Metasomatism of mantle peridotite during continental collision and the origin of heterogeneity in K-rich mafic magmatism

C. SODER[1]*, R. L. ROMER[2], H.-P. MEYER[1], M. TRIELOFF[1,3]

[1]Institute of Earth Sciences, Heidelberg University, Germany (*Christian.Soder@geow.uni-heidelberg.de)
[2]Deutsches GeoForschungsZentrum GFZ, Potsdam, Germany
[3]Klaus-Tschira-Labor für Kosmochemie, Heidelberg

Continental collision zones differ from oceanic subduction zones by a striking absence of arc basalts and the occurrence of mantle-derived shoshonitic to ultrapotassic rocks with subordinate peralkaline varieties (i.e. lamproites). Present models agree on the principal involvement of a depleted mantle source metasomatized by subducted continental material. The origin and nature of the metasomatic liquids (e.g. continental vs. oceanic slabs; transport by aqueous fluids or hydrous melts) and their influence on the considerable chemical heterogeneity within the resulting magmatic associations and on the composition of the subcontinental lithosphere remains a matter of debate. We obtained a systematic set of lamprophyre samples covering exposures of the Variscan orogen in Central and Western Europe (SW Germany, France, SW England, Portugal) and measured their trace element content as well as their Sr–Nd–Pb isotopic compositions. During Variscan collisional tectonics, crustal rocks of regionally different chemical and isotopic composition were subducted to mantle depths and affected by partial melting. The trace element pattern of the lamprophyres is largely inherited from these partial melts, although stable accessory phases may significantly modify these patterns. For instance, allanite is responsible for fractionation in Th/La or Th/U, with values strongly exceeding those of arc basalts. Interaction between slab-derived crustal melts and peridotite results in the removal of orthopyroxene and garnet during channelized flow, with passive enrichment of most incompatible trace elements, only minor trace element fractionation, and assimilation of mantle compatible elements. The modified melts may reach the surface or freeze within the lithospheric mantle to phlogopite-bearing pyroxenites. Thermal adjustment of the lithosphere during post-collisional extension or later tectonic processes (e.g. the Cenozoic intraplate magmatism) may mobilize these metasomes. Mantle-derived rocks have trace element pattern and isotopic compositions that allow for tracing different compositions of subducted crust and show regional distributions following major tectonic zones of the orogen.