JOIDES: Past, Present and Future

from our Geomagnetism Correspondent

As time goes by, the JOIDES deep sea drilling project, a success right from the start, becomes even more successful, more adventurous and, though it is hardly possible, more interesting. With an expedition to the southern seas recently completed, the drilling ship Glomar Challenger has been operating in the Arabian Sea and is now continuing its voyage with a visit to the Red Sea. At the same time, plans have been announced for at least five 56-day cruises spanning three austral summers in Antarctic water (see *Nature*, **236**, 258; 1972).

The cruise to the southern seas included drilling sites on the Lord Howe Rise to the east of Australia, in the South Fiji Basin and in the Coral Sea. This is one of the most geologically complex oceanic areas in the world, and, though a marine region at present, has had strong continental affinities in the geological past. Of particular interest is the region's structural history in the light of the breakup of New Zealand, New Guinea and Australia. Preliminary drilling results support the hypothesis that a major deformation and a splitting-off of continental crust along eastern Australia occurred over 70 million years ago. This continental segment migrated eastwards with the opening of the Tasman Sea, and the northern part submerged 50–60 million years or so ago to form what is now the Lord Howe Rise. New Guinea seems to have separated from northern Australia at least 50 million years ago.

The eastern part of the region under investigation does not have continental characteristics but seems, rather, to have been formed in association with extended periods of volcanism by accretion of new oceanic crust or by extension of the ocean floor eastwards behind a migrating Tonga–Kermadec Island arc. The drilling results indicate that the South Fiji Basin was formed as early as 40 million years ago and that the Lau–Havre basins are much more recent—probably less than 15–20 million years old.

Fossil evidence, which indicates that the older fossil forms have an affinity to temperate latitudes and the younger forms have tropical to subtropical affinities, suggests that in addition to the relative movements within the region, the area as a whole has migrated towards the equator. But a major puzzle is the discovery that in the eastern region there is a break in the fossil record about 45 to 30 million years ago whereas in the west the record is complete. The reason for this break is as yet unknown, but presumably results from major differences in oceanic current systems in the past. It seems essential to suppose that the separation of Australia and Antarctica and the general northward migration of Australia–New Zealand–New Guinea would have altered circulation systems. A possible explanation for the break in the fossil record is thus that at some stage the Circumpolar Current—the large-scale circulation pattern around Antarctica, which is now unimpeded by major land masses—changed from an original path north of Australia to its present southern route.

The present visit of the Glomar Challenger to the Red Sea is particularly exciting because of that region's reputation as an example of ocean floor spreading in its very early stages. The Red Sea is currently only the world's sixteenth largest ocean, being about 1,200 miles long and 130–150 miles wide. But the presence of a deep, almost sediment-free, narrow trough down the centre, and its association with earthquakes, strongly suggests that Arabia and Africa are moving apart from this rift much as North and South America separated from Europe and Africa about 200 million years ago. The unique opportunity thus offered to study the early rifting of continents will be aided by the lack of the thick sediment accumulations which often characterize the continental margins of, for example, the Atlantic. But the Red Sea is also of special interest for other reasons. For one thing, there are known to be pools of hot, salty water in the central region at temperatures up to 138° F and with sodium chloride at near-saturation level. These pools are underlain by brilliantly coloured sediments rich in various metals, and thoughts inevitably turn to the possibility of the development of these undersea resources.

As for the future, JOIDES now offers the enticing prospect of cruises to the Antarctic (Hayes and Edgar, *Antarct. J.*, **7**(1), 1; 1972). In view of the enthusiastic response to a suggestion put forward some time ago by Ewing and Hayes (*Geotimes*, **15**(9), 15; 1970), the first expedition, concentrating on the south-east Indian Ocean and the south-west Pacific Ocean, will begin in December of this year. The second season will begin in January 1974 when a visit will be made to the south-east Pacific, including the Bellinghausen Basin, the Weddell Sea and the Scotia Sea. Precise objectives for the third expedition, starting in February 1975, have not yet been set, but the areas to be visited will include the south-east Atlantic and the south-west and south central Indian Ocean. The Kerguelen Plateau near 70° E latitude is likely to be of particular interest on this trip.

The general objectives of the Antarctic expeditions are four-fold. The first is the acquisition of further data on the chronology of Gondwanaland but with the added possibility of finding oceanic crust older than the Gondwanaland breakup. Models reconstructing Gondwanaland suggest that such ancient crust may be preserved along parts of the Antarctic coastline. The second aim is to study the volcanic, glacial and climatic history of Antarctica by means of drilling near the coast with a view to comparing the geology of the young, tectonically active west part of the continent with the older, more stable east. Third, there will be an investigation of Antarctica as a sediment source, partly with a view to elucidating the formation of Antarctic bottom water, because this water influences the patterns of deep water circulation within all the major oceans. And finally, an objective will be to determine the tectonic history of the Antarctic margin, sub-Antarctic ridges and islands. Of especial interest here are the Macquarie Ridge system, the Scotia Ridge and Arc, the Balleny Ridge and, of course, the Kerguelen Plateau.

Because so little is known about the floor of the Antarctic Ocean, five sets of reconnaissance holes will be drilled first, each set comprising a hole in the continental shelf, one in the continental rise and one in the deep ocean floor. The precise programme to be followed thereafter will depend to some extent on the results of this preliminary drilling, but because of the wide distribution of the reconnaissance holes (longitudes 105° E, 30° E, 15° W, 100° W and 165° W) the resulting data will be valuable in themselves, especially in comparing different regions.

DIELECTRICS

Probing Non-Linearity

from a Correspondent

THE Dielectrics Discussion Group is an informal association of physicists, chemists, engineers and other scientists interested in the theory and applications of dielectrics. The most recent meeting of the group, the fourth in an annual series, was held in Cambridge from March 22–24 and was devoted to non-linear dielectrics.

In the first talk Dr J. C. Burfoot (Queen Mary College, London) described the properties of ferroelectrics