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ACTIVE FAULTING IN W-TANZANIA: COUPLING BETWEEN TECTONICS, VOLCANISM & CLIMATE ?

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Just a century ago, the Rukwa region in the Western Highlands of Tanzania was hit by a Ms 7.4 earthquake on December 13, 1910. Together with the Mw 7.1 May 20, 1990 Sudan earthquake and the Mw 7.0 February 22, 2006 Machaze earthquake in Mozambique, they are the only three M >= 7.0 events instrumentally recorded yet in the East African Rift. The Ms 7.4 Rukwa earthquake was part of a seismic crisis that lasted about 20 years and affected the Ufipa Plateau between Lakes Tanganyika and Rukwa and the Mbozi block, between Lakes Rukwa and Malawi. This region contains evidence for past strong earthquakes as recorded in the neotectonic morphology, paleoseismic trenches and outcropping recent lacustrine deposits in the paleo-shorelines and abandoned floor of Lake Rukwa. The lacustrine deposits also display tephra and pumice layers that have been erupted from the nearby Rungwe volcanic field, south of Lake Rukwa, and can be correlated with dated deposits in the Rungwe region. Lake Rukwa is presently a closed hydrological basin, very sensitive to climate forcing and whose dynamic range of possible lake level fluctuation reaches 190 meters. Lake Rukwa is also in an old but still active rift graben, with active faulting affecting its lake floor, far from the major border faults. The epicentre of the Ms 7.4 Rukwa earthquake was located near Sumbawanga town along the Kanda normal fault system that cut longitudinally the Ufipa plateau (the uplifted footwall of the Rukwa basin on his south-western side). In this complex setting, evidence from the lake floor, the paleo-lake shore, and the Ufipa plateau suggest that pulses of tectonic activity could be related to volcanic activity in the Rungwe area and long-term climatically induced lake level change in Lake Rukwa.

The Kanda fault on the Ufipa plateau has attracted the attention since decades, can be clearly seen on the SRTM-DEM as in Google Earth. In 2004-2005, our team did a systematic mapping of the fault system using geo-referenced air photographs, performed topographic profiling using a differential GPS and imaged the subsurface structure by electric resistivity profiling, investigated the numerous outcrops and performed light paleoseismic trenching studies. This work showed that the Kanda fault has likely been activated during the Ms 7.4 1910 earthquake, with a possible vertical offset of up to 3 meters. It has been dormant since at least 16 Ka ago and up to ~ 5 Ka, after which it was activated episodically at an averaged rate of 3 mm/yr.

In the Katavi paleo shore line at the north-western extremity of Lake Rukwa, morphostructural analysis and paleoseismic trenching showed that a sismogenic fault slipped by cm year ago.

In the Rukwa lake floor, a high-resolution seismic reflection campaign in the southern part of the lake have shown the presence of a network of faults that affect the most recent sediment layers. These seem to lie in the prolongation of known neotectonic faults of the Mbeya Range and the Rungwe volcanic province, south-east of the lake. In between, Late Pleistocene to early Holocene lacustrine sediments deposited during high lake stand are well exposed along natural sections up to 35 meter high along steeply incised temporary streams (in the Galula plain). These sections revealed a succession of high-stand lacustrine episodes separated by low-stand erosional periods and intermediate near-shore periods with massive influx of coarse-grained sediments. Three transgressive periods are evidenced during the last 25 cal. Ka BP (AMS dating on dispersed organic matter, charcoal and paleosoils), with each of them a large proportion of tephra at the base and soft-sediment deformations induced by seismic shaking. The top of the section is dated at 10 to 7 cal. Ka BP, depending on the site and its elevation, corresponding to the cessation of lacustrine sedimentation.

Integrating all these observations, we suggest that the could be a coupling between the climatically-induced lake level fluctuation in Lake Rukwa, seismic activation of the existing fault network on the basin footwall (Kanda fault in the Ufipa plateau) and the lake floor (running trough the Rungwe volcanic field and controlling the location of eruptive centers), and the explosive volcanic activity in the Rungwe volcanic field.