IODP Expedition 346: Asian Monsoon

Site U1430 Summary

Background and Objectives

Site U1430 is located ~300 km southwest of Site U1425 in the southwestern part of the Sea of Japan/East Sea at 37°54.16´N, 131°32.25´E and a water depth of 1075 m. It is situated on the southern upper slope of the eastern South Korean Plateau that bounds the northern margin of the Ulleung Basin. Studies of a piston core from a nearby location suggest sedimentation rates of ~40 m/m.y., which are as slow as those observed at Site U1425. Seismic studies suggest a sediment thickness of 285 m and a basal age of ~10 Ma. If this is correct, the cores recovered at Site U1430 will provide a continuous slow sedimentation record that is ideal to study the long-term history of dust provenance and flux changes since 10 Ma.

Because of its strategic location and proximity to the Asian continent, the sedimentary record at Site U1430 may contain a relatively pristine record of continental input. In addition, by combining the results from this site with those from Sites U1423, U1425, and U1426, it will be possible to reconstruct changes in the position of the atmospheric Westerly Jet axis, as well as dryness of the Gobi desert, and the position and intensity of the early spring storm track in mid-latitude Asia during the last ~5 Ma.

Site U1430 is under the influence of the second branch of the Tsushima Warm Current (TWC) but is located only slightly to the south of the third branch that forms the subpolar front. Therefore, the site may provide a good opportunity to monitor the behavior of the subpolar front and changes in intensity of the TWC. The site is also useful to reconstruct changes in deep water oxygenation and calcium carbonate compensation depth (CCD) during the last 4 Ma by combining the results from deeper sites such as Sites U1424 and U1425, and shallower sites such as Sites U1426 and U1427.

Principal Results

Three holes were cored at Site U1430 using the full and half-length advanced piston corer (APC) and the extended core barrel (XCB) systems. Oriented, non-magnetic core barrels were used with the full APC system in Hole U1430A. Half-length APC cores in Hole U1430A were not oriented, but used non-magnetic barrels. Twenty-nine

APC cores and three XCB cores penetrated to 274.4 m CSF-A in Hole U1430A, recovering 258.24 m (94%). In Hole U1430B, 29 APC cores and eight XCB cores extended from the seafloor to 275 m CSF-A recovering 259.71 m (94%). In Hole U1430C, 33 APC cores and one XCB core penetrated to 250 m CSF-A, recovering 257.02 m (103%). Total core recovery for Site U1430 was 775 m.

The sedimentary succession extends from the middle Miocene to the Holocene and is dominated by clayey silt, silty clays, nannofossil ooze, diatom ooze, claystones and sandstones. Although there are numerous discrete tephra (especially pumice) layers throughout the sediment record, volcaniclastic material represents a minor component of the lithology. The section is divided into three major lithological units (Units I, II, III), distinguished on the basis of sediment composition, referring particularly to the abundance of biosiliceous and siliciclastic fractions.

Lithologic Unit I (Late Pliocene to Holocene) consists of clayey silt, silty clay, and nannofossil ooze with small amounts of diatom-bearing and diatom-rich silty clays. Unit I is further divided into two subunits (Subunits IA and IB) based on the frequency of alternating gray (organic rich) and light greenish gray (organic poor) silty clay intervals. The regularity of this color banding decreases from Subunit IA to Subunit IB.

Lithologic Unit II (Late Miocene to Late Pliocene) is distinguished from Unit I based on a significant increase in diatom content relative to terrigenous material and bioturbation. This unit is further subdivided into two subunits (Subunits IIA and IIB). Subunit IIA is composed of diatom-bearing and diatom-rich silty clays that fluctuate in clay content. This is reflected in the more subdued but regular color banding of Subunit IIA. Subunit IIB is dominated by a dark gray diatom ooze, with diatoms making up to >70% of the sediment based on smear slide analysis.

Lithologic Unit III (Mid-Miocene to Late Miocene) is divided into three subunits. Subunit IIIA is composed of alternating layers of heavily bioturbated diatom ooze, clayey diatom ooze, and diatom rich silty clays. These lithofacies show decimeter- to meter-scale variability between dark gray to very dark gray, but the changes in color can be subtle. An important feature of Subunit IIIA is that some (yet not all) diatom ooze-rich sequences display ~5 cm to ~240 cm thick intervals that are very finely

laminated. Subunit IIIB is characterized by dark gray siliceous silty clay and claystones with few sedimentary structures. The transition from Subunit IIIA to Subunit IIIB is defined by the diagenetic loss of biosiliceous material and the formation of siliceous claystone. XRD results show that opal-CT first appears between Subunit IIIB and the top of Subunit IIIC. Subunit IIIC, which lies at the base of the recovered sequence, is characterized by dark gray, hard glauconite-rich quartz/feldspar-dominated sandstones and light gray glauconite-rich dolomite-dominated sandstones.

