	2.43	1	12	0.44	< 0.2	0.5	16.5	< 10	0.22	0.23	171	4	8	15.1	14	0.04	6	3.98
30: NC_VC-8	1.89	< 1	8	0.32	< 0.2	0.5	12.4	16	0.15	0.35	122	4	5	11.8	18	0.05	6	3.08
31: NC_VC-9	2.50	1	14	0.44	< 0.2	0.8	16.2	15	0.21	0.33	181	4	7	15.7	18	0.09	9	4.06
32: NC_VC-10	0.87	< 1	4	0.16	< 0.2	0.3	4.8	< 10	0.09	0.51	59	3	2	4.6	< 10	0.12	< 5	1.09
33: NC_VC-15	1.72	1	11	0.28	< 0.2	0.2	9.4	< 10	0.16	0.15	114	3	4	9.7	17	0.15	< 5	2.37
34: NC_VC-19	2.56	< 1	11	0.47	< 0.2	0.6	14.0	< 10	0.20	0.24	132	5	7	14.3	15	0.17	6	3.48

Sample ID	Rb ppm	Sc ppm	Sb ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm	Th ppm	Ti %	Tl ppm	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm	Zr ppm
27: NC_VC-3	18.0	< 5	0.3	3.4	< 1	372	< 0.5	0.37	5.7	0.28	< 0.5	0.19	3.37	29	< 1	11.6	1.2	21	634
28: NC_VC-4	8.7	< 5	0.2	2.6	< 1	147	< 0.5	0.29	4.5	0.20	< 0.5	0.13	2.13	15	< 1	7.8	0.8	11	505
29: NC_VC-6	14.1	< 5	0.3	3.0	< 1	181	0.6	0.36	5.4	0.32	< 0.5	0.20	3.86	21	< 1	11.9	1.3	17	470
30: NC_VC-8	17.4	< 5	0.5	2.3	< 1	360	< 0.5	0.27	3.3	0.18	< 0.5	0.15	3.29	30	< 1	8.7	1.0	14	304
31: NC_VC-9	21.7	< 5	0.4	3.3	< 1	262	< 0.5	0.36	4.3	0.27	< 0.5	0.19	2.60	28	< 1	12.1	1.3	21	501
32: NC_VC-10	5.7	< 5	0.4	0.9	< 1	1250	< 0.5	0.13	0.8	0.09	< 0.5	0.08	2.94	13	< 1	5.3	0.4	21	159
33: NC_VC-15	4.5	< 5	1.3	2.0	< 1	352	< 0.5	0.23	2.5	0.13	< 0.5	0.12	1.72	11	< 1	8.0	0.8	12	435
34: NC_VC-19	16.7	< 5	1.0	2.7	< 1	378	< 0.5	0.37	3.0	0.23	< 0.5	0.22	3.45	17	< 1	14.0	1.4	14	435

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Sample ID	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Dy ppm	Er ppm	Eu ppm	Fe %	Ga ppm
35: NC_VC-24	< 1	0.45	< 5	76	< 5	< 0.1	7.5	< 0.2	15.0	1.5	517	< 0.1	< 5	1.13	0.68	0.32	0.56	1
36: NC_VC-25	< 1	0.68	< 5	133	< 5	< 0.1	2.2	< 0.2	21.9	1.8	727	0.2	7	1.74	1.06	0.45	0.79	2
37: NC_VC-27	< 1	0.66	< 5	100	< 5	< 0.1	4.6	< 0.2	25.6	2.0	669	0.1	7	2.11	1.44	0.48	0.91	2
38: NC_VC-31	< 1	0.44	< 5	71	< 5	< 0.1	5.3	0.2	19.7	1.9	677	< 0.1	7	1.66	1.09	0.44	0.78	1
39: NC_VC-32	< 1	0.98	33	83	< 5	< 0.1	13.8	0.2	34.0	4.3	342	0.3	< 5	2.50	1.28	0.70	1.45	3
40: NC_VC-33	< 1	0.61	8	99	< 5	< 0.1	8.3	0.2	29.9	2.2	493	< 0.1	5	2.20	1.24	0.59	0.90	2
41: NC_VC-34	< 1	1.73	19	120	< 5	< 0.1	18.0	< 0.2	24.2	3.8	268	0.9	5	1.59	0.90	0.49	1.33	4
42: NC_VC-37	< 1	1.25	< 5	171	< 5	< 0.1	0.4	< 0.2	23.7	3.5	728	0.2	9	1.64	1.15	0.39	1.31	3

Sample ID	Gd ppm	Ge ppm	Hf ppm	Ho ppm	In ppm	K %	La ppm	Li ppm	Lu ppm	Mg %	Mn ppm	Mo ppm	Nb ppm	Nd ppm	Ni ppm	P %	Pb ppm	Pr ppm
35: NC_VC-24	1.38	< 1	6	0.23	< 0.2	0.3	7.1	< 10	0.10	0.10	78	3	3	7.6	< 10	0.10	< 5	1.87
36: NC_VC-25	2.03	1	13	0.34	< 0.2	0.4	10.6	< 10	0.17	0.09	126	3	7	11.0	13	0.17	< 5	2.66
37: NC_VC-27	2.38	< 1	29	0.46	< 0.2	0.3	12.2	< 10	0.28	0.10	200	3	12	12.7	13	0.21	< 5	3.22
38: NC_VC-31	2.00	< 1	12	0.35	< 0.2	0.2	9.5	< 10	0.18	0.13	128	3	5	10.0	19	0.25	< 5	2.44
39: NC_VC-32	2.86	< 1	5	0.44	< 0.2	0.4	15.7	13	0.17	0.55	206	5	3	17.0	15	0.23	< 5	4.16
40: NC_VC-33	2.49	< 1	9	0.43	< 0.2	0.3	13.9	< 10	0.19	0.27	136	2	6	15.2	14	0.21	< 5	3.70
41: NC_VC-34	1.91	< 1	3	0.30	< 0.2	0.5	11.5	18	0.13	0.45	139	8	4	11.6	14	0.12	5	2.86
42: NC_VC-37	1.68	1	17	0.36	< 0.2	0.6	11.3	< 10	0.22	0.15	257	3	13	10.6	18	< 0.01	6	2.90

Sample ID	Rb ppm	Sc ppm	Sb ppm	Sm ppm	Sn ppm	Sr ppm	Ta ppm	Tb ppm	Th ppm	Ti %	Tl ppm	Tm ppm	U ppm	V ppm	W ppm	Y ppm	Yb ppm	Zn ppm	Zr ppm
35: NC_VC-24	6.0	< 5	0.7	1.5	< 1	422	< 0.5	0.21	1.3	0.09	< 0.5	0.10	1.75	8	< 1	6.8	0.6	< 10	255
36: NC_VC-25	9.5	< 5	0.4	2.2	< 1	154	< 0.5	0.30	2.3	0.23	< 0.5	0.15	1.93	12	< 1	10.7	1.0	10	527
37: NC_VC-27	6.6	< 5	0.5	2.6	< 1	217	0.8	0.33	3.2	0.44	< 0.5	0.23	2.73	15	< 1	13.7	1.6	19	1120
38: NC_VC-31	5.1	< 5	0.6	2.1	< 1	331	< 0.5	0.27	1.8	0.19	< 0.5	0.15	2.70	11	< 1	11.1	1.0	11	480
39: NC_VC-32	11.4	< 5	0.7	3.4	< 1	1330	< 0.5	0.41	2.2	0.11	< 0.5	0.18	4.26	29	< 1	13.2	1.0	19	213
40: NC_VC-33	7.4	< 5	0.7	2.9	< 1	726	< 0.5	0.37	2.5	0.20	< 0.5	0.19	2.41	16	< 1	13.1	1.1	13	361
41: NC_VC-34	23.1	< 5	0.9	2.2	< 1	1130	< 0.5	0.27	2.5	0.13	< 0.5	0.13	4.56	36	< 1	8.4	0.8	21	132
42: NC_VC-37	15.2	< 5	0.2	2.1	1	72.1	0.8	0.27	3.1	0.50	< 0.5	0.18	1.05	22	< 1	9.5	1.2	17	703

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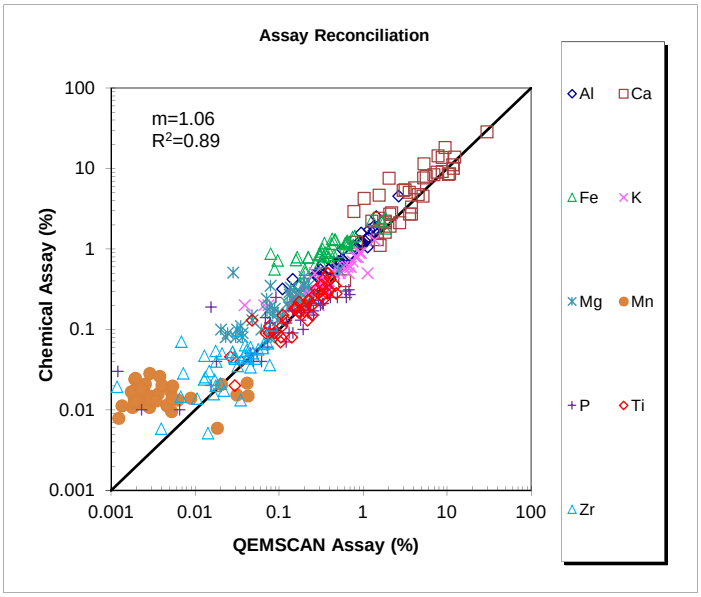
Control Quality Assay
Not Suitable for Commercial Exchange

Tom Watt
Project Coordinator

Appendix C – QEMSCAN Data

South Carolina Department of Natural Resources
CALR-16225-001
MI5017-SEP17

Assay Reconciliation



Sample	GA_VC-1			GA_VC-3			GA_VC-5			GA_VC-6		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.56	0.46	0.58	1.42	0.34	1.47	0.81	0.72	0.84	0.41	0.38	0.59
Al (Chemical)	0.74	-	-	1.79	-	-	1.01	-	-	0.42	-	-
Ca (QEMSCAN)	2.12	5.93	1.52	3.60	4.69	3.55	1.85	0.97	2.12	0.84	0.59	2.44
Ca (Chemical)	1.90	-	-	2.70	-	-	1.60	-	-	1.20	-	-
Fe (QEMSCAN)	0.31	0.02	0.35	0.61	0.06	0.64	0.39	0.04	0.50	0.10	0.05	0.40
Fe (Chemical)	0.84	-	-	1.18	-	-	0.80	-	-	0.72	-	-
K (QEMSCAN)	0.35	0.29	0.36	0.86	0.23	0.89	0.45	0.59	0.41	0.33	0.33	0.34
K (Chemical)	0.40	-	-	0.80	-	-	0.50	-	-	0.30	-	-
Mg (QEMSCAN)	0.10	0.03	0.11	0.14	0.04	0.15	0.10	0.04	0.11	0.04	0.03	0.10
Mg (Chemical)	0.13	-	-	0.24	-	-	0.16	-	-	0.08	-	-
Mn (QEMSCAN)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn (Chemical)	0.01	-	-	0.02	-	-	0.01	-	-	0.01	-	-
P (QEMSCAN)	0.34	0.01	0.39	0.31	0.03	0.32	0.22	0.00	0.29	0.06	0.00	0.46
P (Chemical)	0.21	-	-	0.20	-	-	0.16	-	-	0.04	-	-
Ti (QEMSCAN)	0.20	0.00	0.23	0.29	0.01	0.31	0.17	0.00	0.23	0.04	0.01	0.20
Ti (Chemical)	0.17	-	-	0.28	-	-	0.17	-	-	0.04	-	-
Zr (QEMSCAN)	0.01	0.00	0.01	0.04	0.00	0.04	0.02	0.00	0.02	0.00	0.00	0.03
Zr (Chemical)	0.03	-	-	0.05	-	-	0.02	-	-	0.01	-	-

Sample	GA_VC-7			GA_VC-9			GA_VC-11		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.50	0.38	0.65	0.27	0.16	0.75	0.68	0.40	1.19
Al (Chemical)	0.64	-	-	0.48	-	-	0.84	-	-
Ca (QEMSCAN)	1.51	0.85	2.39	1.57	1.00	4.03	5.34	5.15	5.68
Ca (Chemical)	1.60	-	-	2.40	-	-	11.3	-	-
Fe (QEMSCAN)	0.39	0.03	0.88	0.16	0.02	0.75	0.31	0.19	0.54
Fe (Chemical)	0.94	-	-	0.73	-	-	0.69	-	-
K (QEMSCAN)	0.35	0.33	0.39	0.21	0.16	0.44	0.44	0.30	0.71
K (Chemical)	0.30	-	-	0.30	-	-	0.50	-	-
Mg (QEMSCAN)	0.06	0.03	0.10	0.04	0.03	0.08	0.13	0.09	0.18
Mg (Chemical)	0.10	-	-	0.09	-	-	0.21	-	-
Mn (QEMSCAN)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.01	-	-	0.01	-	-
P (QEMSCAN)	0.24	0.01	0.55	0.18	0.00	0.95	0.18	0.00	0.51
P (Chemical)	0.20	-	-	0.16	-	-	0.13	-	-
Ti (QEMSCAN)	0.34	0.00	0.81	0.11	0.02	0.50	0.10	0.02	0.24
Ti (Chemical)	0.24	-	-	0.11	-	-	0.09	-	-
Zr (QEMSCAN)	0.03	0.00	0.06	0.03	0.00	0.15	0.01	0.00	0.02
Zr (Chemical)	0.05	-	-	0.05	-	-	0.01	-	-

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Assay Reconciliation

Sample	SC_VC-1			SC_VC-4			SC_VC-6		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.54	0.53	0.65	0.93	0.49	1.11	0.36	0.29	0.77
Al (Chemical)	0.68	-	-	1.13	-	-	0.33	-	-
Ca (QEMSCAN)	2.21	2.15	2.59	5.67	13.6	2.42	7.90	8.68	2.94
Ca (Chemical)	2.80	-	-	7.90	-	-	14.2	-	-
Fe (QEMSCAN)	0.67	0.25	3.24	0.39	0.15	0.49	0.20	0.08	1.00
Fe (Chemical)	1.04	-	-	0.80	-	-	0.55	-	-
K (QEMSCAN)	0.30	0.30	0.30	0.59	0.32	0.70	0.29	0.27	0.47
K (Chemical)	0.40	-	-	0.60	-	-	0.20	-	-
Mg (QEMSCAN)	0.08	0.06	0.15	0.16	0.11	0.18	0.09	0.08	0.16
Mg (Chemical)	0.08	-	-	0.24	-	-	0.18	-	-
Mn (QEMSCAN)	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.01	-	-	0.01	-	-
P (QEMSCAN)	0.62	0.61	0.69	0.12	0.17	0.10	0.70	0.72	0.54
P (Chemical)	0.30	-	-	0.07	-	-	0.27	-	-
Ti (QEMSCAN)	0.48	0.12	2.70	0.16	0.01	0.22	0.11	0.00	0.77
Ti (Chemical)	0.28	-	-	0.18	-	-	0.08	-	-
Zr (QEMSCAN)	0.04	0.00	0.29	0.02	0.00	0.03	0.02	0.00	0.12
Zr (Chemical)	0.04	-	-	0.04	-	-	0.02	-	-
Sample	**SC_VC-7**			**SC_VC-14**			**SC_VC-15**		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.51	0.28	0.81	0.33	0.27	0.73	0.98	0.49	1.03
Al (Chemical)	0.69	-	-	0.35	-	-	1.23	-	-
Ca (QEMSCAN)	12.0	18.4	3.34	8.85	9.62	4.43	2.76	6.65	2.37
Ca (Chemical)	10.0	-	-	13.6	-	-	2.10	-	-
Fe (QEMSCAN)	0.27	0.18	0.40	0.20	0.08	0.92	0.68	0.13	0.74
Fe (Chemical)	0.65	-	-	0.51	-	-	1.23	-	-
K (QEMSCAN)	0.30	0.15	0.50	0.21	0.17	0.48	0.65	0.30	0.69
K (Chemical)	0.40	-	-	0.20	-	-	0.60	-	-
Mg (QEMSCAN)	0.15	0.16	0.14	0.07	0.06	0.15	0.21	0.13	0.21
Mg (Chemical)	0.20	-	-	0.17	-	-	0.20	-	-
Mn (QEMSCAN)	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00
Mn (Chemical)	0.01	-	-	0.01	-	-	0.03	-	-
P (QEMSCAN)	0.15	0.13	0.17	0.68	0.68	0.69	0.41	0.18	0.43
P (Chemical)	0.17	-	-	0.31	-	-	0.25	-	-
Ti (QEMSCAN)	0.09	0.00	0.20	0.10	0.00	0.70	0.35	0.00	0.38
Ti (Chemical)	0.09	-	-	0.07	-	-	0.43	-	-
Zr (QEMSCAN)	0.00	0.00	0.00	0.02	0.00	0.11	0.03	0.00	0.04
Zr (Chemical)	0.02	-	-	0.02	-	-	0.10	-	-
Sample	**SC_VC-18**			**SC_VC-19**			**SC_VC-20**		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	1.16	0.46	1.27	1.43	0.38	2.11	0.51	0.25	0.97
Al (Chemical)	1.35	-	-	2.53	-	-	0.70	-	-
Ca (QEMSCAN)	5.23	16.2	3.45	7.67	13.2	4.11	8.83	12.5	2.44
Ca (Chemical)	4.50	-	-	8.90	-	-	9.10	-	-
Fe (QEMSCAN)	0.45	0.14	0.50	0.75	0.19	1.11	0.30	0.14	0.58
Fe (Chemical)	0.84	-	-	1.40	-	-	0.86	-	-
K (QEMSCAN)	0.75	0.27	0.82	0.90	0.29	1.29	0.33	0.16	0.63
K (Chemical)	0.70	-	-	0.90	-	-	0.40	-	-
Mg (QEMSCAN)	0.17	0.11	0.18	0.20	0.13	0.25	0.13	0.11	0.16
Mg (Chemical)	0.23	-	-	0.36	-	-	0.19	-	-
Mn (QEMSCAN)	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.03	-	-	0.01	-	-
P (QEMSCAN)	0.13	0.31	0.10	0.64	1.46	0.11	0.20	0.24	0.12
P (Chemical)	0.09	-	-	0.25	-	-	0.10	-	-
Ti (QEMSCAN)	0.17	0.00	0.20	0.47	0.22	0.63	0.12	0.03	0.28
Ti (Chemical)	0.22	-	-	0.35	-	-	0.13	-	-
Zr (QEMSCAN)	0.02	0.01	0.02	0.06	0.00	0.10	0.01	0.00	0.03
Zr (Chemical)	0.05	-	-	0.06	-	-	0.02	-	-

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Sample	SC_VC-21			SC_VC-22			SC_VC-23			SC_VC-24		
Element	Combined	+212um	-212um	Combined	+212um	-212um	Combined	+212um	-212um	Combined	+212um	-212um
Al (QEMSCAN)	1.34	0.89	1.37	0.31	0.24	1.89	2.65	1.15	3.32	1.13	1.10	1.75
Al (Chemical)	1.67	-	-	0.55	-	-	4.53	-	-	1.06	-	-
Ca (QEMSCAN)	3.80	19.2	2.87	1.04	0.90	4.08	1.61	0.59	2.07	0.78	0.67	3.19
Ca (Chemical)	2.70	-	-	4.20	-	-	1.10	-	-	2.90	-	-
Fe (QEMSCAN)	0.64	0.17	0.67	0.08	0.02	1.44	1.28	0.39	1.68	0.31	0.22	2.11
Fe (Chemical)	1.26	-	-	0.87	-	-	2.31	-	-	0.85	-	-
K (QEMSCAN)	0.81	0.54	0.83	0.27	0.22	1.16	1.37	0.91	1.58	0.94	0.93	1.11
K (Chemical)	0.80	-	-	0.50	-	-	1.30	-	-	0.90	-	-
Mg (QEMSCAN)	0.24	0.12	0.25	0.02	0.01	0.38	0.23	0.06	0.30	0.08	0.06	0.55
Mg (Chemical)	0.25	-	-	0.08	-	-	0.35	-	-	0.08	-	-
Mn (QEMSCAN)	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.01	-	-	0.03	-	-	0.01	-	-
P (QEMSCAN)	0.05	0.37	0.04	0.00	0.00	0.05	0.02	0.00	0.02	0.00	0.00	0.03
P (Chemical)	0.05	-	-	0.01	-	-	0.02	-	-	0.03	-	-
Ti (QEMSCAN)	0.40	0.01	0.42	0.03	0.00	0.68	0.32	0.20	0.37	0.14	0.09	1.19
Ti (Chemical)	0.31	-	-	0.02	-	-	0.36	-	-	0.08	-	-
Zr (QEMSCAN)	0.05	0.00	0.05	0.01	0.01	0.19	0.05	0.02	0.06	0.01	0.00	0.23
Zr (Chemical)	0.06	-	-	0.01	-	-	0.03	-	-	0.01	-	-

Sample	SC_VC-25			SC_VC-26			SC_VC-27		
Element	Combined	+212um	-212um	Combined	+212um	-212um	Combined	+212um	-212um
Al (QEMSCAN)	0.17	0.15	0.38	0.39	0.26	0.72	0.29	0.22	0.43
Al (Chemical)	0.35	-	-	0.56	-	-	0.48	-	-
Ca (QEMSCAN)	11.8	11.3	16.0	10.8	11.7	8.33	10.4	11.6	8.16
Ca (Chemical)	11.0	-	-	8.50	-	-	8.40	-	-
Fe (QEMSCAN)	1.67	1.15	6.14	1.84	2.07	1.23	1.85	1.44	2.66
Fe (Chemical)	2.20	-	-	1.80	-	-	2.44	-	-
K (QEMSCAN)	0.07	0.06	0.21	0.24	0.13	0.53	0.25	0.22	0.29
K (Chemical)	0.20	-	-	0.30	-	-	0.30	-	-
Mg (QEMSCAN)	0.13	0.12	0.25	0.18	0.19	0.16	0.13	0.13	0.14
Mg (Chemical)	0.27	-	-	0.29	-	-	0.29	-	-
Mn (QEMSCAN)	0.03	0.02	0.11	0.04	0.05	0.02	0.04	0.05	0.03
Mn (Chemical)	0.02	-	-	0.01	-	-	0.02	-	-
P (QEMSCAN)	0.09	0.08	0.21	0.07	0.05	0.11	0.08	0.03	0.18
P (Chemical)	0.25	-	-	0.14	-	-	0.12	-	-
Ti (QEMSCAN)	0.08	0.01	0.65	0.18	0.00	0.63	0.33	0.01	0.96
Ti (Chemical)	0.09	-	-	0.16	-	-	0.31	-	-
Zr (QEMSCAN)	0.02	0.01	0.16	0.03	0.01	0.10	0.07	0.00	0.19
Zr (Chemical)	0.02	-	-	0.04	-	-	0.07	-	-

Sample	SC_VC-28			SC_VC-29			SC_VC-30		
Element	Combined	+212um	-212um	Combined	+212um	-212um	Combined	+212um	-212um
Al (QEMSCAN)	0.11	0.05	0.71	0.15	0.09	0.83	0.33	0.20	0.88
Al (Chemical)	0.32	-	-	0.42	-	-	0.64	-	-
Ca (QEMSCAN)	1.49	1.17	4.41	2.09	1.61	7.89	3.59	3.45	4.19
Ca (Chemical)	1.30	-	-	2.70	-	-	5.00	-	-
Fe (QEMSCAN)	0.34	0.08	2.80	0.76	0.61	2.64	0.64	0.42	1.59
Fe (Chemical)	0.81	-	-	1.12	-	-	1.15	-	-
K (QEMSCAN)	0.07	0.04	0.35	0.04	0.00	0.47	0.22	0.15	0.55
K (Chemical)	0.20	-	-	0.20	-	-	0.30	-	-
Mg (QEMSCAN)	0.03	0.01	0.18	0.03	0.02	0.22	0.08	0.06	0.17
Mg (Chemical)	0.08	-	-	0.11	-	-	0.19	-	-
Mn (QEMSCAN)	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.01
Mn (Chemical)	0.01	-	-	0.02	-	-	0.02	-	-
P (QEMSCAN)	0.02	0.00	0.19	0.02	0.00	0.17	0.15	0.13	0.22
P (Chemical)	0.04	-	-	0.19	-	-	0.09	-	-
Ti (QEMSCAN)	0.25	0.01	2.46	0.11	0.00	1.43	0.32	0.08	1.36
Ti (Chemical)	0.15	-	-	0.15	-	-	0.26	-	-
Zr (QEMSCAN)	0.04	0.00	0.43	0.07	0.01	0.87	0.06	0.00	0.29
Zr (Chemical)	0.05	-	-	0.07	-	-	0.06	-	-

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Sample	NC_VC-3			NC_VC-4			NC_VC-6		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	1.24	0.50	1.37	0.52	0.20	0.78	0.80	0.23	0.92
Al (Chemical)	1.47	-	-	0.66	-	-	1.08	-	-
Ca (QEMSCAN)	5.30	15.6	3.46	1.86	2.75	1.14	1.86	3.32	1.54
Ca (Chemical)	7.60	-	-	2.10	-	-	2.20	-	-
Fe (QEMSCAN)	0.64	0.41	0.68	0.33	0.14	0.49	0.42	0.08	0.50
Fe (Chemical)	1.21	-	-	1.00	-	-	1.16	-	-
K (QEMSCAN)	0.71	0.36	0.77	0.39	0.15	0.59	0.53	0.23	0.60
K (Chemical)	0.60	-	-	0.40	-	-	0.50	-	-
Mg (QEMSCAN)	0.20	0.38	0.16	0.08	0.07	0.09	0.15	0.03	0.17
Mg (Chemical)	0.37	-	-	0.16	-	-	0.23	-	-
Mn (QEMSCAN)	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn (Chemical)	0.02	-	-	0.01	-	-	0.02	-	-
P (QEMSCAN)	0.07	0.00	0.09	0.05	0.05	0.04	0.05	0.05	0.05
P (Chemical)	0.06	-	-	0.05	-	-	0.04	-	-
Ti (QEMSCAN)	0.38	0.03	0.44	0.25	0.06	0.40	0.28	0.01	0.34
Ti (Chemical)	0.28	-	-	0.20	-	-	0.32	-	-
Zr (QEMSCAN)	0.04	0.00	0.05	0.05	0.00	0.09	0.01	0.00	0.02
Zr (Chemical)	0.06	-	-	0.05	-	-	0.05	-	-
Sample	**NC_VC-8**			**NC_VC-9**			**NC_VC-10**		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.95	0.52	1.21	1.33	0.97	1.35	0.34	0.13	0.55
Al (Chemical)	1.58	-	-	1.88	-	-	0.48	-	-
Ca (QEMSCAN)	3.18	3.42	3.04	3.79	10.8	3.49	30.2	36.1	24.0
Ca (Chemical)	5.40	-	-	3.30	-	-	28.2	-	-
Fe (QEMSCAN)	0.35	0.11	0.50	0.46	0.32	0.47	0.17	0.12	0.23
Fe (Chemical)	1.18	-	-	1.29	-	-	0.35	-	-
K (QEMSCAN)	0.68	0.44	0.83	0.82	0.57	0.83	0.23	0.14	0.31
K (Chemical)	0.50	-	-	0.80	-	-	0.30	-	-
Mg (QEMSCAN)	0.08	0.04	0.10	0.14	0.16	0.14	0.03	0.02	0.04
Mg (Chemical)	0.35	-	-	0.33	-	-	0.51	-	-
Mn (QEMSCAN)	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.02
Mn (Chemical)	0.01	-	-	0.02	-	-	0.01	-	-
P (QEMSCAN)	0.05	0.00	0.07	0.09	0.01	0.09	0.12	0.07	0.18
P (Chemical)	0.05	-	-	0.09	-	-	0.12	-	-
Ti (QEMSCAN)	0.15	0.01	0.24	0.26	0.04	0.27	0.03	0.00	0.05
Ti (Chemical)	0.18	-	-	0.27	-	-	0.05	-	-
Zr (QEMSCAN)	0.01	0.00	0.02	0.02	0.00	0.02	0.00	0.00	0.01
Zr (Chemical)	0.03	-	-	0.05	-	-	0.02	-	-
Sample	**NC_VC-15**			**NC_VC-19**			**NC_VC-24**		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.33	0.25	0.64	1.11	0.20	1.57	0.36	0.14	0.72
Al (Chemical)	0.38	-	-	1.35	-	-	0.45	-	-
Ca (QEMSCAN)	4.14	4.44	2.96	4.56	2.34	5.68	2.06	2.37	1.54
Ca (Chemical)	5.70	-	-	4.70	-	-	7.50	-	-
Fe (QEMSCAN)	0.22	0.15	0.52	0.32	0.04	0.46	0.09	0.03	0.20
Fe (Chemical)	0.79	-	-	0.93	-	-	0.56	-	-
K (QEMSCAN)	0.22	0.16	0.43	0.71	0.15	0.99	0.21	0.07	0.46
K (Chemical)	0.20	-	-	0.60	-	-	0.30	-	-
Mg (QEMSCAN)	0.05	0.05	0.04	0.07	0.02	0.10	0.02	0.02	0.03
Mg (Chemical)	0.15	-	-	0.24	-	-	0.10	-	-
Mn (QEMSCAN)	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00
Mn (Chemical)	0.01	-	-	0.01	-	-	0.01	-	-
P (QEMSCAN)	0.26	0.24	0.33	0.26	0.10	0.34	0.09	0.04	0.17
P (Chemical)	0.15	-	-	0.17	-	-	0.10	-	-
Ti (QEMSCAN)	0.22	0.11	0.66	0.23	0.05	0.32	0.07	0.00	0.19
Ti (Chemical)	0.13	-	-	0.23	-	-	0.09	-	-
Zr (QEMSCAN)	0.03	0.00	0.14	0.05	0.00	0.08	0.01	0.00	0.03
Zr (Chemical)	0.04	-	-	0.04	-	-	0.03	-	-

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Sample	NC_VC-25			NC_VC-27			NC_VC-31			NC_VC-32		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.55	0.16	0.69	0.46	0.20	0.65	0.29	0.18	0.60	0.57	0.27	1.31
Al (Chemical)	0.68	-	-	0.66	-	-	0.44	-	-	0.98	-	-
Ca (QEMSCAN)	1.28	1.68	1.14	1.57	1.31	1.76	3.02	3.37	2.07	12.4	14.5	7.33
Ca (Chemical)	2.20	-	-	4.60	-	-	5.30	-	-	13.8	-	-
Fe (QEMSCAN)	0.16	0.02	0.21	0.50	0.03	0.85	0.22	0.06	0.69	0.80	0.63	1.21
Fe (Chemical)	0.79	-	-	0.91	-	-	0.78	-	-	1.45	-	-
K (QEMSCAN)	0.38	0.10	0.47	0.24	0.15	0.30	0.19	0.14	0.33	0.36	0.19	0.78
K (Chemical)	0.40	-	-	0.30	-	-	0.20	-	-	0.40	-	-
Mg (QEMSCAN)	0.02	0.01	0.03	0.03	0.00	0.05	0.05	0.05	0.05	0.52	0.52	0.52
Mg (Chemical)	0.09	-	-	0.10	-	-	0.13	-	-	0.55	-	-
Mn (QEMSCAN)	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.03	0.01
Mn (Chemical)	0.01	-	-	0.02	-	-	0.01	-	-	0.02	-	-
P (QEMSCAN)	0.18	0.11	0.21	0.23	0.10	0.33	0.50	0.53	0.41	0.30	0.31	0.27
P (Chemical)	0.17	-	-	0.21	-	-	0.25	-	-	0.23	-	-
Ti (QEMSCAN)	0.22	0.00	0.29	0.40	0.01	0.69	0.16	0.00	0.59	0.08	0.01	0.25
Ti (Chemical)	0.23	-	-	0.44	-	-	0.19	-	-	0.11	-	-
Zr (QEMSCAN)	0.03	0.01	0.04	0.08	0.00	0.14	0.04	0.01	0.13	0.02	0.00	0.06
Zr (Chemical)	0.05	-	-	0.11	-	-	0.05	-	-	0.02	-	-

Sample	NC_VC-33			NC_VC-34			NC_VC-37		
Element	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**	**Combined**	**+212um**	**-212um**
Al (QEMSCAN)	0.56	0.35	0.92	1.19	0.10	3.14	0.92	0.52	1.12
Al (Chemical)	0.61	-	-	1.73	-	-	1.25	-	-
Ca (QEMSCAN)	7.01	9.05	3.51	9.57	12.8	3.79	0.61	0.22	0.80
Ca (Chemical)	8.30	-	-	18.0	-	-	0.40	-	-
Fe (QEMSCAN)	0.36	0.18	0.65	0.43	0.20	0.84	0.47	0.01	0.69
Fe (Chemical)	0.90	-	-	1.33	-	-	1.31	-	-
K (QEMSCAN)	0.37	0.27	0.56	1.13	0.07	3.04	0.49	0.36	0.55
K (Chemical)	0.30	-	-	0.50	-	-	0.60	-	-
Mg (QEMSCAN)	0.16	0.19	0.11	0.20	0.13	0.32	0.11	0.02	0.16
Mg (Chemical)	0.27	-	-	0.45	-	-	0.15	-	-
Mn (QEMSCAN)	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Mn (Chemical)	0.01	-	-	0.01	-	-	0.03	-	-
P (QEMSCAN)	0.33	0.33	0.33	0.08	0.11	0.02	0.01	0.00	0.01
P (Chemical)	0.21	-	-	0.12	-	-	0.01	-	-
Ti (QEMSCAN)	0.21	0.02	0.54	0.05	0.01	0.12	0.38	0.01	0.56
Ti (Chemical)	0.20	-	-	0.13	-	-	0.50	-	-
Zr (QEMSCAN)	0.08	0.00	0.21	0.03	0.00	0.10	0.01	0.00	0.01
Zr (Chemical)	0.04	-	-	0.01	-	-	0.07	-	-

