ASPECTS OF THE GEOLOGICAL HISTORY OF THE NEW HEBRIDES AND SOUTH FIJI BASINS

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The data used in this paper is the result of drilling and airgun profiling on Leg 30 of the Deep Sea Drilling Project. The locations of the figured profiles and the drill sites are shown on Figure 1.

In the New Hebrides Basin at DSDP Site 286 (Andrews, Packham, *et al.*, in press) mid Eocene island arc derived volcanogenic turbidites rest on basalt sea floor and are overlain by late Eocene and Oligocene biogenic ooze and Miocene abyssal clay (Figure 2). Seismic layering in the originally flat lying turbidites are seen in the profiles to follow the form of basement structures that have a relief in excess of 500 metres in the vicinity of the site (Figure 3a). It is concluded that there has been tectonic disturbance of the sea-floor but it is not clear whether or not the deformation post dates the deposition of the biogenic oozes. The most likely time is early Oligocene when sea-floor was obducted on to New Caledonia (see Packham and Terrill, in press, for discussion). Evidence from the South Fiji Basin (see below) indicates that the deformation was pre-middle Miocene. The absence of Miocene volcanic sediments at DSDP Site 286 indicates that the highly active Miocene New Hebrides volcanic arc lay remote from the site probably to the east of its present location.

Pliocene and Pleistocene terrigenous sediments (in part volcanogenic) occur in the eastern part of the basin. These sediments were derived from the New Hebrides. The blocking of the New Hebrides trench west of Malekula as the result of the westward motion of the New Hebrides arc occurred at least by the early Pleistocene (say 1.5 m.y. ago) and perhaps as long ago as early Pliocene (4 m.y. ago).

The profiles show that the turbidites extend up the flank of the ridge on which the Loyalty Islands are located, and so the ridge must essentially represent uplifted sea floor. Later sediments derived from the ridge after its uplift have been deposited at its base. Near the South New Hebrides Trench these sediments have been gently deformed (see north western end of Figure 3b).

The Eocene volcanogenic sequence extends into the north-western South Fiji Basin with the sediments thinning to the southeast and east. A late early Oligocene basement age has been established in the east South Fiji Basin at DSDP Site 205 (Burns, Andrews, *et al.*, 1973). The troughs between the structural ridges over which the deformed turbidites are draped are filled with mid-to late-Miocene volcanoclastic sediments derived from the northern Lau Ridge and build up the Minerva Abyssal Plain to the east as indicated by the drilling results at Site 285 (Figure 2) (Andrews, Packham, *et al.*, in press). These clastics are overlain by Pliocene biogenic sediments and Pliocene Pleistocene Abyssal clay. The supply of volcanoclastic sediment was cut off with the initiation of formation of the Lau-Havre Trough at the end of the Miocene. It appears from the data presented here that the South Fiji-New Hebrides Basin is of Eocene-Oligocene age and that the eastern part is younger but it is not possible to define the mode of crustal generation.

In the southern part of the basin a second Abyssal Plain (the Kupe Abyssal Plain) slopes away from the foot of the N.Z. continental slope, it is the site of a thick clastic deposit.

A marginal plateau with a rough surface, the Northland Marginal Plateau, occupies the region between the continental shelf and the foot of the slope, its shoreward boundary is the Vening Meinesz "Fracture Zone". On the Northland Marginal Plateau is a thick deformed wedge of sediment, thinning seawards (Figure 3c). Only very minor sediment has been deposited since the present structural configuration was attained. The magnetic anomaly profile suggests that the outer limit of the continental crust occurs near the outer margin of the plateau.

