IODP Proposal Cover Sheet

Aleutian Basin Formation

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Title	Drilling to Determine the Origin of the Aleutian Arc-Basin System and the Climate, Oceanographic, Diagenetic, and Deep Biospheric Record in its Sedimentary Fill
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Abstract

We propose scientific drilling to basement at three sites in the Aleutian Basin, a large marginal basin behind the Aleutian arc. There are three sets of scientific objectives: 1) to resolve when and in what tectonic setting the crust of the basin formed, whether by entrapment or rifting; 2) to reconstruct the Cenozoic paleoclimatic and paleo-oceanographic history preserved in its sediments; and 3) to investigate ongoing processes of diagenesis and methane cycling. Magnetic and seismic refraction data reveal that the central Aleutian Basin is underlain by slightly thickened (7.5 -8.1 km thick) magmatic oceanic crust that formed by seafloor spreading but it is controversial when and in what tectonic setting. A long-standing interpretation is that it was captured in early Paleogene time when subduction began beneath the Aleutian Arc but a new interpretation is that it formed as Paleogene backarc basin. These competing hypotheses are testable by drilling into basement to determine its age, tectonic origin, and paleolatitude of formation. Resolving this controversy will also constrain the origins of the Aleutian subduction zone and arc, one of Earth's most important convergent margin, and help constrain our understanding of how new subduction zones form. Drilling into basement will allow examination of Aleutian Basin sedimentary fill, dating to Paleogene and maybe Cretaceous time. Aleutian Basin sedimentary fill consists of thick Neogene sequences of turbidites, ice-rafted debris, ash horizons, and diatom-rich biogenic sediments underlain by Paleogene and perhaps Cretaceous sediments of unknown nature. Penetrating these sediments to drill into basement necessitates selection of drillsites above buried basement highs along the broad Vitus Arch, where sedimentary cover is thinner. Extensive MCS profiling in the Aleutian Basin by the USGS allowed us to identify 3 sites above the buried Farnella, Pear, and Sounder Ridges where basement can be reached with ~500m drilling through sediments. Stuying the overlying sediments will reveal how and when the far North Pacific transitioned from Paleogene Greenhouse to Neogene Icehouse and will provide new constraints about when the Bering Strait oceanic gateway was open or closed. Drilling through sediments will also allow study of the subsurface diagenetic changes and will probe the subsurface microbial biosphere responsible for formation of vast quantities of methane. This will be the first time that Aleutian Basin sediments older than mid-Miocene and underlying basement will be recovered.

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Scientific Objectives

Our primary drilling objective is to sample oceanic basement and the overlying sediments of the deep water Aleutian Basin. The scientific results gained will help reach each of IODP's four thematic goals.

For Theme 1 (Climate and Ocean Change: Reading the Past, Informing the Future), drilling will recover a 50-55 Myr-long paleoclimatic and oceanographic record from a high-latitude, marginal sea. Included will be microfossil evidence concerning the Paleogene and Neogene history of Bering Strait exchange of water and biota between the north Pacific, Arctic, and north Atlantic oceans.

For Theme 2 (Biosphere Frontiers: Deep Life, Biodiversity, Environmental Forcing of Ecosystems), drilling will investigate the influencing and causative roles of the deep microbial biosphere in basin-wide silica diagenesis, silica weathering, methanogenesis, in-situ carbonate deposition and the subsurface sequestration of CO2 and alkali metals.

For Theme 3 (Earth Connections: Deep Processes, Their Impact on Earth's Surface Environment), sampling basal sediment and underlying basement will constrain when and how the intra-oceanic Aleutian subduction zone formed. Studying the tephra record will further understanding of links between explosive arc volcanism and climate.

For Theme 4 (Earth in Motion: Processes, Hazards on Human Time Scales), drilling results will address carbon storage in methane gas below the BSR, in methane hydrate above it, and in diagenetic carbonate minerals. Penetrating basement atop the seamounts will provide information about how escaping, relief-focused fluids localize fluid pathways ascending to the seafloor through and from altering, silica-rich sediment.

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

none

Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
PEAR-01A	56.54830, 175.71234	3835	840	300	1140	Core sediments and core underlying basement
SOUND-01A	58.45927, 178.88529	3740	620	300	920	Core sediments to basement and core basement
FRNLA-01A	57.28072, 177.87281	3810	720	300	1020	Sample sediments and into basement

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