Expedition 320: Pacific Equatorial Age Transect (PEAT I)
Week 2 Report (14-20 March 2009)

22 March 2009

We completed coring, logging, and most shipboard analyses at Site U1331 during this reporting period.

OPERATIONS

After the 1081 nm transit from Honolulu, we began positioning over Site U1331 (PEAT 1-C) at 2330 hr on 14 March. Once on site, we conducted a test of the dynamic positioning system while assembling the drill string in preparation for coring. We extended the bit and tagged the seafloor, raised the bit 10 m, and spudded Hole U1331A was at 0750 hr on 16 March (water depth of 5116.2 m).

Piston coring advanced the Hole U1331A to 138.2 m, which is above the depth of an inferred chert layer. We switched to the XCB coring system at this depth to make sure we didn't damage the APC coring tools. APC cores U1331A-1H through 15H cored cored 138.2 m and recovered 141.3 m of core (102%). Cores 1H to -11H were oriented for paleomagnetic studies. XCB coring advanced the hole from 138.2 m to the basement contact at about 190.6 m. Cores U1331A-15X to 21X cored 52.4 m and recovered 13.6 m (26%); the presence of chert reduced recovery. The last core recovered a short section of the basal carbonate section and a small piece of basalt at the bottom.

We then conditioned the hole with a sweep of high viscosity mud, filled the hole mud, pulled back in the hole to ~80 m, and conducted one logging run to total depth with the "paleo"-combo tool string (natural gamma, density, and magnetic susceptibility). The data provided very useful information on the high-priority lowermost sediment section and was used to guide a coring strategy in subsequent holes at this site. The planned second logging run was aborted because of problems with the logging winch.

The bit was pulled cleared the se floor at 0820 hr on 18 March, the vessel offset 20 m west of Hole U1331A, and Hole U1331B was spudded (water depth of 5116.3 mbsl). Hole U1331B was offset 5 m deeper than Hole U1331A to cover core gaps in the

first hole. Cores U1331B-1H to 17H cored 0 to 156.6 m and recovered 163.13 m (104%). Five formation temperature measurements made. APC and XCB coring from below the chert to the top of basement was not successful. The bit was pulled free of the sea floor at 2220 hr on 19 March and the vessel offset 20 m west of Hole U1331B.

Our third hole, Hole U1331C, was designed to be spot cored to fill in gaps in sedimentary record from the first two holes and to obtain core from below the chert. Hole U1331C was spudded with the APC at 0155 hr on 20 March (water depth 5116.9 mbsl). A total of 189 m of section was penetrated, 107 m of that was cored, and 109.5 m recovered (103%). The third attempt to core the short interval below the chert and above the top of basaltic oceanic crust was successful. Based on the condition of the cutting shoe and bent core barrel, the last core (U1331C-18H) more than vigorously encountered basement. The drill string was pulled free of the seafloor at 1300 hr on 21 March and we departed for Site PEAT-2C at 0500 hr on 22 March.

SCIENCE RESULTS

Three holes were cored at Site U1331. The sediment column at Site U1331 has a strong resemblance to that of ODP Site 1220, but with noteworthy sharp erosive contacts concentrated within the upper two thirds of the section. Six meters of Pleistocene-Pleiocene clay (Lithological unit I) overlie lower Oligocene to lowermost Oligocene nannofossil ooze (Lithological unit IIa), with a sharp lithological change at the Eocene Oligocene transition (~26 m) to alternating radiolarian ooze with nannofossils and nannofossil ooze (Unit IIb), grading into radiolarian ooze with nannofossils and clay with sporadic occurrences of chert (Lithological Unit IIIa), and the basal cherty interval (Lithological unit IIIb, down to ~157 m). Lithological unit IV, below the chert horizon and between 157 to 177 m is comprised of radiolarian ooze and nannofossil ooze with hydrothermal red staining, deposited on top of mid-ocean ridge basalt (Lithological Unit V, at 188.5 m). Carbonate content approaches 80% in Lithological unit IIa within the Oligocene nannofossil oozes, and cycles between 0 and 40% in the middle Eocene section (units II and III). There is a concentration of sharp erosive contacts apparent in the interval between 80 to 120 m, with calcareous material dominating the basal portion

of these contacts, and then fining upwards in grain size into the radiolarian oozes. Rarely, the sediment above a sharp contact contained well-rounded clasts up to 1 cm in diameter.

