Expedition 321: Pacific Equatorial Age Transect (PEAT II)
Week 5 Report (31 May – 6 June 2009)

08 June 2009

OPERATIONS

Hole U1337D was spudded at 1645 hr 30 May with the APC. Recovery of Core 1H placed the seafloor depth, corrected to the rig floor dual elevator stool, at 4476.5 m DRF. APC coring continued through Core 26H to a depth of 237.7 m DSF. Non-magnetic core barrels were used through Core 20H. The FLEXIT core orientation system was deployed successfully with all APC cores and with the exception of Core 22H all barrels fully stroked. Over pull ranged as high as 90 kips. The XCB was used to core through a hard ~0.5 m thick porcellanite ("baby chert") layer and then the APC was used again to core 267.0 m DSF. The XCB coring system was used for Cores 31X through 49X to a total depth of 442.9 m DSF. Total recovery for Hole U1337D using APC was 102.9% while recovery with the XCB coring system was 89.6%. A much higher incidence of imploded or split liners plagued this hole, for which a definitive was not determined. Overall recovery for Site U1337, using both APC and XCB coring systems, was 96.0%. The drill string was recovered, the BHA racked back in the derrick, and the rig floor secured for transit. At 1625 hr 2 June control was switched from DP to cruise mode on the bridge and the ship got underway for Site U1338 (PEAT-8D).

In relatively mild seas and moderate wind the vessel made good time averaging 10.5 kt for the 324 nmi transit. Thrusters and hydrophones were lowered and at 2320 hr 3 June and control was switched from bridge cruise mode to DP. After three attempts a suitable mudline core was obtained, establishing a seafloor depth of 4210.8 m DRF. APC coring continued through Core 24H to a depth of 221.2 m DSF using non-magnetic coring assemblies and with the FLEXIT orientation tool installed. Because of overpull forces we switched to steel core barrels beginning with Core 25H. APC coring eventually ended with Core 26H at a depth of 240.2 m DSF. All barrels fully stroked but last three cores required drill over to extract from the formation. Five successful APCT3 temperature measurements were obtained at 40.7, 59.7, 78.7, 97.7 and 116.7 m DSF respectively. Average core recovery for the APC was 104.5%. XCB coring continued with XCB Cores 27X – 44X achieving an average recovery of 55.9 %. A small piece of basement was recovered in the core catcher of Core 44X end coring at a total depth for Hole U1338A of 410.0 m DSF. XCB coring performance was highly variable with some cores achieving near 100% recovery while others recovered less than 1% and sometimes zero. In the areas of little or no recovery there were diatom mats and chert fragments in the surrounding cores. Overall recovery for the hole using both APC and XCB coring systems was 84.4%. The drill string was pulled clear of the seafloor at 1900 hr 6 June officially ending Hole U1338A. At 2330 hr 6 June, Hole U1338B was spudded after offsetting the ship 20 m to the west

SCIENCE RESULTS

Site U1337

Hole U1337D was planned to target the few remaining areas that had yet to be fully recovered and to duplicate recovery through those sections of the formation already recovered to provide additional sample material. The most troublesome material encountered previously was the large

diatom mats located directly above and below a hard ~0.5 m thick porcellanite (“baby chert”) layer.

Scientists completed processing cores from Hole U1337C and began working on cores from Hole U1337D. The bottom section of Hole U1337C contained nannofossil chalk with sharp color change from light green to pale yellow ~393 m CSF-A. The base of Hole U1337C continues into basement 34 cm as aphanitic basalt. The basalt is fractured and cemented with 2 stages of calcite veins, the latest showing mm-sized euhedral calcite crystals along surface of incompletely filled fracture.

Lithological descriptions from Hole U1337D are consistent with same intervals recovered in previous holes and consist of cyclic alternations between main lithologies that reflect varying amounts of nannofossils, radiolarian and diatoms. Cores U1337D-4H through 20H are intensely bioturbated and thin color bands and color lamina overprint most of the lithologies. Several large dolomite concretions were encountered. Core U1337D-18H contains the first appearance of major laminated diatom ooze interbedded with nannofossil ooze and diatom nannofossil ooze. These laminated "diatom mat" intervals contain abundant *Thalassiothrix* group diatoms. Occasional thin lamina (mm) of porcellanite also occurs within these units. More than 18 m of laminated diatom ooze intervals were recovered in total from Hole U1337D. The basement at Hole U1337D was recovered on Core 49X at 442.9 m DSF. Core 49X contained numerous small (mm) grains of black opaque manganese oxides and aphanitic basalt at the bottom. Basalt shows 1-2 mm vesicular texture along cut surface, with thin veins of calcite filling fracture, and limonite alteration rind through cut surface.

The sedimentary sequence at Site U1337 is divided into four major lithological units. The upper part of the sedimentary sequence (0 to 93.35 m CSF-A, Unit I) is characterized by an alternating sequence of multi-colored nannofossil, diatom and radiolarian oozes of latest Miocene to Pleistocene age. Gray and green biosiliceous (diatom and radiolarian) ooze with varying amounts of nannofossils comprises Unit II (93.35 to 214 m CSF-A). Unit III predominantly consists of white, yellow, green, brown and gray nannofossil ooze and chalk of late Oligocene to early late Miocene age, with generally low but sometimes common abundances of siliceous microfossils. Unit IV comprises aphanitic basalt of late Oligocene age.

The section at Site U1337D seems continuous and contains a full suite of microfossils including planktic and benthic foraminifers, calcareous nannofossils, radiolarians and diatoms. The Miocene shows slightly higher rates of sedimentation compared to the Pliocene/Pleistocene section. The nannofossil, foraminiferal, radiolarian, and diatom datums and zonal schemes generally agree, though some discrepancies occur in the lowest part of the core. Diatoms and radiolarians are well represented throughout the section. The dominance of biogenic silica decreases progressively downhole, resulting in increase and better preservation of the biogenic carbonate. The base of Hole U1337D is uppermost Oligocene (between 23.2 and 24.4 Ma). Calcareous nannofossil and foraminifer abundance and preservation vary markedly through the sediment column, ranging from samples dominated by calcareous microfossils to samples which are almost barren. The nannofossil assemblages are relatively diverse and provide an excellent biostratigraphic framework. Benthic foraminifers are generally well preserved throughout the succession, although abundances fluctuate considerably.

Natural gamma radiation was measured on cores from Hole U1337D. The highest counts per second (cps) are present in the upper 10 m of the sediment column, with values of approximately 65 cps near the seafloor. The strength of the NGR signal decreases from lithologic Unit II to Unit III with most of the variation centered at about 2 counts per second (cps). NGR counts increased to 8 cps around the chert rubble interval in Core 321-U1337D-28H.

The whole-core magnetic susceptibility measurements (MS) correlate well with the major differences in lithology and are highest in Unit I. These variations are characterized by low values in more calcareous intervals and higher values in more siliceous intervals. Across the boundary between Units I and II MS decreases from ~14 to near 2 $x10^{-5}$ SI and remains low for the remainder of the section. There is an increase in the magnetic susceptibility in Unit II from ~ 2 to ~15 $x10^{-5}$ SI at 180 m CSF-A associated with the diatom-rich interval at this depth. Below 180 m CSF-A the susceptibility drops back to 2 $x10^{-5}$ SI for the remainder of Unit II. In Unit III, a similar increase from ~ 2 to ~13 $x10^{-5}$ SI at 340 m CSF-A is associated with a diatom-rich interval.

Variations in grain density follow the changes in lithology. The lithologically diverse Units I and II are characterized by a wide range in grain density (2.17-2.85 g/cm^3) and a low average grain density (2.51 g/cm^3). The more uniform and more calcareous nannofossil ooze of Unit III is characterized by a reduced range in grain density (2.30-2.82 g/cm^3) and a higher average grain density (2.67 g/cm^3).

Natural remanent magnetization (NRM) of archive-half sections of 30 APC cores from Hole U1337D was measured. The Flexit core orientation tool was deployed in conjunction with all APC cores. Measurements of NRM above ~93 m CSF-A indicate moderate magnetization intensities with a patchy but generally weak viscous (VRM) or isothermal remanent magnetic (IRM) coring overprint and polarity reversal sequences are usually clearly recognized. Below ~93 m CSF-A, remanence intensities after AF demagnetization at peak fields of 20 mT are reduced to values close to magnetometer noise level in the shipboard environment. In this zone, sediment magnetizations have been partly overprinted during the coring process.

Site U1338

Site U1338 is drilled to obtain a time slice within 2 degrees of the equator from 18 to 3 Ma. It will tie the PEAT drilling to the ODP Leg 138 latitudinal transect on 10 Ma crust. The recovered sediments will be used to better understand both the Middle Miocene climate optimum and the long cooling trend from there to the present. Site U1338 will also sample another copy of the major middle-late Miocene diatom depositional events found at Site U1337 but not further northwest. An alternate Site, PEAT-8D was proposed early in the expedition, located uphill and to the southeast of PEAT-8C to avoid potential turbidites from a seamount 10 km to the NW of PEAT-8C.

Scientists continue to process cores from Hole U1338A. Sediments from upper part of Hole U1338A are predominantly nannofossil ooze containing varying amounts of minor components (radiolarians, diatoms and calcite). Colors vary from dark grayish brown to pale brown (Cores 1H and 2H) and light greenish gray (beginning in Core 3H). Cores U1338A-4H through 14H

consists of a few thin intervals of increased diatom abundance. Intensive mottling and thin color banding occurs throughout most of this interval. Sediments are predominantly nannofossil ooze with cyclic alternations of thin intervals containing slightly more biosiliceous components. Thin diagenetic color banding and fine-grained pyrite, mainly filling burrow structures, occurs throughout the entire interval. Core U1338A-15H contained ~ 1.5 m of laminated diatom ooze. Core U1338A-29X did not recover sediment except for a large concretion of dolomite in the core catcher. The Pliocene/Pleistocene boundary based on planktic foraminifers and calcareous nannofossils was found within Core 3H (18.25-22.16 m CSF-A) and the Miocene/Pliocene boundary between Cores 8H and 9H (64.51-75.15 m CSF-A). Sediments accumulated above basement were dated at 17.7 Ma.

The APCT-3 temperature tool was deployed with Cores 5H, 7H, 9H, 11H and 13H. The estimated thermal gradient based on APCT-3 measurements is 36.5 °C/km. Data from the whole round multisensor track were downloaded for stratigraphic correlation. Whole round fast-track, multisensor track and natural gamma measurements were completed on Cores U1338A-15H through 33X. Moisture and density (MAD) measurements were completed up to Core U1338A-29X. Analyses of the data are in progress. Geochemical analyses continue on interstitial water and bulk sediment samples from Hole U1338A. Paleomagnetic measurements continue on cores from Hole U1338A.

TECHNICAL SUPPORT AND HSE ACTIVITES

The shipboard labs continue to process cores and samples from Site U1338. The core lab was cleaned for Site U1338 cores during the transit between sites. The gas tank bays were re-arranged to make it easier access to argon gas bottles, and the inlets to the argon and helium gas lines were also modified. The liquid nitrogen generator was started to begin filling the tank so that portable dewars can be filled prior to the next expedition.