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Metal enrichment as a result of SCLM metasomatism? Insight from ultramafic xenoliths from SW Poland.

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Migration of metals such as gold, silver and copper through the subcontinental lithospheric mantle (SCLM) can be tracked by the investigation of sulfides in mantle xenoliths. Therefore, to understand relations between the metal migration and metasomatism of silicate phases in the SCLM beneath SW Poland we studied sulfides in a set of mantle ultramafic xenoliths with variable metasomatic history. The xenoliths occur in the Cenozoic alkaline mafic volcanic rocks from the SW Poland (N Bohemian Massif).

The studied sulfides occur in mantle rocks of variable history: 1) strongly depleted (group A0) to weakly metasomatized peridotites (Group A1); 2) strongly melt-metasomatized peridotites (Group B); 3) pyroxenites (Group C; for details of group definition see Matusiak-Małek et al., 2014, JoP). The metasomatism was of mixed silicate/carbonatite nature. The sulfides are either interstitial or enclosed in the silicates and form mostly globular monosulfide solid solution-chalcopyrite (mss-Ccp) assemblages typical of igneous sulfides separated and crystallized from mafic magmas, with mss partially re-equilibrated to exsolutions of pentlandite (Pn) and pyrrhotite (Po) when temperature dropped to <600°C (e.g., Craig and Kullerud, 1969, Econ. Geol. Monogr.).

The sulfide abundances increase from Group A (≤ 0.008 vol.‰) through Group B (up to 0.060 vol.‰) to Group C (up to 0.963 vol.‰) xenoliths. The sulfides of Groups C ($Po_{15–99}Pn_{0–20}Ccp_{0–70}$)and B ($Po_{0–85}Pn_{14–100}Ccp_{0–27}$) are generally poorer in Ni compared to Group A ($Po_{0–74}Pn_{24–100}Ccp_{0–35}$). Consequently, Ni/(Ni+Fe) in the Group C pentlandites (0.41–0.52) is lower than in those in Group A (0.45–0.69). Moreover, the sulfide grains of Group B are enriched in chalcophile elements (e.g., the median content of Zn is 90 ppm) compared to sulfides from Groups C (52 ppm Zn) and A (51 ppm of Zn). The same relations occur in PGE contents, e.g., Pt in Group B is 1.6 ppm, while in Groups C and A it is 0.1 and 1.3 ppm, respectively. Observed differences in δ^{56}Fe between the Groups are probably due to modal composition of bulk sulfide grains between Groups A (Ni-rich), B and C (Fe-Cu-rich). As no difference is observed between the grains of the same composition, any fractionation of Fe isotopes in sulfide melt seems to be possible only upon its differentiation from

Ni-rich to Fe-Cu-rich.

The host peridotites were affected by strong depletion as the degree of partial melting was possibly ~30%. Thus, the observed enhanced sulfide modes in the metasomatized peridotites (Groups A1 and B) are most likely brought by the metasomatic melt. This is also evidenced by their Fe-Cu-rich composition, similar to that of the sulfides from the pyroxenites. In this view, melt metasomatism likely affects the chalcophile and highly-siderophile metal budget of the continental lithosphere.

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