IODP Expedition 359: Maldives Monsoon and Sea Level
Site U1470 Summary

Background and Objectives

The western Kardiva Channel that connects the open Indian Ocean with the Inner Sea of the Maldives is subdivided into a northern and a southern branch by the Goidhoo Atoll. The second transect of sites drilled during Expedition 359 is located in this southern branch of the Kardiva Channel. Site U1470 (proposed Site MAL-08A) is the westernmost site of this southern transect and has a geographical position of 4°45.9823′N and 72°59.0267′N and a water depth of 399.7 m.

The site location was chosen at a position where seismic data indicated that a carbonate platform existed during the early stages of the drift deposition. This seismic relationship implied that at this location the platform drowning is younger than in the northern Kardiva Channel. The main goal at Site U1470 was therefore to recover the drift to platform succession, which contains a platform that has drowned at a later stage than the platforms in the northern transect. The specific objectives were (1) to provide a detailed reconstruction of the predrowning, drowning, and postdrowning evolution of the carbonate bank by linking the seismic stratigraphic record to the sedimentary record (i.e., depositional facies); (2) to constrain the timing of this platform drowning and the burial by drift sediments; and (3) to reconstruct the neritic carbonate factory of a bank growing in the current-dominated depositional system.

Principal Results

The cores at Site U1470 penetrated 147.9 m of carbonate sands and 186.2 m of limestone of the underlying carbonate platform. The upper 59.1 m (Lithostratigraphic Unit I) of the sheeted drift deposits were unlithified coarse-grained grainstones to packstones with abundant planktonic foraminifera but also benthic foraminifera, ostracods, pteropods, echinoderm spines, bryozoan fragments, and bivalves as well as yellow-red stained lithic grains and red algae fragments. Below this depth, in Lithostratigraphic Unit II (59.1–147.8 mbsf) the grainstones became more lithified and the composition changes to a diverse assemblage of bioclasts (bivalve fragments, benthic foraminifera, echinoderm spines, planktonic foraminifera, bryozoan, and red algae). Crystal overgrowth and cementation is pervasive and was detrimental for biostratigraphy.

Three lithostratigraphic units were identified in the platform succession. Lithostratigraphic Unit III (147.9–188.4 mbsf) is comprised of coral-rich floatstone to boundstone, documenting a shallow-water reefal environment at the top of the drowned platform. Lithostratigraphic Unit IV (198–207.7 mbsf) was a bioclast-rich grainstone to rudstone that—with its composition of large benthic foraminifera, red algae, green algae (*Halimeda*), and coral fragments—resembled a reef-apron facies. Lithostratigraphic Unit V (207.7–334.11 mbsf) is a reef facies with interbedded grayish brown, coral-rich boundstone and red algae floatstones. Coral fragments include massive, platy, and branching forms. Rhodoliths are present in different sizes up to 4 cm long with branching irregular shapes.

Micropaleontological analysis of the core samples from the drift package above the platform carbonates allowed definition of a sequence of biostratigraphic events and a well-constrained age model for the upper part of the sedimentary succession that spans from the Quaternary to the early Pliocene. As at other sites, however, there was a complication that during this interval, the planktonic foraminifera consistently indicate older ages and lower sedimentation rates than the calcareous nannofossils. For the lower part of the cored interval, early Pliocene and possibly topmost Miocene, only a single planktonic foraminiferal event was identified. This suggested that the sedimentation rate remained constant throughout the Pliocene, at ~2.2 cm/k.y., and that the base of the drift sequence is older than 5.92 Ma.

The concentrations of major anions and cations determined from interstitial water chemistry display a near constant and close-to-seawater value through the top 150 m of the unlithified drift sediments. This lack of gradient, and thus indication of diagenetic alteration, is in contrast to the changes in carbonate mineralogy across the same interval that documents the disappearance of high Mg-calcite and formation of small amounts of dolomite. This pattern was observed at several other sites during Expedition 359 and might be the result of massive advection that dilutes the signature of diagenesis in the pore waters of highly porous drift sediment. The drowned platform cored at Site U1470 is mostly limestone with only a short interval with 20% dolomite but also preserved aragonite between 200–250 mbsf. In the platform strata recovered at Sites U1469 and U1465, the drowned platform is considerably more dolomitized.

The paleomagnetic analysis was severely hampered by two problems: a persistent contamination that typically affected the first two sections of each core (this problem already was observed at the other sites); and a novel artifact that mostly affected the measurements below 60 mbsf in Hole U1470A. Starting from Core U1470A-8H, the measured paleomagnetic directions of the "uncontaminated" portion of each core showed a constant direction toward the East with a subhorizontal inclination (~90°/0°), independently from the actual core orientation. A correction was applied to fix this second problem, and the corrected values looked more credible, suggesting even the presence of some reversals in the declination record. However, the inclination has rather high values and given all the uncertainties associated with these measurements, we did not attempt to interpret these results as a record of geomagnetic polarity changes.

The sedimentary succession at Site U1470 can be divided into three physical property (PP) units based on the changes observed in NGR, *P*-wave velocity, bulk density, and porosity measurements. PP Units 1 and 2 (0–148 mbsf) are composed of Late Miocene to Recent drift sediments. The entire package has very high porosity, although in PP Unit 1 porosity decreases from 80% to 60%, with a more gradual decrease ranging from 60% to 40% in PP Unit 2. Sonic velocity is low (1725 m/s on average) and shows a slight increase to the bottom of PP Unit 2. Natural gamma ray fluctuates with high frequency throughout these two units but is low at the unit boundary. PP Unit 3 (148–334.1 mbsf) consists of samples from the carbonate platform succession and can be identified by the abrupt increase of velocity and density values and a concomitant decrease in porosity. Velocity varies widely from 2000 to 5000 m/s.

The interpretation of seismic data shows that the drift sequences overlying the drowned platform are mostly subparallel semi-continuous reflections, mainly of medium amplitude. The top of the drowned carbonate platform is indicated by strong reflections of a lower frequency. Towards the west, at a distance of around 400 m, this platform package thins out, and sequence boundaries DS3 and DS2 almost merge. The sequences DS1 and DS2 at this locality, therefore, bear a platform succession that postdates the drowning event recognized at Sites U1465 and U1469. The DS2 relict bank package is characterized by an elevated top, and shows basinward dipping reflections in its eastern part. To the west, these reflections abut against the basal sequence boundary of DS3, which can be

explained by two processes. This stratal pattern could either show a late stage, predrowning reef package, or it may reflect erosion of the reef-related strata.

Drift sequences DS10 and DS9 correspond to the Lithostratigraphic Unit I, which consists of an unlithified planktonic foraminifera-rich grainstone. This package is followed by partly lithified bioclastic grain- to packstones of Unit II, which comprise sequences DS3 to DS8. The bounding unconformity of DS3 corresponds to the top of the shallow-water platform limestone (Lithostratigraphic Unit III). The top of the coral-rich boundstone and floatstone in Lithostratigraphic Unit V is the reflector for sequence boundary DS1.