All major microfossil groups have been found in sediments from Site U1331, and provide a consistent and coherent biostratigraphic succession from basement up to the top of Lithological unit II. Radiolarian and nannofossil datums and zonal determinations agree, and range from nannofossil zone NP12 in the basal carbonate section (~51–53 million years before present, Ma) to NP 24, and radiolarian zones RP8 just above basement through to RP21 (late Oligocene, older than 25 Ma) in the uppermost section, below the Pleistocene clays. Marked differences in productivity indicators have been observed between the Eocene and Oligocene parts of the sections, which will help us to achieve one of the PEAT objectives. Apparent sedimentation rates in the radiolarian rich section between ~80 m and basement was deposited at a rate of 10 m/Myr, while the late middle Eocene to Oligocene section was deposited at a rate around 4 m/ Myr. The chert horizon spans a time interval of around 2–3 Myr. The presence of all major fossil groups as well as a detailed magnetostratigraphy will allow us to achieve one of the main PEAT objectives arrive at an integrated Cenozoic stratigraphy and age calibration.

A full physical property program was run on cores from all three holes, comprising whole-round multi-sensor core logger measurements of magnetic susceptibility, bulk density, P-wave velocity, non-contact resistivity and natural gamma radiation, followed by discrete measurements of color reflectance, index moisture and density properties, sound velocities and thermal conductivity. Magnetic susceptibility measurements are variable throughout the section, allowing a detailed correlation between different holes. Porosity values are generally high in the radiolarian rich sediments (80%), and decrease within the Oligocene carbonate section.

Using whole-round magnetic susceptibility measurements, Holes U1331A, U1331B and U1331C can be spliced to form a continuous section to ~150 m core composite depth (CCSF), with no apparent gaps. Between. ~177 and 188.5 m, Cores U1331A-22X, U1331C-16H and U1331C-17H achieved our site objective of recovering carbonate bearing material from the time interval just after 52 Ma.

A full range of paleomagnetic analyses was conducted on cores and samples from Site U1331. Shipboard analyses conducted so far suggest that a useful magnetic signal is

preserved in most APC cored intervals, helped by the use of an orientation ("Flexit") tool during coring. Preliminary comparison of biostatigraphic data and changes in magnetic paleo-declinations suggest the recovery of Oligocene magnetochrons to base of the middle Eocene (C21n, ~47 Ma).

A standard shipboard suite of geochemical analysis of pore water, organic and inorganic properties was conducted on sediments from Site U1331, including a pilot study of high-resolution "Rhizon" pore water sampling, which does not require the cutting of core whole rounds for squeezing. Carbonate concentrations are ~80% in the Oligocene nannofossil ooze, and sporadic horizons with up to 40% $CaCO_3$ occur in the radiolarian rich oozes.

TECHNICAL SUPPORT AND HSE ACTIVITES

During this week, the technical staff was fully engaged with (1) processing the cores through the labs, (2) continuing to facilitate the scientists in learning their instruments, methods and data processing steps, and (3) solving problems with new equipment as they arise. Processing of cores and samples from Holes U1331A and U1331B are mostly finished; those from Hole U1331C are being processed.

The technical staff prepared the seismic source and deployment system, in preparation for testing the seismic source at Site PEAT-3C. A vertical seismic profile may be conducted at Sites PEAT-4C and -6C.

Review of current inventory on board the ship is being conducted to ensure appropriate supplies are secured for the next expedition. A fire and boat drill was held on March 21 for the entire ship's complement.