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A Re-Evaluation of Cobalt-Rich Crust Abundance on the Pacific Seamounts

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ABSTRACT

Cobalt-rich crusts on seamounts have been considered a potential mineral resource for the 21st century, and mining programs have been assessed in Japan during recent years. The crust distribution characteristics are not yet clearly known, although the United States, Germany, France and Japan have been conducting its exploration. So far the potential reserve of the crusts is estimated on the basis of their exposed surface coverage on the sea floor. During the research vessel Hakurei-maru No. 2 Survey Cruise in 1991, gravity corings of cobalt-rich manganese crusts were tried at three seamounts near Marcus Island in the Pacific Ocean. The results show the existence of a significant amount of buried cobalt-rich manganese crusts beneath calcareous sediments at the depth of 1,500 to 2,500 m. Based on these results and the associated data, a preliminary re-evaluation of cobalt-rich crust abundance on seamounts was carried out. The re-evaluation concludes that there is a drastic change in the amount of the crust reserve.

INTRODUCTION

Cobalt-rich crusts have become a subject of special interest in recent years. They are expected to be potential resources of cobalt, nickel and platinum in the 21st century (Halbach, 1982; Cronan, 1984; Manheim, 1986).

The crusts which include considerable percentage of cobalt have been observed at depths between 800 and 2,500 m, covering the island slopes, the seamounts and the guyots in the Pacific Ocean. The thickness of crust layer ranges from less than 1 cm to more than 10 cm. Their substrates are basalt, hyaloclastite, limestone, etc. In addition to these geological distribution characteristics, more detailed information in typical areas has also been reported (Halbach et al., 1982; Hein et al., 1985a; Hein et al., 1985b; Pichocki and Hoffert, 1987; Misawa et al., 1987; Ishikawa et al., 1989; Cronan et al., 1991).

Based on these results, resource potential reserve of cobalt-rich crusts has been estimated by Clark et al. (1984) and the Hawaii Department of Planning and Economic Development (1987). But they have considered only exposed surface coverage in the estimations. If shallow-buried crusts are confirmed, a drastic change in the estimates can be expected. Coverage is defined as a portion covered with cobalt-rich crusts in an area, and it includes shallow-buried crusts in the paper. Exposed surface coverage is also defined as a visually observed surface portion covered with crusts in an area.

Buried crusts beneath calcareous sediments have been found on two seamounts near Marcus Island (Fig. 1) during the Research Vessel (R/V) Hakurei-maru No. 2 Survey Cruise in 1991. Based on the visual and acoustic data associated with these buried crusts, the cobalt-rich crust abundance on seamounts is re-evaluated in the paper.

BURIED CRUSTS

A large diameter gravity corer (LC), on which a one-shot still camera was installed as a trigger weight (Fig. 2), was used for the sampling of buried cobalt-rich crusts. The observed results taken by the pilot camera and the sketch of the sampled core are summarized in Fig. 3. The coring procedure and the results were reported in detail by Yamazaki et al. (1993).

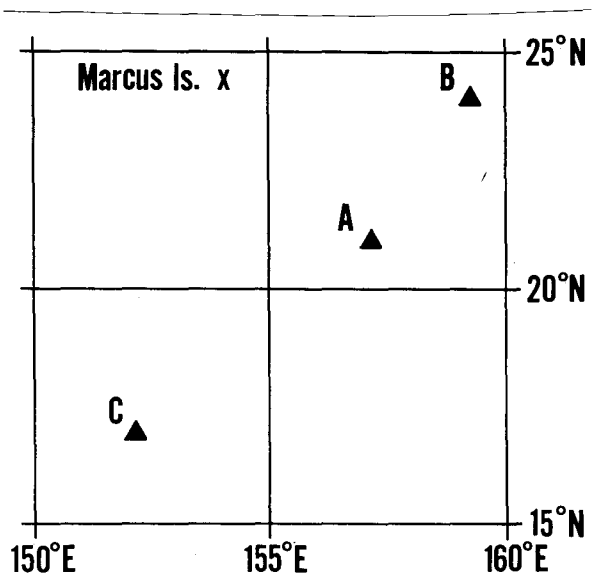

Fig. 1 Locations of Seamounts A, B and C

Because the corer's penetrations into the crusts were insufficient and the sampled calcareous sediments were partially washed away during the recovering operation, the cored columns are incomplete in some cases. Hence, the depth of burial and the thickness of the crust layer, which are estimated from the core sample, may be underestimated. But it is clear from the survey that a significant amount of crust layer exists in the areas where the exposed surface coverage ranges from 0 to about 10% and the depth of burial of the crust varies from 5 to about 165 cm. Therefore, in these cases of buried crust layer, the coverage used for the estimation of resource potential should be considered to be 100%.

ORDINARY METHOD OF RESOURCE ESTIMATION

Visual Observation

The exposed surface coverage was determined by the visual

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KEY WORDS: Cobalt-rich crusts, seamounts, resource potential reserve, buried crusts.