



Mineral Mapping

An assessment of Exploration Targets in Que River – Hellyer area.

This is a review of the exploration potential in the area surrounding the historic Hellyer and Que River VMS deposits. The review was conducted for Bass Metals and based on historic geochemical data sets collected by Aberfoyle and more recent geochemical and hyperspectral data collected by Bass Metals. A technical note on the interpretation methods applied to these data sets is provided as an appendix to this report.

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04/09/2013

Targeting Criteria

Despite 40 years of exploration for volcanogenic massive sulfide deposits in the Que-Hellyer volcanic sequence there are still some significant zones of geochemical anomalism that remain undrilled or poorly tested. Data sets collected by Bass Metals over the last 4 years, combined with 3D modeling and visualization, have greatly enhanced the definition of those targets. The new data has also unexpectedly revealed new insights into ore forming processes that operated in this region, and raised questions about alternative stratigraphic and structural models that bring new target zones into play.

Application of new geochemical assay techniques, namely low detection limit ICP-MS on soil samples and drill core demonstrated that As-Sb-Tl geochemistry is remarkably effective for delineating the alteration systems in the footwall of the massive sulfide lenses, and that traditional Cu-Pb-Zn are ineffective until sampling is carried out directly on top of the sulfide bodies. The trace element chemistry therefore provides a very clear “near-miss” signature. The alteration associated with Hellyer-style massive sulfide deposits is associated with coherent Sb>5ppm, As>50ppm and Tl>2ppm anomalies in soil and/or drill core. This is the signature of ore-stage pyrite.

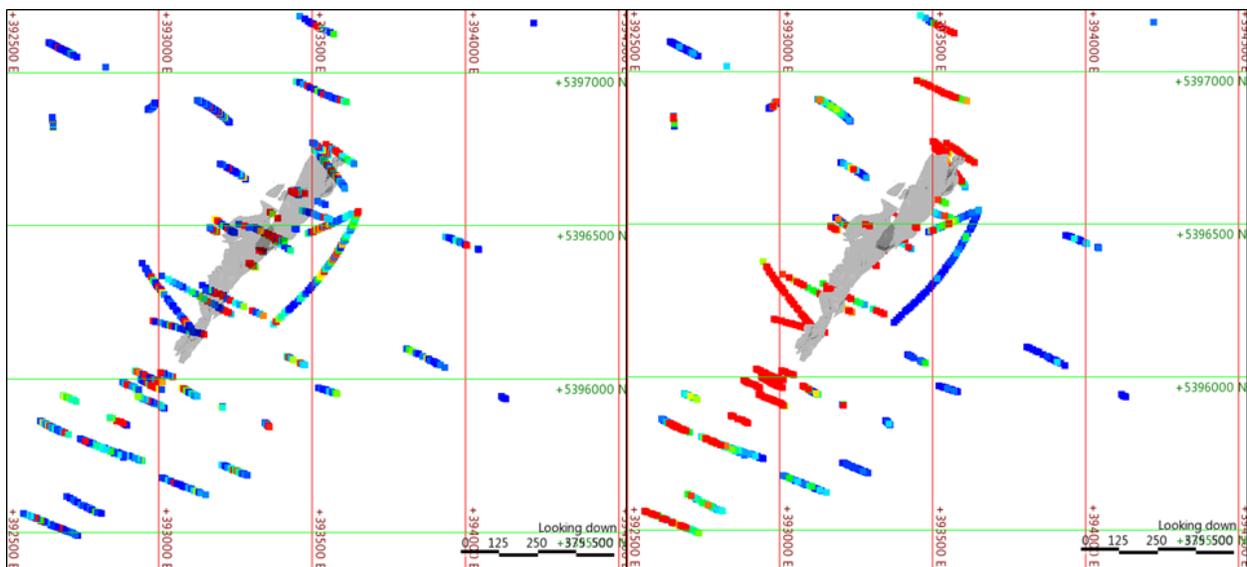


Figure 1. Comparison of zinc (left) distribution vs antimony distribution (right). Zinc; blue<50ppm, red>500ppm; Antimony; blue<1ppm, red>10ppm. The grey wireframe is the shape of the Hellyer orebody. These holes were drilled through the stringer zone (SEZ). The zinc levels are variable through the alteration system; some elevated, and some low. There are also some spurious high values outside of the SEZ. Antimony (and arsenic and thallium) gives a remarkably consistent anomalous footprint! The pathfinders are MUCH better indicators of a near-miss than the ore metals.

The chemical signature of the ore stage pyrite that is illustrated from the drill hole chemistry in figure 1 is also evident in the soil geochemistry. Figure 2 shows an area of soil geochemistry along strike to the south west from Hellyer and Fossey. There are no significant copper assays in this data. The map patterns of Cu, Zn and Pb are dependent on the distribution of chalcopyrite, sphalerite and galena. Without having these minerals in the sample bag, there will not be an anomalous value. There is unlikely to be a coherent, multi-point anomaly unless the samples were taken directly from an outcropping

gossan. However, As-Sb-Tl are in the pyrite lattice and map stringer zone pyrite distribution. There was almost certainly another Hellyer-style orebody eroded off the top of the antimony anomaly highlighted in figure 2.

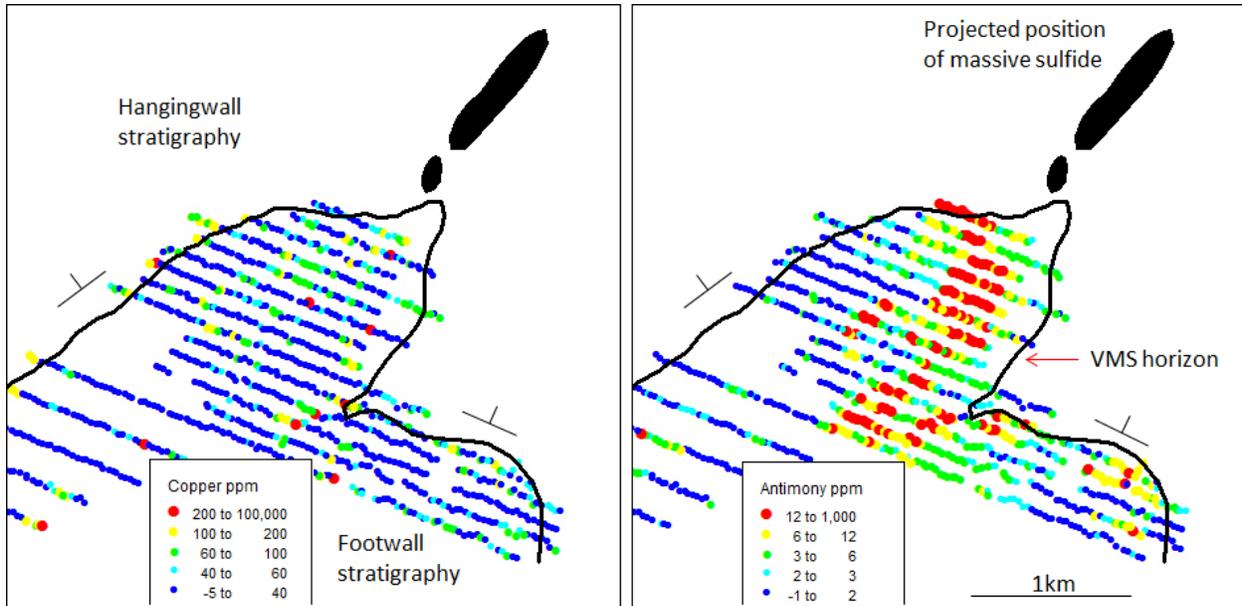


Figure 2. Comparison of copper versus antimony patterns in soil geochemistry. The solid black line shows the location of the “mixed sequence”, with PLS above and footwall andesites below. The solid black shapes show the projected locations of Hellyer and Fossey.

