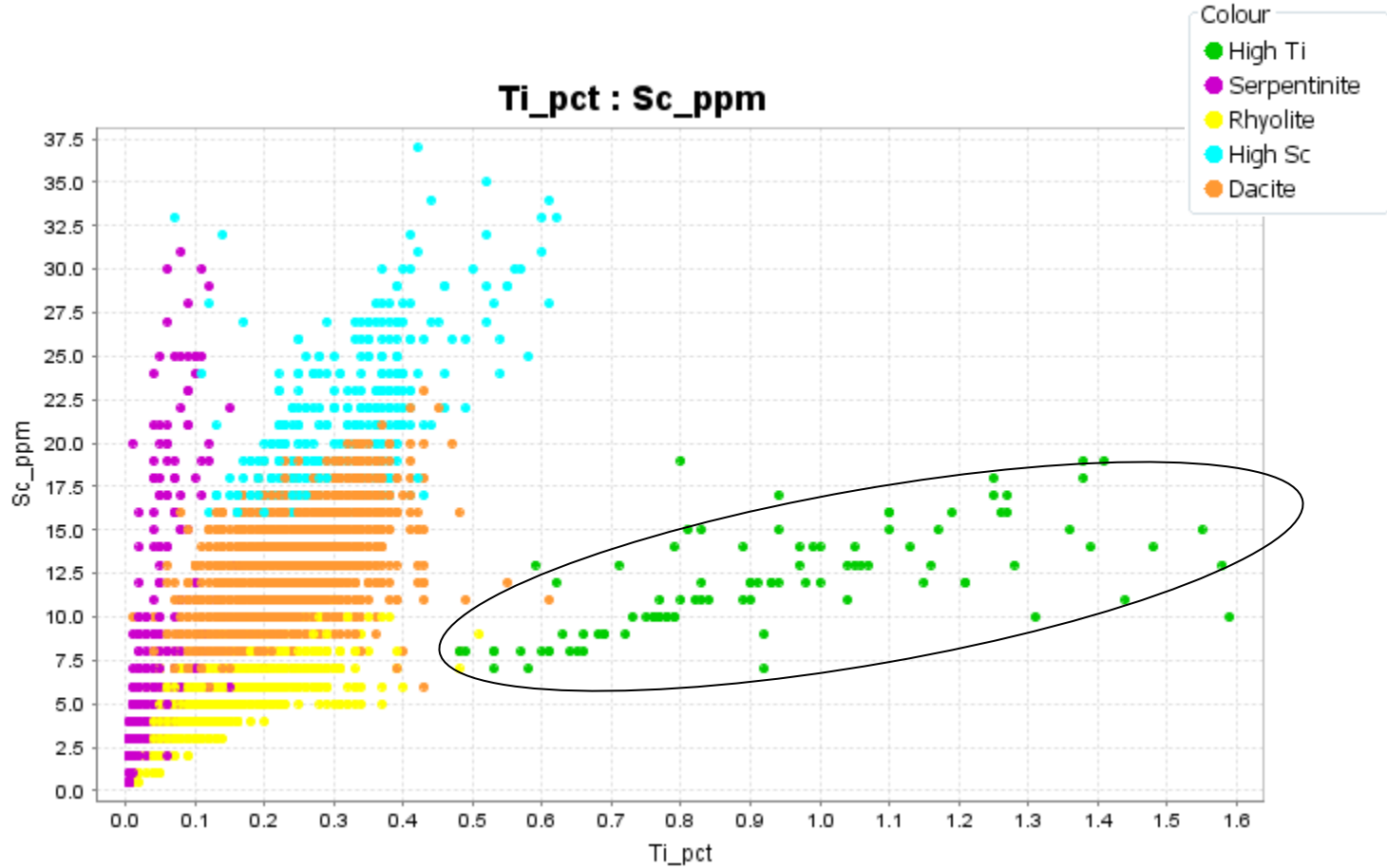


# Thursdays Gossan Geochemistry

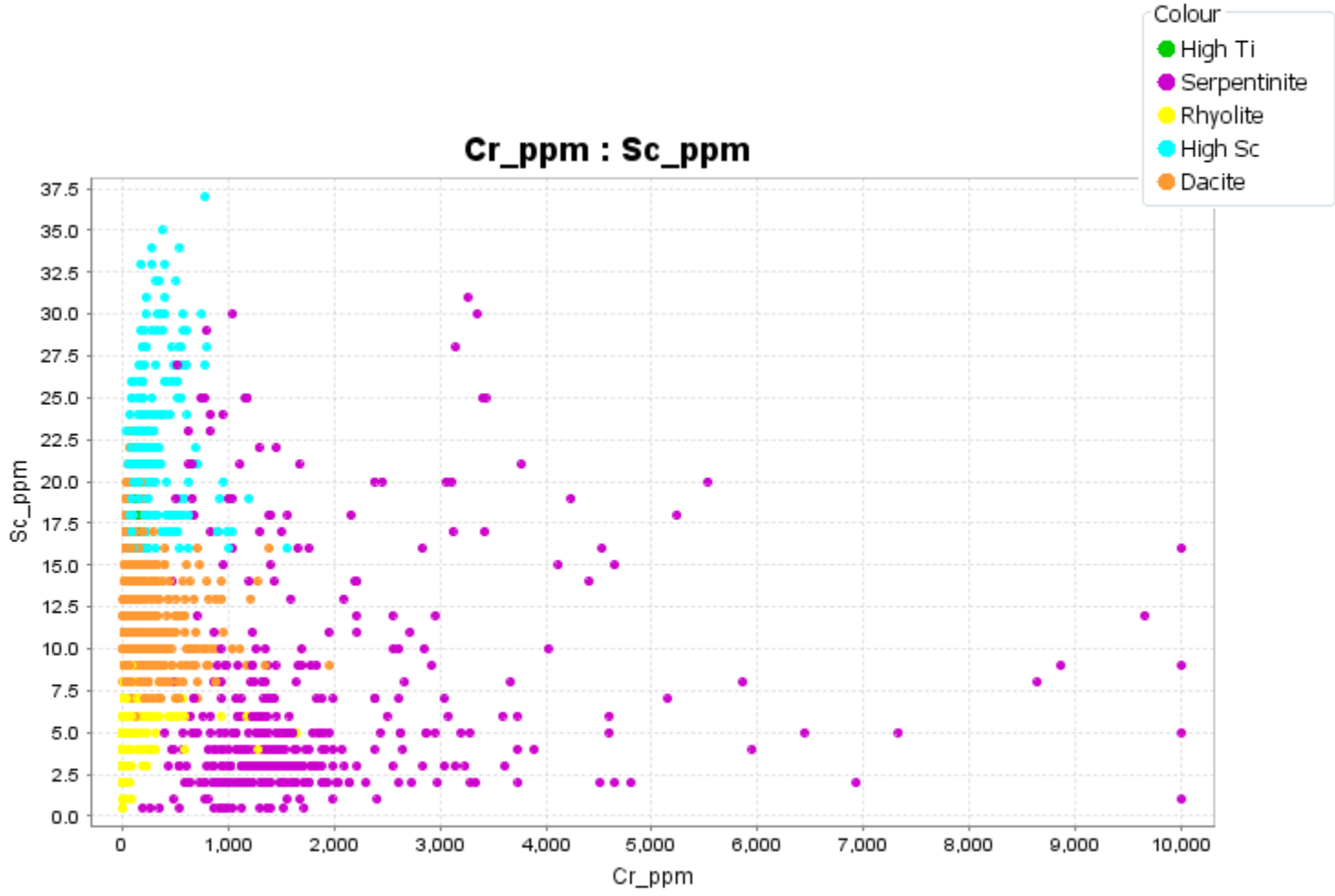
The routine assay method used here is 4 acid digest, ICP-AES. This package includes a few immobile trace elements which can be used to classify rock compositions.

Plot Sc vs Ti. Look for populations in the data. There is a distinct population of high Ti samples (green).



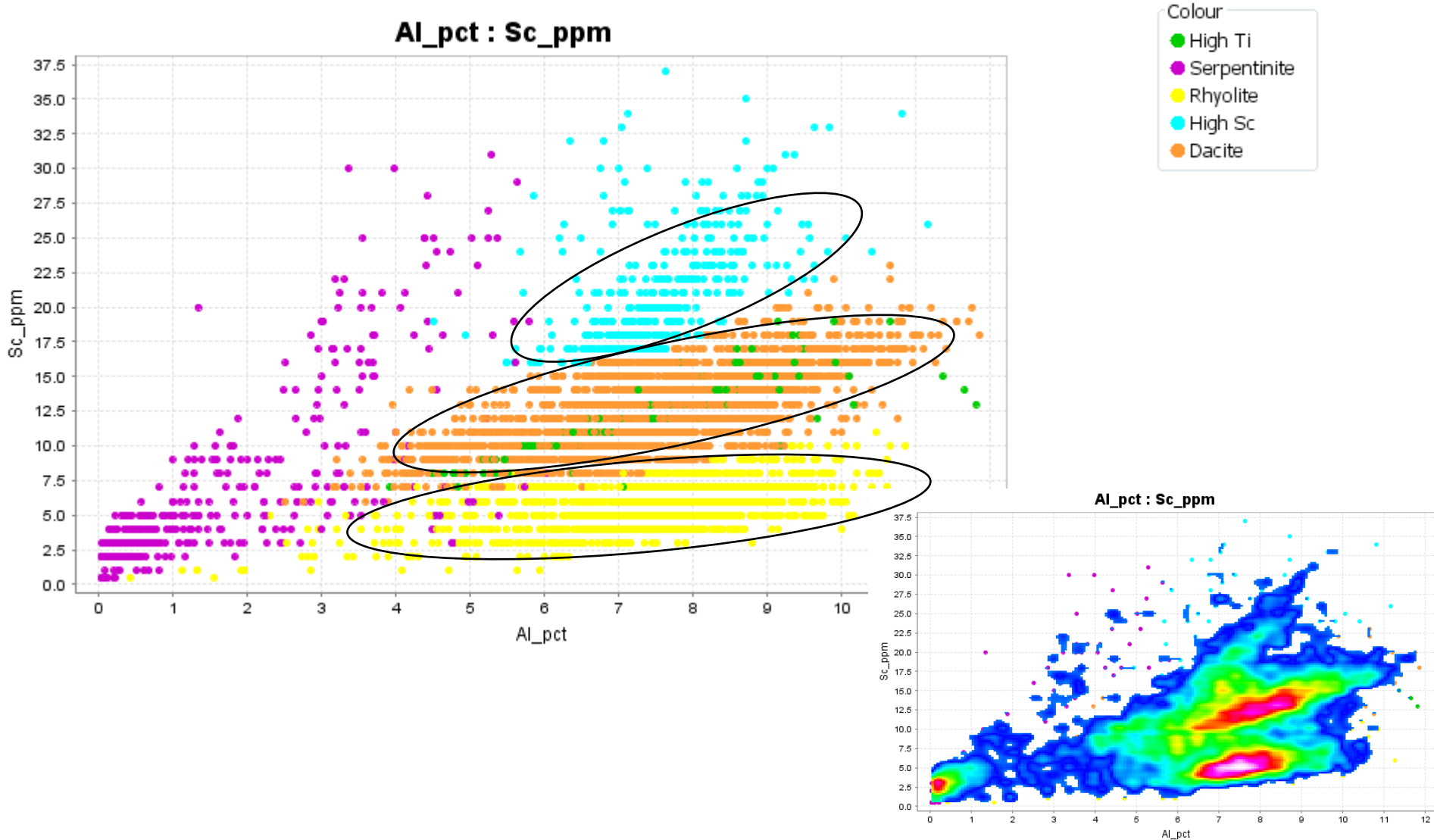
# Thursdays Gossan Geochemistry

Plot Sc vs Cr. Ultramafic rocks generally have >1000 ppm Cr (and Cr correlated with Ni). They also have low Al because of the low feldspar content. There is some mobility of Cr and Ni, but just on a local scale.



