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IODP Proposal Cover Sheet

549-Full6

☐ **New** ☒ **Revised** ☐ **Addendum**

Please fill out information in all gray boxes

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Title:	Monsoonal Variability and Oxygen Minimum Intensity in the Northern Arabian Sea		
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Keywords: *(5 or less)*	Monsoon, Quaternary, Neogene, Climate Variability, OMZ	Area:	Northern Indian Ocean

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Permission to post abstract on IODP-MI Sapporo Web site: ☒ Yes ☐ No

Abstract: (*400 words or less)*

The region off Pakistan is a textbook example of a stable, expanded, open-marine oxygen minimum zone (OMZ), whose intensity at annual to Milankovitch time scales is largely controlled by the strength of the summer and winter monsoon. Our main aim is to recover fully intact sequences of late Neogene hemipelagic sediments in the northern part of the Arabian Sea to study the history of the Indian monsoon and OMZ on annual to tectonic time scales. For this purpose, we propose to drill two depth transects across the OMZ: (1) a transect of three, about 300-525 m deep, triple-APC-cored holes into Pliocene to Quaternary hemipelagic sediments of the Pakistan Margin (Sites POM 1-3) and (2) a transect of four triple-APC-cored sites into Holocene to upper Miocene (~8 Ma) hemipelagic sediments of the Murray Ridge (Sites MR1-4, MR-6, including alternates). The proposed drill sites offer a unique opportunity to study the following objectives: (1) Late Neogene evolution of millennial-scale variations in OMZ intensity; (2) Biogeochemical cycles; (4) Astronomical pacing of the Indian monsoon during long-term global cooling; and (4) Tectonic-scale paleoceanographic and climate changes; (5) 'Deep Biosphere'.

Our main objectives match to the important targets, Environmental Changes, Processes and Effect, Rapid Climate Change and Deep Biosphere as mentioned in the IODP Initial Science Plan and are complementary to the recently approved IODP Proposal 595 by P. Clift et al., which focuses on the deep riser and non-riser drilling on the Indus Fan and Murray Ridge to reconstruct the erosion history of Tibet, western Himalaya and the Karakoram. Our proposal will offer a unique opportunity to answer many open questions, such as: (1) Did millennial OMZ intensity changes also occur before the major onset to northern hemisphere glaciations around 3 million years ago and did they become more prominent during the Pleistocene full icehouse world? (2) Did the astronomical phase relations for the strength of the Indian summer monsoon changed over the past 4 million years as suggested by Clemens et al. (1996) or has the effect of the winter monsoon been underestimated in these reconstructions? (3) Did the closure of the Indonesian gateway (Cane and Molnar, 2001) play a crucial role in ocean circulation and east African aridification around 3-4 million years ago?

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Scientific Objectives: (*250 words or less*)

The **major scientific objectives** of this drilling proposal are:
- Late Neogene evolution of millennial-scale variations in OMZ intensity
- Biogeochemical cycles
- 'Deep Biosphere'
- Astronomical pacing of the Indian monsoon during long-term global cooling
- Tectonic-scale paleoceanographic and climate changes

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	
*POM-1	Indus Slope 23°05.6'N/66°27.9'E	825	400		400	Paleoclimate history of past 1.5 Ma, OMZ fluctuations, deep biosphere
*POM-2B	Indus Slope 23°07.9'N/66°29.5'E	525	300		300	Paleoclimate history of past 2 Ma, OMZ fluctuations, deep biosphere
*POM-3	Indus slope 23°01.9'N/66°23.4'E	1350	525		525	Paleoclimate history of past 3.5 Ma, OMZ fluctuations, deep biosphere
*MR-1	N Murray Ridge 23°18.4'N/63°48.5'E	1840	400		400	Condensend Quat. section, Mioc. to Hol. climate and OMZ fluctuations, deep biosphere
MR-2B	S Murray Ridge 22°15.75'N/63°20.2'E	1910	300		300	see MR-1
*MR-3B	S Murray R. 22°19.7'N/63°04.8'E	2385	350		350	see MR-1
*MR-4B	N Murray Ridge 23°29.3'N/65°21.4'E	1200	500		500	Complete Mioc. to Hol. climate and OMZ fluctuations, deep biosphere
MR-4C	N Murray R. 23°30.65'N/65°22.15'E	1200	400		400	see MR-4A
*MR-6B	N Murray R. 23°32.43'N/65°19.1'E	890	80		80	see MR-1
MR-6C	N Murray R. 23°29.4'N/65°17.5'E	1020	80		80	see MR-1
*high-priority sites						