A Review of surface geochemistry on White Spur EL10/2011 for MMG.

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Introduction

This report is a review of multi element geochemistry collected by MMG on White Spur, over two different sampling campaigns. It includes a mixture of rock chip samples and soil samples. All of the samples were assayed by an ICP-MS/AES method after a 4 acid digest (Intertek method 4A-OM10).

Immobile trace element signatures were used to characterize the magmatic compositions. This was applied to both the rocks and soils. The soils were C-horizon samples, and it was considered that in terms of immobile trace elements, these were comparable with the rocks.

Major element plots were used to estimate the alteration mineralogy of the samples. Only the rock samples were used for this assessment. Both sample media were combined to make pathfinder element maps.

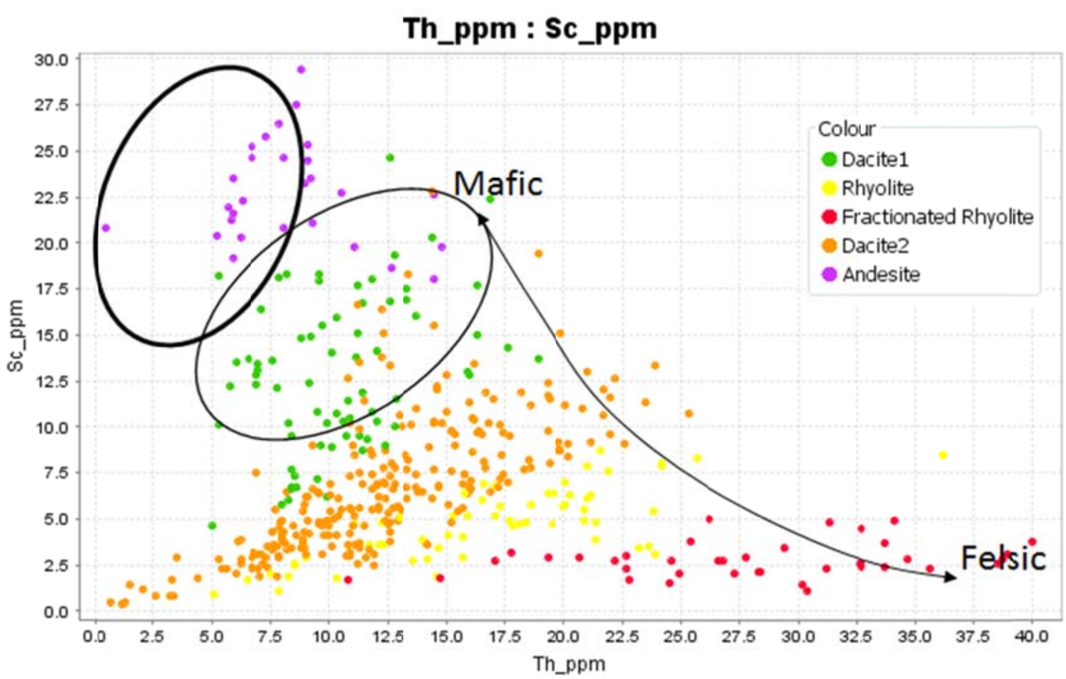
Discussion; using immobile trace elements to fingerprint lithology.

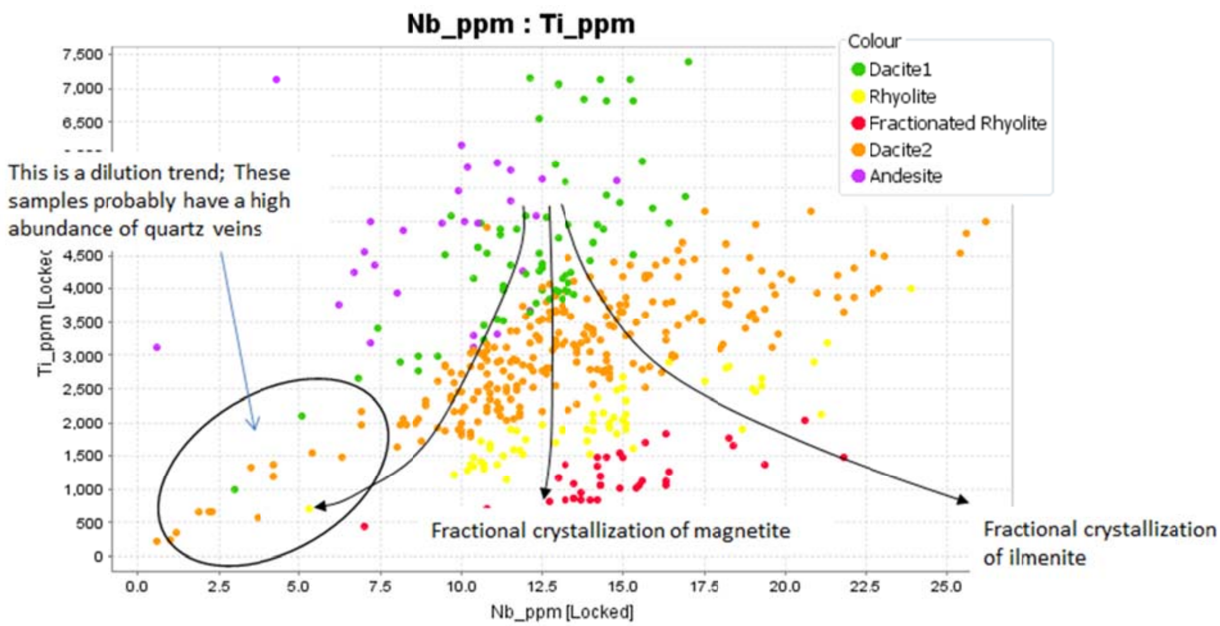
Scandium is a useful immobile element for identifying primary rock compositions because it substitutes for Fe into common silicate minerals such as hornblende, pyroxene, chlorite, etc. Sc can be considered as a proxy for the Fe content, but it is much less mobile than Fe during alteration and weathering. As a guide;

