SnT 2025
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE
8 SEPTEMBER ONLINE DAY
9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE

Unusual earthquakes of the Central Kalahari Game Reserve in Botswana: Anomalies in a Stable Continental Plate

Esther Modise, Motsamai Tarzan Kwadiba, Joseph Maritinkole, Ntebogang Kgangetsile

Botswana Geoscience Institute

Botswana Geoscience Institute
Excellence in Geoscience

INTRODUCTION AND MAIN RESULTS

Botswana is generally seismically quiet, yet it has experienced significant intraplate earthquakes. The Botswana Seismological Network (BSN), consisting of 21 broadband stations, together with the LBTB IMS station, now enables near real-time detection and analysis of seismic activity.

This study highlights patterns of mine-induced, tectonic, and reservoir-related seismicity, and investigates the unusual intraplate activity in the CKGR region.

SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

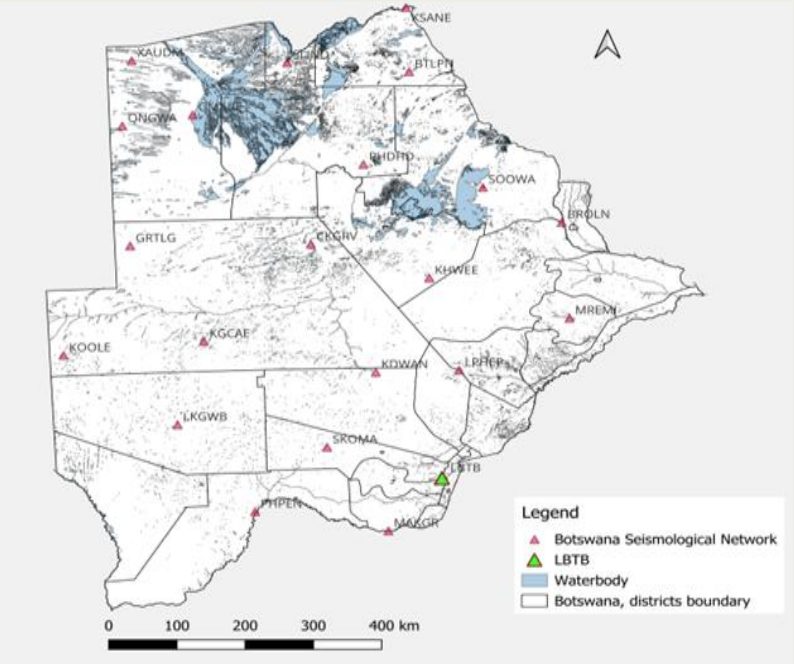
Unusual earthquakes of the Central Kalahari Game Reserve Botswana: Anomalies in a Stable Continental Plate

Esther Modise, Motsamai Tarzan Kwadiba, Joseph Maritinkole, Ntebogang Kgangetsile

P1.2-398

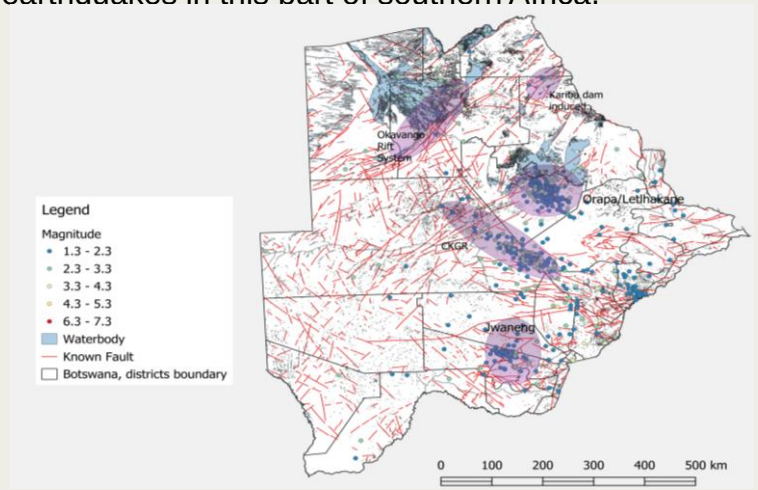
Introduction

Botswana lies within the stable interior of the African Plate and is generally regarded as a low–moderate seismicity region (Key & Ayres, 1998). Despite this, the country has experienced several significant intraplate earthquakes, including the 1952 Okavango Delta events (Mw 6.1 and 6.7) and the 3 April 2017 CKGR earthquake (Mw 6.5).

