IODP Expedition 346: Asian Monsoon

Site U1423 Summary

Background and Objectives

Site U1423 is located in the northeastern part of the Sea of Japan/East Sea (JS/ES; 41°41.95′N, 139°4.98′E) in a water depth of 1785 m. The site is ~130 km to the south of ODP Site 796 and ~100 km to the northwest of the entrance of the Tsugaru Strait. Site U1423 is situated on a terrace on the middle of the slope from Ōshima Island, a small volcanic island located 30 km to the southeast. The site is under the direct influence of the Tsushima Warm Current (TWC) that flows further north beyond the Tsugaru Strait toward the Soya Strait. Because the sill depth of the Soya Strait is only 55 m, the influence of the TWC to the site should have been significantly affected by glacioeustatic sea level changes during the Quaternary. Although Site U1423 is relatively close to ODP Site 796, the tectonic setting of the two sites seems different. Site 796 has been directly influenced by east-west compression due to the incipient subduction along the nearby plate boundary between the North American Plate and Eurasian Plate. In contrast, Site U1423 seems less influenced by this compression because seismic profiles suggest conformable deposition for at least for the last ~5 Ma (upper 300 m of sediment). Relatively slow linear sedimentation rates (LSR) are anticipated based on pre-expedition site survey results. The LSRs are likely to be slow enough to detect the contribution of eolian dust from Asian continent. A core collected for the pre-expedition site survey core contains occasional dropstones in the upper 150 m of the sequence, suggesting this site's suitability for ice-rafted debris (IRD) studies.

Site U1423 is the middle site of the latitudinal transect targeted by Expedition 346, and is also the middle depth site of the depth transect. The location of Site U1423 in the northern Sea of Japan/East Sea was selected to identify the spatial extent of IRD events and their temporal variations. Because sea ice formation in the JS/ES occurred along its northwestern margin due to the strong winter cooling by the East Asian winter monsoon (EAWM) wind, we expect the intensity of the IRD events to reflect the strength of the EAWM. At Site U1423, we hoped to reconstruct the EAWM intensity through examination of IRD abundance and distribution along the northern latitudinal JS/ES transect. Because stronger EAWM wind produces deepwater, called

Japan Sea Proper Water (JSPW), through sea ice formation in the northwestern part of the JS/ES, sea ice formation and deepwater ventilation could also reflect EAWM intensity.

Because of the relatively shallow water depths of Site U1423, calcareous microfossils were expected to be relatively well preserved. Planktic microfossils may allow us to study the nature and strength of the influx of the TWC through the Tsushima Strait and/or the intensity of winter cooling, whereas study of benthic microfossils may allow us to study the nature of the deepwater (e.g., oxygenation, saturation level with respect to $CaCO_3$, temperature and salinity). Examination of the relation between surface water and deepwater characteristics may allow us to explore the linkage between the nature of the TWC and deepwater ventilation. Furthermore, comparison of $CaCO_3$ burial flux and its temporal changes at Site U1422 and this site will allow us to reconstruct behavior of the CCD.

The site is also appropriate for reconstruction of eolian dust flux, grain size, and provenance changes since 5 Ma, considering the relatively slow expected linear sedimentation rate. Although only a slight contribution of IRD to the total terrigenous flux may be expected, the specific grain size eolian dust (4–32 μm) may be used to differentiate the eolian dust component from other terrigenous components, including IRD.

Principal Results

The sedimentary succession recovered at Site U1423 extends from the Pliocene to Holocene and is dominated by clays, silty clays, and diatomaceous ooze with discrete foraminifer-bearing clay levels. Volcaniclastic material represents a minor component throughout the sediment succession, except in tephra layers where it is the dominant component.

The section is divided into two major lithologic units distinguished on the basis of sediment composition, and particularly the biosiliceous fraction content. Unit I, from 0 to ~130 m CSF-A, is further subdivided into two subunits based on the relative frequency of alternating dark and light color variations and the intensity of bioturbation.

Lithologic Unit I consists of Holocene to upper Pliocene silty clay and clay with

lesser amounts of diatom bearing and diatom-rich silty clays, and rare calcareous layers containing abundant foraminifers. Discrete tephra (volcanic ash) layers ranging in thickness from a few millimeters to more than 10 cm are numerous. The total thickness of tephra layers in each core reaches its maximum in lower Subunit IA to Subunit IB. Pyrite is found as a minor component in most lithologies, while fine-grained tephra occurs as a dispersed component throughout much of the section. Unit I primarily represents fine-grained material derived from terrigenous sources.

