IODP Proposal Cover Sheet

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Costa Rica Megathrust Fluid-Pressure

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Title	Testing Mechanisms for Pore Pressure Evolution Along the Costa Rica Megathrust
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Keywords	Osa Peninsula, megathrust fluid-pressure, hydrogeology
Area	Central America

Proponent Information

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Abstract

This Ancillary Project Letter proposes to determine the primary sources of fluids that accumulate along the plate interface of the Costa Rica convergent margin NW of the Osa Penninsula, and to determine whether fault-related drainage of the upper plate is the primary mechanism for controlling fluid content along this zone. Fluids and related fluid pressures have a primary control on fault slip behavior, making it critical to understand where fluids come from and how they drain from the plate interface. Recently acquired 3D seismic reflection data across the Costa Rica margin reveal high-amplitude, polarity-reversed reflections from the plate interface that indicate high fluid content down to depths of 5 km sub-seafloor, but farther down dip the fluid content abruptly decreases. This pattern is not consistent with models of fluid production or expected fluid sources, as the smectite-illite transition occurs much deeper than the region of inferred overpressure making enhanced fault-related drainage a likely cause of the abrupt transition in pore fluid pressure here and potentially at other margins as well. The 3D seismic volume reveals a set of seaward-dipping thrust faults that also appear to have seismic reflection characteristics of dilated, overpressured faults that link the plate interface with the seafloor near the abrupt fluid-rich to fluid-poor transition, and are potentially the primary pathways for fluid drainage of the plate interface. It is these high-angle, seaward dipping thrusts that can provide a more direct pathway, and are more efficient at draining the plate interface than the landward-dipping, shallow angle faults that characterize the rest of the margin. By drilling a single, shallow (~ 500 m) hole through the upper slope cover sequences, we can sample two faults with opposing dips: 1) a landward dipping fault at ~ 240 mbsf that extends into the margin wedge beneath the shelf, and 2) a seaward-dipping thrust fault at ~480 mbsf that extends into the plate interface that is part of the fault system we contend is driving plate interface dewatering. Pore water chemical profiles across both faults will allow us to assess fluid sources across the reflectivity transition and test our hypothesis that the seaward-dipping faults are the most active drainage pathway from the megathrust. By sampling fluids from the plate interface we can advance primary goals of Expeditions 334/344 drilling by determining the sources of fluids and their impact on megathrust slip behavior and the development of the seismogenic zone.

Scientific Objectives

The primary goals at proposed site CRX-01 are:

(i)To determine the pore fluid composition associated with two deeply rooted faults with opposing dip: one that roots deep within the margin wedge and one that roots into the megathrust.

(ii)To assess flow activity associated with both of these faults.

These data will answers the following questions:

(i)Are fluids actively migrating along steep seaward-dipping thrust faults at the shelf-break and provide the primary drainage pathways from the plate interface?
(ii)Is the high fluid content along the shallow plate interface due to fluid from subducted sediment, fluids produced from opal and clay mineral diagenesis, or fluid from within the subducting crust?

Sampling these two faults within a single shallow borehole will allow us to test an emerging model for the hydrogeology of the shallow subduction zone. Constraints on the primary fluid pathways and fluid sources will allow us to test this model and further refine it to develop a more complete understanding of the accumulation of fluids along the megathrust and shallow seismogenesis.

Non-standard measurements technology needed to achieve the proposed scientific objectives

None requested.

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Proposed Sites (Total proposed sites: 1; pri: 1; alt: 0; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
CRX-01 (Primary)	8.7785 -84.1019	447	553	0	553	Determine fluid flow activity and pore fluid composition associated with faults at 240 mbsf and 480 mbsf from thermal structure and fluid chemistry. Constrain regional thermal models, stratigraphy, and slope cover deposition and deformation history.