Antimony (and arsenic and thallium) gives a remarkably consistent anomalous footprint! The pathfinders are much better indicators of a near-miss than the ore metals. The distribution pattern of these metals from the regional data sets should be used to define the drill targets.

The silicate alteration is plagioclase-destructive and generates chlorite+/-sericite+/-KSpAr alteration, and removes all the sodium. From the multielement geochemistry on historic drill core samples, molar ratios of K, Na, Mg and Al were used to create semi-quantitative measures of alteration mineralogy, normalized for primary lithological compositions. The alteration indexes combined with the As-Sb-Tl distribution patterns from drill core and soil samples were used to highlight the alteration distribution in 3D. These parameters highlight both structural and stratigraphic controls on the hydrothermal systems.

The alteration index calculated from the drill hole ICP geochemistry shows that the intense proximal alteration (Chlorite-Sericite-KSpAr) plots on a remarkably linear trend from north of Hellyer to Mt Charter (figure 3). This trend is parallel to the Henty Fault. It seems highly probable that this was a syn-volcanic extensional fault, and perhaps a second order structure related to the Henty Fault. The Que-Hellyer volcanic s form a wedge that thins to the west away from this inferred fault.

All the known mineralization is broadly between the pillow lava sequence and the footwall andesites. However, the stratigraphy is far from being layer-cake, and some of the mineralization has clearly formed in sub-seafloor positions. While the soil geochemistry lights up the Hellyer-Charter corridor, there are also stratiform pathfinder anomalies that follow the favourable host stratigraphy between the

Hellyer-Charter Fault and the Henty Fault. Thus, it is considered that the best potential lies along the Hellyer-Charter Fault and the Henty Fault, and in the areas between the faults at or just below the PLS.

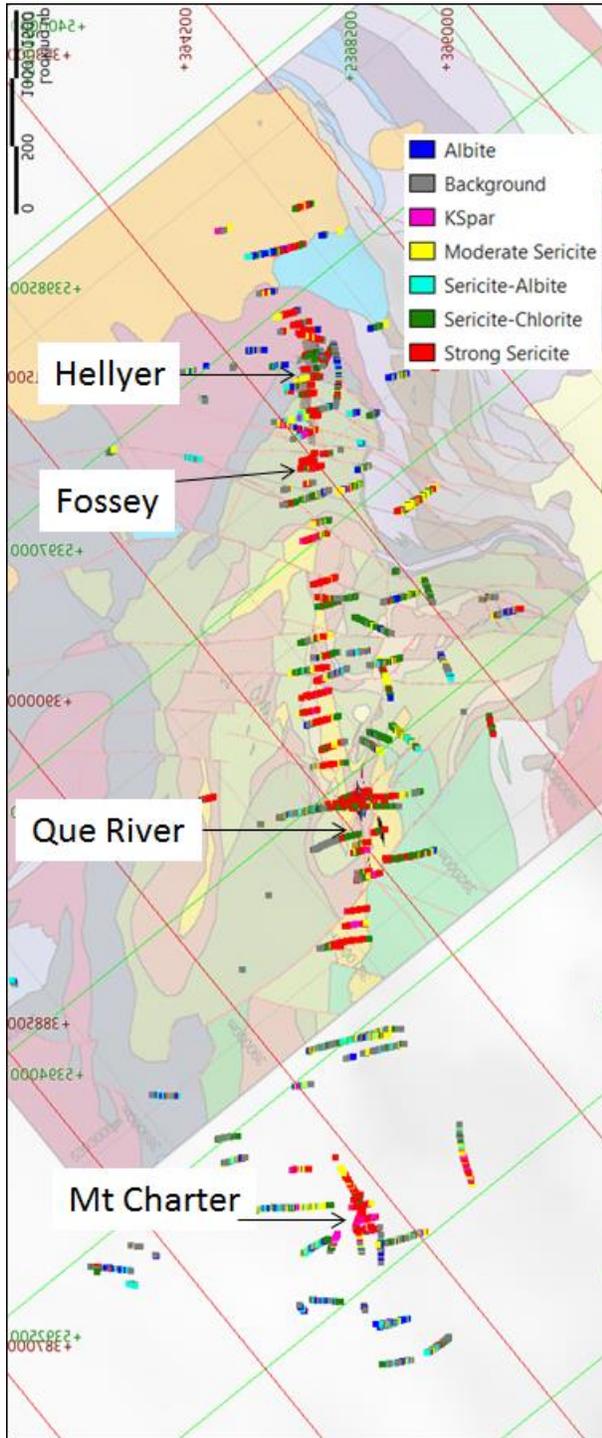


Figure 3. The Alteration Index derived from the multielement assays from the regional exploration drill holes defines a linear trend through all the known massive sulfide occurrences.

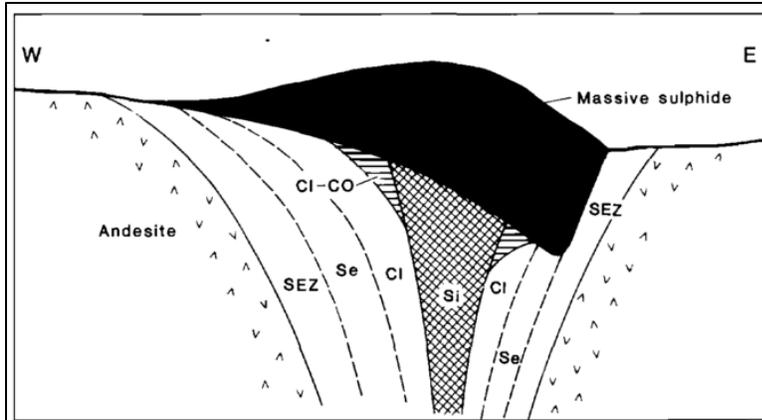


FIG. 6. Schematic pre-Jack fault reconstruction of the alteration zones in the center of the hydrothermal system (approximately 10900 N in Fig. 5). Abbreviations: SEZ = stringer envelope zone (sericite-quartz alteration); Cl = chlorite, CO = carbonate (primarily dolomite), Se = sericite, Si = quartz.

