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Sea-level changes marked by turbidite deposition and slope-adjustment processes

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Highstand shedding, increased sediment production and export during sea-level highstands, is a sedimentation pattern frequently found in sedimentary basins surrounding rimmed, flat-topped carbonate platforms. Highstand bundling, increased number of turbidites deposited during sea-level highstands (interglacials), was demonstrated clearly for the Tongue of the Ocean sedimentary basin of the Bahamas (Droxler & Schlager, 1985). For the last 300kyr sea-level changes also influenced the timing of calciturbidite deposition in the sedimentary basins surrounding Pedro Bank (Northern Nicaragua Rise). The frequency of calciturbidite input show a clear highstand bundling pattern with a three times higher input during interglacial than during glacial marine isotope stages (MIS). For most of the transgressions rapid renewed bank-top flooding was recorded by the onset of calciturbidite deposition. Almost all of the regressions show sediment reorganisation on the upper slope resulting in calciturbidite deposition.

Similar resedimentation processes were observed on the northern slope of Little Bahama Bank. For the last 150kyr sediment reorganisation of upper-mid slope sediments mainly occurred during transgressions and regressions. These large-scale sediment reorganisations resulted in the redeposition of cemented (high magnesium calcite) upper-slope deposits in the mid-slope area.

In Exuma Sound (Bahamas) the Early to Middle Pleistocene (MIS 24 to 10; 900 to 340 ka BP) calciturbidite input pattern agrees with the pattern observed at Pedro Bank. However, calciturbidite deposition during trangressions and regressions is absent after MIS 10, so for the last 340 kyr. This was also observed in the Pleistocene-Holocene basinal sediments from Tongue of the Ocean (Bahamas). Slope sediments in latter basin, however, showed redeposition events in both the leeward and windward setting during the last deglacial phase (MIS 2 to Holocene; Grammer et al., 1993). A change in the sediment storage capacity on the upper slope related to the type of margin setting (accretionary with sediment deposition vs. erosional with sediment bypass) most likely explains the change in calciturbidite input.

In the case studies presented, resedimentation processes during transgressions and regressions are represented by a single event, i.e one debris flow or calciturbidite, while highstands and lowstands in general show a series of redeposition events.

In conclusion, calciturbidite emplacement and slope adjustment processes depend on: (1) Eustatic sea-level fluctuations and associated changes in hydrostatic pressure, the ratio of hydrostatic to pore-water pressure, and wave-base level, (2) variations in sediment production which includes glacial/interglacial variations and windward-leeward differences as well as oversteepening of the slopes in combination with variable degrees of cementation, and (3) sediment storage capacity of the upper slope (depositional vs. by-pass/erosional).