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Complex seismicity patterns in the Rwenzori region: insights to rifting processes at the Albertine Rift.

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Numerous seismological studies in East Africa have focused on the northern and eastern branches of the East African Rift System (EARS). However, the seismic activity along the western branch is much more pronounced. Here, the Rwenzori Mountains are located within the Albertine rift valley, at the border between Uganda and D.R. Congo.

During a seismic monitoring campaign between February 2006 and September 2007 we have recorded more than 800 earthquakes per month in the Rwenzori area. The earthquake distribution is highly heterogeneous. The majority of located events lie within faults zones to the East and West of the Rwenzoris with the highest seismic activity observed in the northeastern area, were the mountains are in contact with the rift shoulders. The hypocentral depth distribution peaks at 16 km depth and extends down to the Moho which was found at 20 – 32 km depths by teleseismic receiver functions. Local magnitudes range from -0.5 to 5.1 with a b-value of 1.1. Fault plane solutions of 304 events were derived from P-polarities and SV/P amplitude ratios. More than 70% of the source mechanisms exhibit normal faulting. T-axis trends are highly uniform and oriented WNW-ESE, which is perpendicular to the rift axis and in good agreement with kinematic rift models.

The area of highest seismic activity NE of the Rwenzoris is characterized by the occurrence of several earthquake clusters in 5 -20 km depth. They have stable positions throughout time and form elongated pipes with 1-2 km diameter and vertical extensions of 3-5 km. From petrological considerations we presume that these earthquake swarms are triggered by fluids and gasses which originate from a magmatic source below the crust. The existence of a magmatic source within the lithosphere is supported by the detection of a shear-wave velocity reduction in 55-80 km depth from receiver-function analysis and the location of mantle earthquakes at about 60 km. We interpret these observations as indication for an initial rifting process that may eventually lead to the complete detachment of the Rwenzori block from the surrounding rift flanks.