- basalt will have 30 to 50 ppm Sc,
- andesite 20 to 30ppm,
- dacite 10 to 20, and
- rhyolite less than 10ppm.

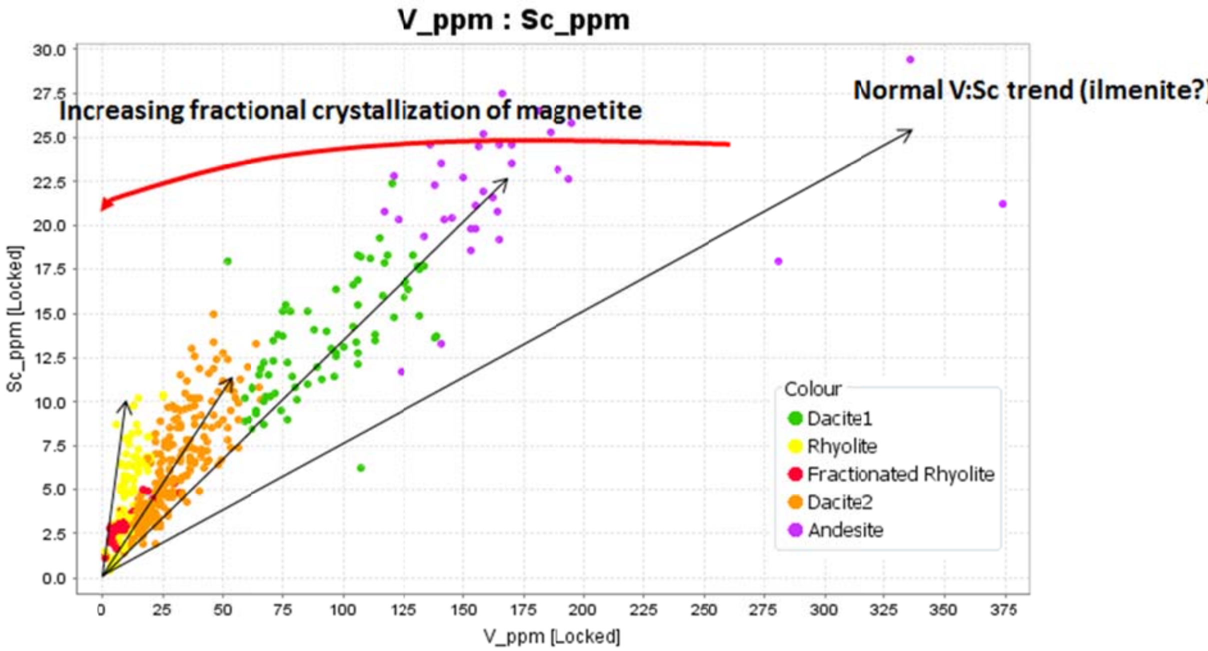
A plot of Sc versus Th plot is analogous to Ti vs Zr plots, but is more informative about compositions.

This plot demonstrates a range from high Sc to low Th in mafic rocks through to low Sc to high Th in felsic rocks.

