

IODP Proposal Cover Sheet

NW Pacific Bend-Fault Hydrology

886 - Pre

Title	Bend-Fault Hydrology in the Old Incoming Plate		
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Abstract

The oceanic plate has played a main role in global deep water circulation within the Earth. The physical, chemical and structural properties of the incoming plate are also crucial for understanding co-seismic megathrust slip at subduction zones. It has been generally accepted that hydration due to plate bending-induced normal faults (bend-faults) occurs in the region between trench and outer rise (outer rise). It is, however, emphasized that little is yet known about the degree and style of hydration in the oceanic plate at outer rises. Bend-fault hydration processes depend on thermal conditions and stress state. Investigating several subduction zones with various conditions is crucial to expand our knowledge of bend-fault hydration processes. The northwest Pacific (NW Pacific) region is one of the world oldest, thus coldest, and most studied oceanic plates, and is therefore a high priority region to study bend-fault hydration. Water circulation (deep penetration and deep upwelling) and hydration through the bend-faults in the NW Pacific region is supported by results from extensive recent geophysical surveys. Here:

(1) Horst and graben structures formed by bend-faulting are the best developed in the world, (2) Large bend-fault earthquakes ($M > 7$) have repeatedly occurred and been well recorded, (3) Detailed Vp/Vs variations within the incoming plate have been determined (only known here), (4) The local stress state is likely to have changed significantly after the 2011 Tohoku Earthquake, and (5) Anomalously high heat flow suggests heat transport by water circulation. In addition, the NW Pacific Plate is the best place to comprehensively study relationships between subduction inputs, subduction tectonics, and subduction zone processes because one successful drilling project (JFAST) and a newly planned drilling project (JTRACK) will further augment the research goals of this proposal and because geochemical compositions of volcanic rocks and their quantitative modeling has also been extensively studied in the northeastern Japan Arc. In order to address (a) hydration processes and their extents along bend-faults and (b) geochemical and geophysical properties of the old incoming plate prior to subduction, we will analyze in-situ physical properties and lithofacies that will be best obtained by ocean drilling in the NW Pacific region.

Scientific Objectives

In order to address the following scientific objectives we propose to conduct in-situ sampling and observations of a damage zone associated with bend-fault hydration in the incoming plate at the northwest Pacific outer rise region:

(1) The Nature of horst-and-graben bend-fault hydration, which includes:

- + What are the mechanisms that enable seawater to penetrate to large depths in the incoming plate at outer rise region in spite of the high pressure and high temperatures at large depth?
- + How much water lies within the incoming plate?
- + What are the factors changing Vp/Vs in the incoming plate?

(2) The physical properties of the plate interface in the incoming plate, namely:

- + What are sediment compositions, permeabilities, and stress fields linked to plate-boundary fault/megathrust behavior?

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

Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
HKD-2A	41.15, 147.17	5180	500	1000	1500	
HKD-1A	41.77, 146.715	6210	500	1000	1500	
THK-2A	38.99, 145.25	5400	500	1000	1500	To sample basaltic rocks from an area where the bend-faults are not observed but seismic structures are altered by the bend-faults induced small cracks and to obtain in-situ geophysical properties for comparing core-samples with the primary site and establishing the relationship between the degree of the development of bend-faults and the structural evolution.
THK-1A	39.04, 144.77	5890	500	1000	1500	To recover complete coring around a bend-fault, to sample sediments focusing on the chert and clay-rich layer, and to obtain in-situ geophysical properties.