Papers

Part 1

East Australian Margin and the Western Marginal Basins

DEPOSITIONAL AND TECTONIC PATTERNS IN THE WESTERN CORAL SEA

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Preliminary results from legs 21 and 30 of the Deep Sea Drilling Project have indicated many inadequacies in the geological history of the Western Coral Sea as proposed by J. Ewing *et al.* (1970), M. Ewing *et al* (1970) and Gardner (1970). These early studies depended solely on seismic reflection and refraction interpretation and lacked the regional stratigraphic control now afforded by DSDP Sites 209, 210 and 287. Reassessment of the data presented by these workers, together with seismic reflection data since obtained during the Bureau of Mineral Resources Continental Margin Geophysical Survey enables the establishment of a reasonably comprehensive picture of regional sedimentation and sheds considerable light on regional tectonics.

The bathymetry and principal physiographic features of the Western Coral Sea are illustrated in Figure 1.

Eocene – Recent Sedimentation

Drilling at Site 287 on the Coral Sea Abyssal Plain has established a sea-floor age of lower Eocene (Andrews *et al.* 1973) and sediments of a similar age were cored at the base of Site 209 on the Queensland Plateau just above acoustic basement (Burns, Andrews *et al*, 1973).

A regional Eocene/Oligocene unconformity associated with changing oceanic current patterns can be recognised in the Coral Sea Basin and on three of the four bordering plateaux. The Marion Plateau appears to have been above sea-level at this time though it subsided across the unconformity as the other plateaux deepened. During the late Oligocene establishment of a flow of equatorial water into the region led to the growth of reefs on basement highs near sea-level. Submergence of plateaux highs during the period of the unconformity resulted in the removal of sources of terrigenous detritus, and pelagic carbonate sedimentation became dominant on the Eastern, Queensland and Marion Plateau.

Examination of heavy minerals from the basal unit cored at Site 209 indicates a sedimentary and low grade metamorphic provenance. The upwards decreasing terrigenous content in this unit reflects the submergence of surrounding landmasses during the Eocene.

Uplift of the Owen Stanley region of Papua New Guinea from the latest Oligocene-early Miocene resulted in shedding of detritus into the Aure, Pandora, Moresby Trough System, Coral Sea Basin and Papuan Plateau. This was greatly enhanced by widespread Miocene volcanism on the western border of the Owen Stanley high.

This pattern of terrigenous sedimentation in the Pandora and Moresby Troughs, Coral Sea Basin and Papuan Plateau, with carbonate deposition (pelagic and reefal) on the remaining plateaux and bordering troughs has persisted to the present.

Heavy mineral studies on samples from Unit 1 (middle Miocene – Recent turbidite unit) at Site 210 indicate a mixed volcanic and metamorphic provenance with a source similar to that of the Miocene Aure Trough greywackes. Miocene sediment transport over considerable distances down the Aure and Moresby Troughs into the Coral Sea Basin is probable. Previously the Fly River Delta has been assumed the source of at least the surficial turbidite deposits in the Coral Sea Basin (Krause, 1967; J. Ewing *et al*, 1970; Gardner, 1970). This study however, shows no significant variation in source of the turbidite deposits from the Miocene to Recent, and reveals considerable differences in mineralogy of sediments from the abyssal plain and Fly Delta. It is concluded that the Fly River is not and never has been a major source of Coral Sea Basin sediment.

Regional Tectonics

Free air gravity lows of -20mgals border the Queensland Plateau and are in part associated with the presence of a 1-3 km thick section of seismic velocity 3-4.5 km/sec (Falvey and Taylor, 1974). This is interpreted to indicate the presence of an Upper Cretaceous – Lower Palaeocene clastic "rift valley" sequence (as defined by Falvey, 1974) on the edge of the Queensland Plateau and in the bordering troughs. Less definitive data suggest the presence of a similar sequence on the southeastern edge of the Papuan Plateau and western portion of the Louisiade Archipelago. Implicit in this interpretation is the extension of continental crust well down the plateaux slopes to water depths of up to 4500 meters. Oceanic crust is thus limited to a maximum width of 400 km perpendicular to the trend of the basin.

