

## **Preliminary Feasibility Study for the Commercial Development of Seafloor Hydrothermal Deposits in the EEZ of the Kingdom of Tonga**

*Se-Hun Park, Hee-Cheol Yang, Kyeong-Yong Lee, and Jai-Woon Moon*

Korea Ocean Research & Development Institute

Ansan, Korea

### **ABSTRACT**

Hydrothermal deposits on deep-sea floor are expected to be potential metal resources for the future demands. Recently, Korea was granted prospecting licences for the exclusive economic zone (EEZ) of the Kingdom of Tonga and is undertaking exploration for hydrothermal metal deposits on the deepsea floor. The Korean Deep Seabed Mining Group (KDSMG), which consists of four Korean companies involved in the marine technologies, oil and gas shipping, and smelter industries, has conducted research to evaluate the area's resource potential in cooperation with the Ministry of Land, Transport and Maritime Affairs (MLTM) of Korea.

This paper presents results of a feasibility study for the commercial development of seafloor hydrothermal deposits, and some exploration results performed on Tonga Arc area with evidence for newly discovered hydrothermal vents.

**KEYWORDS:** Seafloor hydrothermal deposits, Commercial development, Exploration, Feasibility study, Exclusive economic zone of the Kingdom of Tonga

### **INTRODUCTION**

Seafloor hydrothermal deposits have the potential to meet future metal demands for gold (Au), silver (Ag), copper (Cu), zinc (Zn), and lead (Pb) (Haymon and Kastner, 1981; Sillitoe, 1982; Hekinian and Bideau, 1985; Batiza, 1985; Scott, 1985; Iizasa et al., 1999). Since the late 1980s, hydrothermal deposits have been discovered in back-arc basins and oceanic island-arc areas (Halbach et al., 1989; Eulcia and Escartn, 1999). Hydrothermal vent in back-arc spreading center are known from the Mariana Trough, Andaman Sea, Manus Basin, Woodlark Basin, North Fiji Basin and Lau Basin (Malahoff, 1981; Rona, 1985; Fouquet et al., 1991; Bendel et al., 1993; Sarata and Matsumoto, 1999; Kia and Lasark, 1999). Polymetallic sulfide deposits with similar origins have been found on land in Chile, Peru, Japan, etc (Maeda, 1976). The high Au and Ag contents of seafloor hydrothermal deposits have spurred interest in their commercial development, and several national and private companies have undertaken mining feasibility study (Malnic, 2001).

Recently, the Southwest Pacific was especially targeted, it was known that commercial sulfide projects would make a progress by

a private company (Fig. 1). In 2008, Nautilus Minerals Inc. carried out a comprehensive technical and economical pre-feasibility study of the Solwara 1 hydrothermal deposits in Papua New Guinea, the Southwest Pacific. Their scoping study suggested that deep-sea hydrothermal deposits could be economically viable.

A study on the exploitation of hydrothermal deposits of offshore New Zealand prepared for Neptune Minerals evaluated alternative technologies for seafloor mining, ore lifting, dewatering, and surface offtake. A key aspect of this study was examination of the use of existing marine technologies currently deployed in the oil and gas, marine diamond, and offshore dredging industries.

Korea has carried out eight years of government-funded studies on the economic feasibility of mining seafloor hydrothermal deposits (Fig. 2). Korea is now a leading explorer and developer of seafloor hydrothermal deposits, and on 26 March 2008, Korea acquired prospecting licenses for the exclusive economic zone (EEZ) of the Kingdom of Tonga (Fig. 3). Korea is the only country to have such a leasing position in the South Pacific.

This paper outlines a preliminary feasibility study on the commercial development of seafloor hydrothermal deposits and presents the results of laboratory tests and technical analysis conducted for five newly discovered hydrothermal areas.

### **Licensing Regime in the Kingdom of Tonga**

The Kingdom of Tonga is a small island group in the South Pacific. Korea's prospecting license is for an area approximately 3,500 km east of Australia. Offshore exploration licensing in the Kingdom of Tonga, as prescribed in the Mining Act of 1949, has been modified to take into account oceanographic and environmental conditions (<http://legislation.to>). Three types of land tenure are available: Prospector License, Exploration License, and Mining Lease. In addition, the state may also issue a Prospector's Right, which allows a prospector to enter, for prospecting purposes, areas that are not already covered by an Exploration License or Mining Lease and to proceed in identifying areas suitable for application for an Exploration License.

A key justification of the use of Prospector's Rights involves