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ABSTRACT BOOK

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Petrological features and volatile content of ultramafic xenoliths from Eifel (Germany)

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This work focuses on mantle xenoliths sampled from five localities of the Eifel volcanic field, both from the western and eastern side of the rift system, aiming at improving the knowledge of the local SCLM. Together with the petrology of the xenolith suite, which include major and trace element of whole rock and primary mineral phases, fluid inclusion (FI) analyses (He, Ne, Ar, CO_2) were also carried out via single-step crushing.

A remarkable difference exists between eastern and western outcrops. In the former xenoliths are embedded in lava, sills or necks, while in the latter they are found in scoria cone or in pyroclastic deposits.

The xenoliths are lherzolitic, harzburgitic, and wehrlitic in composition with the exclusive modal presence of both amphibole and phlogopite in the western localities. Few ol-clinopyroxenites and one ol-websterite are also present. Texture varies from protogranular, porphyroclastic and equigranular in most of the xenoliths, to cumulitic in some samples.

Mg# [MgO/(MgO+FeO_{tot}) mol%] varies from 83 to 92 for olivine, from 84 to 92 for orthopyroxene, and from 84 to 94 for clinopyroxene. Al_2O_3 content of orthopyroxene and clinopyroxene ranges from 0.5 to 6.5 wt% and from 0.7 to 8.2 wt%, respectively. Spinel is characterized by Cr# [Cr_2O_3/(Cr_2O_3+Al_2O_3) mol%] ranging between 10 and 82, and by Mg# varying from 40 to 78. Xenoliths from the eastern localities are characterized by the highest Mg# for clinopyroxene and Cr# for spinel, together with the lowest Al_2O_3 contents for both pyroxenes. Based on these petrographic and geochemical features, an origin for these xenoliths via cumulitic or melting processes can be proposed.

In terms of CO_2 and noble gas concentration, clinopyroxenes and most of the orthopyroxenes show the highest gas content, while olivines are gas-poor. This variability in FI concentration seems not related to the variations observed in the He, Ne, and Ar isotopic compositions. In detail, $^3He/^4He$ varies between 5.5 and 6.9 Ra, where Ra is the $^3He/^4He$ ratio of air that is equal to 1.39×10^{-6}. These values are within the range proposed for European SCLM (6.3±0.4 Ra), and slightly below that of MORB (Mid-Ocean Ridge Basalts; 8±1Ra), being comparable to previous measurements, which were developed only in western Eifel. The Ne and Ar isotope ratios fall along a binary mixing trend between air and MORB-like mantle. He/Ar* in FI and Mg# and Al_2O_3 content in minerals indicate that variable extents of partial melting occurred in the local SCLM, followed by metasomatic processes. The ongoing carbon isotopic measurements in the most CO_2-rich mantle xenoliths, coupled to the noble gases systematics in FI and mineral chemistry, will help in shedding light on the local mantle composition and the volatile recycling within the European SCLM, adding new clues to the present knowledge. An additional benefit of this type of studies is the possibility of better constraining the composition of fluids rising through the crust, that are usually monitored for volcanic or seismic hazard.