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Geophysical data indicates the presence of continental Upper Palaeozoic basement rocks beneath a Tertiary – Recent sediment cover in the central regions of the Marion, Queensland, Eastern and Papuan Plateaux. On the outer edges of the Queensland and Papuan Plateaux, and in the Queensland and Townsville Troughs the postulated Upper Cretaceous – Lower Palaeocene rift valley sequence appears as the acoustic basement observed on reflection records. A similar rift valley sequence is inferred on the edge of the Marion and Eastern Plateaux though no refraction data is available over these features.

The Louisiade Rise is a problematic structure. Bathymetry, gravity and seismic reflection profiling suggest a continental structure similar to the Queensland Plateau though the absence of reefs suggests a more rapid Eocene subsidence.

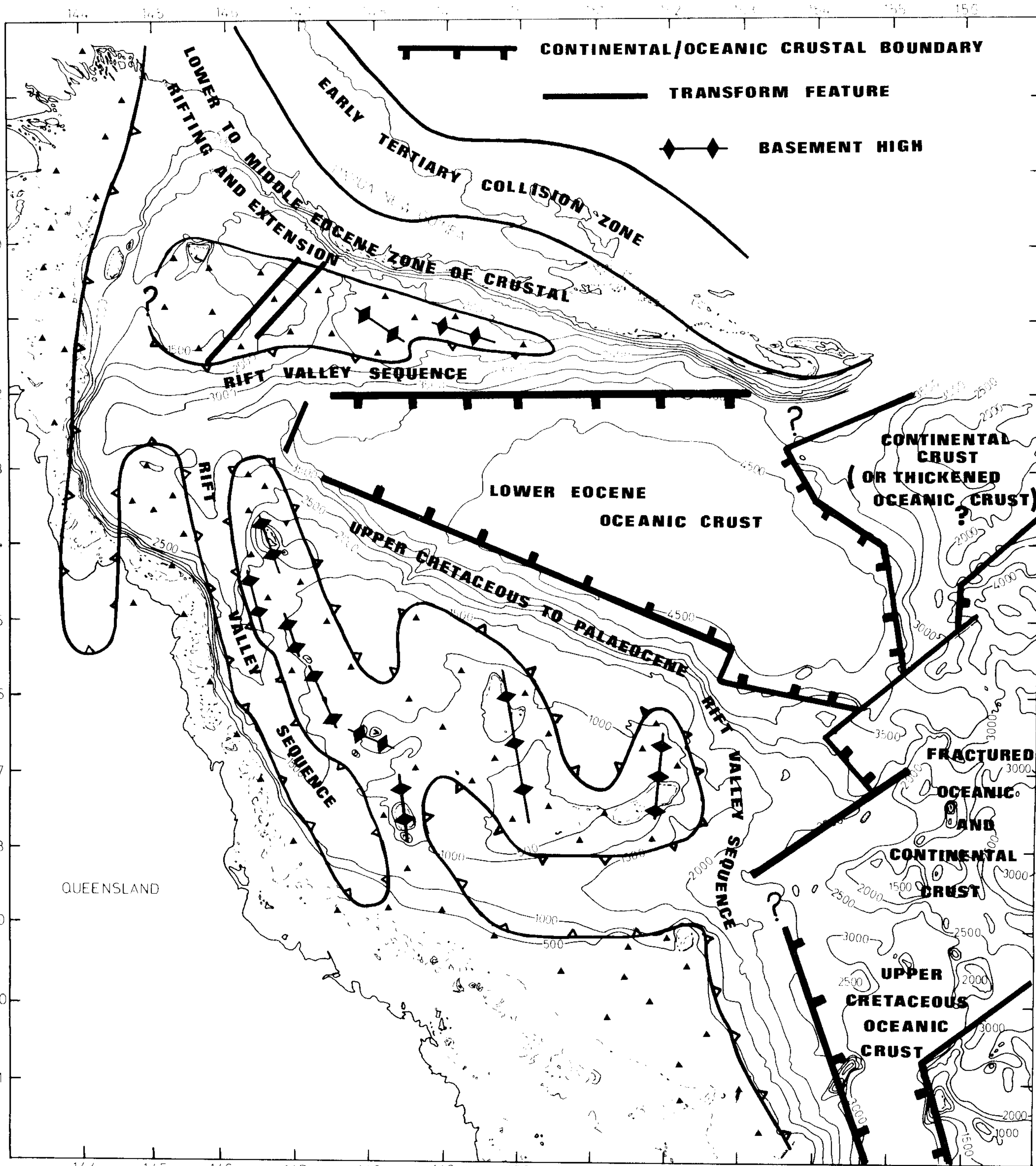

Figure 1: Schematic tectonic map of the Western Coral Sea. Solid triangles denote areas of Palaeozoic continental basement beneath Tertiary – Recent sediment cover. The rift valley sequence is developed on thinned Palaeozoic continental crust and is overlain by Tertiary – Recent sediments.

