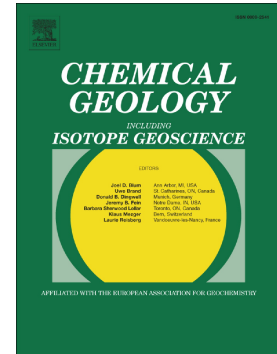


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Regional distribution pattern of carbon and helium isotopes from different volcanic fields in the French Massif Central: Evidence for active mantle degassing and water transport

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Abstract

We report new data of the gas and isotope ($\delta^{13}\text{C}$ and $^3\text{He}/^4\text{He}$) composition of 26 free gas emanations escaping from bubbling springs and mofettes in six different Cenozoic volcanic areas of the French Massif Central, which belongs to the European Cenozoic Rift System (ECRIS). In all six units the CO_2 concentrations in the free gas phase are >96 vol.% throughout, at most locations even >99 vol. %. The $\delta^{13}\text{C}$ values range between -3.6 and -6.3‰ (relative to PDB) and the $^3\text{He}/^4\text{He}$ ratios between 1.05 and 6.36 Ra (Ra= $^3\text{He}/^4\text{He}$ in air). These isotope signatures indicate an origin of helium and CO_2 predominantly in the subcontinental mantle. In addition, the gas composition and the isotope ratios of C, N, He, Ne, and Ar were monitored approximately once a year at two locations in the Mont-Dore Massif during a time span of five and twelve years, respectively. As a result robust data have been obtained, suggesting mixing of variable fractions of atmosphere-derived and sedimentary nitrogen. $^3\text{He}/^4\text{He}$ ratios overlapping the characteristic range of the subcontinental lithospheric mantle (SCLM) indicate fluid transport in deep reaching faults from the magmatic reservoir to the surface and suggest that minor fractions of mantle-derived nitrogen are present also. In comparison with MORB (Mid-Ocean Ridge Basalt), the CO_2 is slightly enriched in ^{13}C , confirming the findings in the Eifel area (Germany) and the western Eger Rift (Czech Republic), two other regions of the ECRIS where SCLM-derived gases escape at the surface.

Highlights

- First complete data sets of SCLM-derived gas compositions recorded in the French Massif Central
- SCLM-derived gases belong to two lithosphere domains with different seismic anisotropy beneath the French Massif Central
- Gases with SCLM-type He signature and higher-than-MORB $\delta^{13}\text{C}$ values are observed in the European Cenozoic Rift System

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