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Predicting the global distribution of iron-wehrlites in the mantle lithosphere with application to the Carpathian-Pannonian Region (Central-Europe)

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Iron-wehrlites are largely interpreted as reaction products between clinopyroxene-saturated silicate melts and peridotites, which present in variable tectonic settings including convergent, divergent and intraplate areas. Although iron-wehrlites tend to occur in all tectonic environments, they represent only a subordinate fraction of the coexisting ultramafic lithologies. Hence, so far little attention has been directed at how pressure, temperature, wall rock composition, and melt-rock ratios modulate their formation.

Here we use alphaMELTS [1] to simulate transformations associated with porous and channelized transport of variable basalt-like liquids (generated via low-degree melting of peridotites at the lithosphere-asthenosphere boundary) through lherzolites, harzburgites, and dunites under various physical conditions of the lithospheric mantle.

Melt-rock reactions simulated along various polybaric cooling paths tend to generate a sequence of the metasomatic products, distributing the dunite–wehrlite–secondary lherzolite series vertically. These findings may explain why wehrlites are rather rare in the shallow mantle commonly sampled by basalts, and suggests that they should be common in the deeper lithospheric mantle sections affected by melt migration, generally underrepresented in the xenolith record. In high heat flow tectonic settings dominated by significant magma fluxes, such as mid-ocean ridges and arcs, high temperatures along the melt migration paths in the mantle restrict reaction products to dunites; therefore, wehrlites tend to be relatively scarce in these settings. In contrast, wehrlitic lithologies are predicted to occur more frequently in the deeper lithospheric mantle of cooler intraplate settings.

The Neogene alkali basalt volcanism transported numerous upper mantle xenoliths to the surface in five localities of the Carpathian-Pannonian Region (CPR; Central-Europe). Among these, only the xenolith record from the Nógrád-Gömör Volcanic Field (NGVF) situated in the northern part of the CPR shows a high proportion (>20 %) of iron-wehrlites. According to our preliminary results, melt migration channels allowing focused flow with high melt-rock ratios may play a key role in the wehrlitization beneath the NGVF. The development and spatial distribution of the channels likely has a strong tectonic control.

[1] Smith & Asimow (2005), *Geochemistry, Geophysics, Geosystems*, *6*(2), 1-8.