IODP Expedition 324: Shastky Rise Formation

Week 5 Report (4 – 10 October 2009)

11 October 09

OPERATIONS

After the driller tagged seafloor at 3275.0 m DRF, Hole U1348A (Prospectus site SRSH-6) was spudded at the beginning of this week. The hole was washed ahead with a wash barrel in place to 84.2 m DSF where rotary coring was initiated. Coring proceeded from 84.2 m to 189.9 m DSF (105.7 m) with a poor average recovery of 3.5% due mostly to the prevalence of chert. Once past this depth and starting with Core U1348A-13R, the recovery improved markedly as the sediments transitioned from the softer elusive pelagic ooze and multi-colored chert to sandstone and then to volcaniclastics. The bottom 134.2 m of the hole was cored at an average rate of penetration of 8.9 m/hr with an average recovery of 57.5%. The average recovery for the cored interval of 239.9 m was 33.7%. The washed interval was 84.2 m. This hole was terminated at 324.1 m DSF subsequent to a science meeting during which it was collectively decided to stop further drilling at this site.

The hole was prepared for logging operations with a wiper trip and displacement with 86 barrel of heavy mud (10.5 ppg). Following the release of the bit at the bottom of the hole, the drillstring was pulled back and the end of pipe placed at 97.6 m DSF. At 2030 hr on 5 October, the Schlumberger equipment was rigged up and the first tool string (triple combo) successfully deployed to ~322 m DSF, only 2 m above the bottom of the hole. Once the triple combo was recovered, the second logging suite (FMS-sonic) was made up and deployed at 0700 hr on 6 October. This tool was also able to reach within two meters of the bottom of the hole. As the tool was being drawn back into the drillstring, it became firmly stuck in the bottom hole assembly with the calipers at the level of the top connector of the mechanical bit release. For 1.5 hours, the logging winch operator attempted to advance the tool with no success.

The only option remaining was to use the Kinley crimper and cutter system to recover the recalcitrant instrument. The Kinley crimper was deployed on the logging line followed 45

minutes later by the hammer that triggered the crimper charge. A positive indication of the firing of the crimper was indicated by the expected loss of signal voltage from the logging tool. The next step was the deployment of the cutter tool and hammer, which went as planned and neatly severed the logging line just above the cable head of the tool suite. The severed end of the logging line was recovered at 2030 hr after which the drill string was retrieved. When the bottom hole assembly was at the surface, the FMS-sonic tool was still firmly pinned by the springs of the broken FMS pad caliper arms inside the top connector of the mechanical bit release.

Once the FMS-sonic was extracted from the bottom hole assembly, the drilling equipment was secured and the beacon recovered. The vessel departed for the next site at 0845 hr on 7 October. The 112 nmi transit to SRCH-5 required 12.2 hours at an average speed of 9.2 knots. By 1245 that afternoon, the vessel was positioning on Site U1349.

The drillstring was routinely deployed and after the driller tagged seafloor at 3138.0 m DRF (3127.0 mbsl), Hole U1349A was spudded with the rotary system at 0600 hr on 8 October. The hole was drilled with a wash barrel to 116 m DSF where coring was initiated. The sediment portion of the hole was cored with the usual low average recovery (23%) because of the prevalence of chert to a depth of 145 m DSF. Basement was encountered at 165 m. By the end of this week we continue coring basement at a depth of 221.7 m DSF (56.7 m into basement) with an average recovery in basement of 56%.

SCIENCE RESULTS

Site U1348, located at the northern flank of the Southern High (TAMU Massif) of Shatsky Rise, is situated on a > 30 km wide basement high where the pelagic sediment cover is thinned.