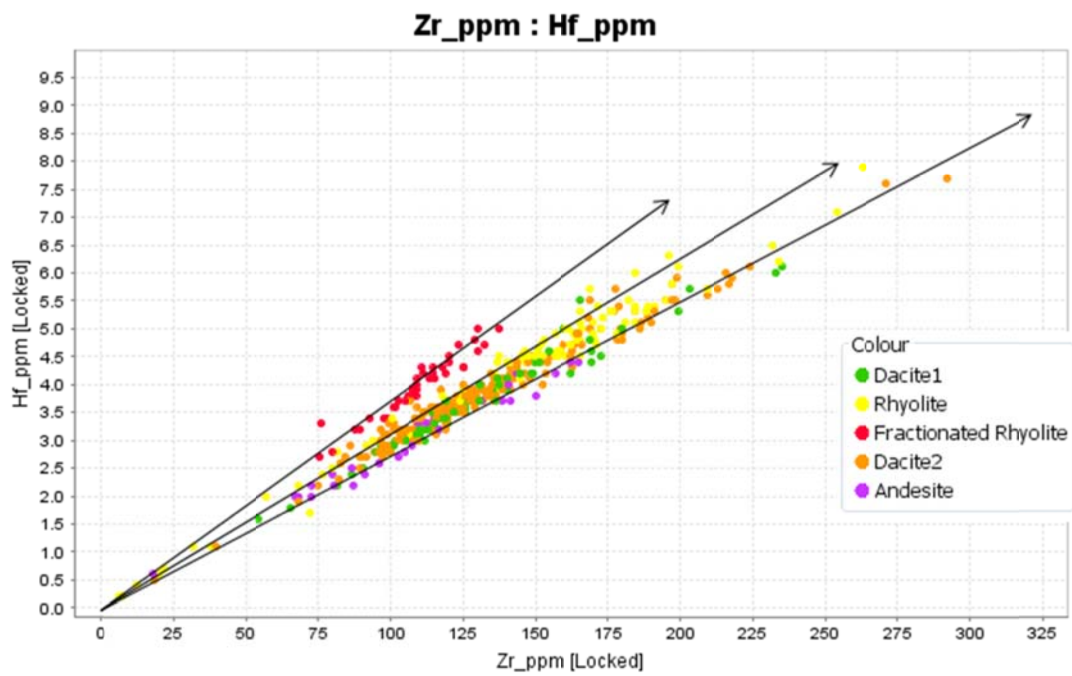




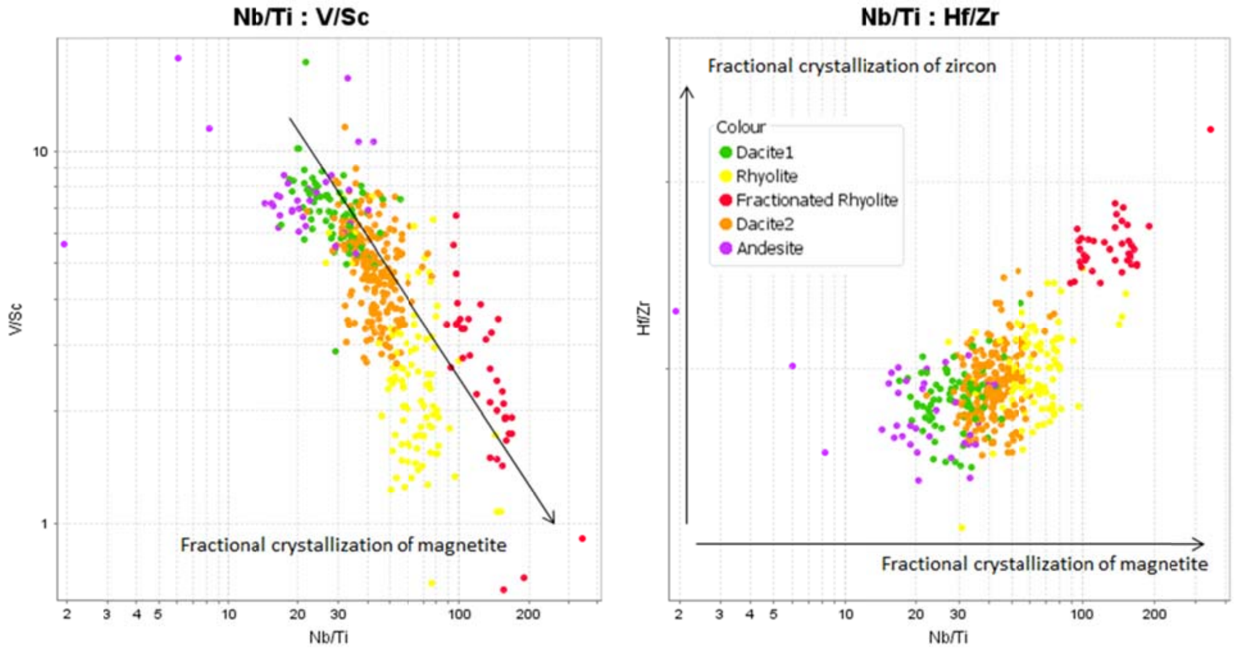
A plot of Ti vs Nb gives information about the nature of the opaque Fe-Ti oxide minerals in each magmatic suite. Ti vs Nb tends to generate a series of linear arrays that project back towards the origin. Nb substitutes for Ti in opaque minerals including titanite, rutile, magnetite and ilmenite. However niobium is relatively incompatible. Therefore the Nb/Ti ratio in the melt increases during fractional crystallization of oxides. The greatest rate of increase occurs when there is fractional crystallization of ilmenite, and the least rate of increase occurs with titanite. A consequence of this is that fractionating reduced magmas become highly enriched in niobium (eg Sn-granites); fractionating oxidized magmas tend to lower Ti, but without Nb enrichment (eg porphyry Cu), and fractionating calc-alkaline magmas (fractionating magnetite) plot somewhere in between.



