AAPG Annual Meeting
March 10-13, 2002
Houston, Texas

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Miocene Carbonate Sequence Stratigraphy Pattern in the Maldives Reconciled with Foraminiferal Oxygen Isotope Records Used as Proxies for Ice Volume Variations

Basin-wide aggradations of the carbonate bank margins between 18.5 and 15 Ma in the Maldives evolved into well-developed margin progradations between 14.5-11 Ma, representing five sea-level cycles generated during an overall regression. The last cycle is characterized by massive gravity-flow deposits triggered by a unique sea-level fall at ~11 Ma. The subsequent late Miocene sequence (11.0-9.5 Ma), flooding the prograding complexes and the earliest middle Miocene bank margins, was deposited during a major sea-level transgression. This Miocene sequence stratigraphy pattern correlates well with ice volume variations estimated based upon a planktic oxygen isotope record at Site 714 (equatorial Indian Ocean) and a benthic oxygen isotope record, corrected for temperature by Mg/Ca, at Site 747 (Southern Ocean; Billups and Schrag, in press). The lightest oxygen isotope values occurred between 18.5-14.5 Ma and 11.0-9.5 Ma. In the planktic isotope record, the 14.5-11 Ma interval is characterized by several ice volume cycles that show a systematic increase of the heaviest values of each cycle, with a maximum ice volume at 11 Ma. Between 14.5 and 13 Ma, the benthic foraminiferal record displays a clear ice volume increase. Although benthic foraminiferal oxygen isotope values do not support a further increase in ice-volume between 13-11 Ma, the seawater oxygen curve displays a series of maximum values, with the highest value linked to a sea-level regression at ~11 Ma. This maximum sea-level lowstand is followed by a major sea level transgression and minimum continental ice between 11.0-9.5 Ma.