

Heterogeneity of the Capitan Reef and Its Importance to Reservoir Development

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The origin of the Capitan Limestone has been a subject of considerable debate for nearly a century. Issues making interpretation difficult include the scale of the Capitan outcrop, rugged terrain with difficult access, and the underlying environmental heterogeneity of a reef setting. Often complicating matters is the extrapolation of results from studies based on limited aerial extent to the Capitan outcrop as a whole. Several recent publications have discussed cryptic habitats, identified from McKittrick Canyon and Bat Cave Draw, that were roofed by fenestellate bryozoans or explanate sphinctozoan sponges arching above the depositional surface. These growth forms generated shelter cavities that were occupied by communities of obligate cryptobionts. It was suggested that such crypts were ubiquitous, forming the dominant habitat on the Capitan depositional surface.

Our studies of the Middle and Upper Capitan reef outcrops support previous interpretations that significant lithological and paleontological differences exist throughout the Capitan reef. Surveys conducted along the Middle Capitan reef exposed on the McKittrick Canyon Permian Reef Geology Trail detected three lithological end-member fabrics, here referred to as Micrite Rich, Crypt, and Framework. Additional lithologies encountered include Mixed Framestone/Grainstone/Boundstone, bedded and cavity-fill Silt/Sand, Spar Rich, and Tubiphytes Boundstone. These lithological categories represent our initial attempt to produce a generalized artificial classification system that was defined by the lithologies exposed along the trail. While crypts are indeed present along certain portions of the Permian Reef Geology Trail, it is not clear to us that crypts represent the dominant habitat of the Middle Capitan reef. Our work in New Mexico also suggests that crypts were not the dominant habitat of the Upper Capitan reef, where fabrics include *Archaeolithoporella* and *Tubiphytes* boundstones, phylloid algal bafflestones, a variety of cement- and fossil-rich boundstones, and sponge-roofed crypts.

Deposition of the Capitan Limestone occurred in a complex setting with a high degree of patchiness and variable patch size, a fact reflected in the lithological fabrics and paleoecological patterns of the Capitan outcrop. It is critically important that statistically significant portions of the outcrop be examined before generalized characterizations are made. To date we have examined less than 3% of the total progradational distance covered by the Capitan reef. At best, this represents no more than 0.1% of the exposed Capitan outcrop in McKittrick Canyon alone. Clearly much work remains to be done before any general form of fabric dominance can be identified, if such exists. This inherent heterogeneity of the constructional fabrics within the Capitan may very well be the reason that the reef's origin has been interpreted in so many different ways. It is quite likely that the scale of sampling has been too restrictive to encompass the range of heterogeneity. Further understanding of the origin of heterogeneity in the Capitan lithofacies should improve the design of models for improved extraction of hydrocarbons from reef carbonates in the subsurface.