Figure 4. Schematic Hellyer cross section from Gemmell, Econ Geol, 1989.

The limitation of these geochemical targeting criteria is that most of the alteration is confined to the footwall. In places where the stratigraphy is relatively flat lying and the sulfides are blind at surface, none of the footwall geochemical patterns will be evident! Where the stratigraphy is tilted, the edge of the alteration system may be detectable at surface, however where the alteration can be measured at surface the immediately associated massive sulfide has already been eroded off; the remaining target will be a down-dip extension.

Targeting therefore is not just a matter of drilling geochemical anomalies, but also of considering the geological context. An appropriate exploration strategy is to use geochemistry to map outcropping alteration zones within the mixed sequence and footwall andesites. However, rather than drilling outcropping alteration, consider the 3D context, and drill holes to test for preserved massive sulfide bodies in the mixed sequence down dip from the outcropping alteration. Modern DHEM techniques are an order of magnitude more sensitive than the methods employed by Aberfoyle in the 1980's, so DHEM follow-up is an essential component of any drilling program.

Targets

Figure 5 shows the most obvious untested drill target on the Que-Hellyer property. This is located at the northern end of the strongest soil geochem As-Sb-Tl in the project area, where this alteration system plunges under the hangingwall basalt. Note that the trend of the soil geochem anomaly is not pointing directly towards Hellyer, but trending more northerly towards an area around 500m west of Fossey. The target is not within the soil geochem anomaly, since any massive sulfide would have been eroded off from here, but beneath the basalt on the northern plunge extension of the soil anomaly.

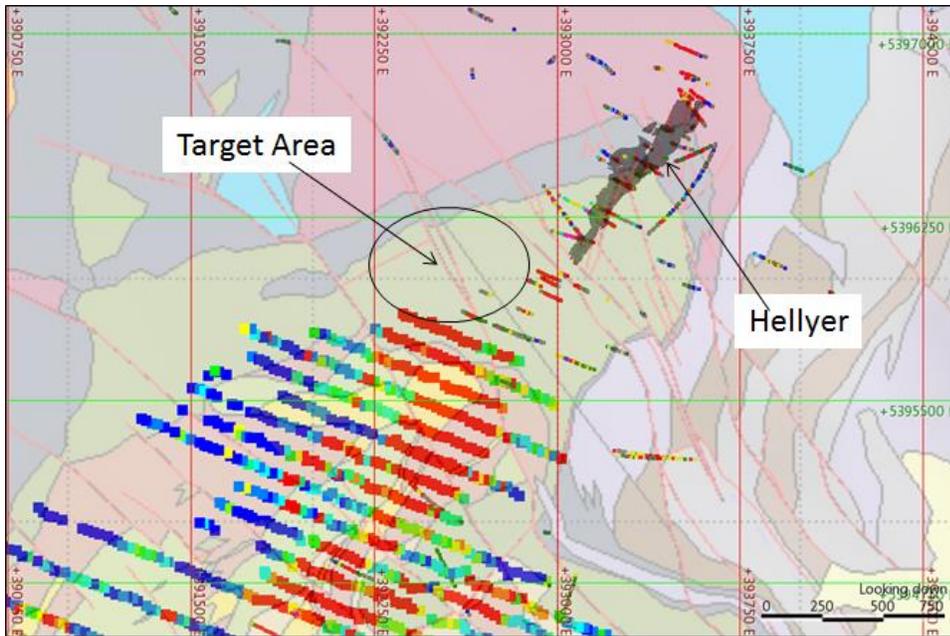


Figure 5. View looking down. The large symbols show antimony assays from the soil geochem; blue<1ppm, red>5ppm. The small symbols show the alteration index from the DDH's. The black shape shows the location of the Hellyer massive sulfide deposit.

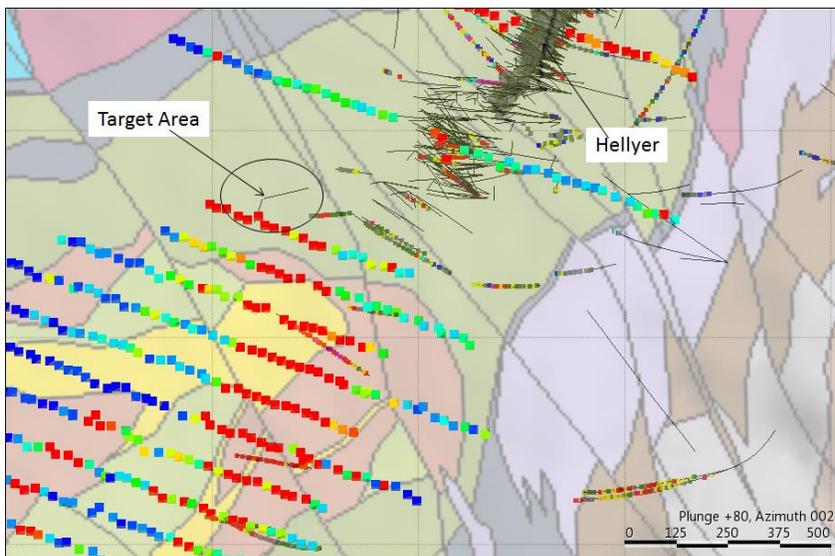


Figure 6. Recent drill holes at Target 1.

Two holes were recently drilled in this area; one hole was drilled directly into the alteration system, and another across strike and away from the alteration. At the time of writing, the results from these holes were not available to the author. The results of this drilling need careful reviewing to see if extra drilling is warranted.

