IODP Proposal Cover Sheet

☐ New ■ Revised ☐ Addendum

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Title:	**697-Full3: The rear arc: the missing half of the subduction factory**
Proponent(s):	Yoshihiko Tamura, Osamu Ishizuka, James B. Gill, Jocelyn McPhie, Richard Arculus, Cathy J. Busby, Yasufumi Iryu, Toshiya Kanamatsu, Yoshiyuki Kaneda, Katherine Kelly, Shuichi Kodaira, Kathleen M. Marsaglia, Kyoko Okino, Robert J. Stern, Susanne Straub, Narumi Takahashi, Yoshiyuki Tatsumi, Rex N. Taylor, Mikiya Yamashita
Keywords: *(5 or less)*	Intra-oceanic arc; continental crust; crustal evolution; arc rifting; across-arc variation
Area:	Izu-Bonin Arc

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Permission to post abstract on IODP Web site: ■ Yes ☐ No

Abstract: (*400 words or less)*

The spatial and temporal evolution of arc magmas within a single oceanic arc is fundamental to understanding the initiation and evolution of oceanic arcs and the genesis of continental crust, which is one key objective of the IODP ISP. The Izu-Bonin-Mariana arc has been a target for this task for many years, but previous drilling efforts have focused mainly on the IBM forearc, and thus the magmatic evolution of the volcanic front through 50 million years. Rear-arc IBM magmatic history has not been similarly well studied in spite of its importance in mass balance and flux calculations for crustal evolution, in establishing whether and why arc-related crust has inherent chemical asymmetry, in testing models of mantle flow and the history of mantle depletions and enrichments during arc evolution, and in testing models of intra-crustal differentiation. Especially, (1) crust develops that is "continental" in velocity structure and seismically similar beneath both the volcanic front and rear arc but is heterogeneous in chemical composition. (2) Magmas at the volcanic front are rich in fluid-mobile recycled slab components that swamp the mantle yet these magmas are so depleted in mantle-derived fluid-immobile elements that they are dissimilar to "average continental crust" in detail. This is less true in the rear arc where the diminished slab signature and lower degrees of mantle melting create crust that is more typical of the continents and allow the temporal history of the mantle source to be tracked more easily. Furthermore, (3) the crust beneath the rear arc is volumetrically more abundant than beneath the volcanic front. In order to understand the evolution of the whole IBM crust, therefore, we propose to drill the Izu rear-arc region in the west of the modern volcanic front to recover a complete record of rear-arc volcanism from the present back to its likely inception in Early Oligocene or Eocene times. Rear arc drilling is the necessary "Other Half" of subduction factory output and essential to the IBM drilling strategy.

Scientific Objectives: (*250 words or less*)

The primary objective of IBM-3C is to test three pairs of alternative hypotheses about crustal genesis and mantle evolution:

1. Geochemically asymmetric crust, which is most like "average continent" in the rear arc, is either (i) a fundamental trait of crust in oceanic arcs that is produced in the steady state throughout arc history from Paleogene inception, or (ii) a secondary trait that develops only after backarc spreading;

2. Intra-crustal differentiation amplifies this asymmetry (i) continuously as a steady state process, or (ii) mostly during non-steady state events such as arc rifting.

3. After or near the cessation of the Shikoku Backarc Basin opening, rear-arc magmatism either (i) started from the western end of the rear arc seamount chains and migrated east, or (ii) started at the same time along the length of the rear arc seamount chains, but ended from west to east.

Testing these hypotheses requires obtaining a temporal record of across-arc variation in magma composition from Eocene to Neogene time. This information is in hand for the volcanic front but missing for the rear arc which overlies the majority of "continent-type" crust. Specifically, our objectives are to establish the temporal history of across-arc variations during five time periods that stand out in the rear-arc evolution: 3 Ma to the present, 9 to 3 Ma, 17 to 9 Ma, 25 to 17 Ma, and >25 Ma. We will determine whether there were across arc variations in even at the initial stage of arc development.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
IBM-3C	31°47.3874'N 139°01.5786'E	2114	1,200	700	1,900	Recovery of sediments and upper most Oligocene-Eocene basement