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Modals

Survey		CALR-16225-001 / MI5017-SEP17														
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Sample		GA_VC-1					GA_VC-3					GA_VC-5				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			13.5		86.5			4.7		95.3			24.1		75.9	
Calculated ESD Particle Size		118	207		110		83	175		81		130	209		116	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.02	0.00	0.00	0.02	0.02	0.10	0.00	0.00	0.10	0.10	0.04	0.00	0.00	0.04	0.05
	Apatite	1.81	0.01	0.06	1.81	2.09	1.68	0.01	0.17	1.67	1.75	1.19	0.00	0.00	1.19	1.57
	Fe-Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Rutile	0.16	0.00	0.00	0.16	0.19	0.18	0.00	0.00	0.18	0.19	0.06	0.00	0.00	0.06	0.07
	Ilmenite	0.32	0.00	0.00	0.32	0.37	0.58	0.00	0.01	0.58	0.60	0.43	0.00	0.00	0.43	0.57
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.00	0.00	0.01	0.01	0.08	0.00	0.03	0.07	0.08	0.03	0.00	0.01	0.03	0.03
	Quartz	88.7	11.0	81.3	77.8	89.9	77.0	3.97	84.9	73.0	76.6	87.4	21.9	91.0	65.4	86.2
	Plagioclase	2.45	0.29	2.17	2.15	2.49	6.07	0.06	1.32	6.01	6.30	3.88	0.54	2.22	3.34	4.41
	K-Feldspar	2.71	0.30	2.23	2.41	2.79	6.63	0.08	1.67	6.56	6.88	3.54	1.11	4.59	2.43	3.21
	Biotite	0.02	0.00	0.01	0.01	0.02	0.07	0.00	0.04	0.07	0.07	0.01	0.00	0.02	0.01	0.01
	Muscovite	0.03	0.00	0.00	0.03	0.03	0.15	0.01	0.12	0.14	0.15	0.02	0.01	0.03	0.02	0.02
	Clays	0.08	0.00	0.00	0.08	0.09	0.21	0.00	0.02	0.21	0.22	0.10	0.00	0.01	0.09	0.12
	Chlorite	0.01	0.00	0.01	0.01	0.01	0.03	0.00	0.00	0.03	0.03	0.05	0.01	0.04	0.04	0.05
	Amphibole	0.61	0.01	0.05	0.60	0.70	0.77	0.00	0.04	0.77	0.81	0.55	0.05	0.20	0.50	0.66
	Epidote	0.37	0.00	0.00	0.37	0.43	0.94	0.00	0.01	0.94	0.98	0.48	0.00	0.00	0.48	0.63
	Grossular	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.05	0.05	0.04	0.00	0.00	0.04	0.06
	Titanite	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.02	0.02	0.00	0.00	0.02	0.03
	Other Silicates	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.01	0.06	0.07	0.01	0.00	0.00	0.01	0.01
	Calcite	2.55	1.91	14.1	0.64	0.74	5.15	0.50	10.7	4.65	4.87	2.06	0.45	1.88	1.60	2.11
	Ankerite	0.07	0.01	0.05	0.06	0.07	0.09	0.01	0.14	0.08	0.09	0.08	0.00	0.01	0.08	0.11
	Dolomite	0.02	0.00	0.02	0.01	0.02	0.09	0.00	0.08	0.08	0.09	0.02	0.00	0.00	0.02	0.03
	Fluorite	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.01
	Total	100.0	13.5	100.0	86.5	100.0	100.0	4.68	100.0	95.3	100.0	100.0	24.1	100.0	75.9	100.0
Mean Grain Size by Frequency (µm)	Monazite	81	0		81		21	54		13		61	0		61	
	Synchysite/Bastnaesite	20	0		20		17	0		17		0	0		0	
	Other REE	10	0		10		22	22		9		0	0		9	
	Zircon	50	26		51		42	17		42		38	22		39	
	Apatite	94	115		94		87	134		87		94	29		94	
	Fe-Oxides	13	14		13		12	20		12		18	0		18	
	Rutile	61	23		61		39	29		39		41	14		41	
	Ilmenite	70	0		70		53	56		53		82	29		82	
	Other Oxides	0	0		0		0	0		0		8	0		8	
	Fe-Sulphides	12	19		12		13	21		12		12	19		12	
	Quartz	114	205		108		86	185		83		128	209		113	
	Plagioclase	84	167		78		47	99		47		68	122		63	
	K-Feldspar	89	195		83		63	120		63		95	193		77	
	Biotite	23	41		22		23	45		23		19	35		15	
	Muscovite	31	21		31		23	43		23		17	39		15	
	Clays	47	24		47		28	31		28		31	31		31	
	Chlorite	13	31		12		15	18		15		18	22		17	
	Amphibole	65	41		66		41	28		41		50	45		51	
	Epidote	54	14		54		38	18		38		57	14		57	
	Grossular	33	0		33		29	22		30		33	14		33	
	Titanite	24	0		24		34	42		34		54	31		58	
	Other Silicates	11	14		11		15	18		15		10	16		9	
	Calcite	133	190		71		54	113		51		64	119		57	
	Ankerite	27	31		26		22	35		22		31	31		31	
	Dolomite	34	41		33		59	142		58		51	0		51	
	Fluorite	25	32		15		11	19		10		17	0		17	
	Gypsum/Anhydrite	25	43		17		115	129		17		25	27		24	
	Phosphates	0	0		0		14	0		14		29	29		0	
	Other	10	17		9		9	14		9		9	17		9	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		GA_VC-6					GA_VC-7				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			86.5		13.5			57.5		42.5	
Calculated ESD Particle Size		275	325		137		182	250		132	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.01	0.00	0.00	0.01	0.07	0.07	0.00	0.01	0.06	0.14
	Apatite	0.34	0.00	0.00	0.34	2.50	1.30	0.03	0.05	1.27	2.98
	Fe-Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Rutile	0.03	0.01	0.01	0.02	0.12	0.19	0.00	0.00	0.19	0.45
	Ilmenite	0.06	0.00	0.00	0.06	0.42	0.73	0.00	0.01	0.73	1.71
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.01	0.01	0.00	0.03	0.01	0.00	0.00	0.01	0.01
	Quartz	93.9	82.1	94.9	11.8	87.6	90.6	54.3	94.4	36.4	85.5
	Plagioclase	1.18	0.83	0.95	0.36	2.66	1.68	0.60	1.04	1.08	2.55
	K-Feldspar	2.62	2.26	2.61	0.36	2.67	2.73	1.45	2.52	1.28	3.02
	Biotite	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	Muscovite	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.02	0.04
	Clays	0.02	0.01	0.01	0.01	0.09	0.12	0.01	0.02	0.11	0.26
	Chlorite	0.02	0.02	0.02	0.00	0.02	0.02	0.01	0.01	0.01	0.03
	Amphibole	0.19	0.11	0.13	0.08	0.61	0.29	0.05	0.09	0.24	0.56
	Epidote	0.14	0.07	0.08	0.07	0.54	0.25	0.00	0.00	0.25	0.58
	Grossular	0.01	0.00	0.00	0.01	0.05	0.05	0.03	0.05	0.02	0.06
	Titanite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Other Silicates	0.02	0.02	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.01
	Calcite	1.38	1.04	1.20	0.34	2.51	1.81	1.03	1.78	0.79	1.85
	Ankerite	0.02	0.01	0.01	0.01	0.08	0.06	0.01	0.01	0.06	0.14
	Dolomite	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.03	0.06
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Total	100.0	86.5	100.0	13.5	100.0	100.0	57.5	100.0	42.5	100.0
Mean Grain Size by Frequency (µm)	Monazite	0	0		0		27	0		27	
	Synchysite/Bastnaesite	0	0		0		12	0		12	
	Other REE	0	0		13		0	0		10	
	Zircon	69	0		69		80	35		87	
	Apatite	125	22		125		120	208		118	
	Fe-Oxides	19	22		15		15	14		15	
	Rutile	50	47		52		62	0		62	
	Ilmenite	78	47		80		108	31		109	
	Other Oxides	16	0		16		8	0		8	
	Fe-Sulphides	21	35		14		15	19		13	
	Quartz	273	316		141		181	248		129	
	Plagioclase	113	155		70		91	119		80	
	K-Feldspar	218	265		103		136	211		97	
	Biotite	38	42		17		23	32		19	
	Muscovite	15	16		15		36	17		38	
	Clays	35	29		39		48	43		49	
	Chlorite	19	19		16		20	16		22	
	Amphibole	51	40		83		50	47		51	
	Epidote	58	46		78		79	0		79	
	Grossular	45	0		45		52	82		35	
	Titanite	42	55		21		26	0		26	
	Other Silicates	25	27		13		13	17		11	
	Calcite	108	127		74		102	165		68	
	Ankerite	26	28		25		26	29		25	
	Dolomite	51	0		51		43	14		43	
	Fluorite	32	32		0		0	0		0	
	Gypsum/Anhydrite	162	162		0		12	0		12	
	Phosphates	11	0		11		8	0		8	
	Other	14	16		11		11	14		10	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		GA_VC-9					GA_VC-11				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			81.4		18.6			64.4		35.6	
Calculated ESD Particle Size		250	327		121		188	291		114	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.02	0.00	0.00	0.02	0.10	0.00	0.00	0.00	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.07	0.00	0.00	0.07	0.36	0.02	0.00	0.00	0.02	0.04
	Apatite	0.96	0.02	0.02	0.94	5.08	0.98	0.00	0.00	0.98	2.75
	Fe-Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Rutile	0.07	0.03	0.03	0.04	0.23	0.04	0.01	0.01	0.04	0.11
	Ilmenite	0.21	0.00	0.00	0.21	1.14	0.22	0.02	0.03	0.20	0.56
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.02
	Quartz	93.2	78.1	95.9	15.1	81.2	79.8	53.4	83.0	26.4	74.0
	Plagioclase	0.69	0.19	0.24	0.49	2.64	2.77	0.89	1.38	1.89	5.29
	K-Feldspar	1.55	0.91	1.12	0.64	3.47	3.40	1.43	2.23	1.97	5.52
	Biotite	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	Muscovite	0.06	0.05	0.07	0.01	0.03	0.06	0.03	0.05	0.03	0.08
	Clays	0.06	0.01	0.01	0.06	0.32	0.06	0.00	0.00	0.05	0.15
	Chlorite	0.03	0.02	0.02	0.01	0.06	0.04	0.02	0.03	0.02	0.06
	Amphibole	0.14	0.06	0.07	0.08	0.46	0.68	0.31	0.47	0.37	1.05
	Epidote	0.18	0.00	0.00	0.18	0.96	0.42	0.20	0.31	0.22	0.62
	Grossular	0.03	0.00	0.00	0.03	0.18	0.03	0.00	0.00	0.03	0.09
	Titanite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.01	0.00	0.00	0.00	0.02	0.06	0.03	0.05	0.03	0.07
	Calcite	2.69	2.01	2.47	0.68	3.66	11.3	7.94	12.3	3.37	9.45
	Ankerite	0.02	0.01	0.01	0.02	0.09	0.10	0.08	0.12	0.03	0.08
	Dolomite	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.03
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Total	100.0	81.4	100.0	18.6	100.0	100.0	64.4	100.0	35.6	100.0
Mean Grain Size by Frequency (µm)	Monazite	94	0		94		0	0		0	
	Synchysite/Bastnaesite	0	0		0		14	0		14	
	Other REE	10	0		10		10	0		10	
	Zircon	66	36		68		65	0		65	
	Apatite	114	58		116		114	0		114	
	Fe-Oxides	15	22		11		18	0		18	
	Rutile	52	58		49		35	27		36	
	Ilmenite	86	43		87		90	63		94	
	Other Oxides	10	0		10		8	0		8	
	Fe-Sulphides	14	24		12		14	16		13	
	Quartz	255	323		121		200	312		115	
	Plagioclase	70	88		65		83	106		75	
	K-Feldspar	130	174		96		122	184		98	
	Biotite	34	44		18		23	32		19	
	Muscovite	46	63		18		37	50		30	
	Clays	63	28		71		53	19		59	
	Chlorite	19	19		20		16	19		13	
	Amphibole	45	40		48		46	46		47	
	Epidote	70	17		73		79	141		56	
	Grossular	41	0		41		38	14		40	
	Titanite	17	36		17		31	33		30	
	Other Silicates	15	16		14		24	28		21	
	Calcite	111	151		62		100	126		67	
	Ankerite	28	37		26		31	37		21	
	Dolomite	26	0		26		59	14		64	
	Fluorite	16	14		16		18	19		12	
	Gypsum/Anhydrite	18	0		18		17	0		17	
	Phosphates	8	0		8		0	0		0	
	Other	14	15		11		11	14		9	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17														
Project		South Carolina Department of Natural Resources														
Sample		SC_VC-1					SC_VC-4					SC_VC-6				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			85.9		14.1			29.2		70.8			86.5		13.5	
Calculated ESD Particle Size		244	282		132		129	196		114		247	278		142	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.01	0.00	0.00	0.01	0.07	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.10	0.00	0.00	0.10	0.68	0.04	0.00	0.00	0.04	0.06	0.04	0.00	0.00	0.04	0.28
	Apatite	3.35	2.83	3.30	0.52	3.68	0.66	0.28	0.94	0.38	0.54	3.78	3.39	3.92	0.40	2.93
	Fe-Oxides	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	Rutile	0.19	0.08	0.09	0.12	0.82	0.08	0.00	0.00	0.08	0.11	0.06	0.00	0.00	0.06	0.42
	Ilmenite	1.16	0.17	0.20	0.99	7.01	0.35	0.01	0.03	0.34	0.48	0.22	0.00	0.00	0.22	1.65
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.00	0.01	0.00	0.01	0.02	0.00	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.01
	Quartz	88.1	77.0	89.6	11.1	78.5	76.5	17.9	61.4	58.6	82.7	76.4	65.2	75.4	11.2	82.7
	Plagioclase	2.08	1.84	2.14	0.23	1.65	3.84	0.58	1.98	3.26	4.60	0.88	0.51	0.59	0.37	2.77
	K-Feldspar	2.37	2.04	2.37	0.33	2.35	4.44	0.64	2.20	3.80	5.37	2.21	1.73	2.00	0.48	3.57
	Biotite	0.01	0.01	0.01	0.00	0.02	0.03	0.01	0.03	0.02	0.03	0.02	0.01	0.01	0.01	0.06
	Muscovite	0.00	0.00	0.00	0.00	0.02	0.13	0.05	0.17	0.08	0.12	0.01	0.00	0.00	0.01	0.06
	Clays	0.12	0.05	0.06	0.07	0.47	0.15	0.00	0.01	0.15	0.21	0.08	0.04	0.04	0.04	0.31
	Chlorite	0.06	0.05	0.06	0.01	0.08	0.06	0.01	0.04	0.04	0.06	0.05	0.04	0.05	0.01	0.08
	Amphibole	0.43	0.31	0.36	0.12	0.84	0.89	0.13	0.43	0.77	1.08	0.39	0.27	0.31	0.12	0.90
	Epidote	0.68	0.39	0.46	0.29	2.07	0.39	0.00	0.01	0.38	0.54	0.13	0.00	0.00	0.12	0.91
	Grossular	0.28	0.20	0.23	0.08	0.58	0.03	0.00	0.00	0.03	0.05	0.04	0.02	0.03	0.02	0.11
	Titanite	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.05	0.05	0.06	0.00	0.01	0.02	0.00	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.02
	Calcite	0.97	0.84	0.98	0.13	0.93	12.3	9.45	32.4	2.80	3.96	15.6	15.2	17.6	0.41	3.06
	Ankerite	0.07	0.04	0.04	0.03	0.21	0.11	0.08	0.28	0.03	0.04	0.11	0.09	0.11	0.01	0.11
	Dolomite	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
	Total	100.0	85.9	100.0	14.1	100.0	100.0	29.2	100.0	70.8	100.0	100.0	86.5	100.0	13.5	100.0
Mean Grain Size by Frequency (µm)	Monazite	66	33		81		38	0		38		41	0		41	
	Synchysite/Bastnaesite	24	0		24		0	0		0		0	0		0	
	Other REE	0	14		10		0	14		11		0	14		23	
	Zircon	84	26		94		55	19		55		107	19		131	
	Apatite	251	306		126		116	166		95		226	251		123	
	Fe-Oxides	17	20		13		16	24		15		21	14		23	
	Rutile	83	99		75		48	19		49		75	24		77	
	Ilmenite	129	127		129		68	87		68		95	29		96	
	Other Oxides	8	0		8		0	0		0		8	0		8	
	Fe-Sulphides	19	22		13		16	22		15		15	14		15	
	Quartz	240	275		127		130	226		115		249	286		140	
	Plagioclase	133	156		60		82	129		77		99	115		83	
	K-Feldspar	177	224		78		98	157		92		205	267		112	
	Biotite	25	28		20		26	47		23		29	35		25	
	Muscovite	20	19		21		48	66		42		25	23		27	
	Clays	64	58		70		64	38		65		74	77		71	
	Chlorite	36	37		30		17	20		16		21	22		19	
	Amphibole	96	111		70		59	52		60		62	62		64	
	Epidote	117	147		93		47	15		48		76	14		82	
	Grossular	58	62		50		35	14		35		37	35		39	
	Titanite	26	28		24		23	0		23		20	0		20	
	Other Silicates	43	46		12		15	17		14		17	17		17	
	Calcite	149	207		53		105	127		67		152	160		55	
	Ankerite	29	31		26		33	37		25		30	32		24	
	Dolomite	34	0		34		35	0		35		34	38		24	
	Fluorite	0	0		0		16	14		16		15	14		15	
	Gypsum/Anhydrite	14	14		13		0	0		0		10	0		10	
	Phosphates	8	0		8		14	14		0		13	0		13	
	Other	12	14		9		13	14		13		11	14		9	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-7					SC_VC-14				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			57.4		42.6			85.2		14.8	
Calculated ESD Particle Size		148	178		120		233	270		130	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.04	0.27
	Apatite	0.79	0.39	0.68	0.40	0.93	3.69	3.14	3.68	0.55	3.75
	Fe-Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Rutile	0.03	0.00	0.00	0.03	0.08	0.04	0.00	0.00	0.04	0.28
	Ilmenite	0.21	0.00	0.00	0.21	0.50	0.24	0.01	0.01	0.24	1.62
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.02	0.01	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.01
	Quartz	64.7	29.3	50.9	35.5	83.3	74.3	62.6	73.4	11.7	79.5
	Plagioclase	2.30	0.77	1.35	1.53	3.59	1.44	1.06	1.24	0.38	2.58
	K-Feldspar	2.19	0.59	1.03	1.59	3.75	1.59	1.05	1.23	0.54	3.67
	Biotite	0.02	0.00	0.00	0.02	0.04	0.02	0.01	0.02	0.01	0.06
	Muscovite	0.02	0.00	0.01	0.02	0.05	0.01	0.00	0.00	0.01	0.04
	Clays	0.06	0.02	0.04	0.04	0.09	0.02	0.00	0.00	0.02	0.15
	Chlorite	0.09	0.07	0.12	0.02	0.05	0.04	0.03	0.04	0.01	0.06
	Amphibole	0.70	0.41	0.72	0.29	0.67	0.31	0.18	0.21	0.13	0.85
	Epidote	0.15	0.00	0.00	0.15	0.35	0.11	0.01	0.01	0.10	0.66
	Grossular	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.12
	Titanite	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.07
	Other Silicates	0.02	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.00	0.03
	Calcite	28.5	25.7	44.8	2.76	6.48	17.9	17.0	19.9	0.89	6.06
	Ankerite	0.18	0.16	0.28	0.01	0.03	0.20	0.17	0.20	0.03	0.20
	Dolomite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	100.0	57.4	100.0	42.6	100.0	100.0	85.2	100.0	14.8	100.0
Mean Grain Size by Frequency (µm)	Monazite	0	0		0		17	0		17	
	Synchysite/Bastnaesite	0	0		0		0	0		0	
	Other REE	0	14		0		14	14		11	
	Zircon	27	23		38		91	23		101	
	Apatite	121	158		98		185	200		129	
	Fe-Oxides	24	24		0		19	14		21	
	Rutile	43	25		45		72	0		72	
	Ilmenite	77	29		77		111	56		113	
	Other Oxides	16	0		16		11	0		11	
	Fe-Sulphides	15	16		15		15	14		16	
	Quartz	146	192		122		233	270		133	
	Plagioclase	97	111		91		137	171		89	
	K-Feldspar	109	140		100		149	195		103	
	Biotite	24	26		24		39	34		50	
	Muscovite	34	28		36		32	17		39	
	Clays	75	54		97		47	21		55	
	Chlorite	20	22		17		20	20		19	
	Amphibole	47	46		49		57	50		72	
	Epidote	58	16		61		70	38		78	
	Grossular	16	14		17		47	0		47	
	Titanite	26	24		27		104	14		123	
	Other Silicates	17	16		18		20	19		22	
	Calcite	120	128		72		154	166		66	
	Ankerite	30	31		21		37	37		36	
	Dolomite	0	0		0		46	51		25	
	Fluorite	25	25		0		21	14		32	
	Gypsum/Anhydrite	14	14		0		21	0		21	
	Phosphates	0	0		0		0	0		0	
	Other	14	14		14		14	14		14	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-15					SC_VC-18				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			9.0		91.0			14.0		86.0	
Calculated ESD Particle Size		125	177		121		115	158		110	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.07	0.00	0.00	0.07	0.08	0.04	0.00	0.03	0.04	0.04
	Apatite	2.21	0.09	0.99	2.13	2.33	0.71	0.23	1.66	0.48	0.55
	Fe-Oxides	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
	Rutile	0.17	0.00	0.00	0.17	0.19	0.09	0.00	0.00	0.09	0.11
	Ilmenite	0.75	0.00	0.01	0.75	0.82	0.38	0.00	0.00	0.38	0.44
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
	Quartz	82.4	7.07	78.9	75.3	82.7	75.5	7.72	55.2	67.8	78.8
	Plagioclase	3.59	0.19	2.16	3.40	3.73	4.84	0.29	2.08	4.55	5.29
	K-Feldspar	5.03	0.18	2.04	4.85	5.33	5.74	0.26	1.87	5.47	6.37
	Biotite	0.05	0.00	0.03	0.05	0.05	0.07	0.00	0.03	0.07	0.08
	Muscovite	0.04	0.01	0.09	0.04	0.04	0.05	0.02	0.13	0.03	0.03
	Clays	0.19	0.00	0.01	0.19	0.21	0.13	0.00	0.01	0.12	0.14
	Chlorite	0.07	0.01	0.11	0.06	0.06	0.05	0.01	0.08	0.04	0.05
	Amphibole	1.22	0.04	0.40	1.18	1.30	0.92	0.05	0.37	0.86	1.00
	Epidote	0.88	0.00	0.02	0.87	0.96	0.63	0.00	0.02	0.62	0.73
	Grossular	0.08	0.00	0.00	0.08	0.09	0.02	0.00	0.03	0.02	0.02
	Titanite	0.02	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.02
	Calcite	3.12	1.35	15.1	1.77	1.95	10.7	5.34	38.1	5.38	6.25
	Ankerite	0.10	0.01	0.17	0.08	0.09	0.09	0.05	0.35	0.04	0.04
	Dolomite	0.01	0.00	0.00	0.01	0.01	0.02	0.00	0.00	0.02	0.02
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	100.0	8.96	100.0	91.0	100.0	100.0	14.0	100.0	86.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	40	0		40		37	0		37	
	Synchysite/Bastnaesite	21	0		21		0	0		0	
	Other REE	0	14		11		0	14		11	
	Zircon	68	14		68		62	83		61	
	Apatite	96	130		95		109	242		86	
	Fe-Oxides	20	17		20		19	0		19	
	Rutile	65	14		65		55	14		55	
	Ilmenite	82	42		82		70	18		70	
	Other Oxides	11	0		11		11	0		11	
	Fe-Sulphides	12	18		12		17	21		16	
	Quartz	121	180		117		113	182		109	
	Plagioclase	84	113		83		77	110		75	
	K-Feldspar	103	147		102		92	123		91	
	Biotite	31	32		31		28	42		27	
	Muscovite	26	52		24		32	51		26	
	Clays	54	20		55		59	49		59	
	Chlorite	17	22		16		17	24		16	
	Amphibole	66	47		67		53	41		54	
	Epidote	67	67		67		55	34		55	
	Grossular	39	14		39		34	44		32	
	Titanite	62	22		62		31	29		31	
	Other Silicates	13	18		13		13	24		12	
	Calcite	93	130		77		87	114		70	
	Ankerite	30	37		29		29	33		25	
	Dolomite	38	0		38		67	17		69	
	Fluorite	26	17		32		0	0		0	
	Gypsum/Anhydrite	21	19		21		0	0		0	
	Phosphates	0	0		0		0	0		0	
	Other	11	14		11		11	17		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-19					SC_VC-20				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			39.0		61.0			63.8		36.2	
Calculated ESD Particle Size		93	353		64		173	221		126	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.03
	Synchysite/Bastnaesite	0.02	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.15	0.00	0.00	0.15	0.24	0.03	0.00	0.01	0.03	0.07
	Apatite	3.44	3.07	7.88	0.37	0.60	1.05	0.83	1.30	0.22	0.61
	Fe-Oxides	0.01	0.00	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.01
	Rutile	0.37	0.14	0.37	0.23	0.38	0.04	0.00	0.00	0.04	0.11
	Ilmenite	0.77	0.00	0.00	0.76	1.25	0.30	0.05	0.08	0.25	0.69
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.14	0.01	0.02	0.14	0.23	0.00	0.00	0.00	0.00	0.01
	Quartz	65.7	24.4	62.6	41.2	67.6	72.6	42.2	66.3	30.4	83.8
	Plagioclase	5.70	0.28	0.71	5.43	8.90	2.05	0.66	1.04	1.39	3.82
	K-Feldspar	6.87	0.79	2.03	6.08	9.97	2.39	0.67	1.06	1.72	4.73
	Biotite	0.16	0.07	0.18	0.09	0.15	0.07	0.04	0.06	0.03	0.08
	Muscovite	0.11	0.00	0.01	0.10	0.17	0.05	0.00	0.00	0.05	0.13
	Clays	0.31	0.06	0.15	0.26	0.42	0.03	0.00	0.00	0.03	0.09
	Chlorite	0.05	0.03	0.08	0.02	0.03	0.08	0.05	0.08	0.02	0.07
	Amphibole	1.01	0.16	0.42	0.84	1.39	0.58	0.25	0.40	0.32	0.90
	Epidote	0.87	0.07	0.18	0.80	1.32	0.25	0.00	0.00	0.25	0.70
	Grossular	0.08	0.07	0.17	0.02	0.03	0.02	0.00	0.00	0.02	0.05
	Titanite	0.02	0.00	0.00	0.02	0.03	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.05	0.00	0.01	0.05	0.08	0.00	0.00	0.00	0.00	0.01
	Calcite	14.0	9.68	24.8	4.28	7.01	20.3	18.8	29.6	1.47	4.07
	Ankerite	0.13	0.10	0.26	0.03	0.05	0.11	0.10	0.15	0.01	0.03
	Dolomite	0.07	0.00	0.00	0.07	0.12	0.00	0.00	0.00	0.00	0.00
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.02	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.01
	Total	100.0	39.0	100.0	61.0	100.0	100.0	63.8	100.0	36.2	100.0
Mean Grain Size by Frequency (µm)	Monazite	38	0		38		114	0		114	
	Synchysite/Bastnaesite	46	50		14		0	0		0	
	Other REE	14	14		11		0	14		13	
	Zircon	43	23		43		55	27		63	
	Apatite	229	314		70		160	200		91	
	Fe-Oxides	21	20		21		21	24		21	
	Rutile	59	252		40		58	22		59	
	Ilmenite	66	29		66		106	182		97	
	Other Oxides	21	0		21		14	14		0	
	Fe-Sulphides	16	18		16		17	18		17	
	Quartz	89	347		62		166	219		124	
	Plagioclase	40	51		39		94	116		86	
	K-Feldspar	54	313		49		107	147		97	
	Biotite	31	39		26		42	50		35	
	Muscovite	18	24		18		42	23		44	
	Clays	27	72		23		66	14		67	
	Chlorite	17	19		15		19	21		16	
	Amphibole	43	40		43		55	48		62	
	Epidote	38	80		37		61	14		62	
	Grossular	41	61		18		34	0		34	
	Titanite	32	14		33		28	14		29	
	Other Silicates	17	17		17		13	14		13	
	Calcite	102	185		51		157	172		74	
	Ankerite	30	34		23		33	33		27	
	Dolomite	36	25		37		16	0		16	
	Fluorite	24	24		0		21	22		11	
	Gypsum/Anhydrite	65	65		0		0	0		0	
	Phosphates	0	0		0		11	0		11	
	Other	11	16		11		16	17		16	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-21					SC_VC-22				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			5.7		94.3			95.6		4.4	
Calculated ESD Particle Size		108	144		106		396	469		90	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.03
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.11	0.00	0.01	0.11	0.11	0.03	0.01	0.01	0.02	0.44
	Apatite	0.29	0.11	1.99	0.18	0.19	0.01	0.00	0.00	0.01	0.25
	Fe-Oxides	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.02
	Rutile	0.33	0.00	0.00	0.33	0.35	0.02	0.00	0.00	0.02	0.34
	Ilmenite	0.62	0.00	0.03	0.62	0.66	0.06	0.00	0.00	0.06	1.46
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02
	Quartz	76.8	2.55	44.8	74.3	78.8	94.4	91.3	95.5	3.04	68.9
	Plagioclase	5.75	0.18	3.12	5.58	5.91	0.77	0.45	0.48	0.32	7.18
	K-Feldspar	6.05	0.19	3.25	5.86	6.21	2.08	1.68	1.76	0.39	8.90
	Biotite	0.07	0.00	0.05	0.07	0.07	0.01	0.01	0.01	0.00	0.09
	Muscovite	0.29	0.06	0.98	0.23	0.25	0.02	0.01	0.01	0.01	0.25
	Clays	0.12	0.00	0.00	0.12	0.12	0.02	0.01	0.01	0.01	0.31
	Chlorite	0.07	0.01	0.13	0.07	0.07	0.02	0.01	0.01	0.01	0.18
	Amphibole	1.41	0.01	0.25	1.39	1.48	0.10	0.00	0.00	0.10	2.19
	Epidote	0.78	0.00	0.02	0.78	0.82	0.10	0.00	0.00	0.10	2.21
	Grossular	0.03	0.00	0.00	0.03	0.03	0.02	0.01	0.01	0.01	0.17
	Titanite	0.02	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.04
	Other Silicates	0.02	0.00	0.01	0.02	0.02	0.00	0.00	0.00	0.00	0.06
	Calcite	7.11	2.57	45.0	4.54	4.81	2.30	2.00	2.09	0.30	6.75
	Ankerite	0.06	0.02	0.37	0.04	0.04	0.07	0.06	0.07	0.00	0.08
	Dolomite	0.01	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.11
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	100.0	5.71	100.0	94.3	100.0	100.0	95.6	100.0	4.41	100.0
Mean Grain Size by Frequency (µm)	Monazite	32	0		32		51	0		51	
	Synchysite/Bastnaesite	0	0		0		0	0		0	
	Other REE	0	0		11		0	0		11	
	Zircon	64	40		64		62	52		72	
	Apatite	80	240		57		62	14		72	
	Fe-Oxides	14	29		14		16	0		16	
	Rutile	69	14		69		51	0		51	
	Ilmenite	68	108		68		79	0		79	
	Other Oxides	14	0		14		0	0		0	
	Fe-Sulphides	14	18		13		26	43		15	
	Quartz	107	181		105		405	462		89	
	Plagioclase	78	107		78		84	118		59	
	K-Feldspar	88	108		88		166	222		80	
	Biotite	34	40		33		30	33		26	
	Muscovite	57	81		54		25	22		28	
	Clays	50	22		50		36	33		38	
	Chlorite	19	30		19		19	19		19	
	Amphibole	57	33		58		52	22		54	
	Epidote	49	16		49		54	14		55	
	Grossular	27	25		27		37	35		41	
	Titanite	38	14		38		36	39		36	
	Other Silicates	16	19		16		16	14		16	
	Calcite	80	101		72		163	217		60	
	Ankerite	28	46		23		53	56		25	
	Dolomite	27	0		27		30	0		30	
	Fluorite	14	14		0		13	0		13	
	Gypsum/Anhydrite	26	29		21		15	0		15	
	Phosphates	0	0		0		11	0		11	
	Other	11	16		11		14	14		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-23					SC_VC-24				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			31.0		69.0			95.4		4.6	
Calculated ESD Particle Size		67	291		50		283	304		113	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.11	0.02	0.05	0.09	0.13	0.02	0.00	0.00	0.02	0.54
	Apatite	0.08	0.00	0.00	0.08	0.12	0.01	0.00	0.00	0.01	0.14
	Fe-Oxides	0.16	0.00	0.01	0.16	0.23	0.00	0.00	0.00	0.00	0.03
	Rutile	0.28	0.04	0.14	0.23	0.34	0.03	0.01	0.01	0.03	0.59
	Ilmenite	0.49	0.12	0.38	0.37	0.53	0.39	0.27	0.28	0.12	2.63
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	1.06	0.11	0.36	0.94	1.37	0.00	0.00	0.00	0.00	0.00
	Quartz	70.1	27.0	87.2	43.0	62.4	87.0	83.8	87.8	3.20	69.5
	Plagioclase	11.2	1.05	3.39	10.2	14.8	3.37	3.07	3.22	0.30	6.53
	K-Feldspar	10.4	2.19	7.07	8.23	11.9	7.42	7.03	7.37	0.39	8.53
	Biotite	0.15	0.01	0.03	0.15	0.21	0.02	0.01	0.01	0.01	0.14
	Muscovite	0.45	0.04	0.14	0.41	0.59	0.02	0.01	0.01	0.01	0.18
	Clays	1.57	0.05	0.16	1.52	2.21	0.01	0.00	0.00	0.01	0.25
	Chlorite	0.10	0.04	0.12	0.07	0.10	0.03	0.03	0.03	0.01	0.12
	Amphibole	1.29	0.09	0.28	1.20	1.74	0.53	0.36	0.38	0.16	3.57
	Epidote	1.14	0.01	0.02	1.13	1.64	0.37	0.26	0.27	0.12	2.54
	Grossular	0.07	0.02	0.06	0.05	0.07	0.00	0.00	0.00	0.00	0.05
	Titanite	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.03
	Other Silicates	0.03	0.00	0.00	0.03	0.05	0.01	0.00	0.00	0.00	0.04
	Calcite	1.18	0.15	0.48	1.03	1.49	0.79	0.58	0.61	0.21	4.51
	Ankerite	0.02	0.00	0.00	0.02	0.02	0.01	0.00	0.00	0.00	0.04
	Dolomite	0.05	0.00	0.00	0.05	0.07	0.00	0.00	0.00	0.00	0.00
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.02	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.02	0.00	0.00	0.02	0.03	0.00	0.00	0.00	0.00	0.00
	Total	100.0	31.0	100.0	69.0	100.0	100.0	95.4	100.0	4.60	100.0
Mean Grain Size by Frequency (µm)	Monazite	21	0		21		0	0		0	
	Synchysite/Bastnaesite	29	29		0		0	0		0	
	Other REE	0	0		21		0	0		0	
	Zircon	35	109		31		128	0		128	
	Apatite	76	14		76		92	0		92	
	Fe-Oxides	31	26		31		27	0		27	
	Rutile	27	100		24		54	31		63	
	Ilmenite	39	200		31		162	228		99	
	Other Oxides	0	0		0		0	0		0	
	Fe-Sulphides	28	67		27		25	26		15	
	Quartz	70	289		48		287	305		113	
	Plagioclase	38	130		35		151	166		79	
	K-Feldspar	43	196		36		205	223		83	
	Biotite	23	36		23		29	24		43	
	Muscovite	19	52		18		30	26		40	
	Clays	21	73		21		50	19		57	
	Chlorite	23	35		19		21	22		17	
	Amphibole	37	109		35		92	98		81	
	Epidote	34	32		34		101	126		71	
	Grossular	22	35		19		26	22		29	
	Titanite	23	40		23		53	29		53	
	Other Silicates	15	14		15		16	15		19	
	Calcite	53	101		50		121	179		63	
	Ankerite	21	47		20		29	34		23	
	Dolomite	41	0		41		18	0		18	
	Fluorite	0	0		0		0	0		0	
	Gypsum/Anhydrite	69	69		0		0	0		0	
	Phosphates	0	0		0		0	0		0	
	Other	11	14		11		14	14		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-25					SC_VC-26				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			89.5		10.5			72.6		27.4	
Calculated ESD Particle Size		248	323		81		164	229		95	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.05	0.01	0.01	0.04	0.38	0.08	0.01	0.02	0.06	0.23
	Apatite	0.49	0.37	0.42	0.12	1.13	0.37	0.21	0.29	0.16	0.60
	Fe-Oxides	1.64	1.04	1.17	0.60	5.67	1.72	1.64	2.26	0.08	0.29
	Rutile	0.03	0.00	0.00	0.03	0.29	0.06	0.00	0.00	0.06	0.23
	Ilmenite	0.18	0.02	0.02	0.16	1.52	0.43	0.00	0.00	0.43	1.57
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.26	0.14	0.15	0.12	1.17	0.12	0.03	0.04	0.09	0.33
	Quartz	66.3	61.5	68.8	4.76	45.2	66.2	47.2	65.0	19.0	69.1
	Plagioclase	0.44	0.30	0.34	0.13	1.28	1.44	0.77	1.06	0.67	2.43
	K-Feldspar	0.31	0.17	0.19	0.14	1.33	1.56	0.49	0.67	1.07	3.89
	Biotite	0.10	0.07	0.08	0.03	0.29	0.12	0.06	0.08	0.07	0.24
	Muscovite	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01
	Clays	0.21	0.20	0.22	0.01	0.10	0.02	0.01	0.01	0.02	0.06
	Chlorite	0.09	0.08	0.08	0.02	0.15	0.07	0.05	0.07	0.02	0.08
	Amphibole	0.19	0.18	0.20	0.02	0.15	0.34	0.22	0.30	0.12	0.45
	Epidote	0.09	0.04	0.05	0.04	0.41	0.13	0.05	0.06	0.08	0.31
	Grossular	0.19	0.17	0.19	0.03	0.25	0.27	0.25	0.35	0.02	0.09
	Titanite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.02	0.01	0.01	0.01	0.13	0.07	0.01	0.01	0.06	0.22
	Calcite	28.2	24.4	27.3	3.83	36.4	25.4	20.1	27.7	5.26	19.2
	Ankerite	1.17	0.75	0.83	0.42	4.03	1.60	1.44	1.98	0.17	0.60
	Dolomite	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.01	0.05
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.02
	Total	100.0	89.5	100.0	10.5	100.0	100.0	72.6	100.0	27.4	100.0
Mean Grain Size by Frequency (µm)	Monazite	41	41		0		0	0		0	
	Synchysite/Bastnaesite	24	0		24		13	0		13	
	Other REE	15	0		15		9	11		9	
	Zircon	59	28		84		54	24		70	
	Apatite	124	142		88		71	78		64	
	Fe-Oxides	54	60		46		47	48		29	
	Rutile	63	17		72		42	16		45	
	Ilmenite	120	114		120		103	18		104	
	Other Oxides	14	14		0		0	0		0	
	Fe-Sulphides	27	29		25		16	16		16	
	Quartz	257	312		79		172	243		100	
	Plagioclase	71	72		67		60	79		47	
	K-Feldspar	114	166		83		89	133		78	
	Biotite	36	41		28		30	36		26	
	Muscovite	16	17		14		15	19		12	
	Clays	207	225		84		27	17		34	
	Chlorite	21	19		37		15	15		17	
	Amphibole	33	33		33		26	25		27	
	Epidote	18	20		17		19	14		24	
	Grossular	106	130		48		63	69		32	
	Titanite	85	92		16		39	41		39	
	Other Silicates	13	15		12		12	13		12	
	Calcite	126	174		46		87	101		57	
	Ankerite	39	52		27		41	44		25	
	Dolomite	24	23		25		30	21		33	
	Fluorite	17	17		16		12	12		11	
	Gypsum/Anhydrite	16	14		18		15	16		14	
	Phosphates	16	18		14		14	21		8	
	Other	13	14		11		9	12		9	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-27					SC_VC-28				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			66.1		33.9			90.3		9.7	
Calculated ESD Particle Size		158	190		119		289	337		121	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.02	0.00	0.00	0.02	0.06	0.00	0.00	0.00	0.00	0.03
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.15	0.01	0.01	0.15	0.43	0.10	0.00	0.00	0.10	0.99
	Apatite	0.41	0.10	0.15	0.31	0.93	0.10	0.00	0.00	0.10	0.99
	Fe-Oxides	1.67	0.99	1.50	0.68	1.99	0.14	0.07	0.08	0.06	0.64
	Rutile	0.11	0.01	0.01	0.10	0.31	0.13	0.02	0.02	0.12	1.23
	Ilmenite	0.83	0.00	0.00	0.83	2.46	0.53	0.00	0.00	0.53	5.46
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	Quartz	67.6	43.9	66.4	23.7	69.8	94.3	87.1	96.5	7.21	74.2
	Plagioclase	0.52	0.14	0.21	0.38	1.12	0.30	0.10	0.11	0.20	2.04
	K-Feldspar	1.71	1.03	1.55	0.68	2.02	0.49	0.23	0.26	0.26	2.66
	Biotite	0.12	0.04	0.06	0.08	0.23	0.03	0.02	0.02	0.01	0.13
	Muscovite	0.01	0.00	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.02
	Clays	0.04	0.00	0.00	0.04	0.13	0.02	0.01	0.01	0.02	0.19
	Chlorite	0.04	0.02	0.03	0.02	0.07	0.04	0.02	0.02	0.02	0.18
	Amphibole	0.20	0.09	0.13	0.12	0.34	0.12	0.04	0.04	0.08	0.81
	Epidote	0.20	0.09	0.14	0.11	0.31	0.08	0.02	0.02	0.06	0.60
	Grossular	0.11	0.00	0.00	0.11	0.33	0.11	0.00	0.00	0.11	1.12
	Titanite	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
	Other Silicates	0.02	0.01	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.07
	Calcite	24.7	18.5	28.0	6.23	18.4	3.41	2.60	2.88	0.81	8.31
	Ankerite	1.54	1.18	1.79	0.36	1.05	0.05	0.02	0.03	0.02	0.25
	Dolomite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Total	100.0	66.1	100.0	33.9	100.0	100.0	90.3	100.0	9.71	100.0
Mean Grain Size by Frequency (µm)	Monazite	82	0		82		54	0		54	
	Synchysite/Bastnaesite	21	0		21		36	0		36	
	Other REE	14	0		14		12	0		12	
	Zircon	72	26		77		96	29		98	
	Apatite	82	85		81		88	14		89	
	Fe-Oxides	47	45		50		53	39		90	
	Rutile	47	40		47		81	70		83	
	Ilmenite	93	0		93		109	29		111	
	Other Oxides	0	0		0		11	0		11	
	Fe-Sulphides	19	22		15		15	16		14	
	Quartz	164	196		125		293	336		116	
	Plagioclase	66	61		69		62	66		61	
	K-Feldspar	151	196		113		120	164		97	
	Biotite	40	31		46		36	35		38	
	Muscovite	24	16		27		18	20		16	
	Clays	47	14		47		49	51		49	
	Chlorite	18	19		18		21	19		24	
	Amphibole	39	31		48		45	34		52	
	Epidote	28	22		35		43	28		51	
	Grossular	48	0		48		53	0		53	
	Titanite	39	14		39		36	29		36	
	Other Silicates	17	23		14		25	18		26	
	Calcite	105	120		76		114	133		79	
	Ankerite	41	44		34		31	28		36	
	Dolomite	19	14		23		38	0		38	
	Fluorite	17	18		15		14	0		14	
	Gypsum/Anhydrite	27	0		27		14	0		14	
	Phosphates	13	14		13		13	0		13	
	Other	31	0		31		11	14		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-29					SC_VC-30				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			92.4		7.6			81.3		18.7	
Calculated ESD Particle Size		334	426		91		233	312		109	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.06
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.17	0.02	0.02	0.16	2.03	0.13	0.00	0.00	0.13	0.68
	Apatite	0.08	0.01	0.02	0.07	0.90	0.79	0.58	0.71	0.21	1.13
	Fe-Oxides	0.77	0.72	0.78	0.05	0.62	0.30	0.29	0.36	0.00	0.01
	Rutile	0.06	0.00	0.00	0.06	0.77	0.11	0.03	0.04	0.08	0.41
	Ilmenite	0.24	0.00	0.00	0.23	3.07	0.82	0.16	0.20	0.66	3.51
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Fe-Sulphides	0.05	0.00	0.00	0.05	0.65	0.03	0.01	0.02	0.01	0.07
	Quartz	92.4	87.5	94.7	4.91	64.4	86.6	72.3	88.9	14.3	76.5
	Plagioclase	0.34	0.15	0.17	0.19	2.51	0.93	0.36	0.44	0.57	3.02
	K-Feldspar	0.25	0.00	0.00	0.25	3.27	1.63	0.85	1.05	0.77	4.14
	Biotite	0.06	0.02	0.02	0.04	0.52	0.07	0.02	0.03	0.05	0.25
	Muscovite	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02
	Clays	0.02	0.01	0.01	0.02	0.26	0.04	0.00	0.00	0.04	0.20
	Chlorite	0.04	0.04	0.04	0.01	0.09	0.10	0.07	0.08	0.03	0.16
	Amphibole	0.08	0.05	0.05	0.04	0.47	0.22	0.10	0.13	0.11	0.60
	Epidote	0.18	0.04	0.04	0.14	1.80	0.09	0.02	0.02	0.07	0.39
	Grossular	0.52	0.48	0.52	0.04	0.48	0.25	0.16	0.20	0.09	0.47
	Titanite	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
	Other Silicates	0.04	0.01	0.01	0.03	0.39	0.01	0.00	0.01	0.00	0.01
	Calcite	4.54	3.26	3.53	1.28	16.8	7.69	6.20	7.62	1.49	8.00
	Ankerite	0.13	0.08	0.09	0.05	0.60	0.19	0.14	0.17	0.05	0.26
	Dolomite	0.01	0.00	0.00	0.01	0.18	0.01	0.00	0.00	0.01	0.08
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.04	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.02	0.00	0.00	0.02	0.20	0.00	0.00	0.00	0.00	0.01
	Total	100.0	92.4	100.0	7.63	100.0	100.0	81.3	100.0	18.7	100.0
Mean Grain Size by Frequency (µm)	Monazite	0	0		0		77	0		77	
	Synchysite/Bastnaesite	27	0		27		0	0		0	
	Other REE	18	18		11		0	14		11	
	Zircon	96	28		124		85	24		91	
	Apatite	64	33		80		117	144		78	
	Fe-Oxides	177	242		35		243	261		19	
	Rutile	65	14		72		44	41		46	
	Ilmenite	108	22		110		115	198		104	
	Other Oxides	11	0		11		12	0		12	
	Fe-Sulphides	22	26		22		18	22		16	
	Quartz	356	431		88		237	308		110	
	Plagioclase	40	36		44		73	110		60	
	K-Feldspar	60	31		61		124	241		81	
	Biotite	23	24		23		39	30		45	
	Muscovite	20	27		13		15	17		15	
	Clays	39	27		44		33	18		35	
	Chlorite	20	20		16		25	23		31	
	Amphibole	35	40		30		42	34		52	
	Epidote	16	21		15		32	18		38	
	Grossular	91	100		42		70	94		49	
	Titanite	39	0		39		68	95		43	
	Other Silicates	13	21		12		17	21		12	
	Calcite	86	114		53		133	163		76	
	Ankerite	27	30		22		34	35		30	
	Dolomite	34	0		34		45	0		45	
	Fluorite	12	0		12		20	20		12	
	Gypsum/Anhydrite	126	128		20		11	0		11	
	Phosphates	12	0		12		0	0		0	
	Other	11	14		11		19	31		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		NC_VC-3					NC_VC-4				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			15.1		84.9			45.0		55.0	
Calculated ESD Particle Size		89	202		81		163	257		125	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.02	0.00	0.00	0.02	0.03	0.01	0.00	0.00	0.01	0.01
	Synchysite/Bastnaesite	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.09	0.00	0.01	0.09	0.11	0.11	0.00	0.00	0.11	0.20
	Apatite	0.38	0.00	0.01	0.38	0.45	0.24	0.12	0.27	0.12	0.22
	Fe-Oxides	0.03	0.00	0.01	0.03	0.03	0.01	0.00	0.00	0.01	0.01
	Rutile	0.25	0.01	0.04	0.25	0.29	0.11	0.00	0.00	0.11	0.20
	Ilmenite	0.69	0.00	0.01	0.69	0.81	0.57	0.09	0.20	0.48	0.87
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.19	0.01	0.07	0.18	0.21	0.01	0.00	0.01	0.01	0.01
	Quartz	73.9	8.32	55.0	65.6	77.3	89.6	40.9	91.0	48.6	88.5
	Plagioclase	5.93	0.30	1.98	5.63	6.63	1.60	0.24	0.53	1.36	2.47
	K-Feldspar	5.26	0.28	1.84	4.98	5.87	2.93	0.44	0.98	2.48	4.52
	Biotite	0.17	0.02	0.10	0.16	0.19	0.09	0.02	0.05	0.07	0.12
	Muscovite	0.03	0.00	0.01	0.03	0.04	0.04	0.00	0.01	0.03	0.06
	Clays	0.15	0.00	0.03	0.14	0.17	0.03	0.01	0.03	0.02	0.04
	Chlorite	0.06	0.01	0.06	0.06	0.07	0.08	0.02	0.05	0.06	0.11
	Amphibole	0.66	0.16	1.05	0.50	0.59	0.30	0.09	0.20	0.21	0.39
	Epidote	0.46	0.02	0.14	0.44	0.52	0.17	0.00	0.00	0.17	0.31
	Grossular	0.05	0.00	0.01	0.05	0.05	0.07	0.04	0.08	0.03	0.05
	Titanite	0.03	0.00	0.00	0.03	0.04	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.11	0.02	0.14	0.09	0.10	0.01	0.00	0.01	0.01	0.01
	Calcite	11.1	5.89	38.9	5.22	6.15	3.99	2.95	6.56	1.03	1.88
	Ankerite	0.19	0.07	0.46	0.12	0.15	0.02	0.01	0.03	0.01	0.01
	Dolomite	0.17	0.00	0.03	0.17	0.19	0.02	0.00	0.00	0.02	0.04
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.01	0.01	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.04	0.01	0.05	0.04	0.04	0.00	0.00	0.00	0.00	0.00
	Total	100.0	15.1	100.0	84.9	100.0	100.0	45.0	100.0	55.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	42	0		42		50	0		50	
	Synchysite/Bastnaesite	27	35		26		0	0		0	
	Other REE	11	0		11		0	14		11	
	Zircon	51	33		51		75	26		77	
	Apatite	64	51		64		152	214		116	
	Fe-Oxides	19	33		19		17	18		17	
	Rutile	38	39		38		49	22		50	
	Ilmenite	78	42		78		98	263		88	
	Other Oxides	0	0		0		11	0		11	
	Fe-Sulphides	16	19		15		17	23		15	
	Quartz	88	194		82		162	257		123	
	Plagioclase	37	36		37		79	86		77	
	K-Feldspar	55	62		55		121	197		113	
	Biotite	36	32		37		51	42		56	
	Muscovite	14	18		14		35	33		35	
	Clays	22	20		23		40	31		51	
	Chlorite	17	17		16		19	21		19	
	Amphibole	39	40		39		50	41		54	
	Epidote	19	17		19		61	14		62	
	Grossular	37	18		37		78	95		62	
	Titanite	39	24		39		33	14		33	
	Other Silicates	15	20		14		17	16		18	
	Calcite	75	136		49		120	148		78	
	Ankerite	22	30		19		24	24		23	
	Dolomite	33	36		33		41	36		41	
	Fluorite	19	19		19		29	29		0	
	Gypsum/Anhydrite	46	46		0		24	0		24	
	Phosphates	11	0		11		21	0		21	
	Other	11	15		11		12	14		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		NC_VC-6					NC_VC-8				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			17.9		82.1			38.5		61.5	
Calculated ESD Particle Size		116	222		105		133	286		100	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.04	0.06
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.03	0.00	0.01	0.03	0.04	0.03	0.00	0.00	0.03	0.05
	Apatite	0.27	0.05	0.25	0.22	0.27	0.22	0.00	0.01	0.22	0.36
	Fe-Oxides	0.01	0.01	0.04	0.01	0.01	0.01	0.00	0.00	0.01	0.01
	Rutile	0.27	0.00	0.01	0.27	0.33	0.10	0.01	0.02	0.09	0.15
	Ilmenite	0.36	0.00	0.00	0.36	0.43	0.29	0.00	0.00	0.29	0.47
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.08	0.00	0.01	0.08	0.09	0.20	0.03	0.09	0.17	0.27
	Quartz	86.7	16.0	89.4	70.7	86.2	82.6	33.3	86.5	49.3	80.1
	Plagioclase	3.12	0.07	0.37	3.05	3.72	3.31	0.50	1.30	2.81	4.57
	K-Feldspar	4.06	0.31	1.72	3.75	4.57	5.20	1.27	3.30	3.93	6.39
	Biotite	0.17	0.01	0.03	0.17	0.20	0.10	0.01	0.04	0.08	0.14
	Muscovite	0.01	0.00	0.01	0.01	0.01	0.08	0.05	0.14	0.02	0.04
	Clays	0.07	0.00	0.01	0.07	0.08	0.13	0.02	0.04	0.11	0.18
	Chlorite	0.08	0.00	0.02	0.08	0.10	0.04	0.01	0.02	0.04	0.06
	Amphibole	0.70	0.01	0.08	0.69	0.84	0.31	0.06	0.15	0.25	0.40
	Epidote	0.43	0.00	0.01	0.43	0.53	0.25	0.03	0.08	0.22	0.35
	Grossular	0.05	0.00	0.00	0.05	0.07	0.07	0.00	0.00	0.07	0.12
	Titanite	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.01
	Other Silicates	0.05	0.00	0.01	0.04	0.05	0.04	0.01	0.02	0.03	0.05
	Calcite	3.32	1.41	7.87	1.91	2.32	6.86	3.16	8.21	3.70	6.02
	Ankerite	0.07	0.02	0.09	0.05	0.06	0.07	0.02	0.05	0.05	0.08
	Dolomite	0.05	0.00	0.00	0.05	0.06	0.04	0.01	0.02	0.03	0.05
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.02	0.02	0.10	0.00	0.00	0.01	0.01	0.02	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.03	0.00	0.01	0.03	0.03	0.04	0.01	0.02	0.03	0.05
	Total	100.0	17.9	100.0	82.1	100.0	100.0	38.5	100.0	61.5	100.0
Mean Grain Size by Frequency (µm)	Monazite	0	0		0		98	0		98	
	Synchysite/Bastnaesite	29	29		0		0	0		0	
	Other REE	0	14		13		0	0		11	
	Zircon	50	31		50		46	24		47	
	Apatite	83	140		77		70	33		71	
	Fe-Oxides	30	119		16		21	24		20	
	Rutile	58	41		59		45	25		48	
	Ilmenite	72	0		72		72	34		72	
	Other Oxides	11	0		11		11	0		11	
	Fe-Sulphides	16	21		16		17	23		16	
	Quartz	114	224		102		128	274		94	
	Plagioclase	49	45		49		38	38		38	
	K-Feldspar	74	120		71		62	98		55	
	Biotite	30	26		30		28	24		29	
	Muscovite	14	27		13		22	51		15	
	Clays	26	33		26		19	20		19	
	Chlorite	18	19		18		16	18		16	
	Amphibole	51	40		52		33	36		32	
	Epidote	31	17		31		26	21		26	
	Grossular	38	0		38		49	29		49	
	Titanite	30	24		30		25	40		23	
	Other Silicates	13	16		13		12	16		12	
	Calcite	65	139		47		80	142		58	
	Ankerite	22	29		20		24	29		22	
	Dolomite	25	29		25		24	24		24	
	Fluorite	28	25		29		11	0		11	
	Gypsum/Anhydrite	42	42		27		26	27		17	
	Phosphates	0	0		0		0	0		0	
	Other	11	15		11		12	15		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		NC_VC-9					NC_VC-10				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			4.1		95.9			50.7		49.3	
Calculated ESD Particle Size		89	162		87		90	181		59	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.05	0.00	0.00	0.05	0.05	0.02	0.00	0.00	0.02	0.03
	Apatite	0.47	0.00	0.04	0.47	0.49	0.66	0.19	0.38	0.47	0.96
	Fe-Oxides	0.03	0.00	0.01	0.03	0.03	0.02	0.02	0.03	0.01	0.01
	Rutile	0.18	0.00	0.05	0.18	0.18	0.02	0.00	0.00	0.02	0.05
	Ilmenite	0.49	0.00	0.04	0.49	0.51	0.04	0.00	0.00	0.04	0.07
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.18	0.01	0.20	0.17	0.18	0.04	0.01	0.02	0.03	0.06
	Quartz	77.3	2.55	62.9	74.8	77.9	21.0	4.11	8.10	16.9	34.4
	Plagioclase	5.77	0.18	4.53	5.59	5.82	1.51	0.09	0.17	1.43	2.89
	K-Feldspar	6.31	0.16	4.05	6.14	6.40	1.78	0.56	1.10	1.22	2.47
	Biotite	0.19	0.01	0.21	0.18	0.18	0.02	0.00	0.01	0.01	0.03
	Muscovite	0.05	0.01	0.19	0.05	0.05	0.00	0.00	0.00	0.00	0.00
	Clays	0.20	0.00	0.07	0.19	0.20	0.00	0.00	0.00	0.00	0.01
	Chlorite	0.09	0.00	0.07	0.09	0.09	0.00	0.00	0.00	0.00	0.00
	Amphibole	0.43	0.02	0.51	0.41	0.42	0.01	0.00	0.00	0.01	0.01
	Epidote	0.31	0.01	0.14	0.31	0.32	0.01	0.00	0.01	0.01	0.02
	Grossular	0.05	0.00	0.00	0.05	0.06	0.00	0.00	0.00	0.00	0.00
	Titanite	0.02	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.05	0.00	0.07	0.05	0.05	0.03	0.01	0.02	0.02	0.04
	Calcite	7.40	1.00	24.6	6.40	6.67	74.0	45.4	89.6	28.6	57.9
	Ankerite	0.08	0.01	0.27	0.07	0.07	0.69	0.25	0.49	0.45	0.91
	Dolomite	0.22	0.00	0.05	0.21	0.22	0.00	0.00	0.00	0.00	0.00
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.08	0.08	1.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.05	0.00	0.09	0.04	0.05	0.09	0.03	0.06	0.06	0.12
	Total	100.0	4.06	100.0	95.9	100.0	100.0	50.7	100.0	49.3	100.0
Mean Grain Size by Frequency (µm)	Monazite	0	0		0		0	0		0	
	Synchysite/Bastnaesite	22	29		21		0	0		0	
	Other REE	14	14		11		20	20		11	
	Zircon	38	14		38		32	0		32	
	Apatite	67	60		67		91	129		81	
	Fe-Oxides	14	18		14		24	30		17	
	Rutile	36	37		36		23	0		23	
	Ilmenite	64	46		65		41	14		42	
	Other Oxides	14	14		0		11	0		11	
	Fe-Sulphides	15	22		15		15	18		15	
	Quartz	90	182		88		98	136		91	
	Plagioclase	40	41		40		62	57		62	
	K-Feldspar	65	68		65		96	114		89	
	Biotite	46	44		46		20	27		19	
	Muscovite	15	32		14		15	18		13	
	Clays	26	20		26		19	14		19	
	Chlorite	21	21		21		11	14		11	
	Amphibole	40	42		40		17	19		17	
	Epidote	22	19		22		14	17		13	
	Grossular	40	22		40		0	0		0	
	Titanite	37	21		37		22	14		22	
	Other Silicates	12	16		12		13	17		12	
	Calcite	57	85		55		77	150		44	
	Ankerite	23	28		23		22	27		20	
	Dolomite	32	30		32		0	0		0	
	Fluorite	17	20		16		29	29		0	
	Gypsum/Anhydrite	91	94		21		0	0		0	
	Phosphates	0	0		0		0	0		0	
	Other	11	15		11		17	22		15	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		NC_VC-15					NC_VC-19				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			79.9		20.1			33.4		66.6	
Calculated ESD Particle Size		225	266		139		104	304		78	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.02	0.00	0.00	0.02	0.09	0.00	0.00	0.00	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.07	0.00	0.00	0.07	0.33	0.12	0.00	0.01	0.12	0.18
	Apatite	1.39	1.05	1.31	0.35	1.73	1.40	0.18	0.54	1.22	1.83
	Fe-Oxides	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01
	Rutile	0.18	0.06	0.08	0.12	0.59	0.13	0.03	0.08	0.10	0.15
	Ilmenite	0.35	0.16	0.20	0.19	0.95	0.47	0.00	0.00	0.47	0.71
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.01	0.05	0.08
	Quartz	86.1	69.0	86.3	17.1	85.1	77.7	30.9	92.3	46.8	70.4
	Plagioclase	1.05	0.67	0.84	0.37	1.87	4.77	0.12	0.36	4.65	6.99
	K-Feldspar	1.62	0.95	1.19	0.67	3.34	5.56	0.39	1.16	5.17	7.77
	Biotite	0.01	0.01	0.01	0.00	0.00	0.05	0.00	0.01	0.05	0.07
	Muscovite	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.02	0.02	0.04
	Clays	0.11	0.10	0.12	0.02	0.08	0.11	0.02	0.05	0.10	0.14
	Chlorite	0.04	0.03	0.04	0.01	0.05	0.04	0.01	0.02	0.03	0.04
	Amphibole	0.12	0.11	0.13	0.02	0.09	0.15	0.03	0.08	0.13	0.19
	Epidote	0.11	0.03	0.04	0.07	0.37	0.17	0.00	0.00	0.17	0.26
	Grossular	0.20	0.09	0.11	0.11	0.56	0.12	0.07	0.22	0.05	0.08
	Titanite	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.03	0.04
	Other Silicates	0.02	0.01	0.02	0.00	0.01	0.04	0.00	0.01	0.03	0.05
	Calcite	8.45	7.53	9.43	0.91	4.55	8.57	1.68	5.03	6.89	10.4
	Ankerite	0.17	0.12	0.15	0.06	0.28	0.23	0.03	0.09	0.20	0.31
	Dolomite	0.00	0.00	0.00	0.00	0.02	0.19	0.00	0.01	0.19	0.29
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.03
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.01	0.01	0.01	0.00	0.01	0.02	0.00	0.00	0.02	0.03
	Total	100.0	79.9	100.0	20.1	100.0	100.0	33.4	100.0	66.6	100.0
Mean Grain Size by Frequency (µm)	Monazite	155	14		175		0	0		0	
	Synchysite/Bastnaesite	21	0		21		25	0		25	
	Other REE	11	14		11		0	14		11	
	Zircon	77	40		81		58	50		58	
	Apatite	145	185		88		70	118		66	
	Fe-Oxides	34	45		16		21	29		16	
	Rutile	159	213		140		38	57		35	
	Ilmenite	132	208		101		61	0		61	
	Other Oxides	11	0		11		0	0		0	
	Fe-Sulphides	17	21		12		15	32		15	
	Quartz	228	274		136		114	335		80	
	Plagioclase	116	150		82		53	104		52	
	K-Feldspar	183	256		130		62	237		59	
	Biotite	34	39		18		20	37		19	
	Muscovite	17	20		14		17	57		16	
	Clays	127	192		43		30	70		28	
	Chlorite	23	22		27		29	26		29	
	Amphibole	42	44		32		31	40		30	
	Epidote	52	38		62		24	14		24	
	Grossular	55	64		49		75	109		53	
	Titanite	43	24		56		46	83		34	
	Other Silicates	19	21		13		13	20		13	
	Calcite	129	137		88		57	81		54	
	Ankerite	36	37		34		28	32		27	
	Dolomite	26	22		29		26	35		26	
	Fluorite	17	14		19		0	0		0	
	Gypsum/Anhydrite	29	29		0		28	0		28	
	Phosphates	11	0		11		21	0		21	
	Other	14	16		11		11	16		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		NC_VC-24					NC_VC-25				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			63.2		36.8			25.6		74.4	
Calculated ESD Particle Size		184	255		124		140	226		123	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.03	0.04
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	Zircon	0.03	0.00	0.01	0.03	0.07	0.06	0.00	0.02	0.06	0.08
	Apatite	0.48	0.15	0.23	0.34	0.92	0.98	0.16	0.62	0.82	1.10
	Fe-Oxides	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Rutile	0.07	0.00	0.00	0.06	0.17	0.21	0.00	0.00	0.20	0.27
	Ilmenite	0.09	0.00	0.00	0.09	0.25	0.29	0.00	0.00	0.29	0.39
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.01
	Quartz	91.5	58.7	92.8	32.8	89.2	91.3	24.2	94.3	67.1	90.2
	Plagioclase	1.31	0.19	0.30	1.12	3.05	2.02	0.11	0.43	1.91	2.57
	K-Feldspar	1.67	0.35	0.55	1.32	3.58	2.98	0.20	0.78	2.79	3.75
	Biotite	0.02	0.01	0.01	0.01	0.04	0.00	0.00	0.00	0.00	0.01
	Muscovite	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Clays	0.27	0.25	0.39	0.02	0.06	0.12	0.06	0.22	0.06	0.09
	Chlorite	0.02	0.01	0.02	0.01	0.02	0.05	0.00	0.01	0.04	0.06
	Amphibole	0.07	0.05	0.07	0.02	0.07	0.09	0.01	0.05	0.08	0.11
	Epidote	0.08	0.00	0.00	0.08	0.21	0.10	0.00	0.00	0.10	0.13
	Grossular	0.09	0.04	0.06	0.05	0.14	0.07	0.01	0.04	0.06	0.08
	Titanite	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.02	0.02
	Other Silicates	0.02	0.00	0.00	0.01	0.04	0.01	0.00	0.01	0.01	0.02
	Calcite	4.23	3.50	5.53	0.73	1.98	1.59	0.88	3.43	0.71	0.95
	Ankerite	0.05	0.01	0.02	0.03	0.09	0.07	0.02	0.07	0.05	0.07
	Dolomite	0.01	0.00	0.00	0.01	0.03	0.01	0.00	0.00	0.01	0.01
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.01	0.00	0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.01
	Total	100.0	63.2	100.0	36.8	100.0	100.0	25.6	100.0	74.4	100.0
Mean Grain Size by Frequency (µm)	Monazite	0	0		0		86	0		86	
	Synchysite/Bastnaesite	15	0		15		0	0		0	
	Other REE	0	14		11		17	21		14	
	Zircon	66	28		81		50	61		49	
	Apatite	81	121		71		87	109		84	
	Fe-Oxides	24	23		25		19	22		19	
	Rutile	50	20		51		64	30		65	
	Ilmenite	81	23		85		76	14		76	
	Other Oxides	11	0		11		14	14		14	
	Fe-Sulphides	16	18		15		13	20		13	
	Quartz	184	255		123		137	229		120	
	Plagioclase	74	113		70		92	131		90	
	K-Feldspar	113	138		108		116	152		114	
	Biotite	22	43		18		20	24		20	
	Muscovite	16	17		16		12	17		12	
	Clays	199	352		36		92	273		59	
	Chlorite	20	22		18		32	22		33	
	Amphibole	37	41		32		60	47		63	
	Epidote	45	14		45		55	26		55	
	Grossular	60	54		66		52	103		48	
	Titanite	32	0		32		36	39		36	
	Other Silicates	13	15		12		14	17		14	
	Calcite	105	139		48		76	101		58	
	Ankerite	26	26		27		29	36		28	
	Dolomite	27	14		27		21	23		21	
	Fluorite	14	14		0		19	25		14	
	Gypsum/Anhydrite	15	0		15		44	41		54	
	Phosphates	11	0		11		23	24		21	
	Other	13	20		12		13	18		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		NC_VC-27					NC_VC-31				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			42.5		57.5			73.2		26.8	
Calculated ESD Particle Size		158	228		128		221	280		139	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.19	0.00	0.01	0.19	0.33	0.09	0.01	0.02	0.08	0.30
	Apatite	1.24	0.23	0.54	1.01	1.76	2.68	2.08	2.85	0.60	2.22
	Fe-Oxides	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01
	Rutile	0.14	0.00	0.00	0.14	0.25	0.05	0.00	0.00	0.05	0.18
	Ilmenite	0.99	0.01	0.02	0.98	1.71	0.41	0.00	0.00	0.41	1.55
	Other Oxides	0.03	0.00	0.00	0.03	0.05	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.02
	Quartz	90.7	40.4	95.0	50.3	87.5	89.2	65.7	89.8	23.4	87.6
	Plagioclase	1.98	0.21	0.50	1.76	3.07	0.95	0.31	0.42	0.64	2.40
	K-Feldspar	1.87	0.49	1.15	1.38	2.40	1.48	0.78	1.06	0.70	2.61
	Biotite	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01
	Muscovite	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
	Clays	0.14	0.00	0.00	0.13	0.23	0.04	0.01	0.02	0.03	0.11
	Chlorite	0.02	0.00	0.00	0.02	0.03	0.12	0.10	0.13	0.02	0.09
	Amphibole	0.15	0.00	0.00	0.15	0.26	0.14	0.08	0.11	0.06	0.24
	Epidote	0.28	0.00	0.00	0.28	0.48	0.05	0.00	0.00	0.05	0.18
	Grossular	0.24	0.09	0.21	0.15	0.26	0.12	0.01	0.02	0.11	0.40
	Titanite	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.00	0.01
	Calcite	1.85	1.04	2.45	0.81	1.40	4.48	3.96	5.40	0.53	1.97
	Ankerite	0.15	0.03	0.07	0.12	0.21	0.13	0.10	0.13	0.03	0.11
	Dolomite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.01	0.01	0.02	0.00	0.01	0.01	0.01	0.02	0.00	0.01
	Total	100.0	42.5	100.0	57.5	100.0	100.0	73.2	100.0	26.8	100.0
Mean Grain Size by Frequency (µm)	Monazite	0	0		0		0	0		0	
	Synchysite/Bastnaesite	0	0		0		0	0		0	
	Other REE	21	21		11		14	14		11	
	Zircon	69	27		71		67	38		74	
	Apatite	101	111		99		177	204		122	
	Fe-Oxides	18	21		18		16	14		17	
	Rutile	54	14		54		47	19		51	
	Ilmenite	92	95		92		95	0		95	
	Other Oxides	21	0		21		16	0		16	
	Fe-Sulphides	15	22		11		19	23		14	
	Quartz	155	224		124		219	278		137	
	Plagioclase	86	90		86		100	106		97	
	K-Feldspar	121	188		108		147	192		116	
	Biotite	23	14		23		30	43		17	
	Muscovite	18	17		18		15	16		15	
	Clays	67	21		69		42	30		52	
	Chlorite	19	18		19		40	46		25	
	Amphibole	64	35		64		41	40		44	
	Epidote	70	17		71		51	17		53	
	Grossular	46	76		37		50	38		52	
	Titanite	34	24		36		21	14		24	
	Other Silicates	19	20		18		19	23		13	
	Calcite	93	138		66		129	147		67	
	Ankerite	41	38		42		32	35		26	
	Dolomite	33	0		33		22	21		23	
	Fluorite	21	0		21		25	29		17	
	Gypsum/Anhydrite	25	0		25		59	59		21	
	Phosphates	11	0		11		11	0		11	
	Other	15	19		11		19	22		13	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		NC_VC-32					NC_VC-33				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			71.0		29.0			63.2		36.8	
Calculated ESD Particle Size		153	244		80		168	225		117	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.03
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.05	0.00	0.00	0.04	0.15	0.18	0.00	0.00	0.18	0.49
	Apatite	1.61	1.18	1.66	0.42	1.46	1.78	1.13	1.78	0.65	1.77
	Fe-Oxides	0.04	0.03	0.04	0.01	0.02	0.00	0.00	0.00	0.00	0.01
	Rutile	0.07	0.00	0.00	0.07	0.24	0.09	0.01	0.02	0.08	0.22
	Ilmenite	0.10	0.01	0.01	0.09	0.33	0.46	0.01	0.01	0.45	1.22
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.39	0.12	0.17	0.26	0.91	0.02	0.01	0.01	0.01	0.03
	Quartz	61.3	42.0	59.2	19.2	66.4	76.3	46.5	73.6	29.7	80.8
	Plagioclase	2.04	0.45	0.64	1.59	5.47	2.03	0.55	0.87	1.48	4.02
	K-Feldspar	1.81	0.33	0.46	1.48	5.10	2.68	1.10	1.74	1.58	4.31
	Biotite	0.38	0.03	0.04	0.35	1.22	0.02	0.01	0.01	0.01	0.02
	Muscovite	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00
	Clays	0.07	0.01	0.01	0.07	0.23	0.12	0.09	0.14	0.03	0.07
	Chlorite	0.42	0.29	0.41	0.13	0.43	0.13	0.10	0.15	0.04	0.10
	Amphibole	1.49	1.08	1.53	0.41	1.41	0.56	0.39	0.61	0.18	0.49
	Epidote	0.21	0.02	0.03	0.19	0.66	0.14	0.01	0.02	0.12	0.34
	Grossular	0.02	0.00	0.00	0.02	0.07	0.05	0.00	0.00	0.05	0.13
	Titanite	0.01	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.03	0.08
	Other Silicates	0.16	0.04	0.05	0.13	0.43	0.03	0.01	0.02	0.02	0.05
	Calcite	28.7	24.5	34.4	4.25	14.7	15.2	13.1	20.7	2.09	5.70
	Ankerite	0.78	0.70	0.98	0.08	0.27	0.20	0.16	0.25	0.04	0.11
	Dolomite	0.07	0.01	0.01	0.06	0.20	0.01	0.00	0.00	0.00	0.01
	Fluorite	0.02	0.02	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.19	0.17	0.25	0.01	0.03	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.09	0.01	0.02	0.08	0.26	0.02	0.01	0.02	0.01	0.01
	Total	100.0	71.0	100.0	29.0	100.0	100.0	63.2	100.0	36.8	100.0
Mean Grain Size by Frequency (µm)	Monazite	32	0		32		65	0		65	
	Synchysite/Bastnaesite	26	29		24		0	0		0	
	Other REE	11	14		11		0	14		11	
	Zircon	84	27		100		90	0		90	
	Apatite	123	139		95		134	148		115	
	Fe-Oxides	29	31		20		16	22		14	
	Rutile	43	18		45		54	69		53	
	Ilmenite	65	45		67		83	79		83	
	Other Oxides	0	0		0		11	0		11	
	Fe-Sulphides	18	21		17		16	20		13	
	Quartz	151	219		90		166	223		118	
	Plagioclase	33	41		31		82	97		78	
	K-Feldspar	45	99		40		127	234		97	
	Biotite	17	28		17		24	27		22	
	Muscovite	13	15		13		15	21		13	
	Clays	26	35		26		57	74		33	
	Chlorite	22	24		18		23	25		21	
	Amphibole	33	39		24		43	43		43	
	Epidote	15	17		15		40	21		44	
	Grossular	32	16		36		38	23		39	
	Titanite	15	22		14		89	14		90	
	Other Silicates	13	18		12		19	18		21	
	Calcite	115	161		43		131	151		71	
	Ankerite	54	71		18		30	31		26	
	Dolomite	27	28		27		27	28		27	
	Fluorite	21	22		19		19	19		0	
	Gypsum/Anhydrite	69	76		27		24	0		24	
	Phosphates	14	0		14		11	0		11	
	Other	12	17		11		15	19		12	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		NC_VC-34					NC_VC-37				
Fraction		Combined	+212um		-212um		Combined	+212um		-212um	
Mass Size Distribution (%)			64.2		35.8			33.3		66.7	
Calculated ESD Particle Size		139	262		76		152	210		133	
		Sample	Sample	Fraction	Sample	Fraction	Sample	Sample	Fraction	Sample	Fraction
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Synchysite/Bastnaesite	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.08	0.00	0.00	0.08	0.23	0.02	0.00	0.00	0.01	0.02
	Apatite	0.42	0.38	0.59	0.04	0.12	0.04	0.00	0.00	0.03	0.05
	Fe-Oxides	0.02	0.01	0.02	0.01	0.03	0.01	0.00	0.00	0.01	0.01
	Rutile	0.04	0.01	0.01	0.03	0.09	0.26	0.00	0.01	0.26	0.38
	Ilmenite	0.08	0.00	0.00	0.07	0.21	0.70	0.00	0.00	0.70	1.05
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.31	0.03	0.05	0.28	0.78	0.01	0.00	0.00	0.00	0.01
	Quartz	63.7	42.7	66.5	21.0	58.7	89.2	31.6	94.9	57.6	86.4
	Plagioclase	2.14	0.20	0.31	1.95	5.44	4.41	0.72	2.15	3.70	5.54
	K-Feldspar	8.40	0.19	0.29	8.21	22.9	3.68	0.92	2.75	2.77	4.15
	Biotite	0.52	0.01	0.01	0.51	1.43	0.14	0.03	0.09	0.11	0.16
	Muscovite	0.02	0.00	0.00	0.02	0.06	0.09	0.01	0.03	0.08	0.12
	Clays	0.14	0.00	0.00	0.14	0.39	0.18	0.00	0.01	0.18	0.27
	Chlorite	0.05	0.03	0.05	0.02	0.05	0.10	0.01	0.02	0.09	0.14
	Amphibole	0.47	0.28	0.44	0.19	0.52	0.48	0.01	0.03	0.47	0.71
	Epidote	0.17	0.01	0.01	0.16	0.46	0.49	0.00	0.00	0.49	0.74
	Grossular	0.03	0.03	0.05	0.00	0.01	0.06	0.00	0.00	0.06	0.09
	Titanite	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.10	0.02	0.03	0.08	0.23	0.06	0.00	0.00	0.06	0.09
	Calcite	22.8	20.0	31.2	2.73	7.64	0.01	0.00	0.00	0.01	0.02
	Ankerite	0.33	0.28	0.43	0.05	0.15	0.00	0.00	0.00	0.00	0.00
	Dolomite	0.04	0.01	0.02	0.03	0.08	0.04	0.00	0.00	0.04	0.06
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.02	0.00	0.01	0.01	0.03	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.17	0.03	0.04	0.14	0.39	0.01	0.00	0.00	0.01	0.01
	Total	100.0	64.2	100.0	35.8	100.0	100.0	33.3	100.0	66.7	100.0
Mean Grain Size by Frequency (µm)	Monazite	32	0		32		0	0		0	
	Synchysite/Bastnaesite	30	33		14		19	0		19	
	Other REE	22	22		0		14	14		0	
	Zircon	130	0		130		44	32		46	
	Apatite	111	122		64		80	60		81	
	Fe-Oxides	21	24		19		15	14		15	
	Rutile	20	23		19		48	33		49	
	Ilmenite	52	43		53		90	29		90	
	Other Oxides	16	0		16		11	0		11	
	Fe-Sulphides	21	21		21		16	18		15	
	Quartz	124	282		57		147	206		127	
	Plagioclase	34	52		32		98	150		92	
	K-Feldspar	31	96		31		98	146		89	
	Biotite	18	25		17		64	89		59	
	Muscovite	13	24		13		26	28		26	
	Clays	16	18		16		57	23		58	
	Chlorite	19	22		14		25	20		25	
	Amphibole	32	43		23		67	105		67	
	Epidote	14	17		14		64	0		64	
	Grossular	31	35		15		22	22		22	
	Titanite	13	14		13		50	38		50	
	Other Silicates	13	20		12		35	15		37	
	Calcite	126	168		44		33	0		33	
	Ankerite	29	33		19		11	0		11	
	Dolomite	25	45		21		66	0		66	
	Fluorite	17	14		18		0	0		0	
	Gypsum/Anhydrite	29	41		25		0	0		0	
	Phosphates	0	0		0		0	0		0	
	Other	12	25		11		12	14		11	

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Modals

Survey		CALR-16225-001 / MI5017-SEP17						
Project		South Carolina Department of Natural Resources						
Sample		GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Calculated ESD Particle Size		118	83	130	275	182	250	188
Mineral Mass (%)	Monazite	0.01	0.00	0.00	0.00	0.00	0.02	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.02	0.10	0.04	0.01	0.07	0.07	0.02
	Apatite	1.81	1.68	1.19	0.34	1.30	0.96	0.98
	Fe-Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Rutile	0.16	0.18	0.06	0.03	0.19	0.07	0.04
	Ilmenite	0.32	0.58	0.43	0.06	0.73	0.21	0.22
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.08	0.03	0.01	0.01	0.00	0.01
	Quartz	88.7	77.0	87.4	93.9	90.6	93.2	79.8
	Plagioclase	2.45	6.07	3.88	1.18	1.68	0.69	2.77
	K-Feldspar	2.71	6.63	3.54	2.62	2.73	1.55	3.40
	Biotite	0.02	0.07	0.01	0.01	0.01	0.01	0.01
	Muscovite	0.03	0.15	0.02	0.00	0.02	0.06	0.06
	Clays	0.08	0.21	0.10	0.02	0.12	0.06	0.06
	Chlorite	0.01	0.03	0.05	0.02	0.02	0.03	0.04
	Amphibole	0.61	0.77	0.55	0.19	0.29	0.14	0.68
	Epidote	0.37	0.94	0.48	0.14	0.25	0.18	0.42
	Grossular	0.00	0.05	0.04	0.01	0.05	0.03	0.03
	Titanite	0.01	0.01	0.02	0.00	0.00	0.00	0.00
	Other Silicates	0.00	0.06	0.01	0.02	0.00	0.01	0.06
	Calcite	2.55	5.15	2.06	1.38	1.81	2.69	11.3
	Ankerite	0.07	0.09	0.08	0.02	0.06	0.02	0.10
	Dolomite	0.02	0.09	0.02	0.00	0.03	0.00	0.01
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.03	0.00	0.01	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.02	0.00	0.01	0.00	0.00	0.00
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	81	21	61	0	27	94	0
	Synchysite/Bastnaesite	20	17	0	0	12	0	14
	Other REE	10	22	0	0	0	10	10
	Zircon	50	42	38	69	80	66	65
	Apatite	94	87	94	125	120	114	114
	Fe-Oxides	13	12	18	19	15	15	18
	Rutile	61	39	41	50	62	52	35
	Ilmenite	70	53	82	78	108	86	90
	Other Oxides	0	0	8	16	8	10	8
	Fe-Sulphides	12	13	12	21	15	14	14
	Quartz	114	86	128	273	181	255	200
	Plagioclase	84	47	68	113	91	70	83
	K-Feldspar	89	63	95	218	136	130	122
	Biotite	23	23	19	38	23	34	23
	Muscovite	31	23	17	15	36	46	37
	Clays	47	28	31	35	48	63	53
	Chlorite	13	15	18	19	20	19	16
	Amphibole	65	41	50	51	50	45	46
	Epidote	54	38	57	58	79	70	79
	Grossular	33	29	33	45	52	41	38
	Titanite	24	34	54	42	26	17	31
	Other Silicates	11	15	10	25	13	15	24
	Calcite	133	54	64	108	102	111	100
	Ankerite	27	22	31	26	26	28	31
	Dolomite	34	59	51	51	43	26	59
	Fluorite	25	11	17	32	0	16	18
	Gypsum/Anhydrite	25	115	25	162	12	18	17
	Phosphates	0	14	29	11	8	8	0
	Other	10	9	9	14	11	14	11

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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Calculated ESD Particle Size		244	129	247	148	233	125	115	93	173	108
Mineral Mass (%)	Monazite	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.10	0.04	0.04	0.00	0.04	0.07	0.04	0.15	0.03	0.11
	Apatite	3.35	0.66	3.78	0.79	3.69	2.21	0.71	3.44	1.05	0.29
	Fe-Oxides	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
	Rutile	0.19	0.08	0.06	0.03	0.04	0.17	0.09	0.37	0.04	0.33
	Ilmenite	1.16	0.35	0.22	0.21	0.24	0.75	0.38	0.77	0.30	0.62
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.02	0.00	0.02	0.00	0.00	0.01	0.14	0.00	0.01
	Quartz	88.1	76.5	76.4	64.7	74.3	82.4	75.5	65.7	72.6	76.8
	Plagioclase	2.08	3.84	0.88	2.30	1.44	3.59	4.84	5.70	2.05	5.75
	K-Feldspar	2.37	4.44	2.21	2.19	1.59	5.03	5.74	6.87	2.39	6.05
	Biotite	0.01	0.03	0.02	0.02	0.02	0.05	0.07	0.16	0.07	0.07
	Muscovite	0.00	0.13	0.01	0.02	0.01	0.04	0.05	0.11	0.05	0.29
	Clays	0.12	0.15	0.08	0.06	0.02	0.19	0.13	0.31	0.03	0.12
	Chlorite	0.06	0.06	0.05	0.09	0.04	0.07	0.05	0.05	0.08	0.07
	Amphibole	0.43	0.89	0.39	0.70	0.31	1.22	0.92	1.01	0.58	1.41
	Epidote	0.68	0.39	0.13	0.15	0.11	0.88	0.63	0.87	0.25	0.78
	Grossular	0.28	0.03	0.04	0.00	0.02	0.08	0.02	0.08	0.02	0.03
	Titanite	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.02	0.00	0.02
	Other Silicates	0.05	0.02	0.01	0.02	0.01	0.01	0.01	0.05	0.00	0.02
	Calcite	0.97	12.3	15.6	28.5	17.9	3.12	10.7	14.0	20.3	7.11
	Ankerite	0.07	0.11	0.11	0.18	0.20	0.10	0.09	0.13	0.11	0.06
	Dolomite	0.00	0.01	0.00	0.00	0.00	0.01	0.02	0.07	0.00	0.01
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	66	38	41	0	17	40	37	38	114	32
	Synchysite/Bastnaesite	24	0	0	0	0	21	0	46	0	0
	Other REE	0	0	0	0	14	0	0	14	0	0
	Zircon	84	55	107	27	91	68	62	43	55	64
	Apatite	251	116	226	121	185	96	109	229	160	80
	Fe-Oxides	17	16	21	24	19	20	19	21	21	14
	Rutile	83	48	75	43	72	65	55	59	58	69
	Ilmenite	129	68	95	77	111	82	70	66	106	68
	Other Oxides	8	0	8	16	11	11	11	21	14	14
	Fe-Sulphides	19	16	15	15	15	12	17	16	17	14
	Quartz	240	130	249	146	233	121	113	89	166	107
	Plagioclase	133	82	99	97	137	84	77	40	94	78
	K-Feldspar	177	98	205	109	149	103	92	54	107	88
	Biotite	25	26	29	24	39	31	28	31	42	34
	Muscovite	20	48	25	34	32	26	32	18	42	57
	Clays	64	64	74	75	47	54	59	27	66	50
	Chlorite	36	17	21	20	20	17	17	17	19	19
	Amphibole	96	59	62	47	57	66	53	43	55	57
	Epidote	117	47	76	58	70	67	55	38	61	49
	Grossular	58	35	37	16	47	39	34	41	34	27
	Titanite	26	23	20	26	104	62	31	32	28	38
	Other Silicates	43	15	17	17	20	13	13	17	13	16
	Calcite	149	105	152	120	154	93	87	102	157	80
	Ankerite	29	33	30	30	37	30	29	30	33	28
	Dolomite	34	35	34	0	46	38	67	36	16	27
	Fluorite	0	16	15	25	21	26	0	24	21	14
	Gypsum/Anhydrite	14	0	10	14	21	21	0	65	0	26
	Phosphates	8	14	13	0	0	0	0	0	11	0
	Other	12	13	11	14	14	11	11	11	16	11

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Modals

Survey		CALR-16225-001 / MI5017-SEP17								
Project		South Carolina Department of Natural Resources								
Sample		SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Calculated ESD Particle Size		396	67	283	248	164	158	289	334	233
Mineral Mass (%)	Monazite	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.03	0.11	0.02	0.05	0.08	0.15	0.10	0.17	0.13
	Apatite	0.01	0.08	0.01	0.49	0.37	0.41	0.10	0.08	0.79
	Fe-Oxides	0.00	0.16	0.00	1.64	1.72	1.67	0.14	0.77	0.30
	Rutile	0.02	0.28	0.03	0.03	0.06	0.11	0.13	0.06	0.11
	Ilmenite	0.06	0.49	0.39	0.18	0.43	0.83	0.53	0.24	0.82
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.00	1.06	0.00	0.26	0.12	0.00	0.00	0.05	0.03
	Quartz	94.4	70.1	87.0	66.3	66.2	67.6	94.3	92.4	86.6
	Plagioclase	0.77	11.2	3.37	0.44	1.44	0.52	0.30	0.34	0.93
	K-Feldspar	2.08	10.4	7.42	0.31	1.56	1.71	0.49	0.25	1.63
	Biotite	0.01	0.15	0.02	0.10	0.12	0.12	0.03	0.06	0.07
	Muscovite	0.02	0.45	0.02	0.00	0.01	0.01	0.00	0.00	0.00
	Clays	0.02	1.57	0.01	0.21	0.02	0.04	0.02	0.02	0.04
	Chlorite	0.02	0.10	0.03	0.09	0.07	0.04	0.04	0.04	0.10
	Amphibole	0.10	1.29	0.53	0.19	0.34	0.20	0.12	0.08	0.22
	Epidote	0.10	1.14	0.37	0.09	0.13	0.20	0.08	0.18	0.09
	Grossular	0.02	0.07	0.00	0.19	0.27	0.11	0.11	0.52	0.25
	Titanite	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Silicates	0.00	0.03	0.01	0.02	0.07	0.02	0.01	0.04	0.01
	Calcite	2.30	1.18	0.79	28.2	25.4	24.7	3.41	4.54	7.69
	Ankerite	0.07	0.02	0.01	1.17	1.60	1.54	0.05	0.13	0.19
	Dolomite	0.01	0.05	0.00	0.00	0.02	0.00	0.00	0.01	0.01
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.04	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.02	0.00
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	51	21	0	41	0	82	54	0	77
	Synchysite/Bastnaesite	0	29	0	24	13	21	36	27	0
	Other REE	0	0	0	15	9	14	12	18	0
	Zircon	62	35	128	59	54	72	96	96	85
	Apatite	62	76	92	124	71	82	88	64	117
	Fe-Oxides	16	31	27	54	47	47	53	177	243
	Rutile	51	27	54	63	42	47	81	65	44
	Ilmenite	79	39	162	120	103	93	109	108	115
	Other Oxides	0	0	0	14	0	0	11	11	12
	Fe-Sulphides	26	28	25	27	16	19	15	22	18
	Quartz	405	70	287	257	172	164	293	356	237
	Plagioclase	84	38	151	71	60	66	62	40	73
	K-Feldspar	166	43	205	114	89	151	120	60	124
	Biotite	30	23	29	36	30	40	36	23	39
	Muscovite	25	19	30	16	15	24	18	20	15
	Clays	36	21	50	207	27	47	49	39	33
	Chlorite	19	23	21	21	15	18	21	20	25
	Amphibole	52	37	92	33	26	39	45	35	42
	Epidote	54	34	101	18	19	28	43	16	32
	Grossular	37	22	26	106	63	48	53	91	70
	Titanite	36	23	53	85	39	39	36	39	68
	Other Silicates	16	15	16	13	12	17	25	13	17
	Calcite	163	53	121	126	87	105	114	86	133
	Ankerite	53	21	29	39	41	41	31	27	34
	Dolomite	30	41	18	24	30	19	38	34	45
	Fluorite	13	0	0	17	12	17	14	12	20
	Gypsum/Anhydrite	15	69	0	16	15	27	14	126	11
	Phosphates	11	0	0	16	14	13	13	12	0
	Other	14	11	14	13	9	31	11	11	19

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Modals

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Sample		NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Calculated ESD Particle Size		89	163	116	133	89	90	225	104
Mineral Mass (%)	Monazite	0.02	0.01	0.00	0.04	0.00	0.00	0.02	0.00
	Synchysite/Bastnaesite	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.09	0.11	0.03	0.03	0.05	0.02	0.07	0.12
	Apatite	0.38	0.24	0.27	0.22	0.47	0.66	1.39	1.40
	Fe-Oxides	0.03	0.01	0.01	0.01	0.03	0.02	0.01	0.01
	Rutile	0.25	0.11	0.27	0.10	0.18	0.02	0.18	0.13
	Ilmenite	0.69	0.57	0.36	0.29	0.49	0.04	0.35	0.47
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.19	0.01	0.08	0.20	0.18	0.04	0.00	0.05
	Quartz	73.9	89.6	86.7	82.6	77.3	21.0	86.1	77.7
	Plagioclase	5.93	1.60	3.12	3.31	5.77	1.51	1.05	4.77
	K-Feldspar	5.26	2.93	4.06	5.20	6.31	1.78	1.62	5.56
	Biotite	0.17	0.09	0.17	0.10	0.19	0.02	0.01	0.05
	Muscovite	0.03	0.04	0.01	0.08	0.05	0.00	0.00	0.03
	Clays	0.15	0.03	0.07	0.13	0.20	0.00	0.11	0.11
	Chlorite	0.06	0.08	0.08	0.04	0.09	0.00	0.04	0.04
	Amphibole	0.66	0.30	0.70	0.31	0.43	0.01	0.12	0.15
	Epidote	0.46	0.17	0.43	0.25	0.31	0.01	0.11	0.17
	Grossular	0.05	0.07	0.05	0.07	0.05	0.00	0.20	0.12
	Titanite	0.03	0.00	0.01	0.01	0.02	0.00	0.00	0.03
	Other Silicates	0.11	0.01	0.05	0.04	0.05	0.03	0.02	0.04
	Calcite	11.1	3.99	3.32	6.86	7.40	74.0	8.45	8.57
	Ankerite	0.19	0.02	0.07	0.07	0.08	0.69	0.17	0.23
	Dolomite	0.17	0.02	0.05	0.04	0.22	0.00	0.00	0.19
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.01	0.00	0.02	0.01	0.08	0.00	0.00	0.02
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.04	0.00	0.03	0.04	0.05	0.09	0.01	0.02
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	42	50	0	98	0	0	155	0
	Synchysite/Bastnaesite	27	0	29	0	22	0	21	25
	Other REE	11	0	0	0	14	20	11	0
	Zircon	51	75	50	46	38	32	77	58
	Apatite	64	152	83	70	67	91	145	70
	Fe-Oxides	19	17	30	21	14	24	34	21
	Rutile	38	49	58	45	36	23	159	38
	Ilmenite	78	98	72	72	64	41	132	61
	Other Oxides	0	11	11	11	14	11	11	0
	Fe-Sulphides	16	17	16	17	15	15	17	15
	Quartz	88	162	114	128	90	98	228	114
	Plagioclase	37	79	49	38	40	62	116	53
	K-Feldspar	55	121	74	62	65	96	183	62
	Biotite	36	51	30	28	46	20	34	20
	Muscovite	14	35	14	22	15	15	17	17
	Clays	22	40	26	19	26	19	127	30
	Chlorite	17	19	18	16	21	11	23	29
	Amphibole	39	50	51	33	40	17	42	31
	Epidote	19	61	31	26	22	14	52	24
	Grossular	37	78	38	49	40	0	55	75
	Titanite	39	33	30	25	37	22	43	46
	Other Silicates	15	17	13	12	12	13	19	13
	Calcite	75	120	65	80	57	77	129	57
	Ankerite	22	24	22	24	23	22	36	28
	Dolomite	33	41	25	24	32	0	26	26
	Fluorite	19	29	28	11	17	29	17	0
	Gypsum/Anhydrite	46	24	42	26	91	0	29	28
	Phosphates	11	21	0	0	0	0	11	21
	Other	11	12	11	12	11	17	14	11

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Modals

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Sample		NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Calculated ESD Particle Size		184	140	158	221	153	168	139	152
Mineral Mass (%)	Monazite	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.00
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.03	0.06	0.19	0.09	0.05	0.18	0.08	0.02
	Apatite	0.48	0.98	1.24	2.68	1.61	1.78	0.42	0.04
	Fe-Oxides	0.01	0.00	0.01	0.00	0.04	0.00	0.02	0.01
	Rutile	0.07	0.21	0.14	0.05	0.07	0.09	0.04	0.26
	Ilmenite	0.09	0.29	0.99	0.41	0.10	0.46	0.08	0.70
	Other Oxides	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
	Fe-Sulphides	0.01	0.01	0.00	0.01	0.39	0.02	0.31	0.01
	Quartz	91.5	91.3	90.7	89.2	61.3	76.3	63.7	89.2
	Plagioclase	1.31	2.02	1.98	0.95	2.04	2.03	2.14	4.41
	K-Feldspar	1.67	2.98	1.87	1.48	1.81	2.68	8.40	3.68
	Biotite	0.02	0.00	0.00	0.01	0.38	0.02	0.52	0.14
	Muscovite	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.09
	Clays	0.27	0.12	0.14	0.04	0.07	0.12	0.14	0.18
	Chlorite	0.02	0.05	0.02	0.12	0.42	0.13	0.05	0.10
	Amphibole	0.07	0.09	0.15	0.14	1.49	0.56	0.47	0.48
	Epidote	0.08	0.10	0.28	0.05	0.21	0.14	0.17	0.49
	Grossular	0.09	0.07	0.24	0.12	0.02	0.05	0.03	0.06
	Titanite	0.00	0.02	0.01	0.00	0.01	0.03	0.00	0.00
	Other Silicates	0.02	0.01	0.02	0.01	0.16	0.03	0.10	0.06
	Calcite	4.23	1.59	1.85	4.48	28.7	15.2	22.8	0.01
	Ankerite	0.05	0.07	0.15	0.13	0.78	0.20	0.33	0.00
	Dolomite	0.01	0.01	0.00	0.00	0.07	0.01	0.04	0.04
	Fluorite	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.01	0.19	0.00	0.02	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.01	0.01	0.01	0.01	0.09	0.02	0.17	0.01
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	0	86	0	0	32	65	32	0
	Synchysite/Bastnaesite	15	0	0	0	26	0	30	19
	Other REE	0	17	21	14	11	0	22	14
	Zircon	66	50	69	67	84	90	130	44
	Apatite	81	87	101	177	123	134	111	80
	Fe-Oxides	24	19	18	16	29	16	21	15
	Rutile	50	64	54	47	43	54	20	48
	Ilmenite	81	76	92	95	65	83	52	90
	Other Oxides	11	14	21	16	0	11	16	11
	Fe-Sulphides	16	13	15	19	18	16	21	16
	Quartz	184	137	155	219	151	166	124	147
	Plagioclase	74	92	86	100	33	82	34	98
	K-Feldspar	113	116	121	147	45	127	31	98
	Biotite	22	20	23	30	17	24	18	64
	Muscovite	16	12	18	15	13	15	13	26
	Clays	199	92	67	42	26	57	16	57
	Chlorite	20	32	19	40	22	23	19	25
	Amphibole	37	60	64	41	33	43	32	67
	Epidote	45	55	70	51	15	40	14	64
	Grossular	60	52	46	50	32	38	31	22
	Titanite	32	36	34	21	15	89	13	50
	Other Silicates	13	14	19	19	13	19	13	35
	Calcite	105	76	93	129	115	131	126	33
	Ankerite	26	29	41	32	54	30	29	11
	Dolomite	27	21	33	22	27	27	25	66
	Fluorite	14	19	21	25	21	19	17	0
	Gypsum/Anhydrite	15	44	25	59	69	24	29	0
	Phosphates	11	23	11	11	14	11	0	0
	Other	13	13	15	19	12	15	12	12

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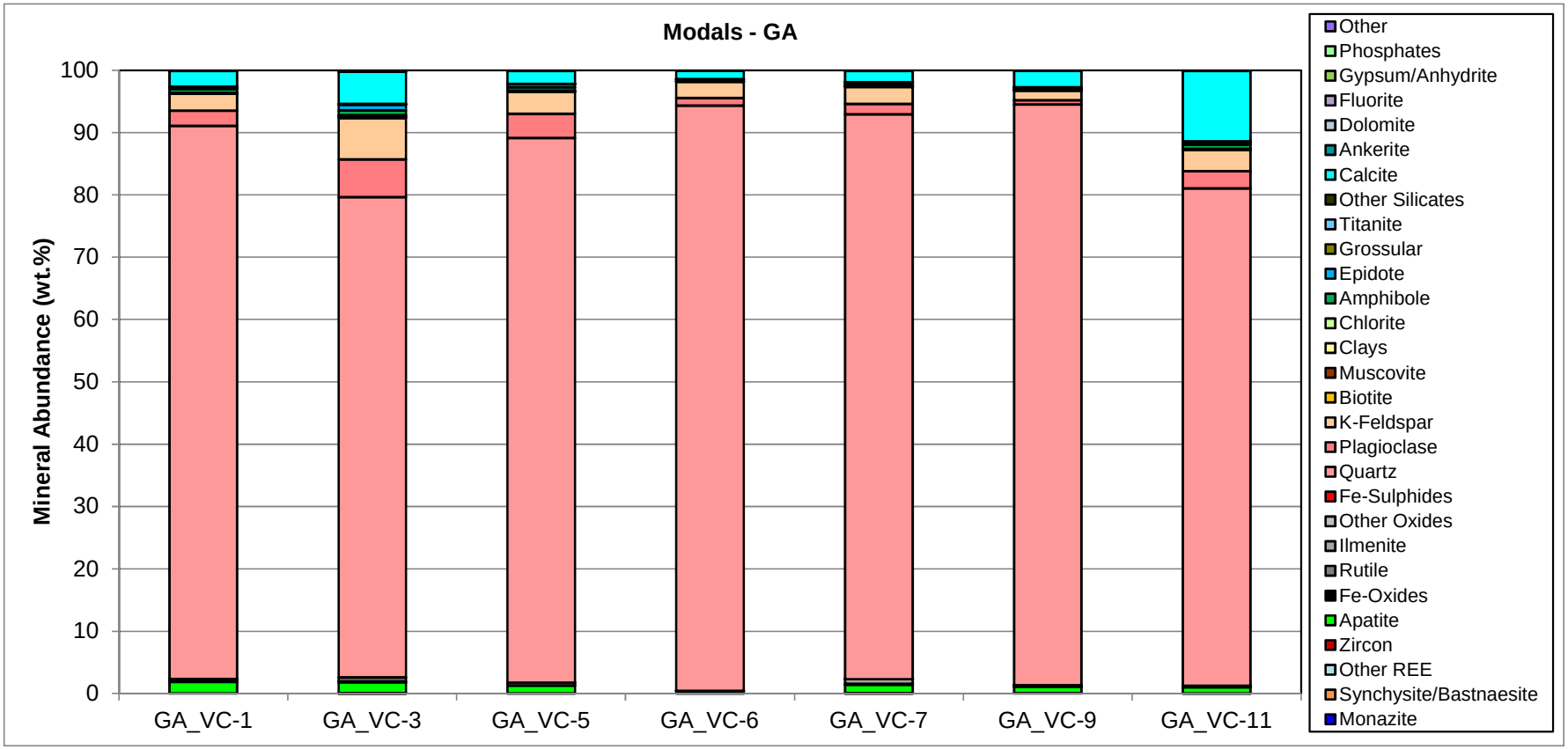
Modal Chart



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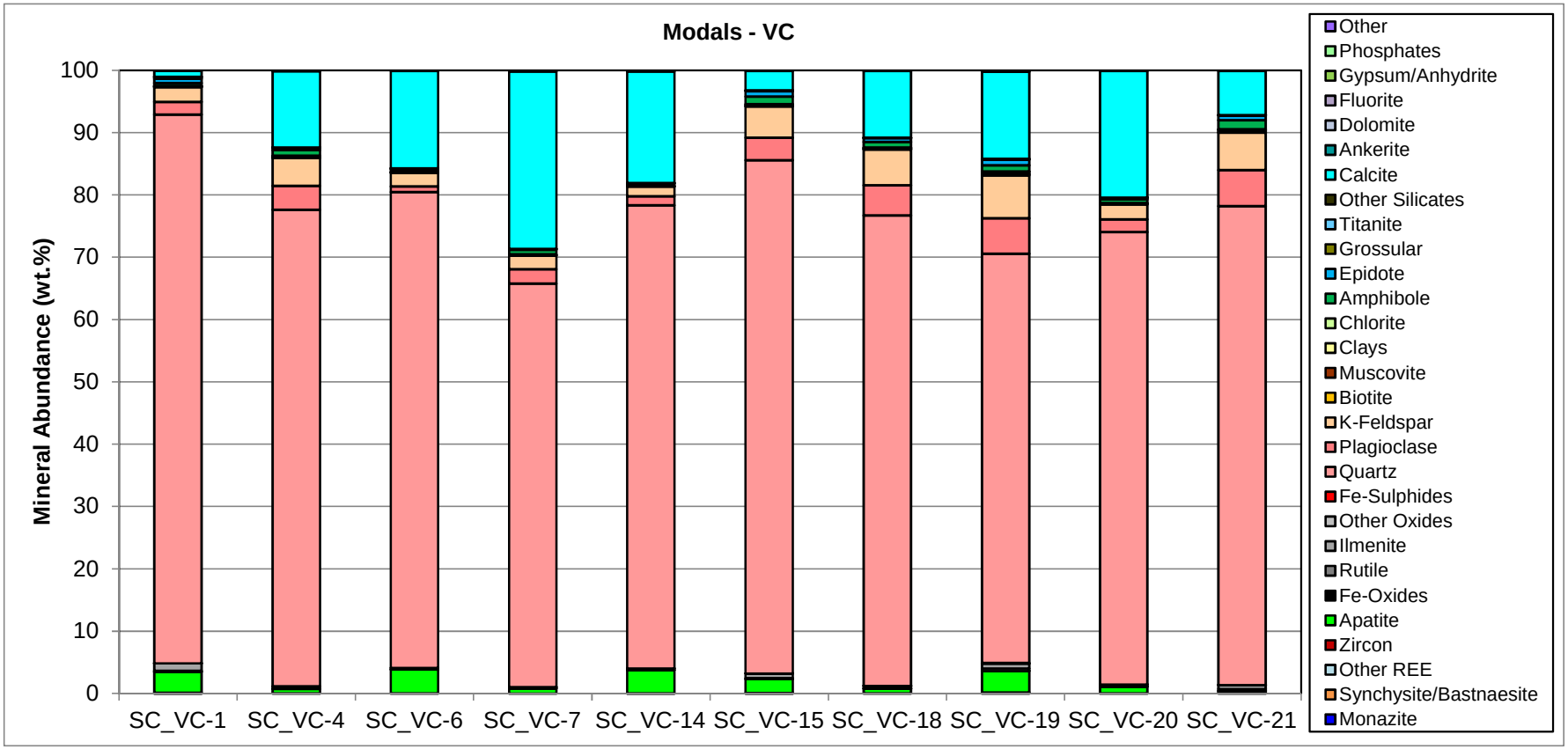
Modal Chart



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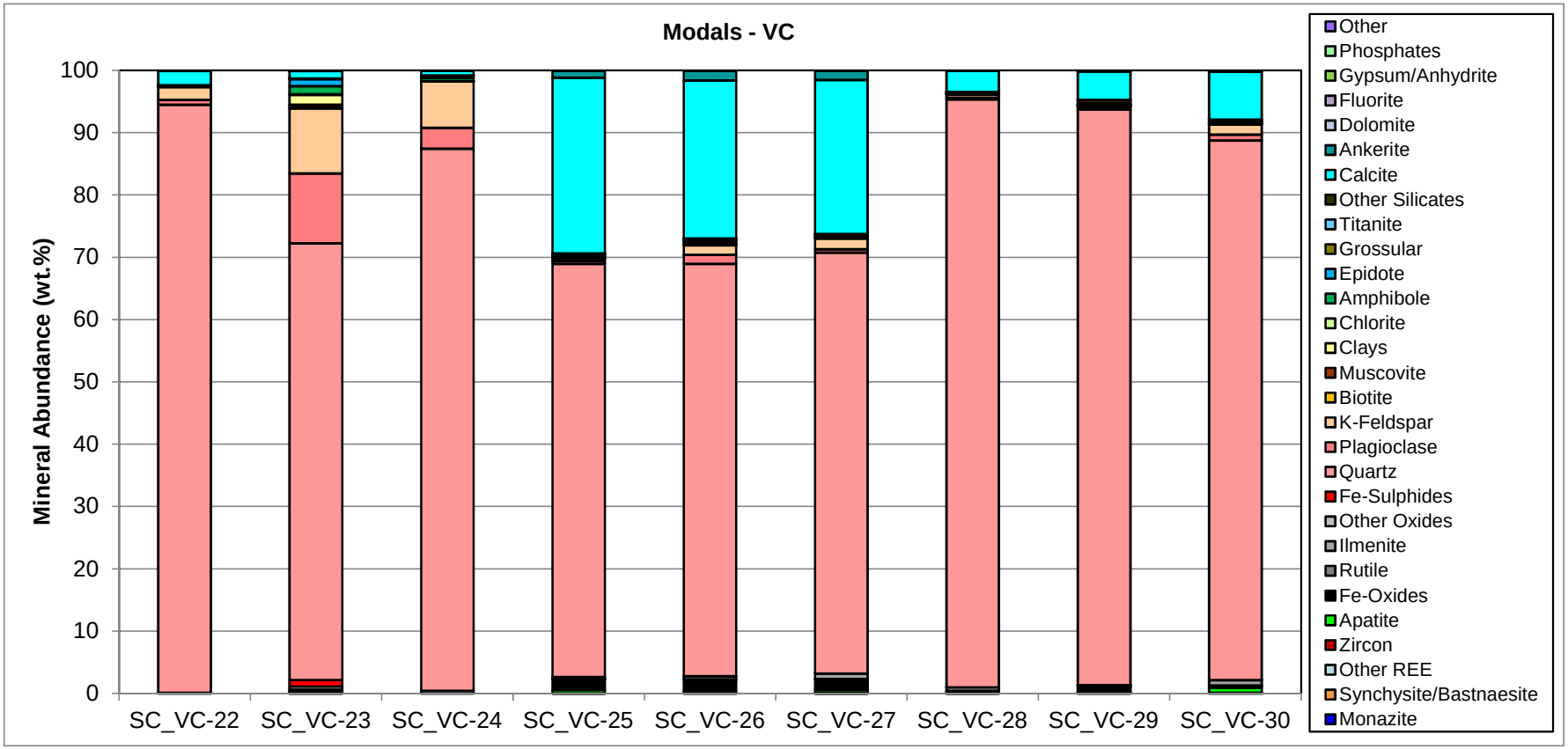
Modal Chart



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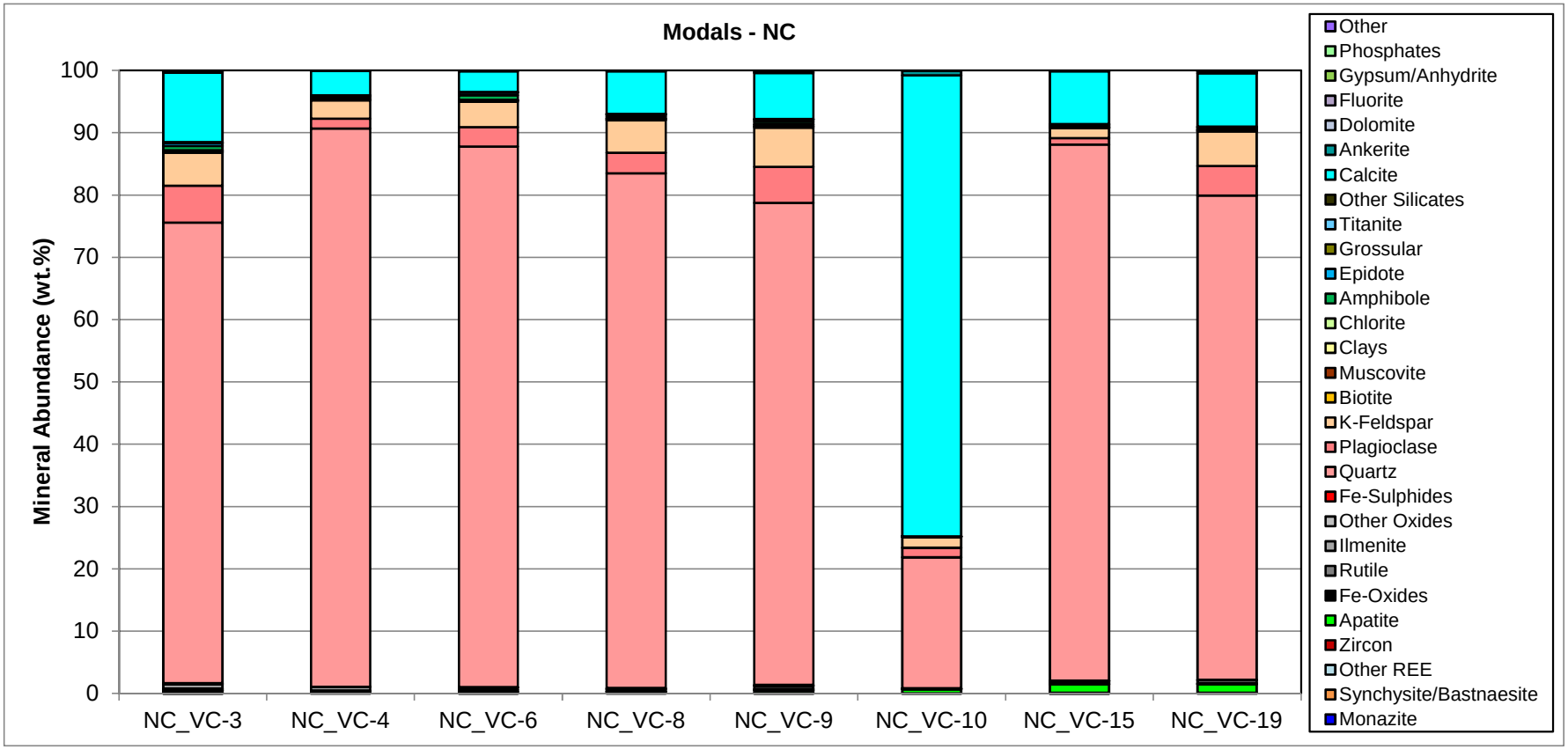

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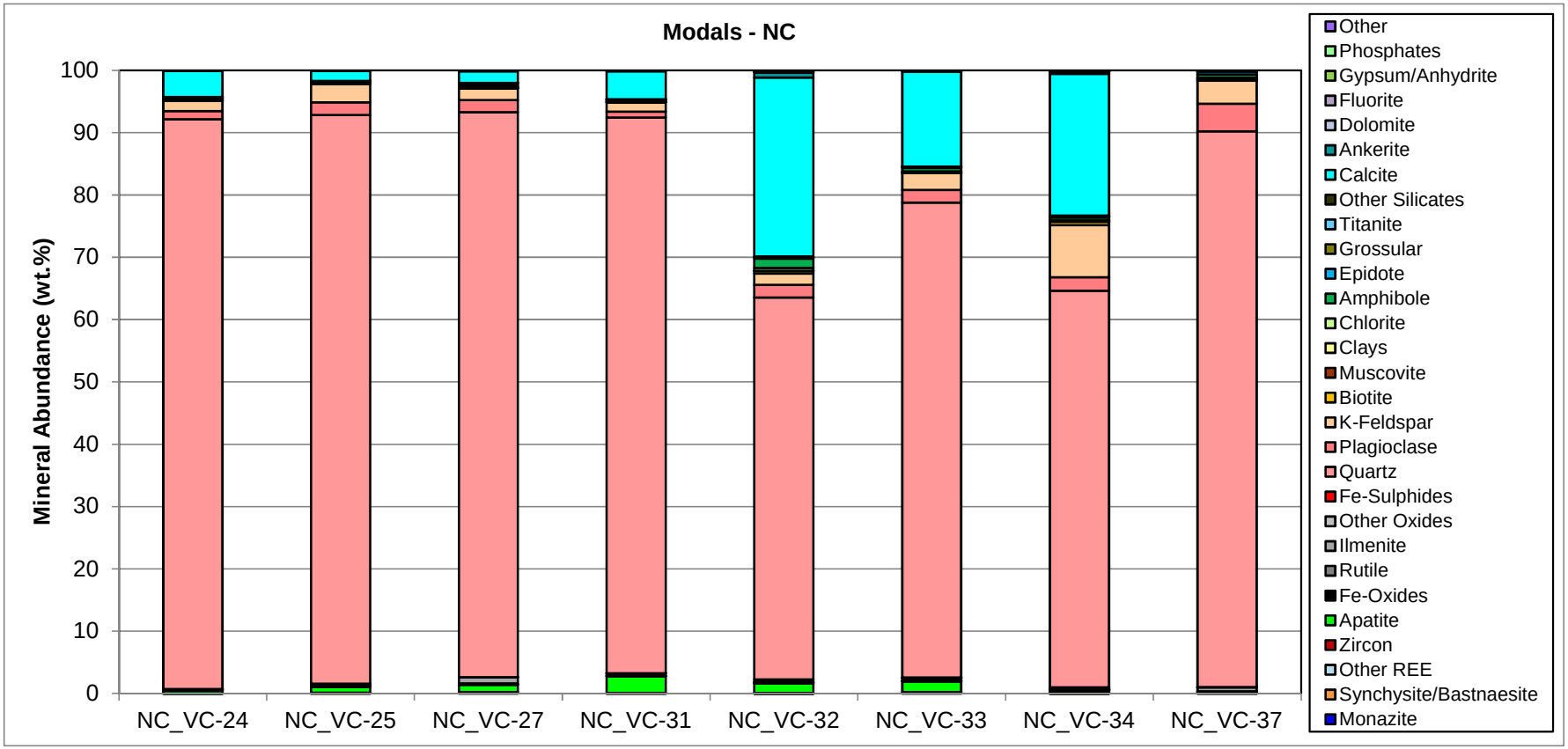

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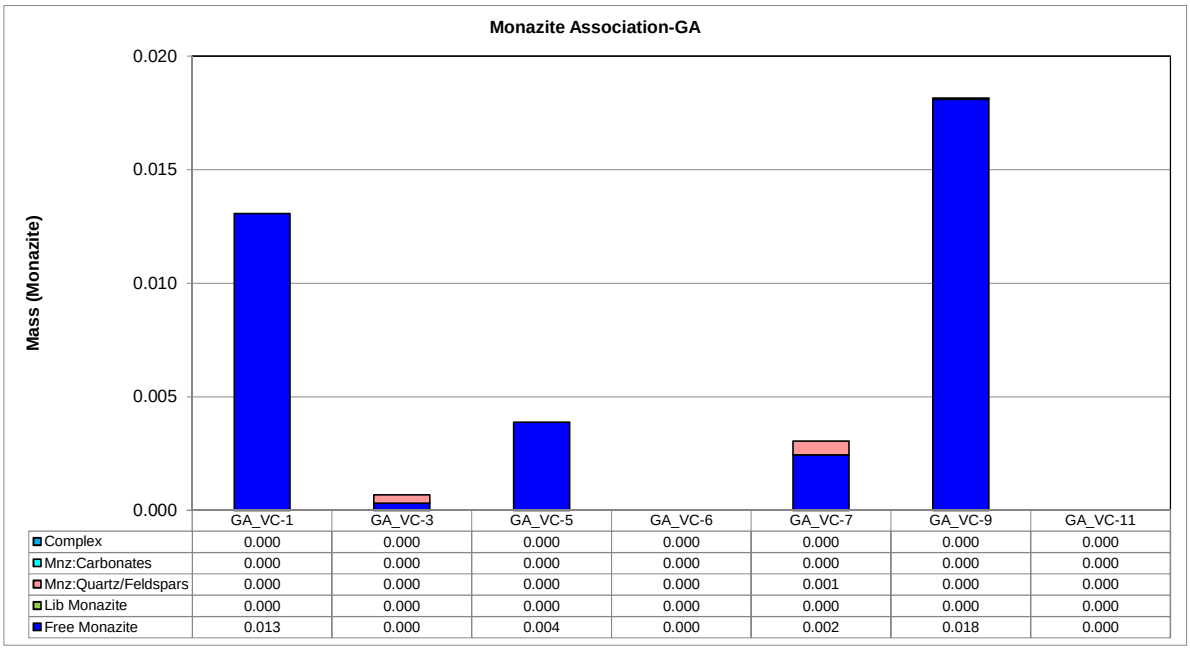
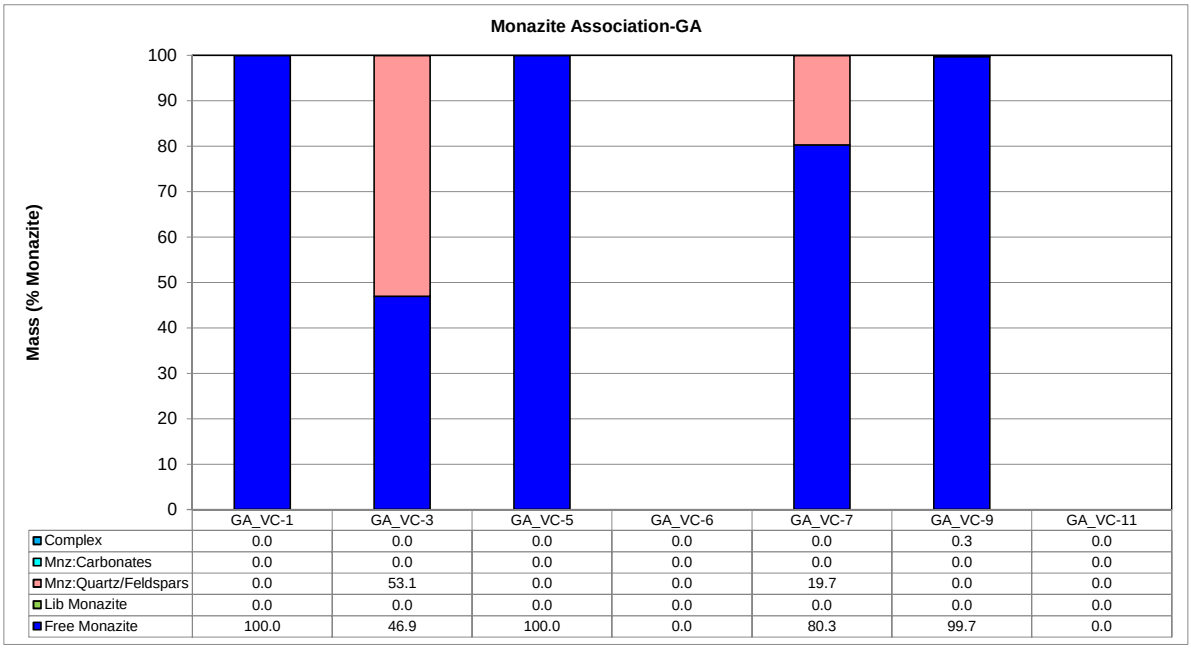
Monazite Association



	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Free Monazite	0.013	0.000	0.004	0.000	0.002	0.018	0.000

Absolute Mass of Monazite Across Samples

Mineral Name	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Free Monazite	0.013	0.000	0.004	0.000	0.002	0.018	0.000
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	0.013	0.001	0.004	0.000	0.003	0.018	0.000



	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mnz:Quartz/Feldspars	0.0	53.1	0.0	0.0	19.7	0.0	0.0
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Free Monazite	100.0	46.9	100.0	0.0	80.3	99.7	0.0

Normalized Mass of Monazite Across Samples

Mineral Name	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Free Monazite	100.0	46.9	100.0	0.0	80.3	99.7	0.0
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mnz:Quartz/Feldspars	0.0	53.1	0.0	0.0	19.7	0.0	0.0
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.0	0.0	0.0	0.0	0.0	0.3	0.0
Total	100.0	100.0	100.0	0.0	100.0	100.0	0.0
Liberated	100.0	46.9	100.0	0.0	80.3	99.7	0.0

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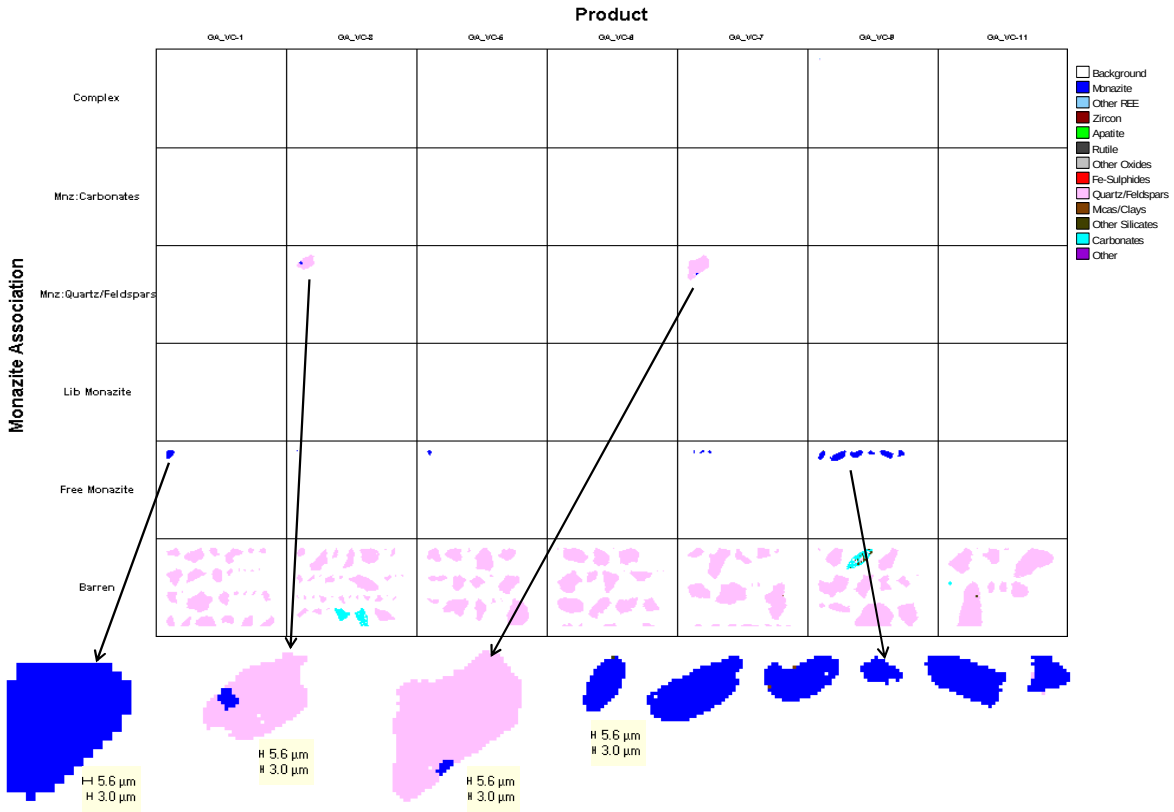
Image Grid of Monazite Association



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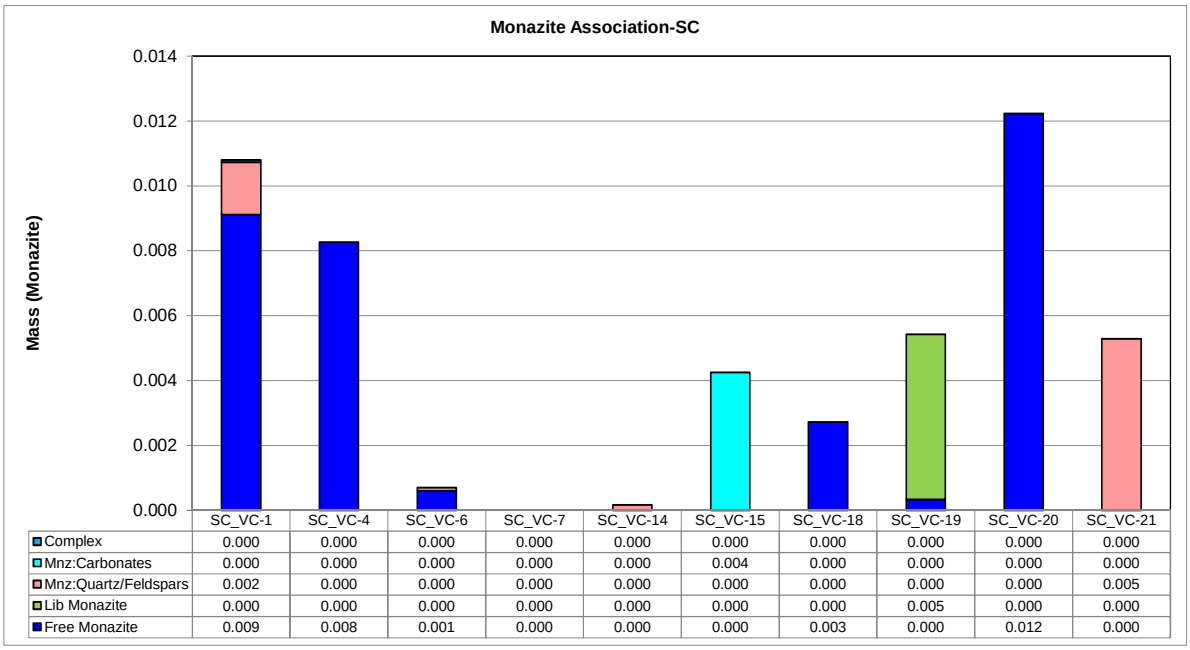
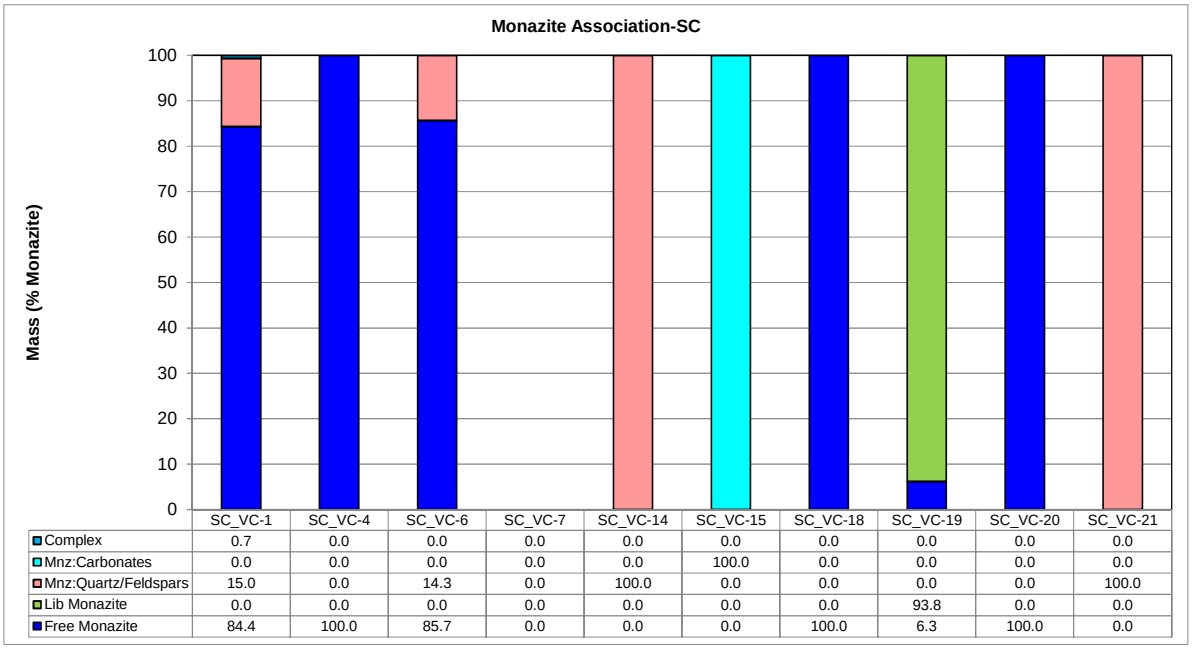
Monazite Association



	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000
Free Monazite	0.009	0.008	0.001	0.000	0.000	0.000	0.003	0.000	0.012	0.000

Absolute Mass of Monazite Across Samples

Mineral Name	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Free Monazite	0.009	0.008	0.001	0.000	0.000	0.000	0.003	0.000	0.012	0.000
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000
Mnz:Quartz/Feldspars	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	0.011	0.008	0.001	0.000	0.000	0.004	0.003	0.005	0.012	0.005



	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Complex	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Mnz:Quartz/Feldspars	15.0	0.0	14.3	0.0	100.0	0.0	0.0	0.0	0.0	100.0
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	93.8	0.0	0.0
Free Monazite	84.4	100.0	85.7	0.0	0.0	0.0	100.0	6.3	100.0	0.0

Normalized Mass of Monazite Across Samples

Mineral Name	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Free Monazite	84.4	100.0	85.7	0.0	0.0	0.0	100.0	6.3	100.0	0.0
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	93.8	0.0	0.0
Mnz:Quartz/Feldspars	15.0	0.0	14.3	0.0	100.0	0.0	0.0	0.0	0.0	100.0
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Complex	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	0.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	84.4	100.0	85.7	0.0	0.0	0.0	100.0	100.0	100.0	0.0

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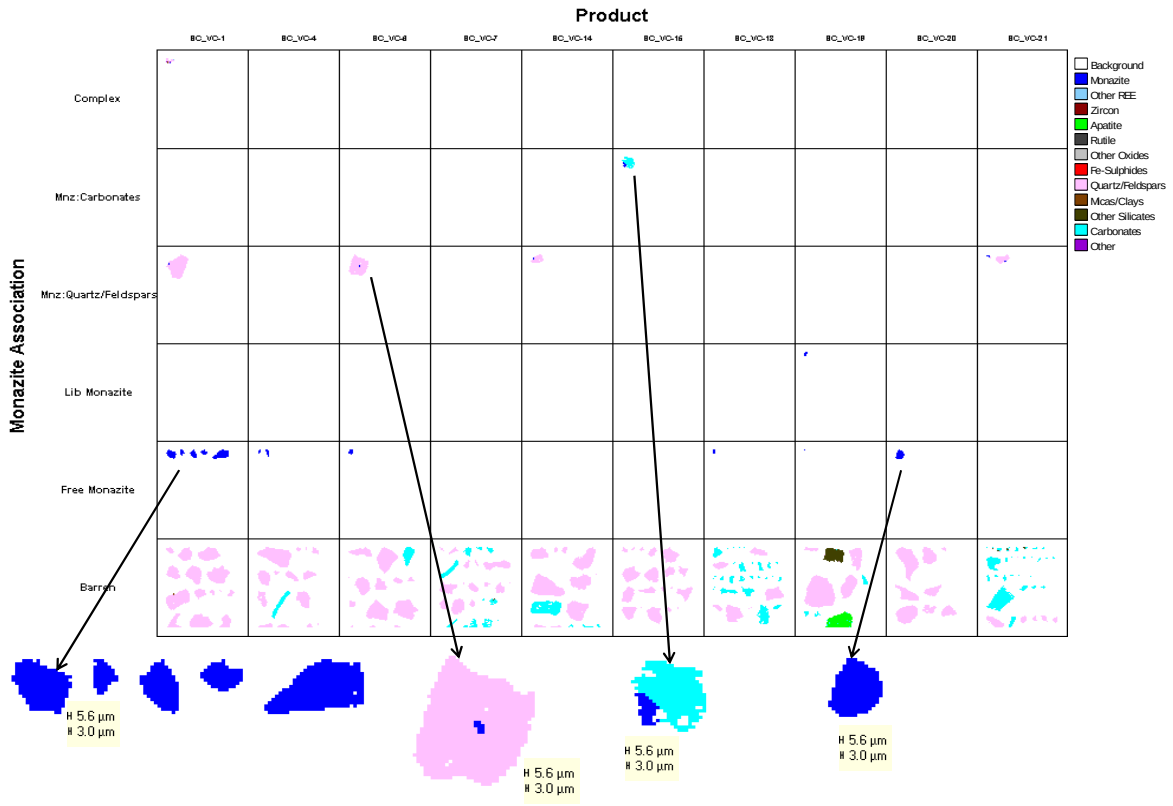
Image Grid of Monazite Association



South Carolina Department of Natural Resources
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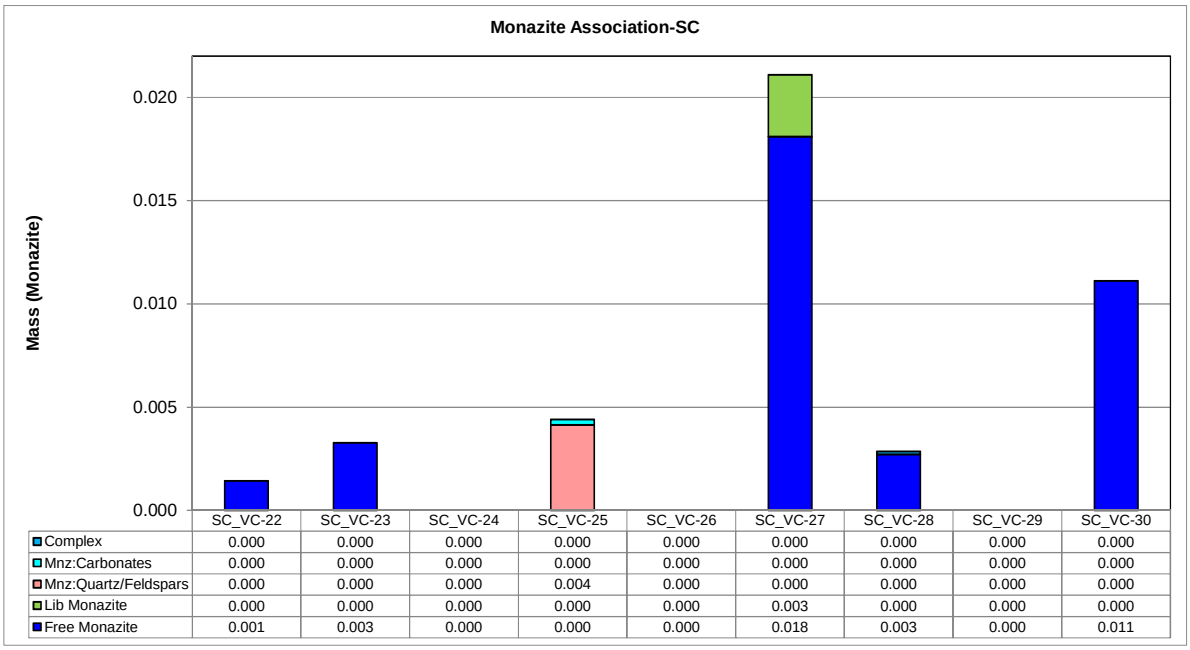
MI5017-SEP17

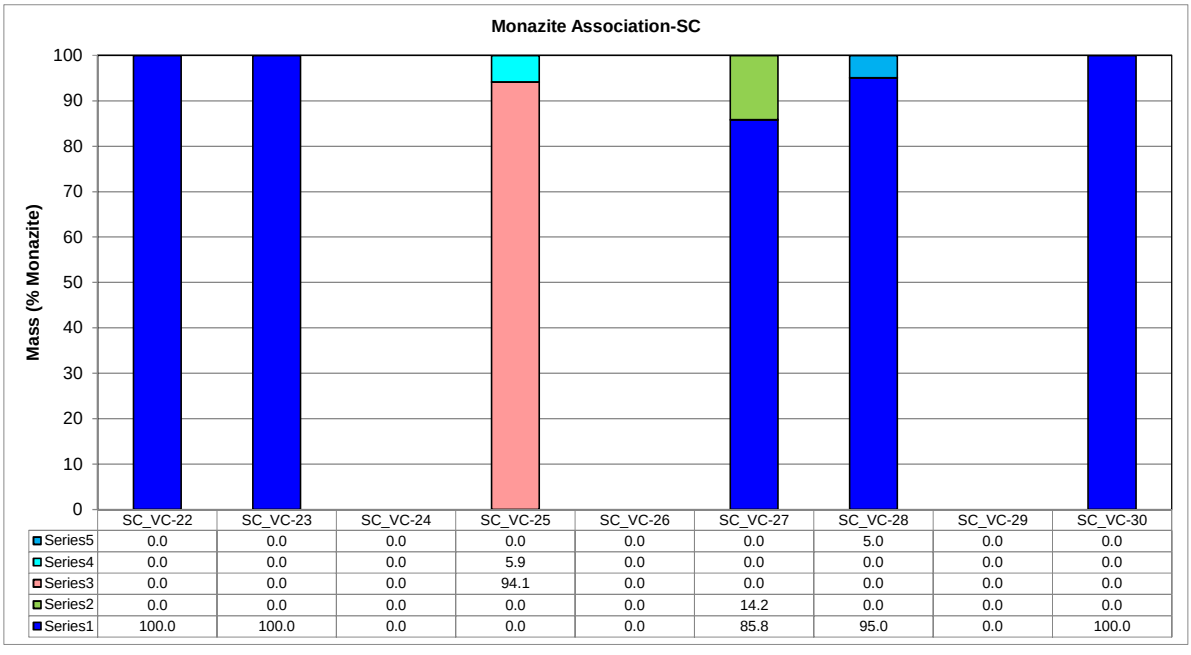
Monazite Association



	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000
Free Monazite	0.001	0.003	0.000	0.000	0.000	0.018	0.003	0.000	0.011

Absolute Mass of Monazite Across Samples

Mineral Name	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Free Monazite	0.001	0.003	0.000	0.000	0.000	0.018	0.003	0.000	0.011
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	0.001	0.003	0.000	0.004	0.000	0.021	0.003	0.000	0.011



	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Series5	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0
Series4	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0
Series3	0.0	0.0	0.0	94.1	0.0	0.0	0.0	0.0	0.0
Series2	0.0	0.0	0.0	0.0	0.0	14.2	0.0	0.0	0.0
Series1	100.0	100.0	0.0	0.0	0.0	85.8	95.0	0.0	100.0

Normalized Mass of Monazite Across Samples

Mineral Name	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Free Monazite	100.0	100.0	0.0	0.0	0.0	85.8	95.0	0.0	100.0
Lib Monazite	0.0	0.0	0.0	0.0	0.0	14.2	0.0	0.0	0.0
Mnz:Quartz/Feldspars	0.0	0.0	0.0	94.1	0.0	0.0	0.0	0.0	0.0
Mnz:Carbonates	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0
Complex	0.0	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0
Total	100.0	100.0	0.0	100.0	0.0	100.0	100.0	0.0	100.0
Liberated	100.0	100.0	0.0	0.0	0.0	100.0	95.0	0.0	100.0

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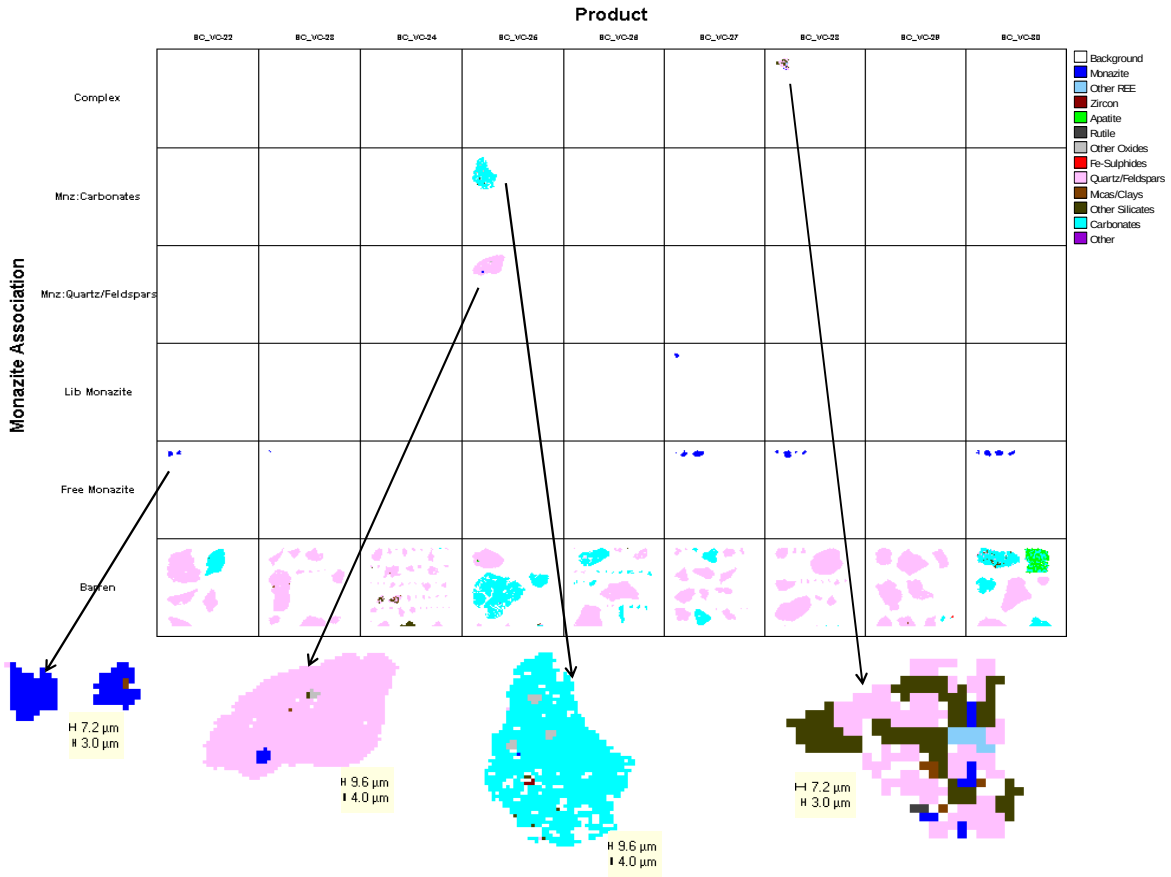

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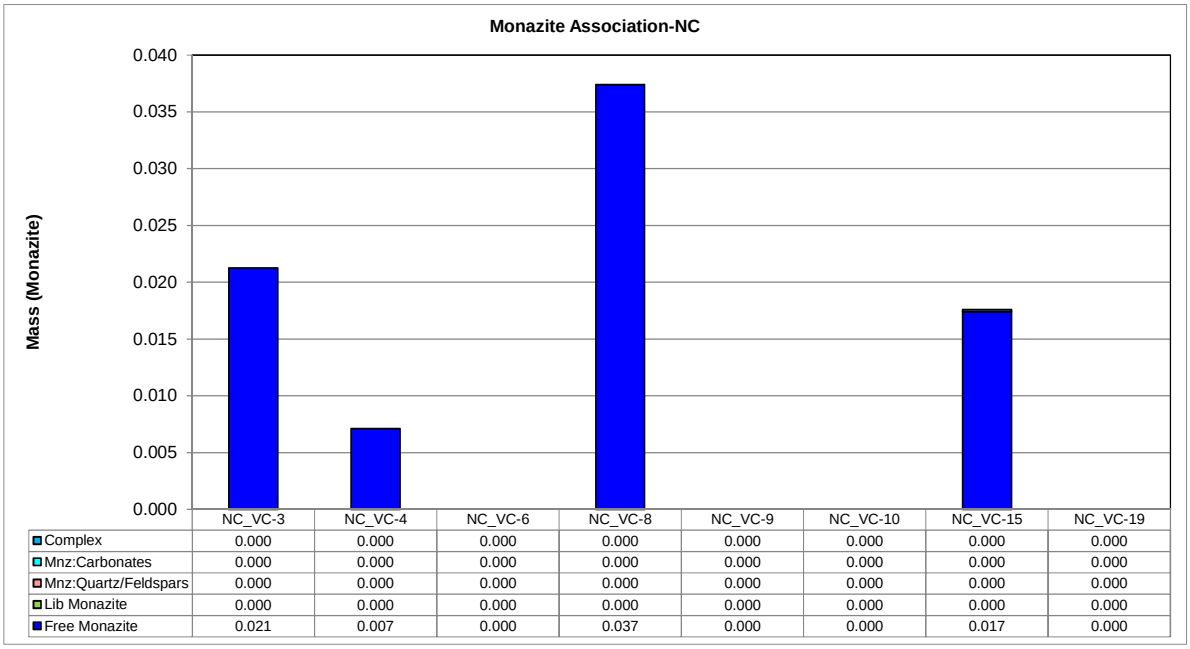
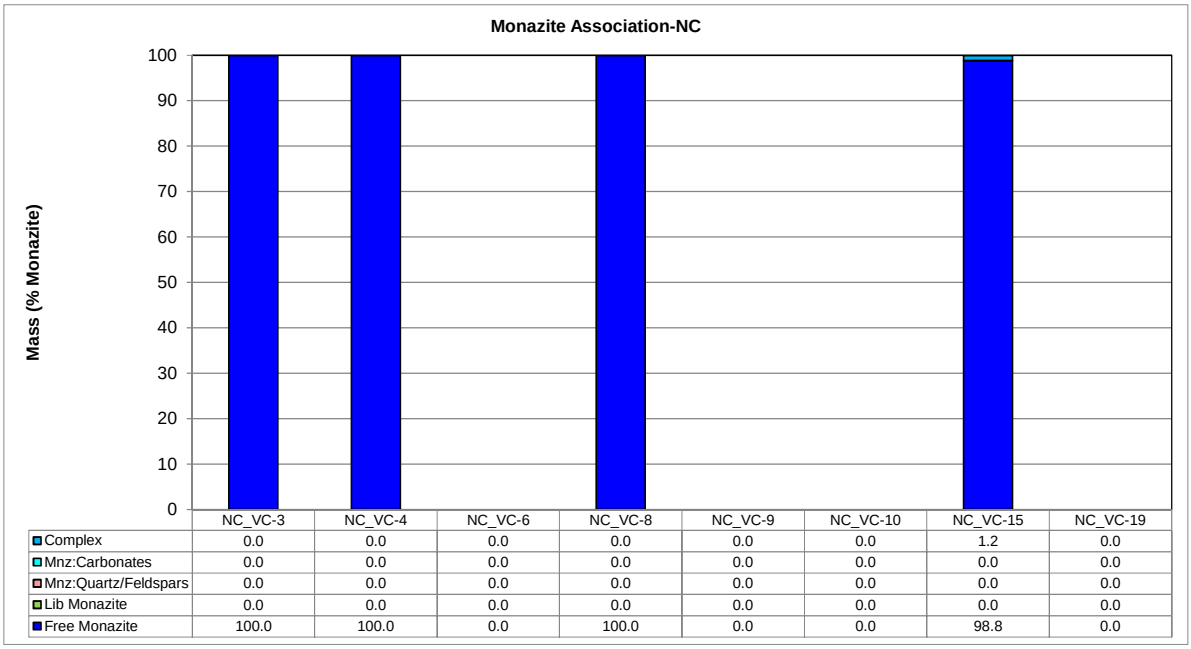
Monazite Association



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Free Monazite	0.021	0.007	0.000	0.037	0.000	0.000	0.017	0.000

Absolute Mass of Monazite Across Samples

Mineral Name	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Free Monazite	0.021	0.007	0.000	0.037	0.000	0.000	0.017	0.000
Lib Monazite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	0.021	0.007	0.000	0.037	0.000	0.000	0.018	0.000



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Complex	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mnz:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Free Monazite	100.0	100.0	0.0	100.0	0.0	0.0	98.8	0.0

Normalized Mass of Monazite Across Samples

Mineral Name	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Free Monazite	100.0	100.0	0.0	100.0	0.0	0.0	98.8	0.0
Lib Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mnz:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mnz:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0
Total	100.0	100.0	0.0	100.0	0.0	0.0	100.0	0.0
Liberated	100.0	100.0	0.0	100.0	0.0	0.0	98.8	0.0

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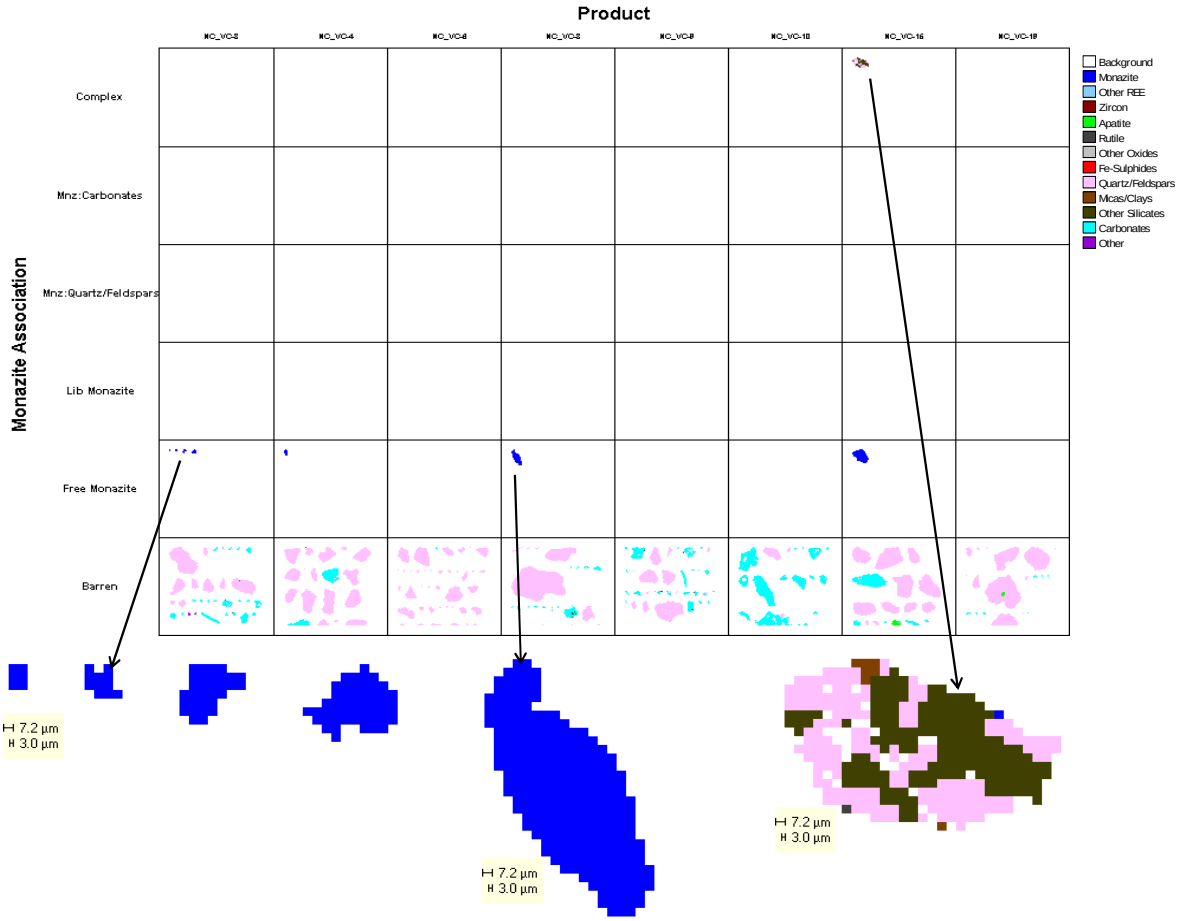
Image Grid of Monazite Association



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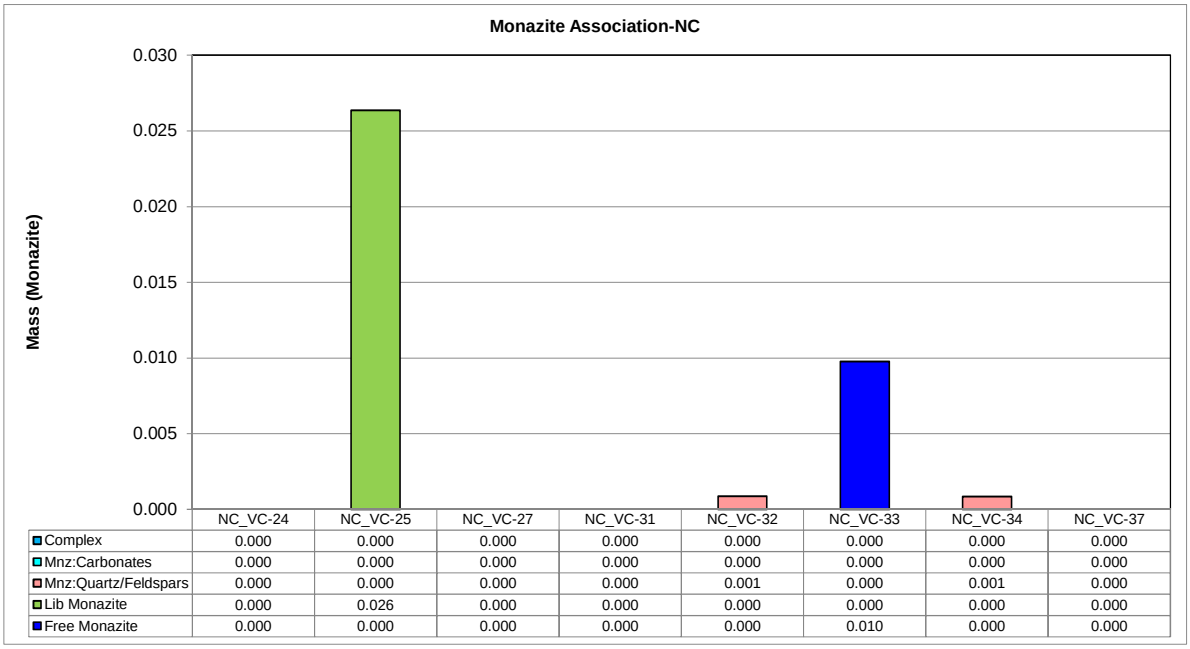
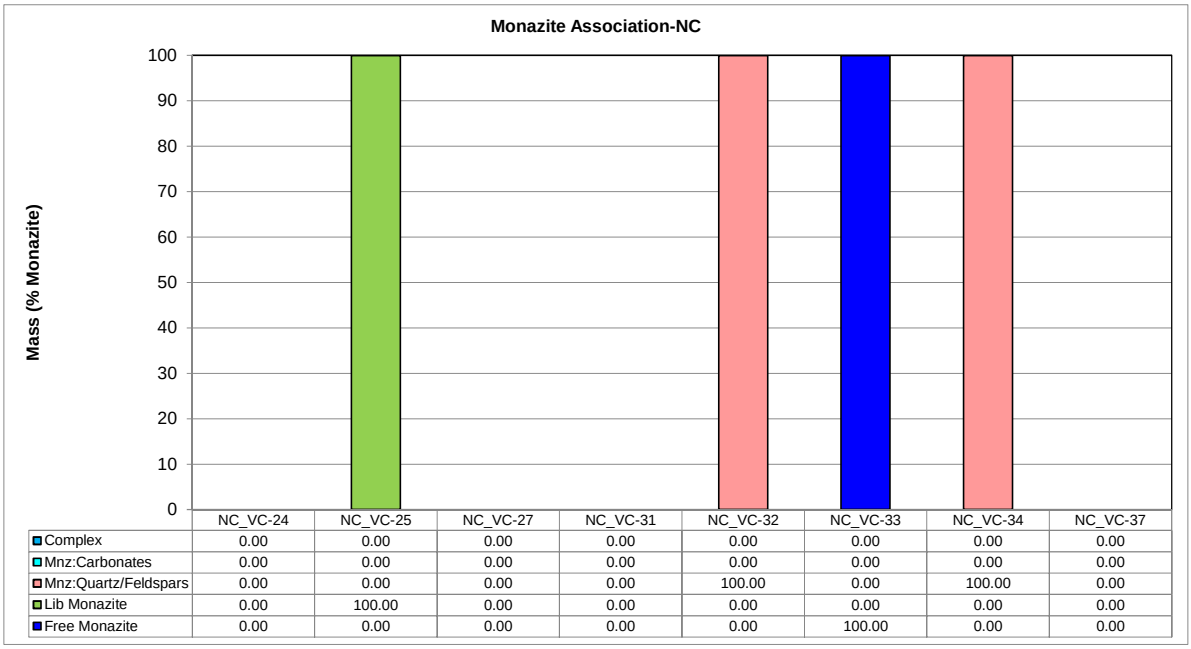
Monazite Association



	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000
Lib Monazite	0.000	0.026	0.000	0.000	0.000	0.000	0.000	0.000
Free Monazite	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000

Absolute Mass of Monazite Across Samples

Mineral Name	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Free Monazite	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000
Lib Monazite	0.000	0.026	0.000	0.000	0.000	0.000	0.000	0.000
Mnz:Quartz/Feldspars	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000
Mnz:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Complex	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	0.000	0.026	0.000	0.000	0.001	0.010	0.001	0.000



	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mnz:Carbonates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mnz:Quartz/Feldspars	0.00	0.00	0.00	0.00	100.00	0.00	100.00	0.00
Lib Monazite	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Free Monazite	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00

Normalized Mass of Monazite Across Samples

Mineral Name	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Free Monazite	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00
Lib Monazite	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
Mnz:Quartz/Feldspars	0.00	0.00	0.00	0.00	100.00	0.00	100.00	0.00
Mnz:Carbonates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Complex	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	100.00	0.00	0.00	100.00	100.00	100.00	0.00
Liberated	0.00	100.00	0.00	0.00	0.00	100.00	0.00	0.00

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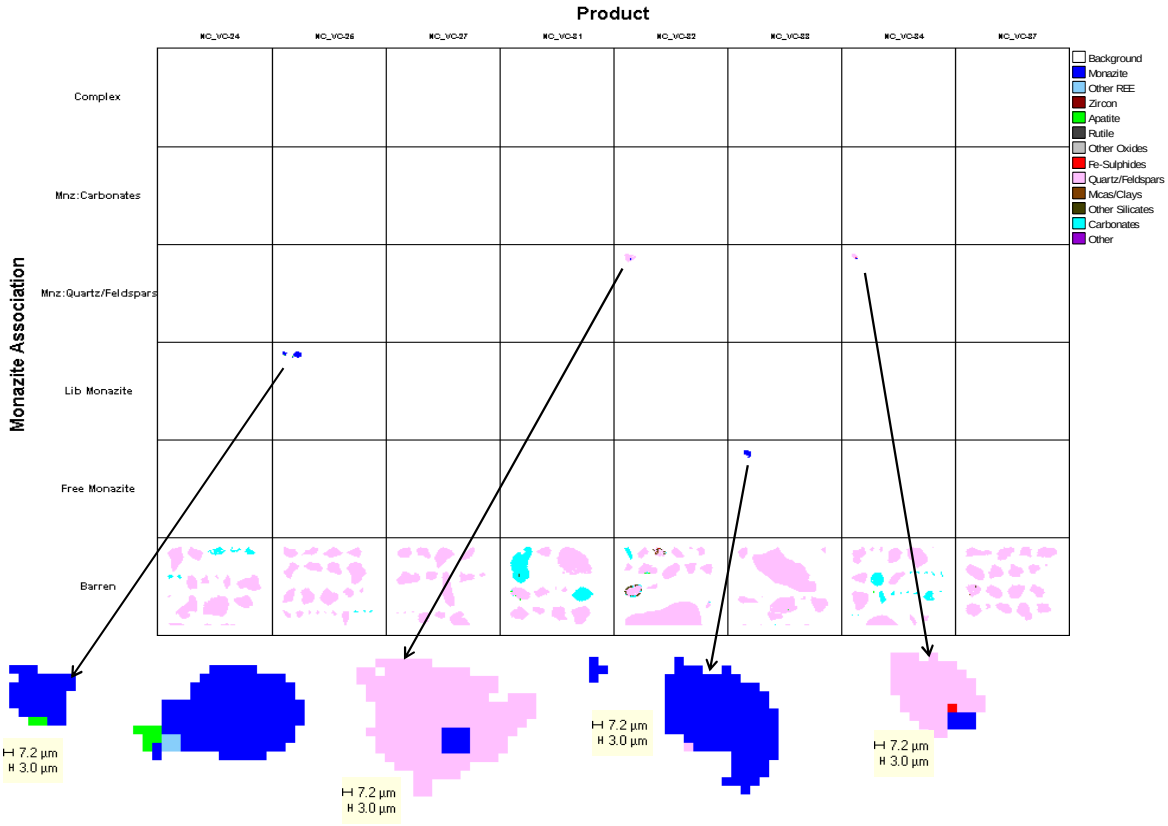
Image Grid of Monazite Association



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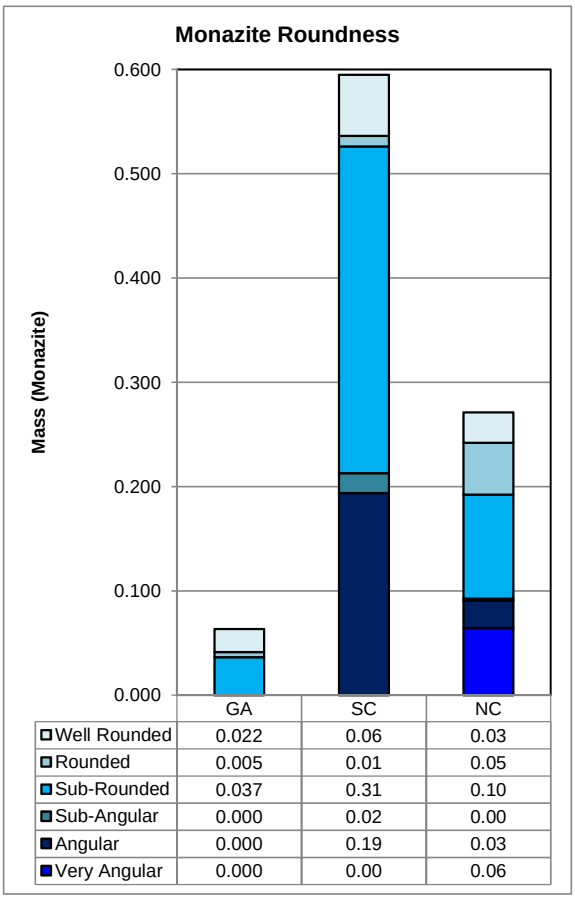
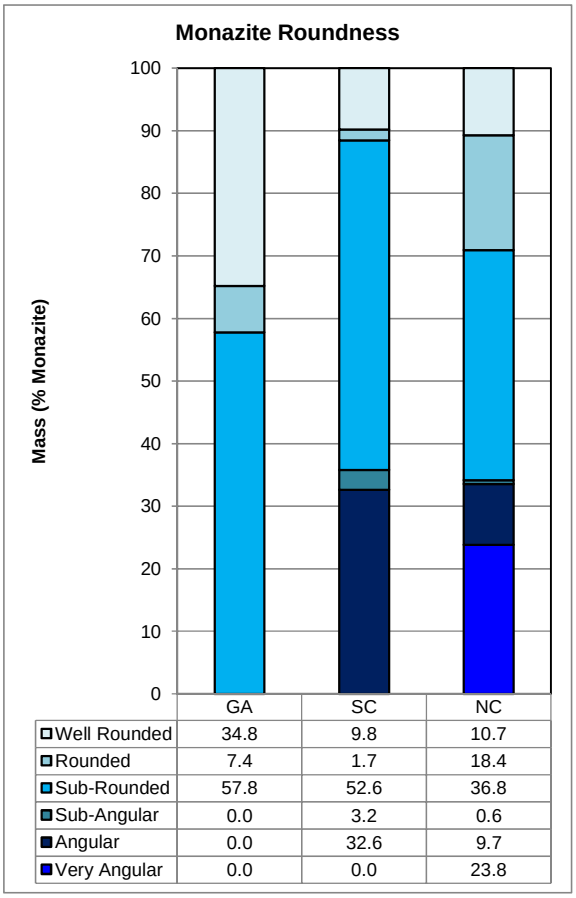
MI5017-SEP17

Monazite Roundness





Absolute Mass of Monazite Across Samples

Mineral Name	GA	SC	NC
Very Angular	0.000	0.00	0.06
Angular	0.000	0.19	0.03
Sub-Angular	0.000	0.02	0.00
Sub-Rounded	0.037	0.31	0.10
Rounded	0.005	0.01	0.05
Well Rounded	0.022	0.06	0.03
Total	0.063	0.59	0.27

Normalized Mass of Monazite Across Samples

Mineral Name	GA	SC	NC
Very Angular	0.0	0.0	23.8
Angular	0.0	32.6	9.7
Sub-Angular	0.0	3.2	0.6
Sub-Rounded	57.8	52.6	36.8
Rounded	7.4	1.7	18.4
Well Rounded	34.8	9.8	10.7
Total	100.0	100.0	100.0

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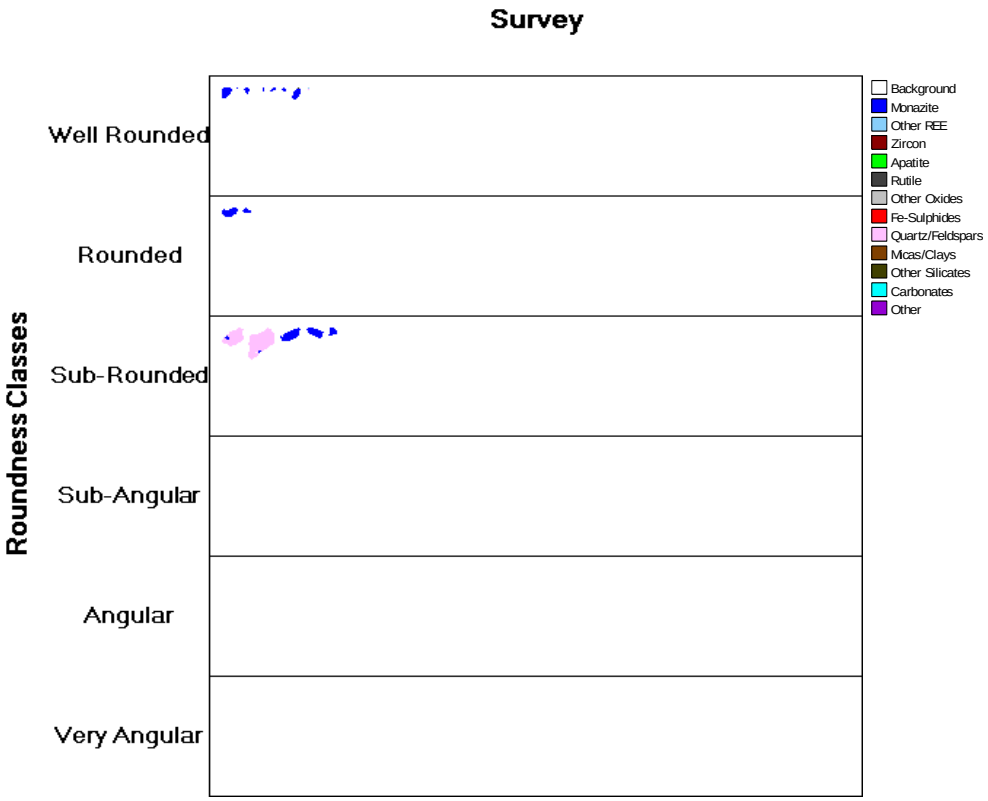
Monazite Roundness-GA



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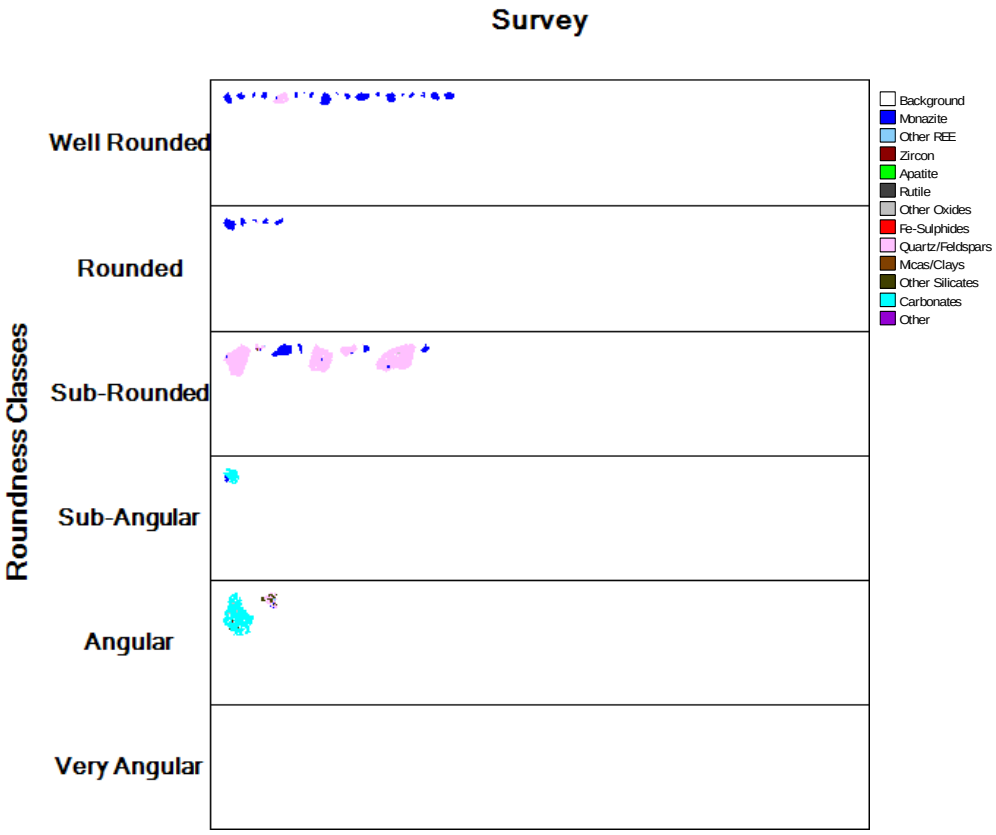
Monazite Roundness-SC



