

海洋地殻構造と地殻内熱水循環

川田佳史* 島伸和** 沖野郷子***

Review of Oceanic Crustal Structure and Seafloor Hydrothermal Circulation

Yoshifumi KAWADA*, Nobukazu SEAMA** and Kyoko OKINO***

Abstract

Seafloor hydrothermal systems are important in relation to global heat and chemical fluxes as well as the distribution of microbial communities within the oceanic crust. From a global context, low-temperature hydrothermal systems located far from the ridge axes are of great importance, because of their large covered area. Our current understandings of seafloor hydrothermal systems come mainly from high-temperature systems on fast-spreading ridges, which are assumed to be typical. Recently, observations have been conducted on high-temperature systems at slow- and ultraslow-spreading ridges. In addition, low-temperature hydrothermal systems far from the ridge axis have been investigated. These findings enable us to obtain a new view of seafloor hydrothermal systems.

This paper summarizes recent observational and modeling studies on low-temperature and high-temperature hydrothermal systems. First, we briefly plot seafloor hydrothermal systems and present some historical remarks. Then, we review the most important properties of the crustal structure such as the distribution of heat sources and permeability, which control hydrothermal circulation. These are described in terms of spreading rate. For instance, a hydrothermal system on a fast-spreading ridge is hosted by a quasi-steady magma chamber under the axis, and a system on an ultraslow-spreading ridges is hosted by long-lived tectonic faults at the axis. We also introduce recent numerical simulations both for low-temperature and high-temperature systems including the authors' studies. The main topic of current research is the pattern of circulation of both systems. High-temperature systems are controlled by the phase separation of seawater and the spatial heterogeneities of heat sources. Low-temperature systems instead are mainly affected by the local permeability structure instead. The presence of seamounts is thought to account for heat transport in the oceanic crust.

Key words : hydrothermal circulation, oceanic crust, crustal structure, permeability, numerical modeling

キーワード : 熱水循環, 海洋地殻, 地殻構造, 浸透率, 数値モデリング

* 海洋研究開発機構地球内部ダイナミクス領域

** 神戸大学内海域環境教育研究センター

*** 東京大学海洋研究所

* Institute for Research on Earth Evolution, Japan Agency for Marine-Earth Science and Technology

** Research Center for Inland Seas, Kobe University

*** Ocean Research Institute, The University of Tokyo