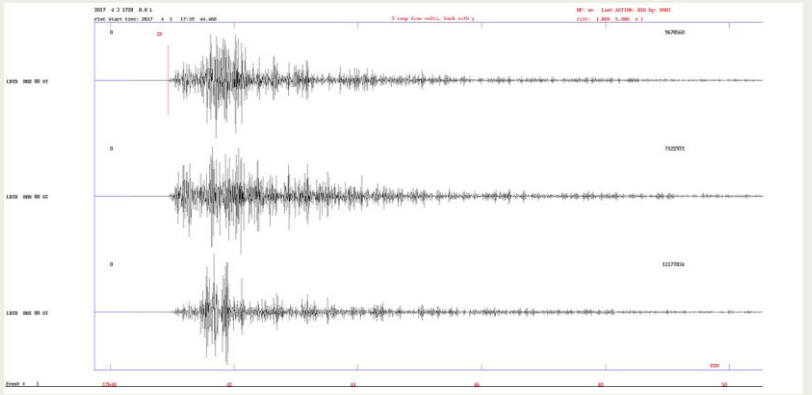


Seismicity Patterns

Seismicity in Botswana exhibits distinct spatial patterns. Clusters around Jwaneng and Orapa-Letlhakane are mine-induced, confirmed by their characteristic waveforms and correlation with blasting schedules. The Okavango Rift System, part of the East African Rift, hosts tectonic earthquakes associated with crustal extension, while activity near Lake Kariba is likely reservoir-induced, reflecting changes in pore pressure and stress due to water impoundment. The CKGR shows unusual intraplate seismicity, including the Mw 6.5 earthquake of 2017, in an otherwise stable region, motivating further study into the mechanisms driving earthquakes in this part of southern Africa.



Contribution of IMS stations during the 2017 CKGR earthquake



The Botswana Seismological Network (BSN) comprises 21 broadband seismic stations distributed across the country, providing systematic monitoring of local and regional seismicity. In addition, Botswana hosts an IMS auxiliary station, LBTB. LBTB has played a key role in capturing seismic activity, including the Mw 6.5 earthquake. Together, the BSN and LBTB stations enhance the detection, location, and characterization of earthquakes in Botswana, a region generally considered seismically stable.

Botswana Geoscience Institute
Excellence in Geoscience

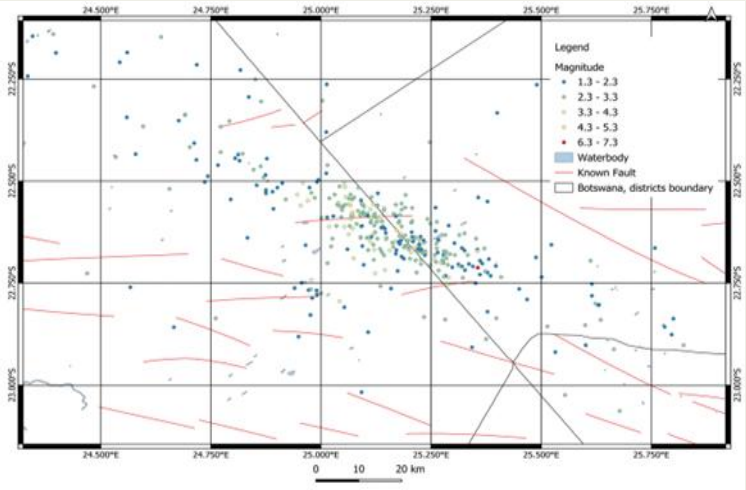
SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

Unusual earthquakes of the Central Kalahari Game Reserve Botswana: Anomalies in a Stable Continental Plate

Esther Modise, Motsamai Tarzan Kwadiba, Joseph Maritinkole, Ntebogang Kgangetsile

