Repository Core Re-Discovery Program

(ReCoRD)

Proposal Form

Received date	2023/05/23
Proposal No.	ReC-001
New / Revised	New

(Above For Official Use Only)

Basic Information

Title:	Tracing Intermediate Water Current Changes and Sea Ice Expansion in the Indian Ocean
Keywords: (5 or less)	Miocene, Indian Ocean, intermediate water, sea ice
Lead Proponent:	Junichiro Kuroda
Affiliation:	The University of Tokyo
Address:	5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8564 Japan
Phone:	+81 4 7136 6120
E-mail:	kuroda@aori.u-tokyo.ac.jp

Permission is granted to post the coversheet/site table on www.j-desc.org.
☒ I permit. ☐ I don't permit.

Scientific Objectives (250 words or less)

Within the proposed ReCoRD, we aim to understand the effect of changing climatic conditions during the "near-future warm period analogs" such as the Miocene Climatic Optimum (MCO), and subsequent cooling during the Middle and Late Miocene and Pliocene had on intermediate water formation and circulation. Model studies indicate that climatic changes lead to a positional shift of the westerlies, related to the expansion and contraction of sea ice around Antarctica. These changes further modulated intermediate water circulation and nutrient transport in the global oceans (see Laufkötter, C. & Gruber, N., 2018; Science 359, 1103–1104).

Based on this hypothesis, we aim to identify and correlate evidence for intermediate water current changes and potential sea ice expansion in the Neogene by re-investigating key Ocean Drilling Project (ODP) Sites in the wider Indian Ocean. Our strategic sampling plan involves a transect through key features of Indian Ocean water masses targeting ODP Sites 707 and 752, as well as DSDP Site 266

The objectives are, therefore:

1) Analyze Site 707 and 752 to define the sedimentological changes related to the hypothesized reorganization of intermediate water circulation.

2) Provide new digital core archives which can be directly correlated to existing visual core descriptions to better quantify current winnowing or ice-rafted debris at the target Sites.
3) Targeted sampling of the study sites for subsequent laboratory-based studies to better define intermediate water changes that provide information regarding the origin and nutrient load of the water masses interacting with the sediment at each Site.

Proposed Target Cores

Leg/Exp.	Site-Hole	Core
115	707A	1H – 15H
121	752A	1H – 10H
28	266	1R – 22R

[Note: Only cores in KCC are available.]

Proposed analysis prior to sampling

X-ray CT scans of cores (AH) are requested to allow comparison of sedimentological description and the application of machine learning to evaluate CT-scanned core material expected drift deposits during the ReCoRD. Site 266 will also be used to ground truth machine learning approaches for ice-rafted debris (IRD) identification in core CT-scanning data of legacy cores. DSDP Site 266 is considered uniquely qualified for this approach as it is located close to Antarctica and has a proven record of IRD based on the shipboard reports.

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

Summary of previous studies of the target cores

ODP Site 707 is located in the tropical western Indian Ocean, at the Mascarene Plateau (present water depth of 1552 m). This site was selected to elucidate the Neogene variation of the Indian Central Water (ICW). Identification of water properties and history of ocean circulation in the western Indian Ocean through the Neogene have long been studied by benthic carbon isotopic records from Site 707 (e.g., Smart, 1998, Ramsay et al., 1998; Smart et al., 2007). In addition to those studies, an important work on Nd isotope was conducted to reconstruct the Indian Ocean circulation over the last 25 Ma (see Fig. 1d below) (Gourlan et al., 2008). The Neogene history of marine primary productivity, ecosystem and biogeochemistry in the tropical western Indian ocean have been investigated based on coccolith assemblages of the sediments from Site 707 (e.g., Suchéras-Marx and Henderiks, 2014; Šupraha and

Henderiks, 2020; Karatsolis et al., 2022). Although Site 707 represents a key low-latitude site in the Indian Ocean, the sedimentological effects of the recorded current dynamics are, as of yet, poorly documented.

ODP Site 752 is located in the southeastern Indian Ocean, on the Broken Ridge (present water depth of 1086 m), where is close to the eastern flow path of Sub-Antarctic Mode Water. This site is particularly important to elucidate the history of Tasman Leakage through the Neogene, on the basis of benthic carbon isotopic records of sediments (e.g., Ridha, 2020; Christensen et al., 2021). Neogene climate change and atmospheric circulations have also been investigated by dust fraction of sediments from Site 707 (Hovan and Rea, 1992). However, the Neogene section of Site 752 is critically understudied in terms of biostratigraphy as well as sedimentological changes related to current changes.

DSDP Site 266 is located on the south flank of the Southeast Indian Ridge. Ice-rafted debris (IRD) were described in the sedimentary cores from Site 266 based on the shipboard description, and a limited number of studies on the bulk sediment geochemistry has been done to identify the sedimentary provenances (Vlastélic et al., 2005). Neogene ecosystem and oceanographic variability have been studied based on organic carbon isotope ratios (Sackett, 1986), biogenic Si (Brewster, 1980), and microfossil assemblages such as diatom (Barron, 1996) and radiolaria (Keany, 1978). The new study on the Miocene sediment from Site 266 may provide a key (low-resolution) record of Miocene IRD in the southern high latitudes of the Indian Ocean by applying new CT-based core scanning methods.

Proponent List

First Name	Last Name	Affiliation	Country	Expertise
Gerald	Auer*	University of Graz	Austria	Micropaleontology, Stratigraphy, Paleoceanography
Werner E.	Piller*	University of Graz	Austria	Micropaleontology, Stratigraphy, Sedimentology
David	De Vleeschouwer*	University of Münster	Germany	Stratigraphy, Paleoceanography
Anna Joy	Drury*		UK	Digital Core Description, Data Processing, Stratigraphy, Paleoceanography
Beth	Christensen*	Roawn University	USA	Paleoceanography, Micropaleontology, Sedimentology

Theresa	Nohl*	University of Vienna	Austria	Sedimentology
Jing	Lyu*	University of Münster	Germany	Stratigraphy, Paleoceanography
Tamara	Hechemer*	University of Graz	Austria	Paleoceanography, Micropaleontology
Xabier	Puentes-Jorge*	University of Graz	Austria	Paleoceanography, Micropaleontology
Jumpei	Yoshioka	University of Tokyo	Japan	Sedimentology

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

In the following pages, please provide a free-format document (3-pages maximum) including figures, tables, and references.