Nannofossils are generally absent with the exception of a few intervals where they are rare and exhibit poor preservation. One calcareous nannofossil datum, the FO of *Emiliania huxleyi*, was documented. Diatoms are generally common and well preserved. Thirteen diatom datums were documented. High abundances of *Chaetoceros* spores are indicative of a productive paleoenvironment. Laminations near 231 m CSF-A in Hole U1430A contain different diatom assemblages in the light and dark layers. Radiolarians are generally abundant throughout the entire succession and are mostly well preserved. Twenty-two radiolarian datums were documented, including the LO of *P. hokurikuensis* (15.0 Ma) near 256.3 m CSF-A in Hole U1430B. The abundance of planktic foraminifers is variable through the succession, ranging from rare to dominant. Planktic foraminifer preservation is generally poor to moderate. The planktic foraminiferal assemblages are characteristic of temperate to subarctic environments and primarily consist of *Globigerina bulloides*, *Neogloboquadrina pachyderma* (sinistral and dextral), and the *Neogloboquadrina kagaensis* group. Two datums are identified: the LO *N. kagaensis* group and the dextral to sinistral coiling change in *N. pachyderma*. Benthic foraminifers are generally moderately to well preserved and abundant within the Pleistocene interval above ~54 m CSF-A. Alternating peak abundances in *Cassidulina* and *Uvigerina* suggest elevated, but fluctuating organic export fluxes to the seafloor through the middle to late Pleistocene. Deeper in the succession, most samples are barren or rarely consist of an impoverished assemblage dominated by a few agglutinated species. The overall composition of assemblages at Site U1430 indicates middle bathyal paleodepths from the late Pliocene to the Pleistocene.

The upper portions of the sedimentary record at Site U1430 have large variations in

organic carbon and carbonate contents, and major changes in interstitial water chemistry. The lower unit has more consistent solid and fluid chemistry. Organic carbon contents vary from 1 to 3 wt% in the upper unit. In this interval, the carbonate content has at least three maxima, with the highest (~24 wt%) at ~33 m CSF-A. The C:N in the upper 80 m of sediment is ~6.4. Methane concentrations are very low compared to other sites recovered during Expedition 346. Due to the high levels of total organic carbon in these sediments we had expected much higher methane values, which may reflect that perhaps any methane produced was not trapped in the sediments due to the very low sedimentation rate. Alkalinity increases from 2.4 to 42 mM, while sulfate gradually decreases from 28.4 to 13.4 mM at ~62 m CSF-A before rising again towards the seafloor. Below ~80 m CSF-A, the lower unit has very high and fairly stable organic carbon content (3.3 wt% on average). Within this interval, however, TOC is higher (3.8 to 4.5 wt%) in the deeper part (~176 m to 232 m CSF-A) in comparison to the upper part (1.7 to 3.6 wt% from 81 m to 168 m CSF-A). Calcium carbonate is virtually absent (<1 wt%) in the lower section, despite some slightly higher values at the very bottom of the section (~2.0 to ~5.7 wt% from 232 m to 245 m CSF-A).

Physical properties measured at Site U1430 generally show trends that are largely similar to Site U1425 and follow the sediment lithology. Magnetic susceptibility, bulk density, and NGR have higher values in Unit I than in Unit II; porosity and water content show the opposite trend. High magnetic susceptibility and *P*-wave velocity show high relative maxima values that correspond to the tephra layers in Unit I. Shear strength generally increases with depth to ~180 m CSF-A due to sediment compaction and then exhibits large variations from ~180 to 240 m CSF-A. Color reflectance shows higher variation in Unit I than Unit II, and is related to the alternating very dark brown to black organic-rich bands and lighter olive to green colored hemipelagic sediments in Unit I. All physical property values change markedly at ~240 m CSF-A, which is inferred to be the opal-A/-CT transition zone.

Paleomagnetic investigations focused on the measurement of natural remanent magnetization of archive-half split-core sections. NRM of archive-half core sections from Hole U1430A were measured before and after 20 mT alternating field (AF) demagnetization at 5 cm resolution. NRM of archive-half core sections from Holes

U1430B and U1430C was only measured after 20 mT AF demagnetization at 5 cm resolution. The FlexIt tool was successfully deployed to orient Cores U1430A-2H to -25H. Paleomagnetic measurements documented the Brunhes/Matuyama boundary (0.781 Ma) at ~33.5 m CSF-A in Hole U1430A, ~34 m CSF-A in Hole U1430B, and ~37 m CSF-A in Hole U1430C. The weak NRM intensity, increased coring disturbance, strong drill string overprint, and the large scatter in paleomagnetic declinations makes magnetostratigraphic interpretations difficult for the deeper part of sediments recovered at Site U1430.

Downhole measurements were made in Hole U1430B to a total depth of ~272 m WSF. The Triple-combo wireline logging tool string was split into two shorter strings to maximize data acquisition in the lowest part of the hole. The logged interval was divided in two Logging Units (LU1, from the pipe entrance to ~244 m WSF; LU2, from ~244 m WSF to the bottom of Hole U1430B). In Logging Unit LU1, the log data mainly reflects variation in diatom content relative to terrigenous clays, and matches lithological changes throughout the section. Preliminary examination of the data revealed apparent high frequency cyclicity in the FMS images. There is a distinct change in log characteristics at ~244 m WSF, which correlates closely with a change downhole to indurated deposits. The core recovery is low in this interval and the good quality of the downhole logs and borehole images should allow us to refine the lithology within the core gaps.

Five formation temperature measurements were made using the APCT-3 tool from the seafloor to 117.6 m CSF-A in Hole U1430A. The measured geothermal gradient is 103°C/km and the calculated heat flow value is 93 mW/m^2.

Stratigraphic correlation at Site U1430 benefited from calm seas and limited gas expansion. A complete splice was generated from the mudline to ~259 m CSF-A between Holes U1430A and U1430B. A CCSF-C depth scale was generated for Hole U1430C, with the exception of Cores U1430C-4H and U1430C-5H because they contained slump features. Depth-age analysis indicates a basal age of ~15 Ma for Site U1430, with sedimentation rates ranging from 2 m/m.y., associated with a glauconite-bearing condensed section, to 44 m/m.y. associated with more detrital- and siliceous-rich intervals.