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Isotopic fingerprint of metasomatism in eclogite xenoliths from the Navajo Volcanic Field (USA)

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In order to quantify mass transfer in subduction zones and link it to inputs at the trench and outputs influencing arc magmatism, the processes in the subduction factory as a function of extensive and intensive variables must be determined. Flat subduction of the Farallon plate below the Colorado Plateau in the Mesozoic and early Cenozoic triggered the formation of serpentinite diatremes in the Navajo Volcanic Field, which contain eclogite xenoliths for which a derivation from the Farallon plate has been considered. These eclogites experienced a multistage history of protolith formation in an ocean floor setting, seawater alteration and subduction-related metamorphism (around 4 GPa, 600°C), providing unrivalled insights into mass transfer processes at subarc depth. Various stages of metasomatism at different P-T conditions induced chemical variability in the sample suite: Na_2O-SiO_2 enrichment, possibly at forearc depth, favored the formation of omphacitites, whereas a massive ca. 30 Ma hydration event related to slab foundering led to late Mg-rich garnet overgrowths and matrix monazite crystallization.

Preliminary U-Pb dating of MgO-poor garnet cores indicates Mesozoic prograde garnet growth, whereas MgO-rich rims likely formed during late hydration. This suggests that the xenoliths were subjected to eclogite facies metamorphism in the subducting Farallon slab and do not represent Proterozoic eclogites from the base of the lithosphere below the Colorado plateau. We are in the process of collecting stable isotope data for multiple elements with the aim to assess the impact and physicochemical parameters of high-pressure metasomatic events. One target is Fe isotopes, the fractionation of which is redox-sensitive, providing information about redox interactions during metasomatism. Lithium isotopes, with their strong fluid mobility and fast diffusion, allow the detection even of short-lived fluid-mediated events. First preliminary results suggest potential correlations of δ^7Li values with LREE (positive) and Na_2O contents (negative). If so, this may indicate that both LREE-rich and Na-rich metasomatic fluids modified the Li isotope compositions of the eclogites. Slab-derived fluids are often isotopically heavy, but previous loss of isotopically heavy Li during prograde dehydration and/or kinetic isotope fractionation driven by preferential diffusion of ^{6}Li into eclogite minerals offer ways to explain low δ^7Li values.