# Thursdays Gossan Geochemistry

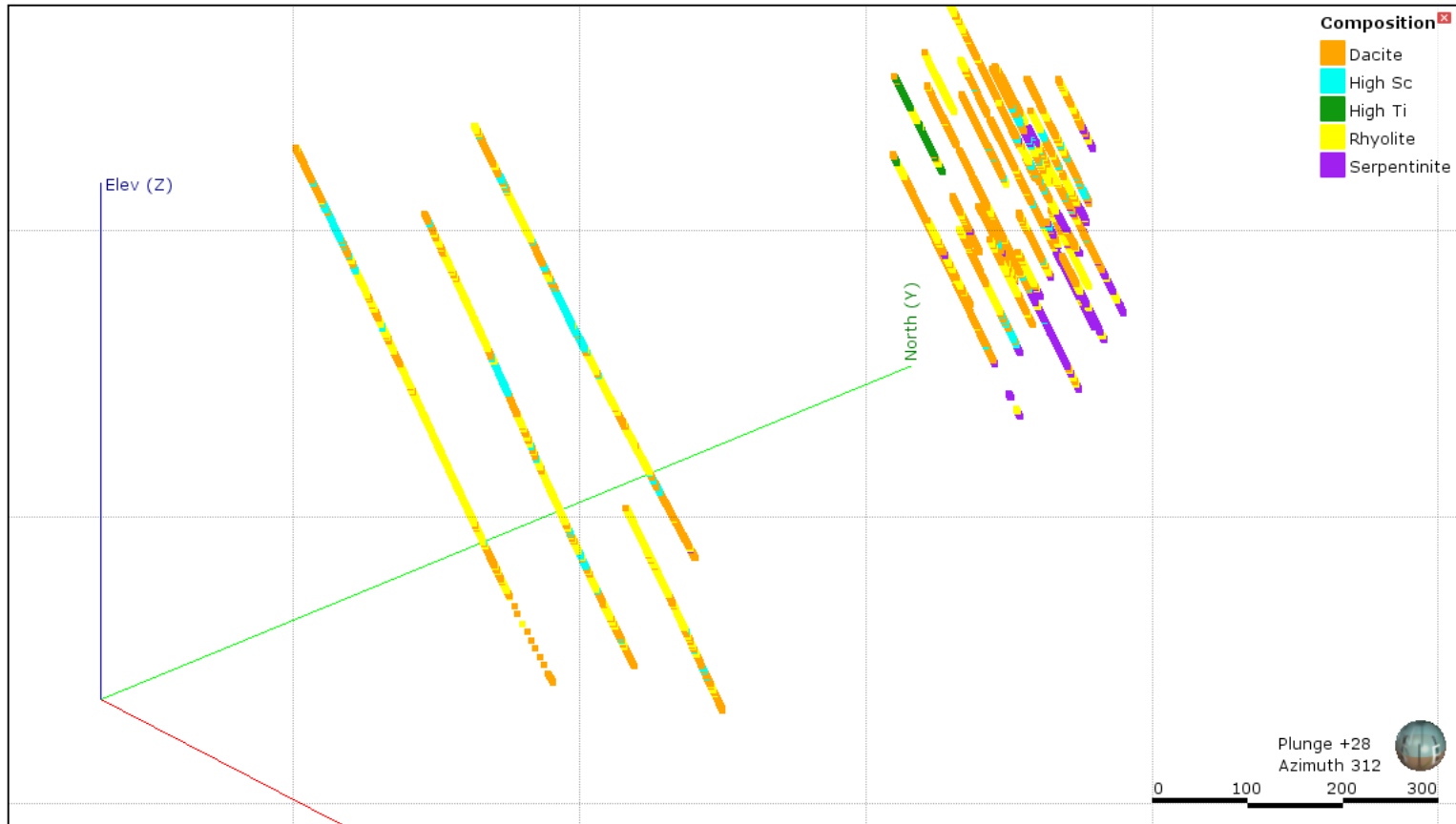
Plot Sc vs Al. Use a point density contour overlay. Other than the serpentinite, these rocks split into 3 compositional groups based on their Sc content.



# Thursdays Gossan Geochemistry

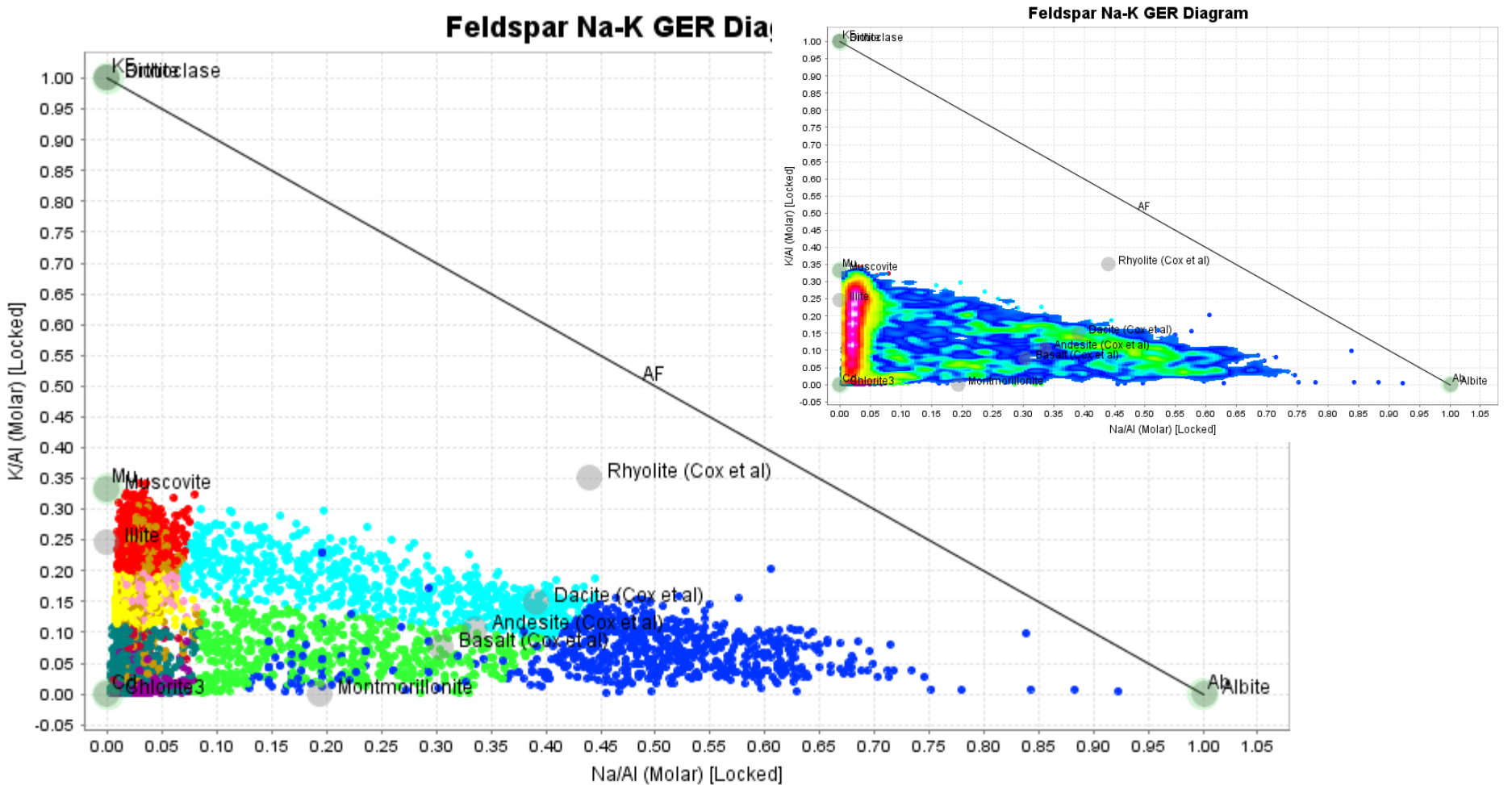
3D view of compositional classifications.

To adequately pick compositional variations from immobile trace element geochem, ICP-MS analyses are required.