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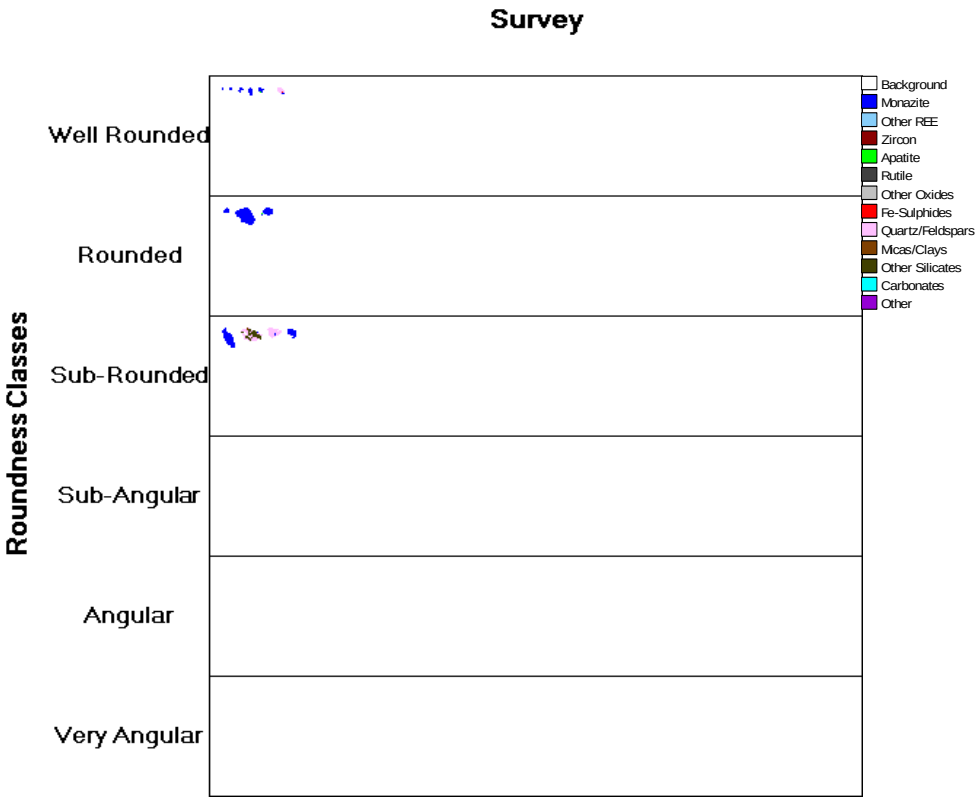
Monazite Roundness-NC



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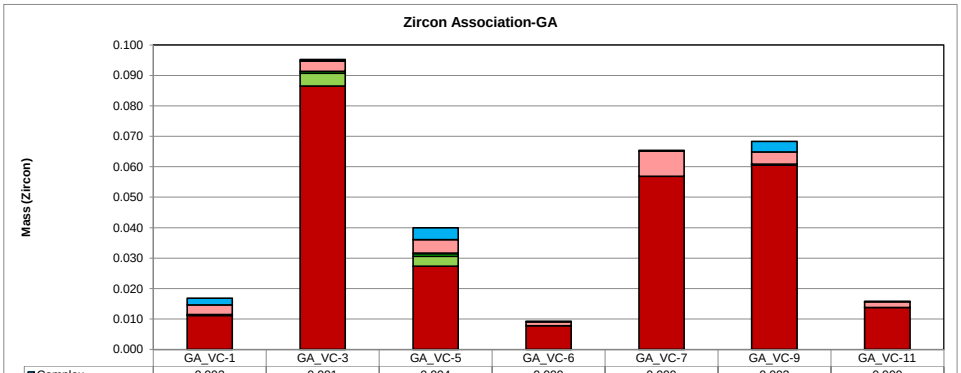
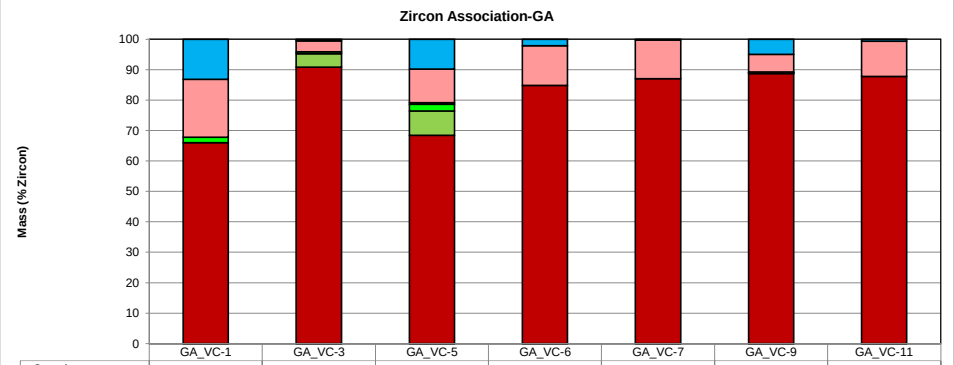
Zircon Association



	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.002	0.001	0.004	0.000	0.000	0.003	0.000
Zrn:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.003	0.003	0.004	0.001	0.008	0.004	0.002
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.000	0.001	0.001	0.000	0.000	0.000	0.000
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Zircon	0.000	0.004	0.003	0.000	0.000	0.000	0.000
Free Zircon	0.011	0.086	0.027	0.008	0.057	0.061	0.014

Absolute Mass of Zircon Across Samples

Mineral Name	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Free Zircon	0.011	0.086	0.027	0.008	0.057	0.061	0.014
Lib Zircon	0.000	0.004	0.003	0.000	0.000	0.000	0.000
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.000	0.001	0.001	0.000	0.000	0.000	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.003	0.003	0.004	0.001	0.008	0.004	0.002
Zrn:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Complex	0.002	0.001	0.004	0.000	0.000	0.003	0.000
Total	0.017	0.095	0.040	0.009	0.065	0.068	0.016



	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	13.2	0.6	9.8	2.1	0.3	5.0	0.7
Zrn:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	19.0	3.5	11.0	13.1	12.7	5.8	11.6
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Apatite	1.8	0.7	2.2	0.0	0.0	0.2	0.0
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Lib Zircon	0.0	4.4	8.0	0.0	0.0	0.2	0.0
Free Zircon	66.0	90.8	68.4	84.8	87.0	88.7	87.8

Normalized Mass of Zircon Across Samples

Mineral Name	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Free Zircon	66.0	90.8	68.4	84.8	87.0	88.7	87.8
Lib Zircon	0.0	4.4	8.0	0.0	0.0	0.2	0.0
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Zrn:Apatite	1.8	0.7	2.2	0.0	0.0	0.2	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.0	0.0	0.5	0.0	0.0	0.0	0.0
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	19.0	3.5	11.0	13.1	12.7	5.8	11.6
Zrn:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	13.2	0.6	9.8	2.1	0.3	5.0	0.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	66.0	95.2	76.4	84.8	87.0	88.9	87.8

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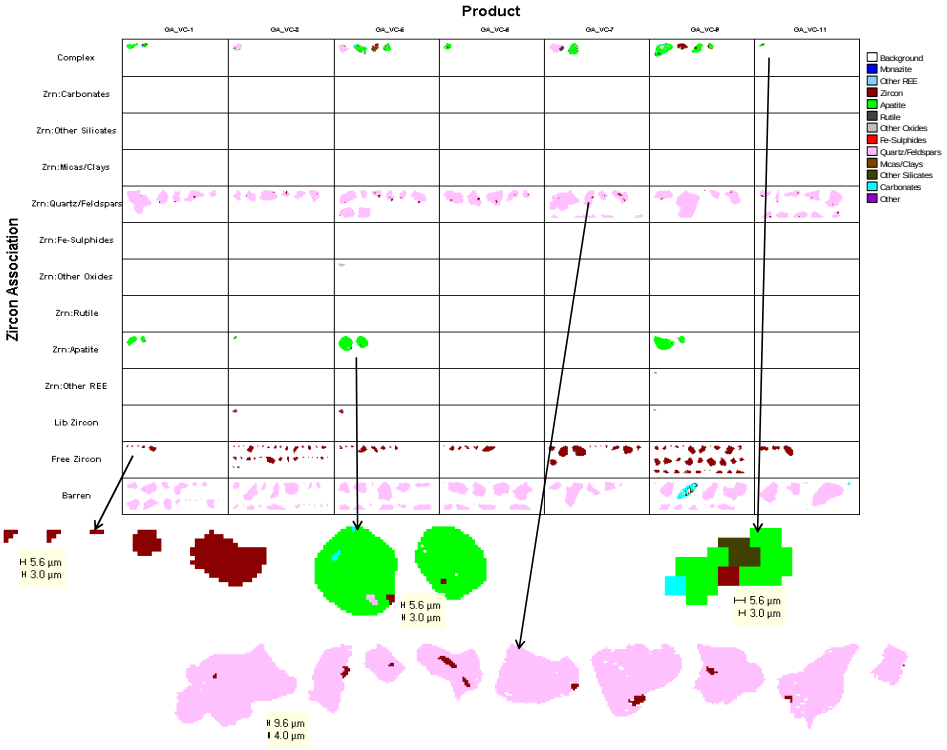
Image Grid of Zircon Association



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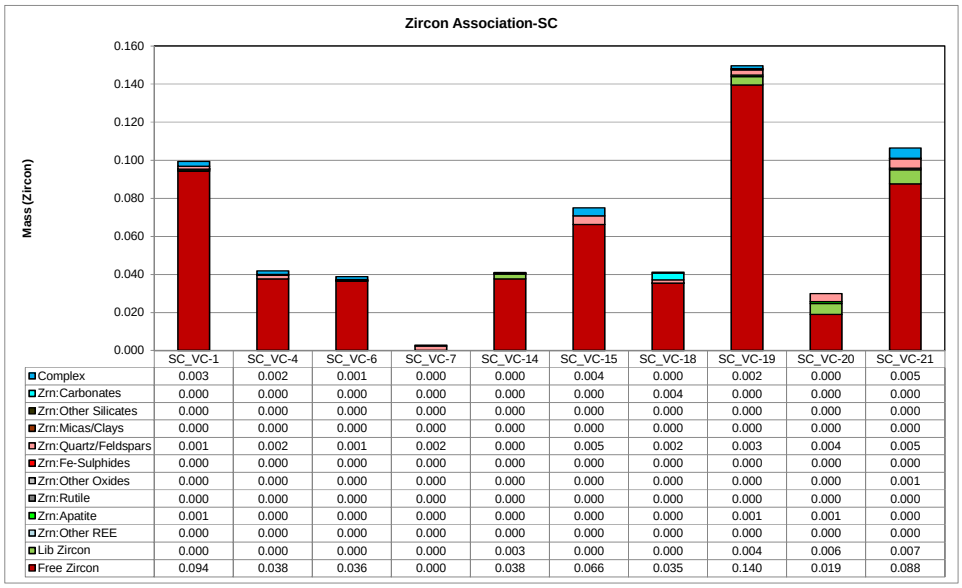
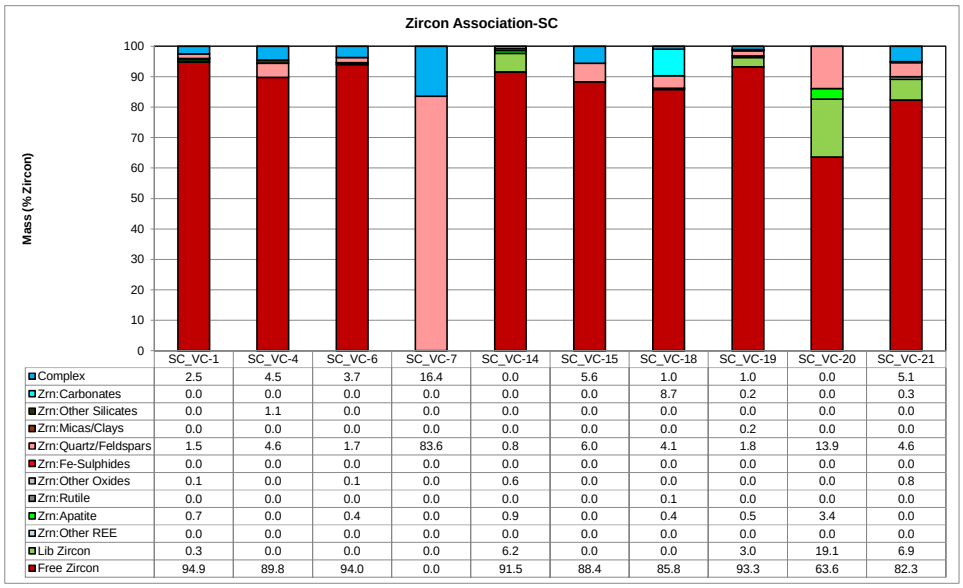
Zircon Association



	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Complex	0.003	0.002	0.001	0.000	0.000	0.004	0.000	0.002	0.000	0.005
Zrn:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.001	0.002	0.001	0.002	0.000	0.005	0.002	0.003	0.004	0.005
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Zircon	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.004	0.006	0.007
Free Zircon	0.094	0.038	0.036	0.000	0.038	0.066	0.035	0.140	0.019	0.088

Absolute Mass of Zircon Across Samples

Mineral Name	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Free Zircon	0.094	0.038	0.036	0.000	0.038	0.066	0.035	0.140	0.019	0.088
Lib Zircon	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.004	0.006	0.007
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.001	0.002	0.001	0.002	0.000	0.005	0.002	0.003	0.004	0.005
Zrn:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Carbonates	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000
Complex	0.003	0.002	0.001	0.000	0.000	0.004	0.000	0.002	0.000	0.005
Total	0.099	0.042	0.039	0.003	0.041	0.075	0.041	0.150	0.030	0.106



	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Complex	2.5	4.5	3.7	16.4	0.0	5.6	1.0	1.0	0.0	5.1
Zrn:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.2	0.0	0.3
Zrn:Other Silicates	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Zrn:Quartz/Feldspars	1.5	4.6	1.7	83.6	0.8	6.0	4.1	1.8	13.9	4.6
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.1	0.0	0.1	0.0	0.6	0.0	0.0	0.0	0.0	0.8
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Zrn:Apatite	0.7	0.0	0.4	0.0	0.9	0.0	0.4	0.5	3.4	0.0
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Zircon	0.3	0.0	0.0	0.0	6.2	0.0	0.0	3.0	19.1	6.9
Free Zircon	94.9	89.8	94.0	0.0	91.5	88.4	85.8	93.3	63.6	82.3

Normalized Mass of Zircon Across Samples

Mineral Name	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Free Zircon	94.9	89.8	94.0	0.0	91.5	88.4	85.8	93.3	63.6	82.3
Lib Zircon	0.3	0.0	0.0	0.0	6.2	0.0	0.0	3.0	19.1	6.9
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Apatite	0.7	0.0	0.4	0.0	0.9	0.0	0.4	0.5	3.4	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Zrn:Other Oxides	0.1	0.0	0.1	0.0	0.6	0.0	0.0	0.0	0.0	0.8
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	1.5	4.6	1.7	83.6	0.8	6.0	4.1	1.8	13.9	4.6
Zrn:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Zrn:Other Silicates	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	8.7	0.2	0.0	0.3
Complex	2.5	4.5	3.7	16.4	0.0	5.6	1.0	1.0	0.0	5.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	95.1	89.8	94.0	0.0	97.7	88.4	85.8	96.3	82.7	89.2

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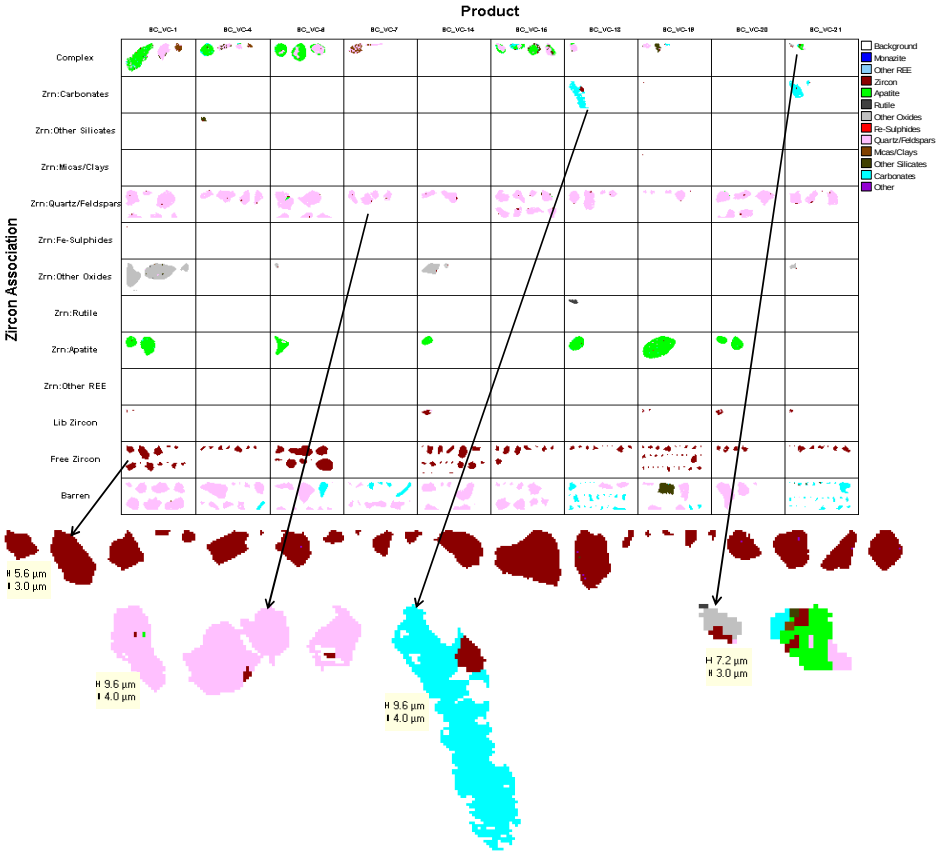
Image Grid of Zircon Association



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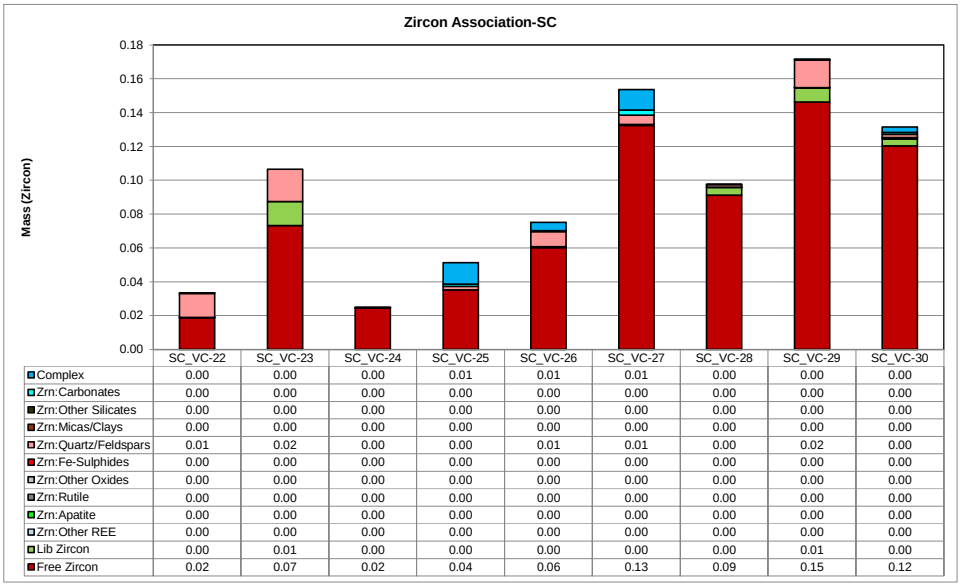
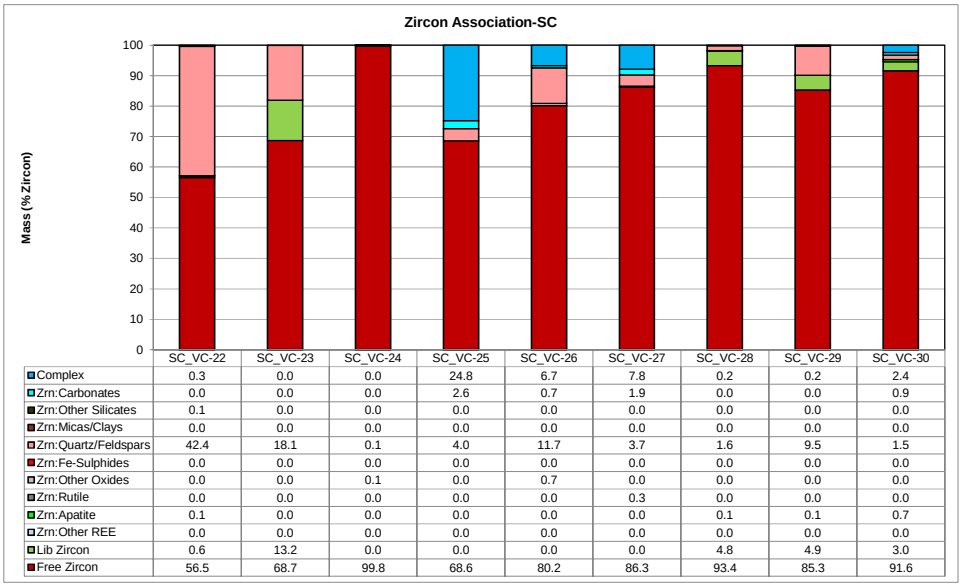
Zircon Association



	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00
Zrn:Carbonates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Quartz/Feldspars	0.01	0.02	0.00	0.00	0.01	0.01	0.00	0.02	0.00
Zrn:Fe-Sulphides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Apatite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lib Zircon	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Free Zircon	0.02	0.07	0.02	0.04	0.06	0.13	0.09	0.15	0.12

Absolute Mass of Zircon Across Samples

Mineral Name	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Free Zircon	0.02	0.07	0.02	0.04	0.06	0.13	0.09	0.15	0.12
Lib Zircon	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Zrn:Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Apatite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Fe-Sulphides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Quartz/Feldspars	0.01	0.02	0.00	0.00	0.01	0.01	0.00	0.02	0.00
Zrn:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zrn:Carbonates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Complex	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00
Total	0.03	0.11	0.02	0.05	0.08	0.15	0.10	0.17	0.13



	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.3	0.0	0.0	24.8	6.7	7.8	0.2	0.2	2.4
Zrn:Carbonates	0.0	0.0	0.0	2.6	0.7	1.9	0.0	0.0	0.9
Zrn:Other Silicates	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	42.4	18.1	0.1	4.0	11.7	3.7	1.6	9.5	1.5
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.0	0.0	0.1	0.0	0.7	0.0	0.0	0.0	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
Zrn:Apatite	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.7
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Zircon	0.6	13.2	0.0	0.0	0.0	0.0	4.8	4.9	3.0
Free Zircon	56.5	68.7	99.8	68.6	80.2	86.3	93.4	85.3	91.6

Normalized Mass of Zircon Across Samples

Mineral Name	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Free Zircon	56.5	68.7	99.8	68.6	80.2	86.3	93.4	85.3	91.6
Lib Zircon	0.6	13.2	0.0	0.0	0.0	0.0	4.8	4.9	3.0
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Apatite	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.7
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
Zrn:Other Oxides	0.0	0.0	0.1	0.0	0.7	0.0	0.0	0.0	0.0
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	42.4	18.1	0.1	4.0	11.7	3.7	1.6	9.5	1.5
Zrn:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Silicates	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Carbonates	0.0	0.0	0.0	2.6	0.7	1.9	0.0	0.0	0.9
Complex	0.3	0.0	0.0	24.8	6.7	7.8	0.2	0.2	2.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	57.0	81.9	99.8	68.6	80.2	86.3	98.2	90.2	94.6

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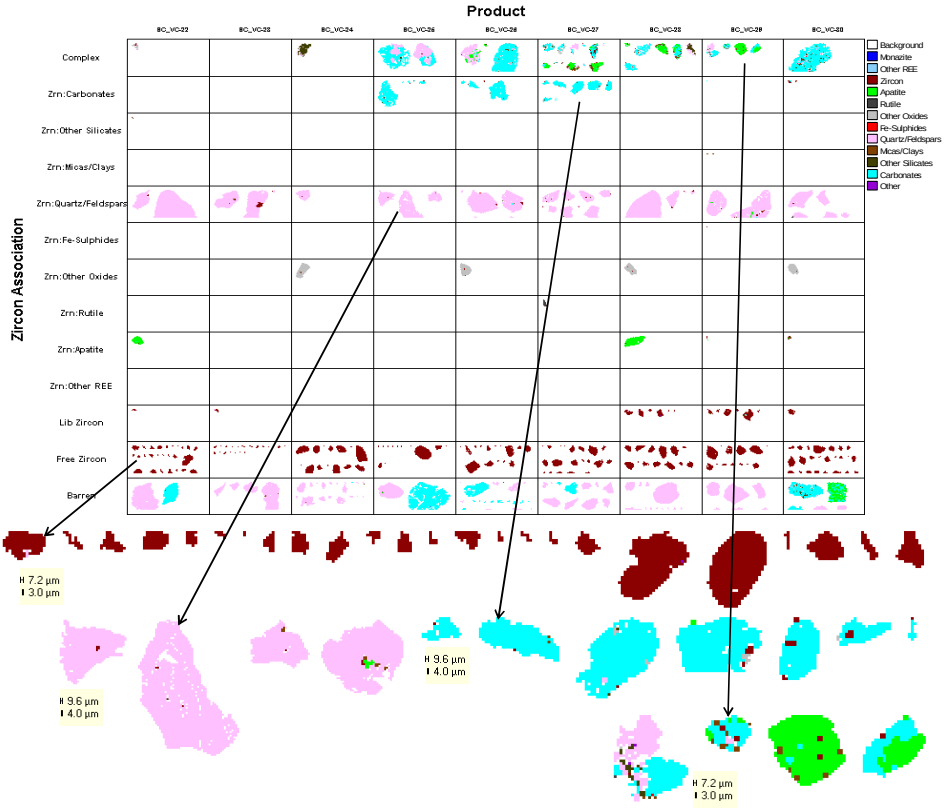
Image Grid of Zircon Association



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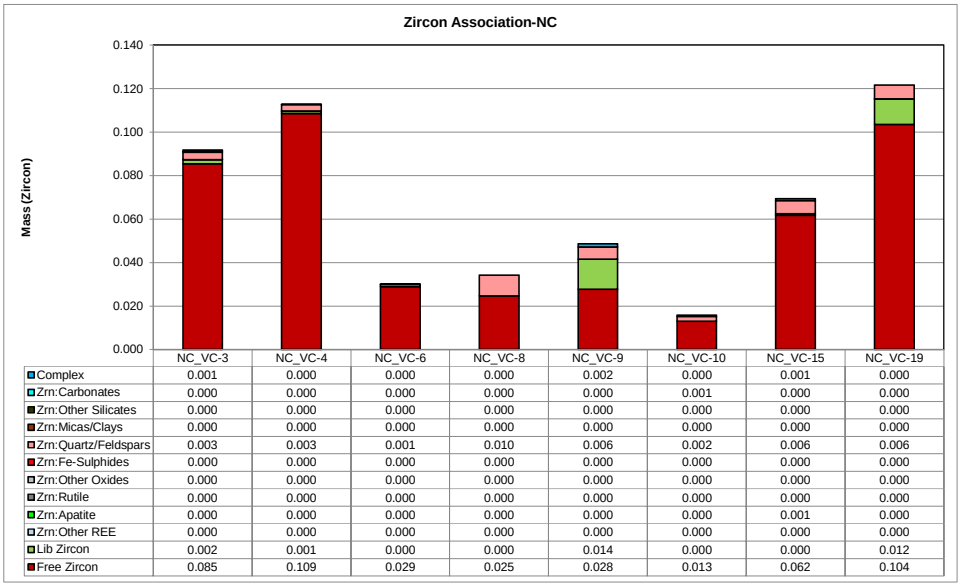
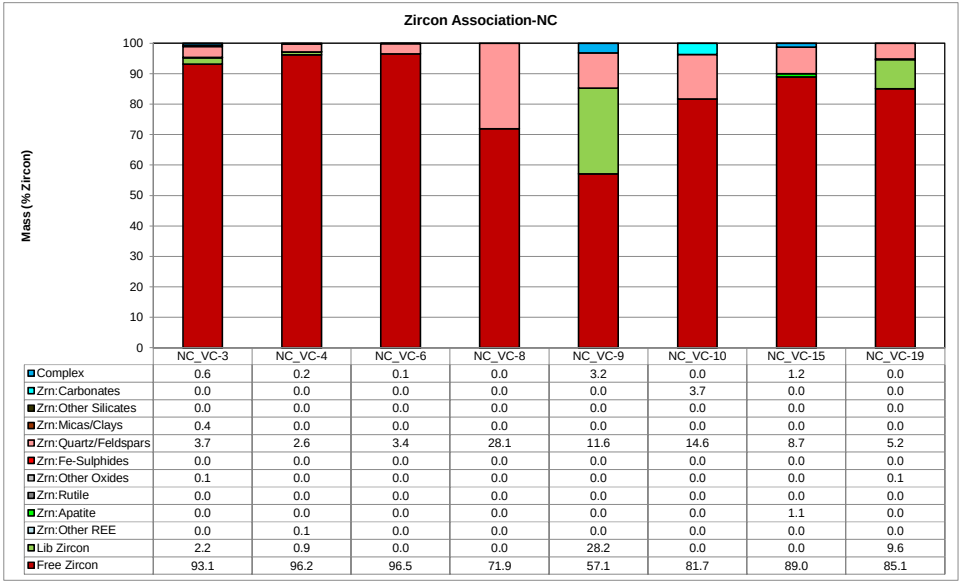
Zircon Association



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Complex	0.001	0.000	0.000	0.000	0.002	0.000	0.001	0.000
Zrn:Carbonates	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.003	0.003	0.001	0.010	0.006	0.002	0.006	0.006
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Zircon	0.002	0.001	0.000	0.000	0.014	0.000	0.000	0.012
Free Zircon	0.085	0.109	0.029	0.025	0.028	0.013	0.062	0.104

Absolute Mass of Zircon Across Samples

Mineral Name	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Free Zircon	0.085	0.109	0.029	0.025	0.028	0.013	0.062	0.104
Lib Zircon	0.002	0.001	0.000	0.000	0.014	0.000	0.000	0.012
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.003	0.003	0.001	0.010	0.006	0.002	0.006	0.006
Zrn:Micas/Clays	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Carbonates	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Complex	0.001	0.000	0.000	0.000	0.002	0.000	0.001	0.000
Total	0.092	0.113	0.030	0.034	0.049	0.016	0.069	0.122



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Complex	0.6	0.2	0.1	0.0	3.2	0.0	1.2	0.0
Zrn:Carbonates	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0
Zrn:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Micas/Clays	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	3.7	2.6	3.4	28.1	11.6	14.6	8.7	5.2
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
Zrn:Other REE	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Lib Zircon	2.2	0.9	0.0	0.0	28.2	0.0	0.0	9.6
Free Zircon	93.1	96.2	96.5	71.9	57.1	81.7	89.0	85.1

Normalized Mass of Zircon Across Samples

Mineral Name	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Free Zircon	93.1	96.2	96.5	71.9	57.1	81.7	89.0	85.1
Lib Zircon	2.2	0.9	0.0	0.0	28.2	0.0	0.0	9.6
Zrn:Other REE	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	3.7	2.6	3.4	28.1	11.6	14.6	8.7	5.2
Zrn:Micas/Clays	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Carbonates	0.0	0.0	0.0	0.0	0.0	3.7	0.0	0.0
Complex	0.6	0.2	0.1	0.0	3.2	0.0	1.2	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	95.3	97.1	96.5	71.9	85.3	81.7	89.0	94.7

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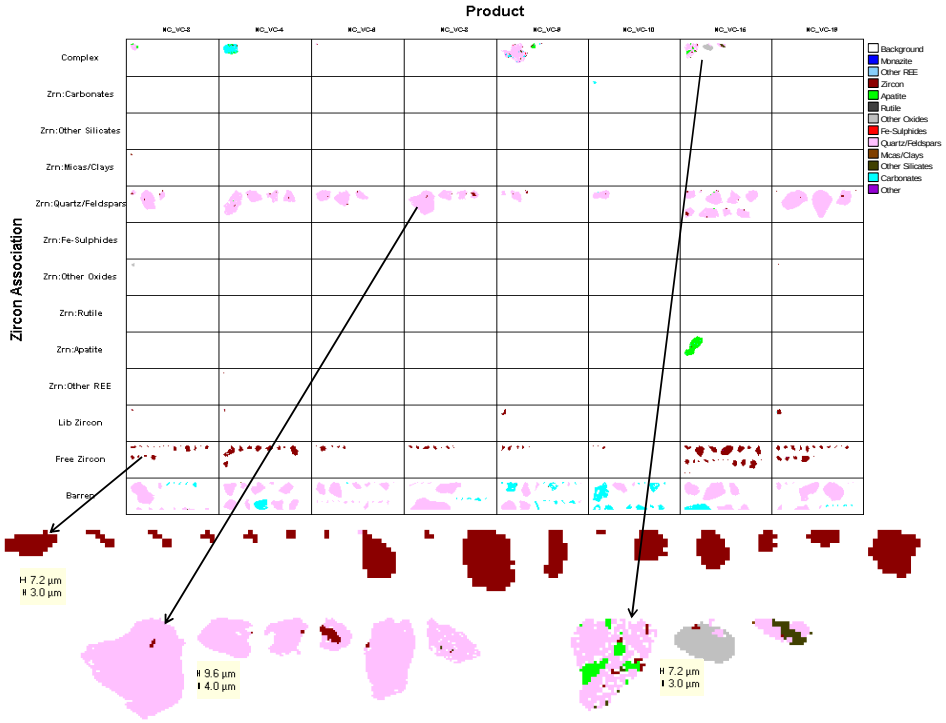
Image Grid of Zircon Association



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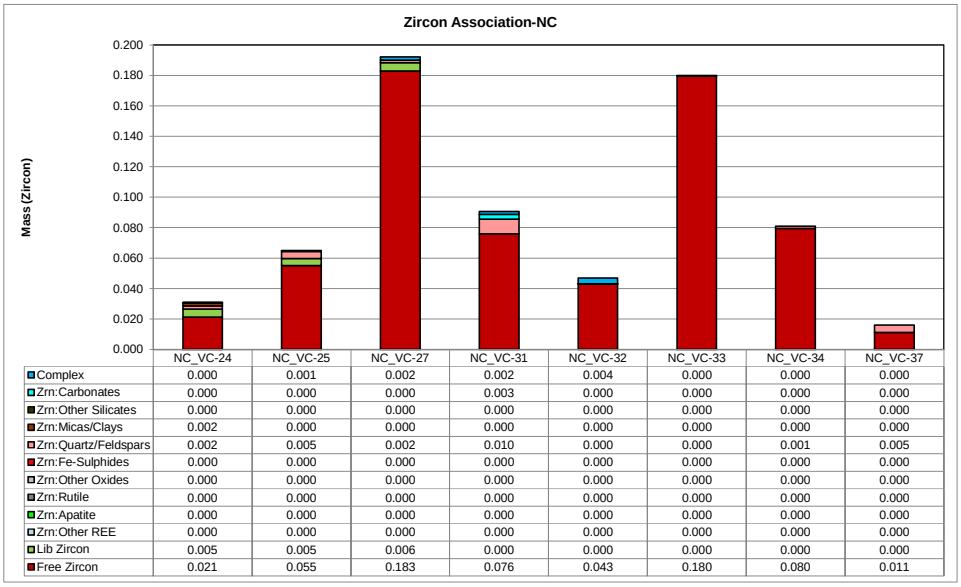
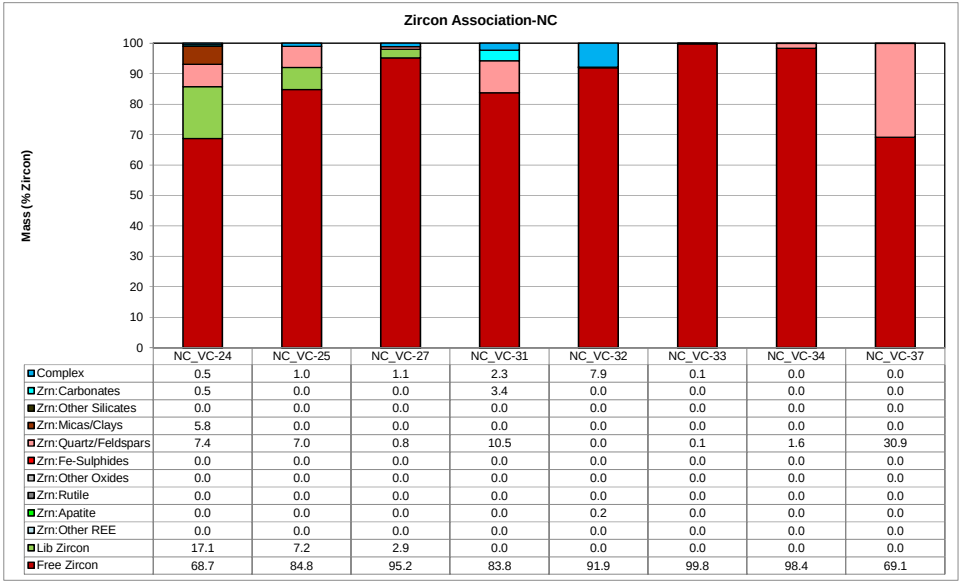
Zircon Association



	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.000	0.001	0.002	0.002	0.004	0.000	0.000	0.000
Zrn:Carbonates	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Micas/Clays	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.002	0.005	0.002	0.010	0.000	0.000	0.001	0.005
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Lib Zircon	0.005	0.005	0.006	0.000	0.000	0.000	0.000	0.000
Free Zircon	0.021	0.055	0.183	0.076	0.043	0.180	0.080	0.011

Absolute Mass of Zircon Across Samples

Mineral Name	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Free Zircon	0.021	0.055	0.183	0.076	0.043	0.180	0.080	0.011
Lib Zircon	0.005	0.005	0.006	0.000	0.000	0.000	0.000	0.000
Zrn:Other REE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Apatite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Rutile	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Oxides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Fe-Sulphides	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Quartz/Feldspars	0.002	0.005	0.002	0.010	0.000	0.000	0.001	0.005
Zrn:Micas/Clays	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Other Silicates	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Zrn:Carbonates	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000
Complex	0.000	0.001	0.002	0.002	0.004	0.000	0.000	0.000
Total	0.031	0.065	0.192	0.091	0.047	0.180	0.081	0.016



	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.5	1.0	1.1	2.3	7.9	0.1	0.0	0.0
Zrn:Carbonates	0.5	0.0	0.0	3.4	0.0	0.0	0.0	0.0
Zrn:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Micas/Clays	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	7.4	7.0	0.8	10.5	0.0	0.1	1.6	30.9
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Apatite	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Zircon	17.1	7.2	2.9	0.0	0.0	0.0	0.0	0.0
Free Zircon	68.7	84.8	95.2	83.8	91.9	99.8	98.4	69.1

Normalized Mass of Zircon Across Samples

Mineral Name	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Free Zircon	68.7	84.8	95.2	83.8	91.9	99.8	98.4	69.1
Lib Zircon	17.1	7.2	2.9	0.0	0.0	0.0	0.0	0.0
Zrn:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Apatite	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0
Zrn:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Quartz/Feldspars	7.4	7.0	0.8	10.5	0.0	0.1	1.6	30.9
Zrn:Micas/Clays	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zrn:Carbonates	0.5	0.0	0.0	3.4	0.0	0.0	0.0	0.0
Complex	0.5	1.0	1.1	2.3	7.9	0.1	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	85.7	92.0	98.1	83.8	91.9	99.8	98.4	69.1

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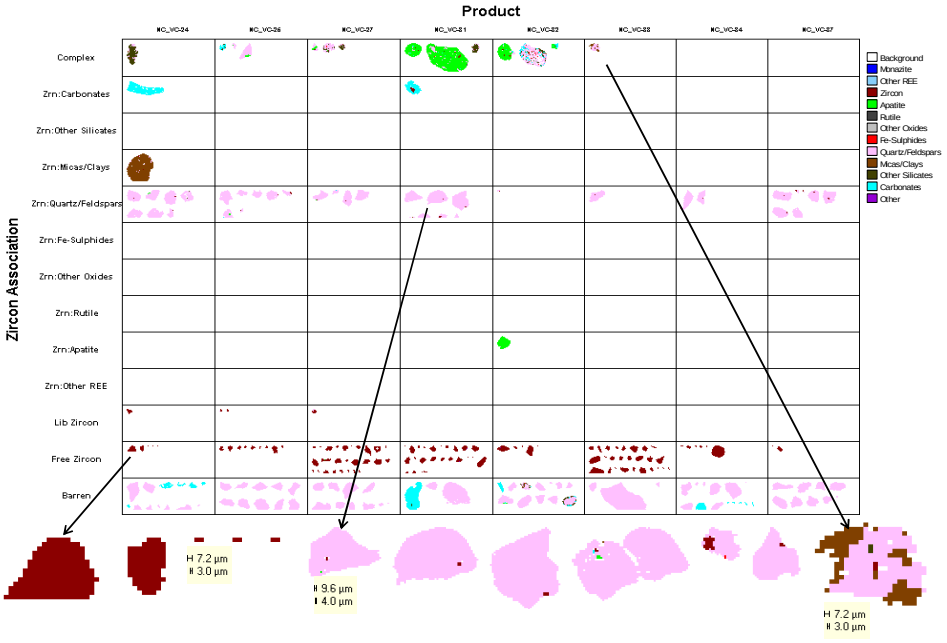
Image Grid of Zircon Association



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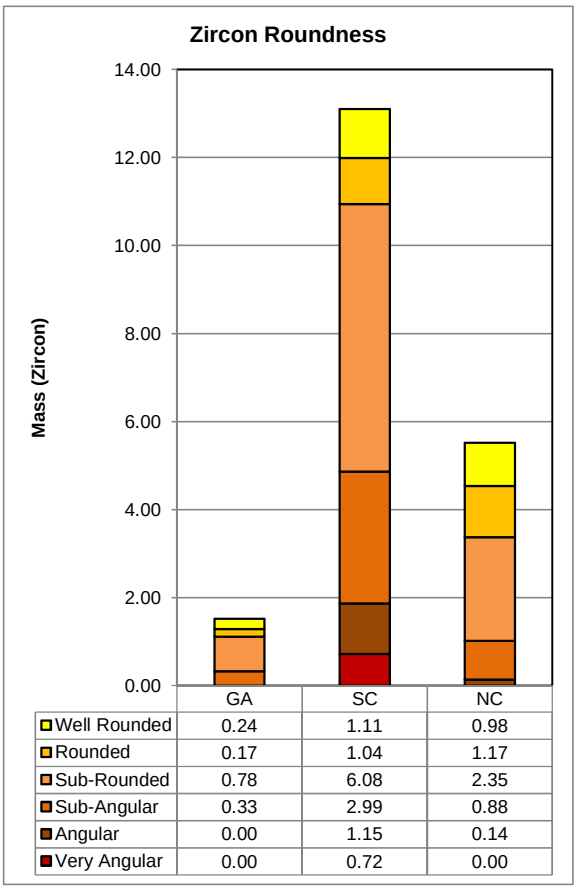
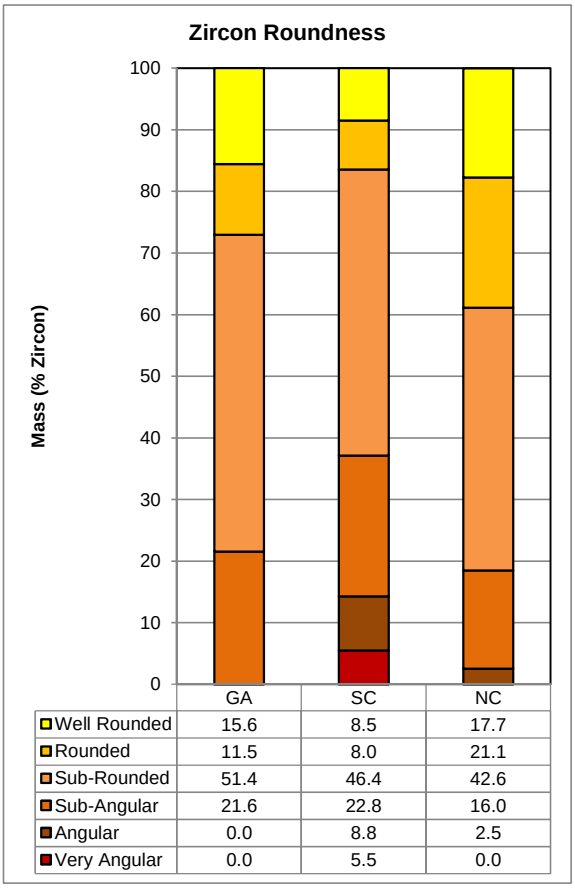
Zircon Roundness



	GA	SC	NC
Well Rounded	0.24	1.11	0.98
Rounded	0.17	1.04	1.17
Sub-Rounded	0.78	6.08	2.35
Sub-Angular	0.33	2.99	0.88
Angular	0.00	1.15	0.14
Very Angular	0.00	0.72	0.00



	GA	SC	NC
Well Rounded	15.6	8.5	17.7
Rounded	11.5	8.0	21.1
Sub-Rounded	51.4	46.4	42.6
Sub-Angular	21.6	22.8	16.0
Angular	0.0	8.8	2.5
Very Angular	0.0	5.5	0.0

Absolute Mass of Zircon Across Samples

Mineral Name	GA	SC	NC
Very Angular	0.00	0.72	0.00
Angular	0.00	1.15	0.14
Sub-Angular	0.33	2.99	0.88
Sub-Rounded	0.78	6.08	2.35
Rounded	0.17	1.04	1.17
Well Rounded	0.24	1.11	0.98
Other	0.00	0.00	0.00
Total	1.52	13.10	5.52

Normalized Mass of Zircon Across Samples

Mineral Name	GA	SC	NC
Very Angular	0.0	5.5	0.0
Angular	0.0	8.8	2.5
Sub-Angular	21.6	22.8	16.0
Sub-Rounded	51.4	46.4	42.6
Rounded	11.5	8.0	21.1
Well Rounded	15.6	8.5	17.7
Other	0.0	0.0	0.0
Total	100.0	100.0	100.0

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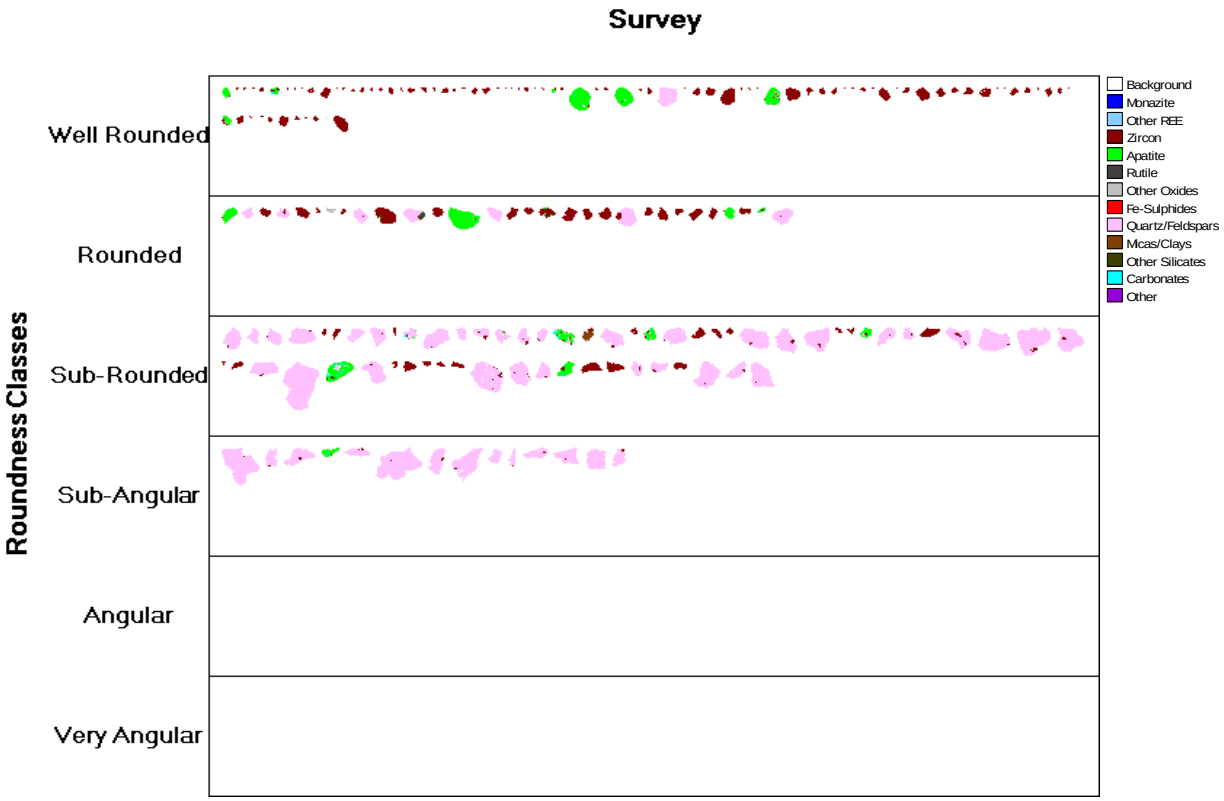
Zircon Roundness-GA



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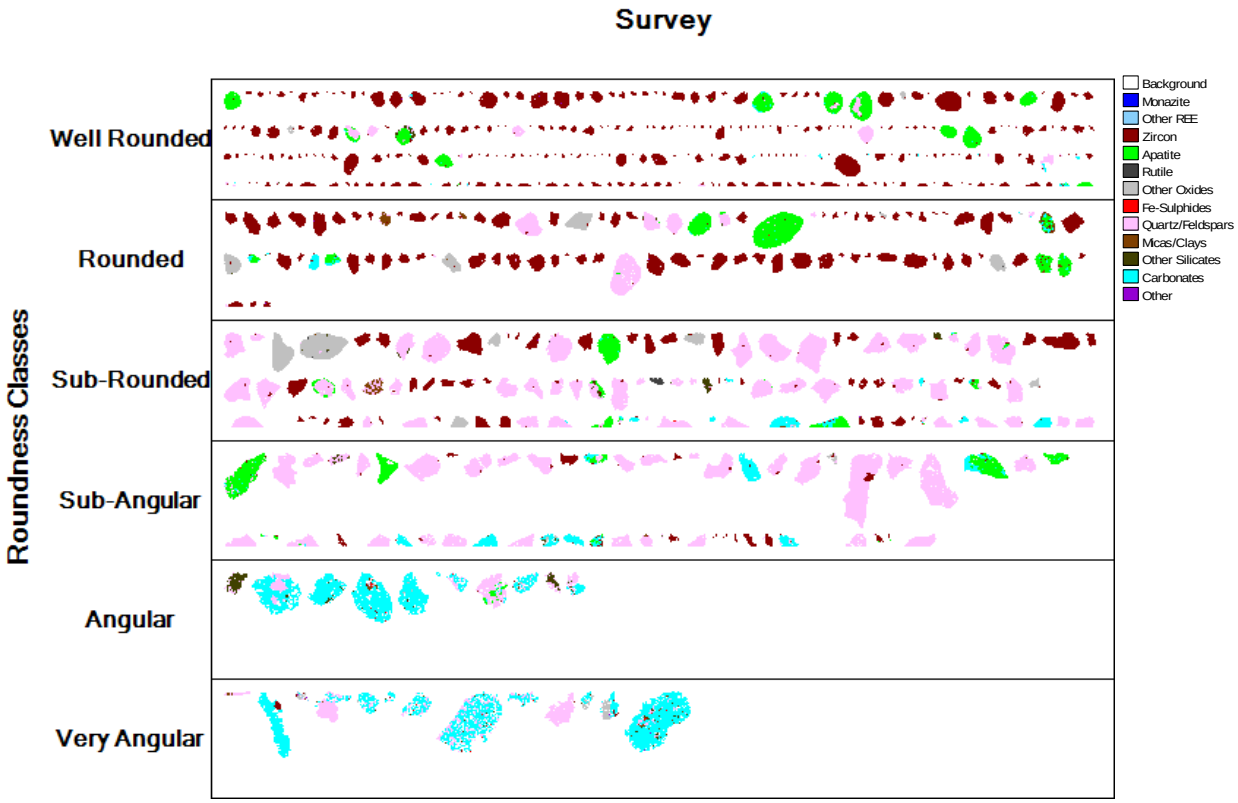
Zircon Roundness-SC



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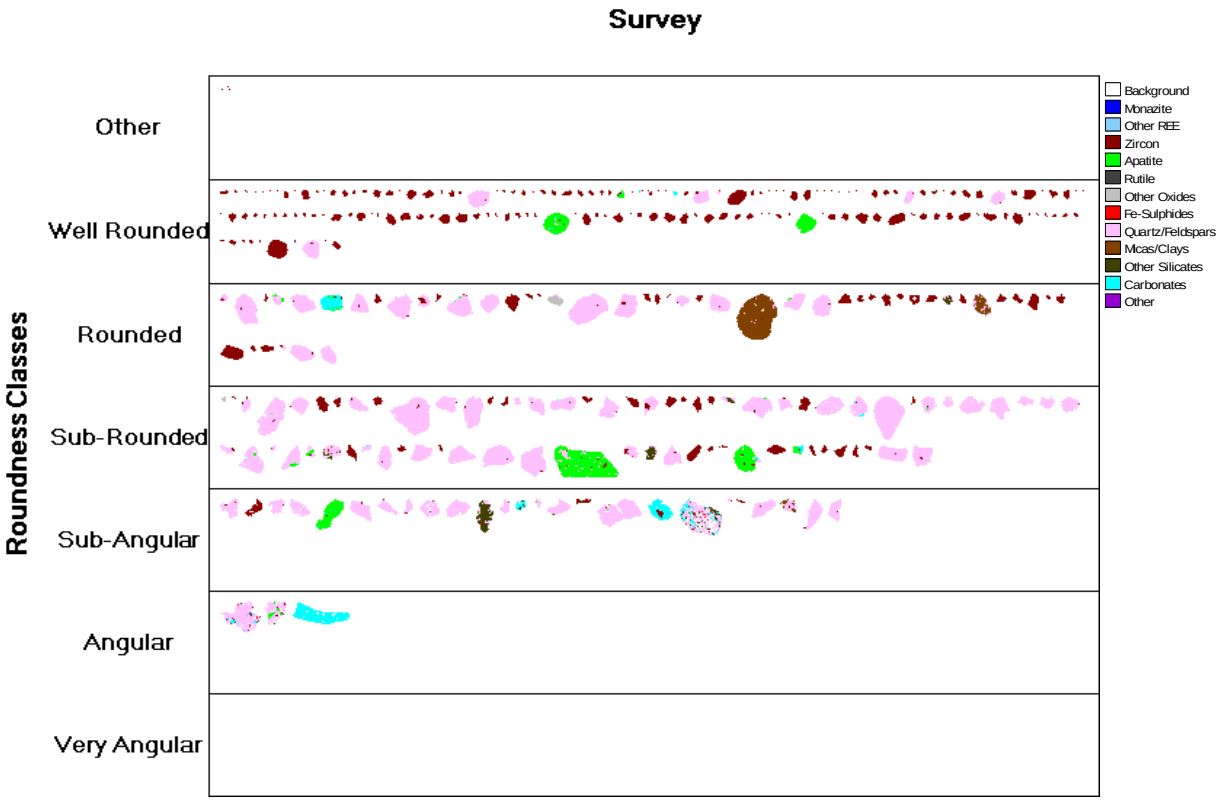
Zircon Roundness-NC



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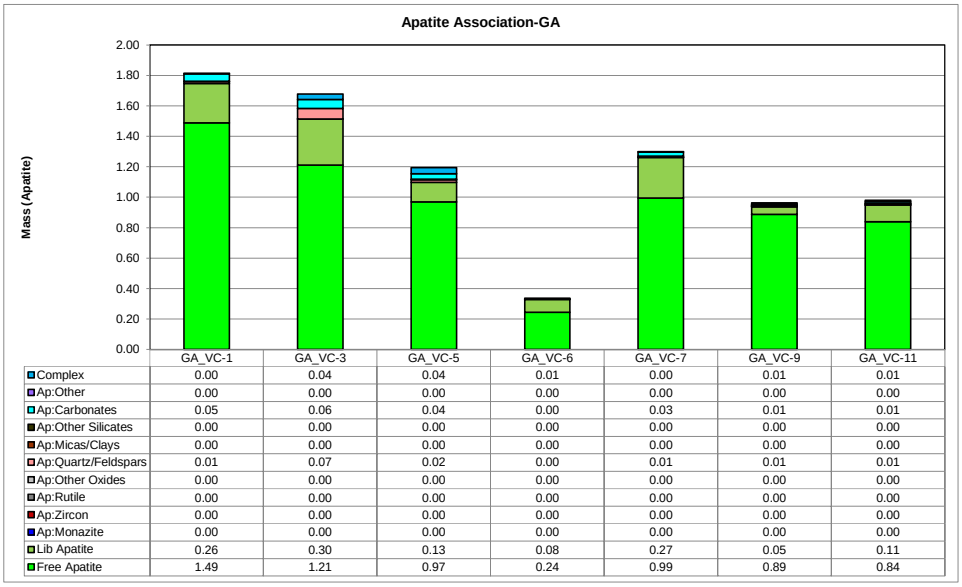
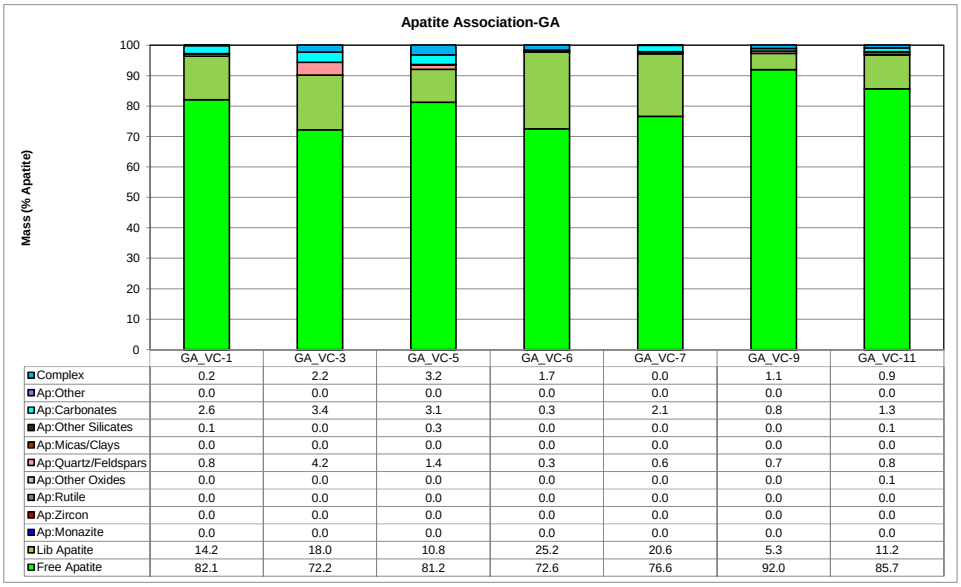
Apatite Association



	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.00	0.04	0.04	0.01	0.00	0.01	0.01
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.05	0.06	0.04	0.00	0.03	0.01	0.01
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.01	0.07	0.02	0.00	0.01	0.01	0.01
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lib Apatite	0.26	0.30	0.13	0.08	0.27	0.05	0.11
Free Apatite	1.49	1.21	0.97	0.24	0.99	0.89	0.84

Absolute Mass of Apatite Across Samples

Mineral Name	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Free Apatite	1.49	1.21	0.97	0.24	0.99	0.89	0.84
Lib Apatite	0.26	0.30	0.13	0.08	0.27	0.05	0.11
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.01	0.07	0.02	0.00	0.01	0.01	0.01
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.05	0.06	0.04	0.00	0.03	0.01	0.01
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Complex	0.00	0.04	0.04	0.01	0.00	0.01	0.01
Total	1.81	1.68	1.19	0.34	1.30	0.96	0.98



	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.2	2.2	3.2	1.7	0.0	1.1	0.9
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Carbonates	2.6	3.4	3.1	0.3	2.1	0.8	1.3
Ap:Other Silicates	0.1	0.0	0.3	0.0	0.0	0.0	0.1
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Quartz/Feldspars	0.8	4.2	1.4	0.3	0.6	0.7	0.8
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Apatite	14.2	18.0	10.8	25.2	20.6	5.3	11.2
Free Apatite	82.1	72.2	81.2	72.6	76.6	92.0	85.7

Normalized Mass of Apatite Across Samples

Mineral Name	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Free Apatite	82.1	72.2	81.2	72.6	76.6	92.0	85.7
Lib Apatite	14.2	18.0	10.8	25.2	20.6	5.3	11.2
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Ap:Quartz/Feldspars	0.8	4.2	1.4	0.3	0.6	0.7	0.8
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Other Silicates	0.1	0.0	0.3	0.0	0.0	0.0	0.1
Ap:Carbonates	2.6	3.4	3.1	0.3	2.1	0.8	1.3
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.2	2.2	3.2	1.7	0.0	1.1	0.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	96.3	90.2	92.0	97.8	97.2	97.3	96.8

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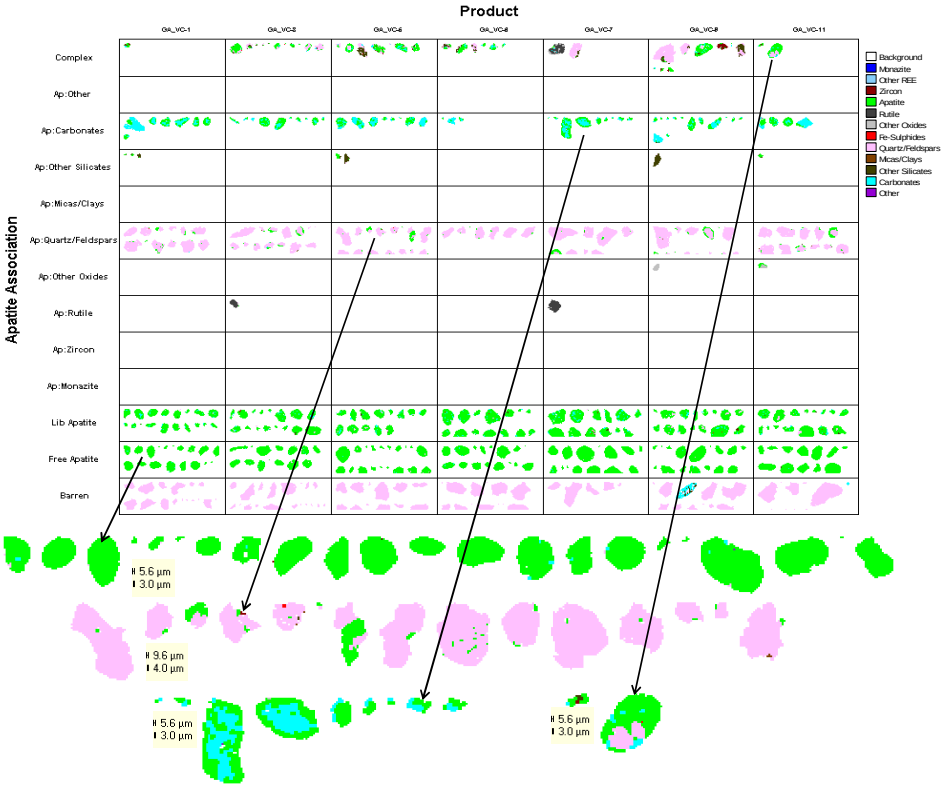
Image Grid of Apatite Association



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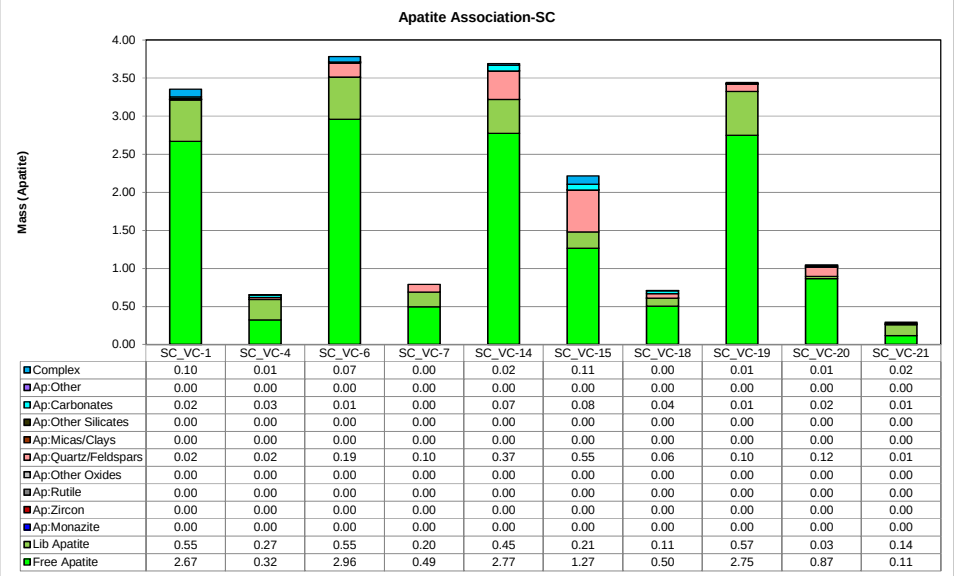
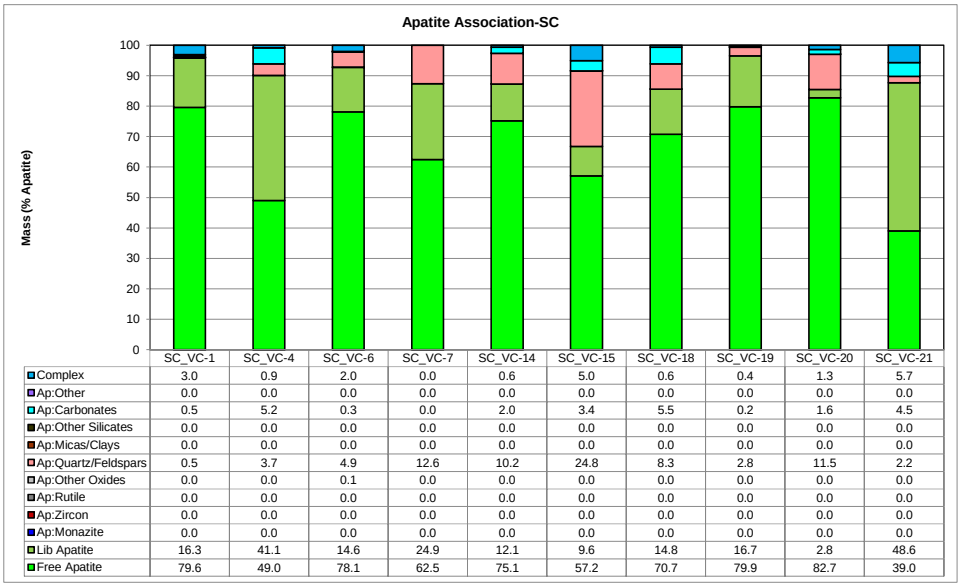
Apatite Association



	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Complex	0.10	0.01	0.07	0.00	0.02	0.11	0.00	0.01	0.01	0.02
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.02	0.03	0.01	0.00	0.07	0.08	0.04	0.01	0.02	0.01
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.02	0.02	0.19	0.10	0.37	0.55	0.06	0.10	0.12	0.01
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lib Apatite	0.55	0.27	0.55	0.20	0.45	0.21	0.11	0.57	0.03	0.14
Free Apatite	2.67	0.32	2.96	0.49	2.77	1.27	0.50	2.75	0.87	0.11

Absolute Mass of Apatite Across Samples

Mineral Name	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Free Apatite	2.67	0.32	2.96	0.49	2.77	1.27	0.50	2.75	0.87	0.11
Lib Apatite	0.55	0.27	0.55	0.20	0.45	0.21	0.11	0.57	0.03	0.14
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.02	0.02	0.19	0.10	0.37	0.55	0.06	0.10	0.12	0.01
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.02	0.03	0.01	0.00	0.07	0.08	0.04	0.01	0.02	0.01
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Complex	0.10	0.01	0.07	0.00	0.02	0.11	0.00	0.01	0.01	0.02
Total	3.35	0.66	3.78	0.79	3.69	2.21	0.71	3.44	1.05	0.29



	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Complex	3.0	0.9	2.0	0.0	0.6	5.0	0.6	0.4	1.3	5.7
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Carbonates	0.5	5.2	0.3	0.0	2.0	3.4	5.5	0.2	1.6	4.5
Ap:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Quartz/Feldspars	0.5	3.7	4.9	12.6	10.2	24.8	8.3	2.8	11.5	2.2
Ap:Other Oxides	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Apatite	16.3	41.1	14.6	24.9	12.1	9.6	14.8	16.7	2.8	48.6
Free Apatite	79.6	49.0	78.1	62.5	75.1	57.2	70.7	79.9	82.7	39.0

