

Tectonic provinces of the Lord Howe Rise

'Law of the Sea' study has implications for frontier hydrocarbons

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Australia's 200-n-mile Exclusive Economic Zone (EEZ) and 'extended continental shelf' beyond Lord Howe and Norfolk Islands in the Tasman Sea takes in an area of about 1.4 million km², similar to that of the State of Queensland. Despite its vast size and long-term hydrocarbon potential, the Lord Howe Rise region is one of the most poorly known parts of Australia's marine jurisdiction. Recent studies for AGSO's 'Law of the Sea' project, in support of defining Australia's jurisdiction, have provided new insights into the tectonic framework and long-term resource potential of this enormous feature.

The rise extends from the Bellona Trough and Challenger Plateau, west of New Zealand, to southwest of New Caledonia, and lies at water depths generally deeper than 1000 m. It is underlain by continental crust which detached from eastern Australia during the breakup of eastern Gondwana leading to the formation of the oceanic Tasman Basin from 85–52 Ma.

During 1999, 'Law of the Sea' project scientists carried out a framework geological study to provide background information pertinent to the definition of Australia's seabed jurisdiction in this region. Owing to the paucity of geophysical data, the project has made extensive use of satellite gravity data to in-fill the interpretation between widely separated seismic lines. Geological samples are equally sparse, being limited to several Deep Sea Drilling Project (DSDP) holes, drilled in the 1970s and 1980s, and a few samples dredged from the flanks of Lord Howe Rise and Dampier and Norfolk Ridges.

Provinces of the Lord Howe Rise

An important early output from this work has been a map of the major tectonic provinces in the region (Fig. 36) — the first such product for this remote part of Australia's jurisdiction.

The 400–600-km-wide rise consists of four subparallel provinces that extend for much of its length. From east to west, these provinces comprise:

- Shallow, planated, probably Palaeozoic basement of the **Lord Howe Platform**, overlain by a few hundred metres of mainly Cainozoic

siliceous and carbonate oozes. To the east, the basement of the New Caledonia Basin is about 5 km deeper and of uncertain crustal affinity, and the western boundary of the platform is defined by a Cretaceous hinge.

- A **central rifted province** characterised by a series of poorly defined basement blocks, normally downfaulted to the west, with 2–4 km of Upper Cretaceous and Cainozoic syn- and post-rift section. This province includes the newly named *Moore Basin* in the south, and the *Faust Basin* in the north.
- A **western rift province** separated from the central rift by a broad fault zone across which basement is downfaulted to the west. Basement and water depths are considerably deeper than in the central rift, and the syn- and post-rift sediments are thicker. This province includes the newly named *Monawai Basin* in the south, and the *Capel Basin* in the north. Near Lord Howe Island, the central and western rifts cannot be separated, and the combined rift has been referred to as the *Gower Basin*.
- A **western bounding complex ridge system** of continental origin. In the north, the *Dampier Ridge* is separated from the western rift province by the *Lord Howe and Middleton Basins*, which may in part be underlain by highly extended lower continental crust. Farther south, where crustal extension is less extreme, the *Monawai Ridge* forms an intact outer margin to the Monawai Basin.

Regional lineaments of the Lord Howe Rise

Regional crustal lineaments are interpreted to be an important factor in the present-day structural divisions of the Lord Howe Rise region. These lineaments are aligned along two principal trends: northeast–southwest, parallel to the Cretaceous–early Cainozoic Tasman Sea spreading direction; and northwest–southeast, resulting from the late Cainozoic formation of the ridge-and-basin complex between Norfolk Ridge and the Tonga–Kermadec Trench. The northeast–southwest lineaments are particularly important to the structural

segmentation of the Lord Howe Rise.

The most prominent of these lineaments extends for about 1800 km north-east from east of Jervis Bay — across the Tasman Sea, Dampier Ridge, Lord Howe Rise, and New Caledonia Basin — as far as the Norfolk Ridge. This lineament (the Barcoo–Elizabeth–Fairway Lineament), has gravity and seismic expression as:

- the boundary between the orthogonal seafloor spreading in the south Tasman Sea and the highly segmented, oblique spreading pattern in the north Tasman Sea;
- an offset in the Dampier Ridge and the major offset between the Lord Howe and Middleton Basins;
- a 130-km offset in the western edge of the Lord Howe Platform, and a commensurate northward narrowing of that province;
- southward termination of the Fairway Trough and Fairway Ridge; and
- a northward constriction, and a corresponding change in structural style, of the New Caledonia Basin.

The northwest–southeast lineaments are mainly restricted to the structural provinces east of Lord Howe Rise, although they may also have overprinted some of the older structuring on the rise. These lineaments are most strongly expressed in the segments of the Vening Meinesz Fracture Zone, north of New Zealand, and by the parallel Cook Fracture Zone, some 600–700 km farther north.

