Received 1-October-2005

IODP Proposal Cover Sheet

633-Full2

☐ New ☑ Revised ☐ Addendum

Please fill out information in all gray boxes

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Title:	Mud extrusion and seamount subduction along the Middle America continental slope – deciphering deep fluid processes at an erosive convergent margin
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Keywords: *(5 or less)*	mud diapirs, seamounts, fluid flow, Central America,
Area:	Central America (Costa Rica)

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Permission to post abstract on IODP-MI Web site: Yes

Abstract: (*400 words or less)*

The active continental margin off Costa Rica and Nicaragua comprises a unique set of geological features that provide insight into deep fluid processes. We propose to drill sites of active fluid dewatering in order to elucidate fluid flow processes and constrain dewatering budgets at an erosive continental margin. Major sites of dewatering are mounds, positive sea floor anomalies, which are related mud diapirism/volcanism and precipitation of authigenic carbonates, and large-scale slides related to the subduction of seamounts. Recent data compilations suggest that fluid advection - triggering the development of mud liquefaction and upward migration –can be attributed to deep structural processes that favor the release of mineral-bound, fresh water from subducting sediments between 10-12 km depth. Preliminary budget calculations based on the total number of dewatering sites and average rates of fluid expulsion indicate that up to 90% of this mineral-bound water is recycled within the forearc. Data from expelled mud volcano fluids, however, show significant spatial differences in geochemical composition suggesting variations in flow velocity and alterations along the flow path. In addition, unequivocal data could not be obtained from any seamount site. Hence, drilling information is needed to understand the interrelationship between deformation and fluid generation in an erosive margin setting.

The suggested drilling will not only improve our understanding of processes controlling and driving fluid flow, but also constrain volatile and material budgets of the erosive subduction system. In general, the following major hypotheses are to be tested: (1) Mud diapirism/volcanism is a major dewatering pathway and provides a window into deep fluid processes. (2) Seamount subduction creates major pathways for deep fluid advection and canalization. (3) Release of deep, freshened fluids controls mud mobilization and hence the formation of the mounds and their internal build-up.

The Pacific margin offshore Costa Rica is one of the best-studied continental margins worldwide and processes observed here might be representative for erosive continental margins in general. Hence, the proposed drilling sites offer the unique opportunity to calculate real mass budgets of forearc recycling of fluids and volatile elements. This knowledge is of key importance in terms of a better understanding of the role of subduction zone processes in global biogeochemical cycles.

633-Full2

Scientific Objectives: (*250 words or less*)

Mound structures observed in numerous places along the Costa Rica and Nicaragua margin are manifestations of dewatering pathways that essentially control and balance the overall fluid budget at this erosive convergent margin. The major pathway of forearc dewatering is triggered by the release of mineral-bound water at the plate boundary (at 10-12 km depth). Characteristic, freshened fluids are flowing upwards along pervasive faults and vent at mounds and seamount scarps at mid-slope depths. We propose to drill 2 deep (800 m) drill holes, one at each of the mounds (Mound Culebra, Mound 11) to trace the main fluid conduits and monitor fluid flow and fluid geochemistry over time.

Seamount subduction at the Central America continental margin provides an unusual mechanism for dewatering and devolatilization of subducting sediments by creating deep-reaching faults and fractures and causing large collapse structures on the slope. It is proposed to drill two deep (1000 m) holes on top of Jaco Scarp and on a terrace near the base of the slide created by it. This will help to identify fluid pathways and dewatering patterns in the wake of the subducting seamount.

The internal build-up of the mounds has major implications for the development of fluid conduits, the potential mixing of fluids from different sources, and allows major conclusions on the evolution and fundamental mechanisms of mound formation. In order to further the understanding of these fundamental questions we propose to drill additional cores (up to 500 m) at the mounds.

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	
CRMD-04A	-86:18:22, 10:17:51	1500	800	0	800	identify source depth and geochemistry of sediments, sediment structure
CRMD-04B	-86:18:33, 10:17:44	1500	500	0	500	
CRMD-04C	-86:18:19, 10:18:05	1500	500	0	500	
CRMD-04E	-86:18:06, 10:18:00	1500	500	0	500	
CRMD-05A	-84:18:15, 8:55:22	2250	800	0	800	identify source depth and geochemistry of sediments, sediment structure
CRMD-05B	-84:18:36, 8:55:22	2250	500	0	500	
CRMD-05D	-84:18:30, 8:55:36	2250	500	0	500	
CRSM-02C	-84:50:00, 9:07:70	1200	1000	0	1000	fluid geochemistry and pathways
CRSM-02D	-84:49:20, 9:09:00	800	1000	0	1000	