Compositional transition in the shallow Eifel Plume: Evidence from Pb isotope and elemental variations

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The Pleistocene West Eifel volcanic field (W Germany) is related to a seismological low-velocity anomaly in the upper mantle (Eifel Plume [1]). Pb isotope ratios of low-SiO_2 lavas from 27 sampling sites were measured and evaluated together with new and published radiogenic isotope and elemental data. In $^{206}Pb/^{204}Pb$ vs. $^{208}Pb/^{204}Pb$ space, low-SiO_2 lavas display two parallel linear arrays, reflecting two major phases of activity previously established [2]. The older phase (>480 ka) has more radiogenic $^{208}Pb/^{204}Pb$ (39.59-39.91) and $^{207}Pb/^{204}Pb$ (15.64-15.69), whereas the younger phase (<80 ka) is less radiogenic in $^{208}Pb/^{204}Pb$ (39.22-39.45) and $^{207}Pb/^{204}Pb$ (15.61-15.64) for a given $^{206}Pb/^{204}Pb$ (19.36-19.82), respectively. Thus, lavas older than 480 ka originated from a mantle source with higher time-integrated ω and κ values compared to the <80 ka group.

The origin of the >480 ka lavas can be explained by interaction between asthenospheric melts with (i) metasomatic and (ii) syenitic domains in the lithospheric mantle. In detail, influence of metasomatic portions is indicated by high radiogenic $^{208}Pb/^{204}Pb$ (up to ~39.91), moderate Nb/Ta (16.6-17.3) and K_2O/TiO_2 (~0.8-1) as well as by a positive correlation in $^{208}Pb/^{204}Pb$ vs. Rb/La space. Interaction with syenitic material caused higher K_2O/TiO_2 (>1.2), higher and more variable Nb/Ta (17.2-19.4) and less radiogenic $^{208}Pb/^{204}Pb$ (~39.6), lacking a correlation in $^{208}Pb/^{204}Pb$ vs. Rb/La space.

In contrast, the <80 ka phase represents melts of seismologically-defined asthenopheric origin with insignificant contribution from lithospheric mantle. Its refractory character appears to result from the consumption of originally available reactive components during the >480 ka activity. The <80 ka Eifel and low-SiO_2 volcanism <100 ka in the Massif Central [3], also related to a low-velocity anomaly, show consistent radiogenic isotope characteristics. Thus, a comparable source evolution during the late Pleistocene may have occurred laterally on a ca. 1000-km scale.

[1] Ritter et al. (2001), *EPSL* **186**, 7-14. [2] Mertz et al. (2015) *J Geodyn*. **88**, 59-79. [3] Hamelin et al. (2009), *Chem. Geol*. **266**, 205-217.