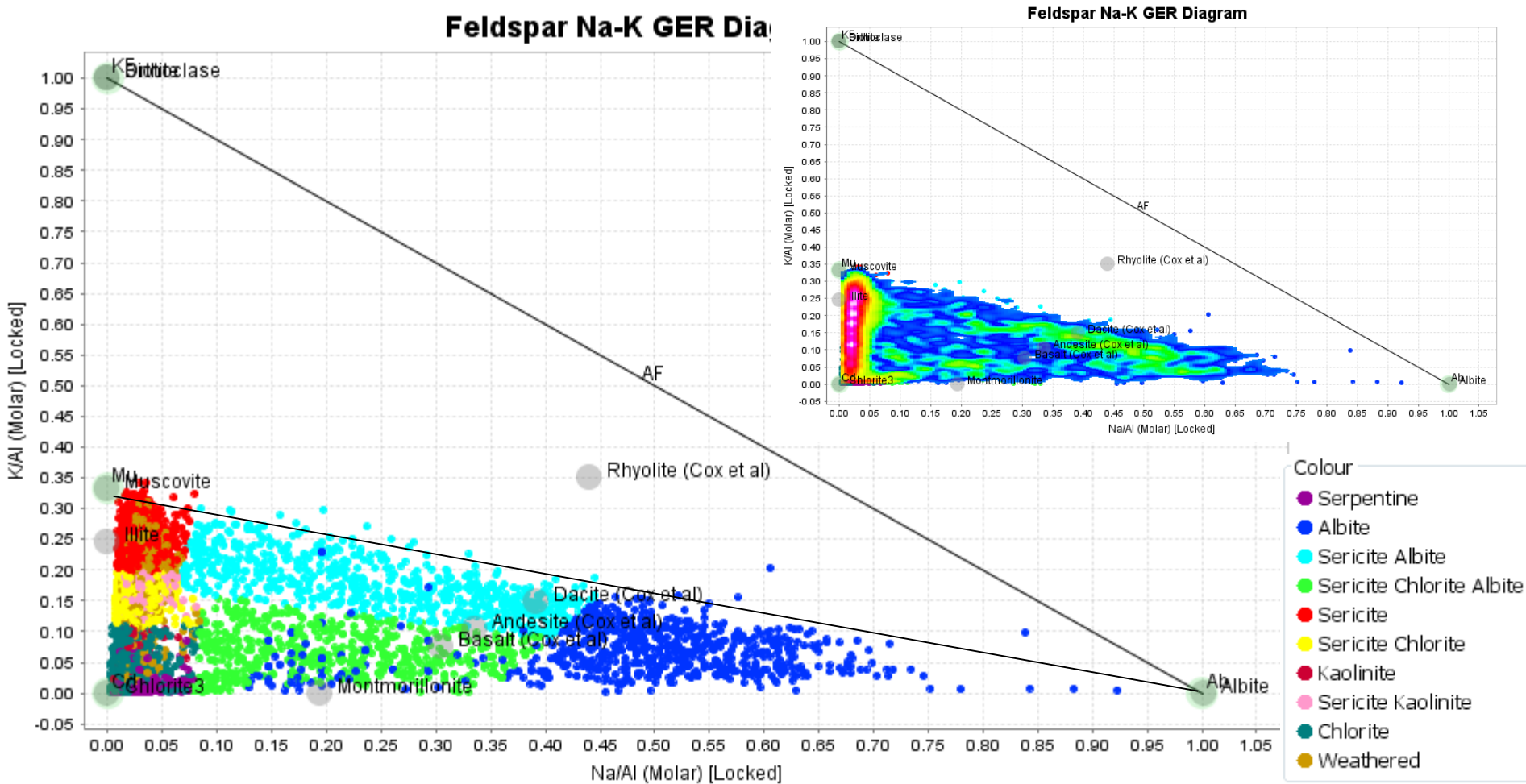
# Thursdays Gossan Geochemistry

K/Al versus Na/Al molar ratio plot. Consider a rock that is totally sericitized. 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 sericitized 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. This plot shows extreme Na-depletion for more than half of the samples in the assay table. The points form a trend between muscovite and an advanced argillic mineral at the origin.



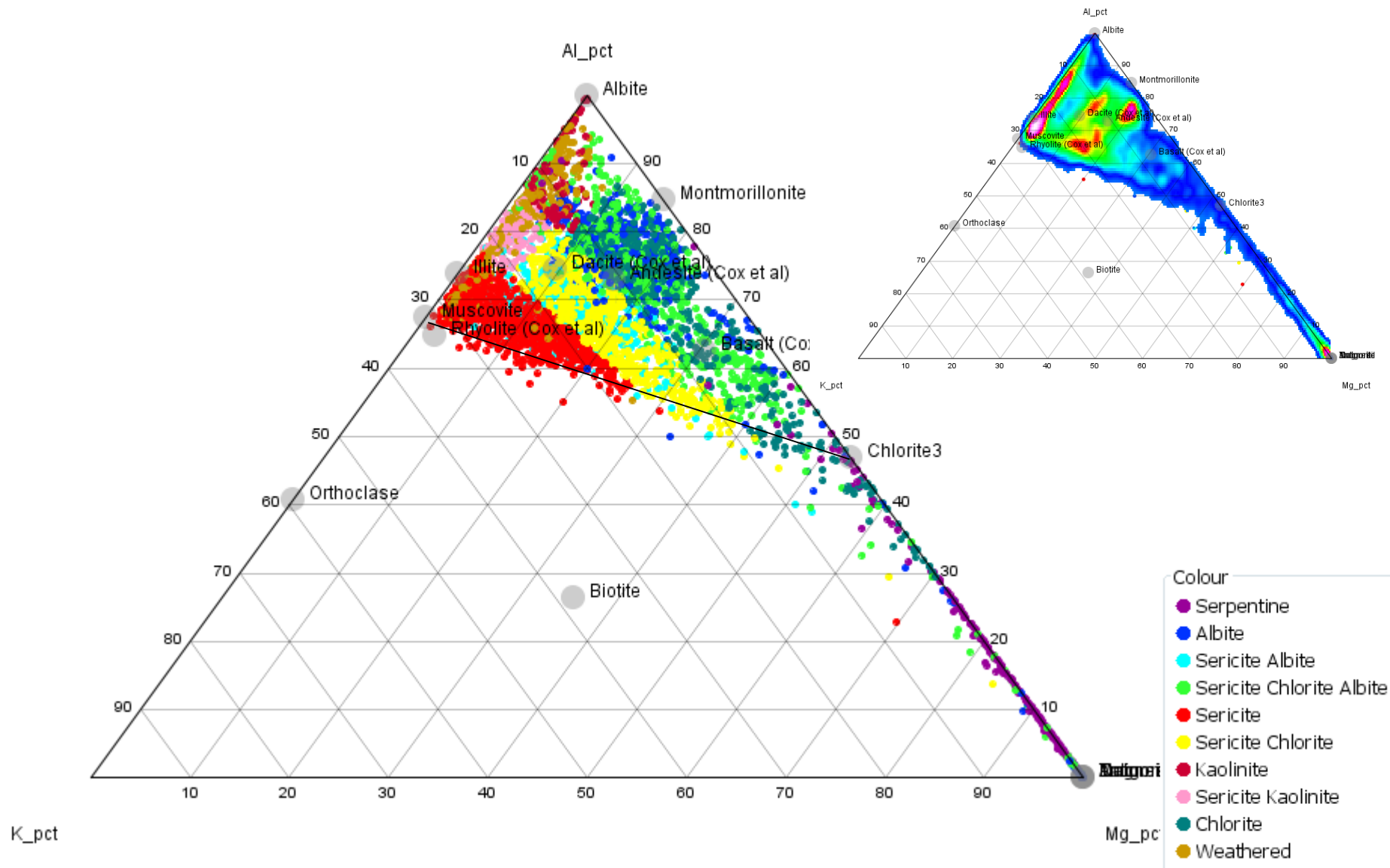
# Thursdays Gossan Geochemistry

There is a natural break in the data along a tie-line between albite and muscovite. Points on the Na-rich side of this trend were classified as albite. Samples with some relict sodium were classified as sericite-albite. Na-depleted samples were split into 3 groups based on the K/Al ratio; sericite, sericite-clay or clay. Samples below the muscovite-albite tie-line are mixtures of sericite albite and chlorite.



# Thursdays Gossan Geochemistry

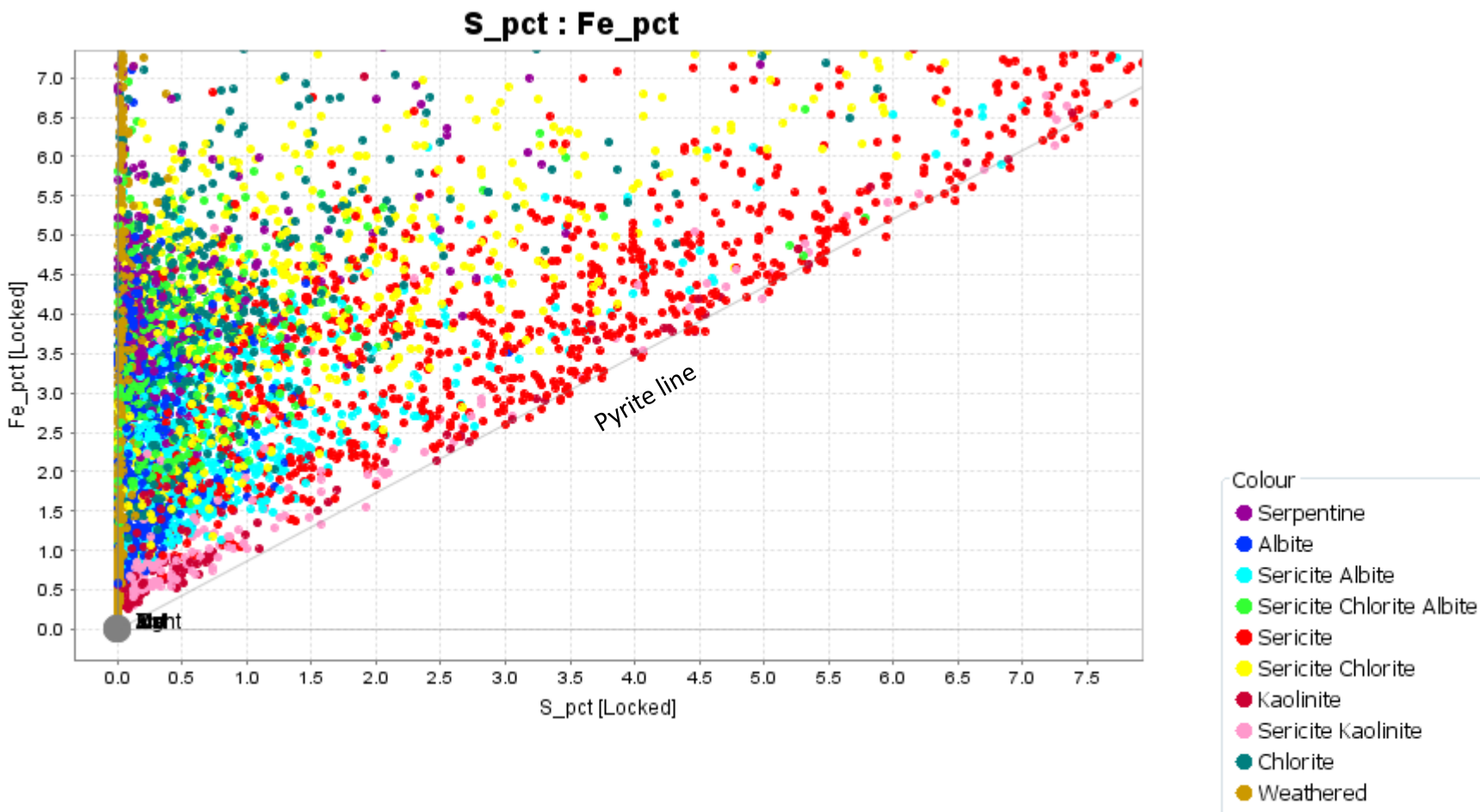
Plot Al-K-Mg ternary. This plot can be used to determine the clay mineral. On the K/Al vs Na/Al plot, the low Na AND low K samples could be either chlorite-rich or kaolinite rich. If they have no Mg it will be kaolinite. If they have Mg, the aluminous phase is probably chlorite.





# Thursdays Gossan Geochemistry

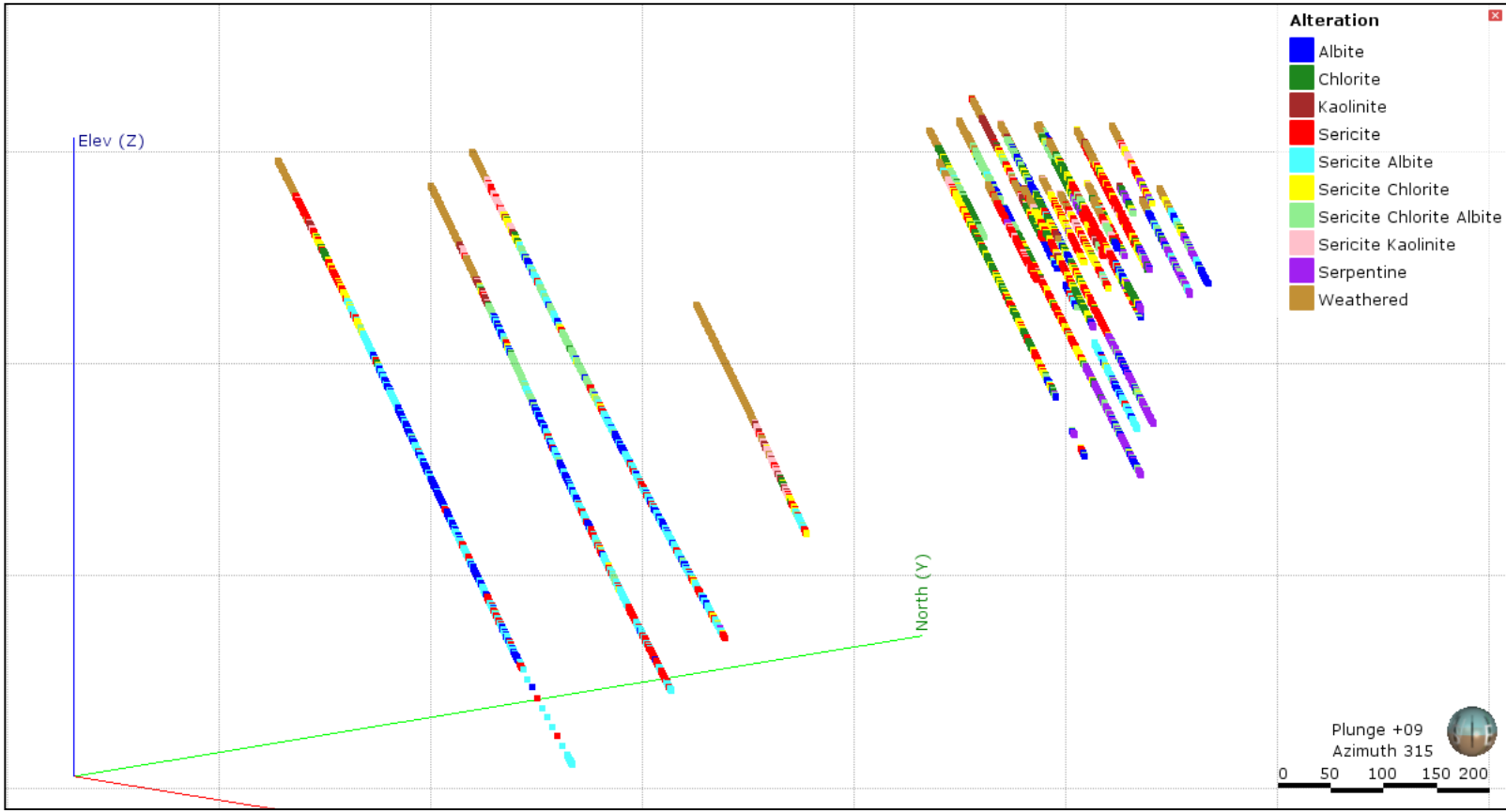
Plot Fe vs S. Kaolinite-rich alteration will be sulfur-rich. Kaolinite samples with no sulfur will be supergene clays rather than hydrothermal clay. Note that the intense sericite alteration plots along the pyrite line, ie quartz-sericite-pyrite rock. There are no points plotting on the S-rich side of the pyrite line, meaning there is no sulfate in the system.





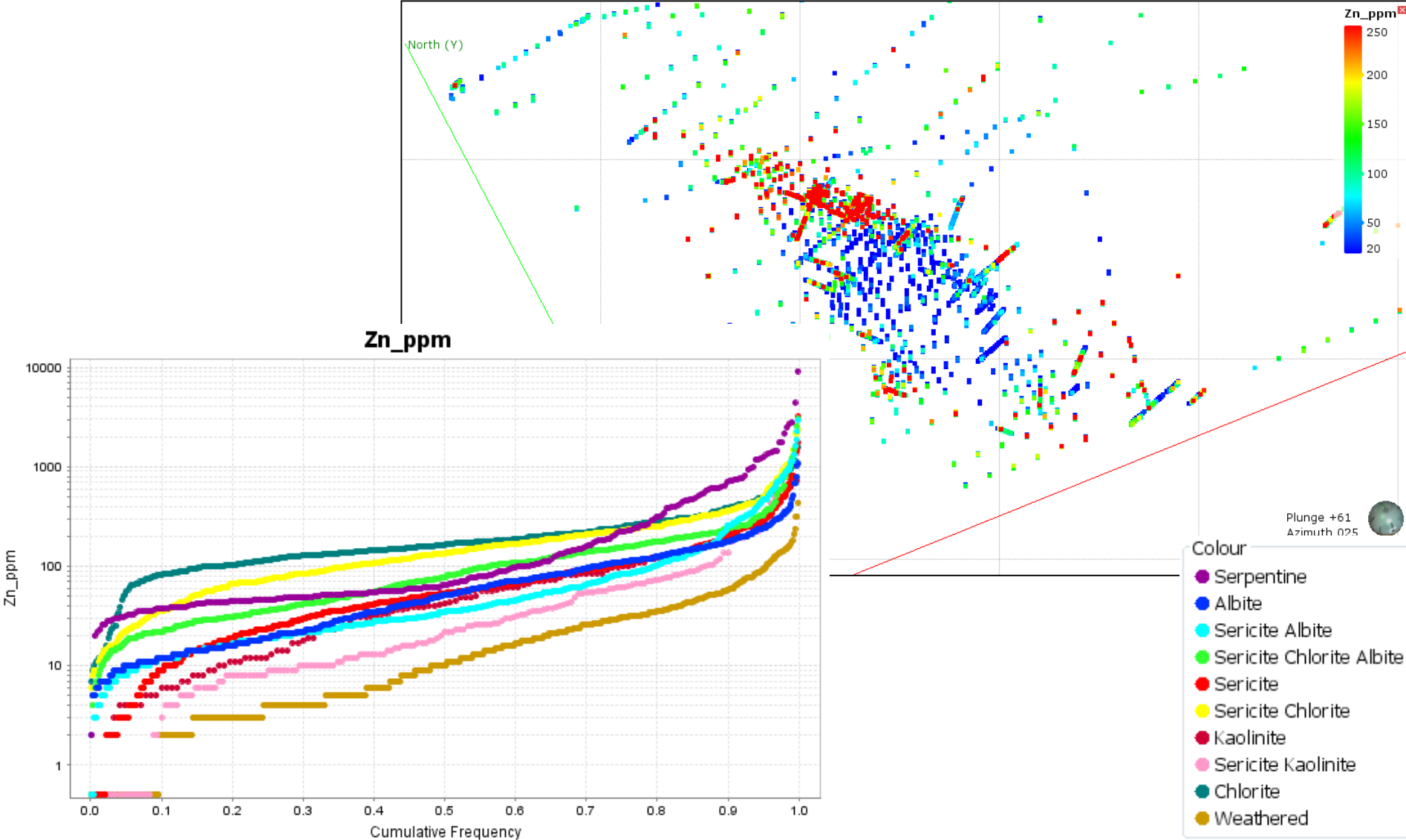
# Thursdays Gossan Geochemistry

3D view of alteration mineralogy estimated from assays.