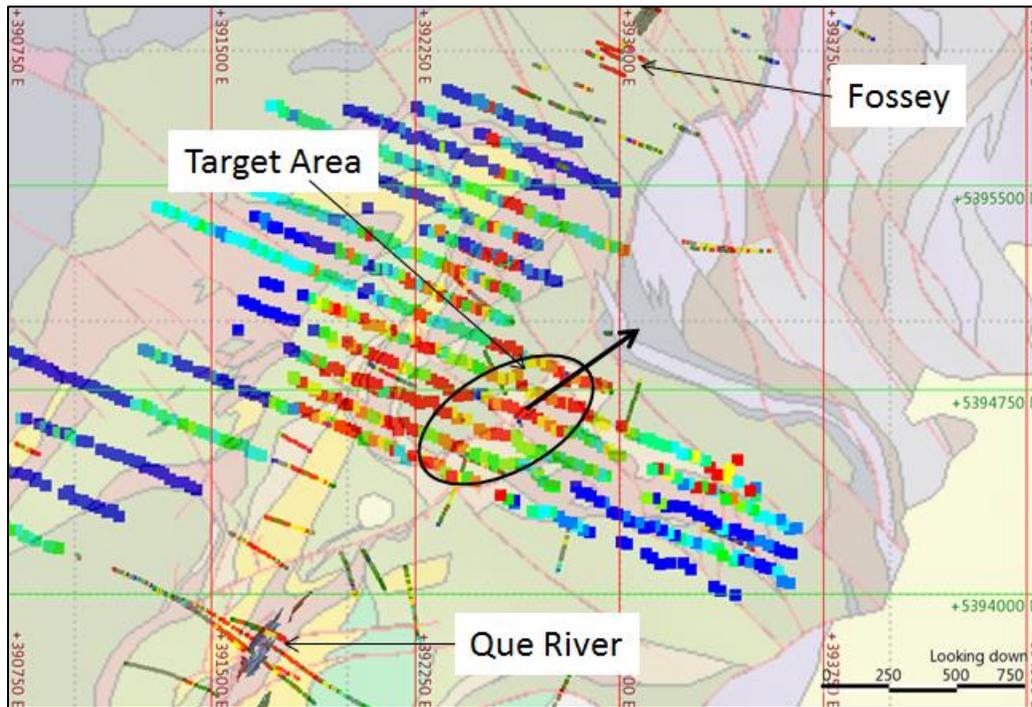


Figure 7. View looking obliquely down to the North. The large symbols show silver assays from the soil geochem; blue<0.2ppm, red>1ppm. The small symbols show the alteration index from the DDH's.

The second area with potentially shallow drill targets is in a zone 1.5km NE of Que River. This is an area with coincident Ag-Pb-Zn anomalism in soil geochem, and relatively modest As-Sb-Tl. The signature of this looks quite different to the main corridor. There are already several holes drilled directly into this zone, but as was pointed out previously, by the time this alteration is exposed, we are already in a footwall zone. The real target here is to find the base of the PLS overlying this alteration, and then drill that contact down plunge. In this area, there are one or two previous holes, but the drilling is sparse! The alteration in this area also looks quite different. This is a much more chloritic zone. The alteration and pathfinder signature look more like a deeper footwall style rather than proximal, shallow, sub-sulfide alteration. There may be some structural complexity down the axis of the syncline.

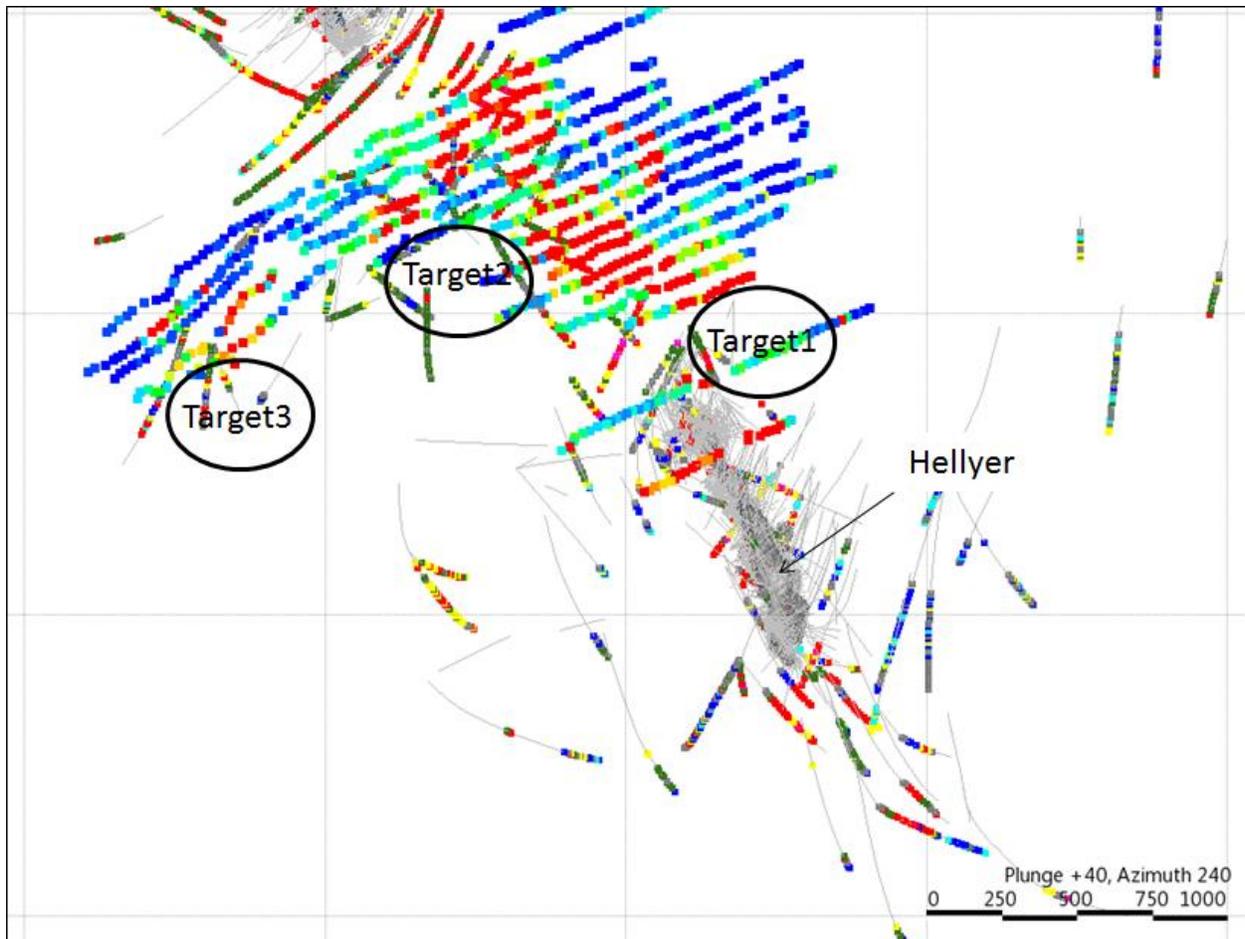


Figure 8. View looking obliquely down towards the south-west. The large symbols show antimony assays from the soil geochem; blue<1ppm, red>5ppm. The small symbols show the alteration index from the DDH's. The black shape shows the location of the Hellyer massive sulfide deposit.

The third target area is the Switchback Prospect. This is close to the intersection of the favourable stratigraphic position, at the base of the Pillow Lava Sequence, with the Henty Fault. There is a very significant As-Sb-Tl anomaly that follows the PLS contact almost from Que River to the Switchback. If the soil geochem coverage was extended further to the north, it is likely that the anomaly would be continuous along the whole contact. Four holes have been drilled here previously, one with quite significant assay results in a mass-flow breccia with massive sulfide clasts. This is an area that is definitely underdrilled.

