# The composition of noble gas and $CO_2$ in the European subcontinental lithospheric mantle

*Rizzo A.L.*[1,2]*, Coltorti M.*[2,3]

[1]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Milano, Via Alfonso Corti 12, 20133 Milano, Italy

[2]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Palermo, Via Ugo La Malfa 153, 90146 Palermo, Italy

[3]Department of Physics and Earth Sciences, University of Ferrara, Via Saragat 1, 44121 Ferrara, Italy

* andrea.rizzo@ingv.it

The investigation of mantle-derived products coming from Sub Continental Lithospheric Mantle (SCLM) is crucial for understanding its geochemical features and evolution, the mantle-crust interaction, the volatiles composition. In this respect, a significant contribution comes from the study of noble gases and $CO_2$ trapped as fluid inclusions (FI) hosted in ultramafic xenoliths, coupled with the petrography and chemistry of the minerals.

Here, we report a reappraisal of the knowledge recently developed on the European SCLM, based on the study of distinct suites of mantle xenoliths representative of the mantle beneath Lower Silesia (19-21 Ma; SW Poland), Persani Mts. (0.6-1.2 Ma; Eastern Transylvanian Basin, Romania), Eifel (0.01-0.5 Ma) and Siebengebirge (6-30 Ma; Germany).

The chemistry of He-Ne-Ar-$N_2$-$CO_2$ reveals that: i) FI are $CO_2$-dominated; ii) there is a systematic disproportion of volatiles between olivine and pyroxene, which probably reflects crystallographic features and/or the distinct crystallization history of the minerals during mantle melting and metasomatism.

The mantle portions below Lower Silesia and Siebengebirge were variably depleted by partial melting, with the overprinting in Lower Silesia of at least one metasomatic event by carbonated hydrous silicate melt related to Cenozoic volcanism. This process resulted in the entrapment of $CO_2$-rich inclusions, whose carbon isotopic composition has a MORB-like signature. Instead, the SCLM beneath Eifel reflect multiple metasomatism/refertilisation events by $CO_2$-rich melts that took place between ~6 and ~ 0.5 Ma. However, the isotopic composition of $CO_2$ indicates evidences of a crustal carbon recycled by old subducted altered oceanic crust. Differently, the mantle beneath Persani Mts. was strongly refertilized by a calc-alkaline subduction-related melt, which reflects the geodynamics of this portion of the European mantle.

The $^{3}He/^{4}He$ ratio varies in the range 5.5–6.9 Ra, indicating a widespread recycling of crustal material related to fossil subduction(s) and confirms the complex geodynamics that characterized the European SCLM.