MECHANICAL MODELING OF FRACTURING AND COLLAPSE ALONG STEEP-RIMMED SHELF MARGIN SYSTEMS

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Abstract

Steep-rimmed carbonate platforms represent a unique depositional setting where nearly instantaneous lithification of some facies (e.g., reef) create dramatic heterogeneity of rock mechanical properties within the shelf-margin and upper slope soon after deposition. The variability of rock strength and facies creates a contrast of brittleness within strata that is prone to fracturing and faulting at areas of highest mechanical contrast. These areas of early deformation impact early and late diagenetic fluid movement and commonly create areas that are prone to subsequent deformation or enhanced subsurface fluid flow. Despite the clear importance of deformation features to shelf margin evolution, little is known about the conditions, controls, or timing of deformation. A variety of mechanisms have been proposed for the development of early-formed fractures including differential compaction adjacent to pre-existing shelf margins, extension by basinward sliding along a dipping shelf margin slope, and influence of sea level changes on pore pressure and slope stability. However, these mechanisms are difficult to assess and rank in importance within paleomargin systems without understanding the mechanics and timing of failure necessitating the use of forward and numeric models to better understand the link between deposition and deformation. To examine these relationships, I propose to (1) develop a database of appropriate rock mechanics properties of modern and ancient carbonate facies; (2) construct finite and discretized-mechanical numerical models that investigate deformation mechanisms along shelf margins; and (3) compare key outcrop analogs to the model results to validate model results.

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