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Wavelet analyses of surface topography in east Africa: the mantle plume signatures

L. Guillou-Frottier (1) and E. Burov (2)

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

Recent numerical model of plume-lithosphere interactions (Burov and Guillou-Frottier, 2005) was the first to take into consideration in a single experiment (1) a free surface boundary condition, (2) visco-elastic-plastic lithosphere, plume and mantle rheology, and (3) the stratified structure of the continental lithosphere. The evolution of plume-induced surface topography was computed during the experiment, from the plume-rising to spreading phases. These experiments have shown that plume-induced surface undulations exhibit temporal succession of uplifts and subsidences at various wavelengths, some of which being several times smaller than the commonly inferred "plume" wavelengths. From spectral (Fourier) analysis of topography undulations in east Africa, it appears that two groups of lithospheric wavelengths of 200-400 km and 60-100 km, predominate. This bimodal signature, possibly generated by normal and shear strains due to plume-lithosphere interactions, mainly overprints the largest wavelength associated with simple surface doming. However, Fourier analysis technically does not allow to attribute this bimodal signature to a specific location neither to relate it a deep source. To circumvent this limit, a wavelet formulation has been developed to discriminate between the tectonically-induced and plume-induced undulations, with application to Europe. We present here a new wavelet analysis of surface topography in east Africa, where tectonic stresses are less present than in western Europe, and where mantle plume(s) have been suggested by several studies. Based on results from Europe, the wavelet analysis of east African's surface topography reveals that both large-scale and medium-scale high energy coefficients are obtained over the supposed plume head, in contrast with homogeneous energy distribution outside the areas affected by mantle plumes.

Burov, E. and L. Guillou-Frottier, Geophys. J. Int., 161, 469-490, 2005.