Deep structure offshore eastern Australia from wide-angle refraction seismic data: from the Tasman Sea to the Lord Howe Rise

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The eastern Australian margin was shaped during the fragmentation of eastern Gondwana in the Late Cretaceous. This led to the opening of the oceanic Tasman Basin and to the formation of sub-parallel ridges and basins, including the Lord Howe Rise. The deep structure of the area is still unknown. In March-May 2016 onboard the R/V *Kairei*, the first large-scale crustal experiment in this region was conducted by JAMSTEC and Geoscience Australia with the deployment of 100 ocean-bottom seismometers (OBS) along a 680 km profile at 27.2°S. The OBSs registered clear refracted arrivals from the crust and the mantle that are recorded at very large offsets of up to 300 km. The variation in the offset of the triplication point between these two refracted arrivals suggests strong crustal thickness variation along the profile. Both pre- and post-critical reflected phases from the Moho (PmP) are also very clearly recorded by the OBSs. We performed first-arrival tomographic inversion to analyze the data The initial layered P-wave velocity model was built using the basement reflection interpreted from coincident multi-channel reflection seismic data andthe PmP arrivals were used during the inversion to constrain the thickness of the crust. The final tomographic Vp model confirms the strong variations in crustal thickness and allows the identification of distinct crustal domains along the profile: Below the Tasman Basin is an oceanic domain with 7 km thick crust; further east, thicker crust (14 km) is present below the Dampier Ridge where granitic rocks have been dredged; directly east of the Dampier Ridge, the crust thins to 8 km below the Middleton Basin; the northern Lord Howe Rise has ~20 km thick crust. Below the northern Lord Howe Rise, lateral variations in upper crustal velocities are associated with Moho relief. Some areas show higher velocities (Capel Basin) compared to surrounding areas (Faust Basin). We propose that these lateral variations are related to weakly-expressed SW-NE oriented lineaments through the northern Lord Howe Rise that link to the Barcoo-Elisabeth-Fairway fracture zone in the oceanic Tasman Basin. Similar variations in crustal velocities are observed in the west below the Dampier Ridge. These variations are also associated with Moho topography. We suggest that the SW-NE trending lineaments linked to major fracture zones active during the opening of the Tasman Basin may have strongly controlled the latitudinal segmentation of the Lord Howe Rise, the Dampier Ridge and adjacent areas. The nature of the crust within the different crustal domains will be inferred using gravity modelling and by comparing the modeled P-wave velocities with previously published results from the western Pacific region. This comparison will help to better understand the processes that led to the fragmentation of eastern Gondwana.