Seismotectonics of the 2017 Botswana earthquake (Mw 6.5): An active zone in intraplate Africa

Mustapha Meghraoui*[1], Vunganai Midzi[2], Mohamed Saleh[1,3], Tarzan Kwadiba[4], Brassnavy Manzunzu[5], and Thifhelimbilu Mulabisana[6]

[1]Institut de Physique du Globe, CNRS-UMR 7516 – EOST-IPGS – 5, rue René Descartes 67084, France
[2]Council for Geoscience, Pretoria, South Africa – 280 Pretoria Street, Silverton, Pretoria, South Africa
[3]NRIAG – Helwan, Cairo, Egypt
[4]Botswana Geoscience Institute (BGI) – Lobatse, Botswana
[5]Council for Geoscience, Pretoria, South Africa – Council for Geoscience, South Africa, South Africa
[6]Council for Geoscience, Pretoria, South Africa – Council for Geoscience, Pretoria, South Africa, South Africa

Abstract

The 3 April 2017 Botswana earthquake occurred along a moderately seismic active zone in central southern Africa, west of the 2006 Machaze earthquake (Mw 7.0). Although located in the continental interior of the African plate, the seismogenic area previously considered as a stable region reveals a background seismicity associated with long-term deformation and faulting. We study this intraplate earthquake using the seismotectonic data of the recent published map of Africa* and the Archean Limpopo–Shashe Tectonic Belt (ALSTB), the geodetic (InSAR) analysis and seismology (aftershock data) determined from a post-earthquake local seismic array. The mainshock location (25.18E, 22.6S) and depth (25 ±3 km) provided by the Council for Geoscience (CGS, Pretoria), Euro-Mediterranean Seismological Center (EMSC) and United States Geological Survey (USGS) was followed by the largest aftershock with Mw 4.5 on the 5 April 2017.
The seismotectonic setting of the ALSTB shows a significant recent background seismicity reaching Ml 4.5 in 2009 along ENE-WSW trending shear zones associated with NW-SE striking dip-slip fault system. Our analysis of Sentinel-1 interferogram (images from ascending orbit) shows 4 to 6 cm coseismic slip on a NW-SE elongated and 30-km-long surface deformation consistent with the mainshock location, normal faulting mechanism and

source time function (http://geoscope.ipgp.fr/index.php/en/catalog/). We also investigate the earthquake rupture at depth from the inversion of surface deformation and obtain slip distribution on a fault plane striking 315○, dipping 45○ and -80○ rake and with Mo 7.12 1018 N.m. The earthquake rupture geometry is in agreement with the ˜500 aftershock locations at surface and depth and confirms the ˜28 km seismogenic layer thickness.

The earthquake sequence affected the ALTSB that limits the Zimbabwe Craton to the north with the Kaapvaal Craton to the south and defines the central Limpopo belt. The ALTSB appears as an analog of the NE-SW trending Okavango active zone that experienced the Ml 6.7 seismic event on 11 October 1952. We also explore the effect of the stress cycle and viscoelastic stress change and possible correlation with the East African Rift System. Although

*Speaker

the seismic strain rate is of low level, the 2017 earthquake rupture characteristics and related seismotectonic framework classify this intraplate region as an active plate interior.

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