Normalized Mass of Apatite Across Samples

Mineral Name	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Free Apatite	79.6	49.0	78.1	62.5	75.1	57.2	70.7	79.9	82.7	39.0
Lib Apatite	16.3	41.1	14.6	24.9	12.1	9.6	14.8	16.7	2.8	48.6
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Other Oxides	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Quartz/Feldspars	0.5	3.7	4.9	12.6	10.2	24.8	8.3	2.8	11.5	2.2
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Carbonates	0.5	5.2	0.3	0.0	2.0	3.4	5.5	0.2	1.6	4.5
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	3.0	0.9	2.0	0.0	0.6	5.0	0.6	0.4	1.3	5.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	95.9	90.1	92.7	87.4	87.2	66.8	85.6	96.5	85.5	87.6

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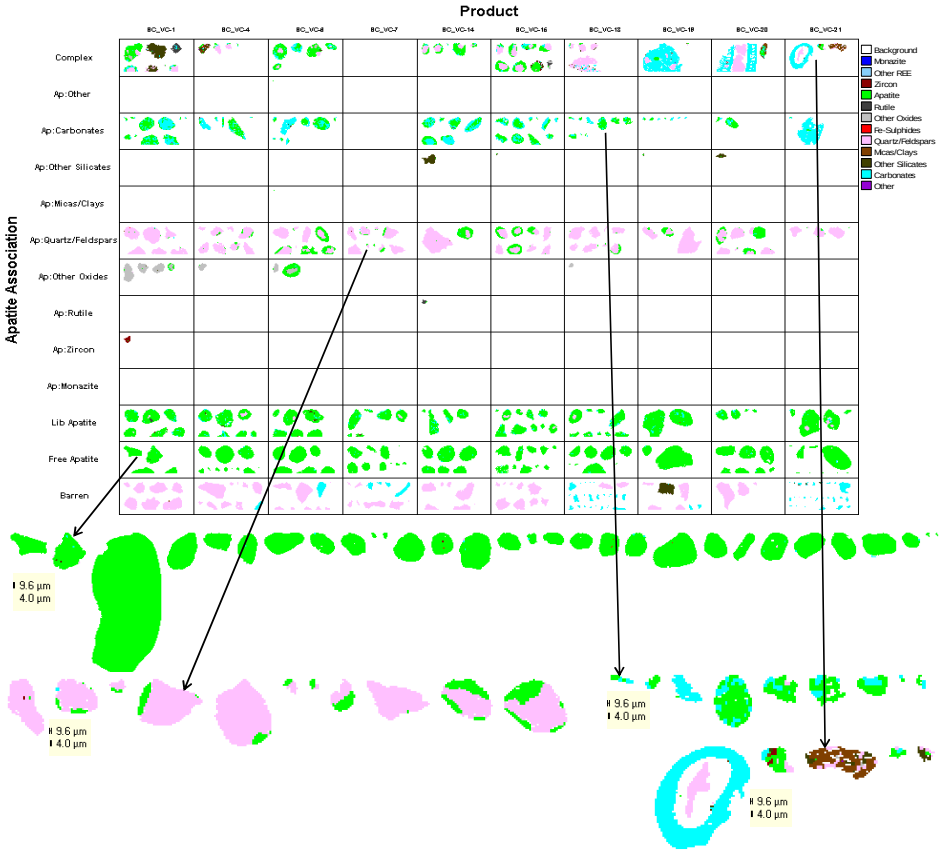
Image Grid of Apatite Association



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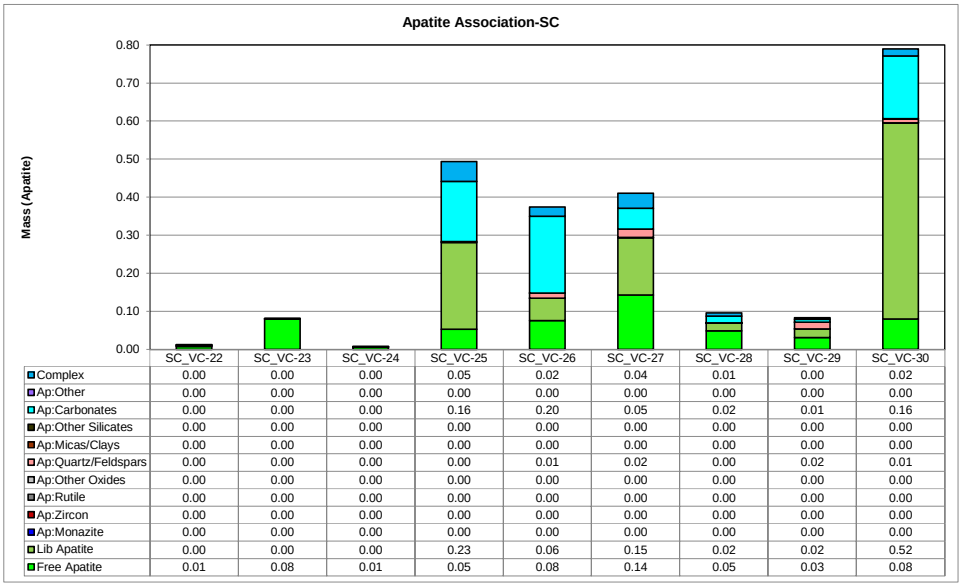
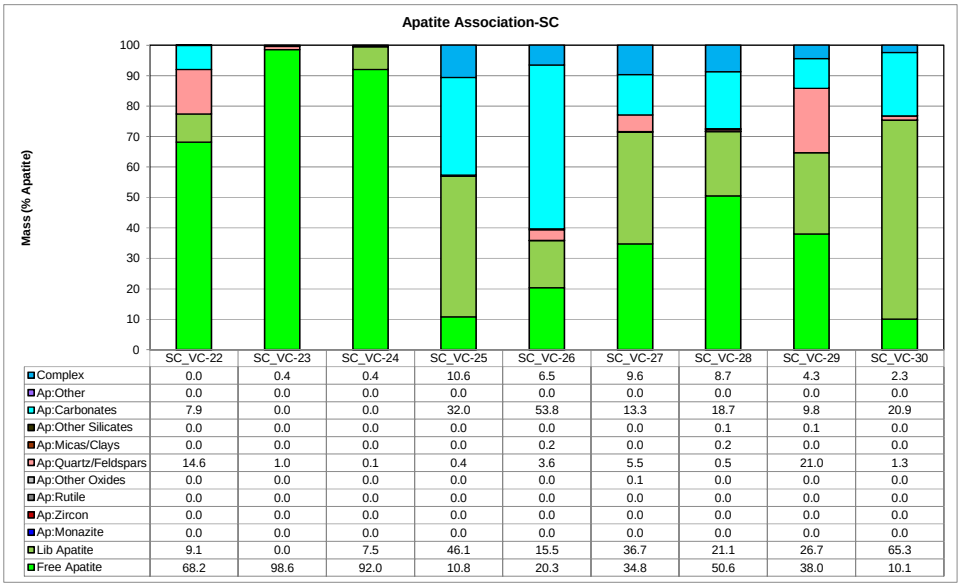
Apatite Association



	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.00	0.00	0.00	0.05	0.02	0.04	0.01	0.00	0.02
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.00	0.00	0.00	0.16	0.20	0.05	0.02	0.01	0.16
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.02	0.01
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lib Apatite	0.00	0.00	0.00	0.23	0.06	0.15	0.02	0.02	0.52
Free Apatite	0.01	0.08	0.01	0.05	0.08	0.14	0.05	0.03	0.08

Absolute Mass of Apatite Across Samples

Mineral Name	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Free Apatite	0.01	0.08	0.01	0.05	0.08	0.14	0.05	0.03	0.08
Lib Apatite	0.00	0.00	0.00	0.23	0.06	0.15	0.02	0.02	0.52
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.02	0.01
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.00	0.00	0.00	0.16	0.20	0.05	0.02	0.01	0.16
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Complex	0.00	0.00	0.00	0.05	0.02	0.04	0.01	0.00	0.02
Total	0.01	0.08	0.01	0.49	0.37	0.41	0.10	0.08	0.79



	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.0	0.4	0.4	10.6	6.5	9.6	8.7	4.3	2.3
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Carbonates	7.9	0.0	0.0	32.0	53.8	13.3	18.7	9.8	20.9
Ap:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0
Ap:Quartz/Feldspars	14.6	1.0	0.1	0.4	3.6	5.5	0.5	21.0	1.3
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Apatite	9.1	0.0	7.5	46.1	15.5	36.7	21.1	26.7	65.3
Free Apatite	68.2	98.6	92.0	10.8	20.3	34.8	50.6	38.0	10.1

Normalized Mass of Apatite Across Samples

Mineral Name	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Free Apatite	68.2	98.6	92.0	10.8	20.3	34.8	50.6	38.0	10.1
Lib Apatite	9.1	0.0	7.5	46.1	15.5	36.7	21.1	26.7	65.3
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Ap:Quartz/Feldspars	14.6	1.0	0.1	0.4	3.6	5.5	0.5	21.0	1.3
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.2	0.0	0.2	0.0	0.0
Ap:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Ap:Carbonates	7.9	0.0	0.0	32.0	53.8	13.3	18.7	9.8	20.9
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.0	0.4	0.4	10.6	6.5	9.6	8.7	4.3	2.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	77.4	98.6	99.5	56.9	35.9	71.5	71.7	64.7	75.4

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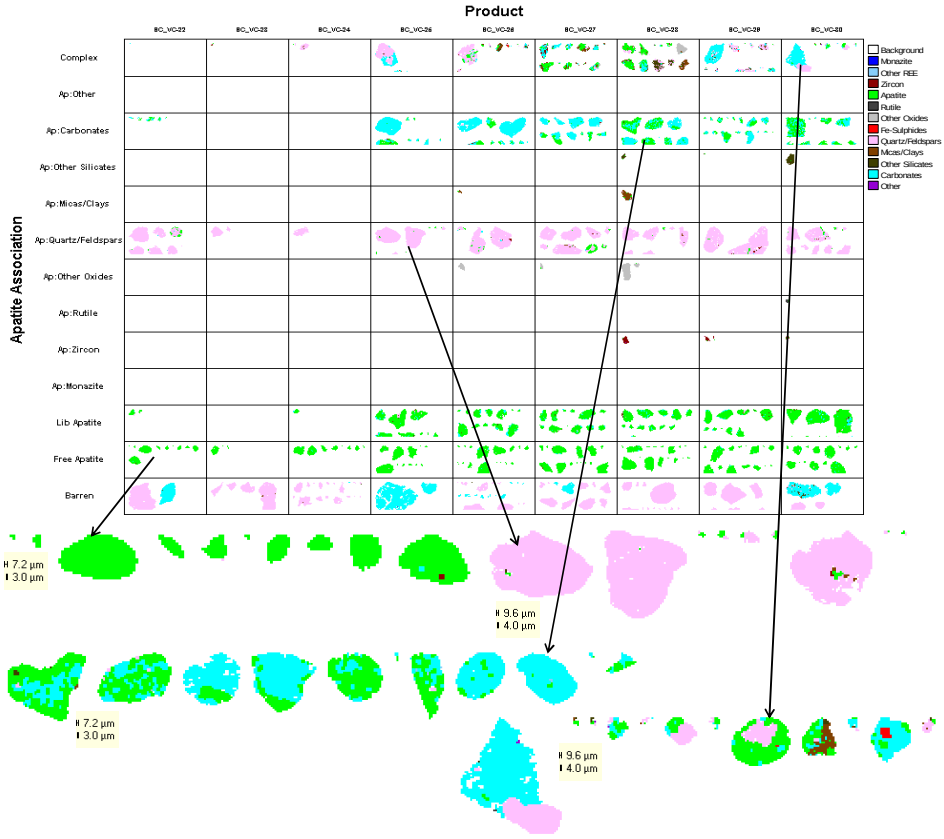
Image Grid of Apatite Association



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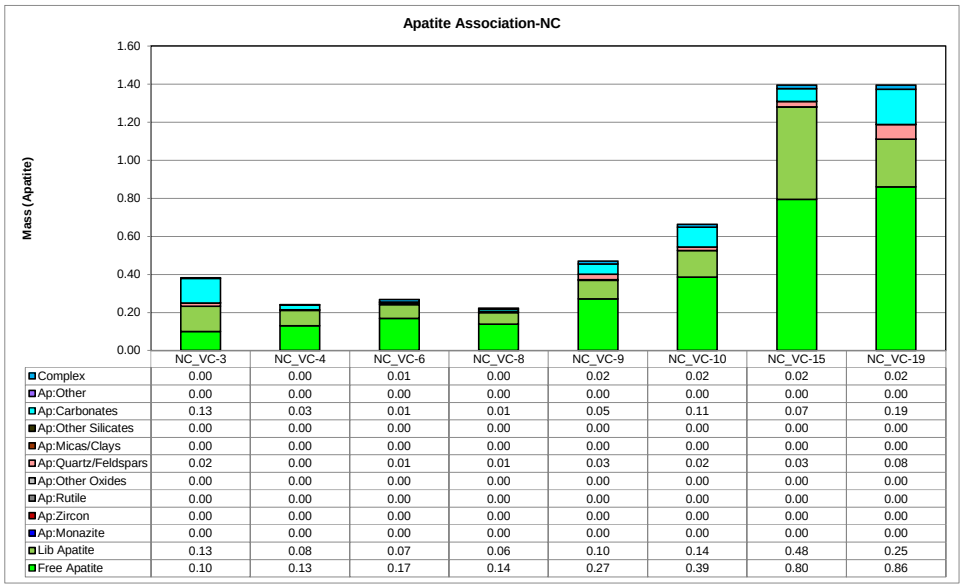
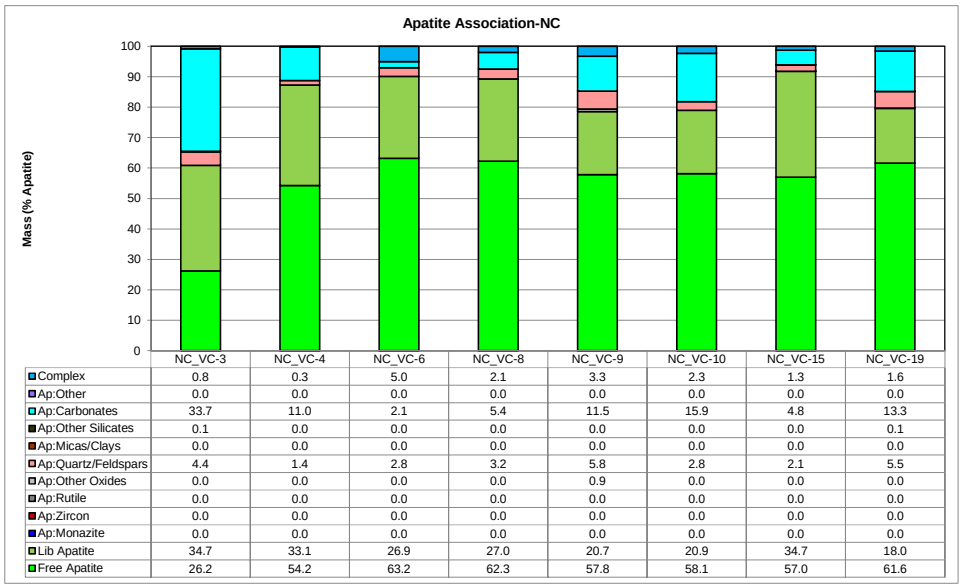
Apatite Association



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Complex	0.00	0.00	0.01	0.00	0.02	0.02	0.02	0.02
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.13	0.03	0.01	0.01	0.05	0.11	0.07	0.19
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.02	0.00	0.01	0.01	0.03	0.02	0.03	0.08
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lib Apatite	0.13	0.08	0.07	0.06	0.10	0.14	0.48	0.25
Free Apatite	0.10	0.13	0.17	0.14	0.27	0.39	0.80	0.86

Absolute Mass of Apatite Across Samples

Mineral Name	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Free Apatite	0.10	0.13	0.17	0.14	0.27	0.39	0.80	0.86
Lib Apatite	0.13	0.08	0.07	0.06	0.10	0.14	0.48	0.25
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.02	0.00	0.01	0.01	0.03	0.02	0.03	0.08
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.13	0.03	0.01	0.01	0.05	0.11	0.07	0.19
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Complex	0.00	0.00	0.01	0.00	0.02	0.02	0.02	0.02
Total	0.38	0.24	0.27	0.22	0.47	0.66	1.39	1.40



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Complex	0.8	0.3	5.0	2.1	3.3	2.3	1.3	1.6
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Carbonates	33.7	11.0	2.1	5.4	11.5	15.9	4.8	13.3
Ap:Other Silicates	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Quartz/Feldspars	4.4	1.4	2.8	3.2	5.8	2.8	2.1	5.5
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Apatite	34.7	33.1	26.9	27.0	20.7	20.9	34.7	18.0
Free Apatite	26.2	54.2	63.2	62.3	57.8	58.1	57.0	61.6

Normalized Mass of Apatite Across Samples

Mineral Name	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Free Apatite	26.2	54.2	63.2	62.3	57.8	58.1	57.0	61.6
Lib Apatite	34.7	33.1	26.9	27.0	20.7	20.9	34.7	18.0
Ap:Monazite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0
Ap:Quartz/Feldspars	4.4	1.4	2.8	3.2	5.8	2.8	2.1	5.5
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Other Silicates	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Ap:Carbonates	33.7	11.0	2.1	5.4	11.5	15.9	4.8	13.3
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.8	0.3	5.0	2.1	3.3	2.3	1.3	1.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	60.9	87.3	90.1	89.3	78.6	79.0	91.8	79.6

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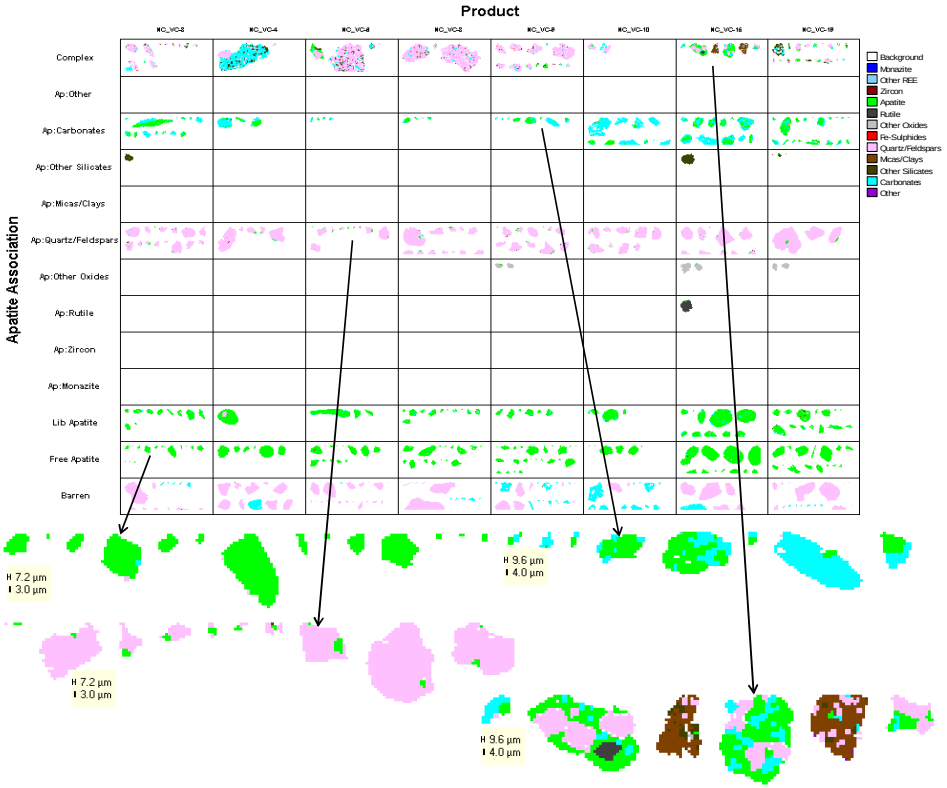
Image Grid of Apatite Association



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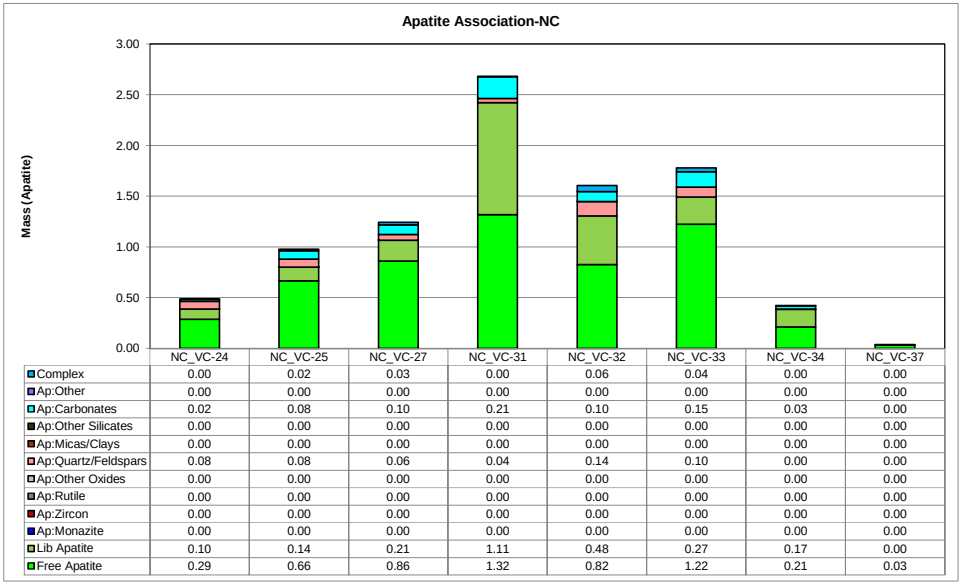
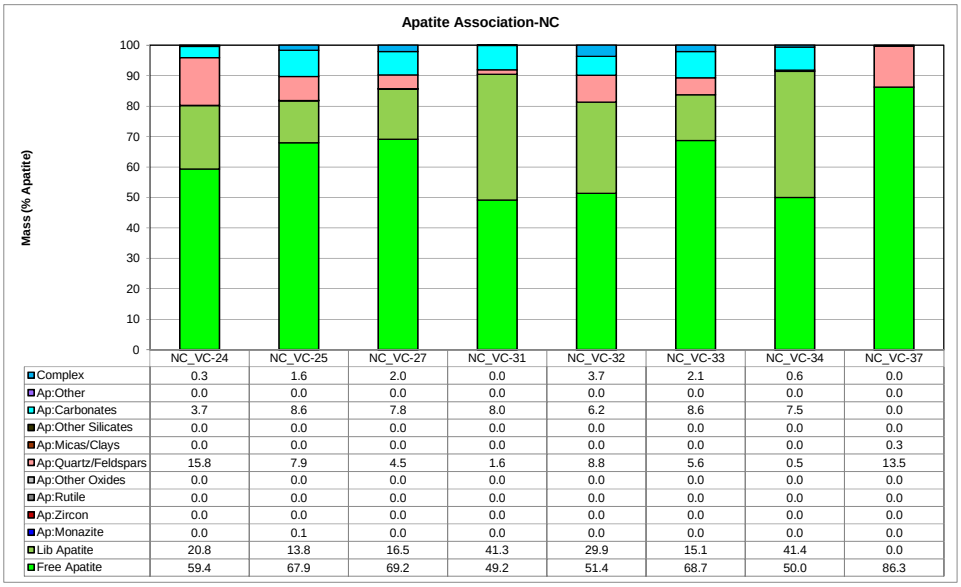
Apatite Association



	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.00	0.02	0.03	0.00	0.06	0.04	0.00	0.00
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.02	0.08	0.10	0.21	0.10	0.15	0.03	0.00
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.08	0.08	0.06	0.04	0.14	0.10	0.00	0.00
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Lib Apatite	0.10	0.14	0.21	1.11	0.48	0.27	0.17	0.00
Free Apatite	0.29	0.66	0.86	1.32	0.82	1.22	0.21	0.03

Absolute Mass of Apatite Across Samples

Mineral Name	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Free Apatite	0.29	0.66	0.86	1.32	0.82	1.22	0.21	0.03
Lib Apatite	0.10	0.14	0.21	1.11	0.48	0.27	0.17	0.00
Ap:Monazite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Zircon	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Rutile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Quartz/Feldspars	0.08	0.08	0.06	0.04	0.14	0.10	0.00	0.00
Ap:Micas/Clays	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Other Silicates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ap:Carbonates	0.02	0.08	0.10	0.21	0.10	0.15	0.03	0.00
Ap:Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Complex	0.00	0.02	0.03	0.00	0.06	0.04	0.00	0.00
Total	0.48	0.98	1.24	2.68	1.61	1.78	0.42	0.04



	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.3	1.6	2.0	0.0	3.7	2.1	0.6	0.0
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Carbonates	3.7	8.6	7.8	8.0	6.2	8.6	7.5	0.0
Ap:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Ap:Quartz/Feldspars	15.8	7.9	4.5	1.6	8.8	5.6	0.5	13.5
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Monazite	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Lib Apatite	20.8	13.8	16.5	41.3	29.9	15.1	41.4	0.0
Free Apatite	59.4	67.9	69.2	49.2	51.4	68.7	50.0	86.3

Normalized Mass of Apatite Across Samples

Mineral Name	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Free Apatite	59.4	67.9	69.2	49.2	51.4	68.7	50.0	86.3
Lib Apatite	20.8	13.8	16.5	41.3	29.9	15.1	41.4	0.0
Ap:Monazite	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Quartz/Feldspars	15.8	7.9	4.5	1.6	8.8	5.6	0.5	13.5
Ap:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Ap:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ap:Carbonates	3.7	8.6	7.8	8.0	6.2	8.6	7.5	0.0
Ap:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.3	1.6	2.0	0.0	3.7	2.1	0.6	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	80.2	81.7	85.7	90.4	81.3	83.7	91.4	86.3

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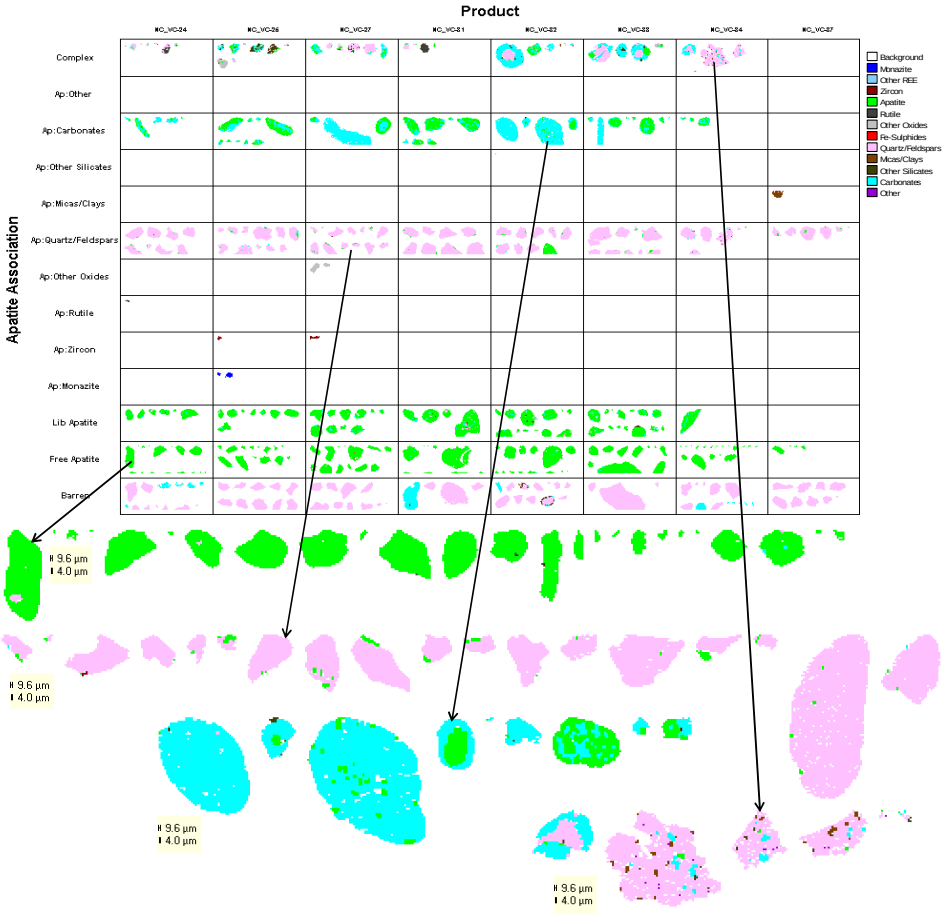
Image Grid of Apatite Association



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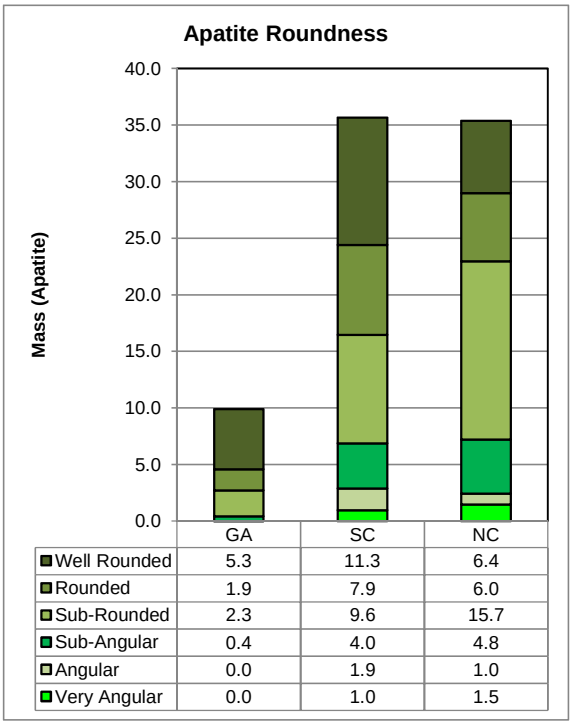
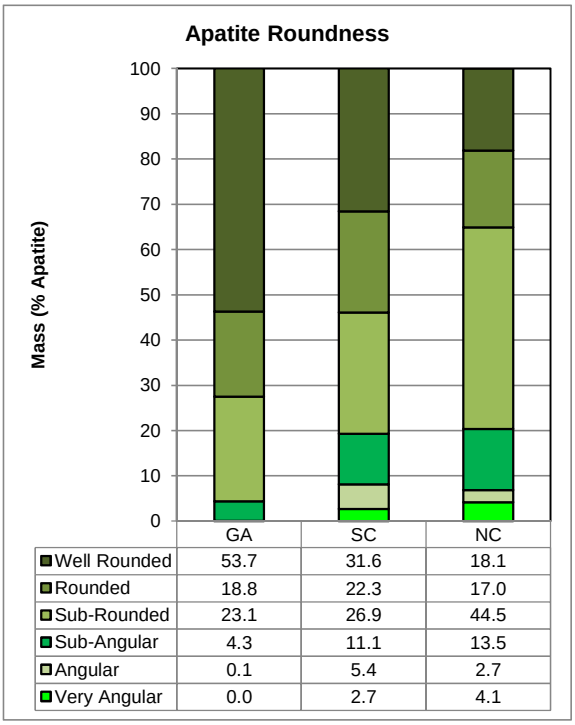
Apatite Roundness



	GA	SC	NC
Well Rounded	5.3	11.3	6.4
Rounded	1.9	7.9	6.0
Sub-Rounded	2.3	9.6	15.7
Sub-Angular	0.4	4.0	4.8
Angular	0.0	1.9	1.0
Very Angular	0.0	1.0	1.5



	GA	SC	NC
Well Rounded	53.7	31.6	18.1
Rounded	18.8	22.3	17.0
Sub-Rounded	23.1	26.9	44.5
Sub-Angular	4.3	11.1	13.5
Angular	0.1	5.4	2.7
Very Angular	0.0	2.7	4.1

Absolute Mass of Apatite Across Samples

Mineral Name	GA	SC	NC
Very Angular	0.0	1.0	1.5
Angular	0.0	1.9	1.0
Sub-Angular	0.4	4.0	4.8
Sub-Rounded	2.3	9.6	15.7
Rounded	1.9	7.9	6.0
Well Rounded	5.3	11.3	6.4
Total	9.9	35.7	35.4

Normalized Mass of Apatite Across Samples

Mineral Name	GA	SC	NC
Very Angular	0.0	2.7	4.1
Angular	0.1	5.4	2.7
Sub-Angular	4.3	11.1	13.5
Sub-Rounded	23.1	26.9	44.5
Rounded	18.8	22.3	17.0
Well Rounded	53.7	31.6	18.1
Total	100.0	100.0	100.0

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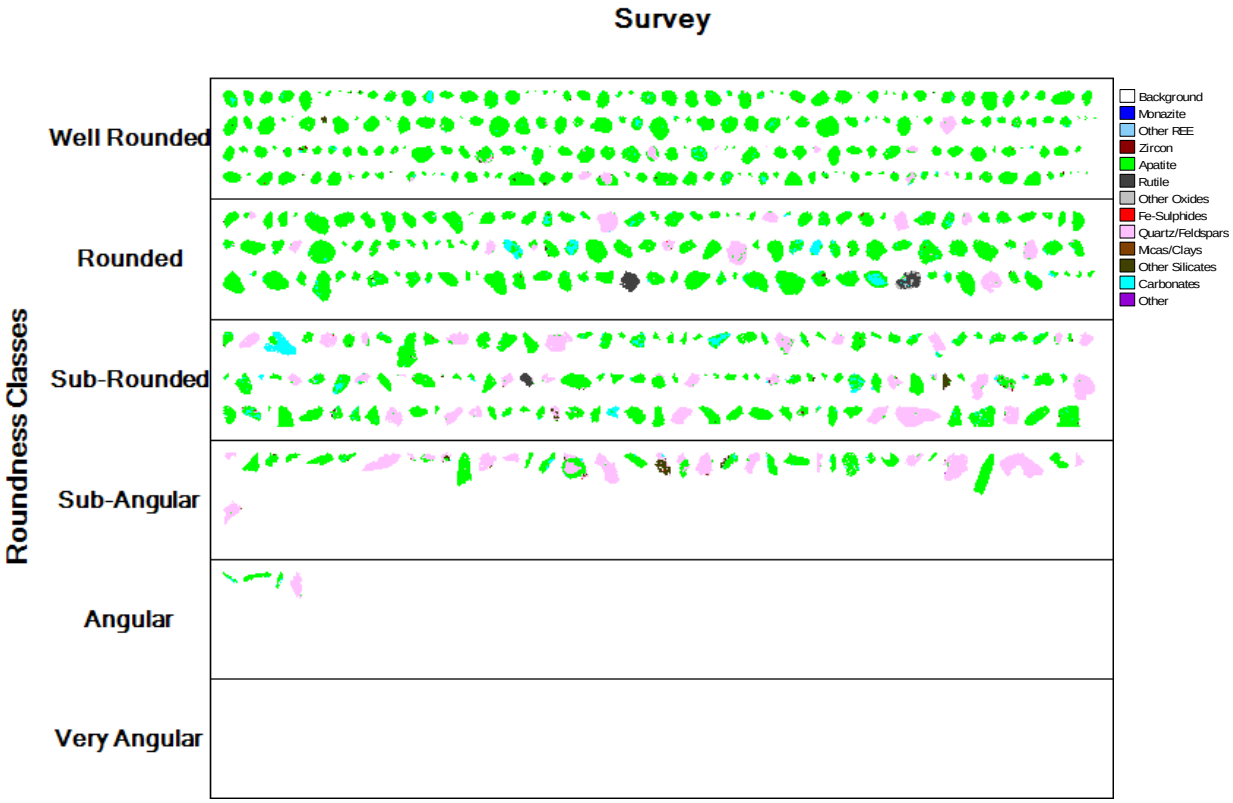
Apatite Roundness-GA



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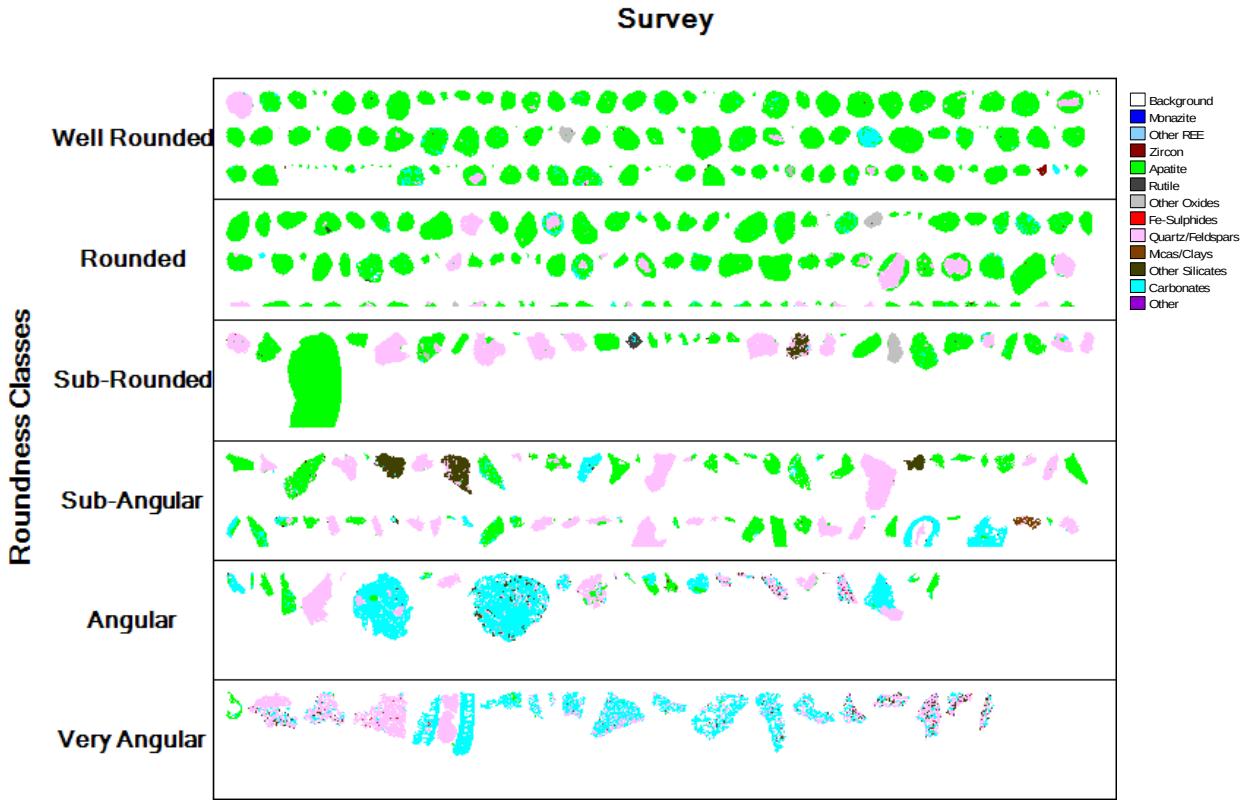
Apatite Roundness-SC



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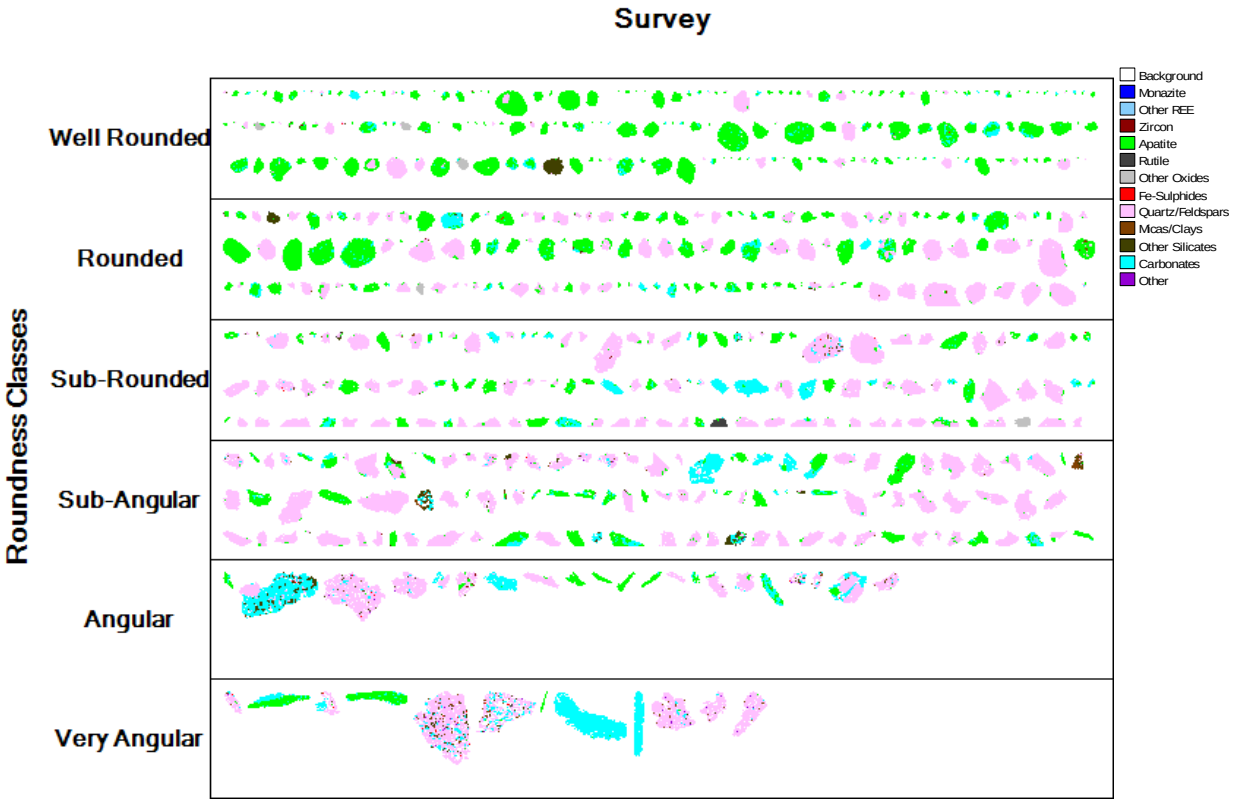
Apatite Roundness-NC



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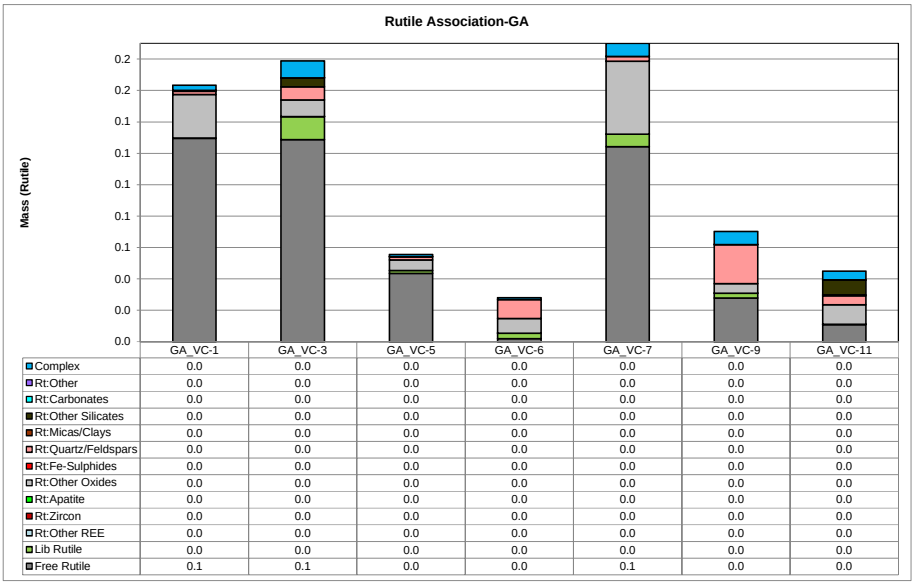
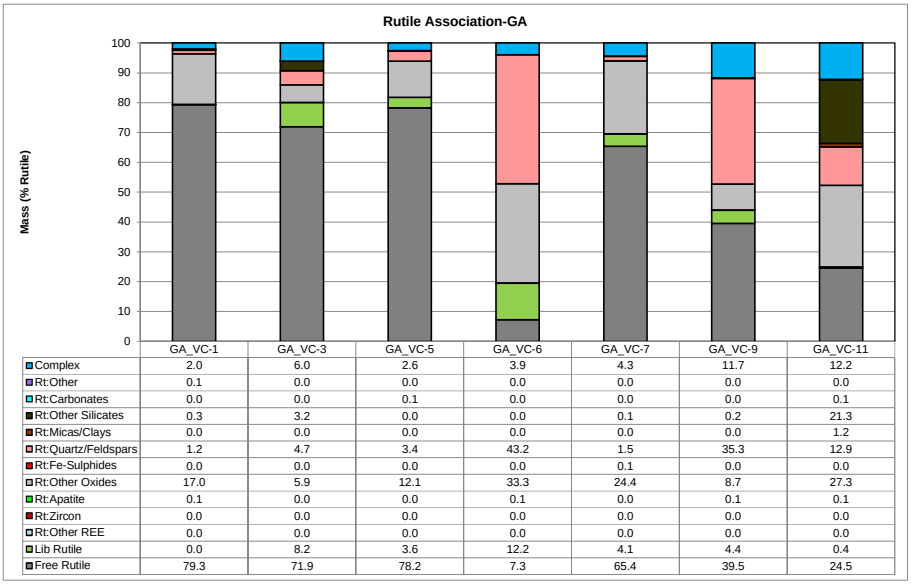


	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Free Rutile	0.1	0.1	0.0	0.0	0.1	0.0	0.0

Absolute Mass of Rutile Across Samples

Mineral Name	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Free Rutile	0.1	0.1	0.0	0.0	0.1	0.0	0.0
Lib Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.2	0.2	0.1	0.0	0.2	0.1	0.0



	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Complex	2.0	6.0	2.6	3.9	4.3	11.7	12.2
Rt:Other	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Rt:Other Silicates	0.3	3.2	0.0	0.0	0.1	0.2	21.3
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Rt:Quartz/Feldspars	1.2	4.7	3.4	43.2	1.5	35.3	12.9
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Rt:Other Oxides	17.0	5.9	12.1	33.3	24.4	8.7	27.3
Rt:Apatite	0.1	0.0	0.0	0.1	0.0	0.1	0.1
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	0.0	8.2	3.6	12.2	4.1	4.4	0.4
Free Rutile	79.3	71.9	78.2	7.3	65.4	39.5	24.5

Normalized Mass of Rutile Across Samples

Mineral Name	GA_VC-1	GA_VC-3	GA_VC-5	GA_VC-6	GA_VC-7	GA_VC-9	GA_VC-11
Free Rutile	79.3	71.9	78.2	7.3	65.4	39.5	24.5
Lib Rutile	0.0	8.2	3.6	12.2	4.1	4.4	0.4
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.1	0.0	0.0	0.1	0.0	0.1	0.1
Rt:Other Oxides	17.0	5.9	12.1	33.3	24.4	8.7	27.3
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Rt:Quartz/Feldspars	1.2	4.7	3.4	43.2	1.5	35.3	12.9
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	1.2
Rt:Other Silicates	0.3	3.2	0.0	0.0	0.1	0.2	21.3
Rt:Carbonates	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Rt:Other	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Complex	2.0	6.0	2.6	3.9	4.3	11.7	12.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	79.3	80.1	81.8	19.5	69.5	44.0	24.9

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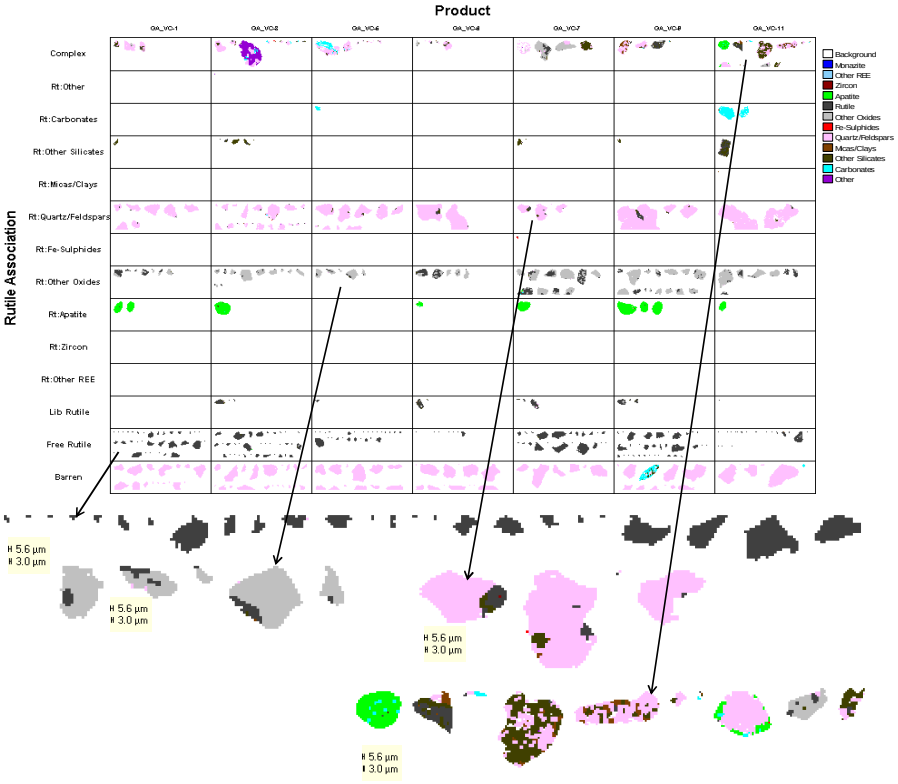
Image Grid of Rutile Association



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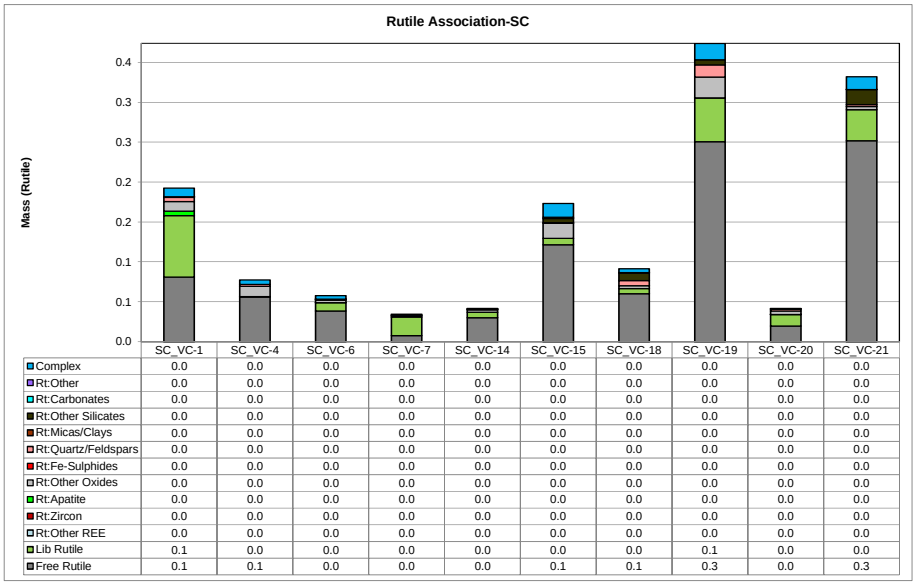
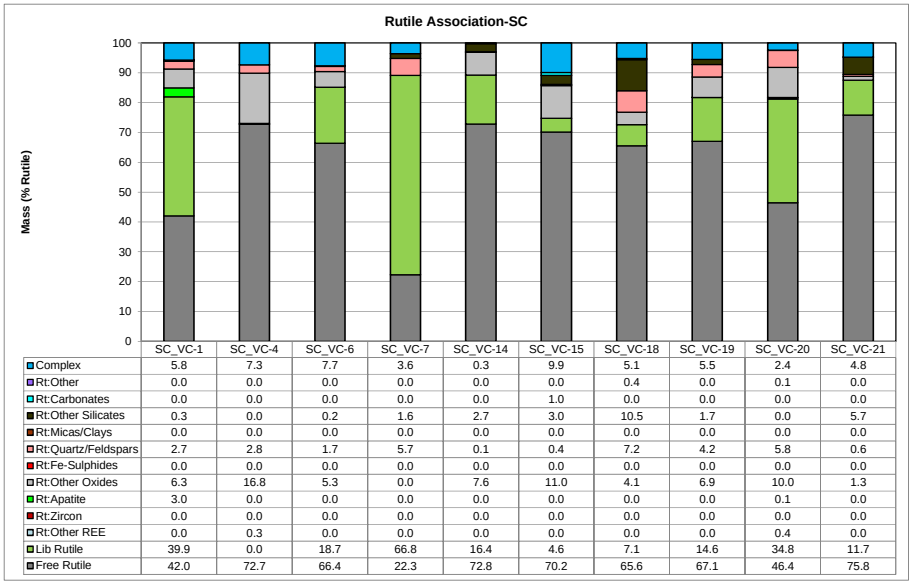
Rutile Association



	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Complex	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Free Rutile	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.3	0.0	0.3

Absolute Mass of Rutile Across Samples

Mineral Name	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Free Rutile	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.3	0.0	0.3
Lib Rutile	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.2	0.1	0.1	0.0	0.0	0.2	0.1	0.4	0.0	0.3



	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Complex	5.8	7.3	7.7	3.6	0.3	9.9	5.1	5.5	2.4	4.8
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.3	0.0	0.2	1.6	2.7	3.0	10.5	1.7	0.0	5.7
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	2.7	2.8	1.7	5.7	0.1	0.4	7.2	4.2	5.8	0.6
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	6.3	16.8	5.3	0.0	7.6	11.0	4.1	6.9	10.0	1.3
Rt:Apatite	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
Lib Rutile	39.9	0.0	18.7	66.8	16.4	4.6	7.1	14.6	34.8	11.7
Free Rutile	42.0	72.7	66.4	22.3	72.8	70.2	65.6	67.1	46.4	75.8

Normalized Mass of Rutile Across Samples

Mineral Name	SC_VC-1	SC_VC-4	SC_VC-6	SC_VC-7	SC_VC-14	SC_VC-15	SC_VC-18	SC_VC-19	SC_VC-20	SC_VC-21
Free Rutile	42.0	72.7	66.4	22.3	72.8	70.2	65.6	67.1	46.4	75.8
Lib Rutile	39.9	0.0	18.7	66.8	16.4	4.6	7.1	14.6	34.8	11.7
Rt:Other REE	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Rt:Other Oxides	6.3	16.8	5.3	0.0	7.6	11.0	4.1	6.9	10.0	1.3
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	2.7	2.8	1.7	5.7	0.1	0.4	7.2	4.2	5.8	0.6
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.3	0.0	0.2	1.6	2.7	3.0	10.5	1.7	0.0	5.7
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.0
Complex	5.8	7.3	7.7	3.6	0.3	9.9	5.1	5.5	2.4	4.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	81.9	72.7	85.1	89.1	89.3	74.8	72.6	81.7	81.2	87.5

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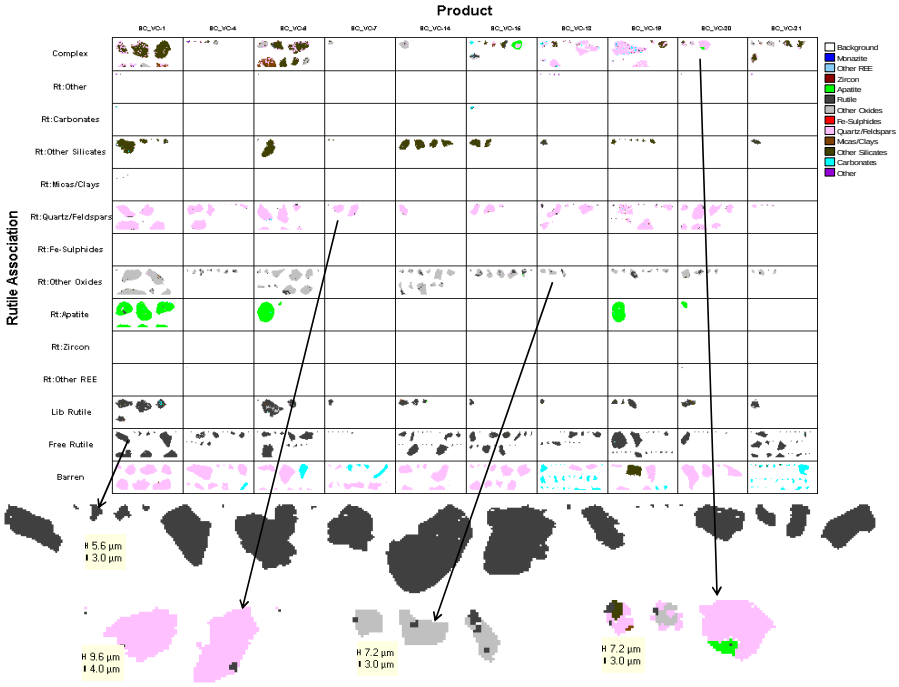
Image Grid of Rutile Association



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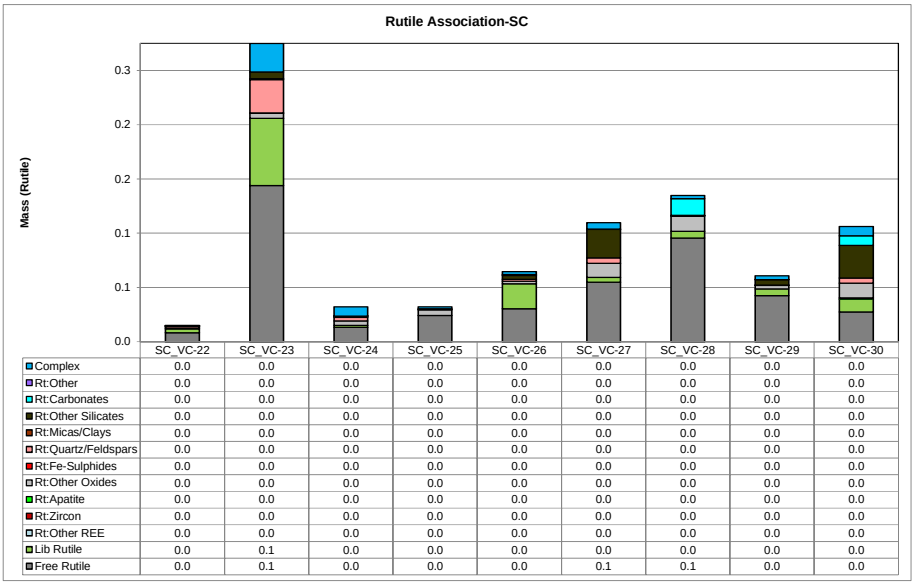
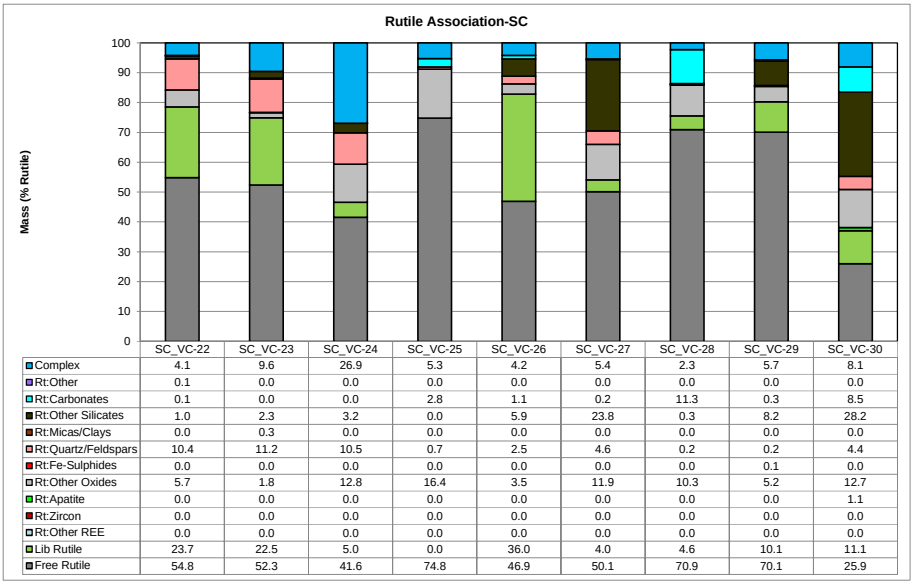


	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Free Rutile	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0

Absolute Mass of Rutile Across Samples

Mineral Name	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Free Rutile	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Lib Rutile	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.3	0.0	0.0	0.1	0.1	0.1	0.1	0.1



	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Complex	4.1	9.6	26.9	5.3	4.2	5.4	2.3	5.7	8.1
Rt:Other	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.1	0.0	0.0	2.8	1.1	0.2	11.3	0.3	8.5
Rt:Other Silicates	1.0	2.3	3.2	0.0	5.9	23.8	0.3	8.2	28.2
Rt:Micas/Clays	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	10.4	11.2	10.5	0.7	2.5	4.6	0.2	0.2	4.4
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Rt:Other Oxides	5.7	1.8	12.8	16.4	3.5	11.9	10.3	5.2	12.7
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	23.7	22.5	5.0	0.0	36.0	4.0	4.6	10.1	11.1
Free Rutile	54.8	52.3	41.6	74.8	46.9	50.1	70.9	70.1	25.9

Normalized Mass of Rutile Across Samples

Mineral Name	SC_VC-22	SC_VC-23	SC_VC-24	SC_VC-25	SC_VC-26	SC_VC-27	SC_VC-28	SC_VC-29	SC_VC-30
Free Rutile	54.8	52.3	41.6	74.8	46.9	50.1	70.9	70.1	25.9
Lib Rutile	23.7	22.5	5.0	0.0	36.0	4.0	4.6	10.1	11.1
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1
Rt:Other Oxides	5.7	1.8	12.8	16.4	3.5	11.9	10.3	5.2	12.7
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
Rt:Quartz/Feldspars	10.4	11.2	10.5	0.7	2.5	4.6	0.2	0.2	4.4
Rt:Micas/Clays	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	1.0	2.3	3.2	0.0	5.9	23.8	0.3	8.2	28.2
Rt:Carbonates	0.1	0.0	0.0	2.8	1.1	0.2	11.3	0.3	8.5
Rt:Other	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	4.1	9.6	26.9	5.3	4.2	5.4	2.3	5.7	8.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	78.5	74.8	46.6	74.8	82.8	54.1	75.6	80.2	37.0

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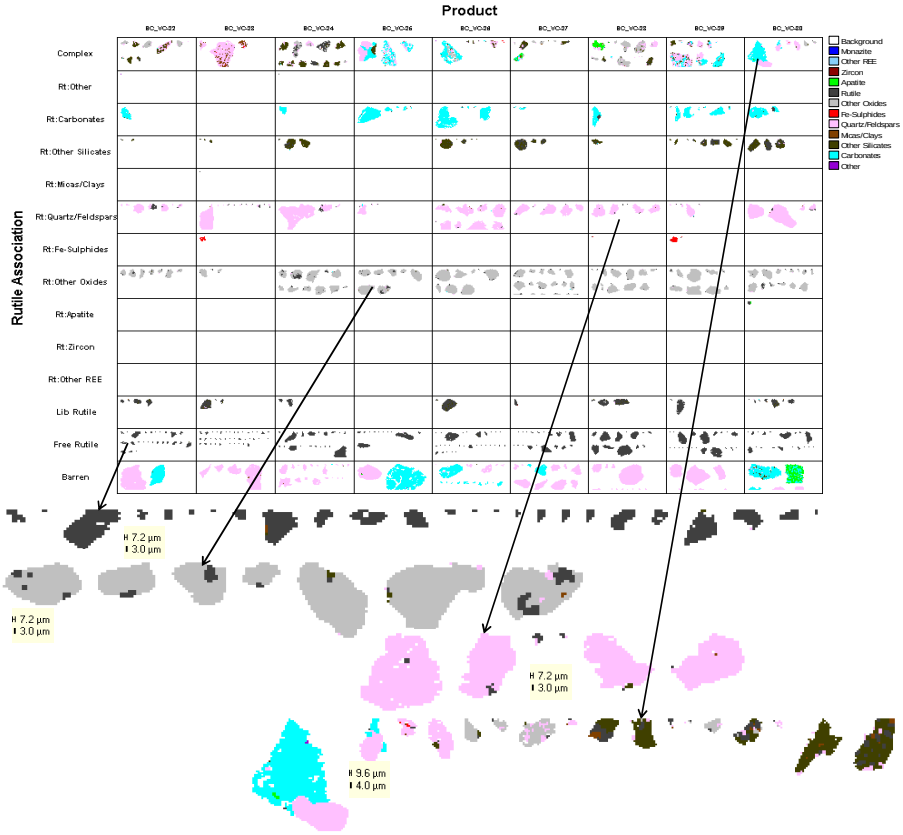
Image Grid of Rutile Association



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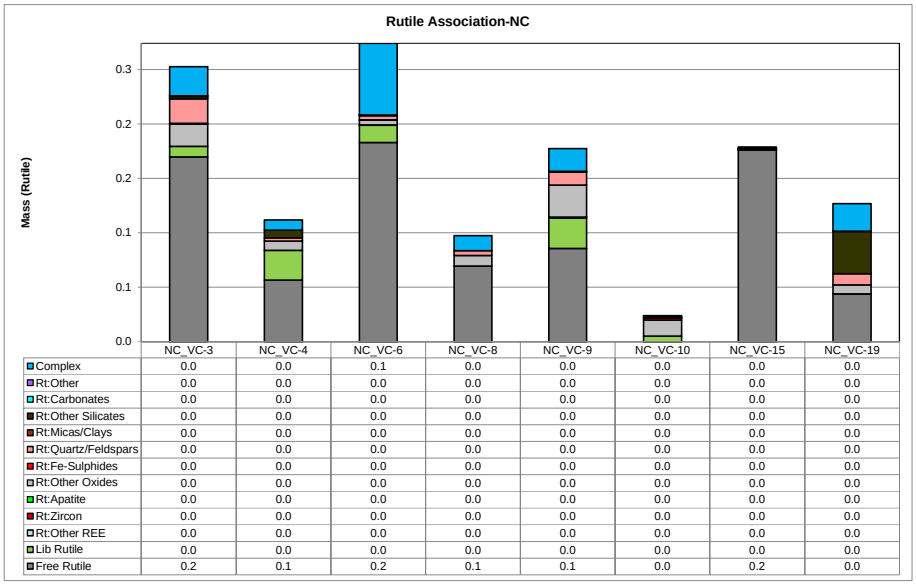
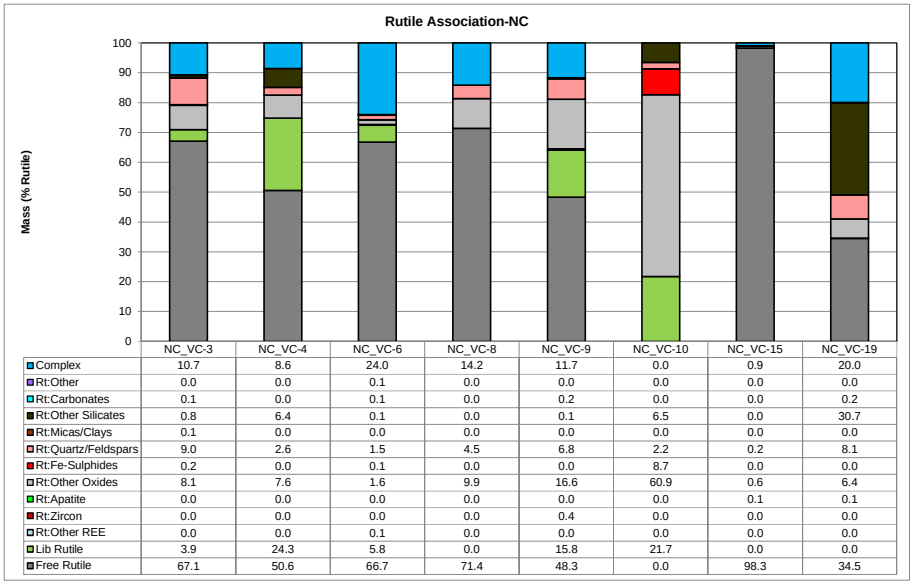
Rutile Association



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Complex	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Free Rutile	0.2	0.1	0.2	0.1	0.1	0.0	0.2	0.0

Absolute Mass of Rutile Across Samples

Mineral Name	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Free Rutile	0.2	0.1	0.2	0.1	0.1	0.0	0.2	0.0
Lib Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Total	0.3	0.1	0.3	0.1	0.2	0.0	0.2	0.1