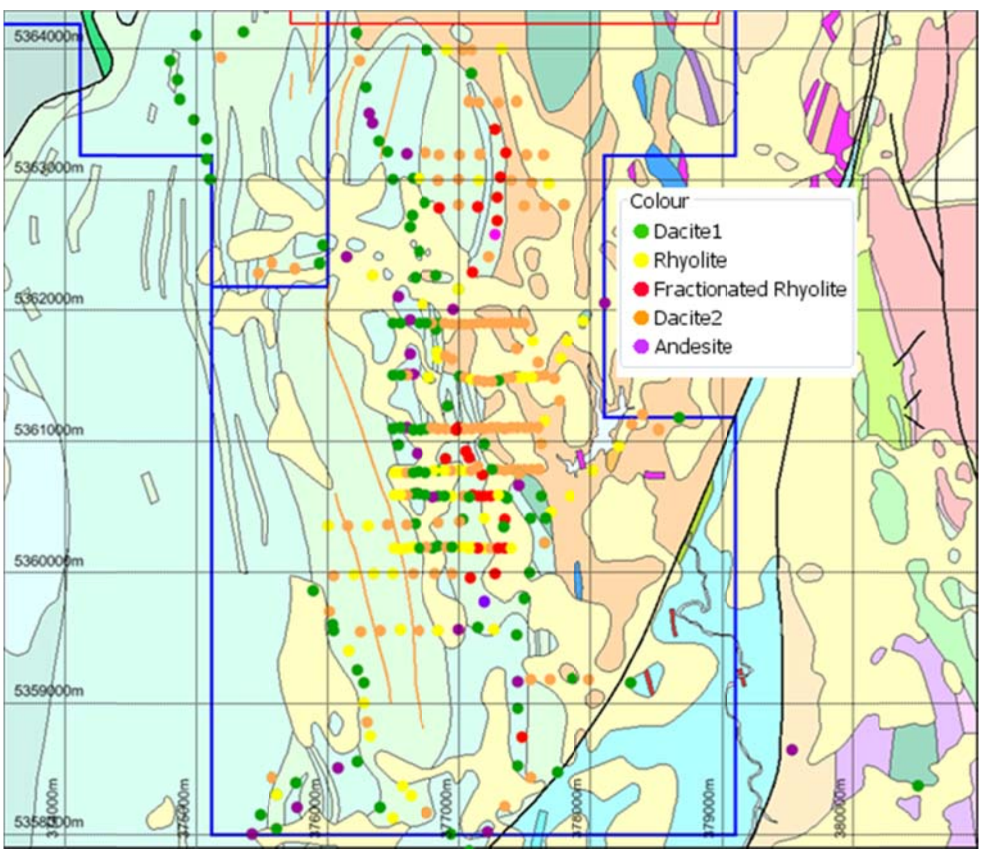
A plot of Sc vs V is a useful way to track fractional of magnetite. Most magmas have a Sc to V ratio of around 1:7. Both Sc and V^{3+} substitute for Fe in amphibole and pyroxene, and they tend to have very linear correlations. However, V^{4+} can substitute into oxides, but Sc^{3+} does not. There is a very high partition coefficient of V into titanomagnetite. Calc-alkaline rocks begin fractional crystallization of magnetite early in the cooling history. As the melts fractionate, V is incorporated into magnetite, the magnetite crystals settle out in the magma chamber, and the remaining melt is depleted in V. The Mount Read Volcanics from around Rosebery show a very distinct signature of magnetite fractional crystallization.



A plot of Hf vs Zr is a very effective way to test for fractional crystallization of zircon. Hf and Zr always plot with a near perfect straight line correlation; Hf can only substitute into the lattice of zircon crystals. However, hafnium is quite incompatible. As zircons crystallize, the melt very gradually evolves to higher Hf/Zr ratios. Zircons tend not to nucleate as new crystals; rather they just form overgrowing rims, so the final Hf/Zr ratio remains constant. Zircons usually crystallize late in the crystallization sequence, and felsic magmas are too viscous to allow crystal settling at that stage. However, where there is fractional crystallization of zircons, early formed zircons sink in the magma chamber, and the separated melt has a lower zircon content but a higher Hf/Zr ratio. This can only happen in melts with a very high water content. The high water content de-polyerizes silicate chains, significantly reduces the viscosity of silicate melts, and allows island silicates like zircon to crystalize earlier than feldspars; hence fractional crystallization can occur. This is a rare process, but an exceptionally good indicator of magmas that have high potential for ore-formation. The lower-most unit of the White Spur Formation shows a VERY distinct signature of fractional crystallization of zircons. This time window in the Mount Read Volcanics has exceptionally high potential for VMS mineralization.

