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Latest Developments on the use of Grain-size Parameters in Periplatform Carbonates

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The significance of grain size as a fundamental property controlling other physically derived properties is well known. The grain-size pattern of marine carbonate sediments is complex because it is a function of 1) sediment availability, which is primarily dependent on carbonate productivity; 2) sediment export and deposition to the periplatform realm (together, these are controlled by sea-level fluctuations as a result of climatic change), and 3) post-depositional changes such as the mechanical removal of sediment through winnowing and/or changes in grain size due to digenetic processes such as cementation, recystallization, inversion, and dissolution. During the last decade grain size has been discussed for carbonate facies successions deposited in response to glacio-eustacy. The authors attempted to use grain size as a "fingerprint" for orbitally driven climatic changes of the late Neogene. Their findings showed that periplatform sediments are dominated by fine-grained material during sea-level highstands and coarser sediments during sea-level lowstands. Later this idea was tested further for different periplatform settings to consider whether these observed grain-size patterns were applicable to different types of marginal settings (accretionary vs. erosional). Here it was observed that the grain-size patterns of both margins were controlled by Neogene sea-level fluctuations but that they responded differently; the accretionary margin sediments indicated a grain-size pattern as previously described in the literature, however, the erosional, margin showed the reverse pattern, with coarser sediments typifying the interglacials. This proposed that the accretionary margin grain-size pattern was controlled by the productivity-export mode of the platform whereas the erosional margin sediment flux pattern was controlled by the impact of mass transport processes. These findings took into account that grain-size is a function of 1) sediment availability, 2) sediment export-deposition processes

and 3) post-depositional changes such as mechanical removal through winnowing. However, they did not consider changes in grain size due to digenetic processes which alter the initial grain-size signal. Recent work however, through examination of the fine-fraction amounts in connection with the assemblage of carbonate constituents from Bahamian cores, have made it possible to determine the effects of diagenetic alteration on the grain-size pattern. Results showed that sediments where the initial grain-size signal was coarser, facilitated early diagenesis due to higher porosities, permeabilities, and increased fluid flow (as indicated by the presence of nodules). This in turn caused a further coarsening of the sediment. Thus the secondary grain-size signal of such sediments exaggerated the initial grain-size pattern. However it was also observed that differences in the resulting secondary grain-size pattern to the initial one was not always consistent for different periplatform settings. Findings showed that to assess the validity of grain size as a proxy for paleoclimatic change it is important to differentiate between absolute and relative changes in the grain-size values; if only the amplitude of the grain-size signal as been changed, without alteration in the overall down-core trend, the secondary grain-size signal could still reflect the initial one and thus also reflect primary influences on the grain-size pattern, e.g. sea-level fluctuations and climatic change. However, where both absolute and relative changes occur in the secondary grain-size signal, it is assumed that the altered down-core trend in grain-size makes grain-size proxies difficult to use in connection with Neogene climatic change. In preiplatform carbonate sediments, which are shown to have high diagenetic potential, grain size should therefore be used with caution and only in conjunction with a component analysis to avoid mis- or over interpretation of the grain-size signal.