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Reconstructing Landscape Evolution Using Surface Exposure Dating, a Case Study on Waterfalls from South Central Africa.

Spiros Olivotos (1), Samuel Niedermann (1), Vasiliki Mouslopoulou (1), Fenton Cotterill (2), and Tyrel Flugel (3)

(1) GFZ Potsdam, Inorganic Geochemistry, Germany, (2) Stellenbosch University, Department of Earth Science, South Africa, (3) Umvoto Africa (Pty) Ltd, South Africa

Northern Zambia and the south-eastern Katanga Province of Congo, also known as the Copperbelt of Central Africa, comprise a tectonically dynamic landscape, which lies within the SW extension of the East African Rift System. Recent geologic research has emphasized the fundamental importance of neotectonics, which controls and radically reshapes all landscapes southwest of the Tanganyika graben. However, the geomorphologic and seismotectonic research in the area has been minimal. Combining geological and biological evidence, Cotterill & de Wit (2011) constrained the formation of the Congo-Zambezi watershed at $\sim$2 Ma. The impacts of recurrent tectonism can explain the topology of the drainage, and equally the vertical profiles of all the major rivers, which are interrupted by numerous waterfalls.

Preliminary Google Earth mapping revealed two major sets of fault systems (Mweru and Upemba fault systems). These fault systems trend NE-SW to intersect, at high angles, the main NNW-SSE trending EAR. Both fault systems are associated with intense microseismicity, highlighting the fact that they are currently active. Analysis of the seismicity patterns recorded within the two fault systems during the last 35 years provides indications for fault interactions over earthquake timescales. The analysis of the geometry and kinematics of the fault systems combined with dating of exposed scarp surfaces will help elucidate the termination mechanism of the Lake Tanganyika section of the EAR.

Our interdisciplinary project combines DNA sequencing of selected fish groups with high precision rock dates of key landforms, using cosmogenic nuclides to quantify how long rocks have been exposed at “knickpoints” since many of them were first formed by faulting. This technique will help us to unravel how and when geologic and climatic events shaped the landscape in these areas, with the ultimate goal of providing a calibration basis for molecular clocks of fish species that can establish a novel dating method for landforms.

Quartz-rich samples were collected from exposed surfaces at waterfalls in northern Zambia and south-eastern Katanga and were measured for cosmogenic ^{21}Ne, ^{10}Be and ^{26}Al. Due to the complex exposure scenarios, involving surface erosion or retreat of waterfalls, the combination of radionuclides and stable ^{21}Ne in all samples is of vital importance. A complete data set has been obtained for seven samples from the Kalangwishi River, Zambia, and indicates burial of the respective area for an extended period of time. This specific burial could be caused by the existence of a significantly deeper Palaeo-Lake Mweru before the modern drainage evolved (Dixey, 1943).

Further cosmogenic nuclide analyses are currently in progress at the GFZ Noble Gas Laboratory and at the Accelerator Mass Spectrometry facility of the Helmholtz Centre Dresden-Rossendorf. More results from Northern Zambia will be presented.

References

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