Submarine Phosphorite Deposits of Chatham Rise
Near New Zealand—Summary

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INTRODUCTION

Phosphate nodules occur several places on the Chatham Rise, a broad submarine platform about 130 km wide and 960 km long, which extends eastward from Banks Peninsula on the east coast of the South Island of New Zealand to slightly beyond the Chatham Islands. The platform of Chatham Rise is outlined by the 500-m isobath (Fig. 1). Average elevation of the platform is approximately 400 m below sea level. The rise is terminated abruptly on the north where the seafloor descends steeply into the Hikurangi Trench; the southern and eastern slopes are more gentle. Pukaki Gap, a narrow saddle with a maximum known depth of 575 m, separates the rise from the shelf at Banks Peninsula; the Pegasus submarine canyon cuts the island shelf and trends northward into the south end of the Hikurangi Trench.

Several shallow banks are present on the Chatham Rise. In the western section, Mernoo, Reserve, and Veryan Banks shoal at 51, 220, and 154 m, respectively. Fleming and Reed (1951) reported channels and ridges on Mernoo Bank which they suggested indicate a period of subaerial erosion. Steep slopes, anomalous geographic location, and volcanic-rock recoveries suggest that Veryan Bank is of volcanic origin, possibly a guyot. Matheson Bank, in the central region of the rise, extends upward in staircase fashion to a depth of 219 m.

On a smaller scale, the bottom topography is characterized by rather smooth, gently sloping profiles and a few jagged profiles of up to 10 m of relief.

PHOSPHORITE OCCURRENCE

Sampling of Chatham Rise sediments in 1950 first revealed phosphorite on the central region of the rise (Reed and Hornibrook, 1952). In describing the phosphorite material of one sample, Reed observed that the nodules consist of highly concentrated Globigerina ooze and contain glauconite and some quartz and schist fragments. The degree of phosphatization varied in the different nodules examined; in some it was complete but, in the majority, large unaltered cores remained. The main phosphate mineral was collophane.

Norris (1964) stated that all the nodules he examined consisted of phosphatized Miocene foraminiferal ooze. Two types of nodules were observed: (1) an abundant, irregular, slabby type with a dull black crust showing a greenish cast enclosing a buff to pale brown calcareous material; and (2) a less abundant type that has a mottled brown surface and is mollusk bored. The blackish crust was found to be mainly glauconite. In considering economic aspects of Chatham Rise, Norris drew attention to the very widespread occurrence of phosphorite of reasonable grade, the very considerable amount of associated calcium carbonate, and the high reactivity of the glauconite in terms of potash release. Summerhayes (1967, p. 275) speculated that 90 million tons of nodules could be present in one relatively small area and considered the economics of recovering materials from the rise for fertilizer use.

The first economic investigation of the phosphate deposits was undertaken in 1967–70 by the Oceanic Division of Global Marine Inc. About 300 bottom samples were dredged from 289 m minimum to 468 m maximum depth. Both frequency of phosphorite occurrence and reserves are concentrated at around 390–400 m depth. Samples were assessed for phosphate content and size distribution, and were analyzed for K, F, U, V, Se, and other trace elements.

ORIGIN OF PHOSPHATE

Several hypotheses have been advanced to account for the origin of the Chatham Rise phosphorite nodules. Reed and Hornibrook (1952) suggested that the Chatham Rise deposits were derived from Miocene sediments (mainly Globigerina ooze). During deposition or immediately following the post-Miocene uplift responsible for the formation of the rise, physicochemical and biological conditions were altered, bringing about saturation or supersaturation with respect to phosphate. This provided a favorable phosphatization.