IODP Drilling to Basement in the Aleutian Basin: What Can We Learn from the Sedimentary Section?

Robert Stern, University of Texas at Dallas
Ginger Bart, U.S. Geological Survey
Dan Scheirer, U.S. Geological Survey
David Scholl, U.S. Geological Survey

The promise and challenges of IODP drilling in the Aleutian Basin were explored in a 2.5 hour mini-workshop on Wednesday evening (December 11) of the Fall 2013 AGU meeting in San Francisco. This workshop, entitled "***IODP Drilling to Basement in the Aleutian Basin: What Can We Learn from the Sedimentary Section?***" was organized and led by Bob Stern (UT Dallas), Ginger Barth, Dan Scheirer, and Dave Scholl (USGS). An IODP pre-proposal (825-Pre) to establish the age and origin of the Aleutian Basin, primarily through study of basement rocks, received feedback from IODP PEP that proponents should broaden the scientific objectives by maximizing the scientific return of drilling through ~1 km of overlying sediment. This feedback inspired organizing this open mini-workshop, whose program consisted of a series of short (~10 min) talks followed by ~10 min discussion periods. The miniworkshop was advertised via GeoPRISMS and Ocean Leadership websites and listserves, and was open to attendance by students, scientists, and anyone else who was interested to discuss ideas and potential collaborations about how more and better science could be carried out in association with proposed drilling into basement of the Aleutian Basin. The miniworkshop was held in a meeting room at the Marriott Marquis Hotel. About 25 geoscientists attended the miniworkshop.

Presentations began with two introductory talks. The first, by Bob Stern, summarized the pre-proposal and described the three sites in the Aleutian Basin where, using riserless drilling technology, the sediments are thin enough to reach buried basement highs. Existing geophysical data (magnetic, gravity, refraction velocity and MCS) and rock and sediment samples set the stage for two end-member hypotheses of Aleutian Basin formation that are the main testing objective of the pre-proposal. Dave Scholl presented the second introductory talk, a succinct review of the contrasting hypotheses about when and how the oceanic crust of the Aleutian Basin came to be emplaced behind the Aleutian Arc and why drilling to basement was the only way to resolve this controversy. These two introductory talks were followed by three presentations by regional experts that focused on how investigating the overlying sedimentary section would advance our paleoceanographic, environmental, paleoclimatic, and stratigraphic knowledge of both the high-latitude Pacific and the global ocean.

Great interest was expressed for studying diatom biostratigraphy, as well as ash and terrrigenous sequences in the sedimentary section, which is expected to reach back to the Paleogene and possibly the Late Cretaceous. Mitch Lyle (TAMU) emphasized that important paleoclimatic and paleo-oceanographic information would be obtained from studying cores of Paleogene and Neogene sediments. Samples from the Aleutian Basin would provide the first record of North Pacific conditions through the Cenozoic, in contrast to existing drill sites on the northern Pacific Plate that experienced significant northward transport. Hypotheses regarding connections

between the Pacific and Atlantic Oceans, postulated North Pacific Deepwater formation, and sea-ice history could be evaluated with sediment records from this part of the Bering Sea.

John Barron (USGS) discussed the importance of investigating the entire sedimentary section to determine when there was open communication between the Bering Sea and the Arctic Ocean and the North Atlantic Oceans and when this important gateway was closed. An oceanic gateway via the Bering Strait allows warmer and possibly saltier Pacific waters to enter the Arctic and also the reverse movement of Arctic and Atlantic waters into the Pacific; such open gateways also facilitate dispersion and mixing of marine faunas, so biostratigraphy provides a key tool for evaluating this exchange. It is of global importance to know for the whole of Cenozoic time when the Bering gateway was open and when it was closed. Barron emphasized the key role that diatoms play in studies of high-latitude sediments and that we have an incomplete record of even the Neogene record for the Bering Sea. The oldest sediments recovered to date from the Aleutian Basin are from a tiny sample of middle Miocene limestone recovered at DSDP Site 190. Along the adjacent Beringian Margin, sediment in basins overlying deformed basement has been recovered at industry COST wells. These sediments are as old as Late Cretaceous but diatoms older than Middle Miocene are not preserved. Sediments dredged from the Beringian Margin in 1978 by USGS contain Oligocene diatoms that resemble those of similar age in the Norwegian Sea, suggesting an open connection through the Arctic at that time.

Ivan Aiello (CSU MLML) provided the concluding presentation and emphasized how cores of Quaternary and older sediments from the Aleutian Basin could be used to better understand the paleogeography of the whole Bering Sea region, a.k.a. Beringia. He noted that Quaternary sediments involve two lithologic end-members: biogenic (diatom) and terrigenous (clay and fine silt), which are deposited in open marine vs. river- and glacial-dominated environments. Because the Bering shelf was subaerially exposed during glaciation, terrigenous deposition moved from mainly filling numerous Beringian shelf basins (e.g., Anadyr, Norton, Bristol, Navarin, and St. George basins) to turbidite deposition in the deep water Aleutian Basins. These observations suggest that an independent record of glaciation in adjacent parts of Alaska and Siberia could be outlined by careful study of the glacial-age sediments that we propose to obtain. An improved history of terrigenous deposition and erosion of the Beringian Margin will aid, too, in understanding the excavation (incision or cutting) there of some of the largest canyon-systems on Earth.

Throughout the mini-workshop, participants contributed helpful insights into topics ranging from experiences with core recovery in turbidite-dominated sediments to issues related to diatom preservation where sea-ice cover is great (so-called “sea-ice diatoms”).

Following these presentations and discussion, the workshop closed by discussing what we needed to do next. It was agreed that a full workshop was not needed and that the team should prepare a full IODP proposal, seeking scientific, coring, and sampling strategy inputs from the larger biostratigraphic, paleoclimatic, and lithologic group that was represented in the mini-workshop.