

Resource Potential of Hydrothermal Activity on the East Pacific Rise (8°N - 14°N)

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ABSTRACT

Investigation of hydrothermal ore deposits on the East Pacific Rise (EPR) and on its off-axis volcanoes was carried out from 1985 to 1994 by the R/V Hakurui-maru No.2. More than one and a-half hundred hydrothermal activity sites were observed in the axial rift and on the off-axis volcanoes along the courses of the investigation. The hydrothermal sites were clustered between 12°47' N and 12°51' N, and between 11°20' N and 11°36' N. Though some percentages of the sites were concentrated on the top of ridge and in the spreading center of the rift, the off-axis volcanoes are considered as the most important area in the EPR from the view point of resource potential.

KEY WORDS: hydrothermal activity, East Pacific Rise, off-axis volcanoes, hydrothermal ore deposits, resource potential

INTRODUCTION

In 1979, the first active hydrothermal site in the open ocean with massive sulfide ores and vent biological colony was found at 21° N in the East Pacific Rise (EPR) by the US and French group (Francherau et al., 1979; Spiess et al., 1980; Hekinian et al., 1980).

Japanese economy demands great imports of minerals from foreign countries. Massive sulfide ores produced by hydrothermal activity was considered to have a potential of future mineral resources. The resource potential investigation of hydrothermal ore deposits in Japan was started from 1985 in the EPR using the R/V Hakurui-maru No.2 by the Deep Ocean Resources Development Co., Ltd. (DORD). DORD was trusted to conduct the investigation by the Metal Mining Agency of Japan which was commissioned to plan the investigation from the Agency of Natural Resources and Energy of the Ministry of International Trade and Industry.

Block surveys in the axial rift of the EPR as well as some off-axis volcanoes between 8° N and 14° N were carried out from north to south by ten cruises from 1985 to 1994. Systematic geophysical surveys such as bathymetry, magnetics, and side-scan sonar survey in each block were followed by water sampling. Several sites were selected for seafloor observation by the geophysical and chemical data. Seafloor observation was conducted by a deep-towed camera system (Finder TV camera mounted

Deep-sea Camera system: FDC) to find ore indications, which were identified by seafloor color anomaly, biological communities and water temperature anomaly. A hydraulic grab sampler (Finder TV camera mounted Power Grab: FPG), a gravity corer (GC), a large-diameter gravity corer (LC), and a chain bucket dredger (CB) were used to confirm the presence of sulfides among the ore indications found by the FDC. The confirmed site is identified as the ore deposit.

This paper is described on the summary of the investigations started from 1985. In the paper, the general geological characteristics of hydrothermal activity in the EPR are summarized and the importance of the off-axis volcanoes from the view point of resource potential is presented. A detailed survey result on an off-axis volcano is introduced as an example.

PREVIOUS WORK

Many remarkable investigations have been conducted between 8° N and 14° N in the EPR. Earlier reports of hydrothermal sulfides around 12°50' N were provided by Hekinian et al. (1983), and Francheteau and Ballard (1983). Submersible study was reported by Ballard et al. (1984). Mapping efforts were taken place by Choukroune et al. (1985) and Gente et al. (1986). The previous investigations in the area are summarized in Table 1. Covered area and type of the work are notified in the table.

Many studies on the off-axis volcanoes are presented (Fouquet et al., 1988; Fournari et al., 1988; Haymon, 1989). Resource potential is discussed in only few papers (Hekinian and Fouquet, 1985; Hekinian et al., 1989).

GEOLOGICAL SETTING

Overview

The investigated area covered 65,000 km² of the EPR axial rift, which is located between the Pacific plate to the west and Cocos plate to the east. The axial rift is 4 to 15 km in width, 2,500 to 2,800 m deep. Overview of the area is shown in Fig. 1. The rift axis is expressed by lines in the figure. The area included most of the ridge segments located among the Orozco Fracture Zone (OFZ), the Clipperton Fracture Zone (CFZ), and the Siqueiros Fracture Zone (SFZ).

Geological setting in the area was described in detail in a series of studies