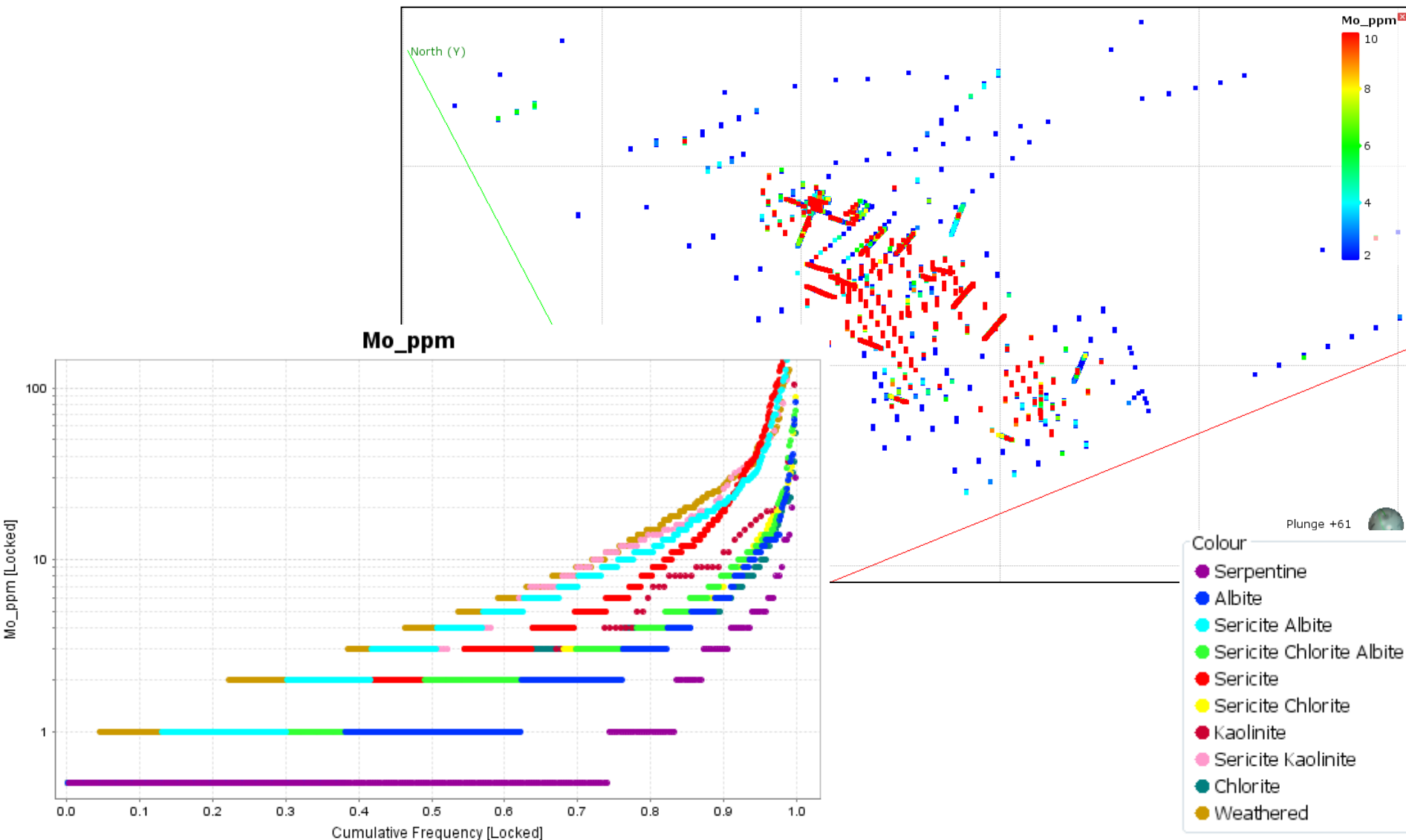
# Thursdays Gossan Zn Geochemistry

A classic pattern in porphyry copper systems is a zone of Zn depletion (and Mn) in the acid alteration outflow zones above the potassic core. The zinc depletion defines a very clear footprint of phyllic alteration at Thursdays Gossan. Something unusual about this is that the most intense zone also lacks sulfur (hence I interpreted it as supergene weathering), but it goes too deep. Thursdays Gossan porphyry system has a hypogene argillic alteration overprint that has stripped copper and sulfur.



# Thursdays Gossan Mo Geochemistry

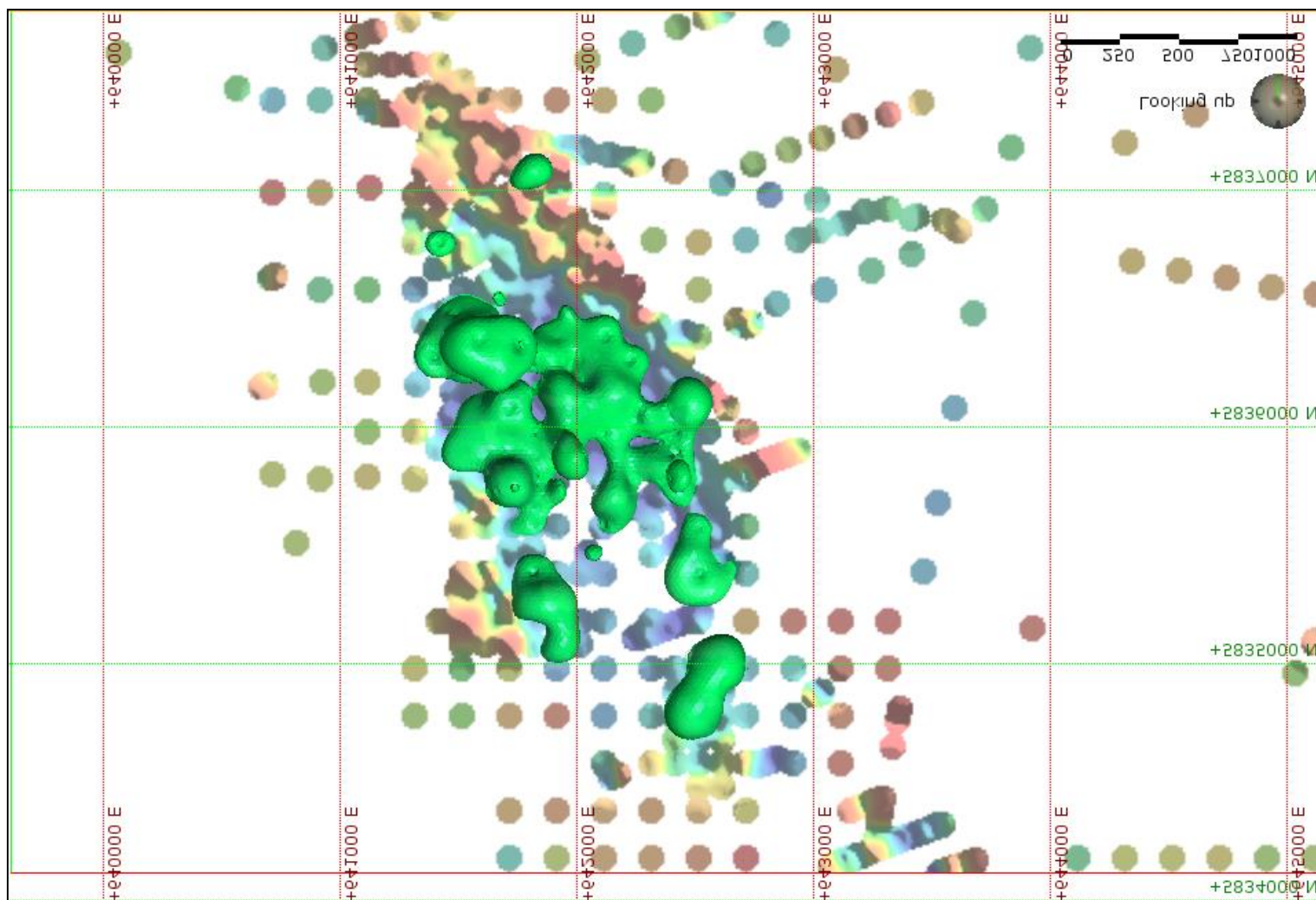
In porphyry systems, Mo occurs with Cu in the potassic zone, but anomalous Mo also extends out through proximal phyllic alteration. At Thursdays Gossan, the high Mo sits neatly inside the footprint of depleted zinc. Surprisingly, the high Mo is mostly in acid, kaolinitic gangue mineralogy, now lacking S.



# Thursdays Gossan metal zoning

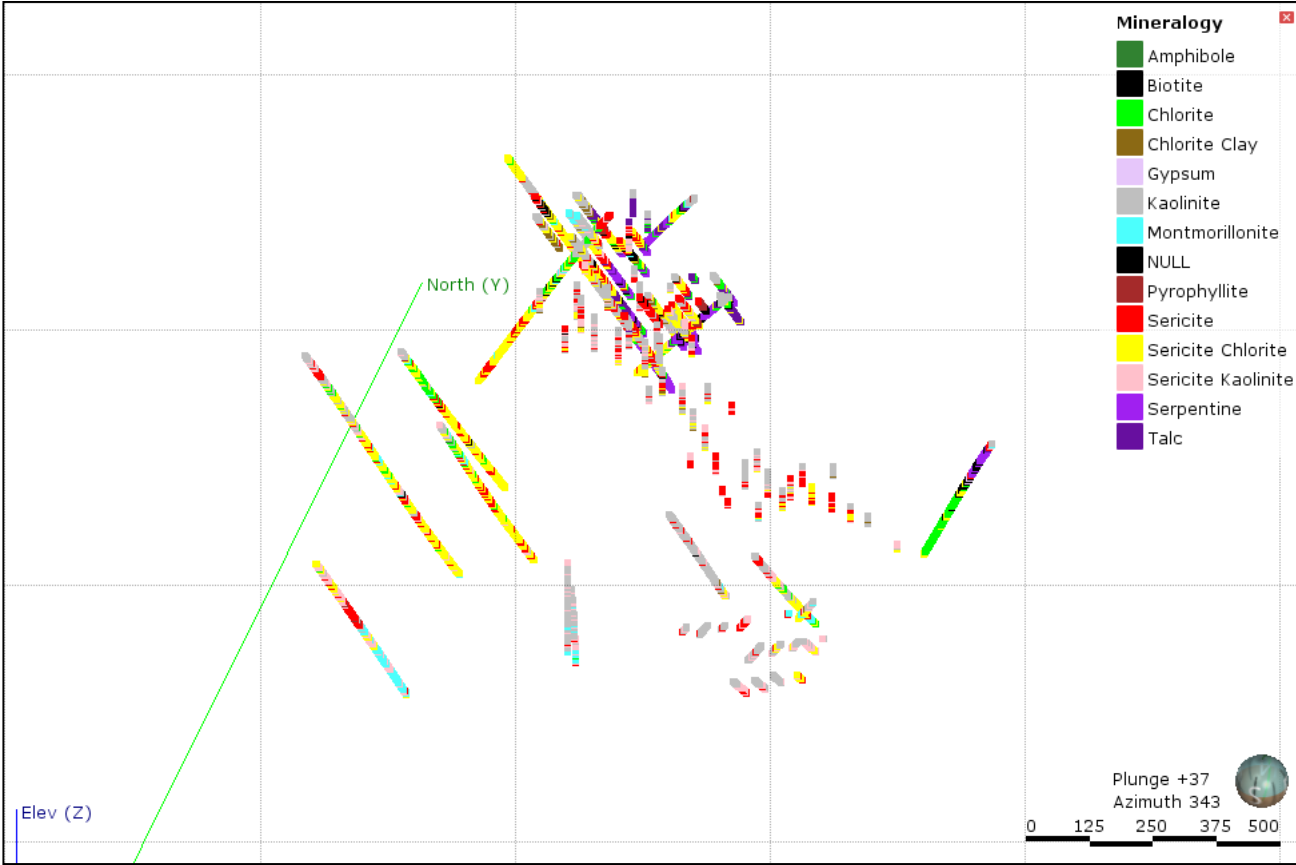
High Mo-low Zn is a proxy for proximal parts of the phyllic alteration.

