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The Albertine Rift, East Africa: Initial rifting, long-term landscape evolution and final surface uplift

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The Albertine Rift and associated Rwenzori Mountains form a striking feature at the north-western portion of the East African Rift System. The Rwenzori Mtns are built up by a dissected Precambrian metamorphic basement block that has been uplifted to heights of more than 5 km. The fundamental subject addressed by this study is the temporal and spatial evolution of the Rwenzori Mtns and adjacent Albertine Rift (western Uganda and Eastern Congo) at different time scales. In order to unlock how and at what time the extreme surface uplift occurred, low-temperature thermochronology methods were applied and combined with thermokinematic modelling.

By means of apatite fission-track, apatite and zircon (U-Th-Sm)/He dating, combined with 2D (HeFTy) and 3D (Pecube) thermokinematic modelling different phases of landscape evolution could be determined for the Albertine area, where movements of surface uplift can be traced from Palaeozoic to Neogene times.

Since the Palaeozoic several cooling events affected the Albertine area and Rwenzori Mtns, as revealed from samples along the rift shoulders and across the mountain range. Results from low-temperature thermochronology and thermokinematic modelling demonstrate that the Rwenzoris were not exhumed as a coherent block but are composed of distinct decoupled blocks with diverging exhumation histories and block movements along inherited faults. Thus, the evolution of the Rwenzoris was not solely triggered by Neogene rifting; moreover, a Mesozoic topographic Albertine high is conceivable.

Since the Miocene renewed rock and surface uplift of distinct blocks with forced movements at the western flank of the Rwenzoris occurred. Rock uplift, thereby, outweighed erosion, resulting in the recent high topography of the Rwenzoris and their asymmetric character. Detrital thermochronology data confirm a Neogene surface uplift and indicate transition of erosional forces in Plio-/Pleistocene times.

Thermokinematic modelling, applied to samples from different parts of the working area allows better constraining the cooling history of the Rwenzori Mtns and surrounding Albertine Rift and will be discussed in the frame of this presentation.