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Deciphering mantle metasomatism using silicate melt inclusions beneath the Nógrád-Gömör Volcanic Field (Northern Pannonian Basin)

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The Nógrád-Gömör Volcanic Field (NGVF) is situated in the northern part of the Pannonian Basin, and is one of the five known Neogene upper mantle xenolith bearing alkaline basalt localities in the region.

In addition to the dominant lherzolites [1], great number of wehrlite xenoliths have also been recognized with specific textural and geochemical features, including clinopyroxene-rich patches on olivine-rich lithology, vermicular spinel forms and enrichment in basaltic elements (e.g. Ti, Al, Fe, Mn). According to our results, the wehrlites were formed by extensive mafic melt metasomatism, which significantly modified the lherzolitic wall rock during the interaction.

In order to get a better insight into the metasomatic process, including trace element behavior, primary, 15-60 μm-sized silicate melt inclusions (SMIs), hosted both in clinopyroxenes and olivines were studied. The SMIs have negative crystal shape and are partially crystallized, containing 1-5 μm clinopyroxene, spinel, amphibole, $\pm$ mica, $\pm$ apatite and $\pm$ sulfide daughter phases and a CO_2 dominated bubble. Twelve representative wehrlite xenoliths have been selected for detailed trace element analysis of the silicate melt inclusions with the use of LA-ICP-MS. The analysis revealed enrichment in incompatible elements, especially in LIL (e.g. Ba, Sr, Pb) and HFS elements (e.g. Nb, Ta, Zr) compared to the host mineral.

To test our formation hypothesis regarding the mantle metasomatism, numerical trace element modelling was carried out using the plate model [2]. The results confirm that a mafic metasomatizing melt was responsible for forming the wehrlites in the upper mantle of the NGVF.

Our results suggest that pressure and the composition of the reacting melt play a key role in wehrlitization, as opposed to the precursor composition, which has no effect on the metasomatic product.

References:
[1] Liptai, N. et al. 2017. Journal of Petrology, 58(6), 1107-1144.
[2] Vernières, J. et al. 1997. Journal of Geophysical Research: Solid Earth, 102(B11), 24771-24784.