This view shows a gridded image of all zinc assays in the top 80m. The green shell is a volume enclosing assay points with  $\text{Mo}/\text{Zn} > 2$  (based on a subset of samples with  $\text{Mo} > 2\text{ppm}$ ). This volume also has very low arsenic. In a porphyry Cu environment, this suggests a relatively deep level of exposure within the porphyry (arsenic increases at shallower levels in the phyllic environment) and/or a very oxidized porphyry system.



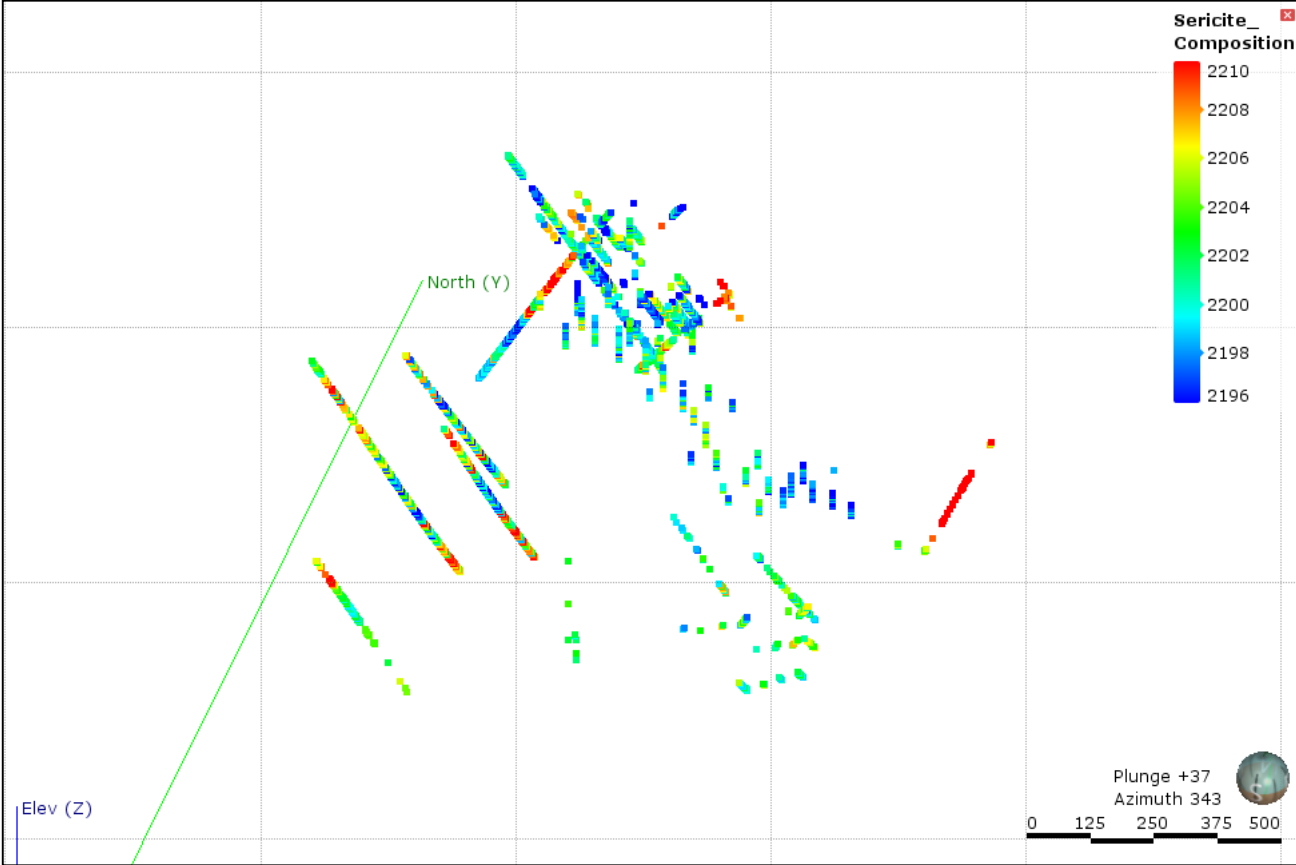
# Thursdays Gossan SWIR Mineralogy

The SWIR mineralogy is dominated by sericite and sericite chlorite. The ophiolite contains both serpentine and talc, with chlorite-rich domains in more mafic lithologies. Pyrophyllite is rare. Kaolinite reports in the weathered zone, but a drill section across the center of the porphyry shows kaolinite and montmorillonite to the bottom of the holes.



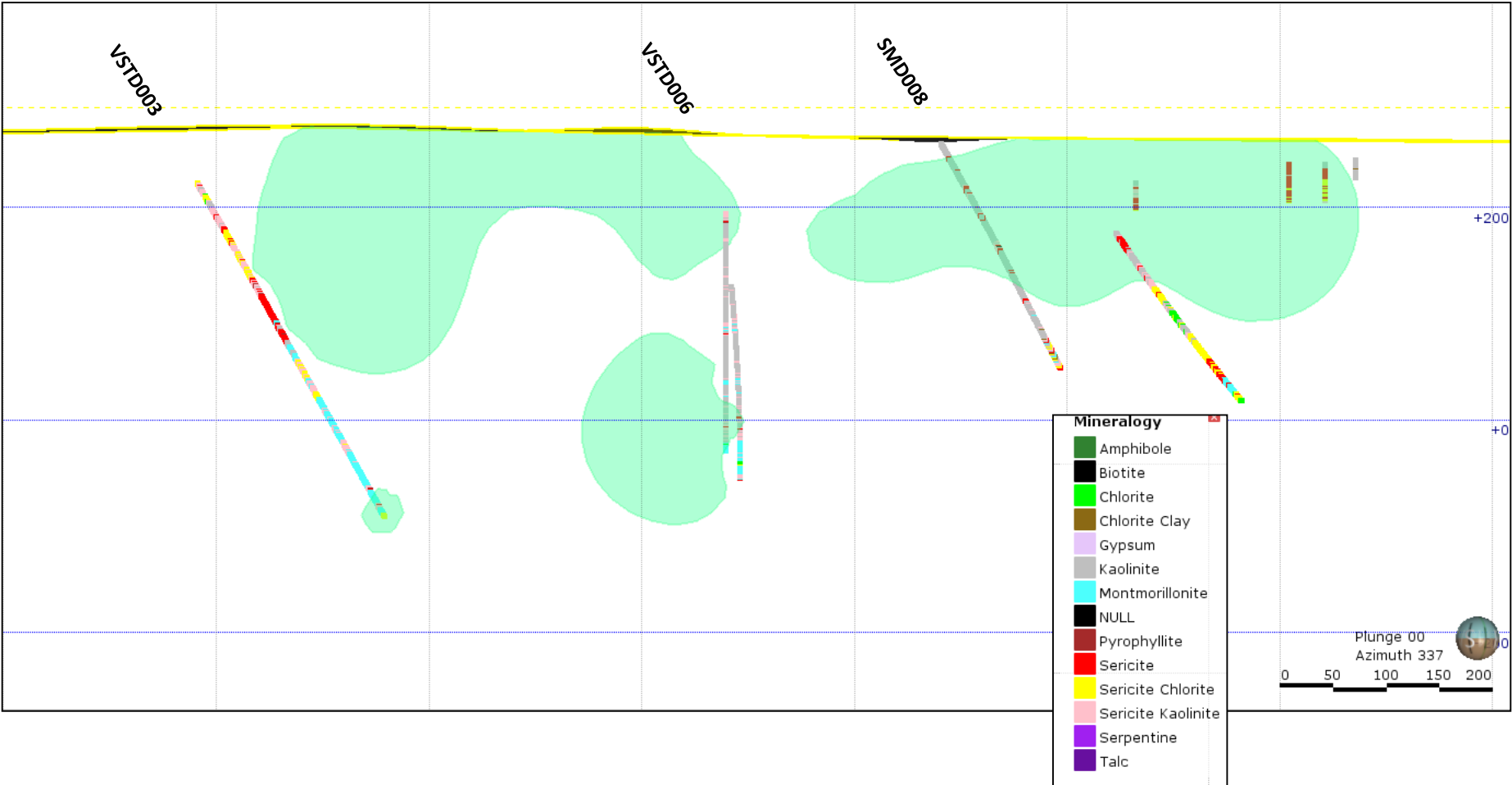
# Thursdays Gossan SWIR Mineralogy

This plot shows the wavelengths of the Al-OH feature for all samples containing white mica. Very short wavelength micas (<2198nm) are typical of very strong phyllic alteration where all of the feldspar is destroyed.



