rewetting. These observations imply: (1) the criteria for recognizing subaqueous shrinkage cracks need reevaluation and (2) a careful study of mud-crack characteristics and their vertical and lateral variations in stratigraphic sections may provide detailed data on basin morphology, hydrology, and sedimentation rates.

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Early Diagenetic Controls on Allochthonous Carbonate Debris Flows—Examples from Egyptian Lower Eocene Platform-Slope

Many of the models that have been proposed for the origin of carbonate debris flows are based upon examples from ancient carbonate slope settings. Few ancient slope environments have been described, however, where submarine cementation processes were prevalent. This early diagenetic phenomenon, common on many modern carbonate slopes and platforms, can control the mechanisms by which debris flows are generated, as well as the ultimate form of the beds they produce.

Within the Duwi Trough of central Egypt, a basin to slope facies transition is preserved within the lower Eocene chalks and limestones of the Thebes Formation. Basinal facies are characterized by sequences of laminated chalks and limestones with thin, intercalated horizons of nodular limestone and limestone hardgrounds. Carbonate platforms developed on structural highs adjacent to the basin and periodically shed bioclastic detritus downslope in the form of fine-grained, skeletal turbidites. Nodular limestones and hardgrounds, that formed upslope, were in places dislocated and reworked into the basin as submarine debris flows. Individual debris flow beds preserved within the lower slope and basinal facies can be traced over 50 km down the trough axis and several kilometers laterally.

Nodular conglomeratic debris found within the flows range from 30 to 300 cm in thickness and are mud supported. Unlike most ancient debris flow breccias, larger clasts are unusually uniform in size and well rounded. This is not a reflection of textural maturity but a result of the primary nodular morphology of these clasts. Channels and basal scour features are poorly developed in these beds owing to the cemented (hardground) nature of the basin-floor during debris flow deposition.

Sites of nodular limestone bed dislocation are not recognized within the slope facies. Neither large-scale rotational slides, nor slump structures associated with translational slides are developed. The proposed mechanism for the detachment of these nodular horizons is one of relatively shallow decoupling of the early-cemented surface layer from the underlying, unconsolidated sediment. This process would have been accelerated by the presence of high pore fluid pressures owing to an impermeable surface layer (hardground) and loading, resulting from both sedimentation and cementation. Where submarine cementation was a continuous process, as on the upper slope, and uninterrupted sequences of nodular limestone were developed, sediments were stable and debris flows were not generated.

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Paleophosphate Determinations: Potentially Useful Paleo-Oceanographic Tool

Using recent hydrographic data from the Indian Ocean, we have derived an empirical relation that predicts PO_4^{3-} concentrations (μg - atoms/l) from the concentration of dissolved O_2 and temperature (°C), where PO_4^{3-} = 4.82 - 2.26 log T -0.30 dissolved O_2. The $\delta^{13}C$ and $\delta^{18}O$ of certain species of planktonic foraminifera have been demonstrated to be functions of apparent oxygen utilization (AOU = 205.0 − 100δ^{13}C) and temperature (calculated from the $\delta^{18}O$ paleotemperature equation). Utilizing the down-core $\delta^{18}O$ and $\delta^{13}C$ of planktonic foraminifera, substituted into the equation above, permits determinations of paleophosphate concentrations for fossil oceans. In rewritten form: PO_4^{3-} = (43.5(16.0) − 7.43 log T) − (43.5 O_2 saturated seawater (ml/l) − 205.0 − 100 δ^{13}C)/145.0. A comparison of the PO_4^{3-} values calculated from recent forams collected from 14 sites in the Indian Ocean with recent hydrographic values showed no significant differences (M = 0.91, B = 0.28, R = 0.89).

Having measured the isotopic concentrations of $\delta^{13}C$ and $\delta^{18}O$ obtained from 5 species of planktonic foraminifera from two cores in the Arabian Sea, we attempted down-core paleophosphate determinations. Foraminifera were collected from three time horizons in each core, the 0, 9, and 18 thousand years before present (KYBP) isochrons as determined from $\delta^{18}O$ ice-volume curves, using a linear age model. Our results indicate that the average surface and deep water (approximate O_2 minimum depth) paleophosphate concentrations for the three isochrons are, respectively: 0.575 and 2.07 at 18 KYBP, 0.205 and 2.30 at 9 KYBP, and 0.33 and 1.92 for the Holocene. These determinations may indicate greater productivity or upwelling at 9 KYBP relative to the Holocene at 18 KYBP.

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Isotopic Composition of Heavy (C_{15}+) Saturate and Aromatic Fractions of Crude Oils

One hundred and sixty oils from producing wells and drill-stem tests in the United States and around the world have been analyzed for the stable carbon isotope composition of the heavy (C_{15}+) saturated and aromatic fractions. Extreme reproducibility in the separation techniques and in the isotope preparation and measurement has allowed the plotting of the aromatic isotope composition versus that of the saturated composition with a very high degree of confidence. It appears that there is a linear relation between the isotopic composition of the aromatic and saturated fractions of oils of marine origin. A parallel relation, but with a more positive "y" intercept, seems to hold for oils of terrigenous origin. Oils which have undergone bacterial degradation show a different linear relation which can be extrapolated to the composition of the original non-degraded oil.

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Modern Depositional Analogs to Monterey Formation

The eastern Pacific Ocean encompasses three regions of modern sediment deposition that could be considered imperfect analogs to the depositional environment of the Monterey Formation. These are: (1) the shelf and slope areas off California; (2) shelf and slope areas off Peru-Chile; and (3) the basin margins of the Gulf of California.

All three regions lie within or near the influence of