Geophysical Research Abstracts, Vol. 9, 10699, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10699
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Linked hyperpycnal flows and Heterozoan reefs as indicators of wetter climates in La Popa Basin, NE Mexico

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The presence of hyperpycnal flows in prodeltaic facies indicates increased flood frequency and magnitude and therefore relates to sea level and climate change. Heterozoan faunal assemblages have been used variously to indicate environments of cooler water conditions or elevated trophic levels associated continental runoff or upwelling zones. Heterozoan reefs periodically developed on salt diapir topographic highs throughout La Popa Basin of NE Mexico during the Early Cretaceous (Aptian-Albian), Late Cretaceous (Turonian and Maastrichtian), and Paleocene. During these times La Popa Basin was located in tropical to subtropical latitudinal belts suggesting that the Heterozoan faunal make up was more likely controlled by increased nutrient levels. The entire basin was in an interior shelf position throughout deposition of the reefs and did not have a geomorphic configuration that would have permitted periodic upwelling into the salt basin.

The Heterozoan reefs formed on salt diapir highs during the transgressive systems tract of third-order depositional sequences. These were periods of time of overall slow siliciclastic sedimentation rates into the basin when diapir rise rates outpaced local sedimentation rates and created local topographic highs in an outer shelf/prodeltaic depositional setting. Superimposed on this period of time of diapir inflation are shorter term fluctuations in siliciclastic influx onto the shelf, which generated halokinetic sequences. Halokinetic sequences are angular unconformity bounded packages of strata that form around diapirs in response to variations in net diapir rise rates relative to net sediment accumulation rates. The sequences consist of heterozoan carbonate facies deposited directly above the angular unconformity, which are in turn overlain by shale.

The carbonate facies thin and pinch out away from the diapir where they interfinger and are onlapped by sharp-based sandstone beds. The sandstones were deposited in the prodeltaic environment by hyperpycnal flows generated during terrestrial flooding events. The flooding events resulted in increased river mouth discharge into the basin that may have significantly increased nutrient levels and permitted development of the Heterozoan reefs on the salt diapir highs. Flooding events were most likely tied to wetter climates.