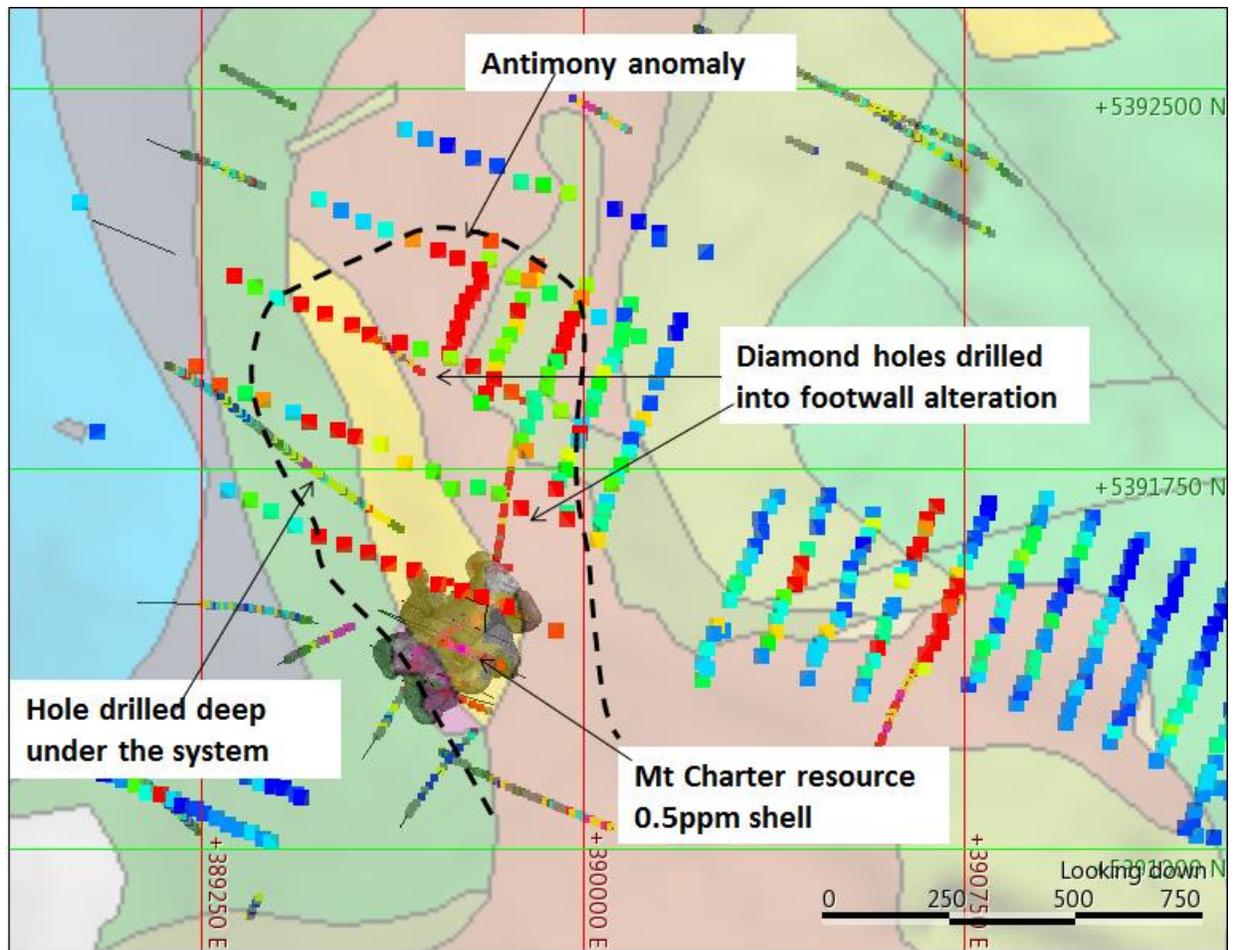
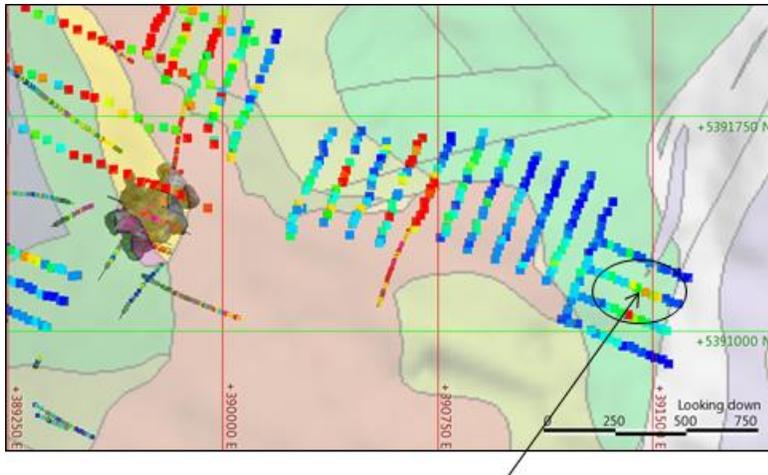


Figure 9.

The fourth target area is immediately north of Mt Charter. The drilling that defines the Mount Charter resource is confined to a very small area at the southern margin of an extensive As-Sb-Tl soil anomaly. To the north of the resource area, two holes have been collared probably too far into the footwall alteration. A third hole has been drilled quite deep under the system. Based on the surface geochemistry, there appears to be a significant strike length of this system that is not yet well drilled. The 3D geology needs to be understood before this target is drilled. It is quite difficult recognizing lithologies in these drill holes due to the intensity of the alteration. However the immobile trace elements, from the holes that were resampled, map several chemically distinct units that can be tracked from hole to hole. Much of the surface anomalism appears to follow a NNW trending contact.



Target Area

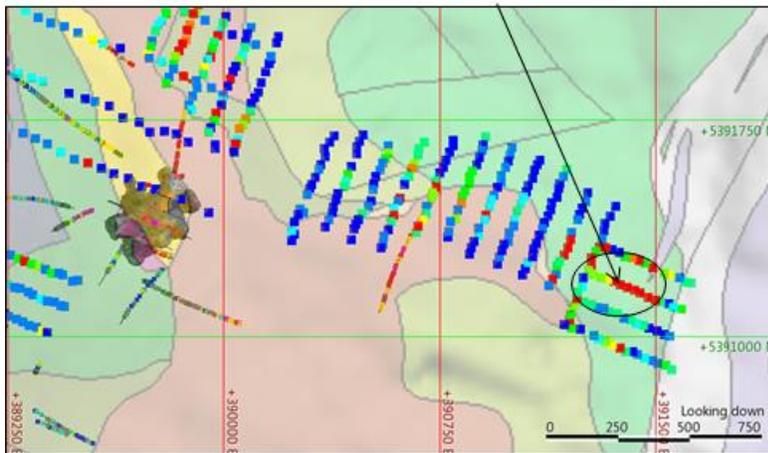


Figure 10. View looking down on Mt Charter. The large symbols show antimony assays from the soil geochem at top; blue<1ppm, red>5ppm; and bismuth assays from soils, lower; blue<0.1ppm, red>1ppm. The small symbols show the alteration index from the DDH's.

The stratigraphic position of Mt Charter shows modest anomalism in the soil geochemistry along the length of its strike from Mt Charter, eastwards to the Henty Fault. Only one hole has previously been drilled into this contact, with good alteration, but without significant assays. The strongest soil anomaly is at the eastern end, near the Henty Fault. This fifth recommended drill target also has significant levels of bismuth, indicating that this is a hotter part of the system. Again, there is no outcropping orebody here, so it is a matter of drilling for a down-dip position and then following up with DHEM.

