



## Geochemistry of noble gas and CO<sub>2</sub> in fluid inclusions from lithospheric mantle beneath Eifel and Siebengebirge (Germany)

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The study of fluid inclusions (FI) composition (He, Ne, Ar, CO<sub>2</sub>) integrated with the petrography and mineral chemistry of mantle xenoliths representative of the Sub Continental Lithospheric Mantle (SCLM) is a unique opportunity for constraining its geochemical features and evaluating the processes and the evolution that modified its original composition. An additional benefit of this type of studies is the possibility of better constraining the composition of fluids rising through the crust and used for volcanic or seismic monitoring.

In this respect, the volcanic areas of Eifel and Siebengebirge in Germany represent a great opportunity to test this scientific approach for three main reasons. First, these volcanic centers developed in the core of the Central European Volcanic Province where it is debated whether the continental rift was triggered by a plume (Ritter, 2007 and references therein). Second, Eifel and Siebengebirge formed in Quaternary (0.5-0.01 Ma) and Tertiary (30-6 Ma), respectively, thus spanning a wide range of age. Third, Eifel is characterized by the presence of CO<sub>2</sub>-dominated gas emissions and weak earthquakes that testify that local magmatic activity is nowadays dormant, but not ended (e.g., Bräuer et al., 2013). It is thus important to better constrain the noble gas signature expected in surface gases in case of magmatic unrest.

This work focuses on the petrological and geochemical study of mantle xenoliths sampled in the West Eifel and Siebengebirge volcanic areas (Germany) and aims at enlarging the knowledge of the local SCLM. Gautheron et al. (2005) carried out the first characterization of noble gases in FI of crystals analyzed by crushing technique (as in our study) but limited to olivines and to West Eifel eruptive centers. Here, we integrate that study by analyzing olivines, orthopyroxenes and clinopyroxenes from a new suite of samples and by including two eruptive centers from Siebengebirge volcanic field (Siebengebirge and Eulenberg quarries).

Xenoliths from the Siebengebirge localities are characterized by the highest Mg# for olivine, clinopyroxene and Cr# for spinel, together with the lowest Al<sub>2</sub>O<sub>3</sub> contents for both pyroxenes, suggesting that the mantle beneath Siebengebirge experienced high degree of melt extraction (up to 30%) while metasomatic/refertilization events were more efficient in the mantle beneath West Eifel.

In terms of CO<sub>2</sub> and noble gas concentration, clinopyroxene and most of the orthopyroxene show the highest gas content, while olivine are gas-poor. The <sup>3</sup>He/<sup>4</sup>He varies between 5.5 and 6.9 Ra. These values are comparable to previous measurements in West Eifel, mostly within the range proposed for European SCLM (6.3±0.4 Ra), and slightly below that of MORB (Mid-Ocean Ridge Basalts; 8±1Ra). 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<sub>2</sub>O<sub>3</sub> content in minerals confirm that the mantle beneath Siebengebirge experienced the highest degree of melting, while the metasomatic/refertilization events largely affected the Eifel area.

#### References

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