Paper Number: 4332

Pleistocene-Holocene seismoturbidite succession above the Lwandle-Nubia plate boundary, offshore South Africa

Hartnady, C.J.H.[1] and Rogers, J.[2]

[1]Umvoto Africa (Pty) Ltd, PO Box 61, Muizenberg, 7950 South Africa chris@umvoto.com
[2]41 Dean Street, Newlands, 7700 South Africa johnrogers1944@gmail.com

---

The tectonic boundary between the Lwandle (LW) and Nubia (NU) plates [1] extends 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). Although some recent plate-kinematic studies [2] locate the LW-NU boundary along the eastern scarp of the submarine Mozambique Ridge parallel to the oceanic transform-fault fabric, marine-geological and geophysical evidence [3,4] indicates a more westerly trajectory in the north that includes continental parts of South Africa, with a southerly extension across old oceanic crust of the submarine Natal Valley and Transkei Basin. The proposed LW-NU trajectory is marked by several, aligned epicentres of moderate to strong earthquakes (1941, 1942, 1956, 1969, 1972, 1975, 1981 and 1989). The largest (ML4.2) of a series of three small earthquakes in the Natal Valley in 2009 is close to a mapped zone of recent seafloor deformation [4] and the site of a 35.54 m-long piston-core sample, MD96-2077 (33.1667°S; 31.2500°E; water depth 3781 m), taken in 1996 by the R.V. *Marion Dufresne* [5].

The MD96-2077 core consists of foram-bearing nanno ooze, interspersed with nine turbidites of quartzose silts and sands with an average inter-turbidite spacing of 3 m. The lower four turbidites are finer-grained quartzose silts at depths of 34.3-34.4 m, 31.7-31.9 m, 28.8-29.0 m, and 25.6-25.8 m, i.e., about 0.2 m thick and a few metres apart. The top five turbidites are coarser-grained quartzose sands at depths of 20.8-21.0 m, 20.0-20.1 m, 19.2-19.3 m, 14.0-14.5 m, and 10.4-10.7 m. These upper turbidites are not only coarser, but also thicker than those farther down-core. The uppermost three units are dated at 250 ka (thousand years before present), 340 ka and 519 ka. In our seismoturbidite interpretation, each of these features in core MD96-2077 represents a major (>Mw7) earthquake along the LW-NU boundary, which triggered a substantial turbidity-current flow from the nearby SE African continental margin.

The modelled low rate of right-lateral, LW-NU slip (~0.50-0.75 mm/yr) across the LW-NU boundary segment [6] suggests that the 1972, 1981 and nearby 2009 earthquakes are instances of a 'long aftershock sequence' in the source zone of the 1850 May 21 'i-Nyikima' event, which was felt over a very wide region of the Eastern Cape Colony and the adjacent territories. This remarkable historic shaking, previously catalogued with an epicentre near Grahamstown and more recently the E Cape village of Tsolo, is now suggested to have been caused by a great (>Mw8), oceanic event along a transform/transpressional zone [6], consistent with the seismoturbidite interpretation of infrequent Late Pleistocene sand deposition in the Natal Valley sedimentary record.

References:

[1] Hartnady CJH (2002). Earthquake hazard in Africa: perspectives on the Nubia-Somalia boundary. S. Afr. J. Sci. 98: 425–428

[2] Stamps D et al. (2008). A kinematic model for the East African Rift. Geophys. Res. Lett. 35: L05304, 1-6.
[3] Hartnady CJH, Ben-Avraham Z, Rogers J (1992). Deep-ocean basins and submarine rises off the continental margin of southeastern Africa: new geological research. S. Afr. J. Sci. 88: 534–539
[4] Reznikov M, Ben-Avraham Z, Hartnady C, Niemi T (2005). Structure of the Transkei Basin and Natal Valley, Southwest Indian Ocean, from seismic reflection and potential field data. Tectonophysics 397: 127-141
[5] Rau A, Rogers J**,** Chen MT (2006). Late Quaternary palaeoceanographic record in giant piston cores off South Africa, possibly including evidence of neotectonism. Quaternary International 148: 65-77
[6] Hartnady, C., Okal, E, Calais, E., Stamps, D.S. and Saria, E. (2013). Seismotectonics of the Lwandle-Nubia plate boundary between South Africa and the Southwest Indian Ridge. Geophysical Research Abstracts 15, EGU2013-10203, European Geosciences Union General Assembly, Vienna