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

MIS010-02 Room: 303 Time: May 23 09:15-09:30

Deep carbon cycle unraveled by deep ocean drilling

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Carbon recycling and flux in the Earth system is one of the important problems, and has been controversial for years (e.g., Marty & Tolstikhin, 1998). Carbon dioxide is emitted from mid-ocean ridges (MOR), arcs and plumes through degassing of mantle-derived magmas (e.g., 2 x 10^{12}mol/year for each setting; Marty & Tolstikhin, 1998). Distribution of carbon within the oceanic lithosphere may give us a clue to our quantitative understanding of the behavior of carbon within the Earth system. Magmas from MOR and some plumes comprise the oceanic lithosphere, from which we can know the amount of carbon emission from undegassed volcanics (e.g., popping MORB glasses; Sarda & Graham, 1990; Saal et al., 2002; Cartigny et al., 2008). A part of carbon stored in the ocean-floor rocks is relayed via decarbonation metamorphic reaction from the subducted slab to the mantle wedge, inducing arc magmatism. The other part of carbon survived from decarbonation will sink into deeper parts of the mantle through subduction, and may ultimately contribute to deep melting for plume and MOR magmatism (e.g., Dasgupta & Hirschman, 2006).
Ocean-floor drilling, especially ultra-deep drilling like 21st-Century Mohole in IODP, will give us sound information about the distribution and way of storage of carbon (especially carbonate) within the oceanic lithosphere. Freshest peridotites related to MORB generation are expected to be recovered from the bottom of the Mohole; they will address to the question where and how much carbon is stored within the abyssal mantle. This possibly gives constraints to the initial amount of carbon in MORB, which has been in controversy (e.g., Saal et al., 2002; Cartigny et al., 2008). The deep ocean drilling is also indispensable to our successful formulation of carbon-related metamorphic reactions (e.g., Kerrick & Connolly, 1998; Sadofsky & Bebout, 2003; Gorman et al., 2006) within the down-going slab, which enables us to sort the total oceanic lithospheric carbon into the sinking portion and subtracting-to-wedge portion.
The Mohole and other deep ocean-floor drilling projects are highly important to solve the global carbon flux problem, and I encourage many people who are interested in this issue to join us to successfully conduct the Mohole.

Keywords: deep ocean drilling, Mohole, carbon flux, carbon recycling