KCC - J-DESC

Repository Core Re-Discovery Program (ReCoRD)

Proposal Form

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Basic Information

Title:	Understanding magnetic architecture of oceanic lithosphere: Insights from Atlantis Bank, Southwest Indian Ridge
Keywords: (5 or less)	Oceanic lithosphere, Source of magnetic anomaly, Melt-rock interaction, Water and rock reaction, Magnetic mineral population
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Scientific Objectives (250 words or less)

Marine magnetic anomalies have been crucial for understand geomagnetic field variations and Earth's tectonics. Sea surface data and advanced near-bottom surveys have enhanced our knowledge of oceanic lithosphere processes like crustal accretion, faulting, hydrothermal circulation, and melt-rock interaction. However, the link between magnetic anomalies and geological data is not well understood, especially due to limited rock magnetic data from oceanic lower crust and mantle rocks.

In this study, we investigate the rock magnetization and ferromagnetic mineral population, along with the microstructural, geochemical and physical features of core samples from Atlantis Bank. By combining detailed mineralogy, potential water pathways, and elemental migration with rock magnetism, we aim to develop a more universal model of magnetization structure reflecting water-rock and melt-rock interactions. The Atlantis Bank sample is a prime example of an ultra-slow spreading environment with a range of gabbro to serpentinite, making it perfect for this study.

We aim to achieve our objectives through the following four tasks.
1) Analyze gabbroic and ultramafic rocks of less-studied core of Atlantis Bank.
2) Evaluate the distribution of remanent and induced magnetization and the magnetic mineral population.
3) Assess crack, mineral, and elemental distribution and reconstruct types of water-rock reactions and melt-rock interactions.
4) Compare the obtained results with existing knowledge from melt-poor mid-ocean ridges (Fujii+2016), the Oman ophiolite (Yoshida+2020, 2023; Akamatsu+2023, 2024), and oceanic core complexes in Philippine Sea (Harigane+2019; Fujii+2024).
This research provides valuable insights for geophysicists, petrologists, and other fields like geochemistry, mineral physics, oceanography, and biology.

Proposed Target Cores

To maximize the opportunities provided by ReCoRD, we have documented the maximum list of the samples of interest. Considering the samples desired by future sample request applicants and the realistic working time adopted, we will ultimately determine the cores to be addressed.

Leg/Exp.	Site-Hole	Cores
Leg 118	732	Hole 732A (rubble) Hole 732B (rubble) Hole 732C (rubble) Hole 732D (rubble)
Leg 118	733	Hole 733B (rubble) Hole 733C (rubble) Hole 733D (rubble and gneiss)
Leg 118	734	Hole 734A (ultramafic) Hole 734B Hole 734D Hole 734F (ultramafic) Hole 734G
Leg 118	735	Hole 735B ・18R–23R (wehrlitic gb, basaltic dyke) ・30R–32R (troctolite included) ・38R–56R (full unit III & IV) ・63R ・66R–67R (hydrothermally gb) ・73R–74R (troctolite unit)

		・77R–88R (full unit VI)
Leg 176	735B	Hole 735B ・147R-4–147R-7 (part of unit X) ・178R-5–183R-3 (part of unit XI) ・189R–209R (troctolite included)
Leg 179	1105	Hole 1105A (full) ・1R-1–29R-1
Leg 360	1473	Hole U1473A ・3R-4 ・2R-1 ・21R–25R (large variation) ・28R (oxide ol-gb→ol-gb) ・32R (diabase) ・39R-6 ・42R (diabase) ・47R–48R (large variation) ・65R-5 ・79R-1 ・85R-1 ・88R-3

Add lines as needed
[Note: Only cores in KCC are available.]

Proposed analysis prior to sampling

We consider three analytical processes prior to actual core sampling.

1. Core photos are utilized as part of a process to pre-select used for pre-selecting of samples. (Existing photographic records could not be identified for some Hole samples.)
2. X-ray CT scans and MSCL of the cores (mainly AH, if needed WH) at the Kochi Core Center are required. X-ray CT scans of the cores will be used to evaluate the relationship between the continuous density and crack distribution and alteration of the cores.
3. MSCL (magnetic susceptibility, elastic wave velocity, resistivity, natural gamma ray, and gamma ray density,) scans of the cores are used for determining vertical

magnetization distribution model and obtaining more precise density estimation. Natural gamma rays are especially essential for contrasting the litho-stratigraphy of the all drilling cores.

[Note: Please describe above any analysis needed prior to sampling. Standard set is X-ray CT, split core image (WH and/or AH), microscopic imaging of smear slide and/or thin section.]

Summary of previous studies of the target cores

Geological overview of Atlantis Bank based on existing surveys is summarized in Dick+ (2000, 2019a, b, 2021).

Magnetic result of lower crustal gabbroic rocks reported by following works; Kikawa & Pariso (1991) and Pariso & Johnson 1993 for Hole 735B; Rao & Krishna 2002 for Hole 1105A; MacLeod+ (2017) and Bowles+ (2020) for Hole 1473A. Hole 735B by Kikawa & Pariso (1991); Pariso & Johnson (1993). These studies are limited to reporting rock magnetic parameters such as magnetic susceptibility, remanent magnetization, and magnetic hysteresis, with no discussion of the factors that control magnetic mineral populations and remanence acquisition efficiency.

No magnetic and petrological studies of ultramafic rocks observed in Hole 732–734 are reported.

Felsic magma evolution in Hole 1473A was reported at Nguyen+ (2018) based on the microstructural and geochemical results. There are no petrological studies of felsic rocks in Hole 735B.

Proponent List

Name	Affiliation	Position	Country	Expertise
Masakazu Fujii	NIPR	Assistant Professor	Japan	Rock magnetism
Yumiko	GSJ, AIST	Senior	Japan	Petrology, Structural

Harigane		Researcher		geology
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Yuya Akamatsu	JAMSTEC	Researcher	Japan	Physical properties

[Note: For proponents who do not have J-DESC memberships, please put an asterisk (*) AFTER his/her name.]