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Lithosphere-asthenosphere upwelling or a plume in seismic tomography beneath the western Bohemian Massif?

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Seismic stations deployed temporarily within the BOHEMA projects (BOhemian Massif Heterogeneity and Anisotropy) recorded teleseismic waves for a joint study of the structure and dynamics of the lithosphere and asthenosphere beneath the Bohemian Massif (BM). BOHEMA I array of portable seismic stations covered a territory of about 270x150 km, with its long axis oriented perpendicularly to the strike of major tectonic units of the geodynamically active western part of the BM and to the Eger Rift. Spacing of stations was generally less than 30 km allowing for a lateral spatial resolution of approx. 20km in the upper mantle. The BOHEMA I project aimed at showing an existence or non-existence of a mantle plume beneath the Eger Rift, similarly to what has been found for several rifts (e.g., in the French Massif Central, Rhenish Massif - Eifel) belonging to the European Cenozoic rift system, which may have a common source of volcanism in the mantle (Granet et al., 1995; Ritter et al., 2001). A new 3D model of the crust has been compiled from various data of deep seismic sounding and from the P receiver functions, to ensure the upper mantle velocity perturbations are not influenced substantially by a leakage of effects of velocity heterogeneities from the crust into the upper mantle. We picked P, PKP and S arrival times to perform standard isotropic tomography, joint P and S inversions as well as a tomography corrected for seismic anisotropy (currently under way).

The high-resolution teleseismic P- and S-velocity tomography in the Bohemian Massif did not image a narrow vertical low-velocity anomaly down to at least 250 km, which could be interpreted as a distinct magma chamber or a small mantle plume beneath the Eger Rift. However, the broad and weak low-velocity anomaly beneath the western Bohemian Massif could be a result of a deep seated mantle plume interacting with the lithosphere. But, alternatively, we can interpret the anomaly by an upwelling of the lithosphere-asthenosphere boundary reflecting a zone of a lithosphere weakness at margins of the paleoplates, retrieved by 3D modelling of upper mantle seismic anisotropy. The low-velocity anomaly forms a broader ridge which parallels the ER rift axis and not a dome structure, which would reflect an interaction of a deep seated mantle plume with the lithosphere.

However, only an additional analysis of all available data can provide a more reliable answer about a possible existence of a plume beneath the Bohemian Massif.