Press Releases

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JAMSTEC
Hokkaido University
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First Successful Retrieval of Primitive Layered Gabbros from Lower Crust of East Pacific Rise (Mid-Ocean Ridge)

1. Overview

The International Ocean Discovery Program (IODP) Expedition 345 was conducted by the US drilling vessel (DV) JOIDES Resolution with co-chief scientists Katheryn M. Gillis of the University of Victoria and Jonathan E. Snow of the University of Houston (previously reported on December 11, 2012): core samples of lower oceanic crust from the Hess Deep rift (Figure 1: map) were taken from the East Pacific mid-ocean rise near the Galápagos Islands by research scientist Natsue Abe of the Institute for Research on Earth Evolution (IFREE) of the Japan Agency for Marine-Earth Science and Technology (JAMSTEC; Asahiko Taira, President); associate professors Jinichiro Maeda and Marie Python of Hokkaido University; assistant professor Takashi Hoshide of Akita University; postdoctoral researcher Sumiaki Machi and PhD student Norikatsu Akizawa of Kanazawa University; and associate professor Toshio Nozaka of Okayama University, and 21 other on-board scientists.

From deep below the ocean floor, the expedition successfully collected the first ever samples of layered gabbros, which are thought to make up the lowermost oceanic crust. Investigation of the mineral assemblages and whole-rock chemical composition of these samples showed that they were precipitated by the mixing of primary magma formed in the upper oceanic mantle with multiple differentiated magmas from the lowermost crust; this indicates that mixing of ascending magmas occurs within the lower oceanic crust, which is composed of layered gabbros.

The research findings provide invaluable insight into the structural and metamorphic processes of oceanic crust, which covers over 60% of the earth’s surface; by recovering so called ‘missing rock’ samples that provide clues to the chemical composition of the entire oceanic crust, we have obtained vital information for considering geochemical cycles and migration of materials deep within the earth. This new knowledge is also expected to shed light on the internal dynamics (activity) of the earth and lead to a better understanding of the mechanisms behind earthquakes, volcanic activity, and other events along plate boundaries.

The findings were published in the January 9, 2014 (JST) digital issue of *Nature*.

Title : Primitive layered gabbros from fast-spreading lower oceanic crust

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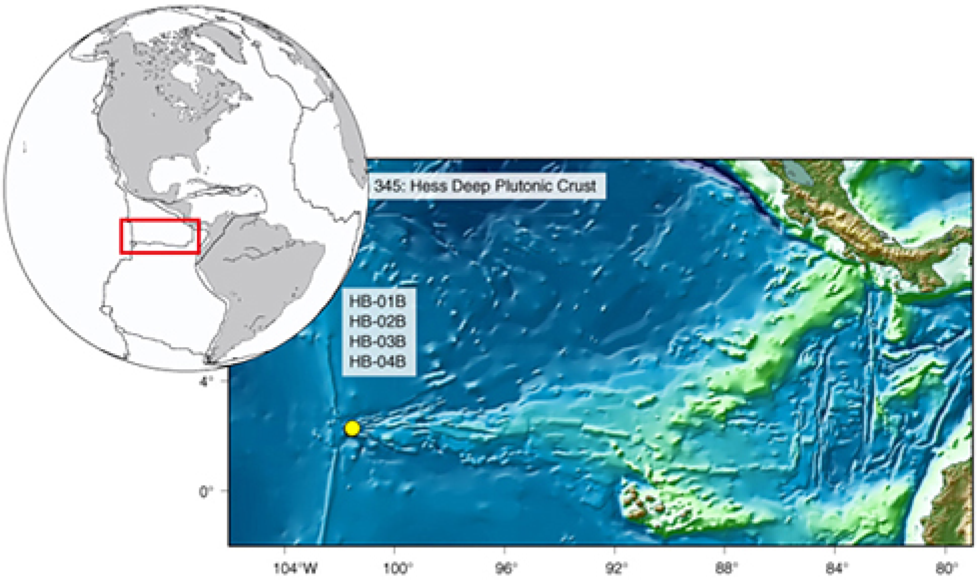

Figure 1: A map showing the expedition drill site and surrounding area. The drill site is marked by the yellow circle.

