IODP Expedition 341: Southern Alaska Margin

Week 1 Report (29 May–2 June 2013)

Operations

Week 1 of Expedition 341 (Southern Alaska Margin), began with the first line ashore at Victoria, BC at Berth A South, Ogden Point at 0745 h on 29 May 2013. The science party and technical staff boarded on the day of arrival. The majority of incoming cargo and off-going cargo was unloaded on 29 May as well. The following day the Siem Offshore crew change was completed. All main port call activities, including preparation of the passage plan were completed. The vessel was secured for sea with final maintenance checks performed prior to departure. Prior to departure a new long range identification and tracking system was delivered, installed and commissioned. On the morning of 31 May, two tugs and the harbor pilot arrived at our location. The last line was released from shore at 1209 h, beginning the 1038 nmi voyage to Site U1417 (GOA18-2A). The pilot departed the vessel at 1237 h and the vessel began the transit to the first site.

At weeks end the vessel was still underway to Site U1417 with an average voyage speed of 10.7 kt and an ETA of 1500 h on 4 June.

Science Results

The science party includes individuals from 12 IODP member countries and 10 nationalities. In addition, two education officers from the USA and New Zealand are on board to conduct outreach activities.

The first five days of the expedition were spent becoming familiar with the laboratories, core flow, curation, sampling, and publication procedures used on the ship. The geochemistry, physical properties, and core describing teams learned how to use equipment and software. The core description and paleontology teams were trained on how to use DESClogik for entering descriptive data into the database. The science party converged on a sampling plan for shipboard analyses. A sampling plan is being finalized for personal research samples that are to be taken on the ship; the majority of personal research samples will be taken postcruise. All of the groups are finalizing their laboratory procedures, which will be included in the “Methods” chapter of the Expedition Reports.

Science Objectives of Expedition

Global climate during the Neogene to Quaternary is distinguished by the transition into a colder more variable world dominated by the onset and intensification of major Northern Hemisphere glaciations and is associated with an increase in erosion rates and sediment delivery to basins. The effects of this increased erosion may be profound, as worldwide analyses of orogenic belts have shown that earth systems cannot be considered to be the product of a series of distinct, decoupled tectonic and climatic processes. Rather, there is a complex interplay between

deformation, exhumation, and climate systems. Exhumation plays a key role in controlling the regional distribution of metamorphic rocks, local climate change, and the development of structures throughout an orogen. As tectonic processes influence regional climate by raising mountains that enhance orographic precipitation patterns and intensity, the Neogene–Quaternary climate transition likely affected tectonic processes through changes in erosion rates, which redistributed mass and subsequently altered stresses in orogenic wedges. Analytical models examining the coupling between glacial erosion and orogenic processes reveal that glacial erosion can significantly modify the patterns and rates of erosion in an orogenic wedge. A critical question is at what stage of the deteriorating Neogene climate is an orogen ultimately driven into sub-criticality. Does this lead to increased exhumation in the glaciated core of a mountain belt, enhanced topographic relief, and migration of the locus of sediment accumulation to the toes of an orogen that impacts deformation patterns?

Addressing the linkages between global climate change, modification of the dynamics of surficial processes, and subsequent tectonic responses requires integrated studies of orogenic systems in areas that exemplify specific end-members of the problem. The Gulf of Alaska borders the St. Elias Orogen of Alaska and Canada, the highest coastal mountain range on Earth and the highest range in North America. This orogen is <30 Ma in age and mountain building has occurred during a period of significant global climate change, allowing this expedition to examine the response of an orogenic system to the establishment of a highly erosive glacial system. Additionally, the implications of the Neogene glacial growth in the circum North Pacific are far reaching beyond a tectonic response to increased glacial erosion and exhumation. As climate determines the timing and patterns of precipitation, it controls glacial dynamics, erosion, and sediment/meltwater fluxes to the ocean. Establishing the timing of northwestern Cordilleran Ice Sheet (NCIS) advance/retreat cycles in southern Alaska will address a major challenge in Quaternary paleoclimatology, which is to know the extent to which glacial-age climate change was a synchronous worldwide event and what the driving mechanisms were for potentially propagating millennial-scale warming/cooling cycles around the globe. Evidence of substantial changes in surface productivity in the Gulf of Alaska since the Last Glacial Maximum indicates that millennial-scale climate change and eustacy in the northeast Pacific Ocean has a first order effect on primary productivity. Thick Pleistocene glacimarine deposits of the Gulf of Alaska continental margin contain a rich history of climate change recorded in both proxy climate data and sediment accumulation rates that can help decipher the architecture of massive late Tertiary and Quaternary high-latitude Northern Hemisphere continental margin sedimentary sequences. Exceptionally high rates of glacigenic sediment accumulation in this region also allow for the development of a paleomagnetic record of geomagnetic field variability on sub-millennial scales to assess geomagnetic persistence, a signature of the mantle's influence on the geodynamo and the paleomagnetic record.

Expedition 341, which combines IODP Proposal 686-Full and ancillary proposal letter (APL)-786 will use a cross-margin drilling transect to investigate the northeast Pacific continental margin sedimentary record formed during orogenesis within a time of significant global climatic deterioration in the Pliocene–Pleistocene, which has lead to the development of the most aggressive erosion agent on the planet, a temperate glacial system. Sedimentary provenance, paleoclimatic, glacimarine and structural sedimentary indicators tied to a multi-component chronology will be used to generate detailed records of changes in the locus and magnitude of glacial erosion, degree of tectonic shortening, sediment and freshwater delivery to the coastal

ocean and their impact on oceanographic conditions in the Gulf of Alaska, and the resulting continental margin stratigraphic record on the interaction of these processes. Because the oceanographic processes in the Gulf of Alaska directly impact the Bering Sea, Expedition 341 will be a strong complement to IODP Expedition 323 by addressing the late Neogene evolution of continental glaciation and freshwater and nutrient inputs, but in a more proximal source to glacial drivers of many of these processes.

Major objectives of planned drilling in the Gulf of Alaska are as follows:

1. Document the tectonic response of an active orogenic system to late Miocene to recent climate change;

2. Establishing the timing of advance and retreat phases of the northwestern Cordilleran Ice Sheet to test its relation to dynamics of other global ice sheets;

3. An expanded source-to-sink study of the complex interactions between glacial, tectonic, and oceanographic processes responsible for creation of one of the thickest Neogene-Quaternary high-latitude continental margin sequences;

4. To understand the dynamics of productivity and intermediate water circulation in the Northeast Pacific, and their role in global carbon cycle;

5. Documenting the spatial and temporal behavior during the Neogene of the geomagnetic field at extremely high temporal resolution in an undersampled region of the globe.

Technical Support and HSE Activities

The following technical support activities took place:

- The cooling pump for the ICP was received and installed.
- The magnetometer was deployed during the transit.
- The VSP guns are currently being setup.
- The trouble shooting of various track problems is on going.
- The surface freight was off loaded and the air shipment was received.
- The received shipments were distributed.

The following HSE activities took place:

- The first boat and fire drill took place on 1 June.
- Lab safety tours were given to scientists on 30 May.
- Safety awareness sheets were completed for chemistry, physical properties, the whole round multi-sensor track, and paleomagnetics areas.
- The safety showers and eyewash stations were tested.
- The gas hoods were checked.