IODP Expedition 342: Paleogene Newfoundland Sediment Drifts
Week 5 Report (1-7 July 2012)

OPERATIONS

Coring in Hole U1406A (3815 m water depth) continued with Cores U1406A-4H through 25H (34.7-217.7 m drilling depth below seafloor [DSF]). Core U1406A-16H experienced the first partial stroke and the APC system was advanced by recovery for this and subsequent cores. The XCB system was deployed for Cores U1406A-26X through 34X to a total depth of 283.3 m DSF. The seafloor was cleared at 1920 h on 2 July 2012, ending Hole U1406A. Overall core recovery for Hole U1406A was 267.30 m for the 283.3 m interval cored (94%). The vessel was offset 20 m to the east and Hole U1406B (3814 m water depth) was spudded at 2055 h on 2 July. Cores U1406B-1H through 22H were retrieved to 188.8 m DSF and the XCB system was deployed for Cores U1406B-23X through 30X to a total depth of 253.6 m DSF. The seafloor was cleared at 1435 h on 4 July, ending Hole U1406B. The recovery for Hole U1406B was 241.34 m over the 253.6 m cored (95%). The vessel was offset 20 m to the south and Hole U1406C was spudded at 1630 h on 4 July. Cores U1406C-1H through 18H were recovered to 161.4 m DSF and the XCB system was deployed to final depth at 241.4 m DSF. Two intervals (2 m and 3 m, respectively) were drilled without coring to cover coring gaps in previous holes. The seafloor was cleared at 0500 h on 6 July.

After clearing the seafloor the drill string was tripped to the surface. The BHA was set back in the derrick with the exception of the lower seal bore drill collar plus subs. The Schlumberger wireline logging tools were then rigged up to conduct a pass-through check on the lower portion of the BHA; the tools were not able to pass through the BHA. The drill floor was secured at 1600 h on 6 July, ending Hole U1406C. The acoustic positioning beacon was recovered and the vessel began the move to Site U1405 to recover the beacon that had been left behind because of weather considerations. The vessel arrived at Site U1407 (proposed site SENR-20A) after a 135 nmi transit from Site U1406. The passage from Site U1406 took 13.25 hours at 10.0 knots. The vessel

stabilized over Site U1407 at 0800 h (UTC-2.5 h) on 7 July. Hole U1407A (3073 m water depth) was spudded at 1655 h on 7 July and Cores U1407A-1H through 9H (0-82.8 m DSF) were recovered

SCIENCE RESULTS

Site U1406 is the last and shallowest site drilled on the J Anomaly Ridge, located in a mid-depth position in the Expedition 342 Paleogene Newfoundland Sediment Drifts depth transect. The site is positioned to capture a record of sedimentation more than 1.1 km shallower than the largely sub-carbonate compensation depth record drilled at IODP Site U1403. Site U1406 is situated to be sensitive to both increases and decreases in carbonate burial, whether these reflect variations in dissolution related to changes in the CCD, changes in carbonate production, or variations in background non-carbonate sedimentation.

Our primary scientific objectives for drilling Site U1406 were (1) to reconstruct Paleogene CCD changes in a primarily carbonate-dominated record, (2) to obtain records of the Oligocene-Miocene and Eocene Oligocene transition events in carbonate-rich sediments that host abundant foraminifers suitable to the construction of geochemical climate records, (3) to evaluate the history of deep water and possible northern hemisphere glaciation on sediment chemistry, grain-size and provenance, and (4) to evaluate biological evolution during Paleogene climate transitions.

The Pleistocene to Paleocene sediments from Site U1406 are distinctly calcareous (average CaCO3 ~50 wt%) compared to Sites U1403 through U1405, and comprise 290 m of nannofossil ooze, nannofossil clay and nannofossil chalk. The downhole sedimentary sequence reveals four lithostratigraphic units. Unit I spans the upper ~2 m and is comprised of extensively bioturbated, brown Pleistocene nannofossil foraminiferal ooze with manganese nodules. A homogenous, light yellow to light greenish grey clayey nannofossil ooze with foraminifers delineates the Unit I/Unit II boundary, and is underlain by ~180 m Oligocene to Miocene aged nannofossil ooze. The vast majority of

Unit II is moderately to well bioturbated, light greenish gray, and contains common ~1-cm thick glauconitic layers. The ~60-m thick Unit III contains Middle Eocene to Early Oligocene nannofossil chalks with foraminifers and is separated from the overlying unit on the basis of the ooze/chalk transition. Unit III contains native copper-like metallogenic phases in thin veins and as single crystals. The Paleocene to middle Eocene nannofossil chalk to nannofossil chalk with radiolarians are delineated as Unit IV primarily on the basis of color, with somewhat pink, light grayish brown chalks and somewhat green, light grayish chalks present in Units IV and III, respectively. Site U1406 is made up of a highly expanded Oligocene-Miocene succession and an Eocene-Oligocene transition that is richer in calcium carbonate than at Site U1404.