Frontiers of hydrocarbon potential

The possibility of unconventional hydrocarbon resources in the Lord Howe Rise region, in the form of gas hydrates, already has been reported (Exon et al. 1998: PESA Journal 26, 148–158). Our study suggests that these resources may be more widespread than originally envisaged. By identifying sedimentary basins that extend for much of the length of the rise, it also confirms the long-term potential of the region for conventional hydrocarbons. The most prospective areas are the central and western rift provinces of Lord Howe Rise, the eastern flank of the rise adjacent to the New Caledonia Basin, and possibly in the New Caledonia Basin itself, where the sediment thickness exceeds 4 km.

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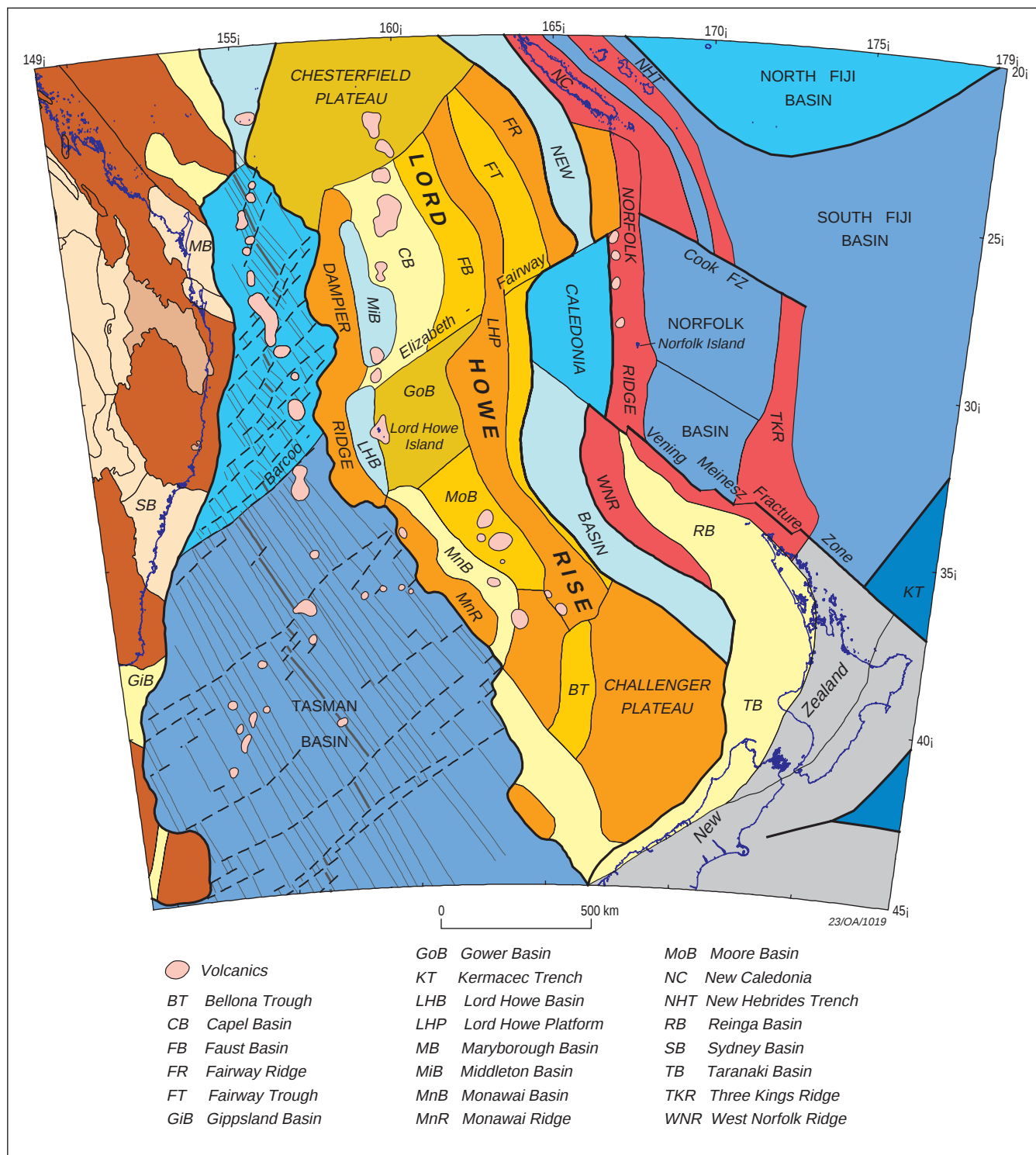


Fig. 36. Structural elements of the Lord Howe Rise region. Blue tones represent ocean basins. On the Australian continent, brown tones represent fold belts; beige, Palaeozoic–Mesozoic basins; yellow, Mesozoic–Cainozoic rift basins. On Lord Howe Rise and ridges to the east, red and deep orange tones represent high-standing basement; yellow, mustard, and pale orange tones, rift-basin elements. New Zealand elements are coloured grey.