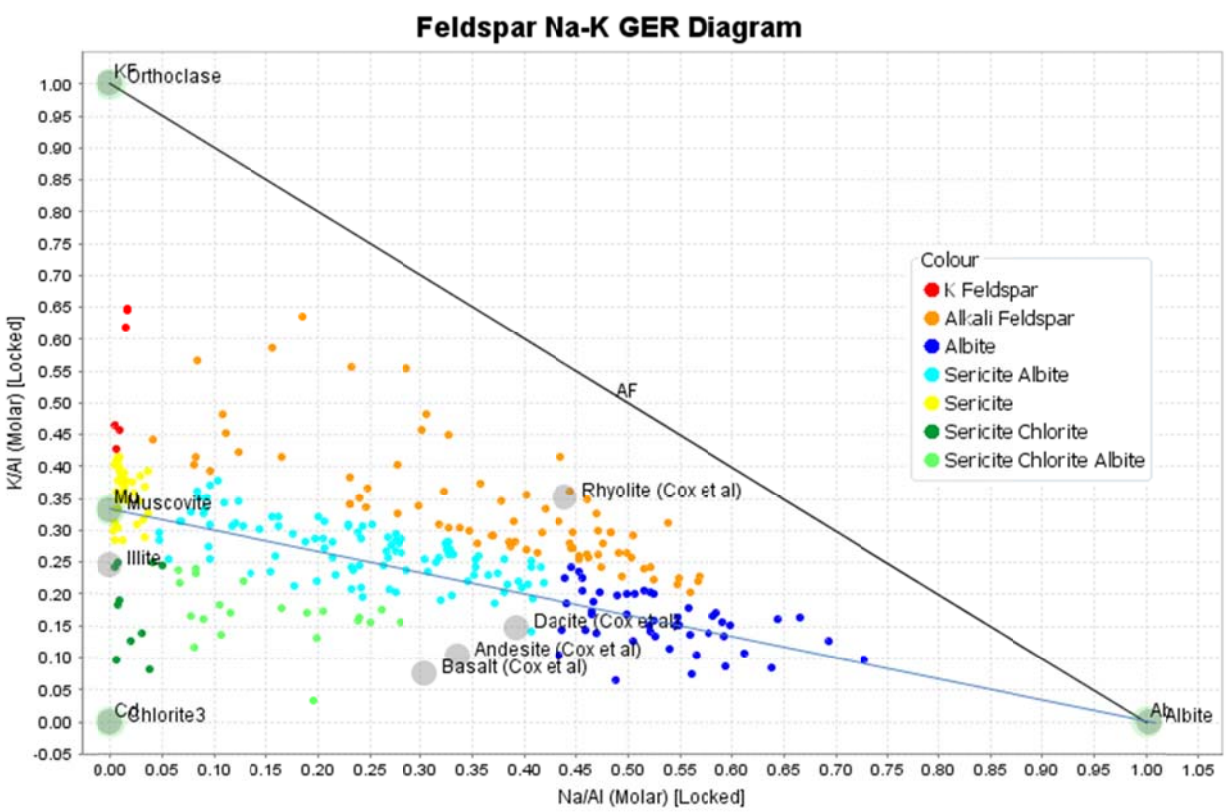


Ratios of these elements can be used as fractionation indexes.

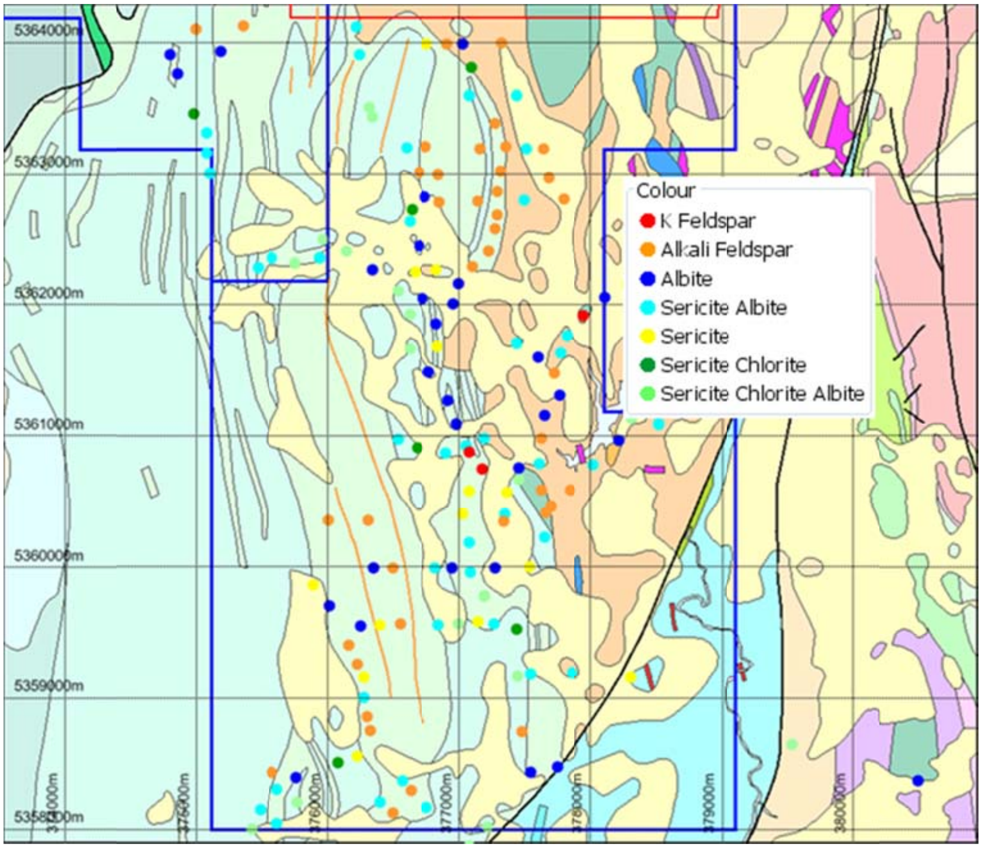


Alteration Mapping

One of the most useful plots for distinguishing alteration is K/Al versus Na/Al, calculated on a molar basis. Consider a rock that is totally sericitised. The mineralogy of the rock might be muscovite-quartz-carbonate-pyrite. All of the K and Al in that rock will be within sericite. Muscovite has a composition of $KAl_3Si_3O_{10}(OH)_2$. Therefore the ratio of K:Al in the sericitised rock is 1:3. Similarly, a totally K feldspar ($KAlSi_3O_8$) altered rock will have a K:Al ratio of 1:1. In the same way, albitisation can also be tracked. Albite is $NaAlSi_3O_8$: Na:Al =1:1.