	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Complex	10.7	8.6	24.0	14.2	11.7	0.0	0.9	20.0
Rt:Other	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.1	0.0	0.1	0.0	0.2	0.0	0.0	0.2
Rt:Other Silicates	0.8	6.4	0.1	0.0	0.1	6.5	0.0	30.7
Rt:Micas/Clays	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	9.0	2.6	1.5	4.5	6.8	2.2	0.2	8.1
Rt:Fe-Sulphides	0.2	0.0	0.1	0.0	0.0	8.7	0.0	0.0
Rt:Other Oxides	8.1	7.6	1.6	9.9	16.6	60.9	0.6	6.4
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Rt:Zircon	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Lib Rutile	3.9	24.3	5.8	0.0	15.8	21.7	0.0	0.0
Free Rutile	67.1	50.6	66.7	71.4	48.3	0.0	98.3	34.5

Normalized Mass of Rutile Across Samples

Mineral Name	NC_VC-3	NC_VC-4	NC_VC-6	NC_VC-8	NC_VC-9	NC_VC-10	NC_VC-15	NC_VC-19
Free Rutile	67.1	50.6	66.7	71.4	48.3	0.0	98.3	34.5
Lib Rutile	3.9	24.3	5.8	0.0	15.8	21.7	0.0	0.0
Rt:Other REE	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Rt:Other Oxides	8.1	7.6	1.6	9.9	16.6	60.9	0.6	6.4
Rt:Fe-Sulphides	0.2	0.0	0.1	0.0	0.0	8.7	0.0	0.0
Rt:Quartz/Feldspars	9.0	2.6	1.5	4.5	6.8	2.2	0.2	8.1
Rt:Micas/Clays	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.8	6.4	0.1	0.0	0.1	6.5	0.0	30.7
Rt:Carbonates	0.1	0.0	0.1	0.0	0.2	0.0	0.0	0.2
Rt:Other	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Complex	10.7	8.6	24.0	14.2	11.7	0.0	0.9	20.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	71.0	74.9	72.6	71.4	64.1	21.7	98.3	34.5

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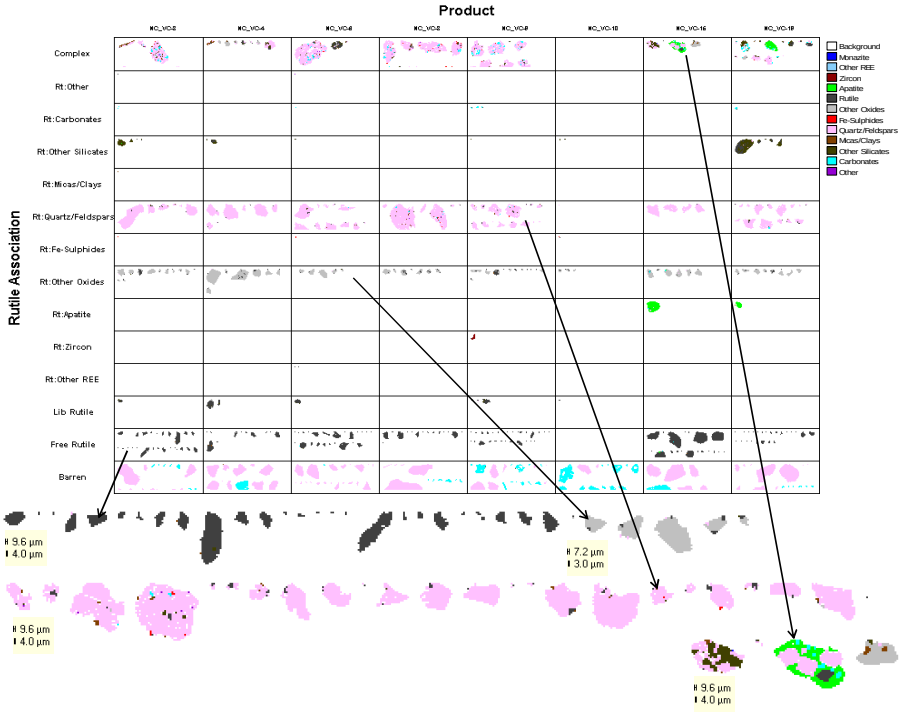
Image Grid of Rutile Association



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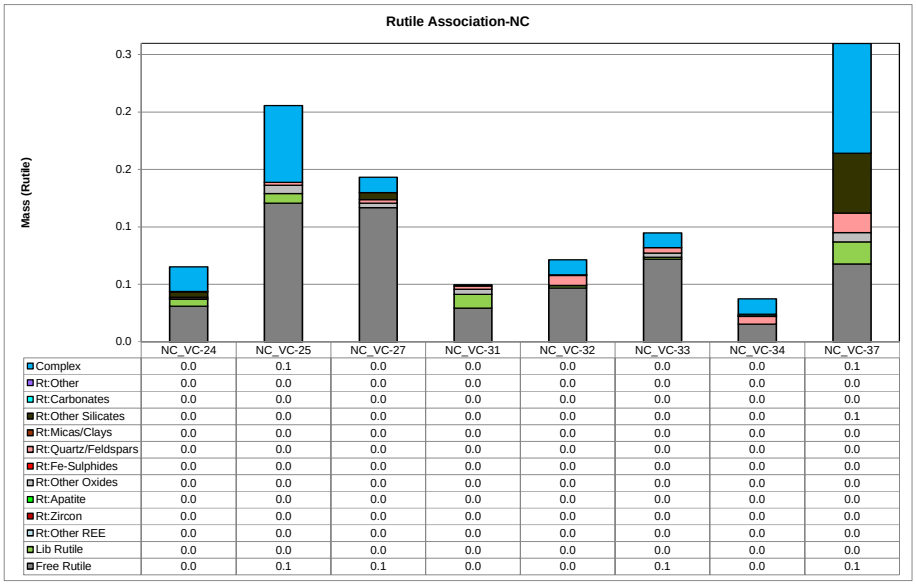
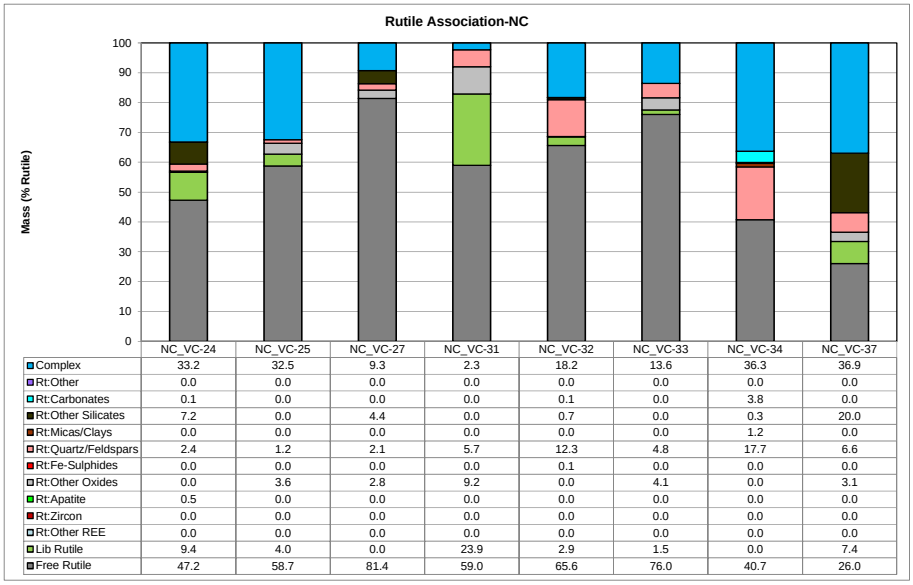
Rutile Association



	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Free Rutile	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.1

Absolute Mass of Rutile Across Samples

Mineral Name	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Free Rutile	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.1
Lib Rutile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Quartz/Feldspars	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Silicates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Rt:Carbonates	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1
Total	0.1	0.2	0.1	0.0	0.1	0.1	0.0	0.3



	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Complex	33.2	32.5	9.3	2.3	18.2	13.6	36.3	36.9
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Carbonates	0.1	0.0	0.0	0.0	0.1	0.0	3.8	0.0
Rt:Other Silicates	7.2	0.0	4.4	0.0	0.7	0.0	0.3	20.0
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0
Rt:Quartz/Feldspars	2.4	1.2	2.1	5.7	12.3	4.8	17.7	6.6
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Rt:Other Oxides	0.0	3.6	2.8	9.2	0.0	4.1	0.0	3.1
Rt:Apatite	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lib Rutile	9.4	4.0	0.0	23.9	2.9	1.5	0.0	7.4
Free Rutile	47.2	58.7	81.4	59.0	65.6	76.0	40.7	26.0

Normalized Mass of Rutile Across Samples

Mineral Name	NC_VC-24	NC_VC-25	NC_VC-27	NC_VC-31	NC_VC-32	NC_VC-33	NC_VC-34	NC_VC-37
Free Rutile	47.2	58.7	81.4	59.0	65.6	76.0	40.7	26.0
Lib Rutile	9.4	4.0	0.0	23.9	2.9	1.5	0.0	7.4
Rt:Other REE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Zircon	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Apatite	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rt:Other Oxides	0.0	3.6	2.8	9.2	0.0	4.1	0.0	3.1
Rt:Fe-Sulphides	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Rt:Quartz/Feldspars	2.4	1.2	2.1	5.7	12.3	4.8	17.7	6.6
Rt:Micas/Clays	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0
Rt:Other Silicates	7.2	0.0	4.4	0.0	0.7	0.0	0.3	20.0
Rt:Carbonates	0.1	0.0	0.0	0.0	0.1	0.0	3.8	0.0
Rt:Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Complex	33.2	32.5	9.3	2.3	18.2	13.6	36.3	36.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Liberated	56.6	62.7	81.4	82.9	68.6	77.5	40.7	33.4

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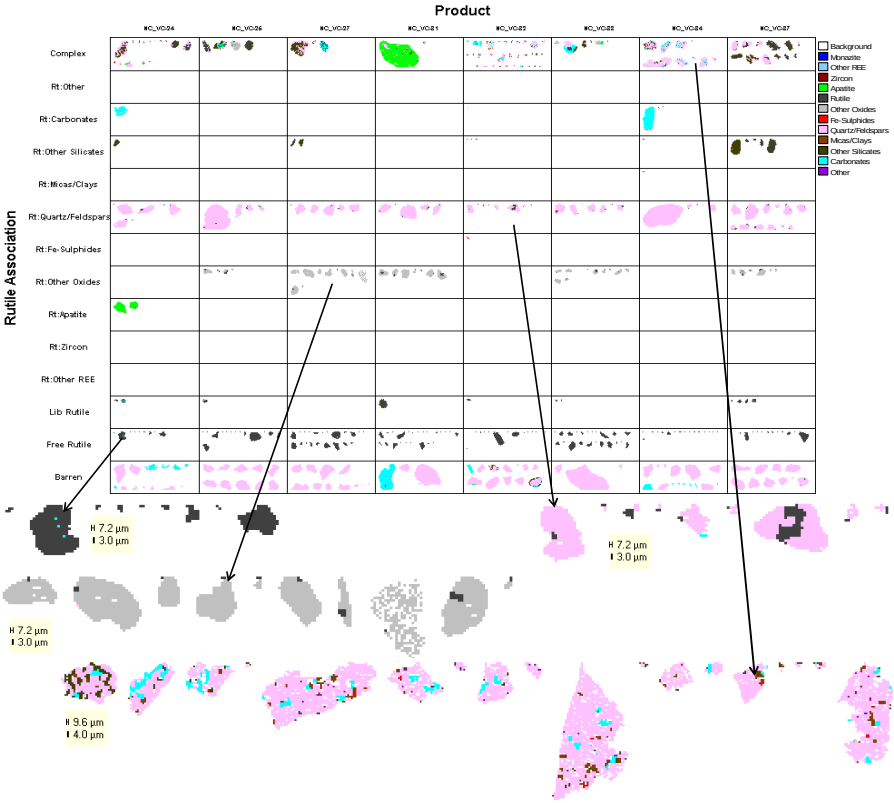
Image Grid of Rutile Association



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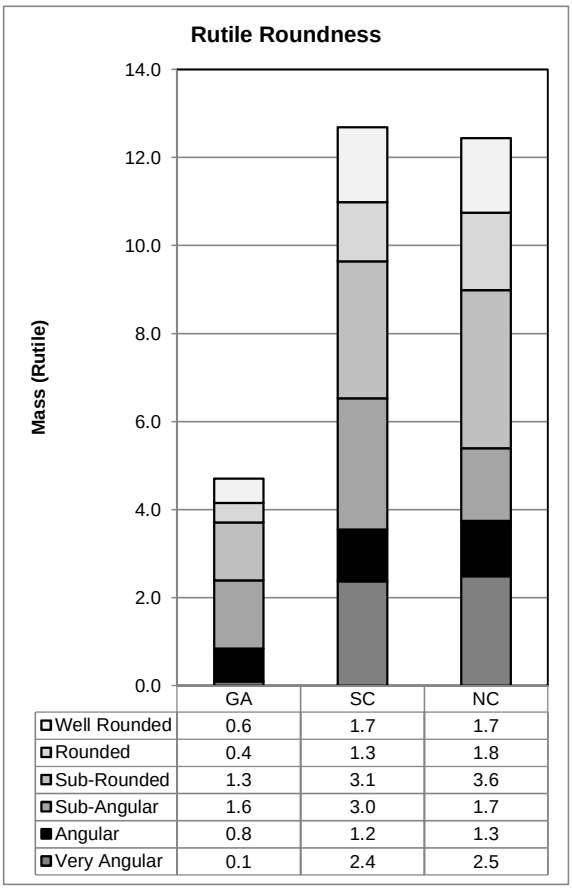
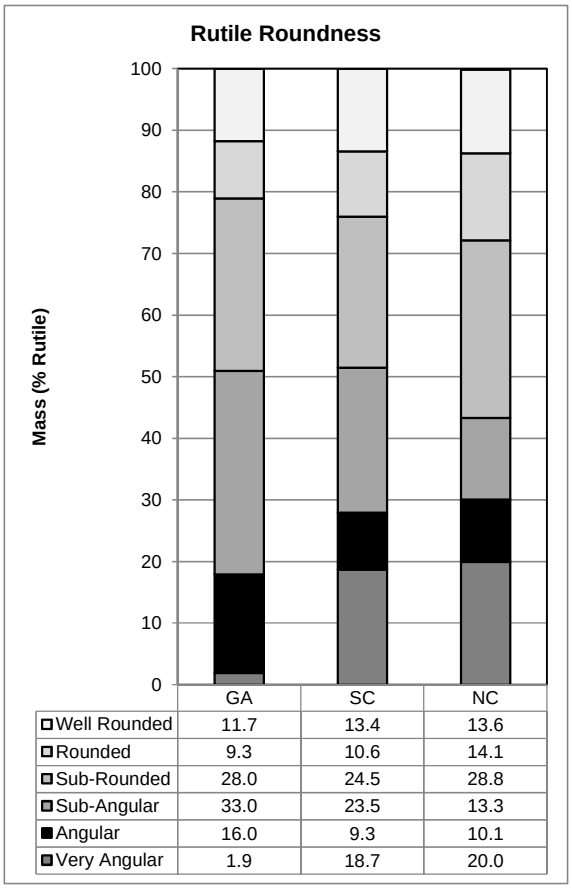
Rutile Roundness





Absolute Mass of Rutile Across Samples

Mineral Name	GA	SC	NC
Very Angular	0.1	2.4	2.5
Angular	0.8	1.2	1.3
Sub-Angular	1.6	3.0	1.7
Sub-Rounded	1.3	3.1	3.6
Rounded	0.4	1.3	1.8
Well Rounded	0.6	1.7	1.7
Other			
Total	4.7	12.7	12.5

Normalized Mass of Rutile Across Samples

Mineral Name	GA	SC	NC
Very Angular	1.9	18.7	20.0
Angular	16.0	9.3	10.1
Sub-Angular	33.0	23.5	13.3
Sub-Rounded	28.0	24.5	28.8
Rounded	9.3	10.6	14.1
Well Rounded	11.7	13.4	13.6
Other			
Total	100.0	100.0	100.0

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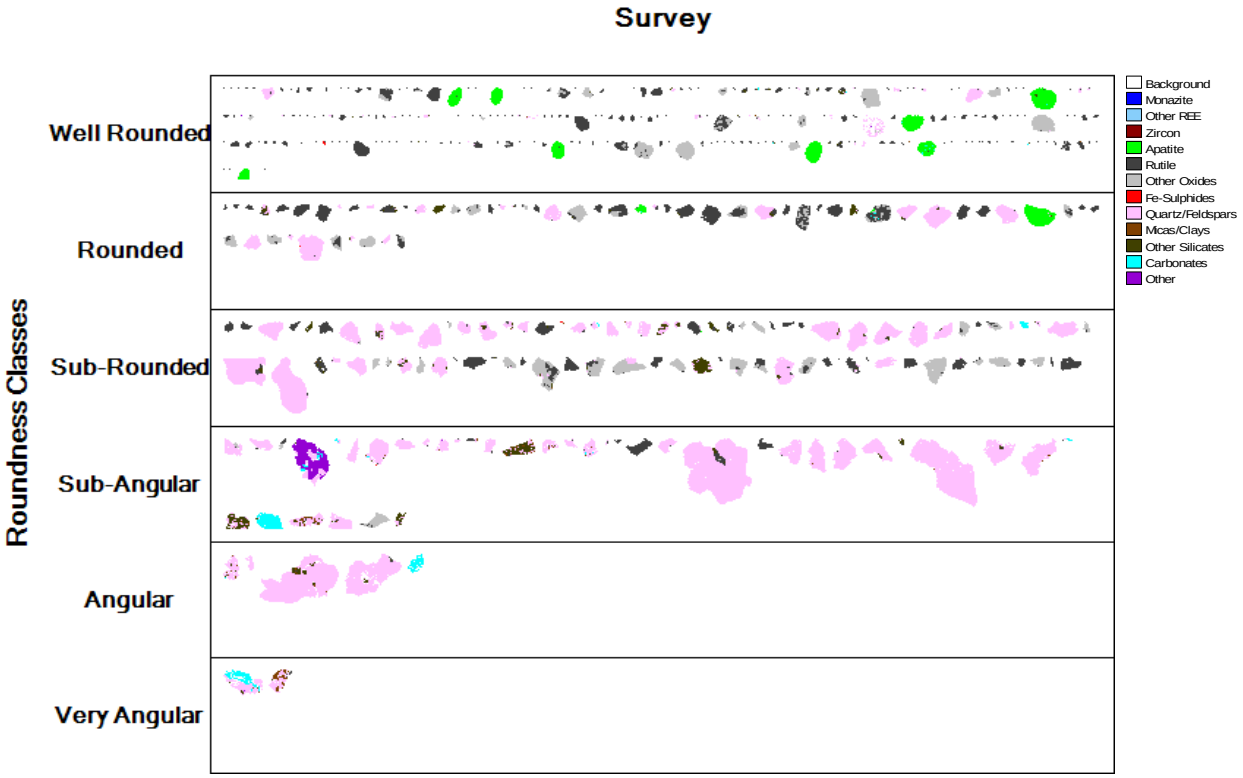
Rutile Roundness-GA



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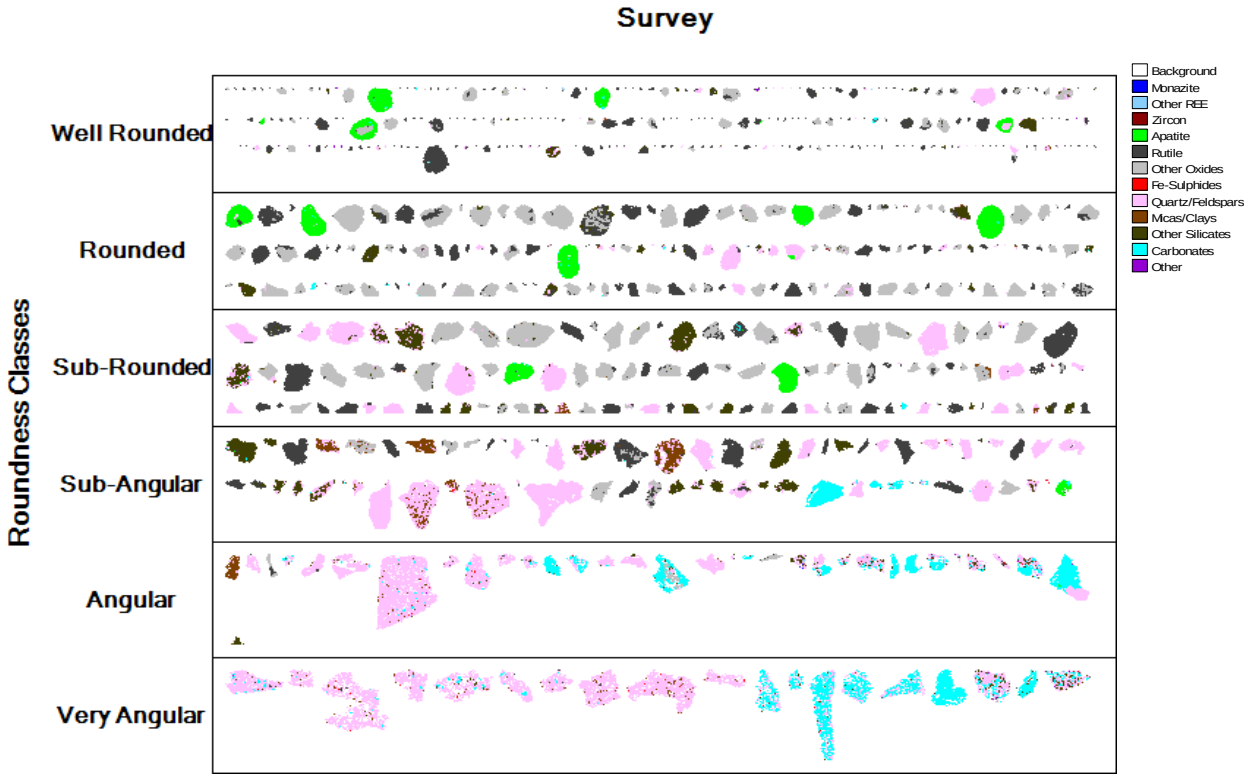
Rutile Roundness-SC



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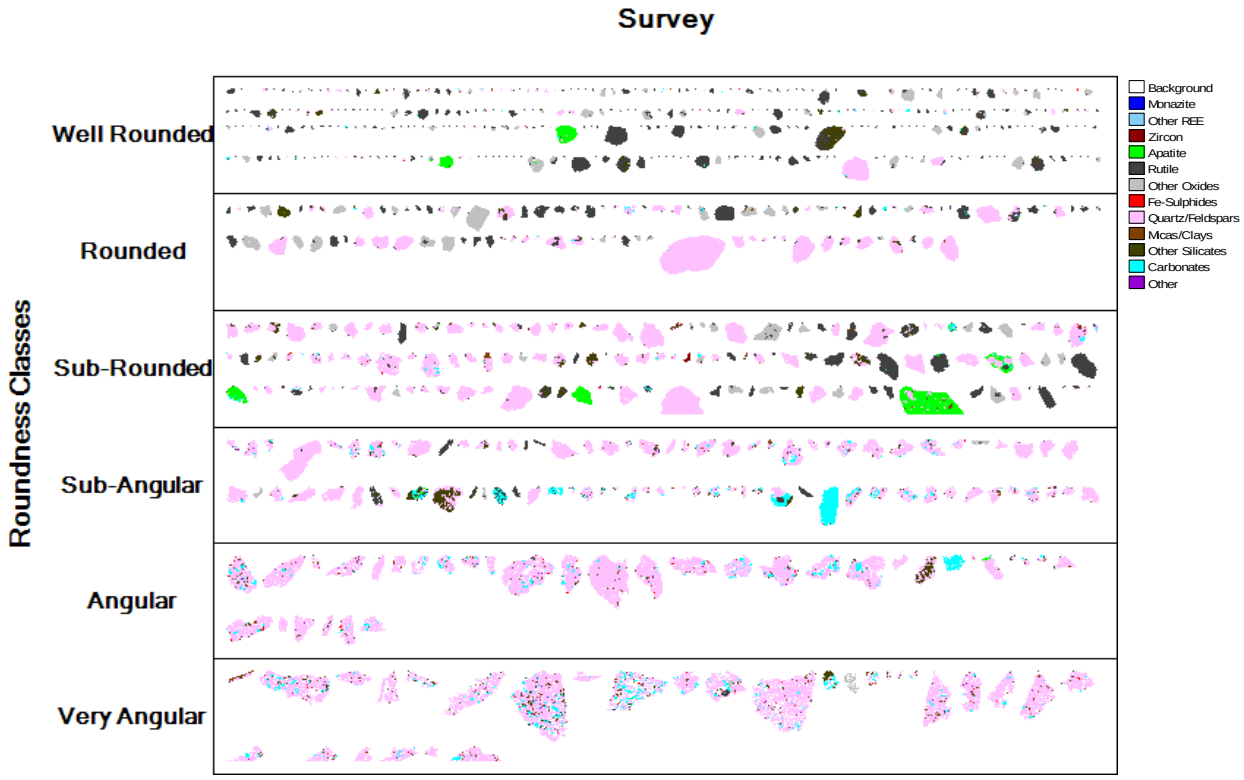
Rutile Roundness-NC



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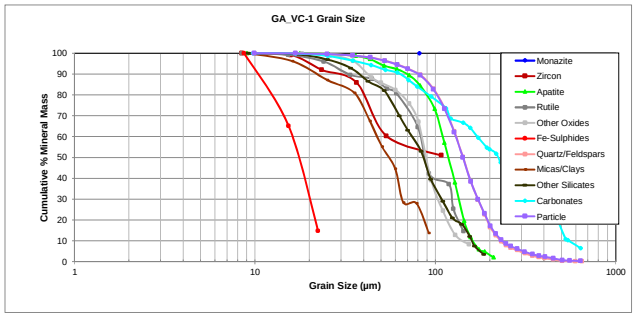
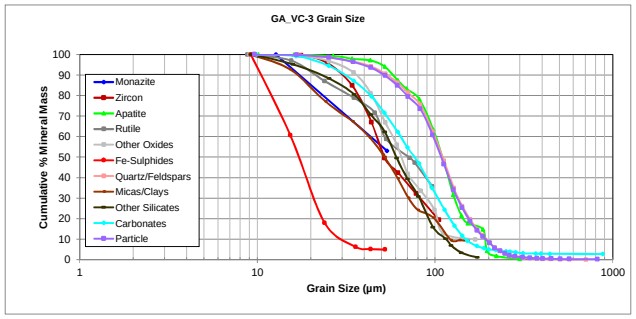
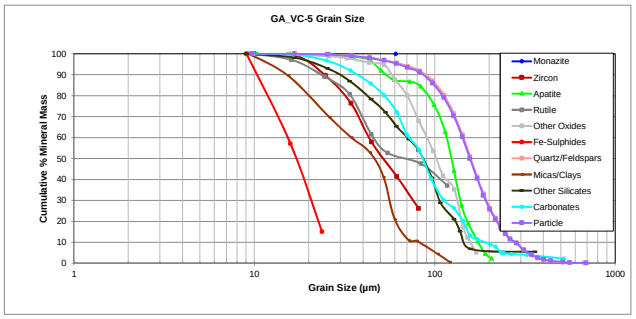
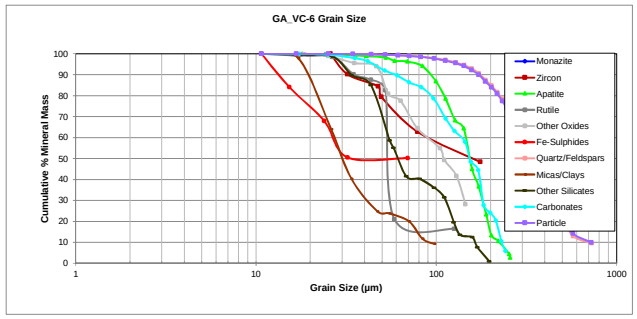
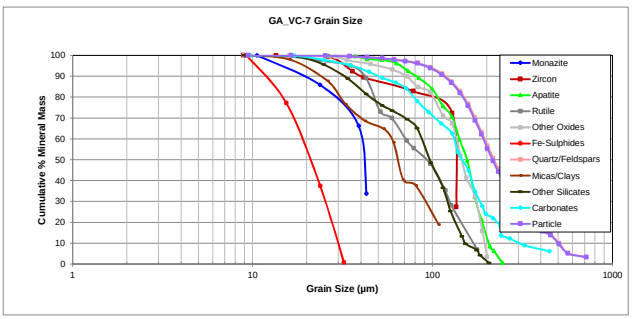
Cumulative Grain Size Distribution

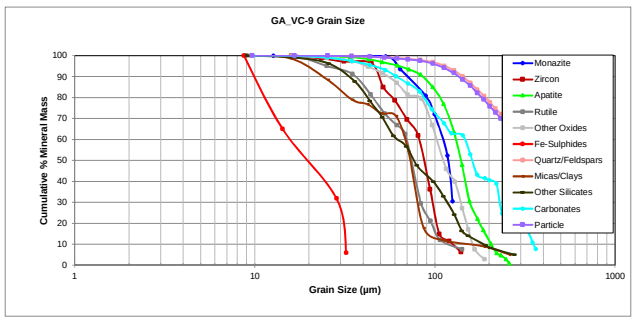












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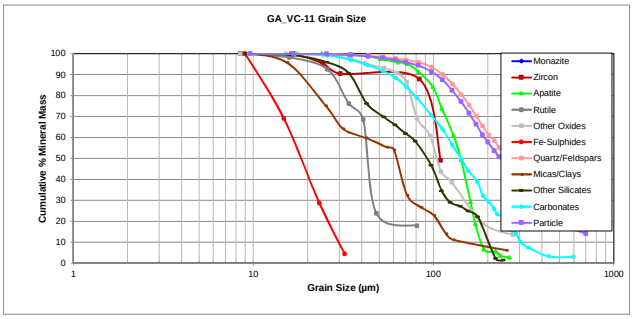
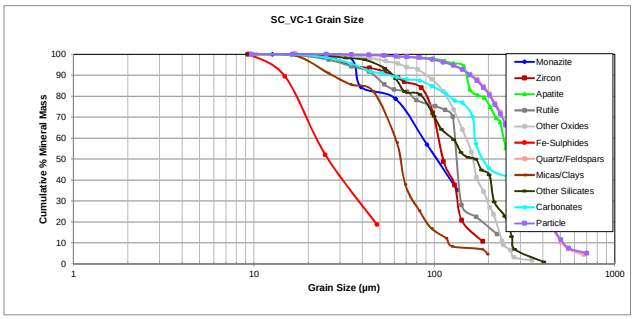
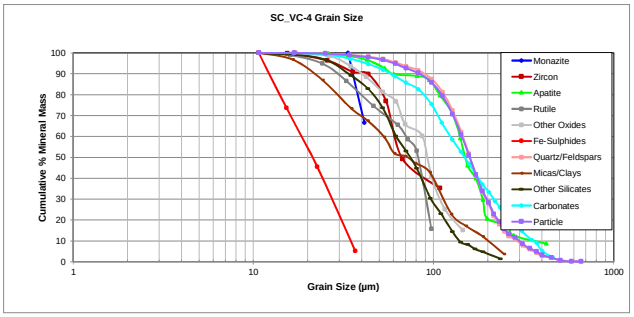
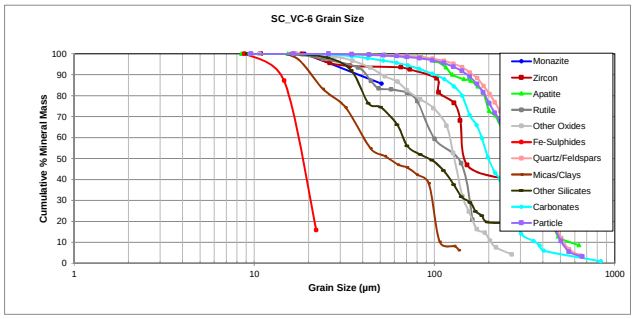
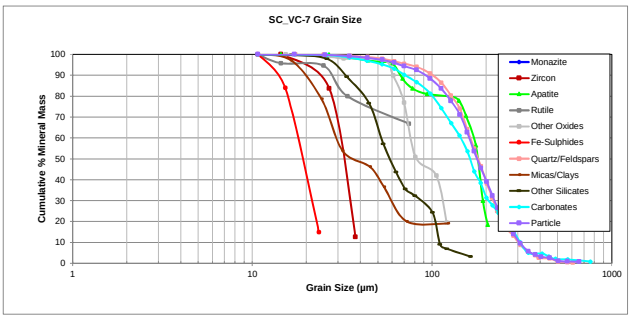
Cumulative Grain Size Distribution

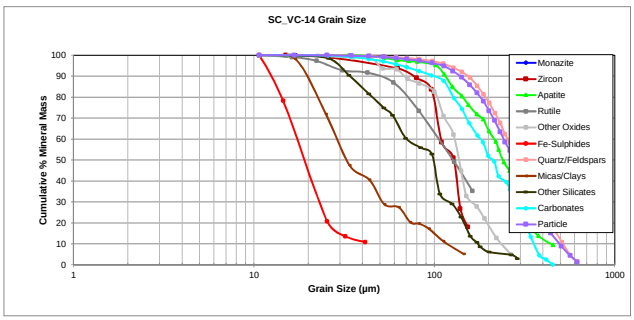












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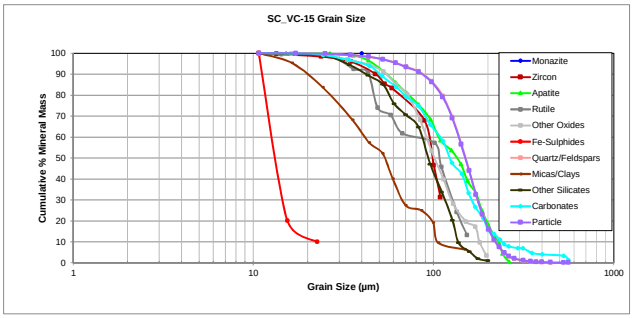
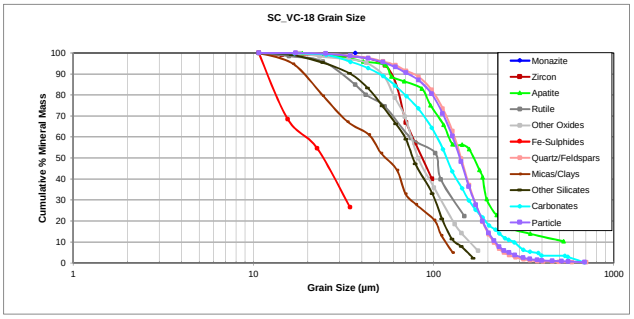
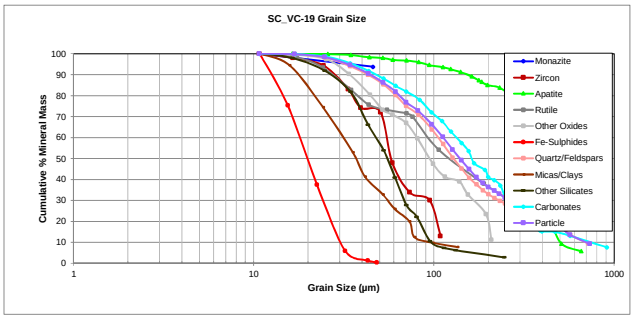
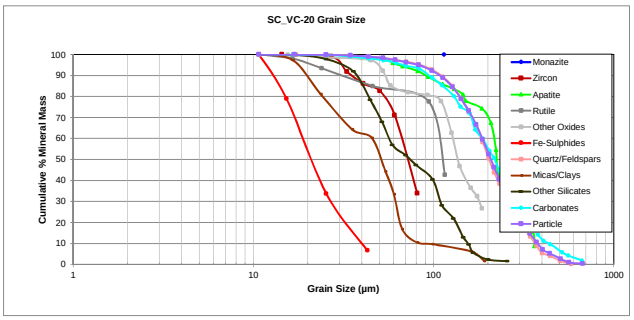
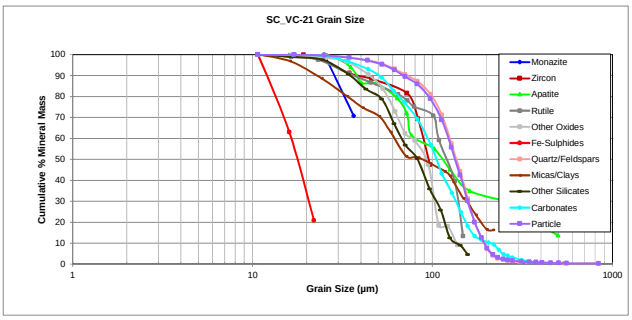
Cumulative Grain Size Distribution

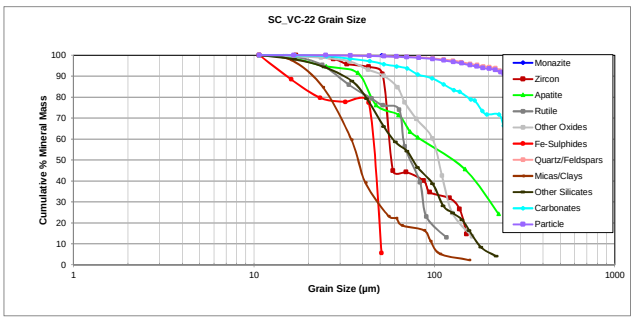












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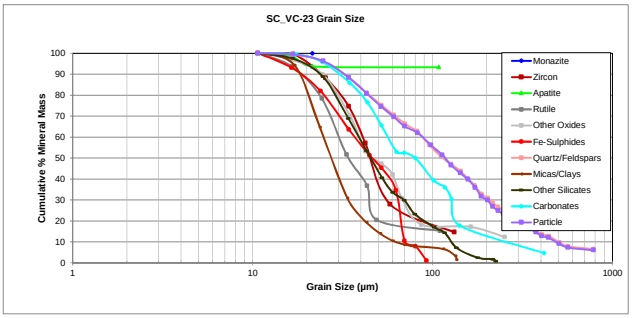
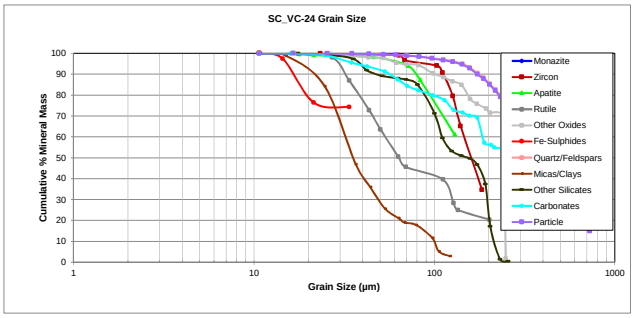
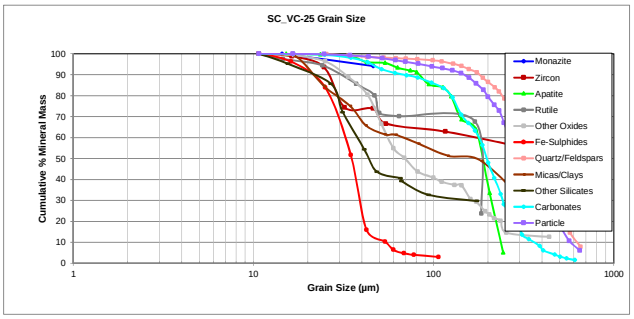
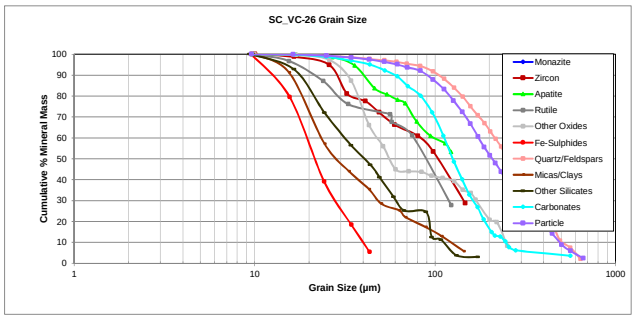
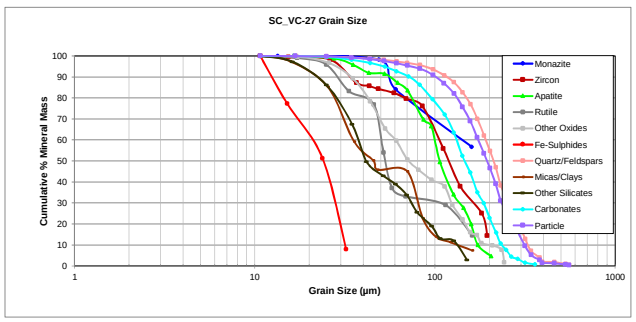
Cumulative Grain Size Distribution

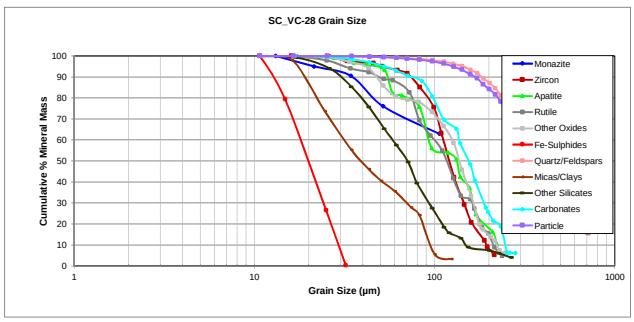












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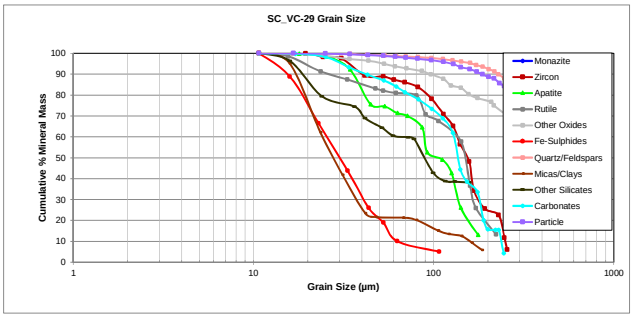
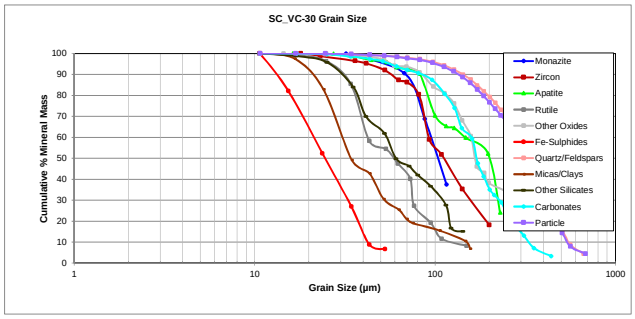
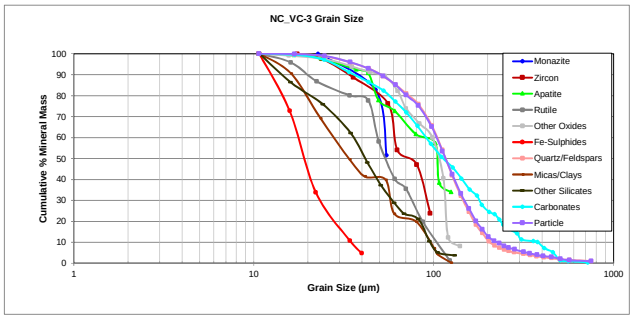
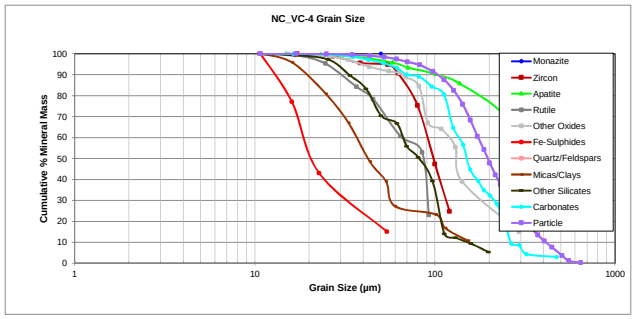
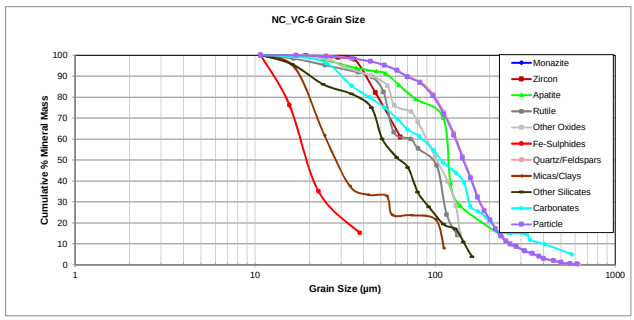
Cumulative Grain Size Distribution

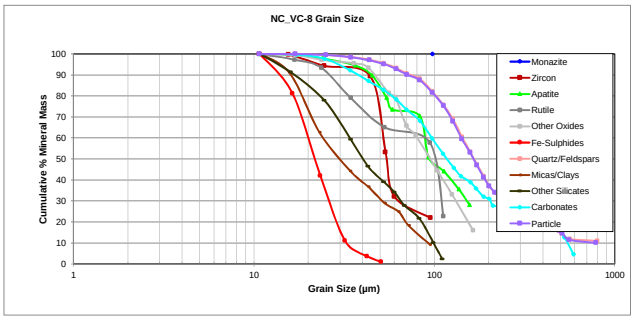












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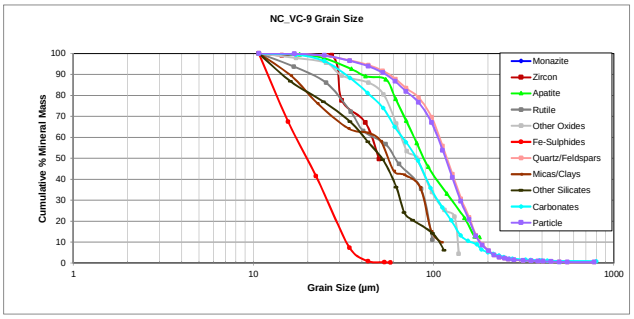
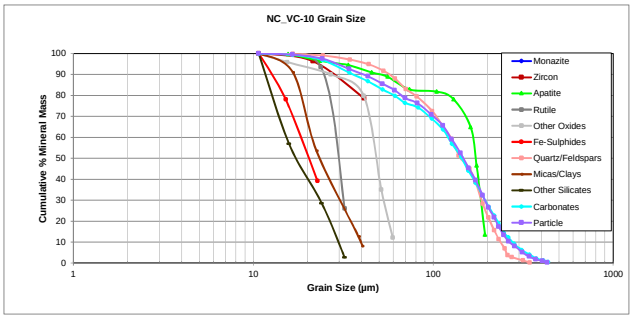
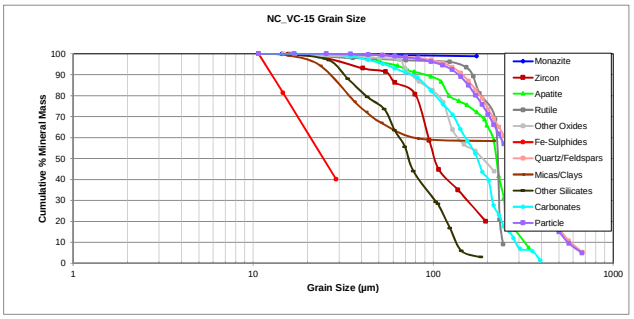
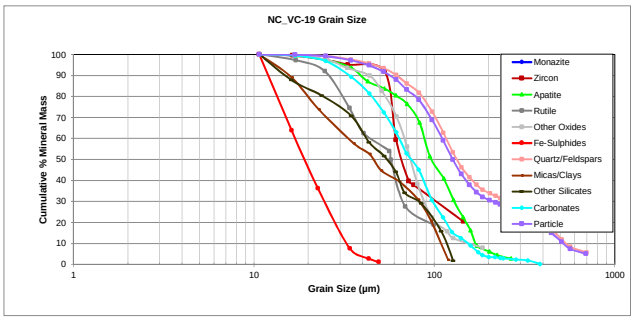
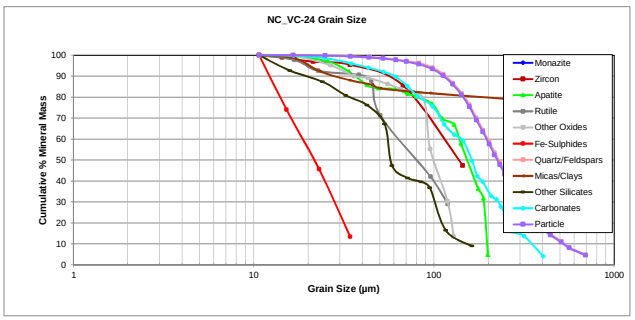
Cumulative Grain Size Distribution

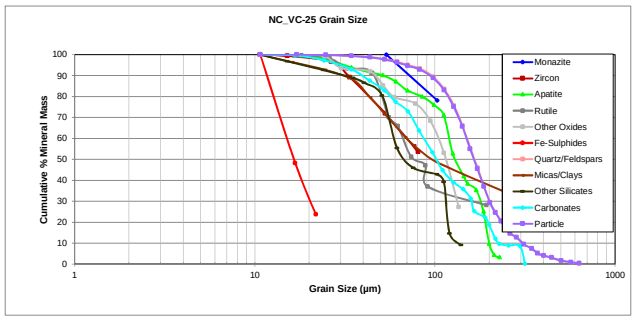












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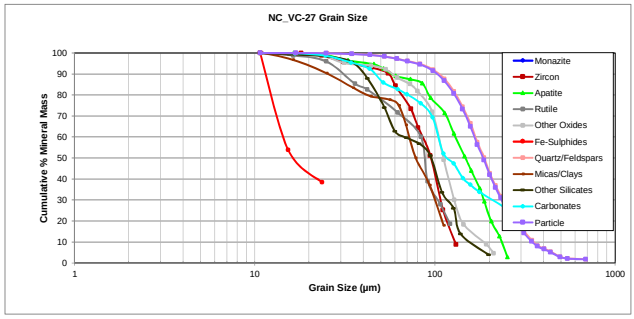
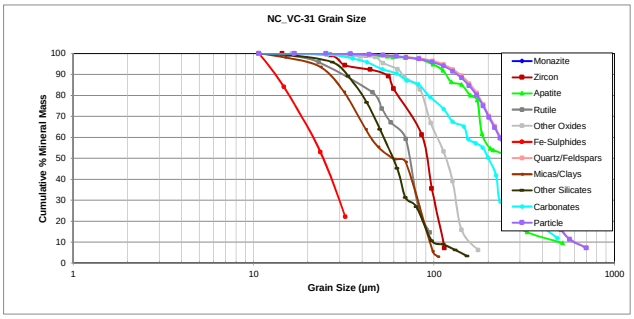
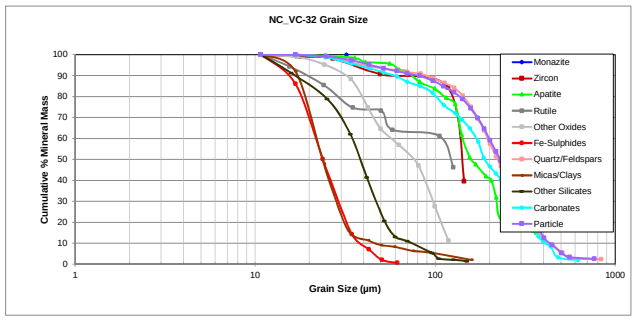
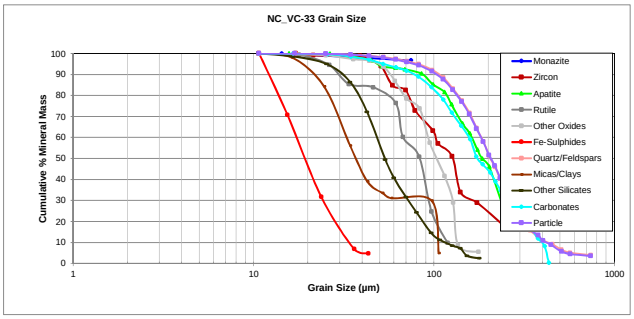
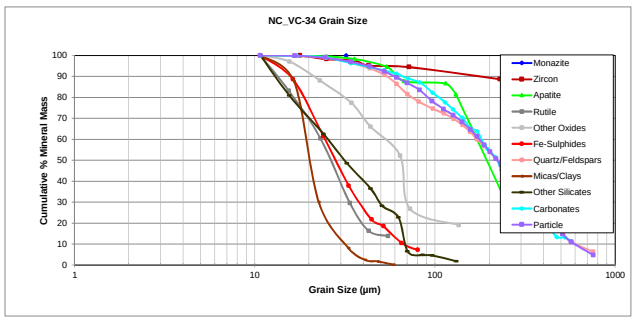
Cumulative Grain Size Distribution

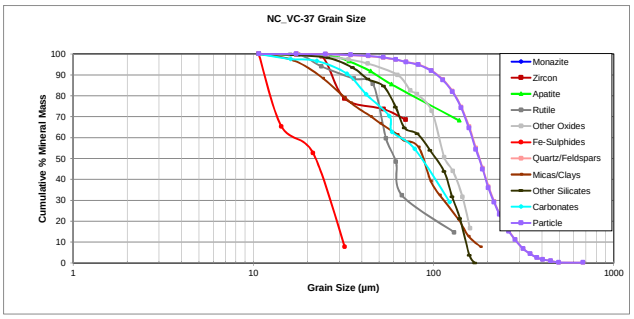












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Cumulative Grain Size Distribution

Sample	D50										
	Monazite	Zircon	Apatite	Rutile	Other Oxides	Fe-Sulphides	Quartz/ Feldspars	Micas/ Clays	Other Silicates	Carbonates	Particle
GA_VC-1	-	108	118	87	89	18	142	55	86	223	142
GA_VC-3	54	52	110	71	65	17	110	52	60	77	108
GA_VC-5	-	52	124	69	102	16	158	46	86	86	157
GA_VC-6	-	175	153	52	110	32	354	30	61	153	351
GA_VC-7	42	134	156	93	145	21	220	64	97	146	215
GA_VC-9	117	87	140	74	111	20	368	73	76	161	352
GA_VC-11	-	110	142	43	104	19	264	62	92	142	236
SC_VC-1	104	112	283	133	164	25	305	65	169	185	303
SC_VC-4	-	66	150	81	92	21	160	72	74	149	159
SC_VC-6	-	146	308	136	129	19	323	56	93	199	304
SC_VC-7	-	33	180	-	82	20	181	36	58	163	178
SC_VC-14	-	129	240	127	137	20	296	33	99	212	279
SC_VC-15	-	99	135	108	101	13	151	54	93	123	150
SC_VC-18	-	87	168	104	82	25	142	54	77	118	140
SC_VC-19	-	58	340	122	95	20	128	37	55	162	140
SC_VC-20	-	72	224	112	136	21	203	51	74	218	208
SC_VC-21	-	95	114	121	93	18	136	89	83	105	134
SC_VC-22	-	58	129	74	105	47	540	38	76	313	535
SC_VC-23	-	44	-	34	46	46	114	28	45	80	118
SC_VC-24	-	160	-	64	243	-	360	36	155	357	354
SC_VC-25	-	272	188	181	69	35	379	171	44	197	319
SC_VC-26	-	91	123	104	56	22	253	28	41	125	208
SC_VC-27	160	119	106	53	71	24	212	46	42	146	195
SC_VC-28	-	121	133	117	137	20	389	39	71	155	380
SC_VC-29	-	155	107	150	-	30	523	28	90	137	500
SC_VC-30	105	112	197	59	167	25	333	34	61	170	319
NC_VC-3	55	74	105	54	108	19	117	34	42	113	116
NC_VC-4	-	98	256	85	132	20	197	42	82	150	197
NC_VC-6	-	-	118	98	102	19	145	28	63	108	143
NC_VC-8	-	54	94	101	95	22	166	30	40	117	165
NC_VC-9	-	50	88	61	81	20	119	56	52	81	117
NC_VC-10	-	-	172	30	48	21	142	24	17	144	147
NC_VC-15	-	101	225	229	138	25	296	217	73	176	281
NC_VC-19	-	66	96	57	74	19	133	46	55	74	126
NC_VC-24		144	154	82	99	22	229	-	57	162	225
NC_VC-25	-	81	129	76	112	17	166	95	67	102	165
NC_VC-27	-	95	148	88	111	15	188	78	96	116	185
NC_VC-31	-	92	257	74	117	24	274	59	59	200	274
NC_VC-32	-	141	158	122	77	24	222	24	38	188	229
NC_VC-33	-	128	185	84	104	19	206	37	53	174	206
NC_VC-34	-	-	205	27	65	28	223	20	31	221	221
NC_VC-37	-	-	-	61	115	21	180	88	103	78	179
Average	**91**	**102**	**166**	**90**	**105**	**23**	**232**	**55**	**71**	**155**	**225**
Minimum	42	33	88	27	46	13	110	20	17	74	108
Maximum	160	272	340	229	243	47	540	217	169	357	535

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Modals

Survey		CALR-16225-001 / MI5017-SEP17				
Project		South Carolina Department of Natural Resources				
Sample		GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Fraction		HLS Sink	HLS Sink	HLS Sink	HLS Sink	HLS Sink
Calculated ESD Particle Size		58	90	330	107	96
Mineral Mass (%)	Monazite	0.54	0.86	0.03	0.19	0.32
	Synchysite/Bastnaesite	0.00	0.01	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00
	Zircon	3.59	4.15	0.74	8.98	4.33
	Apatite	7.07	4.97	13.0	10.7	0.29
	Fe-Oxides	0.05	0.03	3.55	0.14	0.55
	Rutile	5.16	5.11	4.86	7.34	6.32
	Ilmenite	22.3	27.4	11.5	40.1	43.3
	Other Oxides	0.00	0.00	0.02	0.01	0.00
	Fe-Sulphides	0.08	0.02	0.26	0.02	0.05
	Quartz	7.64	3.10	3.34	3.30	4.72
	Plagioclase	2.88	2.39	7.45	2.63	3.16
	K-Feldspar	0.93	0.16	0.03	0.04	0.54
	Biotite	0.07	0.04	0.18	0.01	0.21
	Muscovite	0.22	0.08	0.01	0.01	0.22
	Clays	3.97	4.39	7.55	3.52	2.20
	Chlorite	0.21	0.37	5.51	1.12	1.16
	Amphibole	12.1	19.5	1.46	1.99	15.5
	Epidote	23.1	23.4	2.72	5.83	10.8
	Grossular	1.07	1.73	33.5	11.3	2.75
	Titanite	0.51	0.58	0.05	0.50	0.55
	Other Silicates	0.24	0.20	0.03	0.18	2.37
	Calcite	7.46	1.23	0.14	0.83	0.06
	Ankerite	0.52	0.23	4.01	1.20	0.12
	Dolomite	0.20	0.03	0.00	0.00	0.57
	Fluorite	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00
	Other	0.02	0.01	0.01	0.02	0.01
	Total	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	50	69	39	73	82
	Synchysite/Bastnaesite	17	18	19	19	14
	Other REE	14	12	32	15	13
	Zircon	49	74	105	89	83
	Apatite	78	112	211	118	82
	Fe-Oxides	20	16	164	21	46
	Rutile	48	63	185	70	62
	Ilmenite	56	77	140	96	87
	Other Oxides	0	11	18	14	11
	Fe-Sulphides	16	21	85	16	66
	Quartz	32	27	38	30	37
	Plagioclase	29	31	41	30	39
	K-Feldspar	31	34	28	24	33
	Biotite	25	16	36	18	22
	Muscovite	27	23	21	14	22
	Clays	49	64	150	64	64
	Chlorite	26	28	45	34	25
	Amphibole	55	80	120	68	74
	Epidote	52	72	71	70	63
	Grossular	33	37	97	59	37
	Titanite	27	29	27	40	38
	Other Silicates	22	24	23	36	38
	Calcite	47	65	62	54	34
	Ankerite	27	25	94	35	14
	Dolomite	45	41	14	36	55
	Fluorite	0	0	0	0	0
	Gypsum/Anhydrite	21	13	14	11	14
	Phosphates	12	14	17	11	11
	Other	11	17	17	11	11

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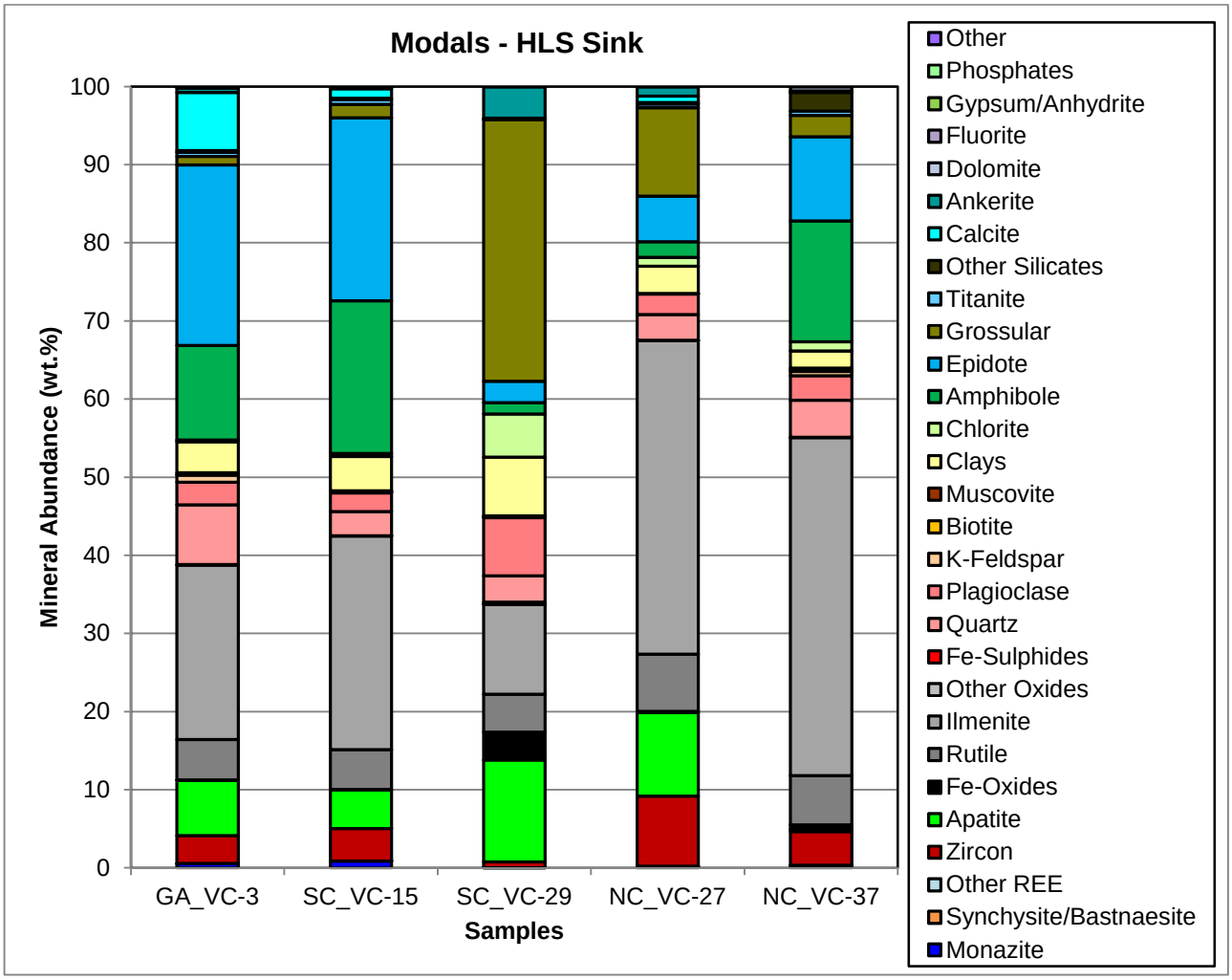
Modal Chart



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Modals

Survey		CALR-16225-001 / MI5017-SEP17									
Project		South Carolina Department of Natural Resources									
Sample		GA_VC-3		SC_VC-15		SC_VC-29		NC_VC-27		NC_VC-37	
Fraction		Head	HLS Sink	Head	HLS Sink	Head	HLS Sink	Head	HLS Sink	Head	HLS Sink
Calculated ESD Particle Size		83	58	125	90	334	330	158	107	152	96
Mineral Mass (%)	Monazite	0.00	0.54	0.00	0.86	0.00	0.03	0.00	0.19	0.00	0.32
	Synchysite/Bastnaesite	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	Other REE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Zircon	0.10	3.59	0.07	4.15	0.17	0.74	0.19	8.98	0.02	4.33
	Apatite	1.68	7.07	2.21	4.97	0.08	13.0	1.24	10.7	0.04	0.29
	Fe-Oxides	0.00	0.05	0.01	0.03	0.77	3.55	0.01	0.14	0.01	0.55
	Rutile	0.18	5.16	0.17	5.11	0.06	4.86	0.14	7.34	0.26	6.32
	Ilmenite	0.58	22.3	0.75	27.4	0.24	11.5	0.99	40.1	0.70	43.3
	Other Oxides	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.01	0.00	0.00
	Fe-Sulphides	0.08	0.08	0.00	0.02	0.05	0.26	0.00	0.02	0.01	0.05
	Quartz	77.0	7.64	82.4	3.10	92.4	3.34	90.7	3.30	89.2	4.72
	Plagioclase	6.07	2.88	3.59	2.39	0.34	7.45	1.98	2.63	4.41	3.16
	K-Feldspar	6.63	0.93	5.03	0.16	0.25	0.03	1.87	0.04	3.68	0.54
	Biotite	0.07	0.07	0.05	0.04	0.06	0.18	0.00	0.01	0.14	0.21
	Muscovite	0.15	0.22	0.04	0.08	0.00	0.01	0.00	0.01	0.09	0.22
	Clays	0.21	3.97	0.19	4.39	0.02	7.55	0.14	3.52	0.18	2.20
	Chlorite	0.03	0.21	0.07	0.37	0.04	5.51	0.02	1.12	0.10	1.16
	Amphibole	0.77	12.1	1.22	19.5	0.08	1.46	0.15	1.99	0.48	15.5
	Epidote	0.94	23.1	0.88	23.4	0.18	2.72	0.28	5.83	0.49	10.8
	Grossular	0.05	1.07	0.08	1.73	0.52	33.5	0.24	11.3	0.06	2.75
	Titanite	0.01	0.51	0.02	0.58	0.00	0.05	0.01	0.50	0.00	0.55
	Other Silicates	0.06	0.24	0.01	0.20	0.04	0.03	0.02	0.18	0.06	2.37
	Calcite	5.15	7.46	3.12	1.23	4.54	0.14	1.85	0.83	0.01	0.06
	Ankerite	0.09	0.52	0.10	0.23	0.13	4.01	0.15	1.20	0.00	0.12
	Dolomite	0.09	0.20	0.01	0.03	0.01	0.00	0.00	0.00	0.04	0.57
	Fluorite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Gypsum/Anhydrite	0.03	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00
	Phosphates	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.02	0.02	0.00	0.01	0.02	0.01	0.01	0.02	0.01	0.01
	Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Mean Grain Size by Frequency (µm)	Monazite	21	50	40	69	0	39	0	73	0	82
	Synchysite/Bastnaesite	17	17	21	18	27	19	0	19	19	14
	Other REE	22	14	0	12	18	32	21	15	14	13
	Zircon	42	49	68	74	96	105	69	89	44	83
	Apatite	87	78	96	112	64	211	101	118	80	82
	Fe-Oxides	12	20	20	16	177	164	18	21	15	46
	Rutile	39	48	65	63	65	185	54	70	48	62
	Ilmenite	53	56	82	77	108	140	92	96	90	87
	Other Oxides	0	0	11	11	11	18	21	14	11	11
	Fe-Sulphides	13	16	12	21	22	85	15	16	16	66
	Quartz	86	32	121	27	356	38	155	30	147	37
	Plagioclase	47	29	84	31	40	41	86	30	98	39
	K-Feldspar	63	31	103	34	60	28	121	24	98	33
	Biotite	23	25	31	16	23	36	23	18	64	22
	Muscovite	23	27	26	23	20	21	18	14	26	22
	Clays	28	49	54	64	39	150	67	64	57	64
	Chlorite	15	26	17	28	20	45	19	34	25	25
	Amphibole	41	55	66	80	35	120	64	68	67	74
	Epidote	38	52	67	72	16	71	70	70	64	63
	Grossular	29	33	39	37	91	97	46	59	22	37
	Titanite	34	27	62	29	39	27	34	40	50	38
	Other Silicates	15	22	13	24	13	23	19	36	35	38
	Calcite	54	47	93	65	86	62	93	54	33	34
	Ankerite	22	27	30	25	27	94	41	35	11	14
	Dolomite	59	45	38	41	34	14	33	36	66	55
	Fluorite	11	0	26	0	12	0	21	0	0	0
	Gypsum/Anhydrite	115	21	21	13	126	14	25	11	0	14
	Phosphates	14	12	0	14	12	17	11	11	0	11
	Other	9	11	11	17	11	17	15	11	12	11

