

IODP Proposal Cover Sheet

 New Revised Addendum

724-Full

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	Please check if this is Mission proposal		<input type="checkbox"/>	<input type="checkbox"/>
Title:	Gulf of Aden Drilling: Constraining Paleoenvironmental Contexts of African Faunal Evolution			
Proponent(s):	Peter B. deMenocal, Kensaku Tamaki, Richard Potts, Tim Eglinton, Francis H. Brown, Sarah Feakins, Gen Suwa, Shigehiro Katoh, Masafumi Murayama, Gerald Ganssen, Phillippe Huchon, Sylvie Leroy, Kyoko Okino, Warren Prell, Tim White			
Keywords: (5 or less)	African paleoclimate, monsoon, human evolution, orbital forcing, volcanism	Area:	Gulf of Aden	

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Permission to post abstract on IODP Web site: Yes No

Abstract: (400 words or less)

Did Late Neogene changes in northeast African climate affect the evolution of African mammalian fauna, including human ancestral lineages? Hypotheses of early human evolution have suggested that climate-driven changes in the African ecological landscape created faunal adaptation pressures that ultimately led to genetic selection and innovation evident in the fossil record. Available paleoclimate evidence suggests that changes in African climate were coincident with some critical evolutionary junctures. But a more rigorous examination of this intriguing idea will only be possible with complete, well-dated, multiple-proxy records of African climate and vegetation changes from new IODP drilling in the Gulf of Aden, the closest marine basin to NE African hominin localities.

The proposed drilling program consists of six drill sites oriented along a SW-NE transect in the Gulf of Aden. The overall research strategy is to use a distal-proximal drill site transect geometry to isolate and quantify paleoclimate and paleovegetation change signals originating from NE Africa. Preliminary molecular biomarker, eolian dust, and pollen data indicates that these proximal sediments are reliable African paleoclimate archives. The drill sites are based on known high-accumulation rate (4-15 cm/kyr) core locations with basal ages extending to 10-12 Ma. These sites will also be used to develop continuous tephrostratigraphic records of NE African explosive volcanism, and geochemical correlation of tephra layers to NE African fossil localities. The paleoceanographic history of the Gulf of Aden includes the development of Indian monsoonal upwelling variability, emergence of modern SST gradients, and the past variability of warm and salty Red Sea Overflow Water (RSOW) that is presently exported through the Gulf of Aden between 400-800m. The most distal sites (GOA-5,-6) should permit integration of the Gulf of Aden paleoclimate and paleoceanographic results with those from nearby sites drilled by ODP Leg 117 in the Arabian Sea.

The drilling is viewed as timely, necessary, and important because the resulting science will vastly improve our understanding of the paleoenvironmental contexts associated with important late Neogene junctures in early human evolution, one of which led to the emergence of our genus *Homo*. Continuous marine sediment sequences accumulating most proximally to NE African fossil localities are necessary because regional terrestrial deposits are commonly incomplete. A minimum scientific dividend of this drilling will be an understanding of how and why climate changed in this region within the context of local and global climate forcing, and providing the baseline paleoclimatic context for evaluating future advances in the fossil record.

Scientific Objectives: (250 words or less)

Scientific objectives of our proposed Gulf of Aden drill site transect are:

- 1) **Reconstruct NE African paleoenvironmental change spanning the late Neogene (10Ma),**
This objective will employ analyses of eolian dust flux, provenance, and grain size, organic molecular biomarker and pollen tracers of past vegetation change to define past changes in NE African climate variability.
- 2) **Understand the causes of northeast African climate change during the late Neogene.**
This objective explicitly addresses themes proposed in the ISP by investigating the various contributions to Late Neogene African climate change resulting from low-latitude orbital insolation and tropical SST forcing, high-latitude climate (ice volume) changes, and changes in regional volcanism and uplift.
- 3) **Constrain tephrostratigraphic records documenting the late Neogene history of northeast African explosive volcanism.** Development of a complete, orbitally-tuned tephrostratigraphic record of NE African explosive volcanism. Shard geochemistry is used to correlate the marine (paleoclimate and paleoceanographic records) and terrestrial (fossil bearing) sequences. The history of tephra deposition may reflect thermal uplift of NE African orography.
- 4) **Late Neogene evolution of SW Indian monsoon intensity.** Late Neogene evolution of the SW Monsoon intensity based on coastal upwelling floral, faunal, and SST records from GOA-4,5,6, and their linkages to Arabian Sea Leg 117 records.
- 5) **Late Neogene initiation and variability of Red Sea Overflow Water ventilation of the Gulf of Aden.** Three of our proposed drill sites (GOA-1, -2, -3) form a depth transect that bracket modern RSOW and isotopic and Mg/Ca analyses of benthic foraminifera can be used to monitor the Late Neogene onset and subsequent variability of RSOW.
- 6) **Integration of drilling science results to understand the late Neogene evolution of northeast African paleoenvironmental change and its influence on African faunal evolution.**

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

None.

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
GOA – 1	11°50.3'N, 43°21.2E	650	250	50	300	African paleoclimate, RSOW, tephra stratigraphy.
GOA – 2	12°09.16N, 44°23.30E	750	410	50	460	African paleoclimate, RSOW tephra stratigraphy
GOA – 3	12°30.0N, 45°30.0E	750	700	50	750	African paleoclimate, RSOW, upwelling, tephra stratigraphy
GOA – 4	12°43.13N, 46°52.96E	1790	450	50	500	African paleoclimate, upwelling, tephra stratigraphy
GOA – 5	13°36.65N, 49°35.24E	1990	530	50	580	African paleoclimate, upwelling, tephra stratigraphy
GOA – 6	13°36.74, 52°58.00E	2520	540	50	600	African paleoclimate, upwelling, tephra stratigraphy, link to Leg 117 sites