Extensions to Hellyer?

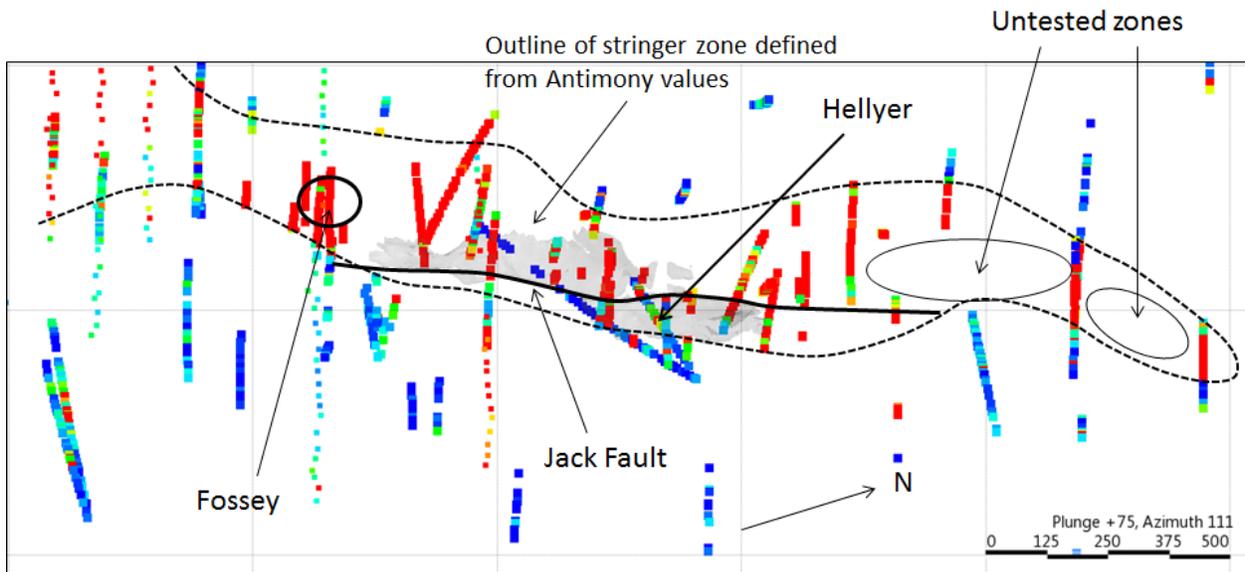


Figure 11. View looking down on Hellyer, down the dip of the Jack Fault. Large symbols are antimony assays in drill holes; Small symbols are antimony assays in soils; blue<1ppm, red>5ppm.

Although the massive sulfide orebody at Hellyer is closed off by drilling, the alteration system keeps heading down plunge to the NNE, with the same intensity of alteration (figure 11). The most northerly hole is 900m beyond the northern tip of massive sulfide, and the alteration in this hole is just as intense as that in the Hellyer footwall. Figure 11 shows significant untested volumes where the stratigraphic position of Hellyer is juxtaposed against the western side of the Jack Fault. Given the intensity of the alteration and the scarcity of the drilling, there is a reasonable probability that there will be additional massive sulfide resources located in these areas. Careful consideration needs to be given to the depth of the target, the economics of mining at this depth, and the required tonnage for an economic project. **Given the variable northerly plunge of the orebody, these areas might be more easily targeted with holes drilled steeply towards the SSE.**

Other Exploration

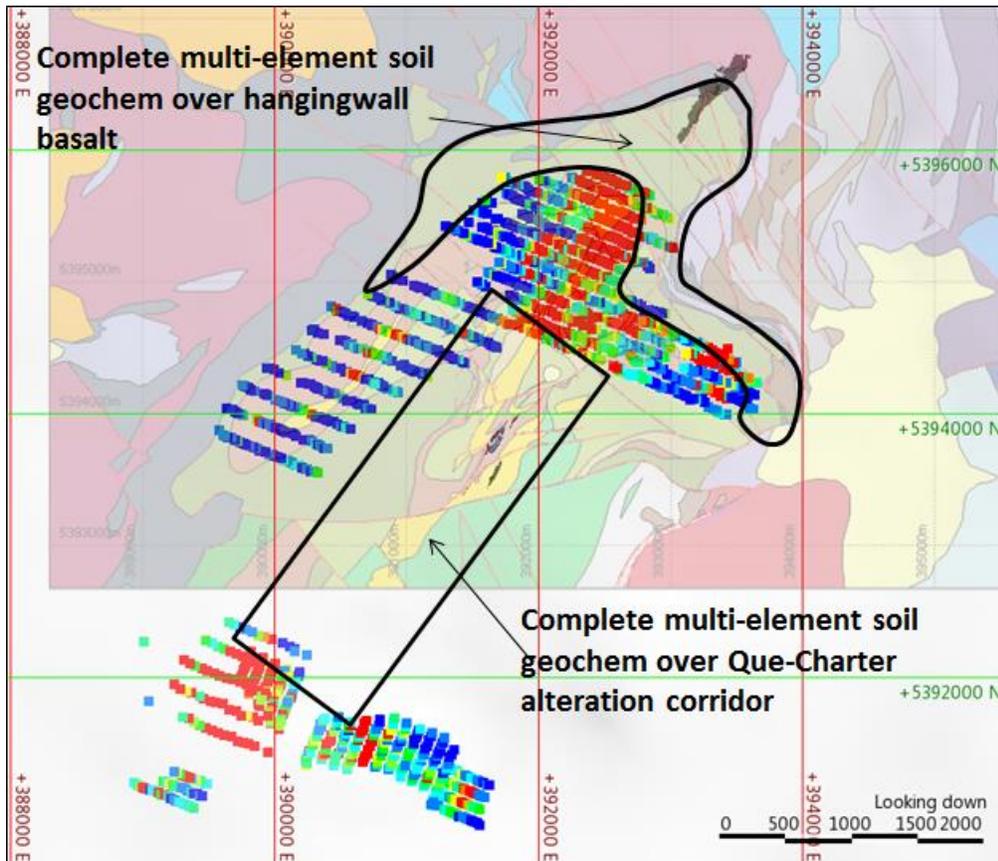


Figure 12. Antimony soil geochem overlaid on geology map.

Figure 12 shows the extent of the new generation, ICP-MS/AES soil geochemistry. Given the effectiveness of this technique for mapping bedrock geology from soil geochemistry and mapping the footwall alteration via detection of pyrite-hosted trace metals, then it is recommended that the soil geochemistry coverage be extended. There are two obvious areas to extend the coverage. The alteration zone from Que River to Mt Charter should be covered with new data. In addition, the hangingwall basalts above Hellyer, and to the west and south of Hellyer should be covered with systematic ICP-MS/AES soil geochemistry. Where the soil geochemistry maps a footwall alteration position, chances are the massive sulfide potential is already removed by erosion. However, Hellyer has a plume of hangingwall alteration which clearly shows up in two trial sampling lines. This should be applied everywhere to see if another intact sulfide system can be detected.