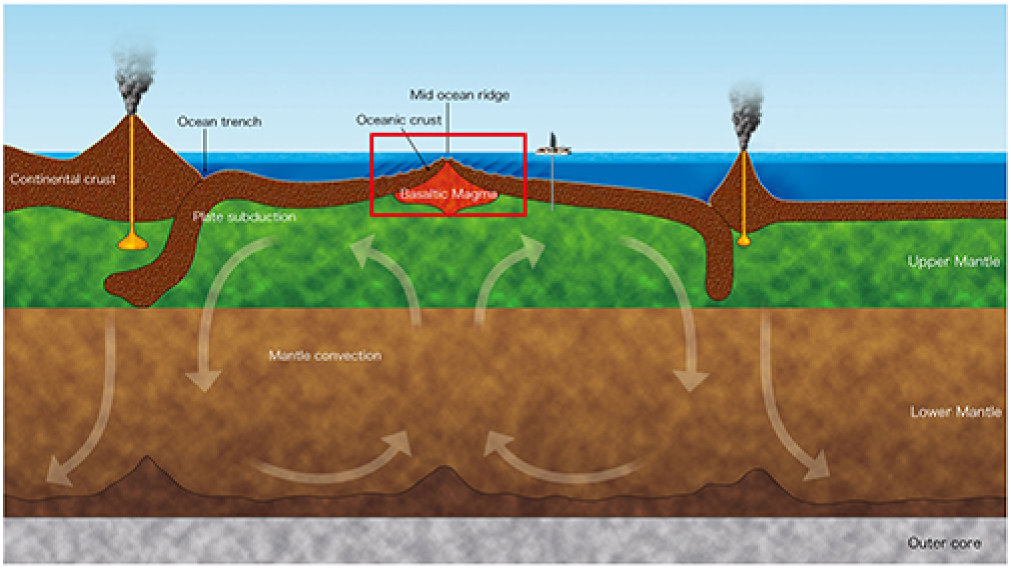

Figure 2: A schematic cross-section of the inner earth structure. The dark brown areas are the plates, which include the crust. The light green, light brown, and dark brown areas below represent the upper mantle, lower mantle, and outer core, respectively. The red square is where the oceanic crust forms along a mid-ocean ridge and marks where drilling was conducted during the expedition. Drilling of the mantle by DV Chikyu is planned for the area outside the red square.

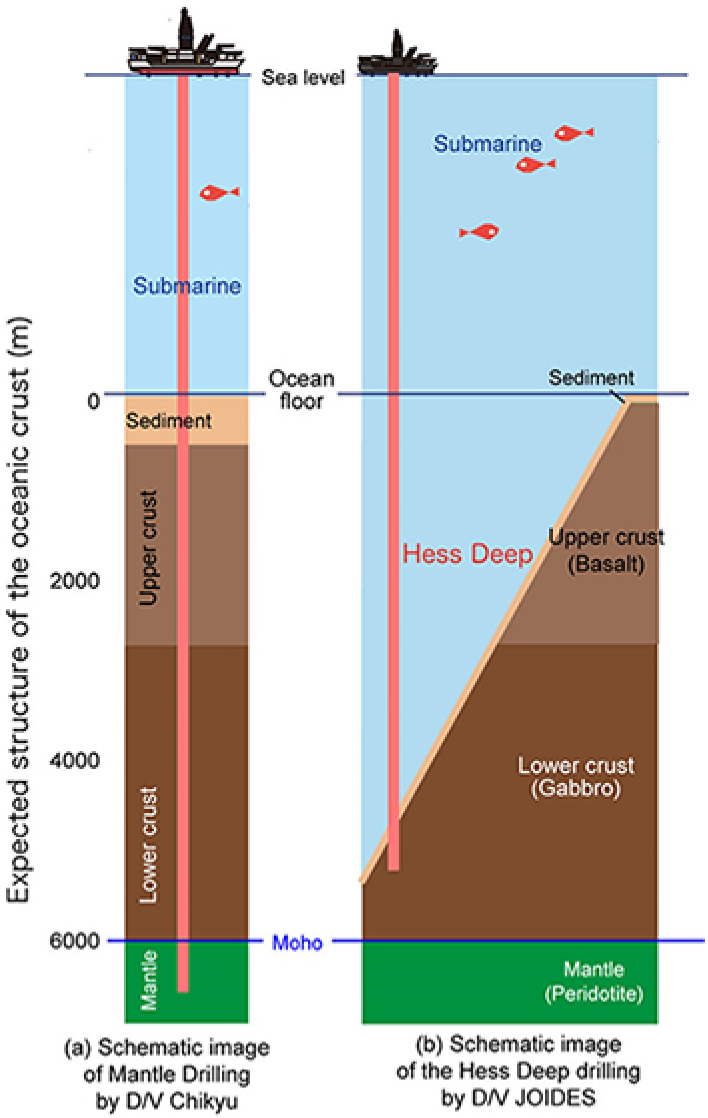

Figure 3: General structure of oceanic crust (a), and that seen at the Hess Deep rift (b). The Hess Deep rift is thought to be a place where cracks have developed and split the ocean floor: rocks that originate from deep within the earth are directly exposed. Lower oceanic crust samples were taken from the base section of a rock face at an ocean depth near 4800 m.