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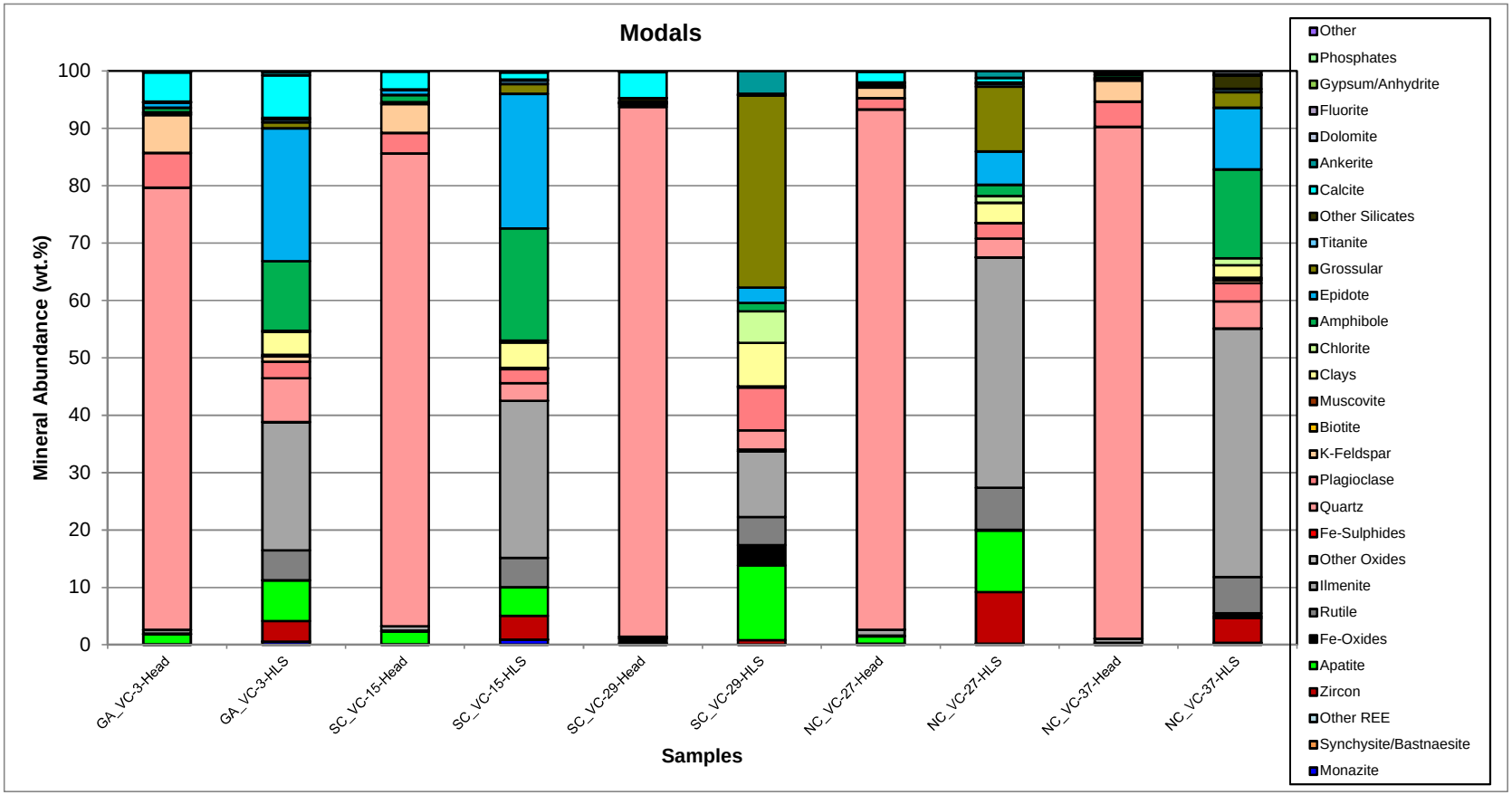
Modal Chart



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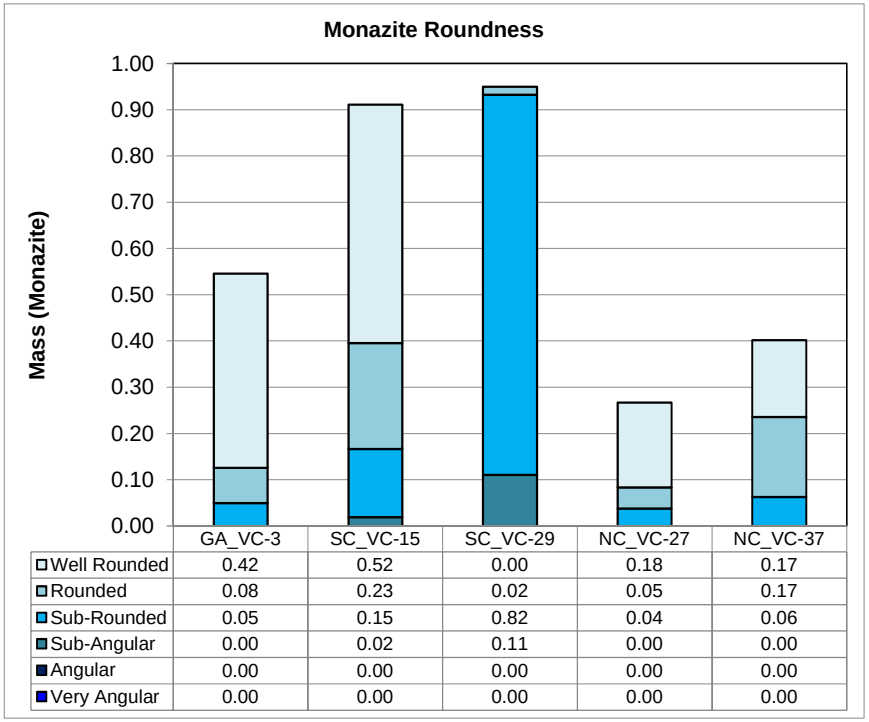
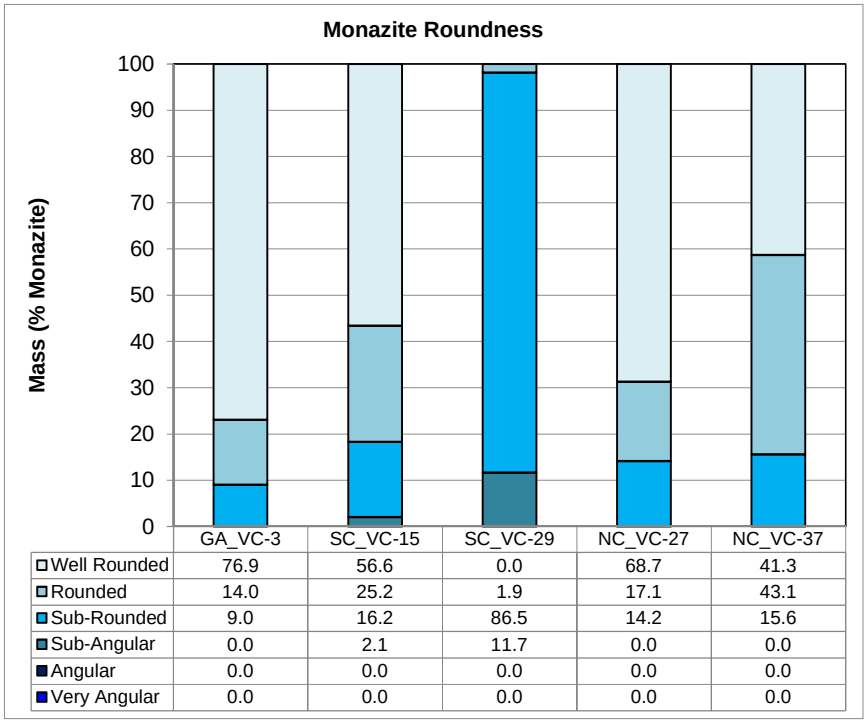
Monazite Roundness



	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Well Rounded	0.42	0.52	0.00	0.18	0.17
Rounded	0.08	0.23	0.02	0.05	0.17
Sub-Rounded	0.05	0.15	0.82	0.04	0.06
Sub-Angular	0.00	0.02	0.11	0.00	0.00
Angular	0.00	0.00	0.00	0.00	0.00
Very Angular	0.00	0.00	0.00	0.00	0.00



	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Well Rounded	76.9	56.6	0.0	68.7	41.3
Rounded	14.0	25.2	1.9	17.1	43.1
Sub-Rounded	9.0	16.2	86.5	14.2	15.6
Sub-Angular	0.0	2.1	11.7	0.0	0.0
Angular	0.0	0.0	0.0	0.0	0.0
Very Angular	0.0	0.0	0.0	0.0	0.0

Absolute Mass of Monazite Across Samples

Mineral Name	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Very Angular	0.00	0.00	0.00	0.00	0.00
Angular	0.00	0.00	0.00	0.00	0.00
Sub-Angular	0.00	0.02	0.11	0.00	0.00
Sub-Rounded	0.05	0.15	0.82	0.04	0.06
Rounded	0.08	0.23	0.02	0.05	0.17
Well Rounded	0.42	0.52	0.00	0.18	0.17
Total	0.55	0.91	0.95	0.27	0.40

Normalized Mass of Monazite Across Samples

Mineral Name	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Very Angular	0.0	0.0	0.0	0.0	0.0
Angular	0.0	0.0	0.0	0.0	0.0
Sub-Angular	0.0	2.1	11.7	0.0	0.0
Sub-Rounded	9.0	16.2	86.5	14.2	15.6
Rounded	14.0	25.2	1.9	17.1	43.1
Well Rounded	76.9	56.6	0.0	68.7	41.3
Total	100.0	100.0	100.0	100.0	100.0

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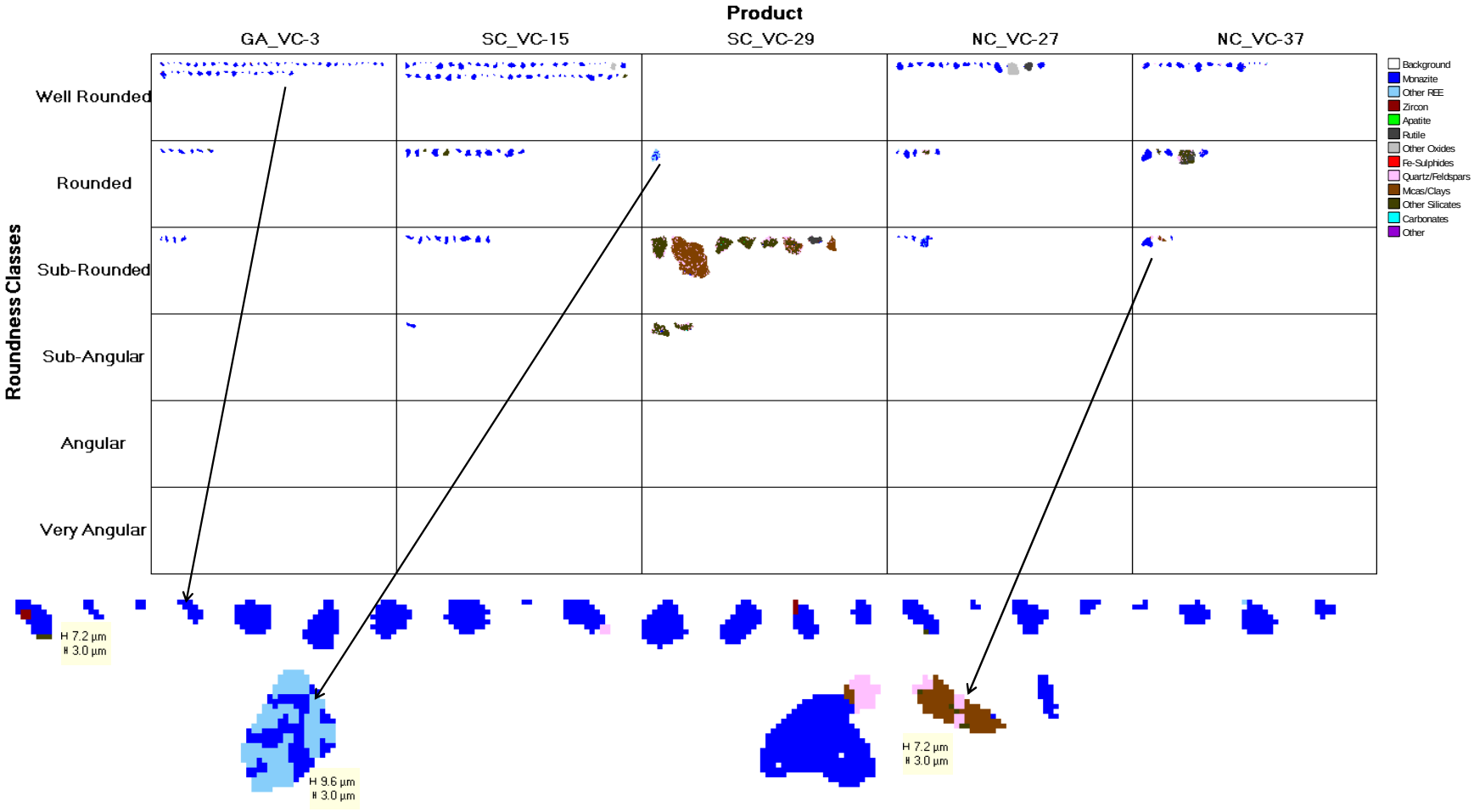
Image Grid of Monazite Roundness



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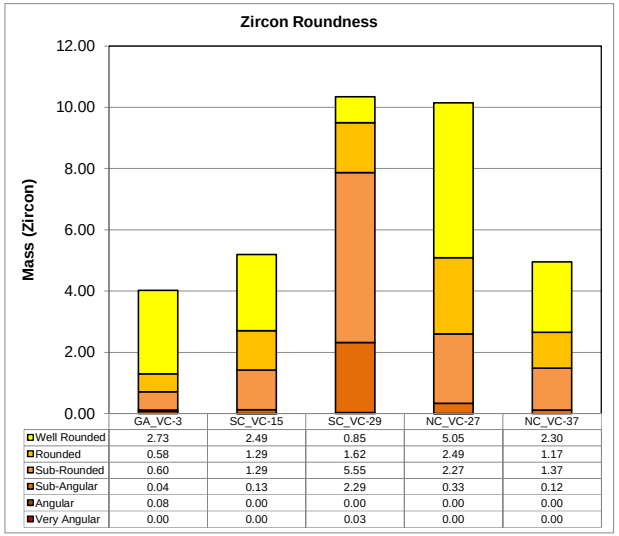
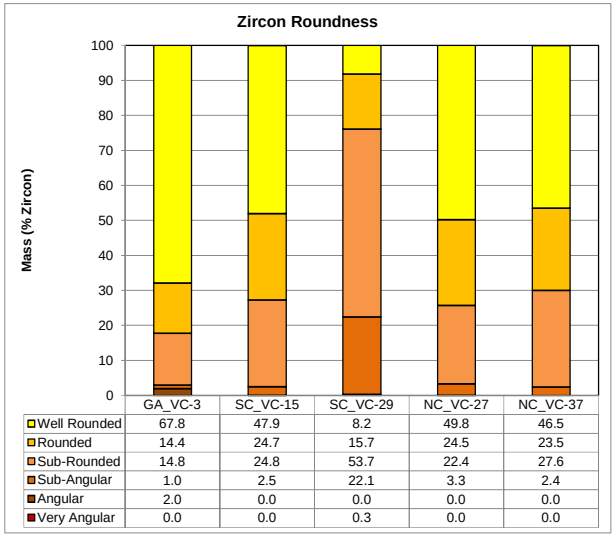
Zircon Roundness



	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Well Rounded	2.73	2.49	0.85	5.05	2.30
Rounded	0.58	1.29	1.62	2.49	1.17
Sub-Rounded	0.60	1.29	5.55	2.27	1.37
Sub-Angular	0.04	0.13	2.29	0.33	0.12
Angular	0.08	0.00	0.00	0.00	0.00
Very Angular	0.00	0.00	0.03	0.00	0.00



	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Well Rounded	67.8	47.9	8.2	49.8	46.5
Rounded	14.4	24.7	15.7	24.5	23.5
Sub-Rounded	14.8	24.8	53.7	22.4	27.6
Sub-Angular	1.0	2.5	22.1	3.3	2.4
Angular	2.0	0.0	0.0	0.0	0.0
Very Angular	0.0	0.0	0.3	0.0	0.0

Absolute Mass of Zircon Across Samples

Mineral Name	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Very Angular	0.00	0.00	0.03	0.00	0.00
Angular	0.08	0.00	0.00	0.00	0.00
Sub-Angular	0.04	0.13	2.29	0.33	0.12
Sub-Rounded	0.60	1.29	5.55	2.27	1.37
Rounded	0.58	1.29	1.62	2.49	1.17
Well Rounded	2.73	2.49	0.85	5.05	2.30
Total	4.03	5.20	10.35	10.15	4.95

Normalized Mass of Zircon Across Samples

Mineral Name	GA_VC-3	SC_VC-15	SC_VC-29	NC_VC-27	NC_VC-37
Very Angular	0.0	0.0	0.3	0.0	0.0
Angular	2.0	0.0	0.0	0.0	0.0
Sub-Angular	1.0	2.5	22.1	3.3	2.4
Sub-Rounded	14.8	24.8	53.7	22.4	27.6
Rounded	14.4	24.7	15.7	24.5	23.5
Well Rounded	67.8	47.9	8.2	49.8	46.5
Total	100.0	100.0	100.0	100.0	100.0

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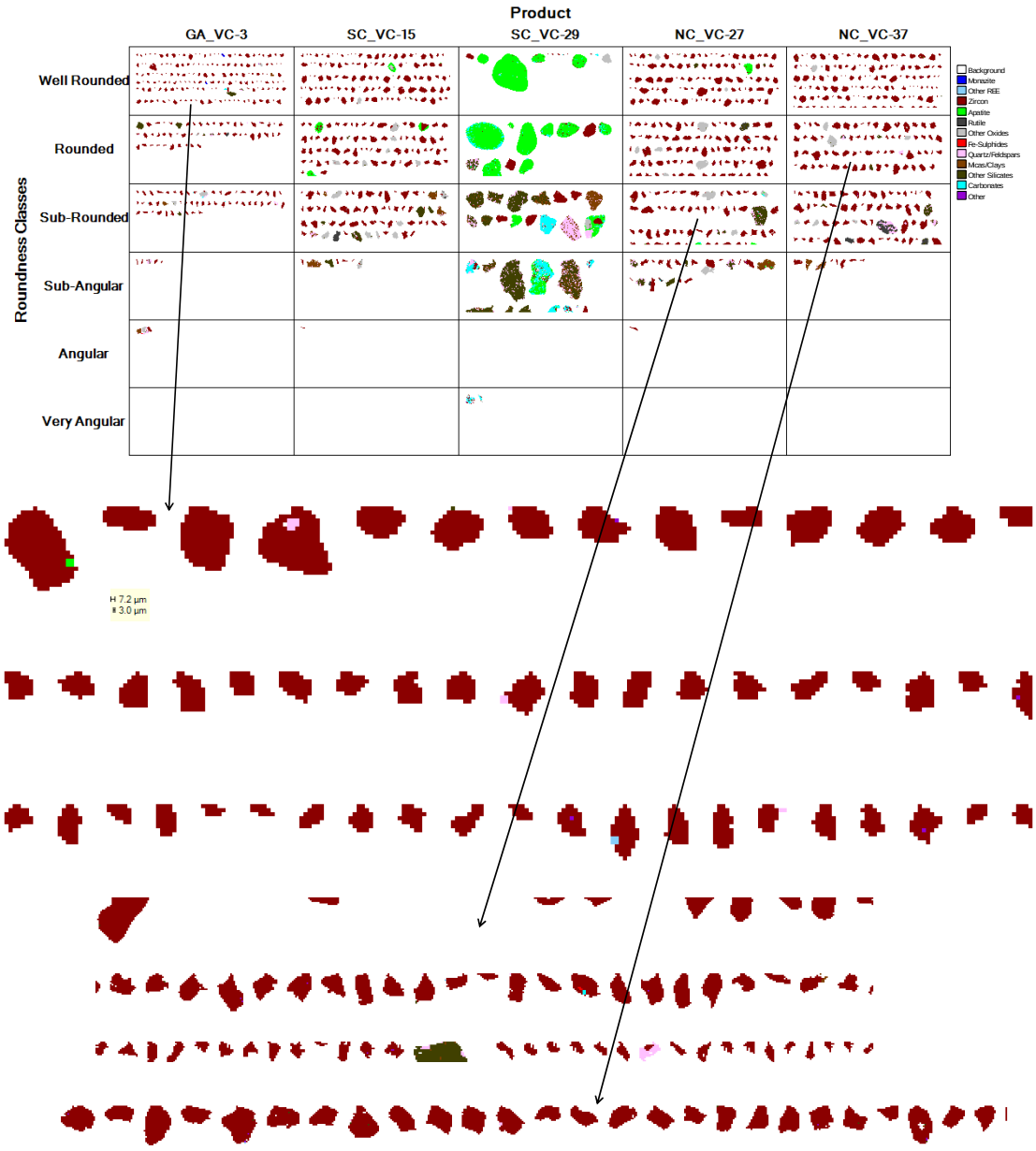
Image Grid of Zircon Roundness



Appendix D – Data from EPMA

No. Analyses	GA_VC-3/Oxide	P2O5	SiO2	ThO2	UO2	Y2O3	La2O3	Ce2O3	Pr2O3	Nd2O3	Sm2O3	Gd2O3	Tb2O3	Dy2O3	Er2O3	CaO	Total
1	Monazite	28.16	1.17	9.64	0.75	1.50	12.41	25.95	2.98	11.53	2.35	1.92	0.23	0.65	0.06	1.18	100.46
2	Monazite	30.15	0.08	4.23	0.81	2.75	14.23	28.15	3.10	11.35	1.92	1.61	0.21	0.81	0.23	1.04	100.66
3	Monazite	29.88	0.27	6.53	1.27	2.60	12.97	26.68	2.92	10.58	1.80	1.58	0.15	0.73	0.11	1.41	99.48
4	Monazite	29.71	0.27	7.59	0.51	2.44	12.01	26.20	2.96	10.91	2.28	1.80	0.16	0.78	0.16	1.47	99.23
5	Monazite	29.48	0.36	6.58	0.16	1.37	13.15	28.30	3.23	11.73	2.07	1.31	0.13	0.51	0.08	1.21	99.68
6	Monazite	29.95	0.13	4.72	0.75	2.90	13.75	26.58	3.16	11.65	1.78	1.59	0.17	0.89	0.23	1.07	99.34
7	Monazite	29.98	0.13	2.70	0.85	2.14	13.94	27.94	3.44	13.04	2.38	2.05	0.19	0.83	0.12	0.68	100.42
8	Monazite	29.10	0.86	9.38	0.97	1.45	12.90	26.45	3.06	11.01	1.92	1.47	0.13	0.47	0.09	1.36	100.62
9	Monazite	29.28	0.23	5.93	0.19	0.09	13.60	30.10	3.54	13.29	1.87	0.87	0.00	0.07	0.00	1.11	100.15
10	Monazite	29.48	0.05	4.24	0.67	1.58	13.50	28.35	3.23	12.32	2.15	1.72	0.13	0.64	0.12	1.01	99.19
11	Monazite	29.46	0.50	4.26	0.14	1.04	14.99	31.09	3.44	11.62	1.53	0.79	0.06	0.34	0.14	0.56	99.96
12	Monazite	30.36	0.09	2.15	2.31	2.77	13.78	28.20	3.13	11.57	2.23	1.90	0.20	0.83	0.20	0.89	100.60
13	Monazite	29.78	0.25	3.48	1.06	2.82	13.85	26.89	3.23	12.31	2.10	1.90	0.17	0.91	0.17	0.80	99.72
14	Monazite	29.61	0.16	2.65	0.81	0.23	14.67	31.26	3.49	12.95	2.16	1.29	0.06	0.08	0.00	0.63	100.05
15	Monazite	30.00	0.07	4.63	1.20	1.78	13.10	27.77	3.16	11.99	2.21	1.95	0.16	0.72	0.04	1.17	99.94
16	Monazite	30.29	0.15	6.21	1.89	3.42	11.99	25.59	2.94	10.36	2.14	2.01	0.25	1.05	0.20	1.59	100.07
17	Monazite	30.26	0.05	3.85	1.15	2.22	13.44	27.61	3.18	12.20	2.17	1.68	0.19	0.75	0.16	1.03	99.93
18	Monazite	29.61	0.32	2.79	0.11	0.29	19.88	33.78	2.98	8.79	0.77	0.39	0.02	0.04	0.00	0.34	100.10
19	Monazite	29.86	0.30	6.52	0.52	2.17	13.73	28.07	3.04	10.73	1.85	1.23	0.09	0.55	0.15	1.21	100.03
20	Monazite	30.03	0.18	5.02	1.00	2.03	13.95	28.18	3.16	11.14	1.88	1.39	0.14	0.56	0.10	1.12	99.87
21	Monazite	29.41	0.50	6.35	0.68	1.30	12.97	29.08	3.31	11.79	1.94	1.17	0.08	0.43	0.08	1.04	100.14
22	Monazite	30.12	0.12	3.08	2.89	2.83	13.09	26.92	3.00	11.49	2.22	1.83	0.19	0.81	0.21	1.20	100.02
23	Monazite	30.25	0.12	3.64	0.57	3.79	13.14	27.19	3.10	11.88	2.21	1.85	0.21	0.91	0.27	0.79	99.92
	Min	28.16	0.05	2.15	0.11	0.09	11.99	25.59	2.92	8.79	0.77	0.39	0.00	0.04	0.00	0.34	99.19
	Max	30.36	1.17	9.64	2.89	3.79	19.88	33.78	3.54	13.29	2.38	2.05	0.25	1.05	0.27	1.59	100.66
	Ave	***29.75***	***0.28***	***5.05***	***0.92***	***1.98***	***13.70***	***28.10***	***3.16***	***11.58***	***2.00***	***1.53***	***0.14***	***0.63***	***0.13***	***1.04***	***99.98***

No. Analyses	SC_VC-15/Oxide	P2O5	SiO2	ThO2	UO2	Y2O3	La2O3	Ce2O3	Pr2O3	Nd2O3	Sm2O3	Gd2O3	Tb2O3	Dy2O3	Er2O3	CaO	Total
24	Monazite	30.09	0.06	4.51	0.36	1.76	14.04	29.12	3.25	12.13	2.00	1.37	0.11	0.54	0.14	0.99	100.47
25	Monazite	29.94	0.09	3.96	1.12	3.30	12.88	27.20	3.09	11.60	2.08	1.98	0.22	1.02	0.20	1.00	99.69
26	Monazite	29.09	0.68	4.86	0.31	1.52	15.28	29.94	3.10	11.39	1.57	1.10	0.11	0.44	0.09	0.52	100.00
27	Monazite	29.60	0.34	5.83	0.26	0.72	15.09	29.52	3.24	11.65	1.63	1.04	0.07	0.29	0.05	0.98	100.32
28	Monazite	29.77	0.11	4.71	0.49	0.41	14.18	29.42	3.27	12.42	2.16	1.47	0.07	0.21	0.02	1.01	99.72
29	Monazite	29.67	0.16	5.47	0.39	0.44	12.76	28.94	3.43	13.17	2.44	1.46	0.06	0.26	0.02	1.18	99.86
30	Monazite	30.11	0.12	5.02	0.60	0.30	14.11	30.44	3.26	11.99	2.00	1.20	0.09	0.15	0.01	1.07	100.49
31	Monazite	29.15	0.50	3.58	0.23	0.52	16.56	32.15	3.29	11.17	1.19	0.57	0.07	0.23	0.04	0.52	99.78
32	Monazite	29.46	0.40	4.54	0.20	1.46	13.47	28.45	3.33	12.69	2.36	1.97	0.18	0.74	0.05	0.64	99.94
33	Monazite	28.75	0.75	6.65	0.42	0.24	13.65	28.93	3.33	12.66	2.10	1.33	0.08	0.19	0.00	0.74	99.82
34	Monazite	29.44	0.30	6.59	0.62	0.16	12.43	28.82	3.48	13.27	2.22	1.16	0.09	0.21	0.00	1.24	100.03
35	Monazite	29.12	0.57	8.68	0.33	0.81	12.27	27.98	3.27	12.21	2.01	1.22	0.07	0.30	0.05	1.37	100.27
36	Monazite	29.53	0.45	6.75	0.50	1.92	14.47	27.95	2.98	10.76	1.68	1.09	0.07	0.53	0.17	1.12	99.98
37	Monazite	30.00	0.13	4.76	0.53	2.69	14.47	28.29	2.96	10.82	1.68	1.41	0.14	0.64	0.25	1.01	99.77
38	Monazite	29.55	0.38	3.88	0.06	0.24	17.69	31.47	3.24	10.56	1.29	0.56	0.02	0.12	0.08	0.92	100.07
39	Monazite	29.90	0.08	4.09	0.76	2.28	13.43	28.59	3.21	12.06	1.98	1.59	0.14	0.67	0.15	0.96	99.89
40	Monazite	29.07	0.59	5.57	0.36	0.15	15.90	31.13	3.28	11.01	1.41	0.72	0.06	0.07	0.01	0.74	100.08
41	Monazite	30.17	0.18	5.71	1.47	2.95	12.42	26.24	3.02	11.31	2.30	1.84	0.22	0.82	0.22	1.36	100.22
42	Monazite	29.34	0.55	4.50	0.41	2.06	13.66	29.16	3.28	11.82	2.15	1.47	0.14	0.66	0.20	0.55	99.96
43	Monazite	30.07	0.07	3.71	0.33	3.05	11.87	26.25	3.26	12.92	2.82	2.42	0.27	1.03	0.23	1.01	99.31
44	Monazite	29.82	0.18	5.53	1.67	1.47	14.28	28.50	3.02	10.57	1.78	1.29	0.13	0.48	0.05	1.33	100.11
45	Monazite	29.51	0.30	4.32	0.51	2.39	12.56	28.29	3.28	12.25	2.39	1.92	0.20	0.78	0.17	0.74	99.62
46	Monazite	28.10	1.19	6.38	0.47	1.45	12.84	28.73	3.39	12.64	2.14	1.55	0.12	0.56	0.13	0.35	100.04
47	Monazite	30.28	0.13	5.44	3.80	3.71	11.40	23.88	2.82	10.50	2.19	1.94	0.23	1.06	0.26	1.86	99.51
	Min	28.10	0.06	3.58	0.06	0.15	11.40	23.88	2.82	10.50	1.19	0.56	0.02	0.07	0.00	0.35	99.31
	Max	30.28	1.19	8.68	3.80	3.71	17.69	32.15	3.48	13.27	2.82	2.42	0.27	1.06	0.26	1.86	100.49
	Ave	***29.56***	***0.35***	***5.21***	***0.68***	***1.50***	***13.82***	***28.73***	***3.21***	***11.82***	***1.98***	***1.40***	***0.12***	***0.50***	***0.11***	***0.97***	***99.96***

No. Analyses	SC_VC-29/Oxide	P2O5	SiO2	ThO2	UO2	Y2O3	La2O3	Ce2O3	Pr2O3	Nd2O3	Sm2O3	Gd2O3	Tb2O3	Dy2O3	Er2O3	CaO	Total
48	Monazite	30.03	0.07	4.27	0.44	1.70	13.86	27.82	3.14	12.23	2.01	1.75	0.04	0.69	0.10	0.96	99.10
49	Monazite	29.63	0.39	7.76	0.24	1.52	10.05	26.09	3.46	14.25	2.41	1.65	0.10	0.58	0.10	1.35	99.58
50	Monazite	30.06	0.26	6.36	0.38	1.44	12.28	27.18	3.25	12.64	2.07	1.74	0.02	0.66	0.09	1.17	99.60
51	Monazite	29.97	0.15	3.58	0.53	0.13	14.48	30.45	3.52	12.90	2.09	1.27	0.02	0.26	0.01	0.70	100.05
52	Monazite	29.94	0.16	4.54	0.81	2.89	12.54	26.06	2.88	11.48	2.01	3.07	0.03	1.09	0.14	1.04	98.67
53	Monazite	30.26	0.15	4.09	1.88	2.57	12.52	27.17	3.13	11.63	1.97	1.84	0.05	0.87	0.15	1.24	99.54
54	Monazite	30.15	0.11	3.34	0.40	0.85	13.65	29.02	3.45	13.36	2.08	1.68	0.00	0.37	0.04	0.73	99.22
55	Monazite	29.81	0.06	1.43	0.48	1.44	16.13	30.42	3.30	11.99	1.66	1.48	0.03	0.56	0.10	0.35	99.24
56	Monazite	29.91	0.12	4.44	0.54	1.69	13.49	27.67	3.21	12.22	1.75	1.90	0.00	0.57	0.02	0.97	98.50
57	Monazite	29.99	0.08	0.70	0.06	0.83	13.07	33.73	3.49	12.64	1.65	1.45	0.00	0.33	0.09	0.21	98.33
58	Monazite	29.71	0.13	3.12	1.36	2.38	13.68	26.91	3.18	12.07	1.88	1.76	0.05	0.80	0.16	0.88	98.06
	Min	29.63	0.06	0.70	0.06	0.13	10.05	26.06	2.88	11.48	1.65	1.27	0.00	0.26	0.01	0.21	98.06
	Max	30.26	0.39	7.76	1.88	2.89	16.13	33.73	3.52	14.25	2.41	3.07	0.10	1.09	0.16	1.35	100.05
	Ave	***29.95***	***0.15***	***3.97***	***0.65***	***1.59***	***13.25***	***28.41***	***3.27***	***12.49***	***1.96***	***1.78***	***0.03***	***0.62***	***0.09***	***0.87***	***99.08***

No. Analyses	NC_VC-27/Oxide	P2O5	SiO2	ThO2	UO2	Y2O3	La2O3	Ce2O3	Pr2O3	Nd2O3	Sm2O3	Gd2O3	Tb2O3	Dy2O3	Er2O3	CaO	Total
59	Monazite	28.77	0.73	3.37	0.20	0.42	13.58	32.54	3.70	13.46	1.70	0.86	0.03	0.15	0.04	0.17	99.72
60	Monazite	27.80	1.45	6.81	0.31	0.22	12.91	30.62	3.61	13.10	1.53	0.67	0.03	0.14	0.00	0.36	99.55
61	Monazite	26.84	1.85	7.96	0.20	1.26	12.60	29.46	3.47	11.98	1.50	1.00	0.07	0.41	0.08	0.28	98.97
62	Monazite	29.83	0.26	5.65	0.22	0.16	14.58	30.07	3.37	12.21	1.73	0.89	0.07	0.10	0.00	1.02	100.17
63	Monazite	29.05	0.51	3.90	0.28	0.90	16.41	32.04	3.18	10.27	1.05	0.56	0.05	0.21	0.05	1.02	99.49
64	Monazite	29.35	0.41	3.77	0.26	0.87	16.28	31.94	3.32	10.55	1.05	0.57	0.04	0.16	0.08	1.06	99.71
65	Monazite	29.63	0.18	1.67	0.14	0.75	18.74	33.05	3.14	9.26	0.82	0.40	0.07	0.11	0.00	1.06	99.00
66	Monazite	29.78	0.12	3.55	0.49	2.29	12.75	27.18	3.30	12.86	2.34	1.79	0.20	0.79	0.20	1.28	98.93
67	Monazite	28.67	0.92	8.79	0.21	0.39	15.72	28.47	2.92	10.26	1.46	0.77	0.07	0.04	0.01	1.19	99.89
68	Monazite	27.96	1.21	5.38	0.15	0.74	14.56	32.74	3.45	10.96	1.03	0.51	0.02	0.18	0.05	0.30	99.24
69	Monazite	29.34	0.52	6.20	0.15	1.03	12.96	29.08	3.39	12.52	2.09	1.37	0.11	0.36	0.10	0.88	100.10
70	Monazite	28.59	0.94	7.63	0.41	1.00	13.78	28.29	3.07	11.49	1.68	1.05	0.07	0.29	0.06	0.87	99.21
71	Monazite	29.82	0.17	4.75	0.16	0.25	14.40	30.06	3.43	12.92	1.86	0.90	0.03	0.05	0.05	0.90	99.73
72	Monazite	30.40	0.08	4.98	1.83	3.09	11.88	25.78	3.00	11.07	2.48	2.11	0.24	0.96	0.18	1.35	99.43
73	Monazite	29.74	0.13	3.37	0.55	0.08	14.76	29.47	3.49	13.13	2.18	1.19	0.09	0.16	0.00	0.71	99.06
74	Monazite	30.00	0.06	0.69	0.05	0.62	19.19	33.84	2.95	9.53	0.86	0.26	0.03	0.16	0.04	0.22	98.50
75	Monazite	28.38	1.17	5.80	0.26	1.09	14.41	29.23	3.36	12.24	1.62	0.98	0.08	0.31	0.08	0.38	99.38
76	Monazite	27.11	2.00	11.57	0.14	0.74	11.38	27.46	3.28	12.31	1.46	0.80	0.00	0.25	0.05	0.75	99.29
77	Monazite	29.60	0.53	5.34	0.09	2.33	12.94	27.90	3.22	12.61	1.97	1.64	0.15	0.73	0.19	0.70	99.95
78	Monazite	29.16	0.62	8.03	0.48	2.09	14.38	27.39	2.88	9.81	1.70	1.30	0.10	0.54	0.18	1.29	99.94
79	Monazite	27.69	0.80	2.50	0.03	0.33	18.14	31.65	3.00	9.61	0.84	0.40	0.00	0.06	0.05	1.69	96.79
80	Monazite	27.87	1.43	8.37	0.70	0.98	12.66	28.03	3.25	12.30	1.74	1.09	0.08	0.41	0.08	0.69	99.69
81	Monazite	28.03	1.32	10.01	0.27	1.18	12.46	26.01	3.00	11.28	2.49	1.99	0.16	0.58	0.06	1.05	99.90
82	Monazite	29.05	0.66	9.62	0.36	0.92	13.14	27.21	2.93	11.07	1.78	1.16	0.09	0.40	0.04	1.49	99.92
83	Monazite	29.62	0.09	1.49	0.15	0.94	10.88	31.62	4.15	15.69	2.44	1.36	0.06	0.40	0.02	0.28	99.19
	Min	26.84	0.06	0.69	0.03	0.08	10.88	25.78	2.88	9.26	0.82	0.26	0.00	0.04	0.00	0.17	96.79
	Max	30.40	2.00	11.57	1.83	3.09	19.19	33.84	4.15	15.69	2.49	2.11	0.24	0.96	0.20	1.69	100.17
	Ave	***28.88***	***0.73***	***5.65***	***0.32***	***0.99***	***14.22***	***29.65***	***3.27***	***11.70***	***1.66***	***1.03***	***0.08***	***0.32***	***0.07***	***0.84***	***99.39***

No. Analyses	NC_VC-37/Oxide	P2O5	SiO2	ThO2	UO2	Y2O3	La2O3	Ce2O3	Pr2O3	Nd2O3	Sm2O3	Gd2O3	Tb2O3	Dy2O3	Er2O3	CaO	Total
84	Monazite	29.61	0.25	5.76	0.96	2.93	12.58	25.82	2.98	11.31	2.27	2.17	0.20	0.86	0.18	1.34	99.21
85	Monazite	27.41	1.67	10.30	0.27	1.76	14.54	27.38	2.61	8.42	1.25	1.00	0.11	0.36	0.16	0.99	98.22
86	Monazite	29.88	0.39	8.16	1.06	2.38	12.61	25.82	2.82	10.48	2.13	1.61	0.18	0.73	0.18	1.59	100.01
87	Monazite	28.14	0.98	6.06	0.20	0.66	15.80	30.35	3.04	10.10	1.19	0.60	0.01	0.21	0.00	0.87	98.21
88	Monazite	29.86	0.10	3.87	0.72	0.19	14.00	30.20	3.38	12.82	1.77	0.93	0.05	0.14	0.00	1.02	99.04
89	Monazite	29.29	0.25	1.85	0.03	0.60	15.79	35.90	2.97	10.12	1.25	0.74	0.09	0.18	0.02	0.23	99.30
90	Monazite	29.72	0.23	4.35	0.15	2.28	13.72	28.08	3.19	12.63	2.19	1.84	0.12	0.60	0.17	0.73	99.99
91	Monazite	29.23	0.53	6.48	0.08	0.35	13.18	28.75	3.40	13.75	1.76	0.92	0.05	0.11	0.04	0.99	99.62
92	Monazite	28.94	0.66	6.16	0.29	0.12	13.65	29.42	3.40	12.87	2.23	1.32	0.05	0.06	0.00	0.80	99.97
93	Monazite	28.89	0.90	7.50	0.48	2.52	13.86	27.82	2.97	9.89	1.63	1.20	0.09	0.62	0.17	0.90	99.45
94	Monazite	29.42	0.24	0.93	0.10	0.72	8.06	30.23	4.54	19.28	3.23	1.49	0.09	0.33	0.07	0.17	98.89
95	Monazite	29.34	0.56	8.36	0.67	1.88	12.76	26.54	2.97	11.33	1.92	1.63	0.12	0.52	0.09	1.38	100.07
96	Monazite	29.31	0.51	3.10	0.10	0.33	18.17	33.60	3.14	9.77	0.84	0.32	0.00	0.08	0.04	0.34	99.66
97	Monazite	29.68	0.32	5.05	0.09	2.90	13.80	28.59	3.19	11.34	1.51	1.34	0.10	0.69	0.19	0.95	99.74
98	Monazite	27.01	2.19	12.19	1.35	5.59	6.75	19.59	2.81	12.76	3.22	3.08	0.32	1.46	0.35	0.95	99.63
99	Monazite	28.52	0.96	5.25	0.40	1.13	14.59	30.36	3.44	12.38	1.38	0.78	0.05	0.26	0.03	0.45	99.98
100	Monazite	29.81	0.16	0.81	0.26	1.38	13.79	31.38	3.85	14.63	2.02	1.12	0.06	0.43	0.11	0.16	99.95
101	Monazite	27.76	1.39	7.35	0.14	1.05	16.53	29.72	2.89	9.52	1.05	0.67	0.08	0.29	0.07	0.84	99.35
	Min	27.01	0.10	0.81	0.03	0.12	6.75	19.59	2.61	8.42	0.84	0.32	0.00	0.06	0.00	0.16	98.21
	Max	29.88	2.19	12.19	1.35	5.59	18.17	35.90	4.54	19.28	3.23	3.08	0.32	1.46	0.35	1.59	100.07
	Ave	***28.99***	***0.68***	***5.75***	***0.41***	***1.60***	***13.56***	***28.86***	***3.20***	***11.86***	***1.82***	***1.26***	***0.10***	***0.44***	***0.10***	***0.82***	***99.46***

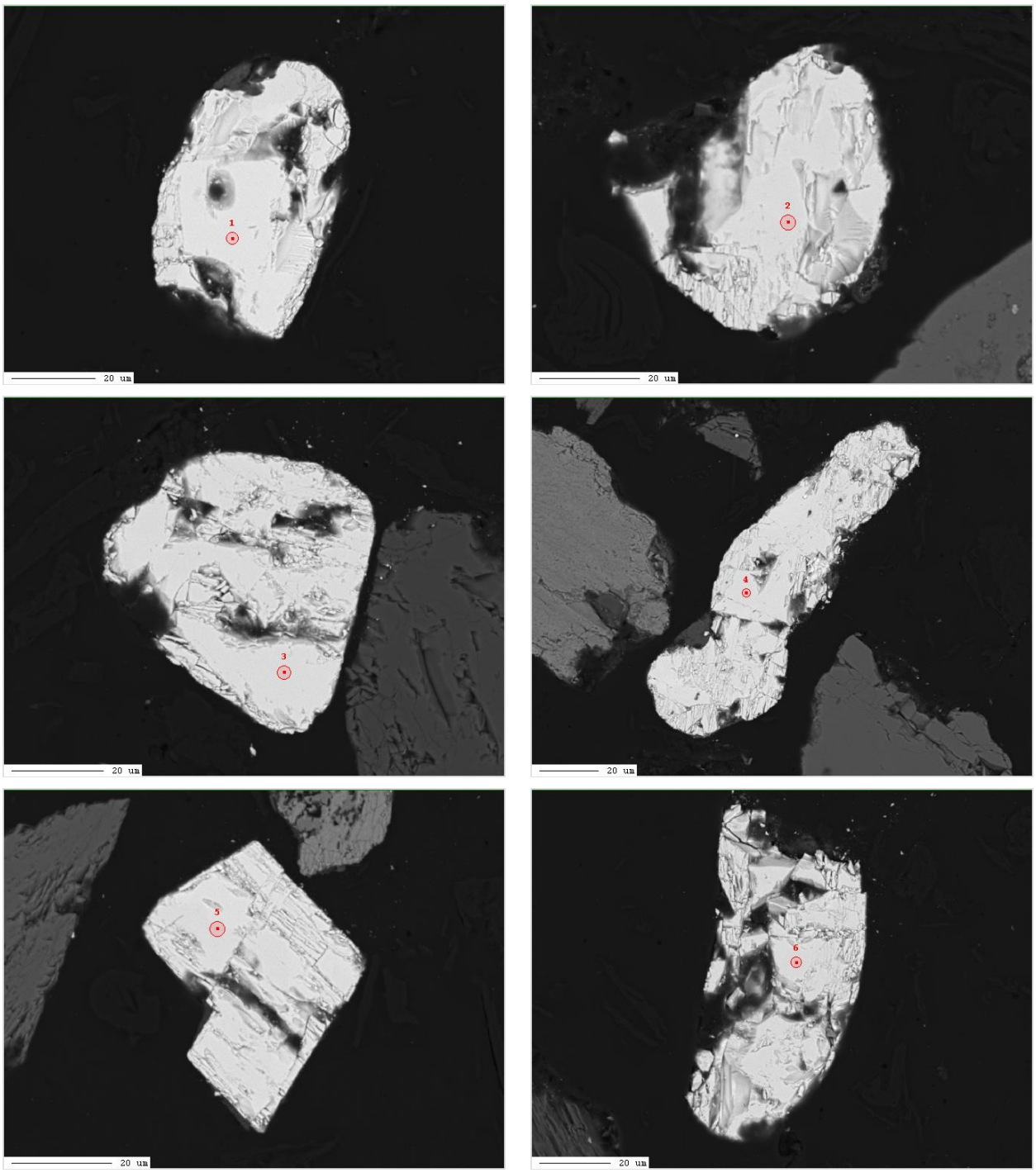


Figure 85: BSE Images of Monazite from GA_VC-3

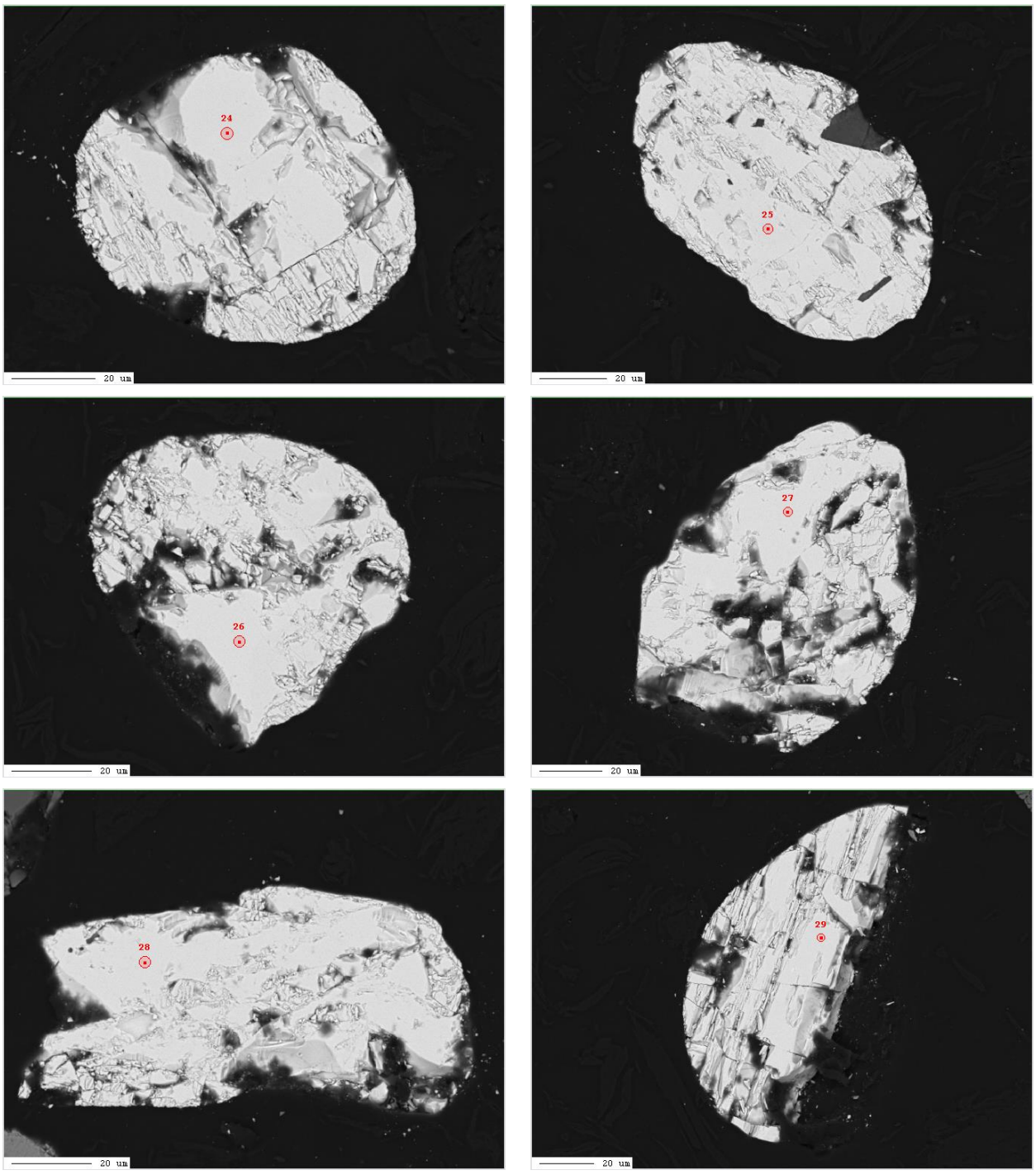


Figure 86: BSE Images of Monazite from SC_VC-15

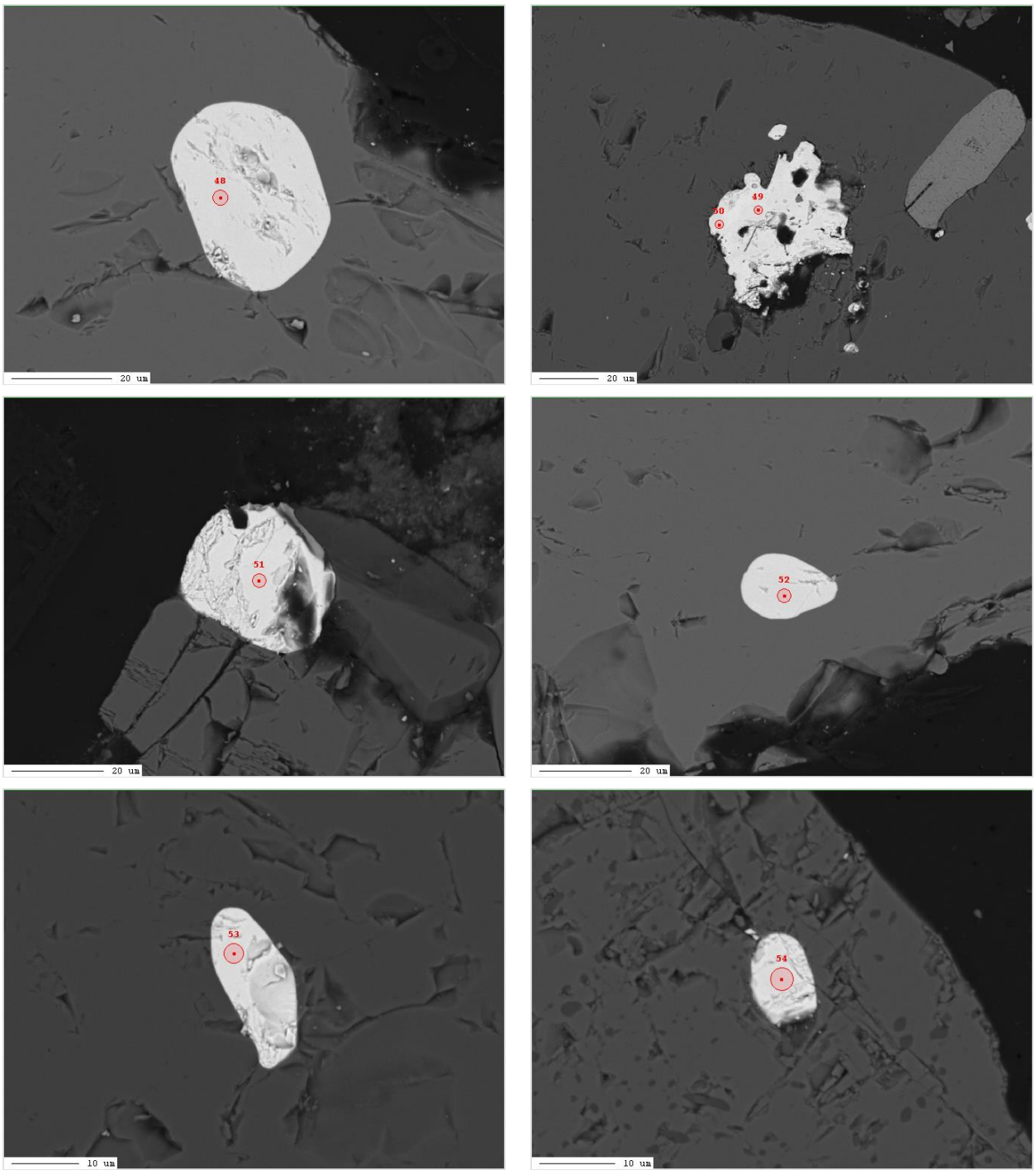


Figure 87: BSE Images of Monazite from SC_VC-29

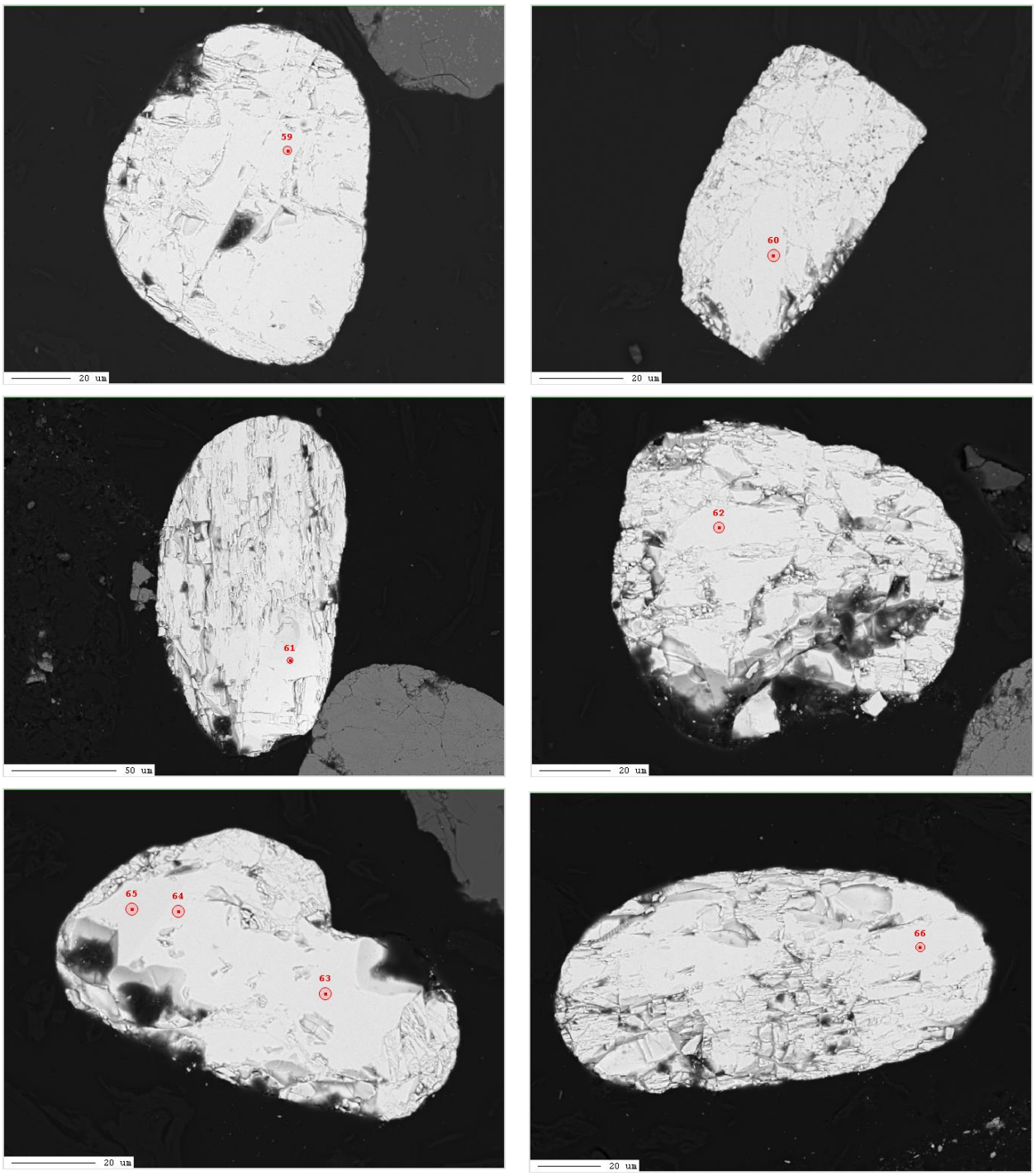


Figure 88: BSE Images of Monazite from NC_VC-27

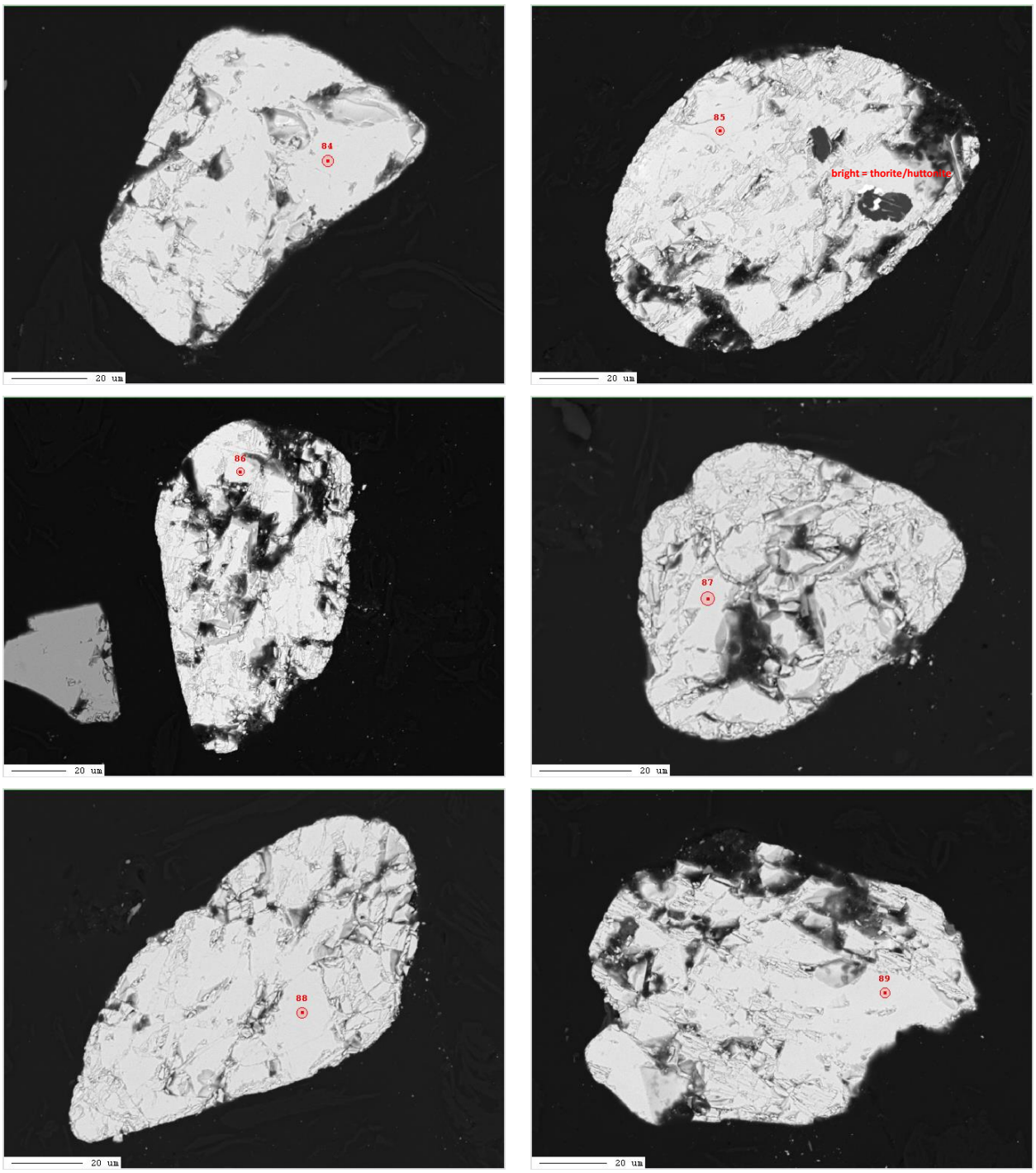


Figure 89: BSE Images of Monazite from NC_VC-37

GA_VC-3	SiO2	Y2O3	La2O3	Ce2O3	Nd2O3	CaO	P2O5	SO3	F	Cl	O = F	O = Cl	Total
Apatite	1.16	0.03	0.01	0.01	0.00	48.09	29.87	2.92	4.24	0.07	1.79	0.02	84.60
Apatite	2.91	0.01	0.01	0.00	0.00	47.77	29.55	2.87	4.36	0.08	1.84	0.02	85.70
Apatite	0.38	0.03	0.00	0.00	0.05	49.03	29.72	2.97	4.18	0.06	1.76	0.01	84.65
Apatite	0.59	0.01	0.04	0.01	0.00	49.58	29.78	3.01	4.44	0.08	1.87	0.02	85.65
Apatite	0.62	0.05	0.00	0.04	0.00	48.82	30.26	2.89	4.26	0.07	1.79	0.02	85.20
Apatite	0.50	0.00	0.02	0.01	0.00	49.24	30.06	2.99	4.39	0.02	1.85	0.00	85.37
Apatite	1.14	0.08	0.05	0.00	0.00	48.67	30.21	2.89	4.45	0.04	1.87	0.01	85.65
Apatite	0.00	0.18	0.06	0.10	0.05	50.23	32.08	2.48	4.18	0.08	1.76	0.02	87.66
Min	0.00	0.00	0.00	0.00	0.00	47.77	29.55	2.48	4.18	0.02	1.76	0.00	84.60
Max	2.91	0.18	0.06	0.10	0.05	50.23	32.08	3.01	4.45	0.08	1.87	0.02	87.66
Ave	***0.91***	***0.05***	***0.02***	***0.02***	***0.01***	***48.93***	***30.19***	***2.88***	***4.31***	***0.06***	***1.82***	***0.01***	***85.56***

SC_VC-15	SiO2	Y2O3	La2O3	Ce2O3	Nd2O3	CaO	P2O5	SO3	F	Cl	O = F	O = Cl	Total
Apatite	0.00	0.08	0.11	0.18	0.07	50.02	31.47	1.70	4.04	0.00	1.70	0.00	85.97
Apatite	0.00	0.03	0.05	0.00	0.02	51.08	32.82	1.43	4.10	0.03	1.73	0.01	87.82
Apatite	0.36	0.04	0.06	0.03	0.00	50.23	31.39	2.05	4.35	0.02	1.83	0.01	86.68
Apatite	0.06	0.18	0.21	0.25	0.12	49.21	33.23	1.38	3.82	0.02	1.61	0.01	86.86
Apatite	0.00	0.03	0.01	0.03	0.00	51.11	33.19	1.92	3.68	0.00	1.55	0.00	88.42
Apatite	1.61	0.13	0.08	0.00	0.05	48.49	29.04	2.61	4.62	0.03	1.95	0.01	84.73
Apatite	0.00	0.00	0.00	0.00	0.00	51.10	35.27	2.56	3.78	0.04	1.59	0.01	91.14
Apatite	0.00	0.04	0.00	0.00	0.00	51.11	32.43	2.36	4.24	0.05	1.79	0.01	88.42
Min	0.00	0.00	0.00	0.00	0.00	48.49	29.04	1.38	3.68	0.00	1.55	0.00	84.73
Max	1.61	0.18	0.21	0.25	0.12	51.11	35.27	2.61	4.62	0.05	1.95	0.01	91.14
Ave	***0.26***	***0.06***	***0.06***	***0.06***	***0.03***	***50.29***	***32.35***	***2.00***	***4.08***	***0.03***	***1.72***	***0.01***	***87.50***

SC_VC-29	SiO2	Y2O3	La2O3	Ce2O3	Nd2O3	CaO	P2O5	SO3	F	Cl	O = F	O = Cl	Total
Apatite	1.90	0.03	0.00	0.00	0.00	45.55	27.51	1.75	4.04	0.09	1.70	0.02	79.15
Apatite	6.90	0.00	0.02	0.01	0.00	44.16	27.00	2.00	4.12	0.05	1.74	0.01	82.53
Apatite	0.22	0.00	0.07	0.02	0.02	49.51	30.71	1.51	4.25	0.11	1.79	0.03	84.61
Apatite	0.24	0.01	0.00	0.00	0.03	44.00	26.28	1.78	4.20	0.03	1.77	0.01	74.80
Apatite	5.29	0.03	0.02	0.05	0.09	43.82	27.15	1.48	3.88	0.10	1.63	0.02	80.26
Apatite	0.00	0.04	0.03	0.01	0.02	51.37	38.75	0.40	3.48	0.03	1.46	0.01	92.65
Apatite	0.05	0.04	0.01	0.04	0.07	49.68	30.57	1.99	4.69	0.04	1.98	0.01	85.19
Apatite	0.00	0.04	0.00	0.02	0.03	49.93	32.15	2.44	3.91	0.12	1.65	0.03	86.97
Min	0.00	0.00	0.00	0.00	0.00	43.82	26.28	0.40	3.48	0.03	1.46	0.01	74.80
Max	6.90	0.04	0.07	0.05	0.09	51.37	38.75	2.44	4.69	0.12	1.98	0.03	92.65
Ave	***1.82***	***0.02***	***0.02***	***0.02***	***0.03***	***47.25***	***30.02***	***1.67***	***4.07***	***0.07***	***1.71***	***0.02***	***83.27***

NC_VC-27	SiO2	Y2O3	La2O3	Ce2O3	Nd2O3	CaO	P2O5	SO3	F	Cl	O = F	O = Cl	Total
Apatite	0.00	0.05	0.02	0.05	0.00	50.22	32.89	1.77	4.08	0.04	1.72	0.01	87.38
Apatite	1.56	0.06	0.02	0.00	0.00	49.05	31.25	2.03	4.34	0.03	1.83	0.01	86.52
Apatite	0.00	0.00	0.00	0.01	0.02	50.61	30.15	2.76	4.34	0.03	1.83	0.01	86.10
Apatite	0.00	0.00	0.04	0.00	0.05	51.19	34.52	2.28	3.79	0.05	1.60	0.01	90.32
Apatite	0.00	0.08	0.03	0.05	0.00	49.29	32.80	1.99	4.22	0.02	1.78	0.00	86.70
Apatite	0.55	0.00	0.03	0.03	0.00	50.57	34.51	1.30	4.00	0.02	1.68	0.00	89.29
Apatite	0.00	0.01	0.02	0.00	0.00	50.79	31.92	1.90	4.18	0.08	1.76	0.02	87.14
Apatite	0.20	0.09	0.05	0.06	0.05	50.23	31.86	2.66	4.19	0.09	1.76	0.02	87.71
Min	0.00	0.00	0.00	0.00	0.00	49.05	30.15	1.30	3.79	0.02	1.60	0.00	86.10
Max	1.56	0.09	0.05	0.06	0.05	51.19	34.52	2.76	4.34	0.09	1.83	0.02	90.32
Ave	***0.29***	***0.04***	***0.03***	***0.02***	***0.02***	***50.24***	***32.49***	***2.09***	***4.14***	***0.05***	***1.74***	***0.01***	***87.64***