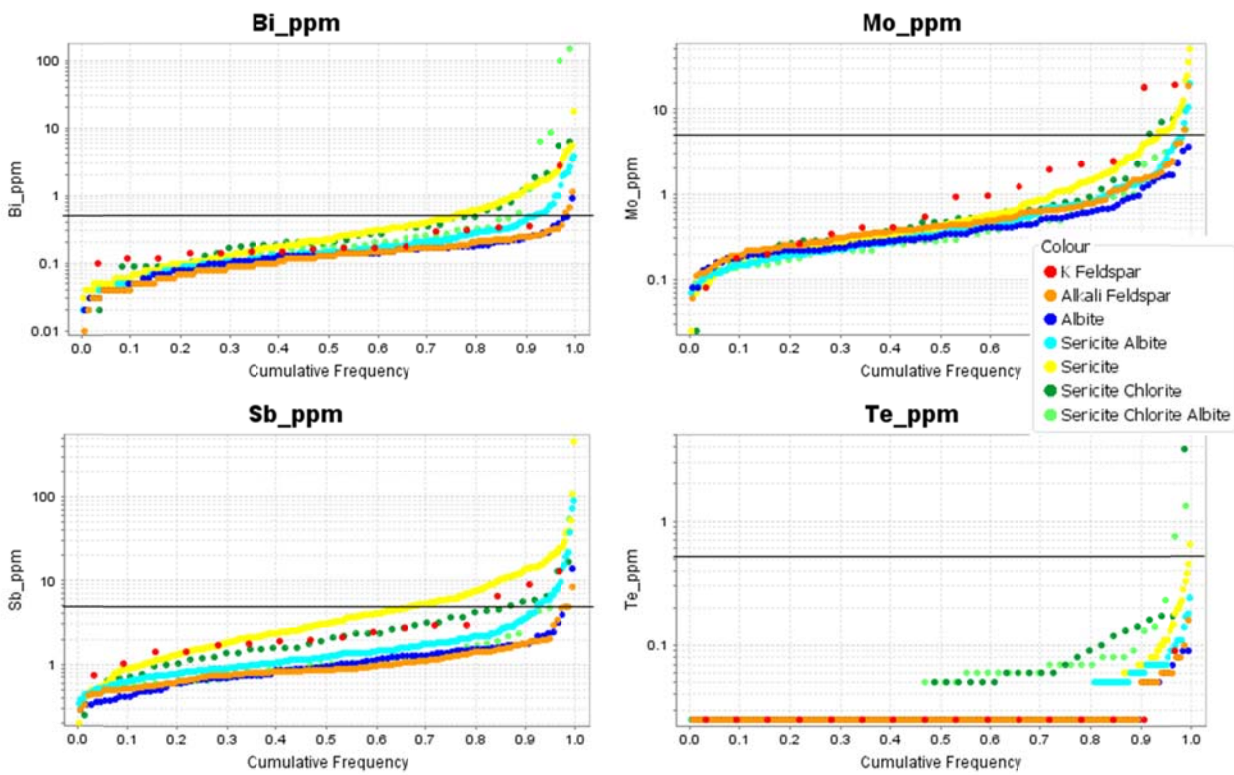
Note the points that plot along the sericite-albite tie line. Some of these are a little more albitic (dark blue) than the expected background. Many are somewhat Na-depleted, and plotting on a trajectory towards sericite (pale blue). There is a cluster of points (yellow) that are completely sericitised, and even a few points with strong K feldspar alteration. Samples that plot below the albite-sericite tieline are albite-sericite-chlorite mixtures.