P1.2-398

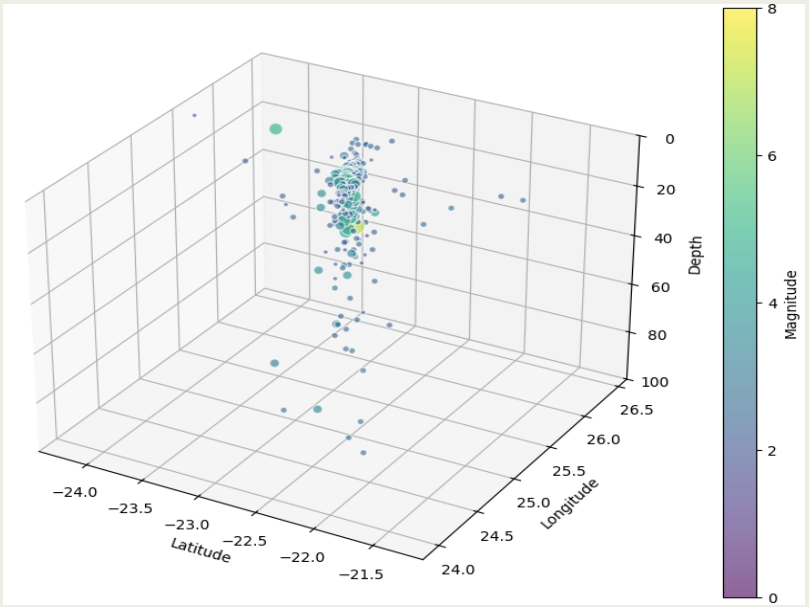
The ghost faults of CKGR: Anomalous seismic activity



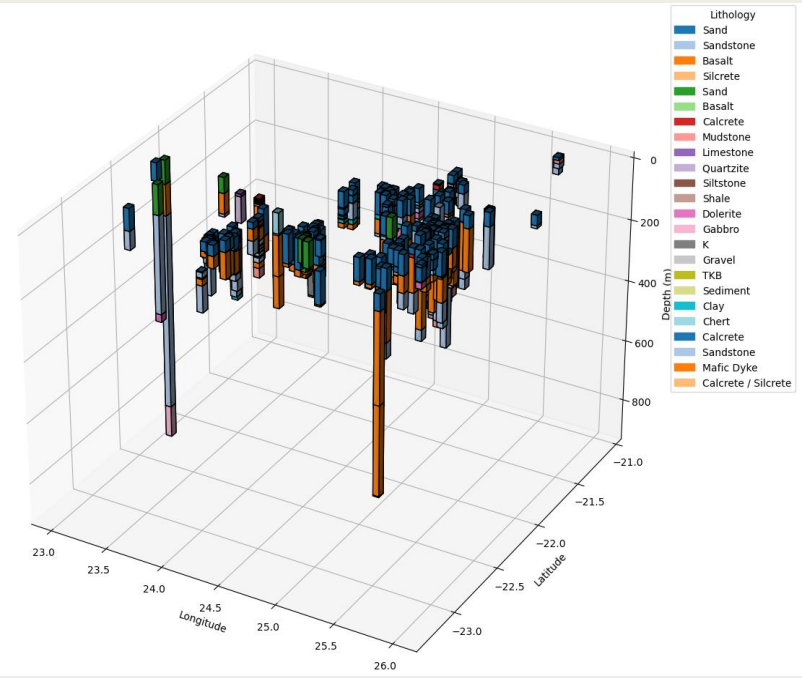
Seismicity in the Central Kalahari Game Reserve (CKGR) is unusual, as no mapped faults are known in this region. In contrast, the Okavango Rift System in northern Botswana aligns with NE–SW trending faults, reflecting expected tectonic activity. The occurrence of the Mw 6.5 earthquake in 2017 suggests that previously unmapped or ancient faults may have been reactivated, generating significant intraplate seismicity. This highlights the presence of hidden structural features and underscores the need for further geophysical and geological investigation to understand the mechanisms driving earthquakes in this stable continental interior

Aftershock distribution

The main Mw 6.5 earthquake in the CKGR was followed by a sequence of aftershocks, which have been spatially plotted to reveal patterns in the subsurface rupture. The aftershock distribution aligns predominantly along a NW–SE trend, suggesting the presence of a previously unrecognized fault in this region. Depth analysis indicates that most aftershocks occurred within the upper to mid-crust, consistent with brittle faulting processes in stable continental interiors. The clustering and alignment of these events provide evidence for the reactivation of an ancient fault.



Subsurface structure from drill logs



Preliminary analysis of exploration and water borehole drill logs reveals subtle but consistent shifts in lithology that may indicate the presence of faulting. While the results are not yet conclusive, the apparent offsets and changes in stratigraphy align with the orientation suggested by seismicity patterns, including the NW–SE trending fault inferred from the CKGR earthquake and aftershock distribution.

Botswana Geoscience Institute
Excellence in Geoscience