Geophysical Research Abstracts
Vol. 12, EGU2010-9777-1, 2010
EGU General Assembly 2010

Testing Melt Induced Weakening of Lithosphere Modeling Rift Induced Delamination Proposed for the Dynamics of Rwenzori Mountains Region

Herbert Wallner and Harro Schmeling
Institute of Earth Sciences, Goethe-University, Frankfurt a.M. (wallner@geophysik.uni-frankfurt.de)

Rift induced delamination (RID) has been proposed as a geodynamic process explaining the extreme elevation of the Rwenzori Mountains. The special situation of two approaching rift tips with a finite offset for RID is given by the southward propagating Albert Rift and northward spreading Edward Rift encirceling almost completely the old metamorphic horst. If upwelling asthenosphere below the rifts, surrounding the stiff lithosphere, has sufficiently reduced the viscosity and strength especially in the lower crust, the delamination of cold and dense mantle lithosphere root may be triggered. This unloading induces uplift of the less dense crustal block along steep inclining faults. Seismological observations, particularly seismicity distribution, low velocity layers seen in receiver functions as well as in tomography and the location of an anomalously deep earthquake cluster strengthen RID hypothesis.

Verification of RID is done by a thermo-mechanical model. Physics comprises two dimensional viscous flow approximated by Finite Difference Method in an Eulerian formulation. The equations of conservation of mass, momentum and energy are solved for a multi component and two phase system. Temperature, pressure and stress dependent rheology, based on laboratory data of appropriate samples are assumed for upper and lower crust and mantle.

Studies on parameter variations of the initial temperature perturbation reveal a restricted range for functioning RID models. The coincidence with the settings of the Rwenzori situation establishes the RID concept furthermore.

Successful numerical models applied a strong initial temperature anomaly within the lithosphere, driving the process. To replace this ad hoc starting condition, we test a melt induced weakening process. Additional heating (supplied by a plume branch, seen in tomography) generates incipient melts in the upper asthenosphere. This partial melt percolates and accumulates, forming regions with high melt fractions. Above a certain threshold melt is extracted and transferred to a higher level assuming (not modeled) short time scale transport mechanisms such as channeling or dyking. After emplacement within the mantle lithosphere or even in the lower crust the melt's energy weakens its surrounding and so boosts advective heat transport. It is a positive feedback of the system and may lead, if strong enough, to RID. The development of the anomaly and its boundary and initial conditions is explored, presented and evaluated.