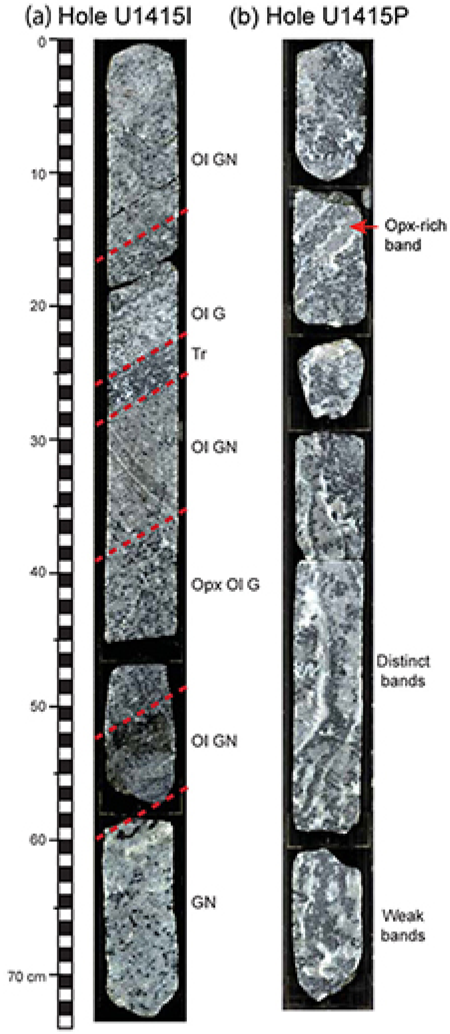

Figure 4: Samples of primitive layered gabbros retrieved during drilling.

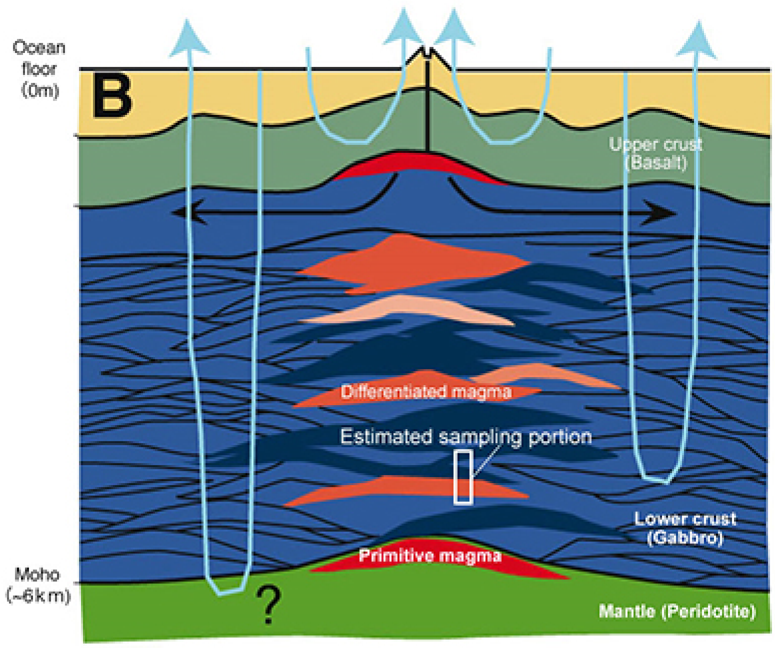

Figure 5: Schematic cross-section of the predicted structure of the area below a mid-ocean ridge. The upper-most mantle is shown at the bottom in green, with liquid magma shown as a red lens-shaped section. In the course of rising and eventually erupting onto the ocean floor, the magma (liquid) is thought to change in chemical composition through the process of crystallization differentiation. The orange to ocher lens-shaped sections represent differentiated magmas. The light and dark blue lens-shaped sections are magmas that have solidified into gabbros.

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