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Seismotectonics for Madagascar

Rakotondraibe, T.[1], Durrheim, R.J.[2], Nyblade, A.A.[3], Wysession, M.E. [4], Rambolamanana, G.[5]

[1] University of the Witwatersrand, South Africa & University of Antananarivo, Madagascar.693593@students.wits.ac.za; tsitsikel@gmail.com.

[2]University of the Witwatersrand & CSIR, South Africa.

[3] Penn State University, USA.

[4]Washington University, St.Louis.

[5]Institute and Observatory of Geophysics in Antananarivo, University of Antananarivo, Madagascar.

Madagascar is an island situated about 1000km from the East African Rift and about 2000km from the mid-ocean ridges of the Indian Ocean. Its separation from Africa conducts the evolution of its structure tectonically and geologically. A two- year seismic deployment by the MACOMO (Madagascar-Comoros-Mozambique) project started in 2011 till 2013 was carried out to investigate the origin of intraplate volcanism in the region and to examine the structure of the crust, lithosphere, and asthenosphere beneath Madagascar [1]. The array was composed of 31 broadband seismic stations. This project provided an opportunity to study the seismotectonics of Madagascar.

Seismic activity in Madagascar was first documented in 1897. From 1897 to 1929, seismic data were compiled into a catalogue by a Reverend Poisson and sent to the Observatory of Antananarivo. In 1974, three short period seismic stations were installed, and the number has increased since then. The main earthquake zones around the central part of the island were defined using data collected between 1974 and 1977[2]. Different studies were conducted using data from the short period and broadband permanent seismic networks included local magnitude scale [2], seismotectonics , and velocity structure [3].

Data from the MACOMO project were processed and about 900 local events located. About 400 selected seismic events; with magnitude exceeded to 2.5 were analysed using the HYPODD double difference method and FOCMEC focal mechanism software in order to characterize the location uncertainty and identify the evolution of the fault structure in the study area, respectively.

This study has expanded the seismic catalogue for Madagascar, helped to develop a new local magnitude scale and characterized area and fault sources for seismic hazard assessment. The new local magnitude scale was obtained from 1.228 waveforms by applying the Richter method [4]. Seismic activity for Madagascar is considered as moderate, with magnitudes seldom exceeding 5 and the majority of events with magnitudes between 1.5 and 3. From this present work, the fault plane solution in the centre, northern and southern part of Madagascar show normal faulting with nodal plane having North South orientation; strike slip faulting, and almost reverse faulting respectively. The orientation of the faults in each zone will be characterized. A possible extension of the main Bongolava-Ranotsara shear zone in the south part of Madagascar has been interpreted and new active faults identified in both the northern and southern parts of the island.

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