Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

SIT038-01 Room: 202 Time: May 26 13:45-13:57

Numerical simulations of hydrothermal circulation in a three-dimensional seamount complex

yoshifumi kawada[1*]

[1]JAMSTEC-IFREE

Oceanic crust experiences high-temperature hydrothermal circulation near mid-ocean ridges and low-temperature hydrothermal circulation away from ridges. In a traditional view, hydrothermal circulation ceases when the age of oceanic crust becomes 65 Myr (e.g. Stein and Stein, 1992). However, careful analyses of heat flow data have revealed the existence of weak but extensive hydrothermal circulation on oceanic crusts older than 65 Myr (e.g. Von Herzen, 2005).

Hydrothermal circulation in old oceanic crusts occurs in various ways. In most places, hydrothermal flow may circulate within the uppermost part of basaltic layer beneath sediment (Fisher, 1998). The existence of fissures or faults cutting sediment layer results in vigorous hydrothermal circulation by connecting subsurface areas and the ocean. In addition, seamounts penetrating sediment layer is important for understanding hydrothermal circulation in old oceanic crusts (Fisher et al., 2003), because they are connected hydrologically to work as a permeable network.

We perform numerical calculations of hydrothermal circulation within and around closely located seamounts penetrating an impermeable sediment layer, the structure of which is commonly observed at, for example, the Eastern flank of the Juan de Fuca Ridge (Spinelli and Fisher, 2003), and the petit-spot volcanoes found at seaward areas of the Japan Trench (Hirano et al., 2006). We model this setting as a two- or three-dimensional porous medium with different permeability depending upon rock types. The size of seamounts and crustal heat flow are treated as parameters for simplicity. In addition, being inspired by Fujiwara et al. (2006,2007) who observed a subsurface volcanic sill under the petit-spot volcanoes, we place an impermeable structure between the seamounts in some calculations to understand hydrological effects of the structure on the fluid flow among the seamounts.

The results are summarized as below:
1) Flow in a single seamount is limited within it. Small seamounts (radius < 1km) show almost no flow.
2) Flow in a pair seamount is connected hydrologically each other. One seamount recharges seawater, and the other discharges it. Even small seamounts work as a fluid passage, if flow is supplied by the other seamount.
3) The existence of impermeable structure between a seamount pair decreases the strength of circulation. On the other hand, flow still occurs if permeable region is remained around them.
We will discuss the flow structure depending upon the size of seamounts and the crustal heat flow in detail.

Keywords: hydrothermal circulation, seamount, petit-spot, numerical simulation, permeable flow, oceanic crust