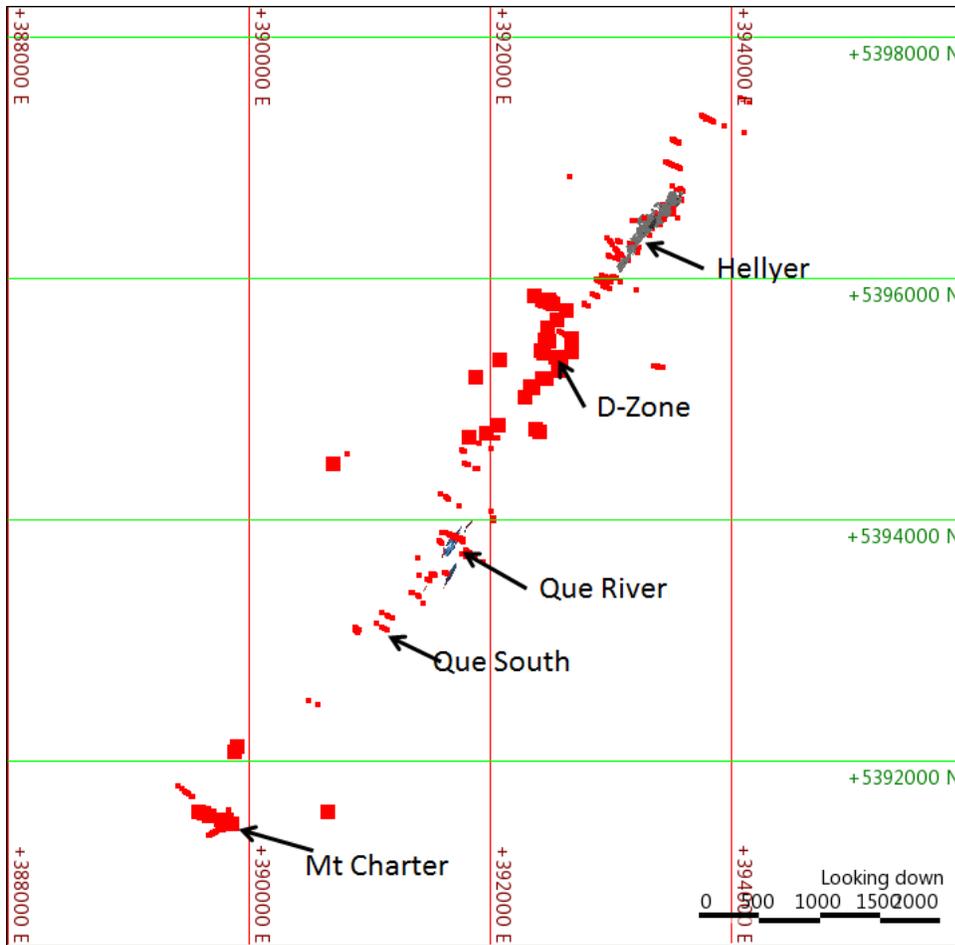


Figure 13. Thallium Geochemistry. Large symbols; soil samples >4ppm TI, small symbols drill hole assays >4ppm TI.

Rather than forming as exhalative massive sulfide bodies, Fossey and in part, Mt Charter was formed as sub-seafloor replacement zones. The mineralogy strongly suggests that these are zones of porous and permeable rock where hydrothermal fluids have mixed with an influx of cold seawater. The distinctive mineralogy includes barite, K-feldspar, long wavelength phengitic white mica and thallium-bearing pyrite. Thallium only substitutes into the lattice of pyrite at temperatures less than 200 degrees. It is possible therefore that thallium may be useful as a guide to picking where Fossey-type mineralization could exist below outcropping alteration zones. The distribution of high thallium zones, with a cut-off greater than 4ppm, is shown in figure 13. Besides Fossey and Mt Charter, the locations with coincident K-Spar, high thallium, phengite and barite are D zone and Que South. These are the best chances for another Fossey Zone.

