DISCUSSION

HIGH-ENERGY CARBONATE-SAND ACCUMULATION, THE QUICKSANDS, SOUTHWEST FLORIDA KEYS—DISCUSSION

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INTRODUCTION

Shinn et al. (1990) document two principal findings from their study of carbonate sediments accumulating on the Marquesas-Quicksands ridge (hereafter, the M-Q ridge), 30 km in the east-west direction, 10 km wide, about 50 km west of Key West. Their principal findings are: large scale crossbeds dip westward at the west end of the M-Q ridge (their fig. 12), and the carbonate sediment in the cross beds and on the ridge are free of oolites, although they rest on oolitic bedrock.

I propose a hypothesis to explain both findings as aspects of the same process. The hypothesis is supported by facts observed by the authors.

HYPOTHESIS

1) The large scale, westward-dipping crossbeds are hurricane deposits, as suggested by the following observations. The mean track of hurricanes in this area is towards the northwest. A hurricane moving northwestward will be fronted by winds from the east, producing currents and waves moving west. A minimum hurricane with winds of 75 miles per hour would produce surface currents of 3 or 4 feet per second (about 1 m/s) merely from wind drag on the water surface, independent of waves. This surface current would entrain the underlying water on the shallow ridge as the current moved west.

The Florida Keys and the M-Q ridge act as a wave guide for westward-moving waves generated by the hurricane winds. Refraction of these waves along the steep slopes of the ridge directs the wave power towards and along the ridge, reducing sediment losses to the deeper water north and south of the ridge and conserving sediment for delivery at the west end of the M-Q ridge. A similar process on a smaller scale produces recurved spits such as the westward-pointing spits on Marquesas Keys (Shinn et al. 1990, fig. 10). The existing shape of Marquesas Keys in figure 10 is that to be expected from the hurricane process described here.

The 10-m contour marks the general outline of the M-Q ridge (fig. 1A). Hurricane waves of 5-m height are expected to undergo steepness-induced breaking at about this depth, transferring additional momentum to the westward currents. While not essential to the hypothesis advanced here, the tidal bars (fig. 9) might be bed forms that are remobilized only during hurricanes by these west-moving currents.

2) The lack of oolites is due to the brief time in travel between source and deposition and to the relative lack of agitation during the particles' transport history. The sediment is largely Halimeda fragments (table 2). The source of this sediment, by the proposed hypothesis, would be the live and recently dead Halimeda from the ridge and keys east of the depositional area. Shinn et al. (1990) consider Boca Grande Channel to isolate the M-Q ridge from the east, which it undoubtedly does during normal weather. However, this channel is shallower than the Quicksands (fig. 3) whose origin is to be explained, and during a hurricane it would pose no interruption to westward-driven waves and currents (fig. 10).

Shinn et al. (1990) observe that typical Bahamian oolites occur closer to the platform margin than do the non-oolitic sediments in the depositional centers at the west end of the Quicksands. They also observe that the underlying oolitic bedrock was probably a beach deposit. Both these observations are consistent with much data suggesting that oolites need repeated agitation in seawater for growth. The bulk of carbonate sediment in transit on the M-Q ridge is not subject to the required continued agitation between mobilizations by hurricanes, although locally there may be tidally-induced exceptions.

SUMMARY

By the hypothesis advanced here, steep crossbeds might be found at the far end of a relatively narrow sand body, with dips in the axial direction of the sand body. Such cross beds result from wave and current travel guided by the sand body itself. Currents induced by hurricane winds and waves harvest carbonate sediment far upstream to feed the deposition. Ultimately, such a deposit will advance too far from the sediment source, or into deepwater. Such sand bodies may then be surrounded by fine sediment deposits.

The lack of oolites in an environment conducive to their occurrence is an indication that the bulk of the sediment moves only when remobilized by infrequent hurricanes.

REFERENCE