Coring at Hole U1348A, recovered a thick sequence (~120 m stratigraphically) of volcanoclastic sediments, topped with shallow water carbonaceous sandstones, greenish clays, and chert-rich sequences. Cores U1348A-1W to 9R contain a mixture of red and yellow cherts, with occasional chalky porcellanite coatings. In Core U1348A-2R a remarkably well-preserved, meter-long section of Cenozoic/Late Cretaceous nannofossil ooze was recovered. Cores U1348A-10R to 13R contain a mixture of mid Cretaceous

bioclastic sandstones and green zeolitic clay bands, interpreted as heavily altered ash-fall deposits. Between Cores U1348A-14R to 26R, a unique sequence of altered volcanoclastic sediments were recovered, thought to represent a mixture of eruptive and turbiditic depositional settings.

Micropaleontology examinations of the pelagic sedimentary cover (Cores U1348A-2R to -10R) revealed that it consists mainly of pelagic oozes and chalks (including those adhering on cherts) that are rich in calcareous microfossils. In the grayish ooze at the top ~10 cm of Core U1348A-2R, the Miocene–Eocene *Discoaster* species was recorded. Calcareous nannofossils from the intervals below are ascribed to the mid- to upper Cretaceous (Aptian–Maastrichtian). For planktonic foraminifera, the examined interval represents the successive occurrences of key zonal marker species, which are ranging from the early Aptian to early Campanian (ca. 120–80 Ma).

The volcaniclastic sediments below apparently contain 100% altered volcanic breccia with various quantities of volcanic glass shards, scoria pieces and some lithic fragments. They can be classified as vitric tuffs and lapillistones. The edges of the glass fragments are straight, angular, curved and in many cases cuspate. The predominance of glass shards in some intervals suggests that these rocks may be pyroclastic in nature and not epiclastic. In most cases, however, the vitric shards are completely altered to palagonite and are filled either with calcite and/or zeolites. The lithic clasts are mainly and almost completely altered to brown clays, while relatively fresh plagioclase microliths may be present. The clasts are commonly rimmed by fibrous or massive zeolites (likely phillipsite, based on XRD data) and cemented by calcite.

A noticeable exception is a ~15 cm interval in Section U1348A-23R-1 that was somehow shielded from the pervasive alteration and contains abundant fresh glass shards. These fresh glasses contain microphenocrysts of olivine (mostly replaced), plagioclase and pyroxene. This unique interval will be very desirable for onshore geochemistry analyses. A preliminary interpretation might be that the volcaniclastic material was produced submarine or from lava upon entry in the ocean, as evidenced by abundant macrofossils included in certain sections. In any case, the angular nature of most of the glass shards suggests very short transport distances.

Structural descriptions of the volcaniclastic succession recorded sedimentary stratifications, particularly in the fine-grained hyaloclastic intervals, showing gentle and parallel bedding. The parallel bedding (less than 10 degree dip) are common in the upper part of the volcaniclastic succession, whereas the bedding tilts slightly steeper (10 to 20 degree dip) in the cores below 219 m CSF-A (Cores U1348A-16R and beyond). In contrast, most veins, however, show steep dip angle over 50-degrees and generally range between 0.1 to 1.5 cm thickness.

The volcaniclastic rocks were also analyzed for physical properties and paleomagnetism. As expected, these samples have relatively low P-wave velocities (ranging from ~2 to 3.3 km/s), low densities (~2 g/cm^3), and very high porosities (30-44%). Since these rocks are volcanolclastics, their magnetization is no longer thermoremanent but detrital, making it difficult to carry out any direction study. Moreover, these samples have a very weak natural remanent magnetization. Eight samples were AF demagnetized and gave mostly positive shallow inclinations with high median destructive fields.

Drilling of Hole U1349A (Prospectus Site SRCH-5) on the Central High (Ori Massif) commenced in the second half of Week 5. Similar to Site U1348, this site is located atop a basement ridge at the summit of the massif. In contrast to the former, Site U1349 shows a strong, coherent acoustic basement reflector in the site survey seismic data that apparently represents the almost-flat top of a summit ridge (former guyot?).

Coring this hole yielded red chert in the uppermost four cores (Cores U1349A-1W to -4R), with occasional ooze and porcellanite intervals. Preliminary results of micropaleontological studies yield poorly preserved calcareous nannofossils of mid-Cretaceous age. Well-preserved, diverse planktonic foraminifera obtained from ooze of Core U1349A-2R allow this level to be dated at Albian.

