Thallium halos in the Rosebery VHMS district; Improving vectoring to mineralisation

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‘Halos’ of anomalous Thallium around SEDEX and some epithermal and VHMS deposits [e.g. 1-3] may be regionally extensive exploration targets (up to 20km from mineralisation for some SEDEX deposits [4]). For example, the Tl halo at the Rosebery VHMS deposit, Tasmania, although more areally restricted than suggested by Large *et al.* [5], was used successfully to discover a new ore lense (Y Lens, 2005).

Although successful as an ‘empirical’ vector to mineralisation, the distribution of Tl in the halo is not well characterised or understood. For example, The bulk Tl content of some sulfide-poor samples proximal to ore are higher than that of massive sulfides, indicating lithophile behaviour of Tl in the halo, however, the correlations between Tl and K and/or Rb, found in some halos and interpreted to indicate that Tl is largely hosted by white mica or alkali feldspar [e.g. 2, 6], are absent at Rosebery.

To better characterise the distribution of Tl around the Rosebery deposit, we analysed sulfides and white micas by LA-ICPMS analyses, in both spot and mapping mode, from 11 samples with varying alteration style and intensity. For the sulfide minerals, Tl is low (<10 ppm) in pyrrhotite, chalcopyrite, sphalerite and recrystallised pyrite, but elevated in galena (mean=398 ppm in two samples) and in ‘primitive’ pyrite (up to 40ppm), where it is largely present in Pb-Bi-Ag-Sb-rich inclusions. These levels are consistent with those reported by Martin [7] from Rosebery ores and there do not appear to be variations in Tl content with distance from the orebodies. The white micas contain 2-380ppm Tl, with a strong correlation between whole-rock Tl and white mica composition. However, Tl content of the micas appears to be a complex function of the style and intensity of alteration, sulfide abundance, and proximity to ore.

[1] Large & McGoldrick (1998) *J. Geochem. Expl.* **63**, 37–56. [2] Gemmell (2007) *Econ. Geol.* **102**, 893–922. [3] Large *et al.* (2001) *Econ. Geol.* **96**, 913–938. [4] Large *et al.* (2000) *J. Geochem. Expl.* **64**, 105–126. [5] Large *et al.* (2001) *Econ. Geol.* **96**, 1055–1072. [6] Shah *et al.* (1994) *Mineral. Deposita.* **99**, 422–426. [7] Martin (2004) unpub. PhD Thesis

The new Mars: Evolving perceptions of the nature of the igneous crust and the mantle

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SNC meteorites constitute igneous samples from as many as seven locations on Mars, and Gusev crater has become the most thoroughly characterized igneous province on the planet. Nearly global geochemical coverage from orbiting spacecraft allow conclusions from analyzed samples to be extrapolated to the crust. SNC data imply only tholeiitic basalt magmatism, but Gusev rocks are mildly alkaline. However, the SNC-based conclusion that Martian basalts contain ferroan olivine and pyroxenes and sodic plagioclase has been sustained. A previous proposal for calc-alkaline (andesitic) volcanism, based on rock compositions at the Mars Pathfinder site and those derived from orbital TES spectra, has been refuted by orbital GRS data. An earlier inference from SNCs that the Martian crust contained only anhydrous rocks has given way to the realization that volatiles were important in some, perhaps many, magmas. TES data have revealed only a few localized occurrences of quartz-bearing rocks. The New Mars is a basalt-covered world, where magmatic fractionation has been very limited and where basalt compositions are more restricted than on Earth. This crustal composition places limits on the nature of the weathering products produced.

The discovery of at least two primitive magma types (olivine shergottite Y-980459 and Adirondack basalts at Gusev) has allowed new constraints to be placed on Martian mantle sources. Two different sources, both Fe-rich but with different Mg/Fe and Ca/Al ratios, are required. Both sources are ancient, and their co-existence can be explained by a magma ocean model. The SNC mantle, at least, is more oxidized and enriched in volatile elements, relative to the Earth.