Fe-Cu-S rich melts in the subcontinental lithospheric mantle: insight from the Lower Silesian (SW Poland) xenoliths

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Migration of strategic metals through the lithospheric mantle can be tracked by sulfides in mantle xenoliths. Cenozoic mafic volcanic rocks from the SW Poland (Lower Silesia, Bohemian Massif) host a variety of subcontinental lithospheric mantle (SCLM) xenoliths. To understand metal migration in the SCLM we studied metal budget of peridotites from the Wilcza Góra basanite and their metasomatic history.

The Wilcza Góra xenoliths are especially appropriate to study metasomatic processes as they consist of 1) peridotites with Ol$_{Fo=89.1-91.5}$ representing depleted mantle (group A); 2) peridotites with Ol$_{Fo=84.2-89.2}$ representing melt-metasomatized mantle (group B), as well as 3) hornblende-clinopyroxenites and websterites with Ol$_{Fo=77.2-82.5}$ representing former melt channels (group C; Matusiak-Małek et al., 2017). The inherent sulfides are either interstitial or enclosed in the silicates. High-temperature exsolutions of pyrrhotite (Po), pentlandite (Pn) and chalcopyrite (Ccp) indicate magmatic origin of the sulfides.

The three peridotitic groups differ by sulfide mode and composition. The sulfide modes are enhanced in group C (0.022-0.963 vol.‰) and group B (<0.028 vol. ‰) with respect to group A (<0.002 vol.‰). The sulfides of group C are Ni-poor and Fe-Cu-rich as reflected in their mineral composition (Po$_{55-74}$Ccp$_{1-2}$Pn$_{24-44}$ in group A, Po$_{67-85}$Ccp$_{1-6}$Pn$_{14-33}$ in group B and Po$_{80-97}$Ccp$_{1-7}$Pn$_{2-20}$ in group C) and major element chemical composition. Ni/(Ni+Fe) of pentlandite is the lowest in group C (~0.25) and the highest in group A (0.54-0.61). Cu/(Cu+Fe) of chalcopyrite is 0.32-0.49 in group C contrasting to ~0.50 in groups A and B.

The sulfide-rich xenoliths of group C indicate an important role of pyroxenitic veins in transporting Fe-Cu-S-rich melts from the upper mantle to the crust. However, the moderately enhanced sulfide modes in melt-mantle reaction zones represented by xenoliths of group B demonstrate that the upper continental mantle is refertilized with these melts during their ascent. Hence, significant portion of S and metals remains in the mantle never reaching the crust, as has been previously observed in the oceanic lithosphere (Ciazela et al., 2018).
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References:

