Expedition 320: Pacific Equatorial Age Transect (PEAT I)
Week 3 Report (21-28 March 2009)

29 March 2009

OPERATIONS

We cored three holes at Site U1332 (Site PEAT-2C). Hole U1332A provided well-recovered, high quality APC cores from the mudline to 125.9 m CSF-A. Core U1332-14H encountered chert after which we switched to XCB coring. XCB coring advanced to 152.4 m DSF, through a ~10 m cherty interval with reduced recovery. In the basal section, XCB Core U1332A-18X recovered a short, ~3.8 m long interval of barren very dense and stiff clay above basalt. The basalt was reached at 152.4 m CSF-A, ~10 m shallower than predicted from the seismic data. Hole U1332A cored 152.4 m and recovered 145.6 m (96%).

A single logging run with the natural gamma, density, and magnetic susceptibility tools obtained good data from basement up to the bit at ~80 m DSF. The logging wireline parted when attempting to get the tool string back into the drill pipe. Multiple attempts to retrieve the tool string failed, so we isolated the logging tool in Hole U1332A under 35 m of cement.

We started coring Hole U1332B with the bit offset 5 m deeper than the seafloor depth established for Hole U1332A. Hole U1332B cored to basement at 148.6 m CSF-A where we recovered ~2.4 m of dark brown sediment above several small pieces of basalt. Hole U1332B cored a total of 148.6 m and recovered 141.8 m (95%).

Hole U13323C was designed to provide stratigraphic overlap, and confirm stratigraphic correlations made between the first two holes. Operations are nearing completion at Hole U1332C during the writing of this report.

SCIENCE RESULTS

Site U1332 was located on 50 Ma oceanic crust so that we could core the interval between 50 and 48 Ma in basal carbonate sediments above the CCD, the second oldest time slice of the PEAT Program. Another objective was to obtain the second deepest

paleo-depth constraint for the Oligocene sediments above the CCD (~4 km during the Eocene-Oligocene transition).

At Site U1332, basalt is overlain by approximately 150 m of pelagic sediments that are divided into four major lithologic units. Unit I is an ~17.7 m-thick, light yellowish brown clay with radiolarians that grades downhole into a very dark grayish brown zeolite clay at ~11 m. Unit II extends from ~17.7 m to 75 m and is composed of Oligocene biogenic sediments. These sediments are dominated by brown to white nannofossil ooze but radiolarian ooze is a secondary major lithologic component in the upper 13 m of this unit. Unit III extends from ~75 m to 126 m and is composed of Eocene biogenic sediments. These sediments are dominated by brown to very dark brown radiolarian ooze but nannofossil ooze is a secondary major lithologic component between ~84 m and 118 m. Unit IV extends from ~126 m to 150 m and is composed of dark brown radiolarian ooze, porcellanite, and very dark brown to black clay. At the base of Hole U1332A, a 16 cm-long piece of calcite-veined basalt was recovered.

The recovered sediments span a near continuous succession from around the Oligocene/Miocene boundary to the early/middle Eocene boundary. Radiolarians are common and well preserved in the Eocene succession but less well preserved in the Oligocene carbonates. There appears to be a complete sequence of radiolarian zones from RN1 down to RP 14 (middle Eocene), just above the top of the cherty interval. Calcareous nannofossils are present and moderately well preserved throughout the Oligocene sequence of alternating nannofossil and radiolarian oozes. The top of the Eocene-Oligocene transition interval is well constrained by the top occurrence of *Coccolithus formosus*. Nannofossils become very poorly preserved or absent through the late Eocene, equivalent to nannofossil zones NP18-20. Middle to late Eocene sediments were recovered with moderately to poorly preserved but generally common to abundant nannofossil assemblages from nannofossil zones NP15 to NP17. The red-brown clays lying directly on basement basalt contain a dissolution-modified assemblage of discoasters that indicate zones NP13-14, close to the lower-middle Eocene boundary, and close to the predicted basement age (48.4-50.7 Ma). Moderately well preserved and relatively abundant planktic foraminiferal assemblages were recovered from the Oligocene succession, equivalent to zones O1 to O6. All Eocene sediments were barren

of planktic foraminifera. Benthic foraminifers were sporadically present and indicate lower bathyal to abyssal paleodepths.

The natural remanent magnetizations reveal a very clear record of geomagnetic field reversals that extend from the Brunhes Chron (0-0.78 Ma) to the top of Chron C2Ar (3.596 Ma) between 0 and 11 m and from the base of Chron C6An.1r (20.439 Ma) to the top of Chron C20n (42.536 Ma) between 14 and 125 m. Site U1332 has so far yielded excellent palaeomagnetic results, that will achieve many of the objectives set out for a detailed intercalibration of bio-, magneto, and other stratigraphies.

Interstitial water analyses indicate dissolved silica concentrations generally increase downhole except for a distinct minimum at ~80 m CSF-A, possibly related to lithological changes at the E/O boundary. Phosphate concentrations decrease with depth, in the upper 30 m. Increasing chloride in the upper 30 m might possibly be related to elevated glacial salinities. Boron and Lithium concentrations show a rapid decrease at ~40 m CSF-A – a zone that also exhibits minima in alkalinity, calcium and magnesium concentrations in the interstitial water, and high (up to 90%) bulk sediment $CaCO_3$ content. A 30 m interval in Hole U1332C was sampled at high resolution (2 per 1.5 m core section) using Rhizon samplers to investigate geochemical gradients defined by pore water data from interstitial water whole rounds.

Whole round and split core sections from all three sites were analyzed on the track systems for magnetic susceptibility, bulk density, P-wave velocity, non-contact resistivity, natural gamma radiation, and color reflectance. Discrete measurements of moisture and density properties, sonic velocity and thermal conductivity were conducted on split core sections from. The track data allow a detailed correlation between different holes primarily using magnetic susceptibility and density. MS varies from ~25×10^{-5} SI in radiolarian ooze dominated sections to ~5×10^{-5} SI in more carbonate-rich intervals. Natural gamma measurements are elevated by an order of magnitude in the uppermost clay layer. Velocities are low and show little variation except for relative highs occurring around lithological boundaries. Bulk density and grain density show a marked increase in carbonate-rich sections. Porosity values are generally high in the radiolarian rich sediments (80-90%), and decrease within the carbonate-rich section (~70%).

At present, we have developed a composite depth section down to the top of the chert interval, near 150 m CCSF-A depth. This will be used to construct a splice representing a complete stratigraphic section to at least 150 m CCSF-A depth based primarily on hole-to-hole correlation of magnetic susceptibility data, which are currently being refined with GRA bulk density and other data.

Downhole natural gamma, density, and magnetic susceptibility logs provide important constraints on the poorly recovered lithologies below and between chert horizons. The logging data documents the occurrence of two thin chert horizons around 126 and 130 m WSF and an approximately 14 m thick interval of increased magnetic susceptibility, reduced conductivity, and enhanced density and photo-electric factor that appears to be the dark and dense clays and zeolitic clays above basement, rather than carbonate.

Eight formation temperature measurements (APCT-3) were conducted in Holes U1332B and U1332C. Three of these yielded good data and will be used together with the core thermal conductivity measurements to derived estimates of heat flow at this site. Tool movement caused by ship heave (up to 3 m) negatively impacted the other measurements.

TECHNICAL SUPPORT AND HSE ACTIVITES

The focus of the technical staff has been supporting core/sample processing through the labs and maintaining the associated instruments and controlling software. Ongoing projects included the organization of the storerooms and inventory updates for the labs.

A fire and boat drill was held 21 March for the entire ship's complement.
Eye wash stations were installed in the thin section lab, the two hazardous stores lockers, chemistry lab, and downhole lab. First aid boxes were distributed throughout the labs.