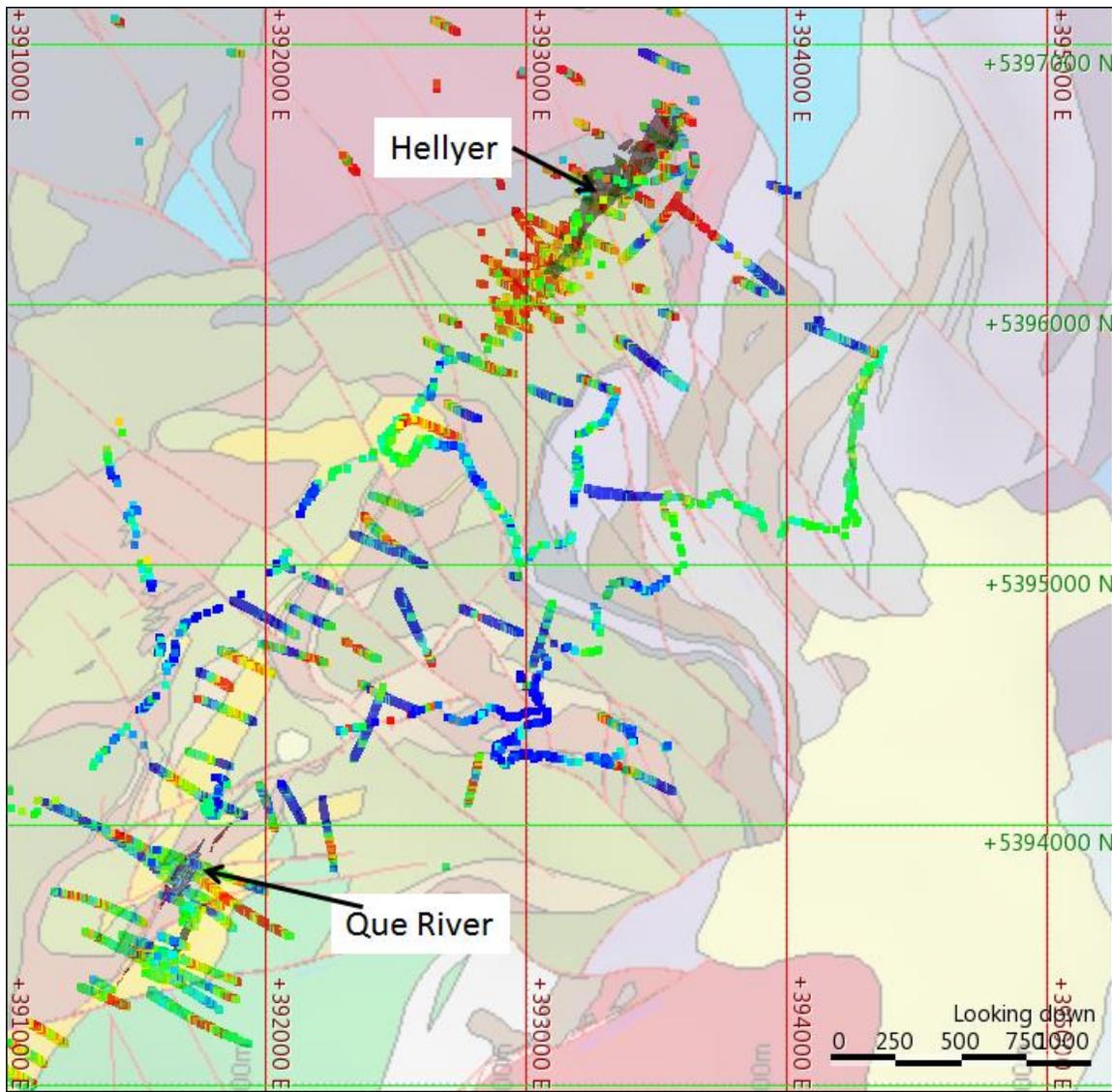


Figure 14. Compositions of sericite from drill core and surface traverses, measured with an infrared spectrometer. The colours show the wavelengths of the characteristic 2200nm absorption features. Blue<2198nm, Red>2218nm. The blue colours are muscovitic compositions. The red colours are phengitic compositions. This is a proxy for pH. Muscovitic micas form in acid conditions. Phengitic micas form in more neutral to alkaline conditions.

Portable infrared spectrometers, such as the Analytical Spectral Devices “Terra Spec” are commonly used as logging instruments in mineral exploration. They are particularly useful in VMS systems, because these are generally acidic hydrothermal systems that give rise to distinctive zoned mineralogical patterns. VMS deposits typically show a zonation pattern in the composition of white micas within the footwall alteration. White micas have distinctive infrared absorption features around 2200nm. In micas that form in acid conditions, this feature will shift to shorter wavelengths (around 2195nm); in more neutral conditions, the micas have longer wavelengths (around 2215nm). The typical pattern measured in VMS systems is a proximal zone of short wavelength sericite in the stringer zone beneath the massive sulfides grading outwards to longer wavelengths on the margins.

The Hellyer district shows some atypical characteristics. It is common to see barite veins and KSpAr in the footwall, which are the result of an influx of seawater into the waning hydrothermal system. Seawater is alkaline, so this has also caused a reversal in the typical infrared wavelength signatures. However, parts of the Hellyer camp DO have the very typical VMS spectral signatures. This is particularly evident in the area between Hellyer and the Switchback. The spectral signatures from drill core and surface sampling in this area are dominated by Fe-rich chlorite and short wavelength sericite. What is particularly encouraging here is that this signature is so pervasive through the area. *All* of the rocks through this area have been altered at a low to moderate intensity by a typical, acidic, hydrothermal VMS fluid. This area includes the number 2 and 3 drill targets described earlier. Given the characteristics of the alteration, it is recommended that ongoing work is directed here to define further drill targets within this broad alteration system. It is now 20 to 30 years since the previous exploration holes were drilled here. There have been enormous advances in down hole EM technology in that time. If the historic holes still have the casing intact, these holes should be re-surveyed with modern DHEM systems. If not, a series of widely spaced holes should be designed for the purpose of gaining geological information and building a 3D geology model, but primarily for providing a basis for complete DHEM coverage along strike and to a reasonable depth down dip through this alteration zone. This might be 6 to 8 drill holes to a depth of around 500m, and would facilitate testing of targets 2 and 3 at the same time.

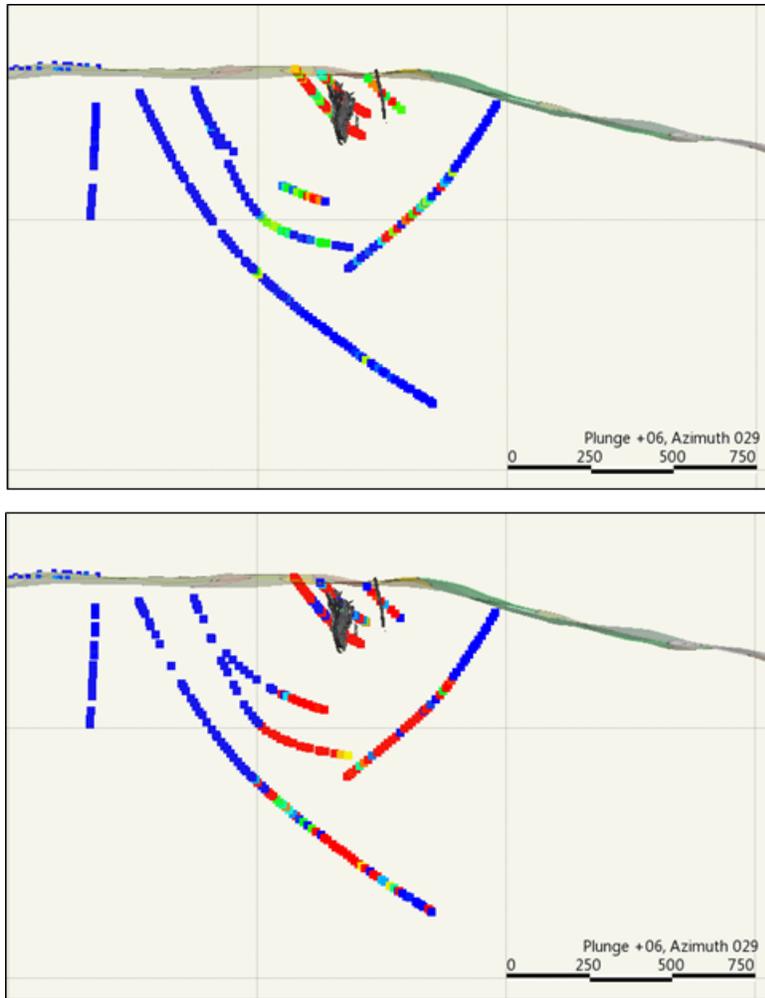


Figure 15. Metal zonation in the Que River stringer zone; top, Thallium ranges, blue<1ppm, red>4ppm; lower, Sulfur Ranges, blue<1%, red>3%.

The pathfinder metals in the stringer zones show a distinct zonation pattern. In figure 15, the sulfur distribution is a proxy for mapping the stringer zone. Note that high Thallium values only occur proximal to the massive sulfide bodies. The metal patterns are zoned from deep on this section to shallow levels, from Bi to As to Sb to Tl. This is a temperature dependent metal zonation. Massive sulfides formed at high temperatures generally have a higher pyrite and chalcopyrite content, and because of this mineralogy, they are good conductors. Massive sulfides formed at lower temperatures are usually more sphalerite, galena, barite-rich, with less pyrite, and therefore are weak conductors. In theory, therefore, it should be possible to predict how effective DHEM is likely to have been, in terms of detecting off-hole conductors in each drill hole. Holes that have very high thallium contents in the alteration zones, or perhaps a high Tl/As ratio, are likely to be associated with lower temperature mineralization that will produce poor conductors.