Landmesser *et al* (in press), however, have tentatively identified magnetic anomalies symmetrically disposed about the crest of the rise with a proposed age of 42 my at the crest. With definitive data lacking they therefore suggest that the rise may be either thickened oceanic crust, or continental crust.

Basement structure over the Queensland, Eastern and Papuan Plateaux reveal three major trends; a separate one dominant on each plateau. On the Queensland Plateau NNW trends prevail particularly in and adjacent to the edge of the trough. These NNW trends are abruptly terminated by the NW trending slope of the plateau and many of the horst structures paralleling the Queensland Trough appear to have been offset in a NW direction. This NNW trend in basement structure may reflect an original Palaeozoic grain along which tensional forces associated with the Coral Sea opening have operated. This trend, however, closely parallels that of the Tasman Sea opening (Hayes & Ringis, 1973) and the Queensland Trough may reflect a rift associated with this event and predating the Coral Sea opening.

On the Papuan Plateau, basement highs trend in a NW direction subparallel to the Coral Sea Basin and basement rapidly deepens towards the Papuan landmass, where an extensive area of middle Eocene submarine tholeiitic basalts outcrops (Southeast Papuan Volcanic Province). This suggests a rifting phase to the north of the Papuan Plateau following the opening of the Coral Sea and may be the result of a jump in the Coral Sea spreading centre to the north of the plateau during the last stages of Coral Sea opening.

Major NE structures prevail on the Eastern Plateau and intersect the trend of the Coral Sea Basin terminating the extent of oceanic crust. This NE trend is considered to be a result of transform motion in continental crust at the time of the basin formation. A consequence of such motion may be the displacement and change in trend of the Owen Stanley Metamorphic Belt at its junction with the Southeast Papuan Volcanic Province. The Papuan Ultramafic Belt, however, shows no such displacement indicating that the overthrusting of the ultramafic mass was a post Coral Sea formation event.

The Aure — Moresby Trough appears to have resulted from early Eocene rifting and possibly crustal extension, the conclusion of which may have been the formation of the Southeast Papuan Volcanic Province. Whether this can be related to the same thermal anomaly associated with the Coral Sea opening or reflects a slightly later event cannot at present be ascertained. Figure 1 is a schematic tectonic map of the region.

It is probable that two or possibly three closely spaced rifting events have occurred during the Cretaceous — early Tertiary history of the western Coral Sea. The first of these was associated with the Tasman Sea opening and resulted in the formation of the Cato and Queensland Troughs and associated NE trending basement features on the Queensland Plateau. No sea-floor generation, however, occurred in the Queensland Trough. Following this, rifting and eventually continental break-up in the early Eocene occurred along the trend of the Coral Sea Basin. This may have been associated with rifting in the Aure — Moresby Troughs and generation of sea-floor basalts in southeast Papua. These later events, however, may be a consequence of a thermal event independent of that responsible for the opening of the Coral Sea.

At present it is not possible to ascertain whether the Coral Sea Basin resulted from a process of normal oceanic crustal generation, or of back-arc spreading as proposed by Karig (1971) and Packham and Falvey (1971). The absence of an obvious Eocene island arc in Papua, however, tends to negate the concept that development took place by a marginal basin process associated with arc migration.

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BASIN EVOLUTION AND MARGINAL PLATEAU SUBSIDENCE IN THE CORAL SEA

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Marginal plateaus, such as the Coral Sea Plateau*, are special structures related to, and occurring within the transition zone between continental and ocean crust. They are continental structures which have been modified by the effects of tectonism associated with the formation of an ocean basin. The structure of a plateau owes as much to an original relationship with the continent adjoining it on one side, as it does to a tectonic relationship with the ocean basin adjoining it on the opposite side. The history of development of a marginal plateau reflects varying condition at a continent/ocean lithosphere boundary during development of a new continental margin.

***Also called the Queensland Plateau (ed.)**