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Seabed environments of the remote southeastern Indian Ocean in the search area for Malaysian Airlines flight MH370 – remnants of Gondwana, mass wasting, spreading ridges and volcanoes

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Between June 2014 and June 2015, high-resolution multibeam bathymetry and sub-bottom profile data were collected along a 180,000 km^2 zone of the Southeast Indian Ocean seabed to aid in the search for Malaysian Airlines flight MH370. This dataset represents the largest continuous high-resolution acoustic mapping effort for the Indian Ocean, improving the resolution of the ocean floor in this region from over 5 km^2 to less than 0.1 km^2.

The search area is centred on Broken Ridge and extends from the eastern flank of Batavia Seamount (a remnant of Gondwana) about 1000 km to the NE of Broken Ridge (25°S, 102°E), to about 1500 km to the SW where it crosses the Geelvinck Fracture Zone (39°S, 87°E). Broken Ridge marks the location where the Southeast Indian mid-oceanic Ridge (SEIR) rifted apart the Kerguelen Plateau-Broken Ridge Large Igneous Province (LIP) over 40 Ma ago. Details of the rifting are recorded along the dramatic southern flank of the ridge, which plunges 5100 m into Diamantina Trench (638 m to 5800 m) and includes escarpments with 1000 m relief, slopes up to 67°, and failed blocks (12 X 25 km; ≥ 1200 m relief). Broken Ridge thereby forms a divide between the distinct geological provinces to the north and south, in which the different morphology of the ocean floor reflects the great contrast in age and in processes that have produced these two types of crust.

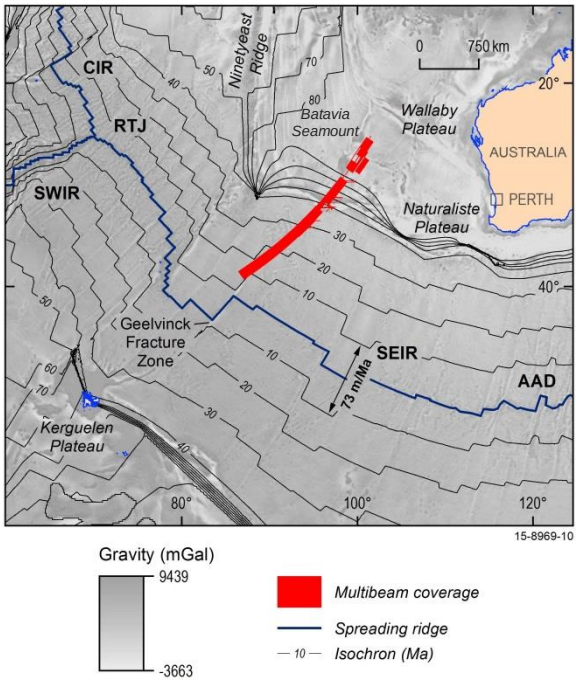

Figure 1: Location Map showing the extent of the multibeam coverage. RTJ: Rodriguez Triple Junction; AAD: Australian-Antarctic Discordance; SWIR: Southwest Indian Ridge; CIR: Central Indian Ridge

To the north of Broken Ridge, the new data indicate a thick cover of oceanic ooze (> 300 m thick), in places reworked by mass wasting events. In contrast, the ocean floor to the south is less smooth and mainly reflects the younger spreading seafloor. Volcanism associated with the spreading formed shield-like volcanoes (up to 1500 m high and 15 km diameter) on the southern margin of Diamantina Trench.

Further south, fracture zones and rift valleys, up to 900 m deep and 8 km wide, cut across spreading ridges of 200 m elevation and ≥ 70 km in length. Volcanoes (n ≥ 220) and fluid escape features, including pockmarks and mud volcanoes, are also common throughout the southern area, mainly in the vicinity of fracture zones.

The new acoustic data highlight the complexity of the ocean floor and the challenges this poses to the search for aircraft wreckage. Importantly, the data provide an accurate, robust geospatial framework for the effective deployment of deep-towed acoustic instruments being used in the search for wreckage.