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Diagenetic and Sedimentary Evolution of Syndepositional Fault Zones in Response to High-Frequence Sea-Level Fluctuation, Permain Seven Rivers, Yates and Tansill Formations, Guadalupe Mountains, New Mexico: Implications for Faulted Carbonate Reservoirs

It has been shown by numerous empirical studies that dynamic properties of fault gouges in siliciclastic rocks can be predicted on the basis of known dimensions and displacements of the faults. However, such prediction is far more difficult in carbonate rocks due to their susceptibility to diagenesis. The present study documents that in carbonate rocks, distribution and properties of fault zone-filling lithologies may be largely independent on the above characteristics of the faults. Instead, they may result from diagenetic and sedimentary processes allocated to the fault zones.

Here we present the results of an integrated stratigraphic and structural study of syndepositional faults and fractures that cut Permian Capitan-equivalent platform strata in Slaughter Canyon, Guadalupe Mountains, New Mexico. The study area is an outcrop analogue for Yates reservoirs in the Permian Basin.

The fault zones localized the development of paleokarst and acted as conduits for dolomitizing fluids. Fault-controlled cavern systems were opened contemporaneously with the growth of the Capitan platform. The caverns were up to 65 m wide, 200 m high and spanned up to 1.3 km along the fault strike. The fill, diagenesis and tectonic fabrics of the fault zones provide evidence for incremental growth of the faults and for multiple phases of brecciation, dissolution, collapse, deposition, cementation and dolomitization. Here, the spatial and temporal evolution of the fault zones is illustrated, and the various controls on their structural, sedimentary and diagenetic evolution are discussed within the context of a well-constrained stratigraphic framework.