First insights into the deep structure offshore east of Australia using the JAMSTEC OBS pool

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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 Tasman Basin and to the formation of sub-parallel rises, ridges and basins, including the Lord Howe Rise (LHR). The driving forces controlling the rifting are not fully understood, and two processes are invoked: slab rollback associated with back-arc extension or a plume impinging the lithosphere. To better understand the deep structure of the region, a 680 km long seismic profile incorporating 100 ocean-bottom seismometers was acquired conjointly with multi-channel seismic (MCS) reflection data onboard the R/V Kairei at 27.2°S (March – May 2016). Beneath the Tasman Basin, the OBSs register clear refracted arrivals from the crust (P$_g$) and the mantle (P$_n$) that are recorded at very large offsets of up to 250 km. The OBSs dropped in the Dampier Ridge, a continental fragment located east of the Tasman Basin show that the refracted arrival from the crust is recorded at very short offset, suggesting a thin sedimentary cover on the ridge. The large offset (80 km) of the triplication point between the refracted arrivals from the crust and the mantle suggests a thick crust. Below the basins located further east including the Middleton, Capel and Faust basins, the crust and mantle arrivals are recorded as high-amplitude first arrivals associated with a very strong PmP arrival. The offset of the triplication point between the crust and mantle refracted arrivals ranges from 40 km to more than 60 km. Towards the eastern end of the profile, the mantle refracted arrivals are recorded as a very low amplitude phase. All along the profile the reflected arrival from the mantle (PmP) is very strong, except from the OBSs dropped in the Tasman Basin. Below the Dampier Ridge, a sub-Moho reflector is recorded by the OBSs. First arrivals tomographic inversion is performed using a four layered initial model, comprising: two sedimentary layers to account for the complex
sedimentary deposits along the profile: (i) a shallower slow velocity layer (1.6 to 2.3 km/s) and (ii) a deeper sedimentary layer with higher velocities (2.5 to 3.5 km/s); and (iii) the crustal layer (5.9 to 7.1 km/s) and (iv) the mantle layer (7.8 to 8.1 km/s). Tomographic Vp model reveal strong variations of the crustal thickness: a thinner crust below the Tasman (~9 km) and Middleton Basins (~7 km) and a thicker crust below the Dampier Ridge (~14 km), where granitic rocks have been dredged and the Capel and Faust Basins (~19 km). The transition between the thinned continental crust (Capel and Faust Basins and Dampier Ridge) and the adjacent thinner crustal domains (Tasman and Middleton Basins) occurs over a narrow area (<50 km). Lateral variations of the upper crustal velocities below the Capel and Faust Basins are observed with slightly higher velocities below the Capel Basin. We propose that this segmentation between the Capel and Faust Basins could be linked the presence of the Barcoo-Elisabeth-Fairway Lineament at depth. Below the Middleton Basin, nature of the thin crust is still enigmatic: oceanic or very thinned continental?