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A small-scale seismological experiment to constrain the faulting systems off the North Tanzanian Divergence

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A temporary deployment comprising seventeen 3-component broadband seismic stations was conducted between June 2016 and May 2018 within the Ngorongoro Conservation Area Authority (NCAA, Northern Tanzania), located at the boundary between the Tanzania Craton and the North Tanzanian Divergence (NTD). The seismic network covered an area of about 45 km by 45 km; station interspace ranged from 8 to 15 km. The goal of the experiment was to broaden the knowledge of the tectonics of the area, to better understand: i) the contribution of the synsedimentary faults to the deposition of the Olduvai and surrounding basins, around which Homo habilis and more recent hominin species lived and evolved; and ii) the tectonic and geometrical relationship between the Tanzania craton boundary and the fault systems of the eastern branch of the African Rift System in East Africa.

At first, we analyse probabilistic power spectra densities of the seismic ambient noise both to obtain insights into its origin and to test the performances of the stations. We find that the ambient noise is highly amplified between 1 s and 2 s. Interestingly, the noise is amplified differently in the vertical and horizontal components of the seismogram. In the vertical component, the amplification increases from west to east suggesting seismic sources located east of the network where the NTD is seismically active. In the horizontal component, the amplification correlates well with the known 3-D extension of the sedimentary basin suggesting a site effect instead.

Secondly, we build the first seismicity map that covers the entire NCAA. We detect events with Ml ranging between 0.7 and 3.3 (Mc=1.8). The well-known faults that accommodated the deposition of the Olduvai basin (the northern part of NCAA) present scarce seismic activity. On the other hand, the boundary between the Tanzania Craton and NTD (the southern part of the NCA), where major fault systems have not been comprehensively mapped yet at the surface and in depth, shows a moderate level of seismicity in the lower crust. The depth extension of the hypocentres suggests a décollement between the Tanzanian craton and the Mozambique belt dipping SE and reaching about 30 km of depth.