

## Origins of the fluids responsible for deformation of the gabbroic rocks in the medial region of Godzilla Mullion

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Godzilla Mullion, the largest oceanic core complex in the world, occurs in the Parece Vela Basin spreading ridge, the Philippine Sea. Fault-related rocks derived from lithospheric mantle and lower oceanic crust were recovered from the surface of Godzilla Mullion, indicating the existence of a detachment fault at the seafloor surface. Harigane et al. (2008, Tectonophysics) revealed that the shear deformation occurred at the gabbroic rocks accommodated with the hydrothermal alteration. However, origins of the fluids and their proportions to the rocks during the deformation have still remained unsolved. In order to understand the effects of fluids on deformation, we made chemical analysis as well as detailed microstructural observations of amphiboles in the deformed gabbroic rocks sampled from the medial region of Godzilla Mullion (the site KH07-02-D18). Mylonites and ultramylonites are characterized by porphyroclastic textures consisting of plagioclase/clinopyroxene porphyroclasts in a fine-grained plagioclase/clinopyroxene/amphibole matrix. Clinopyroxene and secondary amphibole occur ubiquitously within the mylonites and ultramylonites. Amphiboles are pargasite (i.e. brown hornblende: high-temperature origin) with minor amounts of actinolite (i.e. green hornblende: low-temperature origin) around clinopyroxene grains. The trace element compositions of the clinopyroxene and amphibole in a mylonite sample (KH07-2-D18-1) were determined with LA-ICP-MS at Kanazawa University. Chondrite-normalized rare earth element (REE) pattern of clinopyroxene is characterized by flat heavy-REE (HREE) and light-REE (LREE) depletion with slight negative Eu anomaly. Amphibole grains are classified into three types based on microstructure: (1) Bleb type (brown blebs free of intracrystalline deformation enclosed by the core of clinopyroxene porphyroclasts), (2) Replacement type (brown or pale brown amphibole, with intracrystalline deformation such as undulose extinction and fragmentation, replacing clinopyroxene porphyroclasts along the rim), and (3) Green Hornblende type (GHb type; greenish or pale green hornblende, free of deformation, replacing brown hornblende.) The Bleb type amphibole is similar in chondrite-normalized REE pattern to clinopyroxene, showing their chemical equilibration. This, coupled with its occurrence, indicates that the fluids for the formation of Bleb type is of magmatic origin as clinopyroxene was formed from melts. The Replacement type has slight enrichment in LREE with the HREE abundances similar to clinopyroxene. The formation of Replacement type is likely related to syn-deformation retrograde reaction. The GHb type shows slight U-shape REE pattern with positive Eu anomaly, and has much lower HREE abundances than clinopyroxene and other two types. These characteristics indicate a hydrothermal origin for GHb type after deformation. Fluids of several different origins were infiltrated into gabbros during the exhumation of Godzilla Mullion. In particular, infiltration of the fluids during deformation results in the formation of Replacement type amphibole and, therefore, possibly enhances and localizes deformation along the fluid flow.

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