Proceedings of The Eighth (2009) ISOPE Ocean Mining Symposium
Chennai, India, September 20-24, 2009

ISBN 978-1-880653-75-3; ISSN 1946-0066

Biomass Quantification of Ecosystems around Seafloor Massive Sulfide Deposit with Image Analysis

Naoki Nakatani, Masahito Ikemoto, Rei Arai, Tetsuo Yamazaki
Osaka Prefecture University
Sakai, Japan

ABSTRACT

Transition ecosystem area from chemosynthetic community at active hydrothermal venting site to normal seafloor one is the expected place of mining seafloor massive sulfides. No data is available for the distribution characteristics of ecosystems in the transition area. Using visual seafloor observation data obtained by a towed camera system, a preliminary approach to quantify the distribution characteristics of chemosynthetic and transition ecosystems is presented. An example calculation result is introduced.

KEY WORDS: bacteria mat; chemosynthesis; environmental assessment; hydrothermal vent; RGB intensity; seafloor massive sulfide; seafloor observation.

INTRODUCTION

Kuroko-type seafloor massive sulfides (SMS) in the western Pacific have received much attention as resources for gold, silver, copper, zinc, and lead for the commercial mining by private companies (http://www.nautilusminerals.com; http://www.neptuneminerals.com). Since the first discovery in the Okinawa Trough near Japan (Halbach et al, 1989), SMS have been found in the back-arc basin and on oceanic island-arc areas at 1 to 2 km of water depths. The typical representatives found are on the Izu-Ogasawara Arc near Japan (Iizasa et al. 1999), in the Lau Basin and the North Fiji Basin near Fiji (Fouquet et al., 1991; Bendel et al, 1993), and in the East Manus Basin near Papua New Guinea (Kia and Lasark, 1999). The high gold, silver, and copper contents in the East Manus Basin have increased the likelihood that mining would be profitable, and a pioneer commercial mining operation with 6,000 t/d in production scale was scheduled to start in a few years (http://www.nautilusminerals.com).

However, the baseline data provided in the environmental impact statement (EIS) presented to Papua New Guinea Government (http://www.nautilusminerals.com) was insufficient for quantifying the distribution characteristics of chemosynthetic and transition ecosystems. Lack of quantitative method to observe and analyze the distribution characteristic is one of the reasons. The approaches they took for the EIS were conventional style scientific observations conducted by ROVs, and many biological samplings for megabenthos such as shrimps, crabs, shellfishes, and tubeworms. The analyses were also scientific style classification, distribution mapping, genome analysis, etc.

In the previous study (Yamazaki et al, 2009), the same type image analysis has been introduced. A preliminary quantification method of the distribution characteristics, on the basis of the study, is introduced in the present study. An example calculation result is presented. Importance of this type approach for the environmental assessment of mining SMS is mentioned.

EXPECTED MINING AND ENVIRONMENTAL IMPACTS

Expected Mining Site of Seafloor Massive Sulfides

The mining of SMS is expected not to be taken place at active hydrothermal venting sites. The inactive dead ore bodies are very much attractive targets for the aged accumulation of sulfides than the active younger ones.

Keeping safe distance away from high temperature hot water for protecting the mining hardware is the other reason to select inactive ore bodies as the mining targets. Not only the active hydrothermal venting sites but also the sites where small chemosynthetic communities are present are dangerous zones for the seafloor miner. The vents and the sites have active hydrothermal flux routes through fissures and/or faults. High temperature water supply through the routes may be increased and/or induced with the excavation and removal of sulfide ore body. The miner's computer-based control and pressure-tight mechanisms are very weak against the high temperature even in the range of 40 - 50 ºC and higher. Avoiding direct contact with chemosynthetic communities is necessary for the safer mining operation. Therefore, the inactive ore bodies should be the targets of mining from this viewpoint, too.

Because of the geological formation mechanism of SMS, the attractive targets easy for finding out and mining are located adjacent to the active sites as illustrated in Fig. 1. Transition ecosystem area from chemosynthetic community to normal seafloor one is the expected place of the mining operation.