Cu-rich serpentine at a crust-mantle transition zone – remnants of primary sulfide accumulation?

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Copper sulfide deposits at oceanic crust-mantle transition zones are known from the Oman ophiolite. The corresponding sulfides are seen as late secondary formations. Whether or not primary Cu and S enrichment occurred is unclear due to the ophiolite's complex history. The crust-mantle transition zone exposed in the southern part of the Kane Megamullion oceanic core complex on the MAR [1] provides an *in-situ* analogue for such enrichment. Highly enhanced chalcophile-element concentrations occur in plagioclase harzburgites, gabbro-peridotite contact zones and mantle derived dunites from this zone [2]. Bulk Cu and S are highly correlated [3], implying that chalcopyrite should be or was abundant.

Here we report the results of ore microscopy, EMP and LA-ICPMS analyses of these rocks. Sulfides occur in all the samples, with the highest modal amounts in rocks richest in Cu and S. Unexpectedly, pentlandite and pyrrhotite, but not chalcopyrite, are the common sulfides. Both contain little Cu (on average 82 and 251 ppm, respectively). Hence, another Cu-rich phase is needed to explain the high whole-rock Cu contents. We find that serpentines from the melt-impregnated plagioclase peridotites are highly enriched in Cu, Zn, and other chalcophile elements. In particular, serpentines in contact with gabbros contain on average 436 ppm Cu and 317 ppm Zn, and those in other plagioclase harzburgites contain on average 79 ppm Cu and 50 ppm Zn. For comparison, serpentines from Kane Megamullion spinel harzburgites, representing residual mantle peridotite, contain on average 10 ppm Cu and 39 ppm Zn. Therefore, we believe that initially chalcopyrite and pyrrhotite crystallized with plagioclase during late-stage melt impregnation. Although chalcopyrite was subsequently dissolved during serpentinization, S and Cu were not mobilized. Plagioclase-peridotites produced by late-stage melt-rock reaction in the shallow mantle are common beneath the crust, and thus are a likely candidate source rock for hydrothermal sulfide deposits both in the transition zone and in any overlying hydrothermal deposits.

[1] Dick et al. (2010) *J Petrol* **51**, 425-467. [2] Ciazela et al. (2015) Geophysical Research Abstracts **17**, EGU-1044. [3] Ciazela et al. (2015) *Workshop for scientific drilling in the Indian Ocean crust & mantle*, 31-32.