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Topographic imaging of european mantle plumes

L. Guillou-Frottier (1), E. Burov (2), P. Nehlig (1) and R. Wyns (2)

(1) BRGM, Orléans, France; (2) University P. & M. Curie, Paris, France (Contact l.guillou-frottier@brgm.fr/Fax +33 238643652)

When a mantle plume rises and impinges on the base of the lithosphere, it expectably produces variations in surface topography. Taking into consideration a realistic mantle rheology, plume ascent rates can reach hundreds of metres per year, whereupon the impingement of the plume head at the base of the lithosphere can be considered as an "impact". Recent numerical experiments based on tectonically realistic formulations for the lithosphere and a representative mantle rheology, have shown that plume-induced undulations exhibit temporal successions of uplift and subsidence at various wavelengths. From spectral (Fourier) analyses of the undulations would appear that two groups of wavelengths (200-400 km and 60-100 km) predominate. Interestingly, a spectral analysis of Europe's topography also reveals two dominant groups. In the present study, we have used a spectral analysis with a wavelet formulation in order to discriminate between tectonically-induced undulations (uni-directional deformation) and plume-induced undulations (omni-directional deformation). The European lithosphere is well-suited for this approach since it has been suggested that two mantle plumes (the Massif Central and the Eifel area) underlie Western Europe, where Alpine compression has folded the lithosphere over several hundreds of kilometres. The wavelet analysis of Europe's surface topography confirms that the energy distribution of the topographic undulations outside the two main volcanic provinces is homogeneous, thus contrasting with the large-scale and medium-scale high-energy features that are obtained for the Massif Central and Eifel areas. Similar signatures are also found beneath the northern Sudetes area.