Biostratigraphy at Site U1406 is based on nannofossils and planktic and benthic foraminifers throughout the 281-m thick Pleistocene to middle Paleocene succession of nannofossil ooze with varying amounts of clay and biosiliceous material (mainly radiolarians). Radiolarians are absent from the ~105-m thick interval spanning the Oligocene-Eocene. The lower Miocene (~17 Ma) to middle Eocene (48 Ma) and uppermost (~56.5 Ma) to middle (~60 Ma) Paleocene successions appears to be stratigraphically complete, at the resolution of shipboard biostratigraphy. A significant hiatus exists between the middle Eocene and uppermost Paleocene, which includes the entire lower Eocene and uppermost Paleocene, including the PETM. The Eocene/Oligocene transition falls within nannofossil zone NP21, which is identified by the top *Coccolithus formosus* and top *Discoaster saipanensis* at 199 m core depth below seafloor (CSF-A). Carbonate is continuously present across the transition interval and through the upper to middle Eocene. Preservation of calcareous nannofossils and planktic foraminifers is good to very good through this interval. Siliceous microfossils are more poorly preserved than in the lower Miocene and upper Oligocene at Sites U1404 and U1405, and diatoms are consistently rare or absent. The Paleocene radiolarian assemblages appear to span a late Paleocene gap in the existing biozonation and include the first occurrences of several species previously known only from the earliest Eocene. In general, well-preserved benthic foraminifers reflect high productivity for the upper

Eocene to Miocene sequence and lower productivity in Paleocene to middle Eocene sediments.

The paleomagnetism team completed routine demagnetization measurements on archive section halves from Holes U1406A, U1406B and U1406C. For Hole U1406A, step-wise demagnetization, bulk susceptibility and AMS measurements were conducted on selected samples. Further analysis of Site U1405 data resulted in two series of magnetozones that can be correlated to C5Br / C5Cn.1n (15.974 Ma) through C5Cn.2r / C5Cn.3n (16.543 Ma) and C6Bn.2n/C6Br (22.268 Ma) through C6Cn.3n / C6Cr (23.295 Ma) for Hole U1405A. We have identified the Oligocene-Miocene transition, which is marked by the base of Chron C6Cn.2n (23.030 Ma), at ~160-170 m CSF-A. Hole U1405A magnetostratigraphy indicates at least two substantial (1-3 my) unconformities during rapid (~33-57 m/my) deposition of the Middle-Late Miocene green clay drift deposits, whereas in Holes U1405B and U1405C, we clearly recognize only one of these hiatuses.

The stratigraphic correlation team completed a composite depth scale and spliced record for Site U1404. A very tentative composite depth scale and spliced record for Holes U1405A, U1405B and U1405C was also constructed. The homogeneity of the green clay at Site U1405 means that splicing is not straightforward. Also pronounced sedimentation differences appear to be present between the three holes. Shore-based work is needed to test the composite depth scale and confirm the shipboard hypothesized sedimentation history. Splicing at Site U1406 has proven more straightforward because clearer signals in magnetic susceptibility and gamma ray attenuation data are present in the three holes drilled, attributable to higher calcium carbonate contents compared to Sites U1404 and U1405. At Site U1406, real-time depth-assessment was possible, some adjustments were made to drilling operations and a complete Eocene/Oligocene transition was recovered.

The geochemistry program completed analysis of Site U1405 sediments by coulometry and flash elemental analysis for total carbon, inorganic carbon, total nitrogen, and total sulfur contents. These measurements were done in parallel with analysis of interstitial water constituents from Sites U1405 and U1406. In addition, sediment samples from Site

U1404 containing high total organic carbon contents were measured by source rock analysis to determine the type and preservation of organic matter in the sediment samples. As the week progressed, the geochemistry program focused work on carbonate samples from Site U1406. Following completion of the analysis of samples from Hole U1406A, it was apparent that a middle Eocene sequence containing several excursions in carbonate contents was recovered so we conducted high-resolution sampling of this interval (Cores U14046B-23H to 30X and Cores U1406C-22H, 24X, and 25X). These cores were sampled at 50 cm resolution and subsequently analyzed for inorganic carbon contents by coulometry. Operations at Site U1407 commenced at the end of the week and the geochemistry program began to measure pore fluid constituents from 5 cm-long, whole round samples from Hole U1407A.

A full physical properties program was run on cores from all three holes at Site U1406 and for Hole U1407A. This included Whole-Round Multisensor Logger (WRMSL) measurements for magnetic susceptibility, bulk density, P-wave velocity, and natural gamma radiation (NGR), followed by discrete measurements on section halves for color reflectance, magnetic susceptibility, moisture and density properties, and compressional wave velocity. The report for Site U1405 was finalized and results show two major trends in almost all physical properties, one in each lithostratigraphic unit.

EDUCATION AND OUTREACH

The newest video, “Episode 3: Time Machine”, was released on YouTube just two days ago and already has about 300 views. The videographer has begun work on the fourth video. Five blog entries were posted on the JoidesResolution.org website. The most popular was the informal interview with scientist Chris Junium. There were only two videoconference broadcasts this week. Paleontologist Paul Bown answered questions for the Marine Science Summer Camp in Cape May, NJ. Paleontologist Chris Hollis and his team at GNS orchestrated a large event with the New Zealand’s Wellington Museum of Sea and Sky. The morning’s event included a live broadcast with Caitlin Scully, Chris Hollis and Paul Wilson, examples of sediment cores, microscopes with foraminifers, and

prizes for the audience. The event was very successful and the mixed group had great questions. The *JOIDES Resolution* was also the star of a three-minute segment on KBTX, a local TV station in College Station, Texas. Sandy Kirtland Turner and Peter Blum did a great job answering questions before our time was cut short. Posts continue on Facebook, Twitter, and tumblr.

TECHNICAL SUPPORT AND HSE ACTIVITIES

The shipboard labs have been busy processing cores. A fire and boat drill was held on Monday, 2 July. Eye wash stations were tested Monday July 2.