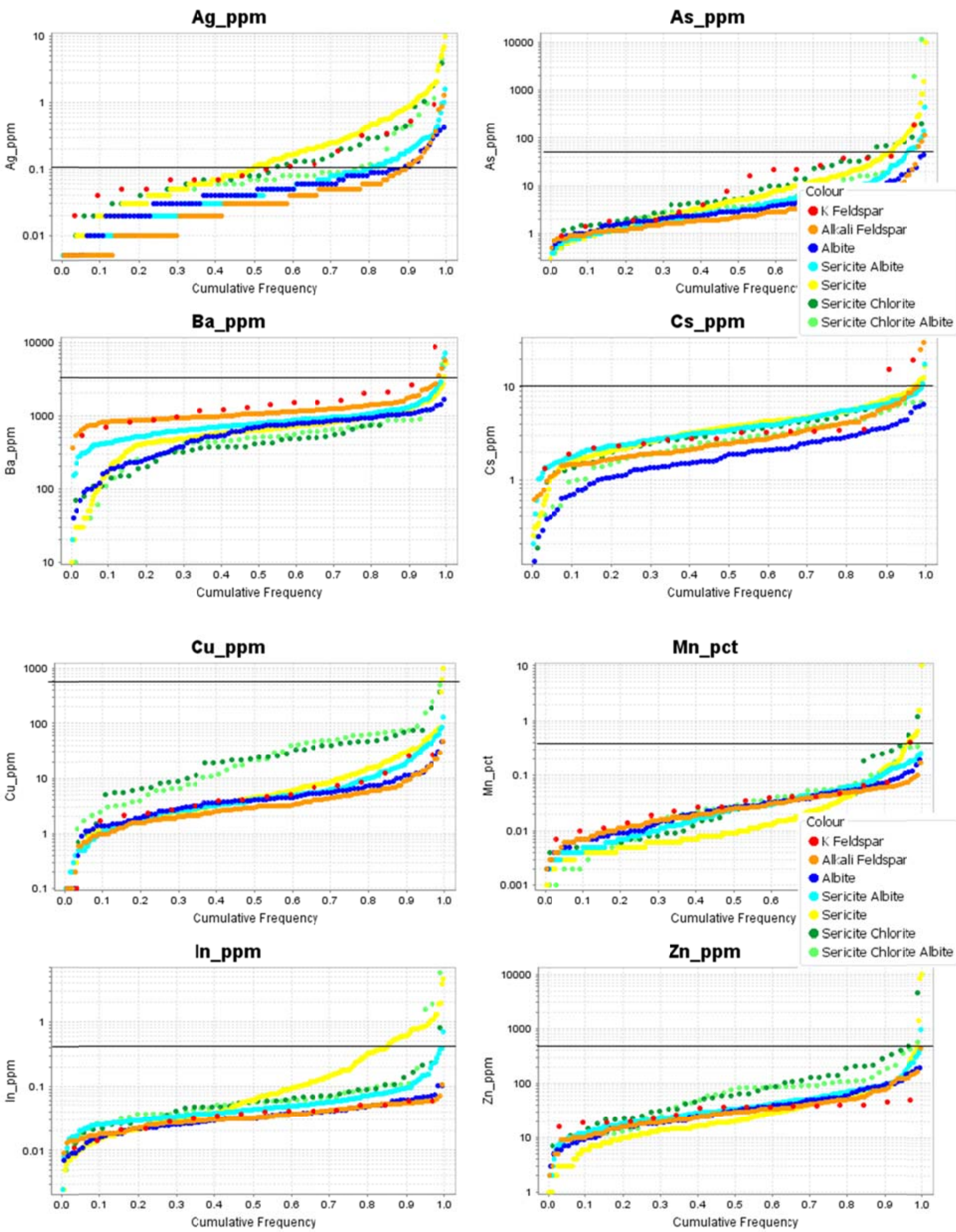


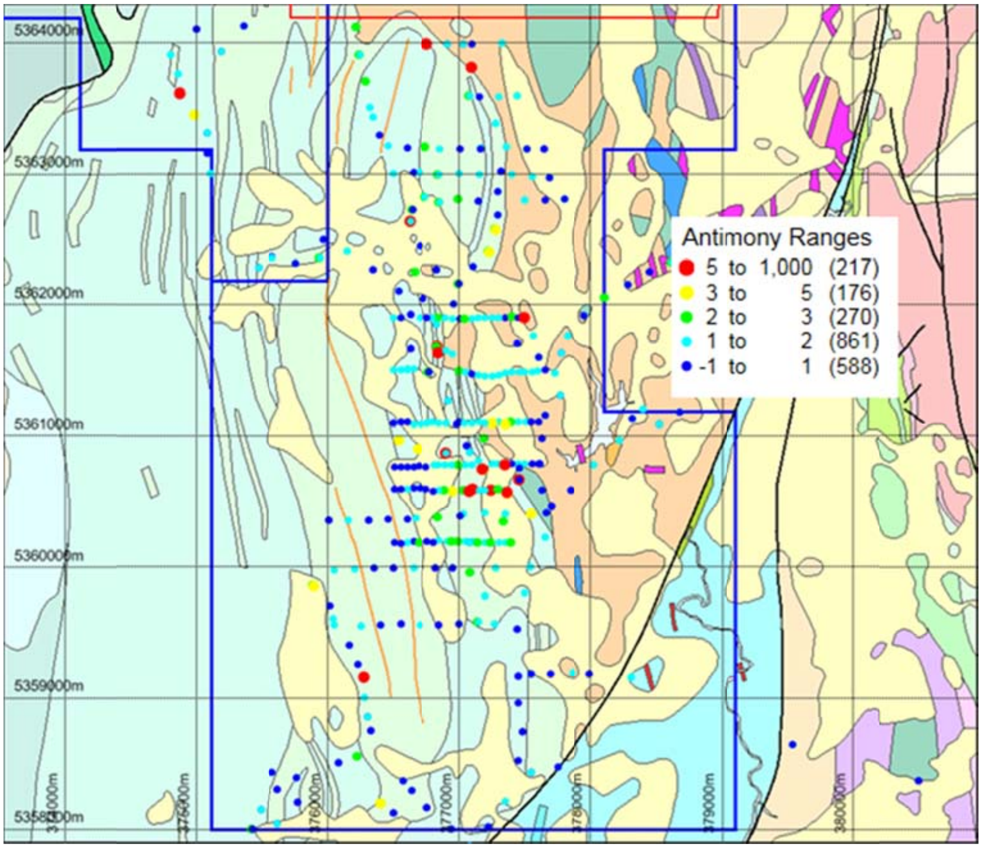
Colour
K Feldspar
Alkali Feldspar
Albite
Sericite Albite
Sericite
Sericite Chlorite
Sericite Chlorite Albite
5364000m
5363000m
5362000m
5361000m
5360000m
5359000m
375000m
376000m
377000m
378000m
379000m
380000m

