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QUANTIFICATION OF CARBONATE-RAMP SEDIMENTATION AND PROGRADATION RATES FOR THE LATE HOLOCENE ABU DHABI SHORELINE

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ABSTRACT: **We utilize new radiocarbon dates and detailed sedimentological logging of the Abu Dhabi sabkha to produce the first well-constrained, internally consistent rates for late Holocene carbonate-ramp sediment accumulation and progradation for the southern shore of the Persian Gulf. These data are applied to test the hypothesis that, in low-angle carbonate ramp systems, ramp geometry is the primary control on sedimentation and progradation rates and, therefore, estimates acquired from other depositional environments cannot be applied to low-angle carbonate ramp systems. Average calculated progradation rates of 0.75 m/yr are higher than progradation rates proposed for other late Holocene and Recent carbonate settings; a relationship that is explained by the lack of accommodation space in the low-angle laterally extensive ramp system. In the sedimentary record, such relatively high progradation rates would produce laterally extensive lithologically uniform units with little or no evidence of progradational features and would appear to be largely contemporaneous across their extent.**

The total average sediment accumulation rate of 0.029 cm/yr is lower than those proposed from most other late Holocene to Recent shallow-water carbonate depositional environments; again, a relationship interpreted to result from the limited accommodation space of low-angle carbonate ramp systems. Calculated sediment accumulation rates show little variation over the past ~ 1,400 years, yet the calculated progradation rates exhibit a sharp decline from a maximum of 1.03 m/yr before 677–946 cal BP to 0.70 m/yr afterwards. This is interpreted to reflect a rise in relative sea level or distal steepening of the ramp system. Applying the progradation rates proposed in this paper, the lagoon system in the study area would be completely infilled in less than 4,000 years.

Calculated sediment accumulation rates for syndepositional and early postdepositional interstitial displacive evaporite formation are higher than those for carbonate and microbial mat intervals. Continued precipitation of evaporite minerals during burial would result in a further increase in their relative contribution to the sediment pile. Conversely, compaction, particularly of microbial-mat intervals, will result in a decrease in apparent sediment accumulation rates for non-evaporite intervals. These processes need to be considered when modeling the basin evolution of mixed evaporite–carbonate sequences in the stratigraphic record. During calculation of sedimentation rates it is important to consider both a correction for compaction and a correction for evaporite formation.

INTRODUCTION

Many of the world's petroleum reservoirs are hosted in carbonate sediment that was deposited in ramp systems (e.g., Read 1998; Van Buchem et al. 2002; Grötsch et al. 2003). The development of accurate depositional models and reliable simulations for these reservoirs requires a thorough knowledge of modern analogues for these systems, supported by quantifiable data sets. The low-angle coastal ramp of the southern shore of the Persian Gulf provides the only modern analogue for studying carbonate sedimentation and progradation rates in a depositional setting that is believed to be directly analogous to many of the Mesozoic petroleum reservoirs of the Middle East (e.g., Alsharhan and Kendall 2002). Late Holocene progradation of the Abu Dhabi coastline has been proposed by a number of authors (e.g., Evans et al. 1969; Kinsman and Park 1976; Wood et al. 2006). A few previous studies have published radiocarbon dates for the coastal sediment of the Persian Gulf (Illing et al. 1965; Evans et al. 1969; Patterson and Kinsman 1982; Baltzer et al. 1994); however, there has been little attempt to translate these figures into quantifiable sedimentation and progradation rates. This study provides the first accurately constrained figures for late Holocene to Recent carbonate-ramp sedimentation and progradation for the Abu Dhabi coastline.

In this paper we propose and evaluate the hypothesis that the low-angle geometry of carbonate ramp systems is the primary control on sedimentation and progradation rates. We also evaluate whether it is inappropriate to apply rate estimates from other depositional environments when considering the low-angle ramp system. The study also aims to assess the relative contribution of carbonate and evaporite sediment to the intertidal- to supratidal-zone deposits of the carbonate ramp system. Finally, we shall consider the implications of these sedimentation and progradation rates for the future development of the Abu Dhabi coastline.

These objectives are achieved through the application of new radiocarbon dates and detailed sedimentological logging of sediment from twelve sample stations established in the intertidal to supratidal zone of the Abu Dhabi shoreline. These data provide the largest and most

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