

IODP Expedition 324: Shastky Rise Formation

Week 3 Report (20-26 September 2009)

27 September 09

OPERATIONS

The 370 nmi voyage to Site U1347 (SRSH-3B) was completed at 1730 hr on 21 September (average speed of 8.0 knots). The vessel's progress on the southerly course was impeded by strong head winds and rough sea and swell generated by the outer fringes of Typhoon Choi-Wan. Even though this "Super Typhoon" was nearly 1000 nmi west of us and moving in the opposite direction, it was responsible for generating near gale force winds at our location.

After the driller tagged seafloor at a depth of 3461.0 m DRF, Hole U1347A was spudded with the rotary core barrel at 0710 hr on 22 September. The hole was drilled with a wash barrel in place to a depth of 71.0 m CSF-A where rotary coring was initiated. While coring the interval from 71 to 109 m, the average recovery was ~5% due to chert fragments jamming in the core catcher. As the hole was extended beyond this depth, recovery and penetration rate improved because chert became much less prevalent. We reached basaltic basement at a depth of ~158 m CSF-A. Coring into basement continued until 2145 hr on 25 September when operations were suspended in order to change to a fresh bit after the present rotary bit had accumulated 60 rotating hours. After flushing the hole with a 50-barrel mud sweep, the drill string was pulled back to 155 m CSF-A and the hole displaced with 57 barrels of heavy mud.

A Free Fall Funnel (FFF) was made up and deployed at 0130 hr on 26 September. The TV camera system (VIT) was then launched to monitor the extraction of the bit through the FFF. Shortly after the VIT was suspended ~10 m above the FFF, a hydraulic supply hose to the VIT winch ruptured resulting in the TV camera frame rapidly descending a short distance where it came in contact with the lip of the deployed FFF. It required one hour for the rig mechanic to replace the defective hose. Once the repairs were concluded,

the bit cleared of FFF at 0515 hr. After the VIT was recovered, an inspection of the camera assembly indicated no obvious damage except for a slightly bent compass arm.

The coring results with the first bit were 71 m drilled and 171.7 m cored with an average recovery of 32.4%. The cored interval of basement was 84.7 m with an average recovery of 46.5% and an average rate of penetration of 1.8 m/hr. While coring with the first bit, heave frequently exceeded 3 m making it difficult to keep the bit on the bottom of the hole. An inspection of the bit indicated that the bit body was under-gauge by ~3/8-inch. With the exception of two chipped teeth, the cutting structure was intact as well as the cone seals. There was some noticeable shirt tail wear, but overall the bit was in remarkably good condition for the accumulated hours.

SCIENCE RESULTS

Site U1347 (Prospectus Site SRSH-3B) is located on the upper slope of the east side of the summit of the Southern High (“TAMU Massif”), the highest and largest volcanic edifice of Shatsky Rise. TAMU Massif is considered to represent the main phase of the initial Shatsky Rise formation stage. At this site a deep (up to 300 m basement penetration) hole is planned to recover fresh and hopefully multiple lava flows from early Shatsky Rise eruptions. The exact location of this site was chosen because of the relatively thin sediment cover (estimated to be ~154 m based on seismic site survey data) and because of the special character of the igneous basement. In most locations on the summit and southern flank of TAMU Massif, the upper igneous basement appears layered indicating the presence of late stage sills or lava flows interbedded with sediment (such as recovered during Leg 198 at Site 1213 at the southern flank of TAMU Massif). At Site U1347, this layered basement appears to be thin (estimated ~80 m thick) and more normal igneous basement is closer to the surface.

Coring of Hole U1347A commenced at a depth of 71 m CSF-A and yielded a total of ~18 m of sediment in the first eleven cores, before reaching the first basaltic rock in Core U1347A-11R at 157.6 m CSF-A, only 4 m deeper than predicted. The recovered sediments were all deposited in fully marine environments, as the large radiolarian

component testifies, but exhibit a strong volcanogenic influence throughout. So far, these sediments have been divided into three broad stratigraphic units. Unit I, representing the stratigraphically highest sediments, is composed predominantly of chert and chalk fragments (poorly recovered) and is similar in composition and recovery to the Unit I sediments described at Site U1346. Unit II sediments are cross-bedded, glauconitic, carbonate-bearing radiolarites, probably deposited in a very shallow marine environment close to a volcanic source. Unit III contains a significant thickness of sandy siltstones and clays of volcanogenic origin, probably deposited in a lower shoreface to offshore environment.

The calcareous nannofossil assemblage observed in sediments of Unit I and II has a low diversity and is primarily dominated by Watznaueriaceae with a small proportion of Chiastozygazeae. The absence of commonly used marker species, except for *C. cuvillieri*, greatly hinders the biostratigraphic age control. Benthic foraminifera are sporadically present through Cores U1347A-6R to -8R with low abundance. Precise paleodepth interpretations need further examination, yet the three genera recorded to date are the same faunal elements as those observed in the previous Site U1346 assemblage, implying a neritic-upper bathyal setting supporting the suggested relative shallow depositional environment. Planktonic foraminifera are completely absent; instead, radiolaria are common to dominant.

