Geophysical Research Abstracts
Vol. 15, EGU2013-10203, 2013
EGU General Assembly 2013

Seismotectonics of the Lwandle-Nubia plate boundary between South Africa and the Southwest Indian Ridge

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The Lwandle (LW) plate shares a boundary with the Nubia (NU) plate, extending from a diffuse triple junction with the Rovuma plate in Southern Mozambique to a triple junction with the Antarctic plate along a segment of the Southwest Indian Ridge (SWIR). The LW-NU boundary terminates in the ∼750 km-long, complex transform of the Andrew Bain Fracture Zone (ABFZ), but its exact locus is still unclear. Recent works locate it along the eastern boundary of the submarine Mozambique Ridge, parallel to the pre-existing, oceanic transform-fault fabric. However, an early concept of the LW block ('ambiguous region' of Hartnady, 1990, Fig. 2) indicates a more westerly trajectory in the north that includes parts of South Africa, with a southerly extension across old oceanic crust of the submarine Natal Valley and Transkei Basin. This proposed boundary is marked by several, aligned epicentres of moderate to strong earthquakes (1941, 1942, 1956, 1969, 1972, 1975, 1981 and 1989). Our re-examination of seismographic records from the 1975 'intraplate' earthquake (-37.62ºN, 30.98ºE, mb5.0), in the oceanic crust of the distal Transkei Basin, shows a thrust-faulting focal mechanism along a nodal plane striking N272ºE. The largest (ML4.2) of a series of three small earthquakes in the Natal Valley in 2009, close to a zone of recent seafloor deformation mapped in 1992, has similar first-motion patterns at Southern African seismograph stations. When the 1975 slip-vector result (N173ºE) is combined with a normal-faulting slip vector (N078ºE) from a 1986 onland earthquake (-30.53ºN, 28.84ºE, mb5.0) near the Lesotho-KZN border, and both are incorporated into the wider data-set previously used to solve for East African Rift kinematics, they produce a LW-NU rotation pole that is located south of Africa, near the Agulhas Plateau, and approximately 950 km from the Natal Valley deformation zone. The modeled low rate of right-lateral, LW-NU slip (∼0.50-0.75 mm/yr) across this LW-NU boundary segment suggests that the 1972, 1981 and nearby 2009 earthquakes are instances of a 'long aftershock sequence' in the source zone of the 1850 'i-Nyikima' event, which was felt over a very wide region of the Eastern Cape Colony, and the adjacent territories of British Kaffraria and Pondoland. This remarkable historic shaking appears to have been caused by a great (Mw8.0+), oceanic event along a segment of the LW-NU boundary, resembling the 1942 SWIR event along the ABFZ and the recent (2012 March 11) North Indian Ocean events along the incipient boundary between the Indian and Australian plates. This new interpretation has implications for the re-assessment of seismic and submarine-landslide (tsunami) hazard along the SE continental margin of South Africa.

Reference

Hartnady CJH (1990). Seismicity and plate boundary evolution in southeastern Africa. S. Afr. J. Geol. 93, 473 484.