Deposition of Prograding Carbonate Sand Shoals and Their Subsequent Diagenesis—Lower Glen Rose (Cretaceous), South Texas

The lower Glen Rose in southwest Texas is a widely explored, but oil- and gas-barren, carbonate sequence (200 to 300 m thick) that was deposited on a broad, shallow-marine shelf. Three cyclic, shoal-water complexes, consisting of high-energy grainstone and coral-stromatoporoid-caprinid boundstone, developed over the Pearsall arch of south Texas. Facies distributions, determined from core and electrical logs, show that these linear complexes trend east-west for at least 125 km, and are located about 80 km inland of the Cretaceous shelf edge and 70 km seaward of the Cretaceous shoreline.

The shoal-water, cyclic sequences change upward from: (1) sandy, fossiliferous mudstone/wackestone deposited in an open-shelf environment; (2) echinoid-mollusk and oncolite-caprinid packstone deposited in intertidal shoals and subtidal grain flats; (3) coated-grain and echinoid-mollusk grainstone deposited in sand flats, tidal channels, spits, and bars; and (4) coral-stromatoporoid-caprinid boundstone and packstone deposited as patch reefs and flanking deposits. Lagoonal deposits, consisting of toucasiid-oyster-miliolid wackestone, boundstone, and mudstone enclose each of the shoal-water sequences, and indicate successive seaward progradations, interrupted by transgressions of open-shelf facies. The patch reefs may have prograded out across the shelf and formed the initial buildup of the Stuart City shelf margin.

Four gradational phases of grainstone diagenesis have caused almost continuous loss of porosity during burial. Micritic envelopes and isopachous crusts are early submarine cements. Next, development of an extensive meteoric-water system during burial to shallow depths led to dissolution or neomorphism of aragonite and precipitation of equant, isopachous cement, syntaxial cement, and nonferroan, equant calcite. As burial increased, subsurface brine displaced the original connate fluids and caused complex cementation and replacement by zoned ferroan and nonferroan calcite, lutecite and megaquartz, anhydrite, and saddle dolomite. The highest porosity is found in mappable facies of shoal-water grainstone.

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Stanley Field, North Dakota: New Model of Stratigraphically Trapped Oil, Mission Canyon Formation, Central Williston Basin

Stanley field provides a new model for exploration in the Mission Canyon Formation of the Williston basin. Moreover, it establishes for the first time the economic significance of early mechanical compaction of limestone with implications for both trapping and preservation of primary porosity.

Stanley field is a stratigraphically trapped oil accumulation producing from the Bluell interval of the Mission Canyon Formation. The field, discovered in 1977, lies midway between older established production along the Nesson anticline in the center of the basin and anhydrite stratigraphic traps paralleling the northeast side. There are currently 18 producing wells with the pay interval (maximum thickness, 37 m) cored in 16 wells in and near the field.

At Stanley field, during late Mission Canyon time, low, intertidal-supratidal barrier islands developed along depositional strike, separated laterally by marine channels and shoreward by shallow lagoons. Island sequences were syndepositionally cemented by both freshwater and beach rock-like marine cements whereas marine sequences remained uncemented, and both were overlain by massive anhydrite. Subsequent deposition of the overlying Charles Formation caused progressive mechanical compaction of upper Mission Canyon marine sediments, while cemented island sediments resisted compaction. The distribution of the different depositional facies and their control over subsequent diagenesis resulted in a reservoir formed of porous (primary interparticle porosity) marine grainstone-packstone and fractured, cemented island sediments locally retaining primary fenestral porosity. Trapping is accomplished by combination of overlying massive anhydrite and updip compacted marine (lagoonal) lime mudstone and wackestone.

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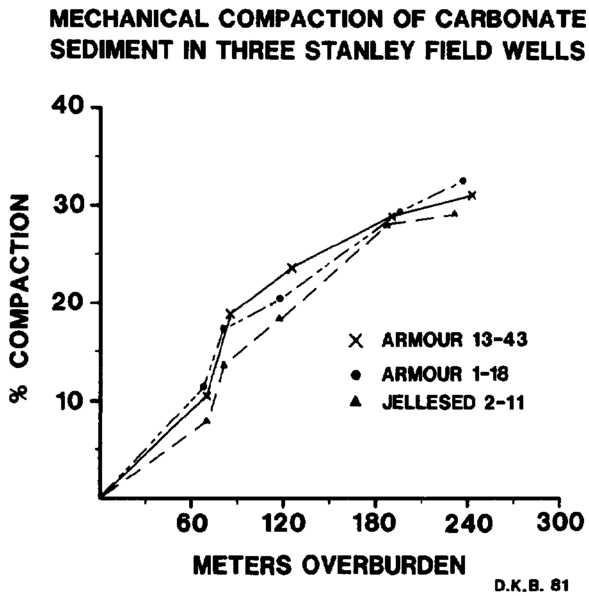
Stanley Field, North Dakota, Economic and Quantitative Significance of Mechanically Compacted Shallow-Water Limestone

Stanley field, producing from the Mississippian Mission Canyon Formation in the east-central Williston basin, establishes the economic significance of shallow subsurface mechanical compaction of shallow-water marine limestone, and provides a quantitative measure of mechanical compaction with increasing depth of burial.



In the field the upper 65 m of the Mission Canyon is formed of subtidal marine and intertidal-supratidal island facies. Marine facies escaped pervasive early cementation and were significantly compacted. Evidence of mechanical compaction of marine facies in cores include: (a) horizontal aspect of mottling (burrows); (b) horizontal orientation of fossil fragments; (c) drag, drape, and penetration effects; (d) microstylolitic "horsetail" swarms; and (e) broken and crushed fossils (ostracods, trilobites, corals, and crinoids). Island facies, syndepositionally cemented by both fibrous marine (beach rocklike) and equant spar (freshwater) cements, show no evidence of significant mechanical compaction.

Compacted marine mudstone and wackestone form the updip seal for the field. Preserved primary interparticle porosity in compacted marine grainstone and packstone provides the principal reservoir facies.

Structure and isopach maps of various intervals of the Mis-