Mobility of Au and other metals in supra-subduction zone oceanic crust: insight from the Troodos ohiolite

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The Troodos ophiolite is an ideal location to investigate the relationship between metal mobility from source areas and the formation of volcanogenic massive sulphide deposits (VMS). Previous studies have shown that epidosite altered portions of the lower sheeted dyke section of are significantly depleted in base metals including Cu and Zn. The VMS in the Troodos ophiolite, are Cu rich but also host non-negligible Au, As, Sb and Se. However the behaviour of Au and related elements during the hydrothermal alteration of the Troodos ophiolite has not been investigated.

Fresh glass analyses reveal that the Troodos primitive crust has a similar metal distribution to modern day back arc environments such as the Manus basin. Sulphur concentrations suggests that the crust is sulphide-undersaturated during most of the magmatic differentiation (until 3.5 % MgO). Au, Se and Cu, which are strongly chalcophile, thus behave as incompatible elements until sulphide saturation. As, Sb, Zn and Pb also behave as incompatible elements but are not affected by sulphide saturation. VMS in the Manus basin are Au-rich and different from those of Troodos. This difference can be attributed to the difference in metal potential of the primitive crust combined with magmatic fluid input and seafloor boiling.

Mass balance of metal mobilisation from epidosite zones shows that significant depletion of Au (-87.9±16.3 %), As (-88.5±21.3 %), Sb (-60.9±11.8 %), Se (-91.6±20.1 %), Cu (-84.2±17.9 %), Zn (-61.7±8.7 %) and Pb (-69.6±9.8 %) occurs. Greenschist altered diabases show also significant metal depeltion which suggests that source areas of VMS are not restricted to epidosite zones. The metal quantity mobilised from the lower sheeted dykes of the Solea graben is compared with three VMS within the graben. Of the large masses of metals mobilised from the source areas, 20 % Au, 19 % As, 2 % Sb, 38 % Se, 51 % Cu and 6 % Zn are trapped within VMS deposits which suggest relatively high metal trapping efficiency relative to other tectonic settings.