Just plain pyrite? Understanding Te and Se in Cyprus-type VMS deposits

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Tellurium (Te) and selenium (Se) are identified as critical in low carbon technologies under the European Union's strategic energy technology plan (SET-Plan). The future economic importance of Te and Se in emerging technologies is paralleled by a poor understanding of the source, mobilisation and concentration of Te and Se within ore deposits. To begin to address this issue the distribution and enrichment of Te and Se has been characterised in volcanogenic massive sulphide (VMS) deposits of the Troodos ophiolite, Cyprus. Initial screening of crushed samples using portable-XRF highlights significant enrichment of Se associated with "off axis" mineralisation; e.g. Kokkinovounaros at 300 ppm. Aqua regia digestion and ICP-MS analysis reveals that deposits associated with the Solea graben, one of three axial graben areas, exhibit the most significant enrichment in both Te and Se.

Laser ablation ICP-MS of sulphide minerals from 18 VMS deposits shows both Te and Se may be significantly enriched in pyrite with concentrations of 152 and 3900 ppm respectively. This is a significant enrichment of 76000 and 78000 times average crustal abundance for Te and Se.

Distribution of Te and Se is extremely heterogeneous; time resolved laser analysis suggests Se occurs in solid solution (substituting for S) whilst Te occurs as mineral inclusions. The laser data indicate a preferential enrichment of Se in chalcopyrite over pyrite with concentrations up to 2400 ppm. In contrast, sphalerite is depleted in Te and Se relative to pyrite. Sb and Au also exhibit significant enrichment in pyrite from the Marla VMS up to 200 and 2.6 ppm, respectively.