# Thursdays Gossan SWIR Mineralogy

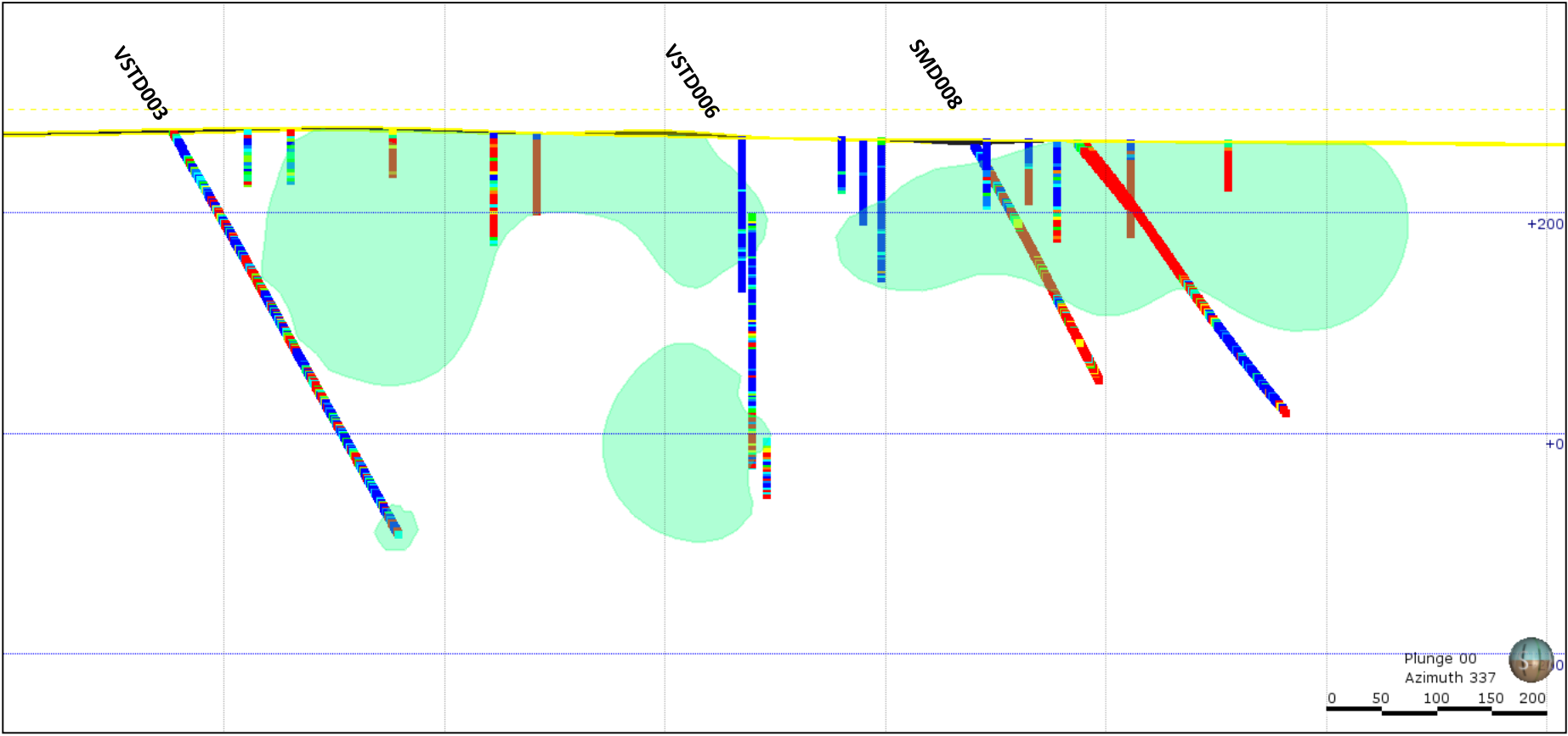
This shows the ASD mineralogy section across the center of the porphyry. The green volume is the high Mo/Zn zone. It is very common to see low temperature clay overprints in porphyry systems. Early formed mica-rich alteration is usually quite resistant to overprinting. However, feldspars are easily hydrolysed (feldspar + water = clay). The deep clay alteration on these sections is likely to be replacing feldspar, not sericite. Hole SMD008 in particular has high Mo, but no S and no Cu. Hole SMD008 has a very high quartz vein density, and the veins have the morphology of B veins. There is a high enough vein density here to suggest that this was close to the center of the porphyry outflow zone. This looks like the kaolinite overprint was sufficiently acid to re-dissolve all the sulfide minerals. There is a reasonable probability that this is an acid overprinted potassic zone.





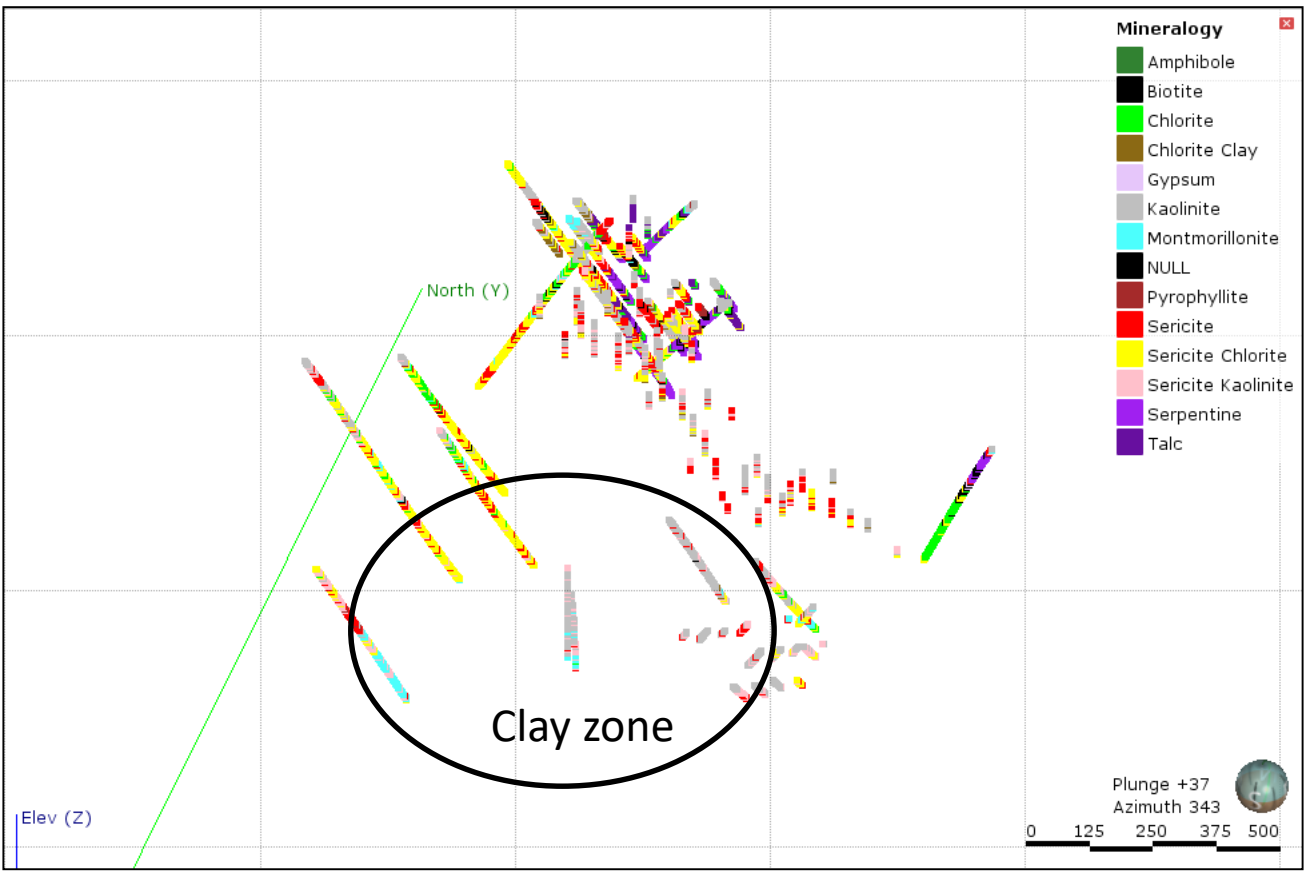
# Thursdays Gossan SWIR Mineralogy

This shows the ASD mineralogy section across the center of the porphyry. The green volume is the high Mo/Zn zone. It is very common to see low temperature clay overprints in porphyry systems. Early formed mica-rich alteration is usually quite resistant to overprinting. However, feldspars are easily hydrolysed (feldspar + water = clay). The deep clay alteration on these sections is likely to be replacing feldspar, not sericite. Hole SMD008 in particular has high Mo, but no S and no Cu. Hole SMD008 has a very high quartz vein density, and the veins have the morphology of B veins. There is a high enough vein density here to suggest that this was close to the center of the porphyry outflow zone. This looks like the kaolinite overprint was sufficiently acid to re-dissolve all the sulfide minerals. There is a reasonable probability that this is an acid overprinted potassic zone.



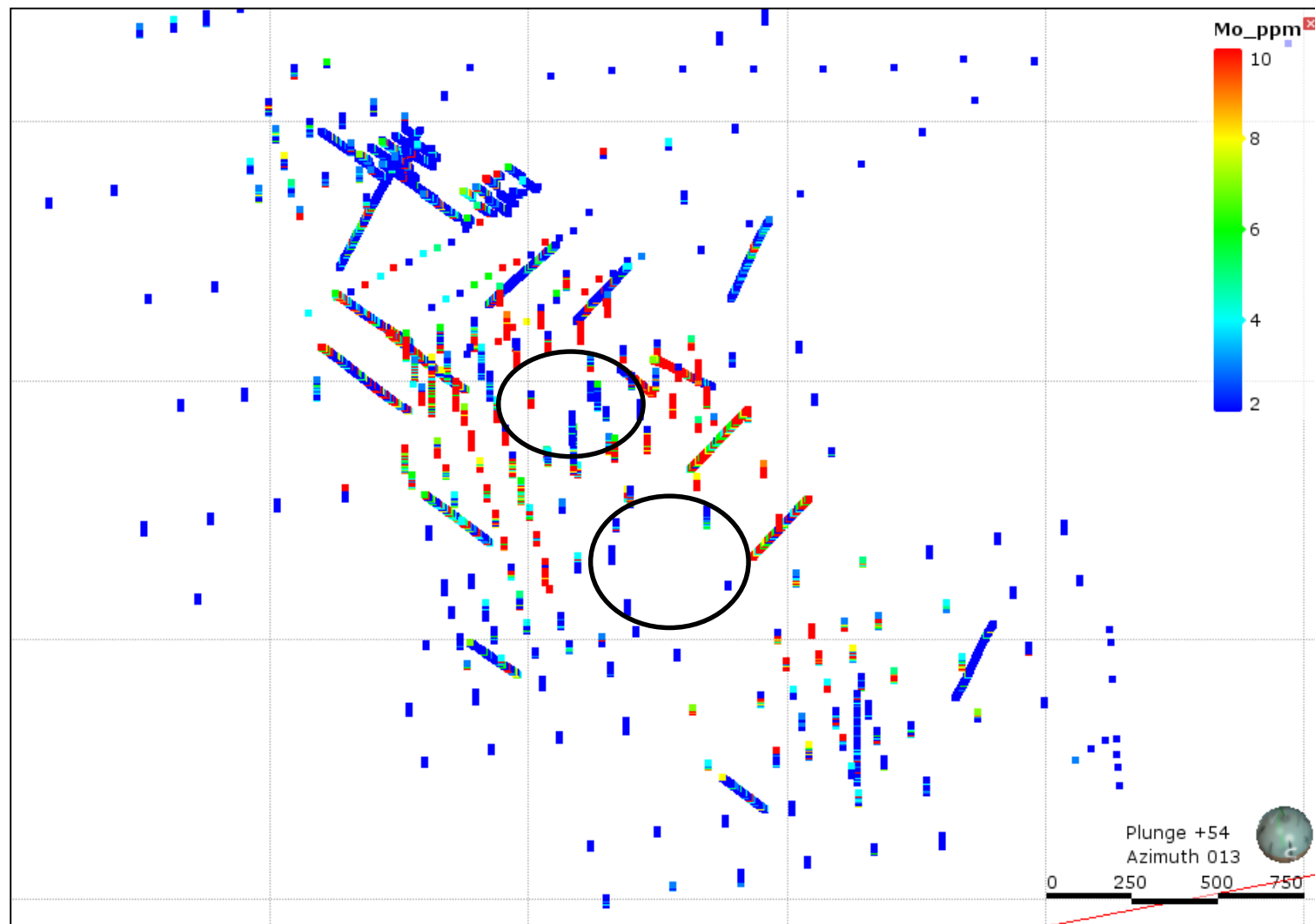
# Thursdays Gossan Clay zone

Although the clay zone appears to be right in the center of the porphyry footprint, and has a very high vein density, it is totally devoid of copper and sulfur. This looks like a late acid fluid overprint. Is this an acid fluid formed from condensing magmatic volatiles that has descended from above, or is it an acid condensate that is rising from the magmatic system? If it is an ascending fluid, then the copper has been lost. If it is a descending fluid, then there is an opportunity for hypogene copper enrichment. How can we tell the difference? Stable isotopes to pick a meteoric input?