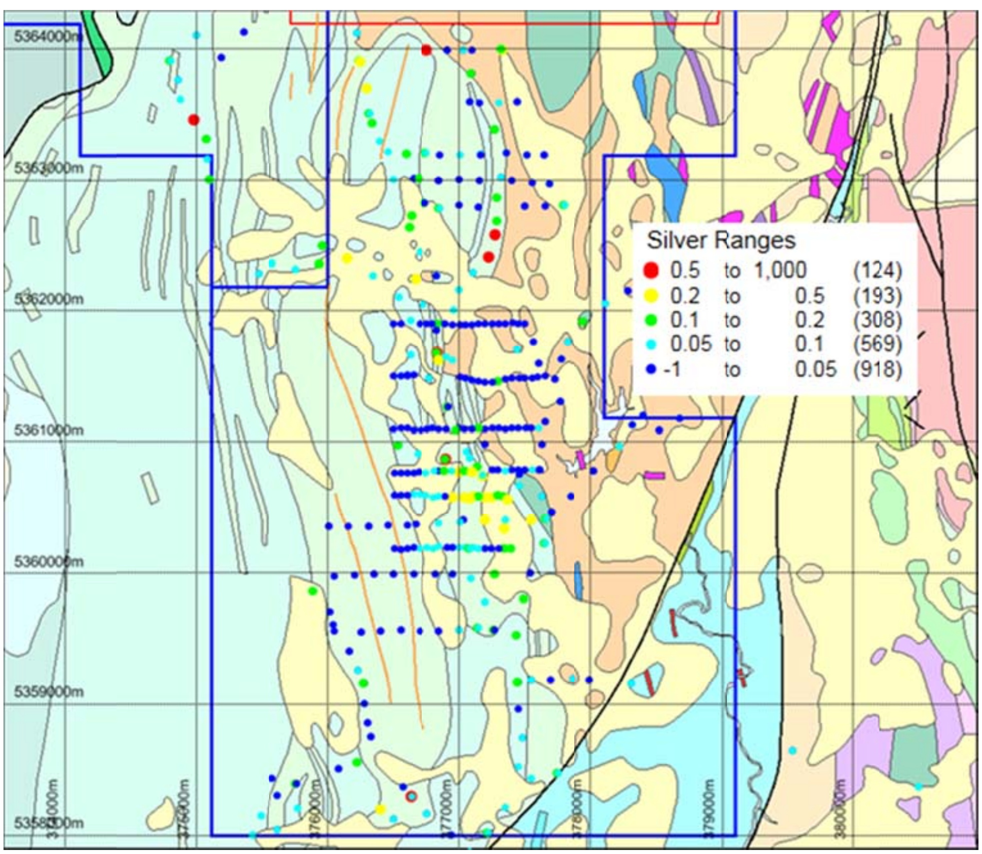
Pathfinder Elements

A very useful way to evaluate the level of anomalism in an assay data set is to look at cumulative frequency plots coloured by the alteration mineralogy (as in this case) or by classified lithology. These plots show cumulative frequency coloured by alteration mineralogy, for a suite of pathfinder elements. The black lines show 10x average crustal abundance eg., significant threshold level. The most anomalous metals in this data relative to the expected background are antimony, silver and bismuth.




Ag_ppm
Ag_ppm
Cumulative Frequency
As_ppm
As_ppm
Cumulative Frequency
Colour
K Feldspar
Alkali Feldspar
Albite
Sericite Albite
Sericite
Sericite Chlorite
Sericite Chlorite Albite
Ba_ppm
Ba_ppm
Cumulative Frequency
Cs_ppm
Cs_ppm
Cumulative Frequency
Cu_ppm
Cu_ppm
Cumulative Frequency
Mn_pct
Mn_pct
Cumulative Frequency
Colour
K Feldspar
Alkali Feldspar
Albite
Sericite Albite
Sericite
Sericite Chlorite
Sericite Chlorite Albite
In_ppm
In_ppm
Cumulative Frequency
Zn_ppm
Zn_ppm
Cumulative Frequency


Antimony Ranges
5 to 1,000 (217)
3 to 5 (176)
2 to 3 (270)
1 to 2 (861)
-1 to 1 (588)
5364000m
5362000m
5361000m
5359000m
377000m
379000m


Silver Ranges
0.5 to 1,000 (124)
0.2 to 0.5 (193)
0.1 to 0.2 (308)
0.05 to 0.1 (569)
-1 to 0.05 (918)
5364000m
5361000m
5359000m
377000m
379000m

The White Spur prospect has a relatively small (<1km strike) anomalous footprint of Sb-Ag-Pb, associated with a localized cell of K feldspar alteration and felsic volcanics in the lowest unit of the White Spur formation that are derived from an extremely fractionated magma source.

Although this is a small anomaly, it would be worth reviewing historic drill core from here to see what the fractionated rocks look like in core, and it would also be worth reviewing historic IP data to see how the rock chip and soil geochem anomaly matches up with the chargeability. Has the previous drilling tested the best part of the geochem anomaly and/or most chargeable zone?