The sediments of the Kupe Abyssal Plain could not have been carried over the rough topography of the Northland Marginal Plateau. The Kupe Abyssal Plain is probably constructed from early Miocene to Pliocene volcanogenic sediments derived from the volcanic activity in Northland and the Coromandel Peninsulas (Thompson, 1960; Schofield, 1967; Stipp and Thompson, 1971). The wedge of sediment on the marginal plateau is probably part of the same sediment mass, deposited on the shelf and shelf margin. These data suggest that subsidence of the Plateau probably commenced in the late Pliocene. However the present depth of the plateau surface of about 2,000 metres seems excessive for such a youthful feature. No evidence exists for an old trench along this part

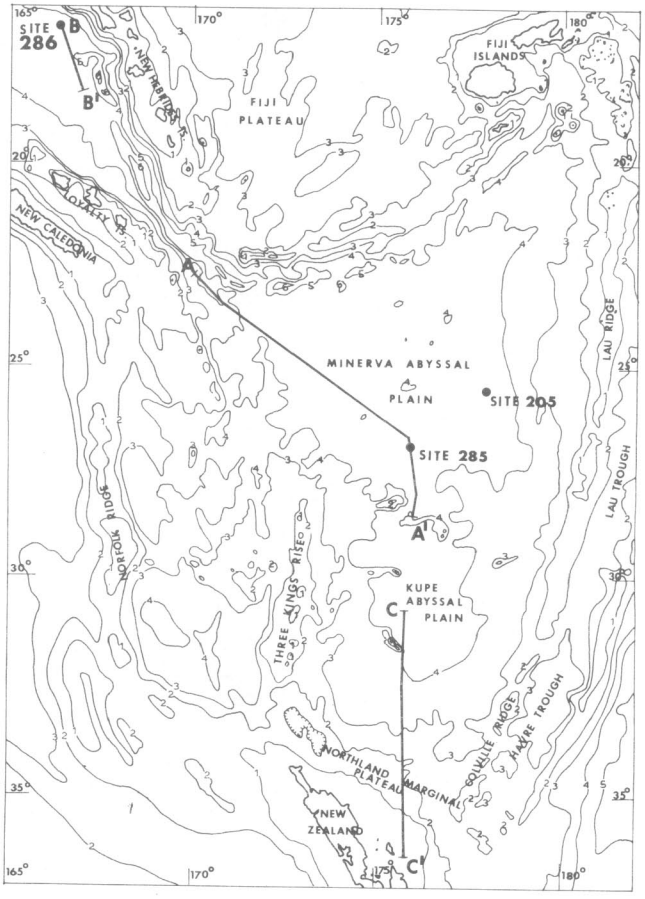

Figure 1.
Locality map for seismic profiles and Deep Sea Drilling Sites. Bathymetric contours are in kilometres.

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of the New Zealand Continental Margin as suggested by Brothers (1974) and Ballance (1974).

The interpretation arrived at above sheds some light on the evolution of the India-Pacific Plate boundary. The New Hebrides Basin and northern South Fiji Basin formed in the Eocene near the active subducting plate boundary behind an island arc. As the South Fiji-New Caledonia Basin formed in the Eocene-Oligocene the arc and the active plate boundary moved to the east. Overthrusting in New Caledonia and deformation of the sea floor may have been the result of the temporary location of the plate boundary on the western side of the basin. Deposition of a thick volcanic sediment pile in the South Fiji Basin in the middle and late Miocene suggests a high rate of subduction in the Tonga-Kermadec Trench. The sediment supply was cut off when the Lau-Havre Trough started to form at the end of the Miocene and the plate boundary again moved to the east as the India plate was once more extended in that region. Sedimentological data considered here demonstrates that westward motion of the New Hebrides volcanic arc commenced *at least* in the early Pliocene with part of the India Plate being consumed in the New Hebrides Trench and the Hunter Fracture zone developed as a transform structure. Falvey (this volume) suggests from his study of Fiji Plateau magnetic anomalies that the westward motion of the arc commenced about 9 m.y.b.p. (early late Miocene). The arc would have been too remote at that time for volcanic sediment derived from it to have reached what remains of the New Hebrides Basin.

