Geophysical Research Abstracts
Vol. 13, EGU2011-2409, 2011
EGU General Assembly 2011

Crust-mantle decoupling in the French Massif Central and the Bohemian Massif constrained by geologic and seismic anisotropy data

Vladislav Babuska, Jaroslava Plomerova, and Ludek Vecsey
Institute of Geophysics, Czech Acad. Sci., Seismology, Prague 4, Czech Republic (v.babuska@ig.cas.cz)

We have obtained constrains on the crust-mantle decoupling by comparing surface geology with a domain-like structure of the mantle lithosphere of the two Variscan Massifs, its thickness and fabric modelled by systematic orientation of olivine crystals. The fabric is derived from lateral variations of seismic anisotropy evaluated in 3D, specifically from directional terms of P-wave travel-time delays and the shear-wave splitting observed at dense networks of temporary and permanent seismic stations.
Three major lithosphere domains with different orientation of seismic anisotropy are distinguished in the French Massif Central (MC; Babuska et al., 2002). A suture in the deep lithosphere between the western and eastern MC parallels the major crustal boundary, the late Variscan Sillon Houiller transfer fault in the south and the Tauve-Aigueperse fault in the north, with an offset of about 20 km between the surface and mantle parts of the faults. This offset indicates that the rigid upper crust is detached from the mantle lithosphere. Also the Bohemian Massif (BM) lithosphere consists of several domains (Plomerova et al., 2007). Three domains of mantle lithosphere represent the major tectonic units (microplates), which assembled during the Variscan orogeny and mostly preserved their pre-assembly olivine fabric. A lateral offset of the north-western rim of the Tepla-Barrandian Unit (TBU) from its mantle counterpart, extending for about 20 km, also indicates a detachment of the rigid upper crust from the strong mantle lithosphere (Babuska et al., 2009).
Seismic reflection (Tomek et al., 1997) and refraction profiling in the BM indicates an underthrusting of the Saxothuringian crust beneath the TBU and a significant decoupling, most probably located in the lower crust and extending over several tens of km or more. Unlike this large-scale crust-mantle decoupling caused by the Variscan continental collision, the $\sim$20km offset between the surface and the mantle trace of the Variscan strike-slip faults (sutures) may be at least partly related to the intraplate Cenozoic extension of the weakened and thinned lithosphere in both massifs. We suggest that the Variscan mantle sutures (microplate boundaries), hidden beneath a detached allochthonous crust, control the crustal tectonics and magmatism. The reactivated mantle suture in the southern MC predestined a space for the major volcanism (Mont Dore, Cantal). Similarly, the rejuvenated mantle suture in the western BM controlled positions of the Eger Rift and the Cheb Basin, and provided open paths for the Quaternary volcanism and the present-day ascent of 3He- and CO2-rich fluids from the asthenosphere.