Upper Cretaceous and Paleogene Sediments from the Northern Kerguelen Plateau

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Abstract

Upper Cretaceous and Paleogene pelagic sediments sampled from the Northern Kerguelen Plateau during cruise MD35 of the Marion Dufresne are described and correlated with the Late Paleogene sequence drilled at site ODP 737 (Leg 119). Taking into account geophysical data obtained by the cruise MD26, a Lower Cretaceous age is computed for the unsampled acoustic basement. A major tectonic/volcanic event in the Late Paleogene, related to rifting, gave rise to a marked unconformity and hiatus termed the “Acoustic Discordance.” Tertiary sediment facies changes were strongly influenced by the evolution of the Antarctic environment.

Introduction

The Kerguelen Plateau, an aseismic ridge located in the southern Indian Ocean, extends in a NW-SE direction between 46°S and 64°S towards Antarctica. This plateau, about 2,000 km long and 500 km wide, stands up to 3,500 m above the adjacent marine basins (Fig. 1). The Kerguelen Plateau and Broken Ridge, an aseismic plateau located on the opposite flank of the southeastern Indian Ridge, belonged to a single entity before separation by spreading along the southeastern Indian Ridge. This separation occurred during Late Eocene (Goslin and Patriat 1984) or Late Cretaceous (Mutter and Cande 1983) and is related to the Antarctic-Australia breakup.

The northern part of the ridge, namely the Kerguelen-Heard Plateau (KHP), is the shallowest part, less than 700 m deep (Fig. 2). The only islands of the ridge are the Heard Island and the Kerguelen Archipelago. They are of volcanic origin and were built during the span of the late Eocene to the Quaternary (Giret 1983). The southwestern flank of the plateau exhibits a gentle slope without any preferential structural direction, whereas the northeastern edge displays a characteristic rift morphology, with a steep and straight escarpment due to normal faulting and associated volcanic relief. The tectonic events are related to the Kerguelen Plateau-Broken Ridge breakup (Wicquart and Fröhlich 1983).

Kerguelen and Heard islands are separated by a sedimentary basin 2,000 to 2,500 m thick in fill. This was first investigated during cruises of the R.V. Gallieni (Schlich and others 1971) and the R.V. Eltanin (Houtz and others 1977), and some seismic profiles were recorded in the southern part of the Kerguelen Plateau (near Heard island) during the Rig Seismic cruise 2 (Ramsay and others 1986a, 1986b). The most complete data set was collected during cruise MD26 of the R.V. Marion Dufresne and consists of ten multichannel (24) seismic reflection profiles, 300-500 km long and 50 km apart (Guglielmi 1982, Wicquart 1983, Wicquart and Fröhlich 1986, Munschy and Schlich 1987). Two main seismic units, separated by a strong and widespread reflector, the “Acoustic Discordance” (A.D.) (reflectors A, Houtz and others 1977), were recognized on the proceeded seismic records. The lower unit, resting upon the acoustic basement, is about 0.8 to 1.1 s thick (double time) and comprises parallel, subhorizontal reflectors. Within the lower unit, Wicquart (1983) recognized an upper subunit, 200 to 300 m thick that is acoustically more transparent, bounded downwards by a strongly reflective unconformity: the Intermediate Reflector (I.R.) (Ramsay and others 1986b) or reflector H1 of Munschy and Schlich (1987). Both the I.R. and the A.D. crop out in the northeast (Fig. 3). The upper unit, above the A.D., has an av-
average thickness of about 1 s (dt) but thins northeastwards to expose the A.D.; it is characterized by numerous and undulating reflectors. Just above the A.D. the upper unit shows a lenticular configuration. The undulating pattern is caused by the occurrence of these lenses. At the top, a discordant subunit fills the depressions formed by the undulating reflectors, to produce a near-planar sea floor.

This upper unit was drilled in 1988 during Leg 119 at site 736 and 737. As previously predicted (Wicquart 1983, Wicquart and Fröhlich 1986), this unit consists of Middle Miocene to Quaternary diatom-rich calcareous oozes that turn upwards to diatom oozes (Barron and others 1988). A thin, but widespread, glauconitic layer occurs at the top of the sedimentary sequence (Wicquart and Fröhlich 1986, Odin and Fröhlich 1988). The A.D. was reached at site 737, but only the upper part of the lower unit, Middle Eocene to lowermost Miocene, was drilled. At site 737, the A.D. coincides with a hiatus of 8 M.a. (Barron and others 1988). The I.R. was not reached, and the main part of the lower unit has not been sampled. In the southern Kerguelen Plateau, basal sediments, Cretaceous and Paleogene in age, were recovered during Leg 119 (Barron and others 1988) and Leg 120 (Leg 120 Shipboard Scientific Party 1988). Basement was also sampled in the southern Kerguelen Plateau during cruise MD48 of Marion Dufresne (Leclaire and others 1987).

The northern Kerguelen Plateau (Kerguelen-Heard Plateau), bearing the Kerguelen and Heard islands, is shallower and considering the tectonics, is quite distinguished from the southern Plateau. Thus it probably exhibits a quite different geological evolution. Sampling, with piston-cores and dredging, of an Upper Cretaceous and Tertiary sedimentary sequence (Fröhlich and others 1983) during cruises MD21 (1980), MD26 (1981), and especially MD35 (1983) (Fröhlich 1983, Fröhlich and others 1983) of R.V. Marion Dufresne, give some data about the undrilled lower sedimentary unit of the Kerguelen-Heard Plateau, and also about the geological evolution of this northern part of the Kerguelen Plateau. This is the subject of this article.

Sampling

More than 60 piston-cores and 3 dredge hauls are taken by R.V. Marion Dufresne within 4 distinct areas on the northern Kerguelen Plateau (Fig. 1). The faulted northeastern flank of the plateau, where outcrops of the lower unit were expected according to seismic data, have been investigated in detail. Preliminary sedimentological and stratigraphical studies were performed aboard the ship. A detailed bathymetric map of the northeastern flank of the Kerguelen-Heard Plateau (Fig. 2) was established before sampling. This