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Unusual tin enrichment in hydrothermal sulfides from ultramafic environment on the MAR

Catherine Evrard (1), Nima Moussa (1,2), Yves Fouquet (1), Joel Etoubleau (1), and Marcel Bohn (3)

(1) Ifremer, Brest, France (catherine.evrard@ifremer.fr), (2) IUEM, UMR 6538 Domaine océanique, Brest, France, (3) CNRS, Brest, France

Some sulfides collected during the Serpentine Cruise in 2007 on the Mid-Atlantic Ridge Hydrothermal areas show unusual concentration of tin (Sn). The samples were collected on the Ashadze and Logatchev area and have a mean concentration of tin of 400 ppm, with a maximum of 2040 ppm. All these hydrothermal sulfides are hosted in ultramafic rocks, which contain less than 1 ppm tin. The bulk sulfide chemistry was realized by X-Ray fluorescence and show, for the sample with a concentration of tin higher than 500 ppm, a mean concentration of sulfur, iron, copper and zinc from respectively: 32 %, 20 %, 10 % and 25 %. Microscope and X-Ray diffraction show principally chalcopyrite and sphalerite, with some secondary copper sulfides (isocubanite, bornite, covellite ...). Iron sulfides, pyrrothite, are mostly present in the Ashadze samples and are absent in the Logatchev samples. No tin minerals were observed in the thin sections. Electron microprobe analyses and element mapping allowed locating extensive tin concentration, both in chalcopyrite and in sphalerite, at the limit of the two minerals. Average concentrations in tin in enriched areas are around 3 wt% in sphalerite and around 2 wt% in chalcopyrite. The tin is mostly localized in the sphalerite. The location of tin is concentrated on one side of the minerals. Furthermore, in sphalerite, there is a slight negative correlation between zinc and tin, but copper in this mineral show a correlation with tin. Different possibilities can explain the presence of tin in sphalerite. The tin can substitute to zinc or it can crystallise in chalcopyrite inclusions in sphalerite or as inclusion of tin minerals (stannite and kuramite). All these observations seem to be related to a thermal gradient trough the chimney.