Core U1347A-11R (157.4 to 159.6 m CSF-A) recovered the basement/sediment contact, marked by a lava top consisting of glass-rimmed fragments passing down into a massive flow core. Downhole, the succession continued into a series of five large basaltic lava flow units of an estimated 8-10 m thickness each. Where recovered, each has a chilled, rubbly, glassy top, and a uniformly massive core, with narrow basal chill margin and glassy contact. In two cases a mud- to sandstone sedimentary bed of 1-2 m thickness occurs interlayered between the uppermost massive lava flows of this succession perhaps explaining the layered character of the upper igneous basement seen in the seismic data. However, sedimentary intervals are absent below 210 m CSF-A so far, ~52 m below the top of the (layered) volcanic basement. If no more sediment intervals are recovered, the

beginning of the more typical, non-layered basement apparently occurs somewhat higher than predicted by the seismic data.

The uppermost large lava units (layered basement) have vesicular tops, sparsely vesicular cores with occasional pipe vesicles, and a minor increase in vesicularity in the narrow basal chill zones. Compared to Hole U1346A on Shirshov Massif, these basalts are much less altered, have volcanic glass abundantly preserved in numerous different intervals, and some flows are plagioclase-phyric containing large numbers of individual lath-shape crystals (ca. 5 to 8 mm in size) or glomerocrysts of interlocking acicular plagioclase. The first thin sections have been made and are being analyzed at this moment. The lower igneous units (tentatively believed to represent the non-layered basement) are currently still under investigation.

Structural investigation confirmed the interpretation that the recovered igneous units show dominantly massive flow character, similar to the units cored at Hole 1213B during Leg 198, with a transition to more and dominant pillow structures in the lower part (non-layered basement?) and heterogeneously distributed cracks and veins. Boundaries between sedimentary intervals and the upper massive flows of basaltic rocks are often preserved as chilled margins of the basalts in contact with baked sediment. The boundaries are perpendicular and partly oblique orientated to the core. The structural data of some veins are tentatively interpreted to reflect the gravitative stress (e.g., loading of lavas) resulting in orientations and morphologies of en echelon and sigmoidal structures.

Scientists are awaiting the first geochemical analyses from lava flows of Hole U1347A to compare with those recovered in Leg 198 Hole 1213B to test the speculation that lava flows of the widespread layered basement can be correlated over long distances on the TAMU Massif.

Although the alteration specialists began their investigation of Site U1347 rocks, most of their time during this week was spent by catching up with the macroscopic and microscopic description of alteration features in the highly altered cores from the

previous Site U1346. Upon completion of the entire thin section template entries into the new data capture application (DESClogik) by the igneous, alteration and structural lab groups, all data (saved in DESClogik workspaces for each thin section) was uploaded to the LIMS database. Photomicrographs of important alteration features were uploaded to LIMS as well. Also, XRD data of alteration minerals in samples from Hole U1346A have been interpreted.

Similarly to the alteration group, many other lab groups finished and wrapped up their work on samples and data obtained from the previous site during this week. The geochemistry group completed their investigation of Site U1346 samples during by analyzing 24 ICP-AES measurements of 22 lava samples (including two samples of carbonate-rich veins). In addition to the igneous samples, six sedimentary samples from Site U1346 were analyzed for carbonate and for total carbon. Organic carbon content was calculated by subtraction of carbonate carbon from total carbon. Processing of sedimentary and first igneous samples from the current Site U1347 is underway as well.

Compared to the previous Site U1346A on Shirshov Massif, the magnetic susceptibility of both sediments and basalts are higher at Site U1347A; in some cases more than double the highest value. NGR counts at this location, however, are much lower than those from the previous site. Bulk densities, as measured by the GRA, are generally between 1.5 - 1.9 g/cm³ throughout the sediments increasing to nearly 2.9 g/cm³ in the basalts downhole. The first discrete samples from Hole U1347A have begun their circuit through the PMAG/PhysProps measurement cycle.

Also in this week, the paleomagnetists completed all the thermal and alternating field demagnetization measurements on the discrete samples obtained from previous Hole U1346A cores. Most of samples show stable components between 300-475° C steps. These samples from Hole U1346A are characterized by dominantly shallow negative inclinations with an average of $-20.5^{\circ} \pm 5.4^{\circ}$. Additionally, measurements on discrete samples obtained from current Hole U1347A are underway. The investigation of the unsatisfying demagnetization behavior of the 2G magnetometer continued during this

week (with support from the shore).

Downhole logging data from Site U1346 was processed and included natural and spectral gamma ray, density, photoelectric factor and electrical resistivity measurements from three depths of investigation. A total of fourteen logging units were identified in the section: three in the section covered by pipe, four in the sedimentary sequences in open hole and seven in the basement section based on gamma ray and electrical resistivity measurements. Logging preparations continue for Site U1347 with three planned deployments: triple combo, FMS-sonic and UBI.

TECHNICAL SUPPORT AND HSE ACTIVITIES

After the arrival of the first core on deck at Site U1347, all shipboard labs were busy processing cores and samples. A fire and boat drill was held on September 26 for the entire ship's complement. New fume hood alarms were installed on all of the laboratory fume hoods. An eyewash station was installed in the Underway Lab.