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Seismic hazard of the Kivu rift (western branch, East African Rift system): new neotectonic map and seismotectonic zonation model

Damien Delvaux (1), Jean-Luc Mulumba (2), Stanislas Sebagenzi Mwene Ntabwoba (2), Silvanos Fiama Bondo (3), François Kervyn (1), and Hans-Balder Havenith (4)

(1) Royal Museum for Central Africa, Geology - Mineralogy, Tervuren, Belgium (damien.delvaux@africamuseum.be), (2) University of Lubumbashi, Dept. of Geology, Lubumbashi, DR Congo , (3) Centre de Recherche en Sciences Naturelles (CRSN), Dept. of Geophysics, Lwiro, DR Congo, (4) University of Liège, Dept. of Geology, Liège, Belgium

The first detailed probabilistic seismic hazard assessment has been performed for the Kivu and northern Tanganyika rift region in Central Africa. This region, which forms the central part of the Western Rift Branch, is one of the most seismically active part of the East African rift system. It was already integrated in large scale seismic hazard assessments, but here we defined a finer zonation model with 7 different zones representing the lateral variation of the geological and geophysical setting across the region. In order to build the new zonation model, we compiled homogeneous cross-border geological, neotectonic and sismotectonic maps over the central part of East D.R. Congo, SW Uganda, Rwanda, Burundi and NW Tanzania and defined a new neotectonic sheme.

The seismic risk assessment is based on a new earthquake catalogue, compiled on the basis of various local and global earthquake catalogues. The use of macroseismic epicenters determined from felt earthquakes allowed to extend the time-range back to the beginning of the 20th century, spanning 126 years, with 1068 events. The magnitudes have been homogenized to Mw and aftershocks removed. From this initial catalogue, a catalogue of 359 events from 1956 to 2015 and with M > 4.4 has been extracted for the seismic hazard assessment. The seismotectonic zonation includes 7 seismic source areas that have been defined on the basis of the regional geological structure, neotectonic fault systems, basin architecture and distribution of thermal springs and earthquake epicenters.

The Gutenberg-Richter seismic hazard parameters were determined using both the least square linear fit and the maximum likelihood method (Kijko & Smit aue program). Seismic hazard maps have been computed with the Crisis 2012 software using 3 different attenuation laws. We obtained higher PGA values (475 years return period) for the Kivu rift region than the previous estimates (Delvaux et al., 2016). They vary laterally in function of the tectonic setting, with the lowest value in the volcanically active Virunga – Rutshuru zone, highest in the currently non-volcanic parts of Lake Kivu, Rusizi valley and North Tanganyika rift zone, and intermediate in the regions flanking the axial rift zone. Those are to be considered as preliminary values, as there are a number of important uncertainties such as the heterogeneity and relatively short duration of the instrumental seismic catalogue used (60 years), the absence of locally derived attenuation laws and thus the choice of the attenuation laws used, and the seismic zonation scheme.

Delvaux, D. et al., 2016. Journal of African Earth Sciences, doi: 10.1016/j.jafrearsci.2016.10.004.