IODP Expedition 359: Maldives Monsoon and Sea Level
Site U1472 Summary

Background and Objectives

Site U1472 (proposed Site MAL-06B) is in the middle of the southern transect at 4°46.2653′N and 73°4.0111′E, at a water depth of 379.34 m. The site is located well within the middle part of the west to east prograding contourite fan. The target for coring at this site was the lower sequence boundary of DS1, but it was not reached due to time constraints at the end of the cruise. The coring penetrated to 251.9 m and recovered 233.75 m (93%), providing a valuable data set for understanding of drift deposition in the Inner Sea and the contourite fan depositional system. The specific objectives at this site were: (1) to constrain the ages of the drift depositional sequences; (2) to analyze the cyclostratigraphy of drift deposits, therefore providing reconstructions of changes in the current regime and monsoon cyclicity; and (3) to retrieve the lithology of the wavy seismic facies to confirm their current-controlled deposition.

Principal Results

The succession at Site 1472 is subdivided into four lithostratigraphic units. Lithostratigraphic Unit I from the seafloor down to 52.70 mbsf consists of unlithified packstone and grainstone texture and mud-lean fine to medium sand. Deposits contain abundant fairly well preserved planktic foraminifera, pteropods, otoliths, echinoid fragments, and shell fragments. This facies is similar to the top units of all the sequences drilled during Expedition 359. Layers of floatstone contain large bioclasts such as pteropods and solitary corals. Light gray to brownish gray sediment colors were interpreted to reflect the presence of organic matter and also of iron in reduced form. This provides evidence for suboxic conditions at the seafloor, which is supported by higher natural gamma radiation (NGR) measured on the cores. Varying gray-brown color changes associated with cyclic pattern of L* color reflectance and NGR likely indicate that these conditions fluctuated through time.

While lithostratigraphic Unit I had grainstone to packstone textures, lithostratigraphic Unit II (52.70 to 195.20 mbsf) consists of packstone to wackestone. The composition of the sediment is similar to lithostratigraphic Unit I sediments, with the difference that Unit II does not contain pteropods. NGR values in Unit II are distinctly lower than in Unit I,

and the top of Unit II contains large bioclasts and shells, suggesting a phase of intensified bottom current.

The transition from packstone to grainstone texture and the grain size change from predominantly medium- to coarse-grained sand defines the top of Unit III. Unit III is characterized by the appearance of large benthic foraminiferal assemblages typical of neritic environments. Foraminiferal shells have extensive overgrowths, masking their original shape. The textural, grain size, and biota assemblage changes collectively imply that this unit represented a shallowing-upward succession.

Unit IV extends from 224.22 to 249.24 mbsf and is marked by a change towards a grainstone texture and coarse-grained sand. The bioclast assemblage is composed of corals, red algae, large benthic foraminifers, and bivalves. Texture, grain size, and inclined layers indicate that these deposits were deposited under high-energy conditions that existed on the top of the contourite fan drift sequence.

Calcareous microfossils are present throughout the sequence, showing good preservation in the upper 100 m and poor to very poor preservation below. The calcareous nannofossil biostratigraphy suggested a late Miocene age for the bottom of the sequence. A useful sequence of biostratigraphic events through the Quaternary and early Pliocene provides a fairly clear age-model, which indicates a sedimentation rate of 2.6 cm/k.y. throughout the succession. As observed at other Expedition 359 sites, the planktonic foraminifers in this interval consistently indicate older ages and, therefore, lower sedimentation rates than those based on the calcareous nannofossils.

Interstitial water analysis indicates that the slight increase in chloride in pore waters at Site U1472 is higher than the increase observed at Site U1471, but not as strong as that at Sites U1466 or U1468. This may be a relict signal of Last Glacial Maximum seawater that has not yet diffused away. Negligible rates of bacterial sulfate reduction relative to advection of seawater at Site U1472 are indicated by the constant alkalinity concentrations with depth. XRD analysis of the sediments showed that neomorphism of aragonite to low magnesium calcite (LMC) does not appear to be occurring with the same intensity as at other sites in Expedition 359. The high abundance of aragonite even at 200 mbsf was unique to this site, and may be related to the general lack of modern, active diagenesis inferred from constant pore fluid profiles. The constant alkalinity at Site

U1472 also implied that the small amounts of dolomite present in the sediments are the result of previous episodes of alteration and are not actively forming in the modern sediment column. Carbonate diagenesis and dolomitization must have occurred in previous time intervals but, unusually, did not seem to have resulted in aragonite neomorphism to LMC.

Measurements of the magnetic sediment properties exhibited early vertical and negative inclinations in the top 30 mbsf of Hole U1472A, which could be interpreted as a coring disturbance in these soft and fluid-rich sediments. The rest of the inclination record, although showing generally shallower inclination, still had a rather erratic behavior that was not easily interpretable as a sequence of reversals.

Due to time constraints at the end of the expedition, only a reduced suite of physical property measurements was performed on the Site U1472 cores (primarily whole-round and split core track measurements). Four physical properties units are observed and correlate well with the lithostratigraphic units. Lithostratigraphic Units I and II had high NGR values in their lower part, and decreasing values towards the top. Lithostratigraphic Units II to IV generally show lower NGR values with little variation but some isolated peaks of higher values. Sediment bulk density at Site U1472 shows a continuous downhole increase, whereas there is an inversion of the *P*-wave velocities below 185 mbsf. As in other sites, porosity was very high at the top (>70%) and decreased to ~50% at 200 mbsf.

Site U1472 comprises a complete succession of all drift sequences DS1–DS10 in the southern transect. For a time-to-depth conversion, the checkshot information from Site U1470 was used, because the sediments had similar characteristics at both sites. The sheeted drift sequences DS7 to DS10 are imaged by well-stratified continuous reflections of medium- to low-amplitude. The subhorizontal reflections of the topsets of DS4–DS06 are discontinuous to wavy at the position of Site U1472, but the reflections become more continuous in a distal direction to the east. While sequences DS5 and DS6 are sheet-like, drift sequences DS3 and DS4 have a divergent pattern and thicken basinward. The calibration of these seismic facies was one of the objectives for Site U1472.

Lithologic Unit I corresponds to the Pleistocene drift sequences DS10 and DS9. The underlying drift sequences DS8 to DS5 are dominated by packstones, which are

increasingly lithified with depth. Large benthic foraminifera in Sequence DS4 indicate shallow water conditions. The transition from lithostratigraphic Unit III to Unit IV at 224 mbsf is within sequence DS3 and is accompanied by a significant increase in benthic foraminifera and by more diverse skeletal components. Both sequences DS3 and DS4 showed a characteristic chaotic reflection pattern of high-amplitude that correlated well to the abundance of coarse material in Units III and IV and layers with downcutting erosion. Both these features indicated a high-energy depositional regime within this drift sequence.