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Fe-Cu isotope signatures and trace element contents of sulfide blebs from peridotite xenoliths beneath the Nógrád-Gömör Volcanic Field (Northern Pannonian Basin)

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The Nógrád-Gömör Volcanic Field is a peridotite xenolith-bearing alkali basalt occurrence in the Carpathian-Pannonian region. After thorough sampling, a lherzolite and a wehrlite xenolith series were distinguished based on their petrography and geochemistry. The lherzolites represent precursors for the metasomatic wehrlites.

Here we present sulfide minerals, which are more abundant in the wehrlites ($\sim$0.04 vol. %) compared to the lherzolites ($\sim$0.01 vol. %). The sulfides appear both as inclusions within silicates or as interstitial grains with sizes of 5-80 μm and 5-200 μm, respectively. The sulfides consist mostly of pentlandite, pyrrhotite and chalcopyrite. Pyrrhotite and chalcopyrite are frequent in wehrlites and rare in lherzolites.

We studied the compositional differences between bulk sulfides from the two xenolith series using electron microprobe (EPMA). The wehrlitic sulfides show higher Fe and Cu, but lower Ni and Co contents compared to the lherzolitic sulfides. To better understand the sulfide behavior, we applied the ElementXR femtosecond laser ablation inductively coupled plasma mass spectrometer (fs-LA-ICPMS) to obtain in situ trace element data. Neither the highly siderophile (e.g. Os, Ir, Ru, Rh, Pt, Pd, Re, Au) nor the chalcophile (e.g. As, Bi, Cd, Sn, Sb, Se, Te) elements show differences between the two xenolith series. Furthermore, using fs-LA coupled to another ICPMS (NeptunePlus), we in situ determined the δ65Cu (deviation of 65Cu/63Cu from NIST SRM 976 expressed in ‰ and δ56Fe (deviation of 56Fe/54Fe from IRMM-014 expressed in ‰ values of bulk sulfide grains in two lherzolite and four wehrlite xenoliths. The δ65Cu results differ in the two xenolith series. -0.65 – +1.12 and -1.33 – -2.04 for the wehrlites and lherzolites, respectively. However, chemical difference was not observed in case of the δ56Fe: -0.25 – +0.84 and -0.28 – +0.83 for the wehrlites and lherzolites, respectively.

The distinct major element compositions between lherzolitic and wehrlitic sulfides correlate well with their origin related to the wehrlitic metasomatism. In addition, sulfide precipitation from melt percolating through the upper subcontinental mantle appears to trigger Cu isotope fractionation. In contrast, Fe isotope fractionation between the two xenolith series was not observed, which is probably due to the ubiquitous presence of iron in mantle silicates (olivine, pyroxenes) implying additional impact of sulfide melt-silicate melt fractionation on top of melt-mantle fractionation. The lack of difference in trace elements supports the idea that several lherzolites also undergone cryptic metasomatism at the time of wehrlitization, as proposed by Liptai et al. (2017).

References:
Liptai, N. et al. 2017. Journal of Petrology, 58(6), 1107-1144.