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Results from a 14-month hydroacoustic monitoring of the three mid-oceanic ridges in the Indian Ocean

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From October 2006 to January 2008, an hydroacoustic experiment in the Indian Ocean was carried out by the CNRS/University of Brest and NOAA/Oregon State University to monitor the low-level seismic activity associated with the three contrasting spreading ridges and deforming zones in the Indian Ocean. Three autonomous hydrophones were moored in the SOFAR channel by R/V Marion Dufresne for 14 months in the Madagascar Basin, and northeast and southwest of Amsterdam Island, complementing the two permanent hydroacoustic stations of the Comprehensive nuclear-Test-Ban Treaty Organization (CTBTO) located near Diego Garcia Island and off Cape Leeuwin.

The three instruments successfully collected 14 month of continuous acoustic records. Combined with the records from the permanent stations, the array detected 1780 acoustic events consisting mostly of earthquake generated T-waves, but also of iceberg tremors from Wilkes Land, Antarctica. Within the triangle defined by the temporary array, the three ridges exhibit contrasting seismicity patterns. Along the Southeast Indian ridge (SEIR), the 272 acoustic events (vs 24 events in the NEIC catalog) occur predominantly along the transform faults ; only one ridge segment (76˚E) displays a continuous activity for 10 months. Along the Central Indian Ridge (CIR), seismicity is distributed along fracture zones and ridge segments (269 events vs 45 NEIC events), with two clusters of events near the triple junction (24-25S) and south of Marie-Celeste FZ (18.5S). Along the Southwest Indian Ridge (SWIR), the 222 events (vs 31 NEIC events) are distributed along the ridge segments with a larger number of events west of Melville FZ and a cluster at 58E. The immediate vicinity of the Rodrigues triple junction shows periods of quiescence and of intense activity. Some large earthquakes (Mb>5) near the triple junction (SEIR and CIR) seem to be preceded by several acoustic events that may be precursors. Finally, off-ridge seismicity is mostly detected in the southern part of the Central Indian Basin as a result of the intraplate deformation between the Capricorn and Australian plates.

Other signals of interest are identified such as a 6-week long series of broadband (1-125 Hz) explosive signals detected only by the instrument located between Kerguelen and Amsterdam islands, many cryogenic tremors easily recognizable from their varying tones and harmonics, some of which can be precisely located off the Antarctic shelf, and finally whale calls attributed to four different whale species. This vocal activity is found to be highly seasonal, occurring mainly from April to October with subspecies variations. Detailed analyses of this unique data set are still underway.