Geophysical Research Abstracts
Vol. 12, EGU2010-12413, 2010
EGU General Assembly 2010

Anomalous deep earthquakes beneath the East African Rift: evidence for rift induced delamination of the lithosphere?

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The over 5000 m high Rwenzori Mountains are situated within the western branch of the East African Rift System, at the border between Uganda and the Democratic Republic of Congo. They represent a basement block within the rift valley whose origin and relation to the evolution of the EARS are highly puzzling. During 2006/2007 a network of 27 seismological stations was operated in this area to investigate crustal and upper mantle structure in conjunction with local seismicity. The data analysis revealed unexpectedly high microseismic activity. On average more than 800 events per month could be located with magnitudes ranging from 0.5 to 5.1. Hypocentral depths go as deep as 30 km with a pronounced concentration of activity at a depth of about 15 km.
This presentation focuses on a cluster of seven earthquakes that were located at anomalous depths between 53 and 60 km. According to our present knowledge these are the deepest events so far observed within the EARS and the African Plate. Their origin might be connected to magmatic intrusions. However, the existence of earthquakes at this depth is enigmatic, especially within a rifting regime were one expects hot and weak material close to the surface, which is not capable of seismogenic deformation. We think that these events are closely related to the evolution of the Rwenzoris. A recent hypothesis to explain the extreme uplift of the Rwenzori Mountains is rift induced delamination (RID) of mantle lithosphere that is captured between two approaching rift segments. By numerical modelling we show that the RID-process is also able to bring material that is cold and brittle enough to release seismic energy into greater depth. Therefore the RID-mechanism gives a consistent explanation for the detected deep events as well as for the uplift of a mountain block in a rift setting.