Cores U1349A-5R to -7R contain volcanoclastic conglomerates/breccias and sandstones, stratigraphically below the chert beds. Below, highly vesicular basaltic basement was encountered in Core U1349A-7R at 165.06 m CSF-A (exactly at the predicted depth of ≈165 m based on the seismic site survey data).

In general, the basalts are highly to completely altered (~90-100%), based on visual description of the cores. One main type of reddish brown alteration has been identified, characterized by complete replacement of plagioclase by white and/or green clays, and complete replacement of pyroxene in the groundmass and olivine phenocrysts to iddingsite (with a typical orange-brown color). The very high vesicle content in these amygdaloidal basalts re-appears in many closely-spaced bands throughout the upper part of the basement, suggesting a possible "spongy" pahoehoe flow top of a larger flow unit, similar to the volcanic flows found on Kilauea, Hawaii. The vesicles are mainly filled with calcite, green clays, a yellow clay (not yet identified) and rare opaque phases. Calcite veins, with minor green clays, are predominant throughout the cores, and commonly show an alteration halo of brown-orange clays**.**

Most remarkably, these basalts are olivine-phyric (with olivine phenocrysts up to ~4 mm in size, now completely replaced) and likely also contain olivine in the groundmass (not yet confirmed by thin section examination), making this basalt of higher alkalinity when compared to basalt drilled in Holes 1213B (Leg 198) and U1346A (this expedition). From Core U1349A-10R and beyond, the modal amount of pyroxene phenocrysts is increasingly dramatically. Very densely packed zones with more than 20-50% pyroxenes are now being identified and readied for later thin section study during Week 6.

Because of the style of weathering and the presence of subaerial-looking red scoria at the top of Core U1349A-10R, a subaerial formation of the basalt is tentatively assumed.

First analysis of whole round samples measured from this site yield some of the highest magnetic susceptibility (MS) readings seen during this expedition. MS values for the basaltic basement samples are only comparable to the MS highs seen in the fresher/massive unit at the base of Hole U1347A. Similarly, the volcaniclastic sediments above the basement (Sections U1349A-5R to the top of -7R) have a much higher (~2x) magnetic susceptibility than the similar-looking volcaniclastics that were recovered at the previous Site U1348 (possibly because of the larger clast sizes).

In addition to examining Sites U1348 and U1349 samples, several lab groups were still wrapping up their analyses from Site U1347 during this week. The paleomagnetism group completed the thermal demagnetizations on discrete samples from the igneous units recovered in Hole U1347A. The main trends reveal four magnetic zones downhole: (1) the top igneous core section (Section U1347A-12R-1) with shallow negative inclination (-6º ±7), (2) Sections U1347A-17R-2 to 26R-1 (Units IV to VII), with an average inclination of 28º ±13, (3) Sections U1347A-26R-2 to 29R-4 (Units IX to XIV) with an average inclination of 20º±14, and (4) Sections U1347A-26R-2 to 29R-4 (Unit XV) with an average inclination of 54º±27. While results in the upper three zones appear reasonably reliable, detailed rock magnetic analyses is necessary to interpret the erratic magnetic behavior of the lowermost zone.

Likewise, the geochemistry group completed ICP-AES analysis, data reduction, and data interpretation for the batch of 19 lava samples from Site U1347 that were begun in Week 4. By the end of this week, work had been completed on a total of 40 basement samples from Site U1347. In addition, preparation for ICP-AES analysis of 13 samples from the rocks of Site U1348 got underway. No new analyses of sedimentary samples for carbonate or total carbon were carried out in Week 5.

TECHNICAL SUPPORT AND HSE ACTIVITES

During the short transit between Site U1348 to Site U1349, the towed magnetometer was deployed. Labs were busy processing cores. A fire and boat drill was held on October 5 for the entire ship's complement.