Color banding is the most diagnostic feature of Unit I and is inferred to be related to variable content of organic matter and pyrite. Dark gray to dark olive gray organic-rich intervals occur between light green to light greenish gray, organic-poor intervals.

Lithologic Unit II is dominantly composed of moderate to heavily bioturbated diatomaceous silty clay and clay, and diatom ooze. Unit II is distinguished from Unit I on the basis of a significant increase in diatom content relative to terrigenous sediment from top to bottom. Color banding is less common in Unit II than in Unit I and nearly disappears in the lower part of Unit II.

Microfossil abundance and preservation at Site U1423 varies depending on the microfossil's mineral composition. The nannofossil, radiolarian, and diatom datums and zonal schemes generally agree, with only minor inconsistencies, and the biostratigraphic zonation ranges from Pliocene to late Pleistocene.

Calcareous nannofossils are generally rare or absent yet are sporadically distributed throughout. Planktic foraminifers are rare to absent, with moderate to poor preservation, except in the upper part of the succession, where they are abundant. As such, the regional planktic foraminiferal datums and zonal scheme only have limited application. Radiolarians are generally common to abundant, and diatoms are well preserved with abundances ranging from 2–5% to >60%. Diatom mats and oozes are found in the Pliocene samples. Benthic foraminifers occur intermittently throughout the succession, exhibiting marked changes in abundance, preservation, and species distribution. The overall assemblage composition indicates bathyal paleodepths. The assemblage composition appears to reflect variations in organic export flux to the seafloor and deepwater oxygenation.

Operations during the occupation of Site U1423 were ideal for coring, including very

low sediment expansion (~4%) and calm seas. These conditions allowed us to target and recover selected intervals in Hole U1423C to fill in coring gaps from Holes U1423A and U1423B. This approach saved considerable time compared to continuously coring all of Hole U1423C. The resulting Site U1423 splice covers the entire length of overlap among holes at this site, from the seafloor to 218.8 m CCSF-D. Sedimentation rates at this site vary as a function of lithology. Unit I (silty clay and clay) is characterized by low sedimentation rates of 30 to 40 m/m.y. The higher rates of up to 82 m/m.y. in Unit II (diatomaceous silty clay, clay and diatom ooze) presumably reflects siliceous productivity.

The geochemical profiles of Site U1423 are dominated by degradation of organic material and the formation and alteration of carbonate phases. These processes affect a number of dissolved species, such as Mn which is liberated as Mn^{2+} at shallow depths and depleted at deeper depths by the formation of carbonate minerals such as rhodochrosite. Additionally, Ba is presumably released from barite at the sulfur-methane transition. Methane concentrations are related to changes in sedimentation rate and are overall much lower than at Site U1422.

Physical properties measured generally show trends that follow the lithostratigraphy. Magnetic susceptibility, bulk density, and NGR total counts have higher values in lithostratigraphic Unit I than Unit II, whereas porosity and water content show an opposite trend. *P*-wave velocity and shear strength gradually increase with depth due to sediment compaction. Color reflectance shows higher variation in lithostratigraphic Unit I than Unit II, and is closely related to the lithology of the former, which consists of alternating very dark brown to black organic-rich bands and the lighter olive to green colored hemipelagic sediments.

Paleomagnetic investigations mainly focused on measurement of natural remanent magnetization of archive split core-halves before and after 20 mT AF demagnetization. NRM of core sections from Holes U1423B and U1423C were only measured after 20 mT AF demagnetization. We also measured NRM for seven selected discrete samples after stepwise AF demagnetization up to a peak field of 60 mT. NRM intensity of the measured core sections after 20 mT demagnetization is on the order of 10^{-2} A/m for the top ~22 m, and decreases to ~10^{-4} to 10^{-3} A/m below ~22 m CSF-A. The Brunhes/Matuyama Chron transition (0.781 Ma) was found at 54

m CSF-A in Hole U1423A and 52 m CSF-A in Hole U1423B. The Matuyama/Gauss boundary (2.581 Ma) was found at 113 m CSF-A in Hole U1423A and at 112 m CSF-A in Hole U1423B.

Downhole measurements were made in Hole U1423B to a total depth of 251 m CSF-A. Formation MicroScanner images were of excellent quality because of the good borehole conditions and sea state during logging operations. The combination of logs closely reflects lithological changes in the recovered cores, including ash layers. There is a distinct change in log characteristics at ~124 m CSF-A, which correlates closely with the lithostratigrahic boundary between Subunit IIA and IIB and with a change downhole to a more diatomaceous rich lithology. Preliminary inspection has also revealed apparent cyclicity in some parts of the section.