Geophysical Research Abstracts
Vol. 13, EGU2011-4021, 2011
EGU General Assembly 2011

Lateral constrictional flow of hot orogenic crust: geological and geophysical implications

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We provide an in situ geological perspective on fabrics produced by syn-convergence lateral crustal flow of hot orogens. The work is based on a structural study of the Neoarchean orogen exposed by the wide crustal transition of the Dharwar craton (India), and a comparison with modern orogenic plateaus and other types of hot orogens. We document a pervasive, three-dimensional flow mode of the lower crust, called lateral constrictional flow (LCF), which combines orogen-normal shortening, lateral constrictional stretching, and transtension. LCF achieves gravity-driven flow, lateral escape, and 3D mass redistribution in a viscous lower crust submitted to convergence. LCF tends to mechanically and thermally homogenize the lower crust and efficiently compensates topographic relief at a shallow level in the crust.

Three type-geodynamic contexts are envisaged for LCF: plateau interiors, inner parts of collisional crustal wedges or plateau edges, and throughout wide ultra-hot orogens such as the Neaoarchean orogen of South India. LCF makes the lower crust act as a strain gauge between lateral gravitational collapse or tectonic thickening of the upper crust, thrust stacking in the lowermost crust (collisional crustal wedge case), crustal shortening, and/or lateral flow of the upper mantle. In the case of plateau interiors or ultra-hot orogens, LCF of a thick lower crust enables coupling of upper crustal deformation with upper mantle flow through a hot and thin lithosphere being shortened coherently.

LCF provides a geologically realistic alternative to syn-convergence lateral channel flow because it involves a component of horizontal, orogen-normal shortening and a component of vertical thinning. LCF generates a sub-horizontal lamination that should produce a strong seismic reflectivity of the crust. LCF may therefore be considered as an alternative to extension, channel flow or even thrusting for producing the thick reflective lower crust of hot orogens such as Tibet or Precambrian accretionary orogens.