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Reinterpretations of re-sedimented deepwater carbonates: Examples from the Permian Basin, southeast New Mexico and west Texas, U.S.A.

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Deepwater carbonate depositional systems represent historically understudied environments. The Permian Basin of west Texas and southeast New Mexico, USA provides an advantageous location to re-evaluate these settings due to subsurface data density as well as existing outcrop and subsurface studies providing a framework on which to expand. Regional well-log mapping in the Delaware Basin, the western subdivision of the Permian Basin, coupled with cores and seismic data highlight a range of carbonate accumulations along the slopes and in the deeper basin indicating a need for updates to current Permian Basin basinal depositional models.

Thickness maps and cross-sections through Wolfcampian and Leonardian (Asselian-Kungurian) strata highlight multiple mounded and elongate carbonate-mud-rich accumulations along the northwestern slopes of the Delaware Basin. The mounded nature, lack of platform focused sourcing, and presence of oblique cross-cutting channels suggest these features represent carbonate drifts as opposed to gravity-driven deposits. Drifts range in thickness from 250m-800m and may extend into the basin up to 40km. The drifts extend from the slopes at specific locations corresponding to bathymetric irregularities that likely locally weakened currents, causing deposition. Drift accumulations significantly alter slope gradients, slope width, and platform to basin relief, promoting higher rates of platform progradation in subsequent strata overlying the features. In contrast, bottom currents responsible for drift accumulation appear to also sweep sediments locally from toe-of-slope environments, inhibiting progradation. The variable bottom current influence therefore exerts a previously undocumented first-order control on margin and slope geometry in the basin.

In the deeper basin, mapping highlights previously undocumented radially distributed carbonate accumulations interpreted as calciclastic submarine fans. The fans appear to be point-sourced from the platform by antecedent topography, slope reentrants, and regional faults. Some fans extend into the basin over 100km and reach 250m in thickness. The fans range in composition, containing both carbonate debrites and turbidites, and varying volumes of mud-rich siliciclastic turbidites. Runout of gravity flows resulted in concentration of comparatively coarser carbonate material in proximal fan environments and finer siliciclastic mudstone, siltstone, and organic matter in fan fringe environments. Identification of fan systems therefore provides a predictive tool for facies architecture in the deeper basin.

This work highlights the first recognition of a carbonate drift system and the expanded interpretation of large-scale calciclastic submarine fans in the Permian Basin. As the Permian Basin represents one of the most heavily studied and geologic data-rich areas in the world, these new interpretations indicate carbonate drifts and calciclastic submarine fans systems are likely more common and overlooked in the ancient rock record.