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Palaeontological Studies for CRP-3

Introduction

The drillhole at CRP-3 was the deepest of the project and offered early hopes of retrieving a long plalaeontological record. However, the reality was that the fossil content dropped off markedly in the lower half of the hole, leaving some tantalising unknowns and uncertainties concerning palaeoenvironments and biochronology. Thus, authors agree that the age of the bottom of CRP-2/2A is early Oligocene, as is the top of CRP-3, but the amount of possible overlap is debatable and even slight underlap is likely. Likewise, despite some palaeontological hints that the lower part of the Cenozoic sequence could be within the topmost Eocene, just how much is uncertain.

Twelve papers address aspects of the fossil remains found within the CRP-3 drillcore so far.

Siliceous microfossils, described by Harwood and Boharty, are abundant but are essentially limited to the upper 193 m of the core. Of approximately 130 taxa, those from the top 70 m suggest deposition in a coastal setting in water depths between 50 and 200 m, but the poorer quality of preservation below this level precludes meaningful palaeoenvironmental interpretation. All are consistent with an early Oligocene age, and the absence of several key species is taken to indicate that the upper 200 m of CRP3 drillcore is equivalent to part of the stratigraphical interval missing within the unconformity at c. 366 mbsf in CIROS-1.

Calcareous nannofossils were likewise found only in the upper 200 m of the core, but contrast with the siliceous microfossils in being depauperate and sporadic in occurrence. Watkins and co-workers speculate that the species present indicate not only cold surface water conditions but perhaps also abnormal surface water chemistry. Age-diagnostic species are generally absent although the presence of *Transversopontis pulcheroides* suggests an early Oligocene age.

Foraminifera are more persistent down-core to about 340 mbsf, over which interval half of the levels sampled proved fossiliferous. Strong and Webb consider that the assemblages, which all lack planktic species, represent a single biofacies, characterised by low diversity and dominant occurrence of a few taxa. The foraminifera suggest mid to outer shelf environments, with water depths of 50–200 m, in good agreement with interpretation of the siliceous microfossils. Likewise, their indication of glacially influenced environments and poor oceanic conditions is consistent with the interpretation of the calcareous nannofossils. Analysis of the species present suggests minimal stratigraphical overlap between the CRP-2/2A and CRP-3 drillcores. Galeotti and Coccioni undertook morphometric analysis of two species of foraminifera from the CIROS-1 core, as well as from the three CRP sites, with a view to assessing changes in size and shape as possible environmental indicators. They conclude that the most important factors affecting morphological variation were bottom-water temperature and trophic conditions, and that morphometric variations in populations have potential for regional correlation.

Dingle and Majoran report on sparse but generally well preserved early–late Oligocene ostracods from both CRP-2/2A and CRP-3. Although mainly cool-water species, they nevertheless suggest palaeotemperatures were a little higher than those of the Ross Sea today. Taxonomic affinities point to faunal links with both the Antarctic Peninsula/South American region and southern Australia.

The review of marine microfossils is completed with the preliminary report by Hannah and others on marine palynomorphs. Assemblages are moderately diverse but only down to 162 mbsf, below which diversity falls off rapidly until most samples are barren. Three marine palynomorph units, based on the distribution of dinoflagellate cysts, are recognised, of which the lowest (330.17–823 mbsf) is earliest Oligocene–?latest Eocene in age.

Evidence of penecontemporaneous conditions on land come from terrestrial spore-pollen assemblages, (Raine and Askin), a single leaf of *Nothofagus*, (Cantrill), and from assemblages of phytoliths (Thorn), transported into the marine basin. Early Oligocene spore-pollen assemblages above 410 mbsf are dominated by *Nothofagus* but the total flora is more diverse and thought to be comparable with that of the woodland of the present-day Magellanic region of southern South America. Below 410 mbsf, samples were mostly barren, but a relatively high diversity assemblage with *Casuarina*-type pollen at 781 mbsf could point to warmer conditions, and is also consistent with the presence of Eocene strata. Just as one swallow does not make a summer, so one leaf does not make a forest. Yet it is another important piece of evidence leading to an emerging picture of cooler Tertiary climates in East Antarctica than in West. Phytoliths, although sparse, occur throughout much of the drillcore from both CRP-2/2A and CRP-3. Dominated by forms similar to those from modern trees and shrubs, there are also rarer occurrences of forms similar to those from modern grasses, whereas grasses are not represented in the palynological record. Most are consistent with a cool climate, but below 250 mbsf in CRP-3 there are also phytoliths of Palmae and other taxa suggestive of the existence on land of local 'warmer' pockets where less cold-tolerant species could survive.

Marine macrofossil occurrences are dominated by bivalves, with fewer numbers of such taxa as brachiopods, bryozoa and gastropods (Taviani and Beu), but there is also a noteworthy occurrence of solitary corals in one lithological unit (Stolarski and Taviani). For the most part, the fossil assemblages point to inner/middle shelf or deep muddy shelf environments. Taviani and Beu consider that occurrences of turritellid gastropods and modiolid and veneroidean bivalves indicate temperatures warmer than at present, and perhaps more comparable to those of the present-day Subantarctic. Lavelle and others made stable isotope analyses of growth increment of some of the marine bivalves from CRP-2/2A and CRP-3, enabling them to estimate the spring to late summer temperature range. Figures of 3ºC for the early Miocene and between 1 and 5ºC for the early Oligocene indicate temperatures significantly warmer than those of the present day in the same area and confirm the interpretations made independently from several of the above fossil groups. A coherent palaeoenvironmental picture is beginning to emerge.

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