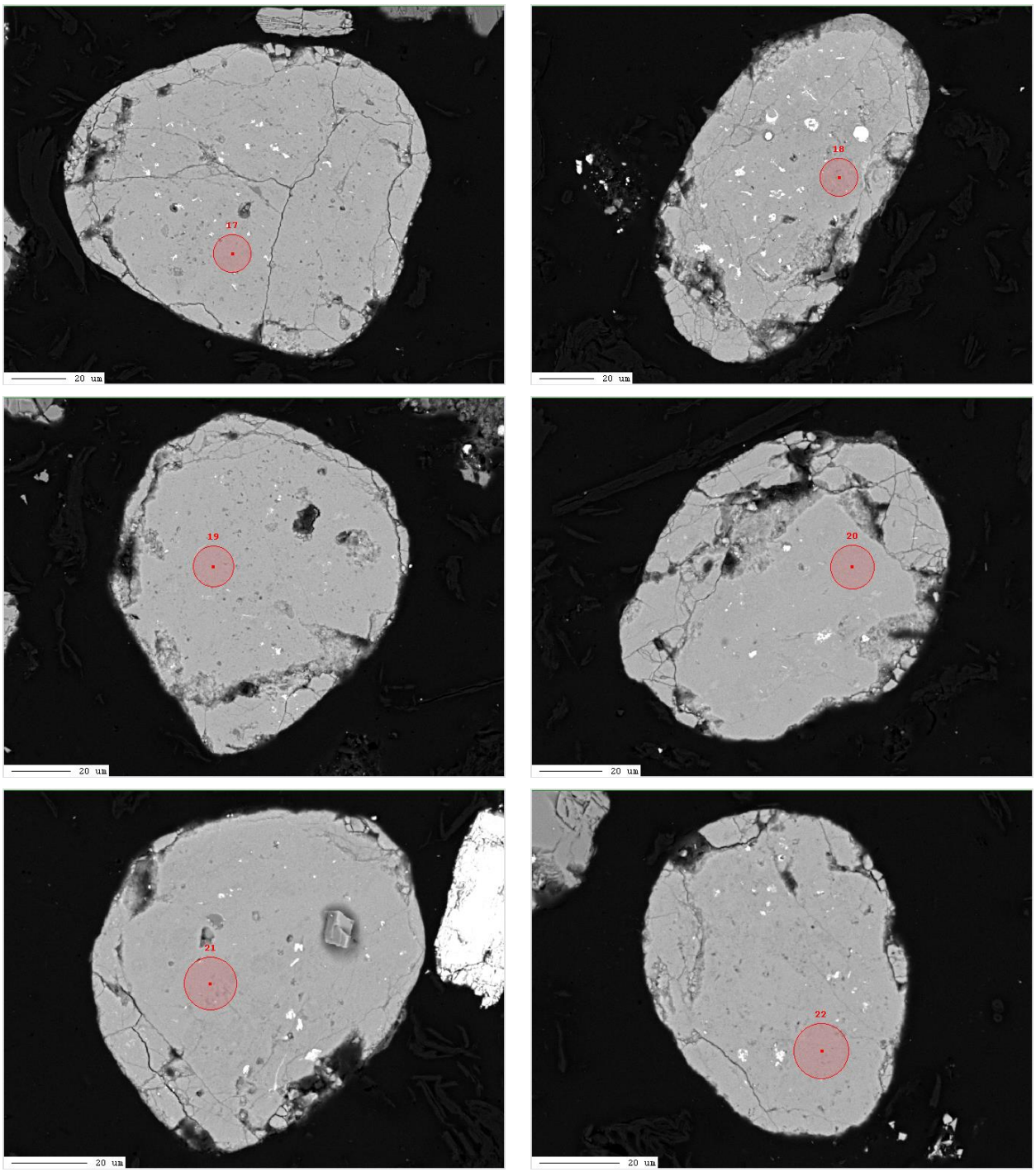


Figure 90: BSE Images of Apatite from GA_VC-3

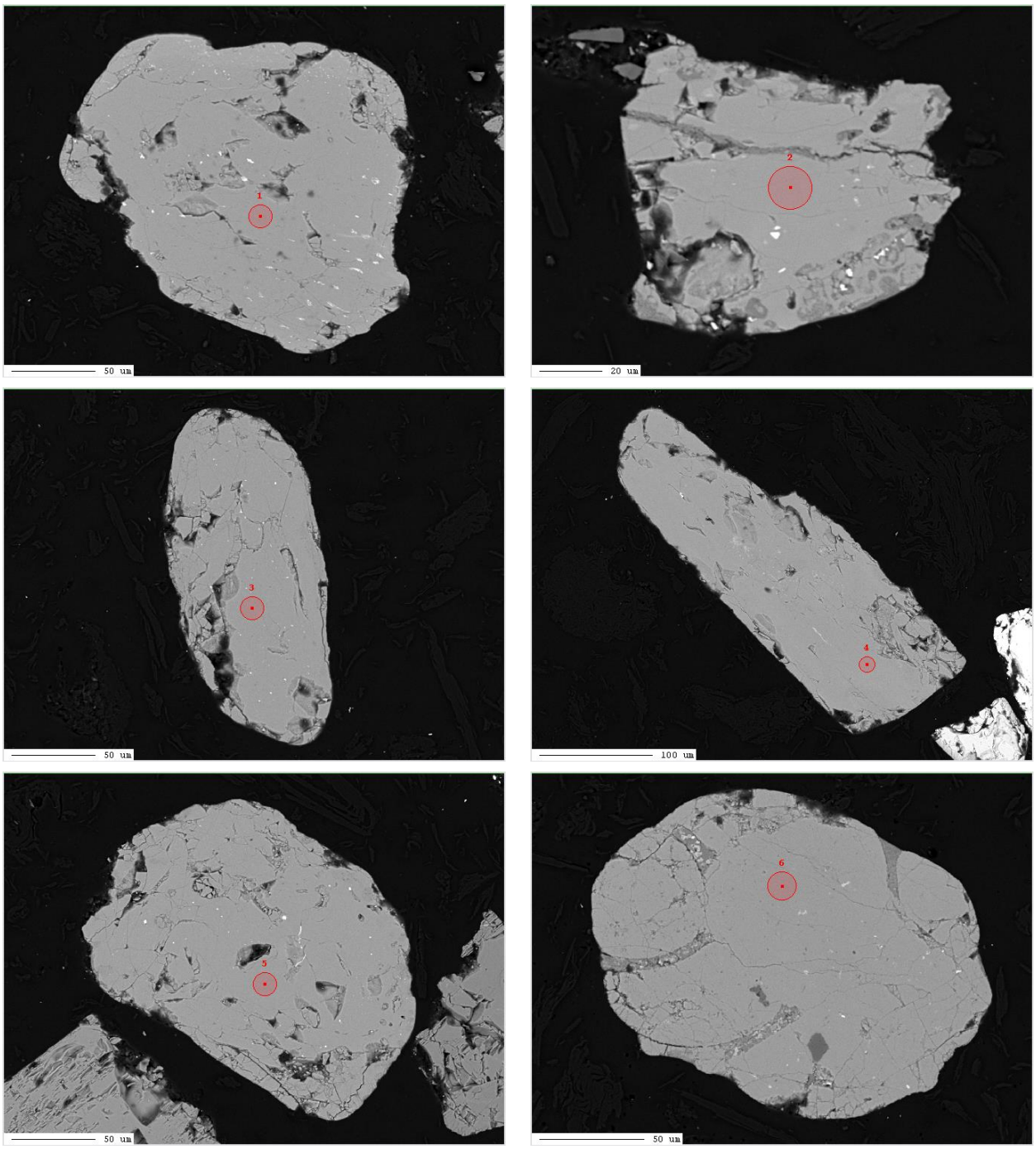


Figure 91: BSE Images of Apatite from SC_VC-15

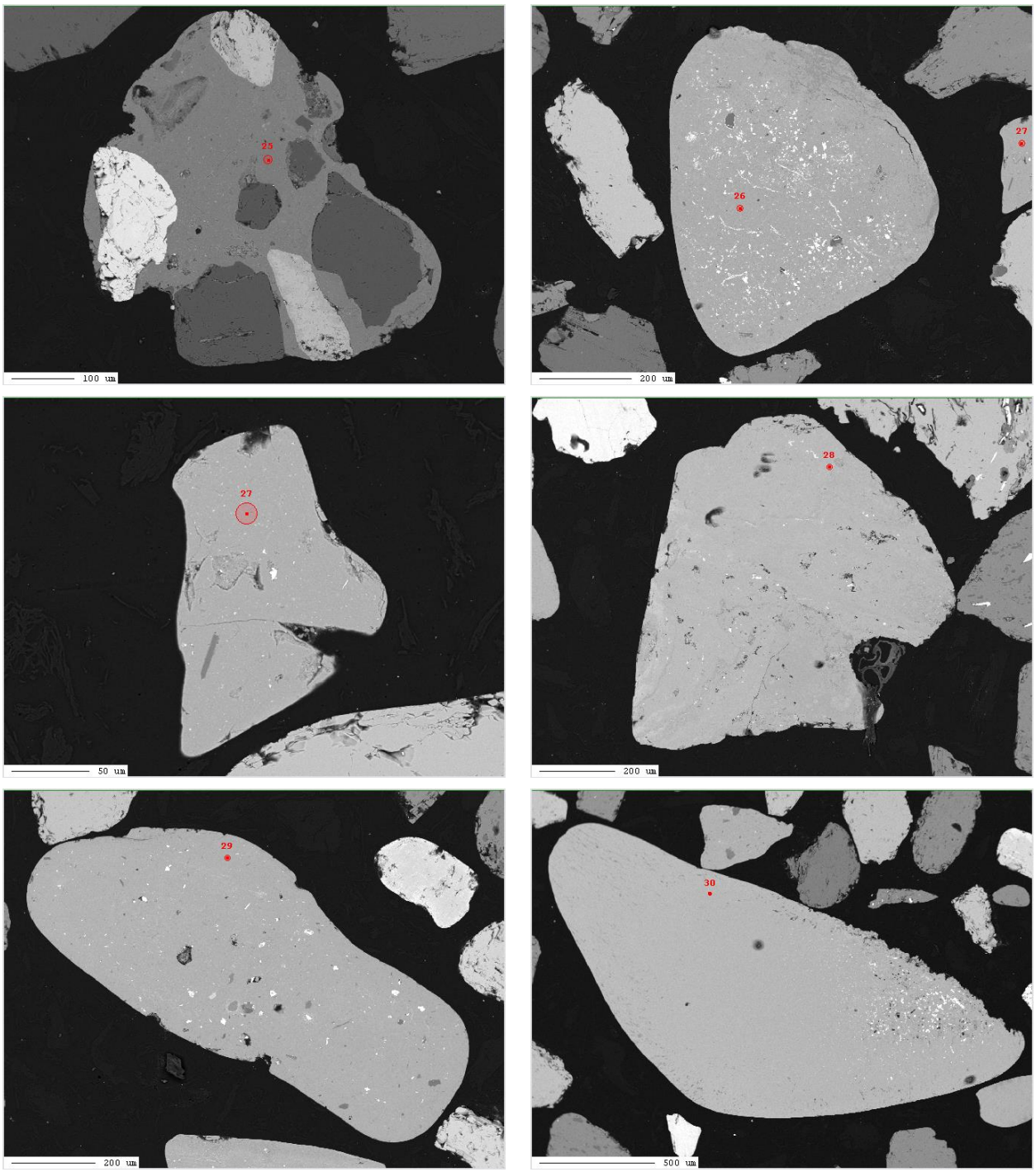


Figure 92: BSE Images of Apatite from SC_VC-29

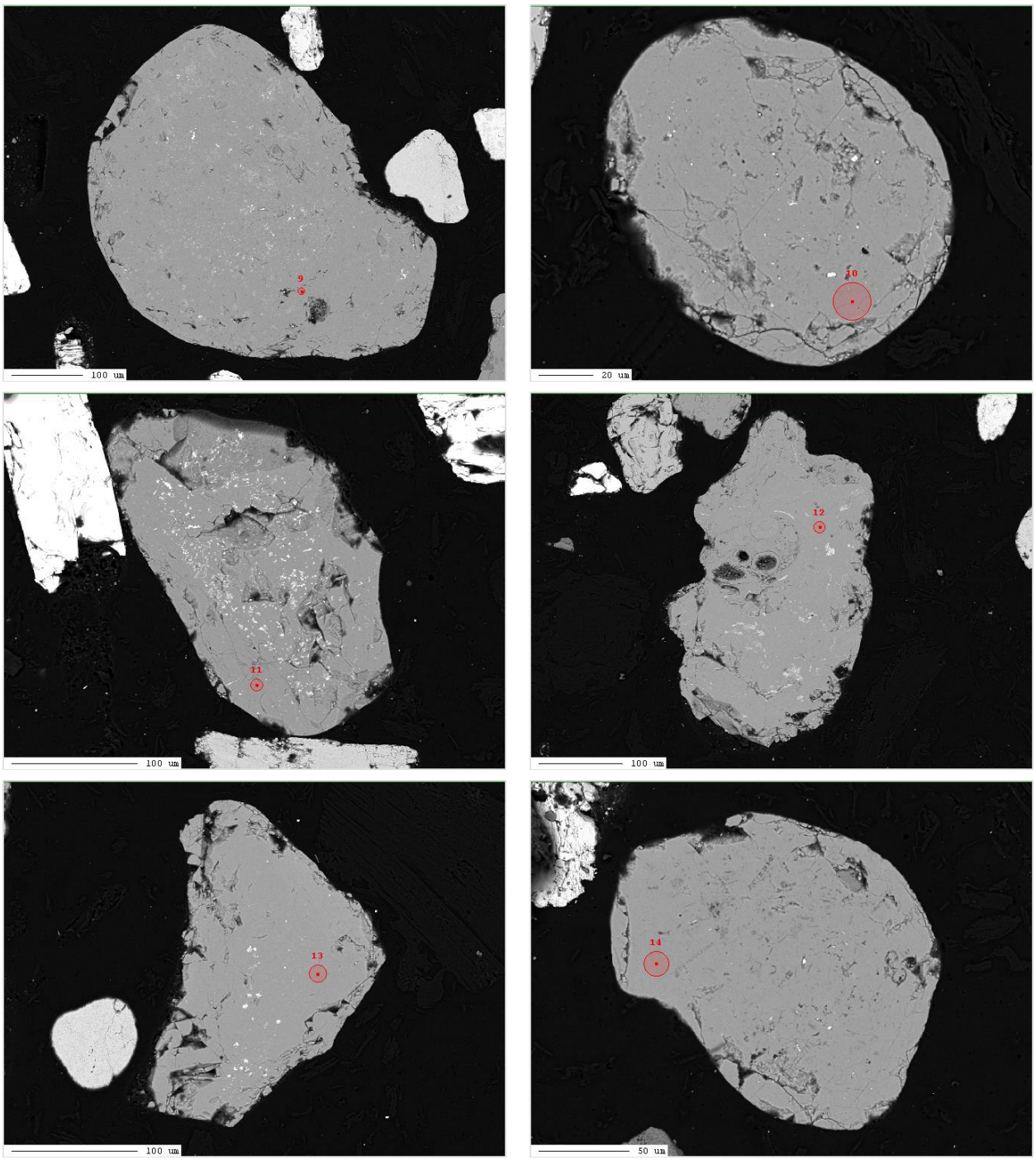


Figure 93: BSE Images of Apatite from NC_VC-27

GA_VC-3	SiO_2	ZrO_2	HfO_2	UO_2	Y_2O_3	La_2O_3	Ce_2O_3	Nd_2O_3	Dy_2O_3	Total
Zircon	32.13	66.23	1.29	0.00	0.08	0.01	0.01	0.00	0.00	99.75
Zircon	32.71	66.52	1.07	0.11	0.01	0.00	0.00	0.00	0.00	100.43
Zircon	32.48	65.90	1.16	0.05	0.05	0.00	0.00	0.00	0.03	99.66
Zircon	32.59	66.44	1.09	0.02	0.27	0.01	0.00	0.00	0.01	100.42
Zircon	32.35	65.91	1.52	0.08	0.10	0.00	0.00	0.00	0.00	99.95
Zircon	32.63	66.21	1.25	0.09	0.11	0.02	0.00	0.00	0.02	100.34
Zircon	32.46	66.25	1.33	0.02	0.14	0.01	0.00	0.00	0.00	100.24
Zircon	32.72	65.89	1.35	0.00	0.11	0.00	0.01	0.00	0.00	100.09
Min	32.13	65.89	1.07	0.00	0.01	0.00	0.00	0.00	0.00	99.66
Max	32.72	66.52	1.52	0.11	0.27	0.02	0.01	0.00	0.03	100.43
Ave	***32.51***	***66.17***	***1.26***	***0.05***	***0.11***	***0.01***	***0.00***	***0.00***	***0.01***	***100.11***

SC_VC-15	SiO_2	ZrO_2	HfO_2	UO_2	Y_2O_3	La_2O_3	Ce_2O_3	Nd_2O_3	Dy_2O_3	Total
Zircon	32.63	66.05	1.45	0.07	0.06	0.00	0.01	0.00	0.01	100.29
Zircon	32.63	65.94	0.97	0.05	0.12	0.01	0.00	0.01	0.00	99.73
Zircon	32.30	65.72	1.00	0.03	0.33	0.02	0.01	0.00	0.03	99.44
Zircon	32.41	65.84	1.23	0.01	0.09	0.00	0.00	0.00	0.00	99.58
Zircon	32.50	66.10	1.04	0.02	0.05	0.02	0.01	0.00	0.02	99.75
Zircon	32.49	66.78	1.19	0.05	0.06	0.00	0.00	0.00	0.01	100.59
Zircon	32.34	66.50	1.02	0.00	0.20	0.00	0.02	0.00	0.02	100.10
Zircon	32.43	66.66	1.08	0.03	0.12	0.00	0.00	0.00	0.00	100.32
Min	32.30	65.72	0.97	0.00	0.05	0.00	0.00	0.00	0.00	99.44
Max	32.63	66.78	1.45	0.07	0.33	0.02	0.02	0.01	0.03	100.59
Ave	***32.47***	***66.20***	***1.12***	***0.03***	***0.13***	***0.01***	***0.01***	***0.00***	***0.01***	***99.97***

SC_VC-29	SiO_2	ZrO_2	HfO_2	UO_2	Y_2O_3	La_2O_3	Ce_2O_3	Nd_2O_3	Dy_2O_3	Total
Zircon	32.39	65.29	1.91	0.13	0.10	0.00	0.02	0.02	0.00	99.86
Zircon	32.40	65.67	1.71	0.19	0.16	0.00	0.00	0.01	0.00	100.13
Zircon	32.53	65.23	0.71	0.02	0.40	0.02	0.00	0.02	0.00	98.94
Zircon	32.74	66.12	1.26	0.02	0.07	0.01	0.00	0.00	0.00	100.22
Zircon	32.39	65.85	1.12	0.00	0.29	0.02	0.00	0.00	0.01	99.68
Zircon	32.72	65.94	1.16	0.00	0.02	0.00	0.01	0.00	0.02	99.87
Zircon	32.89	66.09	1.21	0.04	0.08	0.00	0.03	0.00	0.00	100.34
Zircon	32.66	66.51	1.16	0.00	0.08	0.01	0.01	0.00	0.00	100.43
Min	32.39	65.23	0.71	0.00	0.02	0.00	0.00	0.00	0.00	98.94
Max	32.89	66.51	1.91	0.19	0.40	0.02	0.03	0.02	0.02	100.43
Ave	***32.59***	***65.84***	***1.28***	***0.05***	***0.15***	***0.01***	***0.01***	***0.01***	***0.00***	***99.94***

NC_VC-27	SiO_2	ZrO_2	HfO_2	UO_2	Y_2O_3	La_2O_3	Ce_2O_3	Nd_2O_3	Dy_2O_3	Total
Zircon	32.47	66.23	0.91	0.04	0.32	0.01	0.00	0.01	0.00	100.00
Zircon	32.44	67.03	1.11	0.01	0.02	0.00	0.00	0.00	0.09	100.70
Zircon	32.50	65.68	0.97	0.00	0.30	0.02	0.02	0.03	0.00	99.52
Zircon	32.52	65.80	1.15	0.03	0.09	0.01	0.00	0.00	0.00	99.60
Zircon	32.57	65.99	1.07	0.01	0.13	0.02	0.00	0.00	0.01	99.80
Zircon	32.48	65.24	1.47	0.09	0.23	0.01	0.01	0.02	0.02	99.56
Zircon	32.62	66.79	1.18	0.03	0.05	0.00	0.00	0.02	0.00	100.71
Zircon	32.77	65.44	1.29	0.05	0.08	0.00	0.02	0.01	0.00	99.65
Zircon	32.46	65.25	1.10	0.00	0.09	0.00	0.02	0.01	0.00	98.93
Min	32.44	65.24	0.91	0.00	0.02	0.00	0.00	0.00	0.00	98.93
Max	32.77	67.03	1.47	0.09	0.32	0.02	0.02	0.03	0.09	100.71
Ave	***32.54***	***65.94***	***1.14***	***0.03***	***0.15***	***0.01***	***0.01***	***0.01***	***0.01***	***99.83***

NC_VC-37	SiO_2	ZrO_2	HfO_2	UO_2	Y_2O_3	La_2O_3	Ce_2O_3	Nd_2O_3	Dy_2O_3	Total
Zircon	32.55	66.13	1.27	0.00	0.05	0.00	0.02	0.03	0.00	100.05
Zircon	32.38	67.08	1.22	0.01	0.07	0.00	0.01	0.02	0.00	100.80
Zircon	32.14	65.86	0.92	0.02	0.38	0.04	0.02	0.00	0.00	99.39
Zircon	32.74	65.86	1.32	0.02	0.10	0.00	0.00	0.01	0.06	100.11
Zircon	32.45	67.01	1.25	0.07	0.14	0.01	0.01	0.00	0.00	100.94
Zircon	31.40	65.20	1.20	0.04	0.02	0.01	0.11	0.29	0.01	98.27
Zircon	32.57	66.28	1.13	0.06	0.08	0.00	0.01	0.00	0.04	100.18
Zircon	32.79	66.49	0.95	0.00	0.04	0.00	0.01	0.00	0.00	100.28
Min	31.40	65.20	0.92	0.00	0.02	0.00	0.00	0.00	0.00	98.27
Max	32.79	67.08	1.32	0.07	0.38	0.04	0.11	0.29	0.06	100.94
Ave	***32.38***	***66.24***	***1.16***	***0.03***	***0.11***	***0.01***	***0.02***	***0.04***	***0.01***	***100.00***

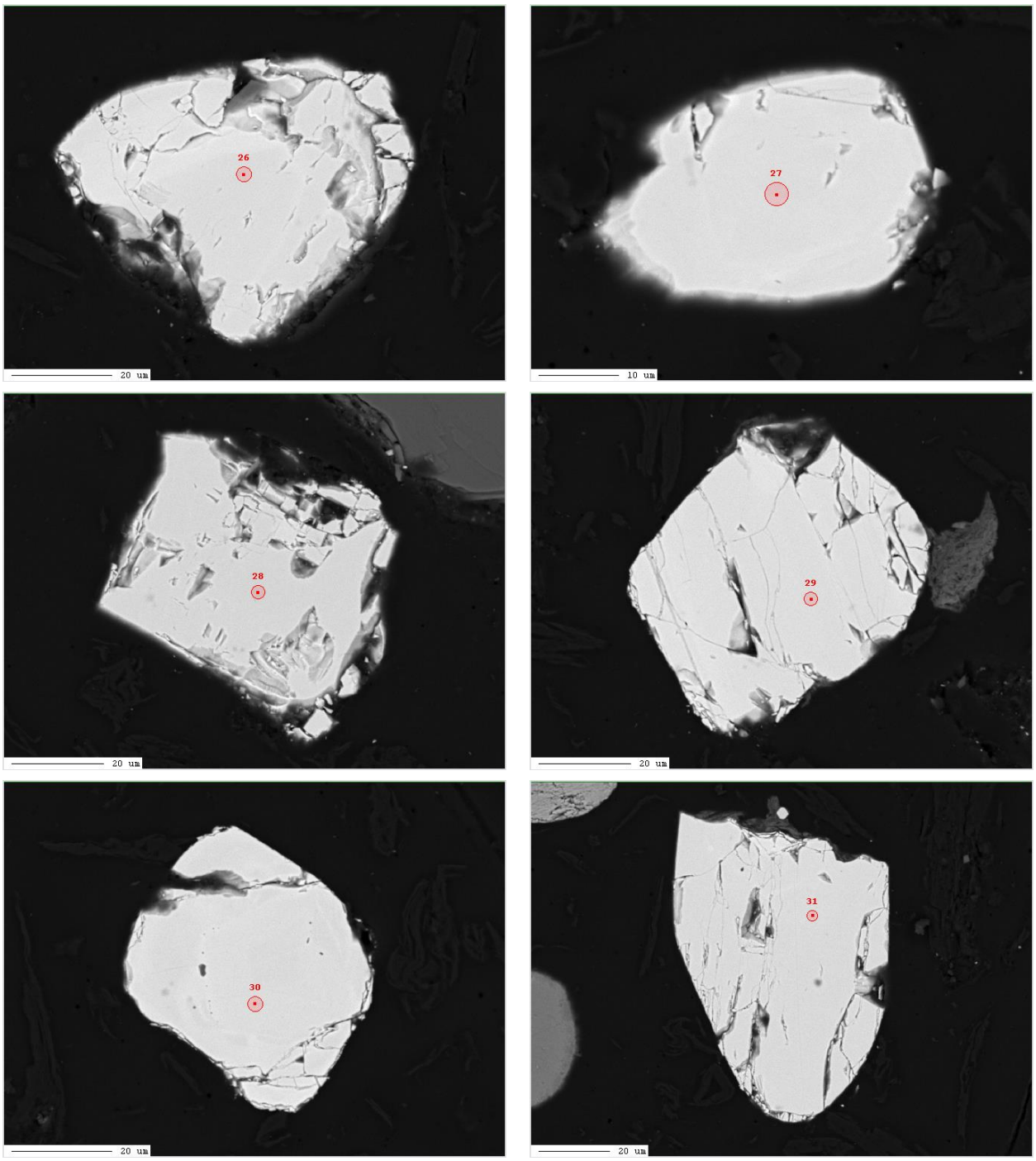


Figure 94: BSE Images of Zircon from GA_VC-3

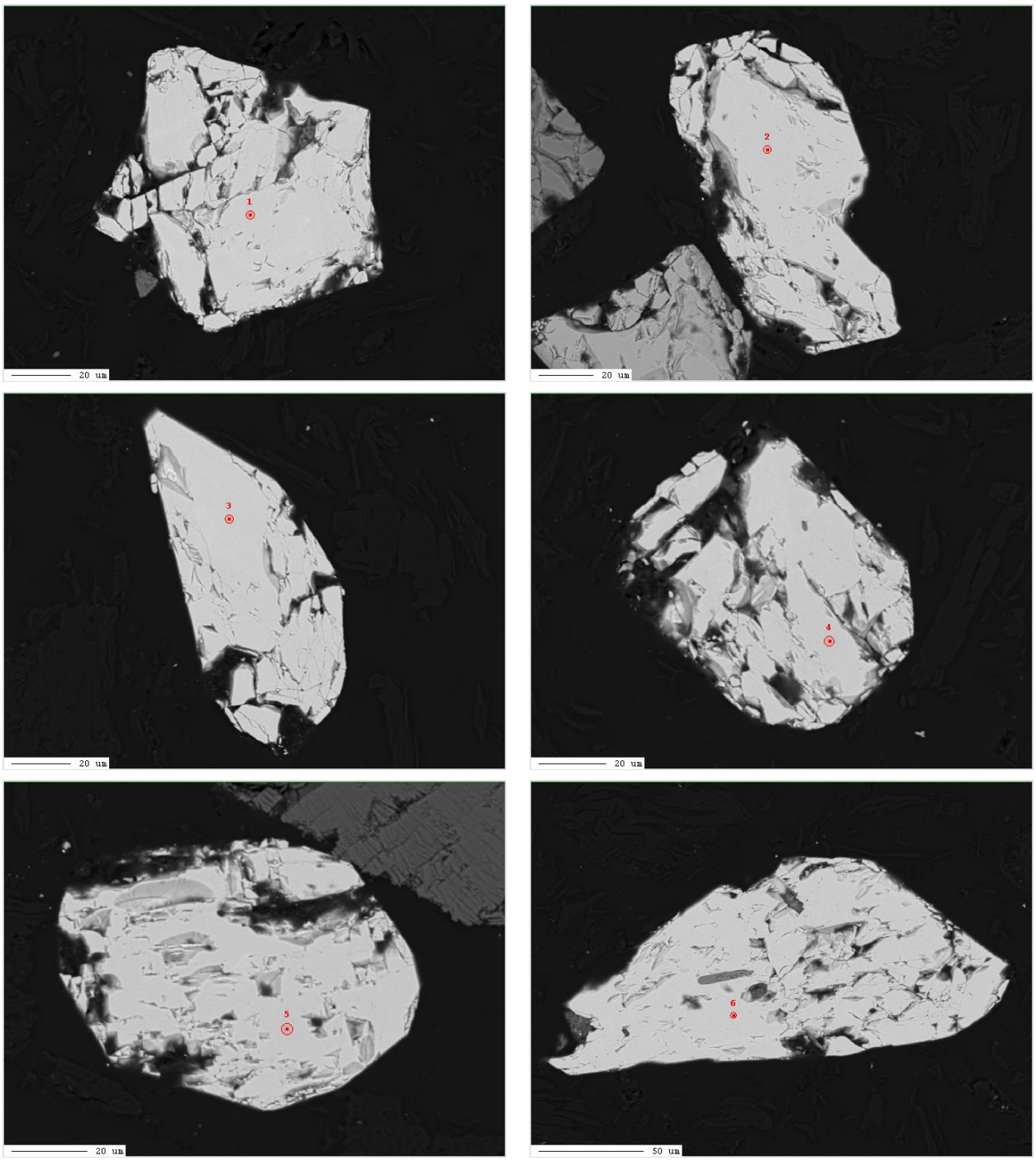


Figure 95: BSE Images of Zircon from SC_VC-15

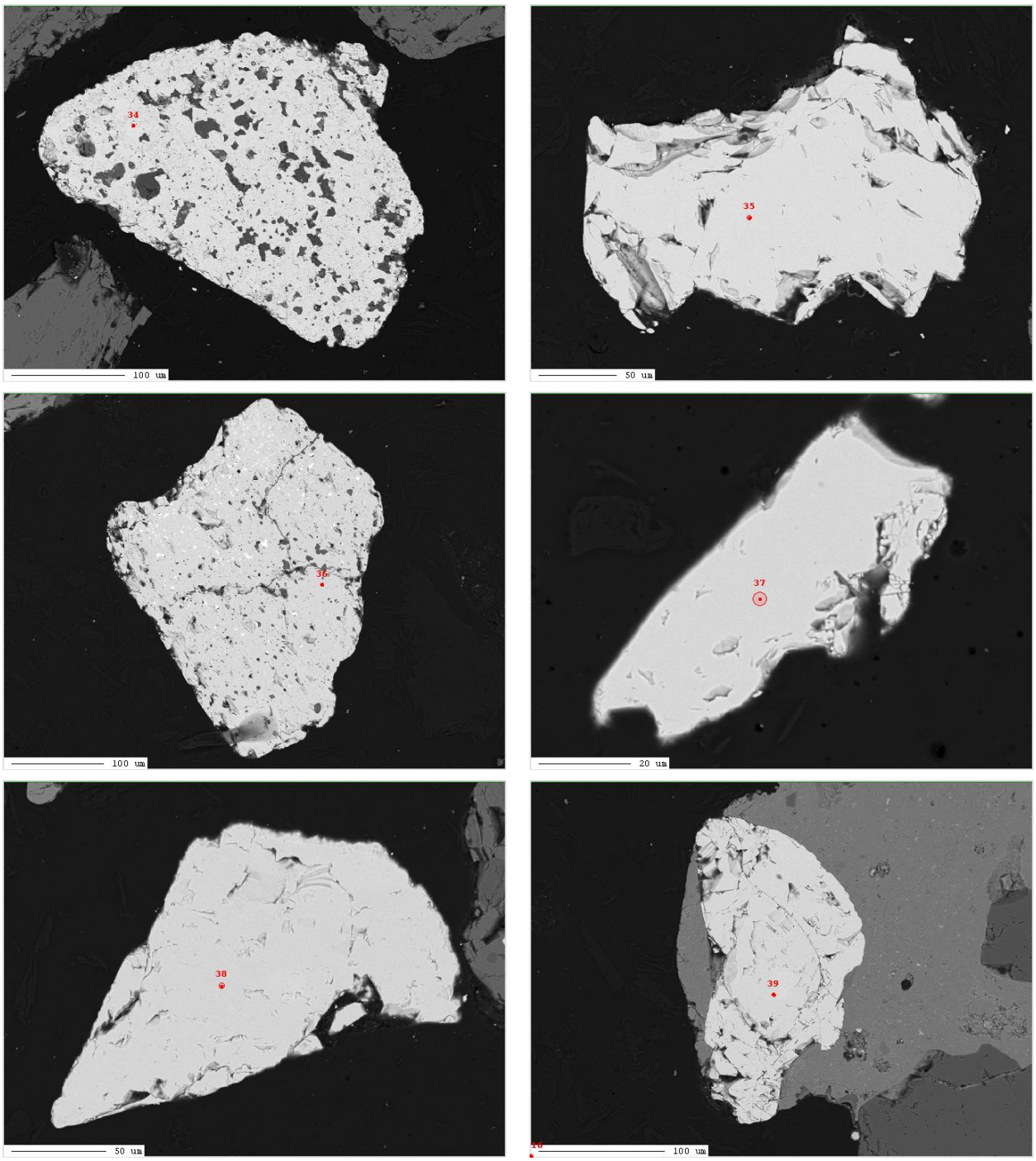


Figure 96: BSE Images of Zircon from SC_VC-29

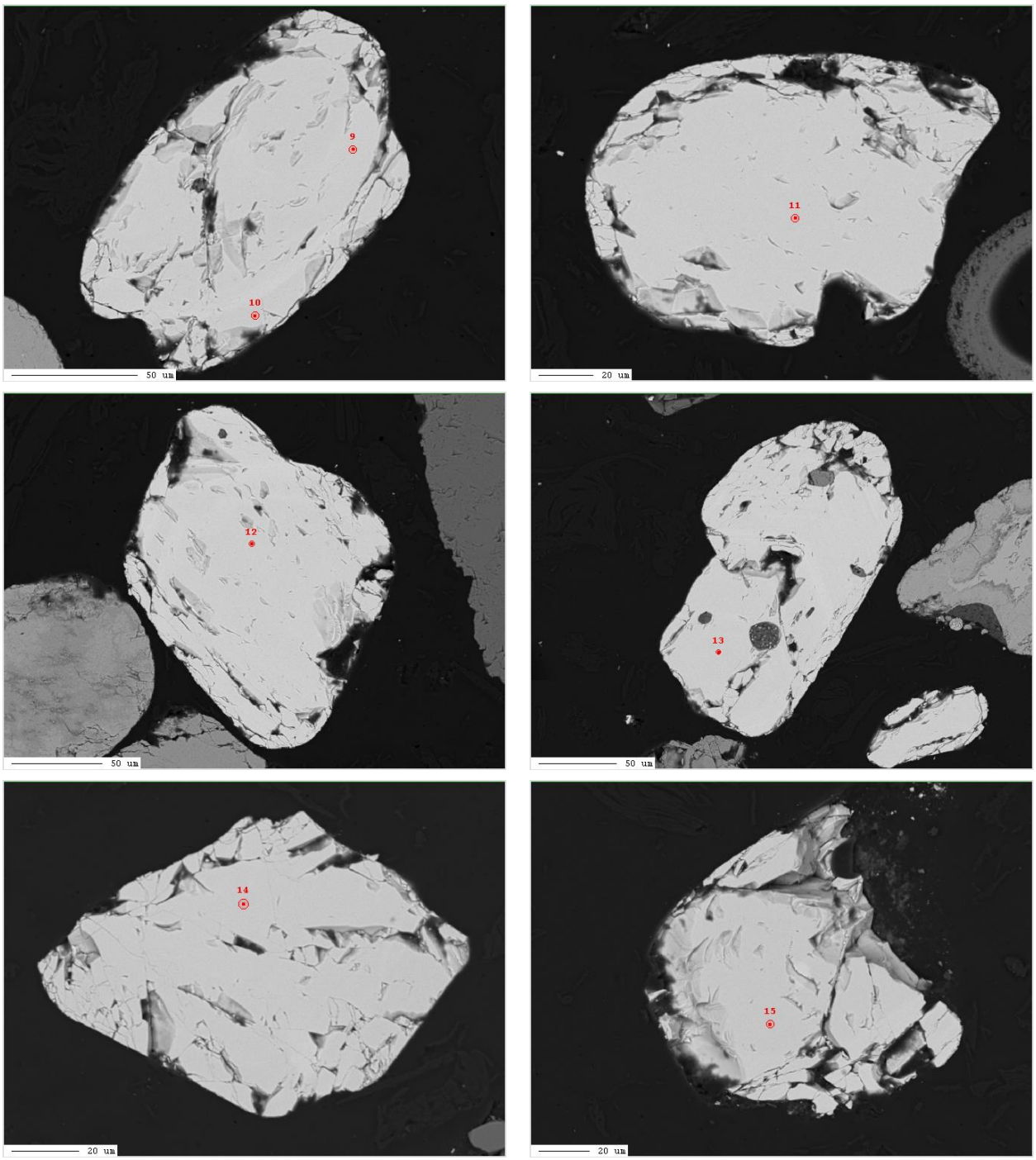


Figure 97: BSE Images of Zircon from NC_VC-27

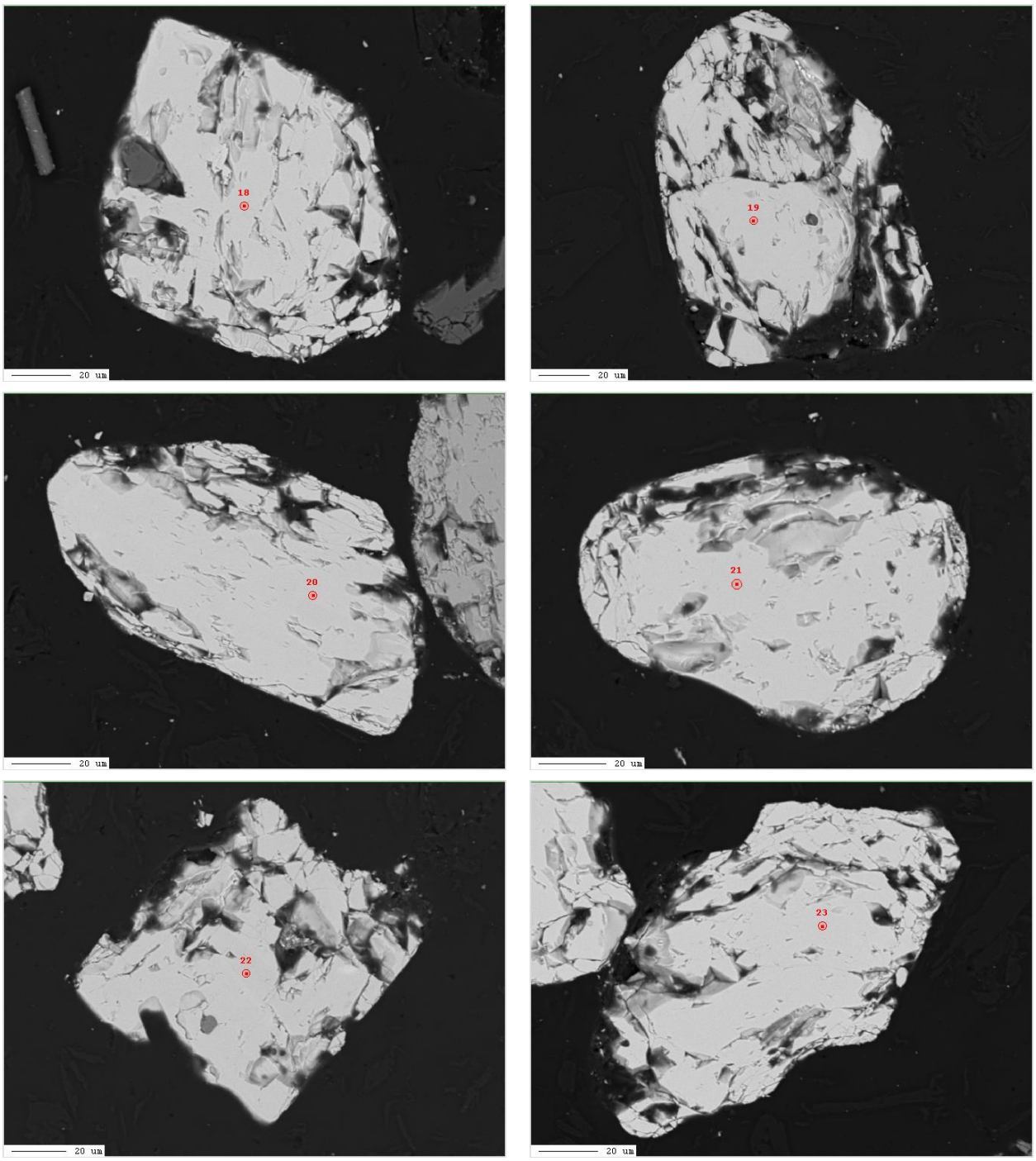


Figure 98: BSE Images of Zircon from NC_VC-37

No. Analyses	GA_VC-3/Oxide	Nb_2O_5	Ta_2O_5	SiO_2	TiO_2	SnO_2	Cr_2O_3	Fe_2O_3	Total
1	Rutile	0.30	0.00	0.00	98.48	0.00	0.03	0.55	99.37
2	Rutile	1.51	0.09	0.00	97.44	0.02	0.05	0.84	99.96
3	Rutile	0.08	0.01	0.59	90.62	0.01	2.57	1.76	95.65
4	Rutile	0.51	0.03	0.00	98.68	0.00	0.07	0.36	99.65
5	Rutile	1.92	0.28	0.00	96.39	0.02	0.13	0.92	99.66
6	Rutile	0.03	0.00	0.00	99.42	0.00	0.17	0.42	100.04
7	Rutile	1.66	0.13	0.00	96.84	0.01	0.08	0.79	99.52
8	Rutile	2.51	0.20	0.00	95.41	0.01	0.10	1.05	99.29
	Min	0.03	0.00	0.00	90.62	0.00	0.03	0.36	95.65
	Max	2.51	0.28	0.59	99.42	0.02	2.57	1.76	100.04
	Ave	***1.07***	***0.09***	***0.07***	***96.66***	***0.01***	***0.40***	***0.84***	***99.14***

No. Analyses	SC_VC-15/Oxide	Nb_2O_5	Ta_2O_5	SiO_2	TiO_2	SnO_2	Cr_2O_3	Fe_2O_3	Total
1	Rutile	2.75	0.42	0.00	94.44	0.04	0.05	1.63	99.33
2	Rutile	0.17	0.00	0.00	99.83	0.00	0.04	0.39	100.44
3	Rutile	0.18	0.02	0.00	98.91	0.00	0.20	0.06	99.37
4	Rutile	0.10	0.00	0.00	98.70	0.00	0.00	0.91	99.71
5	Rutile	0.89	0.05	0.01	97.82	0.01	0.06	0.41	99.25
6	Rutile	3.18	0.24	0.00	94.27	0.05	0.06	1.91	99.72
7	Rutile	1.73	0.19	0.00	96.73	0.04	0.10	0.90	99.68
8	Rutile	1.69	0.09	0.00	96.81	0.00	0.00	1.41	100.01
	Min	0.10	0.00	0.00	94.27	0.00	0.00	0.06	99.25
	Max	3.18	0.42	0.01	99.83	0.05	0.20	1.91	100.44
	Ave	***1.34***	***0.13***	***0.00***	***97.19***	***0.02***	***0.06***	***0.95***	***99.69***

No. Analyses	SC_VC-29/Oxide	Nb_2O_5	Ta_2O_5	SiO_2	TiO_2	SnO_2	Cr_2O_3	Fe_2O_3	Total
1	Rutile	0.32	0.00	0.00	98.84	0.00	0.05	0.23	99.45
2	Rutile	0.27	0.01	0.00	99.24	0.00	0.12	0.23	99.88
3	Rutile	1.10	0.07	0.00	97.41	0.01	0.02	0.66	99.27
4	Rutile	0.10	0.00	0.00	99.26	0.01	0.06	0.19	99.63
5	Rutile	0.08	0.00	0.01	100.31	0.00	0.03	0.15	100.58
6	Rutile	0.13	0.01	0.00	99.62	0.00	0.04	0.20	100.00
7	Rutile	0.15	0.00	0.00	99.51	0.00	0.09	0.32	100.06
8	Rutile	0.27	0.00	0.01	98.96	0.01	0.08	0.18	99.51
	Min	0.08	0.00	0.00	97.41	0.00	0.02	0.15	99.27
	Max	1.10	0.07	0.01	100.31	0.01	0.12	0.66	100.58
	Ave	***0.30***	***0.01***	***0.00***	***99.14***	***0.00***	***0.06***	***0.27***	***99.80***

No. Analyses	NC_VC-27/Oxide	Nb_2O_5	Ta_2O_5	SiO_2	TiO_2	SnO_2	Cr_2O_3	Fe_2O_3	Total
1	Rutile	0.29	0.00	0.00	98.89	0.00	0.05	0.17	99.41
2	Rutile	0.50	0.02	0.00	98.19	0.02	0.06	0.43	99.23
3	Rutile	0.34	0.01	0.00	98.68	0.01	0.09	0.07	99.21
4	Rutile	0.13	0.01	0.00	98.92	0.01	0.07	0.00	99.14
5	Rutile	0.31	0.02	0.37	98.27	0.00	0.01	0.32	99.30
6	Rutile	0.15	0.03	0.02	99.04	0.00	0.02	0.15	99.42
7	Rutile	0.13	0.01	0.00	98.52	0.00	0.12	0.31	99.08
8	Rutile	0.40	0.02	0.00	98.29	0.00	0.12	0.16	98.99
9	Rutile	4.94	0.03	0.00	92.04	0.02	0.13	2.38	99.53
10	Rutile	7.38	0.06	0.01	88.97	0.03	0.18	3.43	100.06
11	Rutile	0.43	0.03	1.27	94.87	0.00	0.02	1.92	98.54
	Min	0.13	0.00	0.00	88.97	0.00	0.01	0.00	98.54
	Max	7.38	0.06	1.27	99.04	0.03	0.18	3.43	100.06
	Ave	***1.36***	***0.02***	***0.15***	***96.79***	***0.01***	***0.08***	***0.85***	***99.26***

No. Analyses	NC_VC-37/Oxide	Nb_2O_5	Ta_2O_5	SiO_2	TiO_2	SnO_2	Cr_2O_3	Fe_2O_3	Total
1	Rutile	0.03	0.02	0.89	95.05	0.00	0.05	1.32	97.35
2	Rutile	0.68	0.02	0.01	98.62	0.01	0.02	0.20	99.57
3	Rutile	0.15	0.01	0.00	99.83	0.01	0.00	0.25	100.26
4	Rutile	0.29	0.02	0.58	97.71	0.00	0.01	0.22	98.82
5	Rutile	0.45	0.01	0.00	99.10	0.01	0.02	0.51	100.10
6	Rutile	0.05	0.00	0.00	99.17	0.00	0.31	0.08	99.61
7	Rutile	0.17	0.01	0.01	99.26	0.00	0.00	0.48	99.93
	Min	0.03	0.00	0.00	95.05	0.00	0.00	0.08	97.35
	Max	0.68	0.02	0.89	99.83	0.01	0.31	1.32	100.26
	Ave	***0.26***	***0.01***	***0.21***	***98.39***	***0.00***	***0.06***	***0.44***	***99.38***

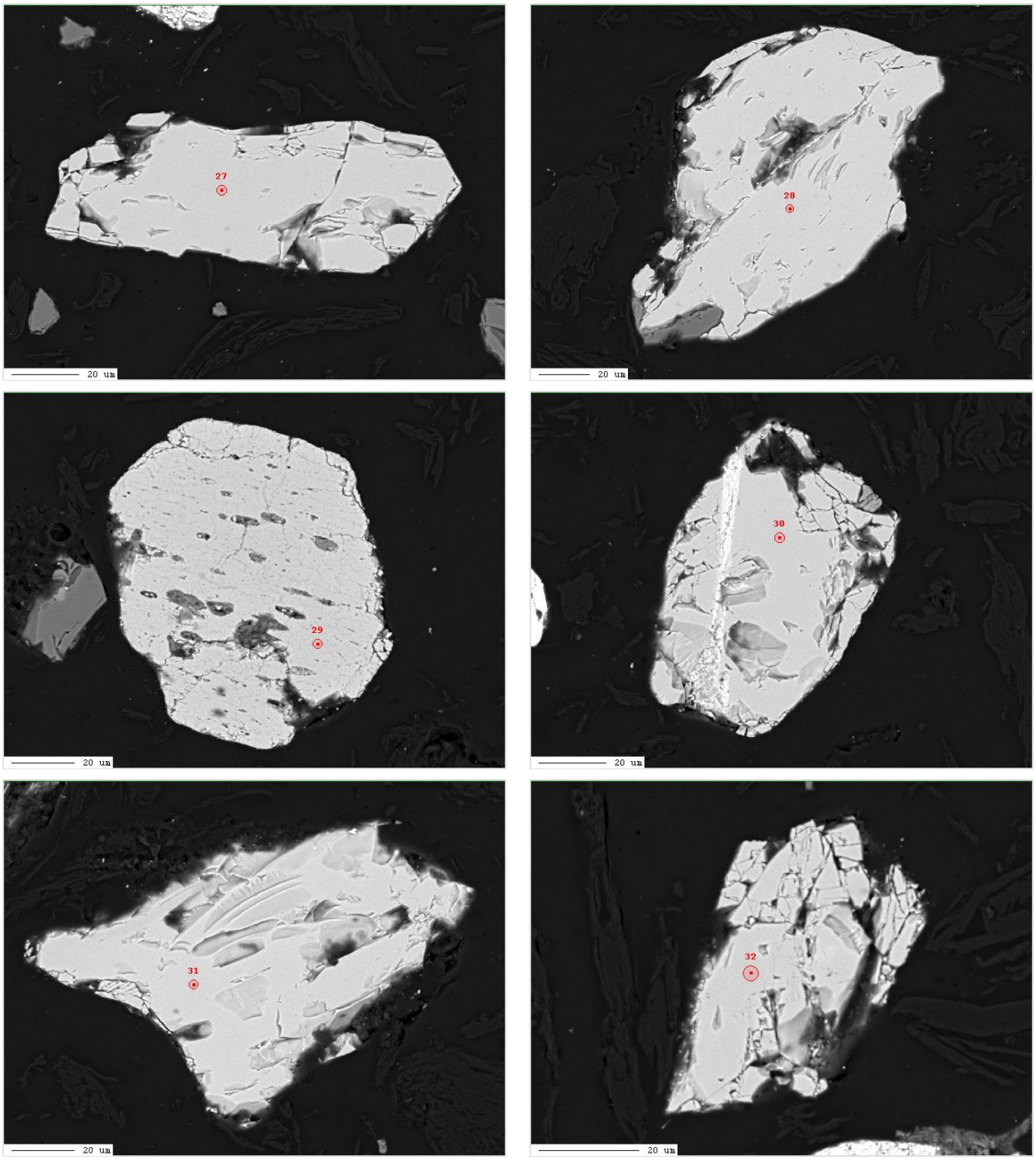


Figure 99: BSE Images of Rutile from GA_VC-3

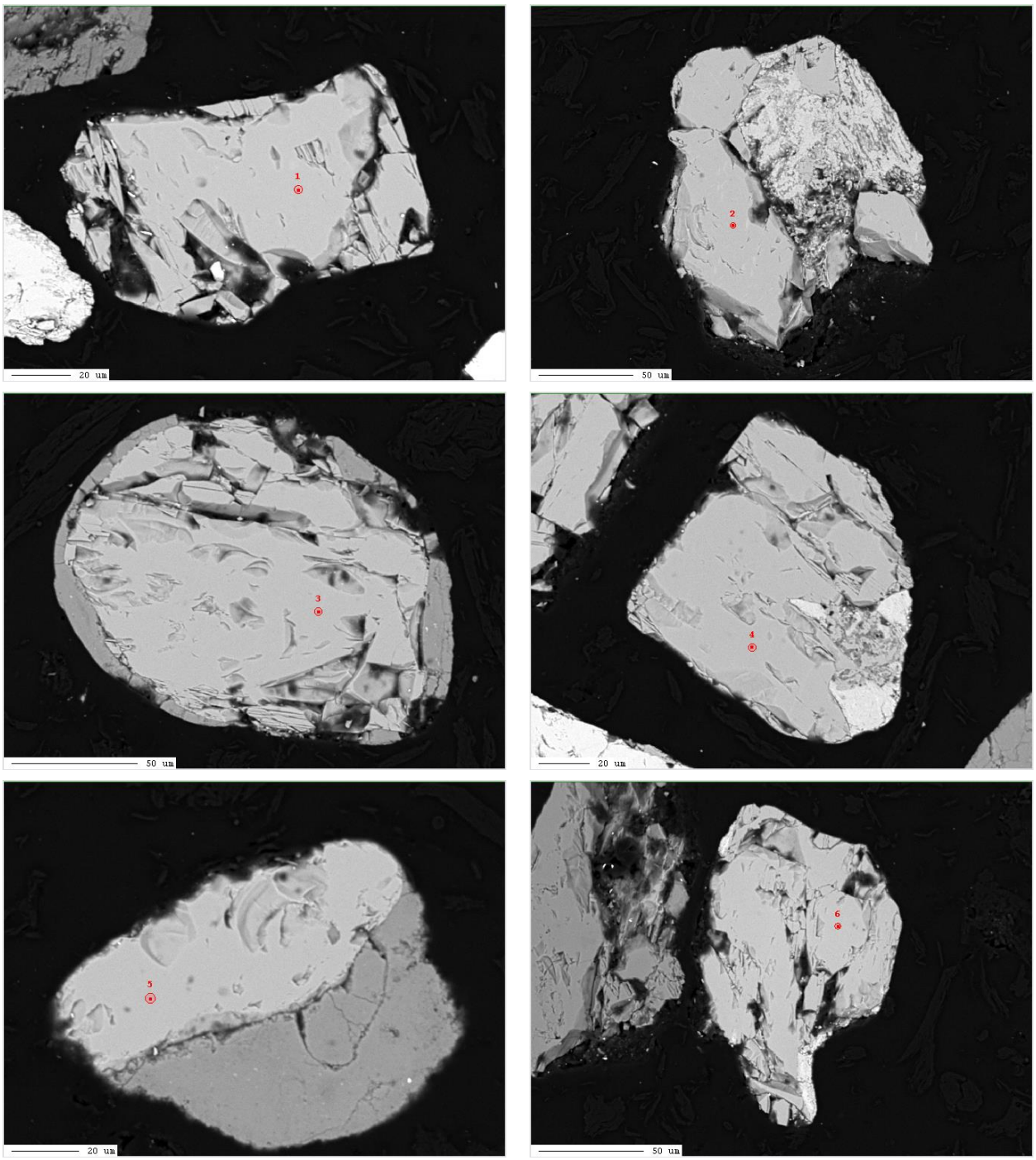


Figure 100: BSE Images of Rutile from SC_VC-15

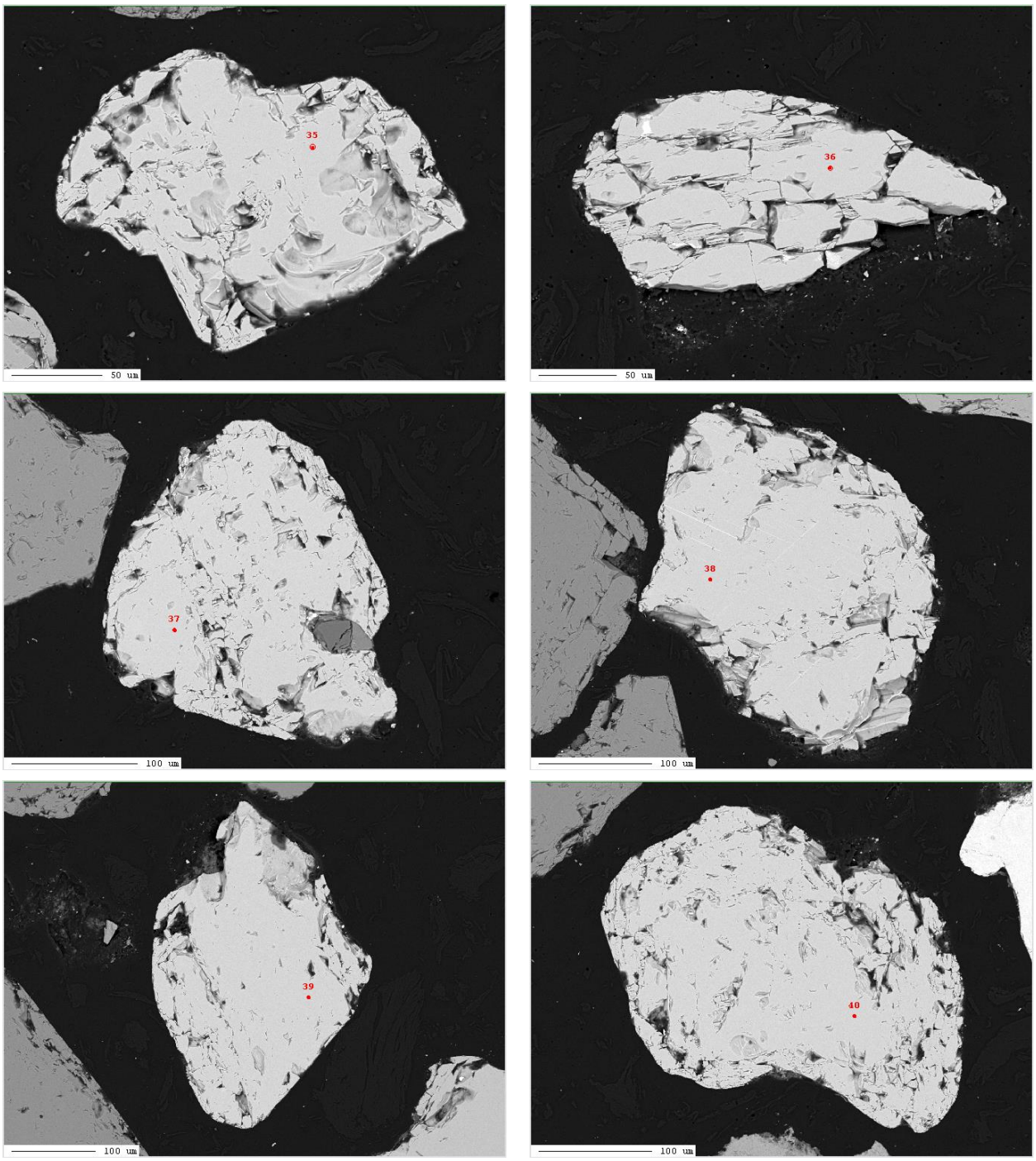


Figure 101: BSE Images of Rutile from SC_VC-29

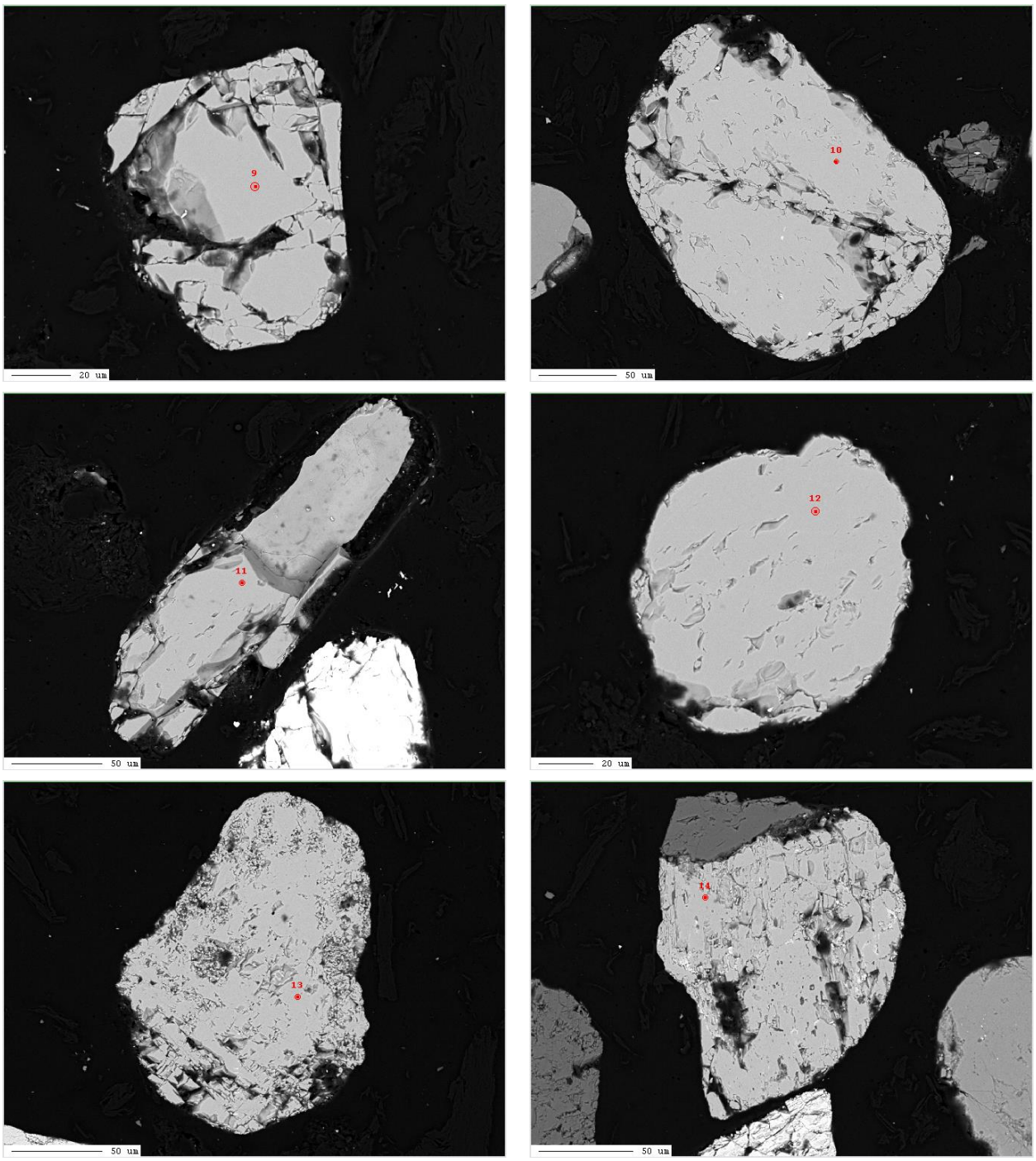


Figure 102: BSE Images of Rutile from NC_VC-27

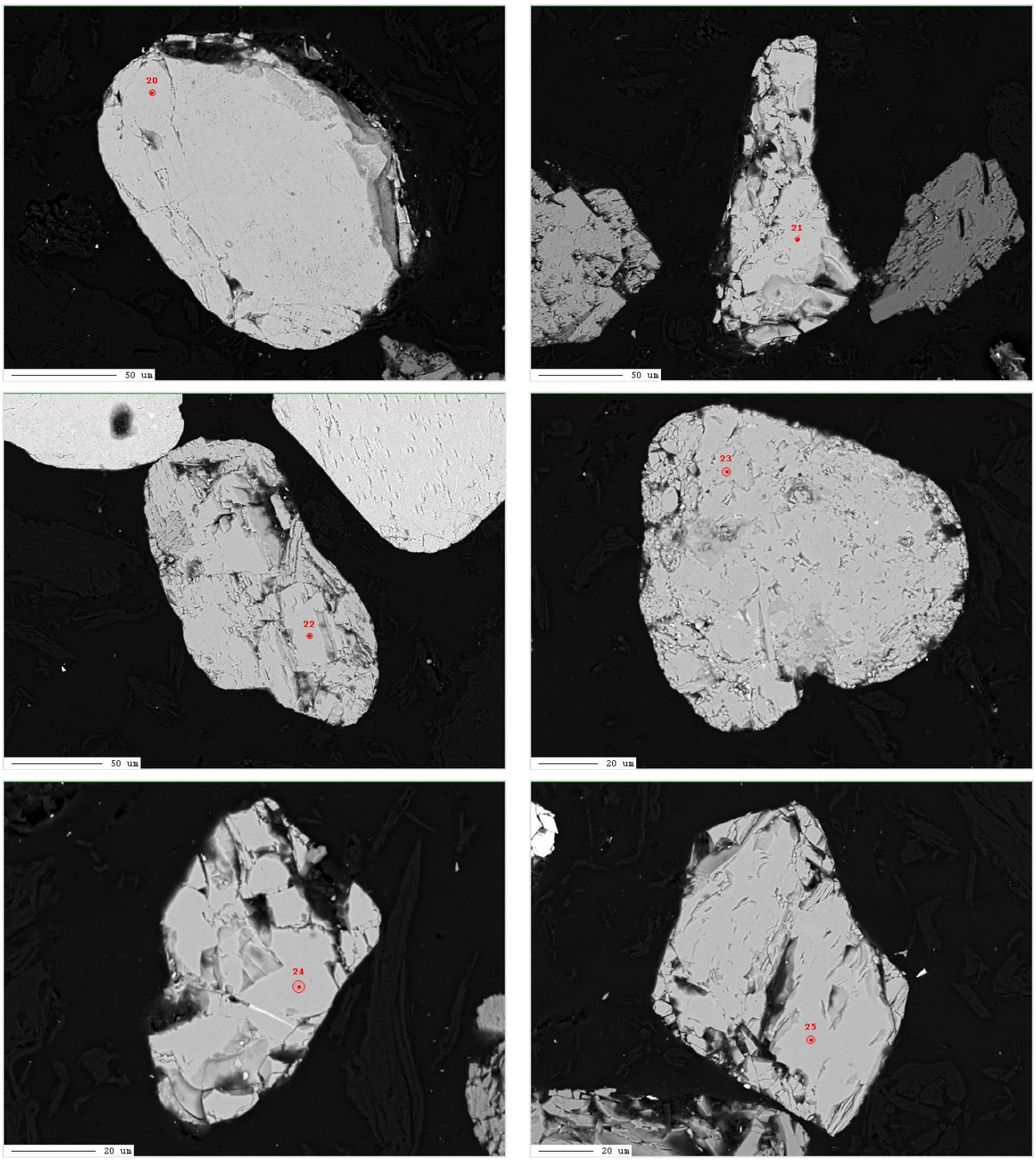


Figure 103: BSE Images of Rutile from NC_VC-37

Appendix E – Definitions and Terminology

Note that the qualitative descriptions and quantitative measurements are based on observations made in two-dimensional section through polished blocks of the sample. Various descriptive terms are used in this report; these terms are defined as follows:

Area %: Particles and grains are exposed at the surface of a polished section as two dimensional cross-sections. Any quantification of mineral characteristics is based on measurements, in pixels, of the exposed areas.

Association: Association refers to adjacency. Two minerals are "associated" if a pixel of one of the minerals occurs adjacent to a pixel of the other mineral. In this report association takes into account both vertically- and horizontally-adjacent pixels.

Association Mineral %: The number of pixels of a mineral type adjacent to the mineral of interest expressed as a percentage of all the pixels associated with the mineral of interest.

Calculated Chemical Composition: The major elemental chemical composition of the sample can be calculated by taking the SG (density) and theoretical chemical composition of each mineral into account. This QEMSCAN calculated chemical composition is compared to the measured chemical composition and a good agreement serves as validation of the mineralogical composition. Please note that the calculated and measured chemical compositions are never exactly similar due to uncertainties in the mineral chemistry.

Grain: A mineral grain that consists of a single mineral type. Several grains can make up a particle. In the case of a liberated grain, the terms grain and particle are equivalent.

Exposure %: The number of pixels of a specified mineral type adjacent to background, expressed as a percentage of those associated pixels to background.

Liberated: In the context of this report a particle containing >80 area % of the mineral of interest is considered “liberated”. The set limit might vary depending on the mineral or process used to treat it.

Locked: In the context of this report, a mineral of interest is considered locked when the mineral has 0% background association.

Mass %: If a statistical number of mineral grains are measured, then the area % of each mineral can be converted into mass % taking the SG of each mineral into account.

Particle: Several grains make up a particle. A particle usually refers to a fragment of a rock or ore, the size of which is dependent on crushing and milling conditions.

Grain Size: The size of the minerals as shown in the table below 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.

Liberation, Association

Association classes were defined as the follows:

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% of the total particle area and liberated (≥80%). 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, mineral associations including the mineral of interest.

Association classes were defined as the follows:

- Free Monazite - a particle that has ≥95% of Monazite
- Liberated Monazite - a particle that has ≤95% to ≥80% of Monazite
- Binary/ternary Monazite: quartz/feldspars - a particle that has ≥95 area% of Monazite: quartz/feldspars
- Binary/ternary Monazite: carbonates - a particle that has ≥95 area% of Monazite: carbonates
- Monazite complex - particles that do not fall into the above categories

The liberation and association characteristics of these minerals for each sample are given below. Note that when minerals are present in trace amounts, roughly <0.2 wt%, statistical data might not be adequate to calculate the liberation and association. Thus, results must be interpreted with caution.