IODP Proposal Cover Sheet

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Godzilla Megamullion Lithosphere Architecture

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Title	The nature of the back-arc basin lower crust and upper mantle at the Godzilla Megamullion
Proponents	Yasuhiko Ohara, Katsuyoshi Michibayashi, Henry J.B. Dick, Jonathan E. Snow, Yumiko Harigane, Shigeaki Ono, Norikatsu Akizawa, Masakazu Fujii, Osamu Ishizuka, Matthew P. Loocke, Tomoaki Morishita, Wendy Nelson, Kyoko Okino, Alessio Sanfilippo, Hiroshi Sato, Kenichiro Tani, Hiroyuki Yamashita
Keywords	back-arc, lithosphere, Godzilla Megamullion, ophiolite
Area	Parece Vela Basin, Philippine Sea

Proponent Information

Proponent	Yasuhiko Ohara
Affiliation	Hydrographic and Oceanographic Department of Japan (also at Japan Agency for Marine-Earth Science and Technology)
Country	Japan

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Abstract

Ocean drilling has long sought to understand the architecture of the ocean crust and processes of its origin in the upper mantle. This is being approached in large part through drilling in tectonic windows and in the development of eventual total crustal penetration. A significant fraction of the ocean floor is created in back-arc basins, where crust and mantle likely differ significantly from that formed at major ocean ridges. This is because water infiltrated as fluid or melt from the subduction zone contributes to magma genesis and mantle rheology. Yet there is not a single long core of back-arc basin lower ocean crust or mantle. Moreover, ophiolites, fossil ocean crust in orogenic mountain belts, are largely attributed to the suprasubduction zone environment. Yet assigning modern analogs to these complexes (arc, back-arc, fore-arc, or deep ocean crust) is hampered by a lack of any direct knowledge of what the differences are between the deep ocean crust and mantle at ocean ridges, and that generated in back-arc basin environments exist. Existing long and short gabbro cores from diverse settings at major mid-ocean ridges, such as Hess Deep, MARK (Mid-Atlantic Ridge at Kane Fracture Zone), Atlantis Massif and Atlantis Bank, will provide a ready basis for comparison to back-arc basin crust and mantle if such material could be obtained.

Godzilla Megamullion is a very large oceanic core complex, located in the extinct Parece Vela Basin in the Philippine Sea, where substantial lower crust and mantle is exposed in the rift-mountains of an extinct spreading center. It is thus arguably the best place in the world to study the architecture of back-arc basin lithosphere. Extensive site survey data for Godzilla Megamullion provides the basis for a full drilling proposal, with complete bathymetric data, extensive bottom sampling, multi-channel seismic profiling, and seismic velocity models.

Here we propose a full-leg riserless drilling program at the Godzilla Megamullion that will provide an excellent opportunity to better understand the architecture of back-arc basin lithosphere. By recovering a substantial section of the igneous lower crust and possibly upper mantle at the Godzilla Megamullion, we will be able to address specific key challenges set out in the IODP Science Plan 2013-2023 (Challenges 8, 9 and 14).

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Scientific Objectives

The objectives are to address the following scientific questions:
• Scientific question 1: How does mature back-arc spreading mantle, as found at the distal end of the Godzilla Megamullion, compare to that found at slow-spreading ridges? Can we see the influence of subduction zone fluids on the mantle-melting regime there?
• Scientific question 2: How does the crustal architecture evolve with changing melt supply rate?
• Scientific question 3: Is the crust formed in a mature back-arc basin directly equivalent to that formed at slow spreading ocean ridges, or does it have unique components not found at the latter, but frequently seen in ophiolitic crustal sections presumed to have formed in an arc-related setting?
• Scientific question 4: How does back-arc basin lower crust compare as source rocks for hydrothermal vents and massive sulphide deposits to those exposed at slow spreading ocean ridges?

Non-standard measurements technology needed to achieve the proposed scientific objectives

None

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Proposed Sites (Total proposed sites: 4; pri: 2; alt: 2; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
GM-01A (Primary)	15.6004 139.0342	4554	20	380	400	To characterize the layer 2-like structure imaged by P-wave velocity model in the distal part of the Godzilla Megamullion.
GM-02A (Primary)	16.3002 139.4175	3817	0	1200	1200	To characterize the shallow high velocity body imaged by P-wave velocity model in the proximal part of the Godzilla Megamullion.
GM-03A (Alternate)	15.6519 139.3009	4756	20	380	400	To characterize the layer 2-like structure imaged by P-wave velocity model in the distal part of the Godzilla Megamullion.
GM-04A (Alternate)	15.8208 138.9235	4537	0	1200	1200	To characterize the shallow high velocity body imaged by P-wave velocity model in the distal part of the Godzilla Megamullion.