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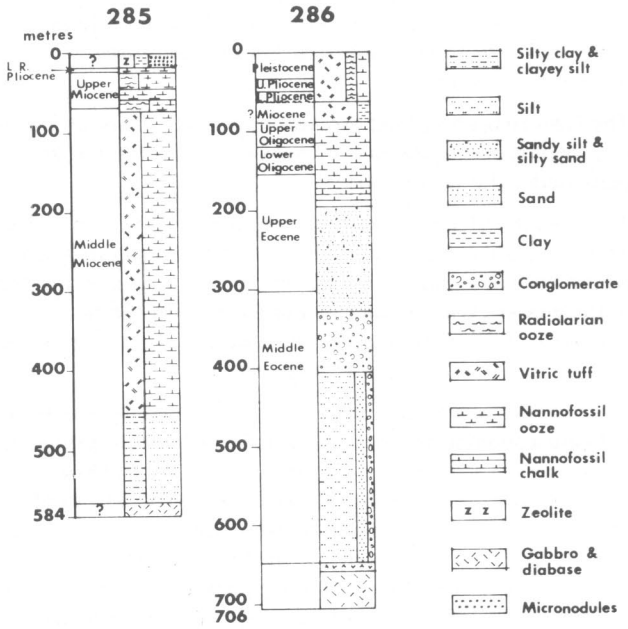

Figure 2.
Stratigraphic columns for Deep Sea Drilling Project Sites 285 and 286.

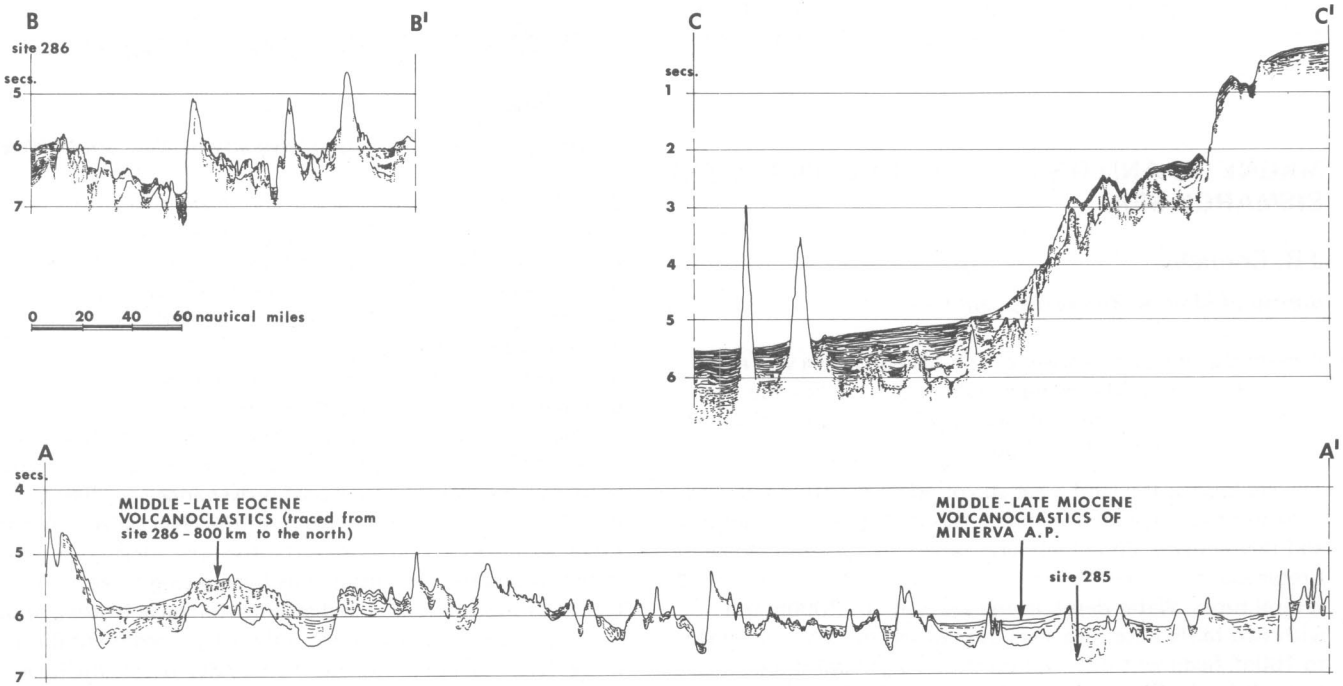

Figure 3. Drawings of airgun seismic profiles taken on Leg 30 of the Deep Sea Drilling Project on the D.V. Glomar Challenger. Locations of profiles are shown in Figure 1. Depths are two way travel time.