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Sequence Architecture of a Late Guadalupian Rimmed Shelf, Walnut Canyon, Guadalupe Mountains, New Mexico: Evidence of Lowstand

The Tansill Formation (uppermost Guadalupian), as exposed in Carlsbad Caverns N. P., provides a unique opportunity to document a near-complete platform-to-basin transition of a carbonate rimmed shelf system. More than 1000-m of measured section and extensive bed tracing using photomosaics enabled construction of a detailed sequence-stratigraphic framework for the 1.2-km, depositionally dip-oriented, exposures along lower Walnut Canyon. Comparatively rapid evolution in Late Permian fusulinacean faunas aided in further refinement and provides independent verification of the hierarchy of stratigraphic cyclicity. This biostratigraphically-constrained, high-resolution sequence-stratigraphic framework consists of two composite sequences (CS) and at least four high-frequency sequences (HFS).

Evolutionary stages of the Tansill system began with marine transgression over the karst-modified Hairpin dolomite (Guadalupian 27 HFS). Maximum accommodation was reached during the Guadalupian 28 HFS as shelf crest grainstones aggraded constructing 25-m of relief. The Guadalupian 29 HFS was dominated by lowstand sedimentation as indicated by platform karstification, margin failure, downward shift of coastal onlap, and basinward thickening of the Reichelina lamarensis zone. Likewise, the Lopingian 1 HFS is dominated by lowstand sedimentation characterized by large clastic-filled fractures, facies tract offset, and a four-fold basinward expansion of the Paraboultonia zone within 0.3-km.

This newly proposed high-resolution sequence framework provides a more dynamic and inclusive depositional model by incorporating observations at various scales. During lowstand, brittle failure of the platform margin generates subaerially exposed fracture systems and increases accommodation. Across the shelf, subtle topography develops as differential compaction occurs across near vertical, en echelon, penecontemporaneous faults and joints. Rapid basinward thickening of fusulinacean zones, absence of mud-dominated rock fabrics, lowstand-induced margin failure, karstification, and sequence architecture provide evidence of significant sea level fall (>60-m) during Tansill time.