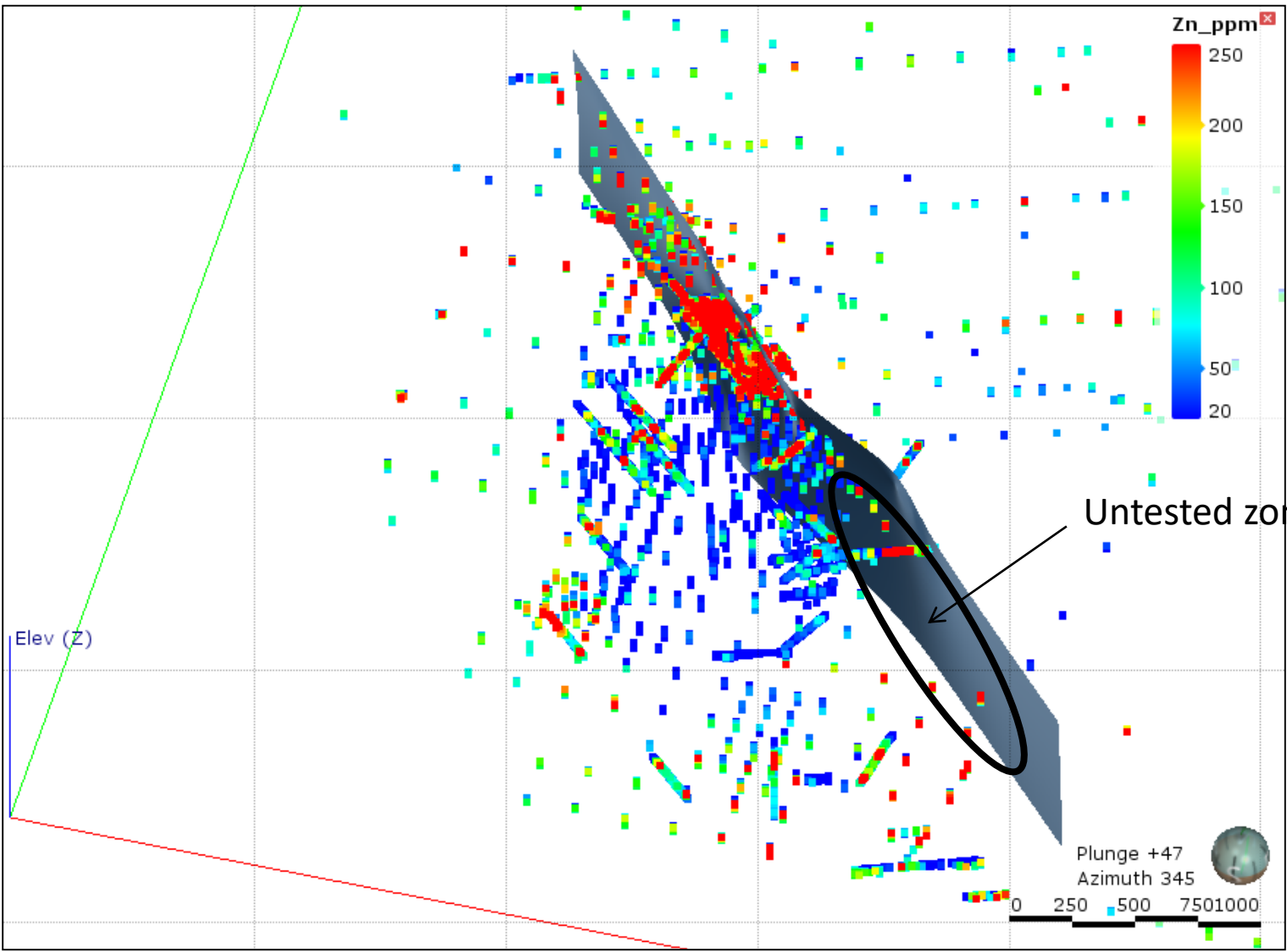
# Thursdays Gossan Clay zone

Inside the Mo footprint, there are a couple of Mo dead zones. What are these low Moly zones; Could be the cores of the porphyry, with Mo forming a donut shape outside the copper shell, or these could be post or late mineral porphyries. These hypotheses can be tested by counting and plotting vein density.

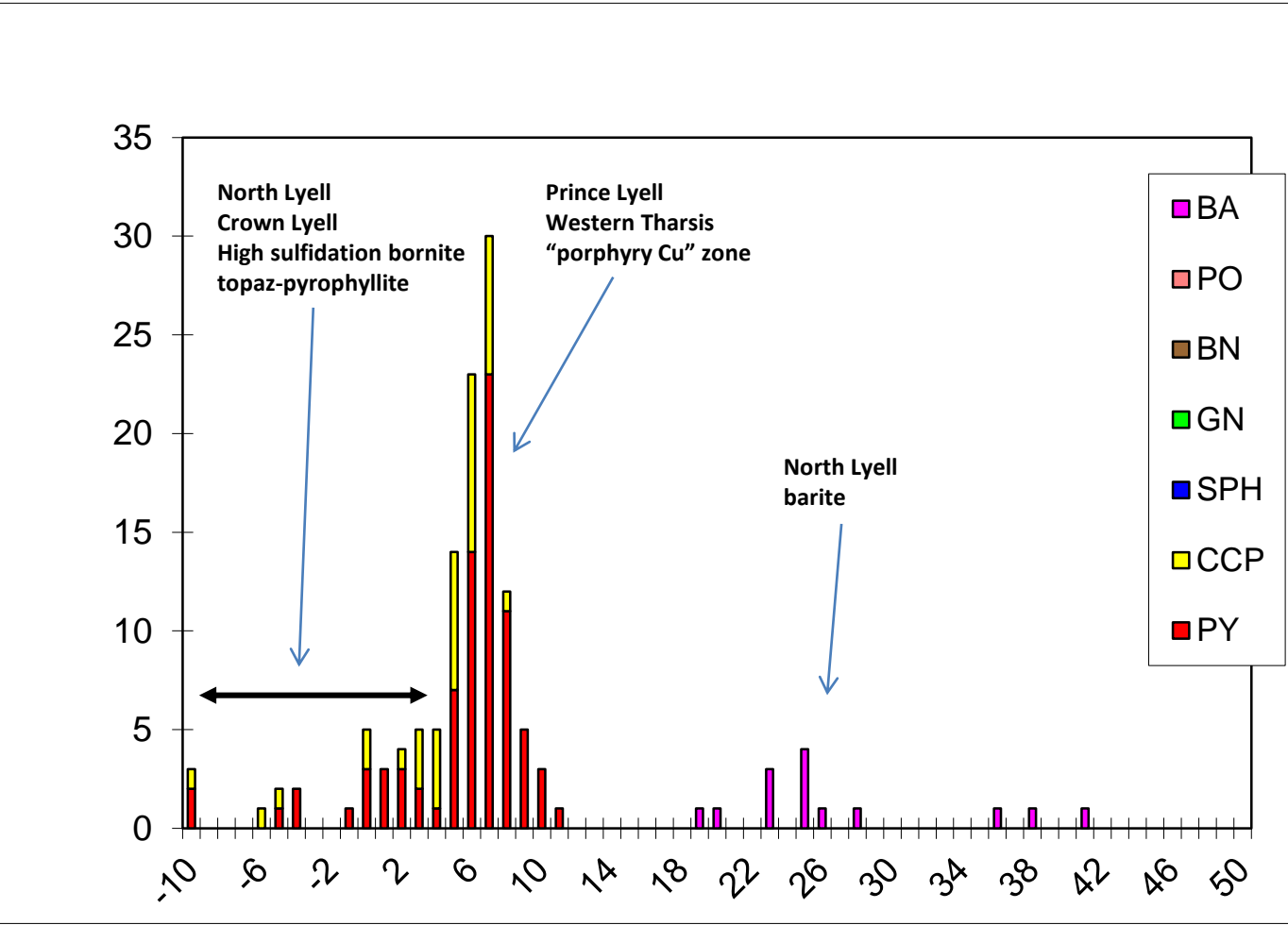


# Thursdays Gossan Intermediate sulfidation epithermal targets.

This image shows zinc assays plotted relative to the UM contact. What is the chance of finding ore veins along the UM contact to the SE? The small amount of drilling here shows some zinc. First-pass testing of this zone could be done with auger sampling (200m by 50m; analysis by ME-MS61), initially trying to define a base-metal corridor.



# Sulfur isotope data from Mt Lyell.



## Recommendations.

Count the vein density from drill core photos. This is an effective way to map porphyry centers. Plot the number of veins per meter like plotting an assay interval.

Collect 6 to 10 samples from each identifiable intrusive unit. Have these analysed by ME-MS61L. See if a magmatic fractionation sequence can be identified.

If the center of this system is a porphyry Cu from which the sulfides were later leached, then is this acid fluid descending or ascending? Is there potential for intact chalcopyrite at depth, or hypogene enriched chalcocite? It might be worth trying CSAMT to model conductivity at deeper levels. Terry Hoschke is the best qualified geophysicist to advise on that.