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Abstracts

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Conley Field, Hardeman County, Texas: Chappel (Mississippian) Production from Facies-Selective Porosity in Carbonate-Sand Buildups

The Mississippian Chappel formation at Conley field in Hardeman County, Texas, produces oil and gas from skeletal grainstone buildups, not from Waulsortian-style mud mounds or crinoid banks. Petrographically defined microfacies indicate that these depositional bodies represent current-swept, bioclastic sand waves consisting of grainstones and packstones that contain 24-69% fragmented and sorted crinoidal and bryozoan debris.

These carbonate sands are flanked by packstones and wackestones that consist of 20-60% crinoidal debris and up to 70% mud. Spiculiferous, silty wackestones to mudstones occupy the platform areas farther away from the sand buildups. Presumably, those muds represent the ambient "shelf depositional mode," and the sand banks represent conditions that required a special combination of hydrodynamics, topography, and biology. Perhaps subtle antecedent topography on the Ellenburger surface helped to "anchor" the sand waves and perpetuate the buildup.

Reservoir porosity occurs only in the crinoidal bryozoan sands where it is linked with the intraparticle spaces in fenestrate bryozoan fragments. To a lesser extent, interparticle pore spaces exist, along with solution-enhanced interparticle porosity. The chief porosity destroyers have been calcite cementation and compaction. Because the porosity is mainly intraparticle in nature, permeability is low—typically 1.0 md and less except where fractures are present.

Although Conley field has a large amount of post-Mississippian structural closure, the reservoir is dependent on the petrographic and stratigraphic properties that resulted from Chappel deposition and early diagenetic processes. Exploration and development techniques in such a field require careful attention to paleostructures and their telltale isopach signatures.

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Effects of Diagenesis on Reservoir Properties in Lobo Sandstones, Webb County, Texas

Cored intervals of the late Paleocene Lobo sandstones of Webb County, Texas, were studied between depths of 9,066.5 and 9,900.5 ft (2,763.5-3,018 m). Diagenesis has extensively modified these sandstones, both compositionally and texturally. Porosities and permeabilities within the sandstones range from 6 to 28% and 0.01 to 10.0 md, respectively. Porosity and permeability are dependent on depositional facies and diagenetic history.

Density and sonic logs, coupled with petrographic analysis, were used to delineate the burial history of the sandstones. Primary porosities as high as 40% were reduced to 25-30% through a combination of compaction, bioturbation, and quartz cementation during the first 3,000 ft (914 m) of burial. Calcite cement, up to 26%, infilled essentially all remaining pore spaces and decreased porosity to irreducible levels between 3,000 and 6,500 ft (914 and 1,981 m). During deep burial, secondary porosity was created by the dissolution of calcite cement and framework grains. This last stage of sandstone diagenesis appears to be in response to the generation of abnormally high fluid pressures in surrounding shale sections.

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Diagenesis of Knox Group (Cambrian-Ordovician) Carbonates Exposed Along Alligator Creek, Bibb County, Alabama

Diagenetic products observed in Knox Group carbonates from the Alligator Creek section have been described from thin section and placed into a paragenetic sequence on the basis of cross-cutting relationships. Eogenetic processes include freshwater granular calcite cementation and vug formation in exposed carbonate highlands that developed during relative sea level falls. Later transgressions produced a mixing zone between advancing marine water and interstitial meteoric water. Extensive replacement dolomitization and silicification occurred in the mixing zone, including the formation of silica cements in pore space.

Mesogenetic processes produced fractures, stylolites, and pressure seam dolomite. Burial fluids migrated along fractures and through previously formed intercrystalline porosity to produce vugs. Dolomite-bearing fluids later reduced intercrystalline, fracture, and vuggy porosity by precipitating dolomite cement. Folding and thrusting associated with the Allegheny orogeny produced fracturing, brecciation, and calcite mineralization. Blocky calcite cement occluded much of the remaining fracture and vuggy porosity in the section.

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Diagenetic Controls on Reservoir Development and Quality, Smackover Formation of Southwest Alabama

Smackover reservoirs in southwest Alabama are much more complex than those encountered in the central and western portions of the Gulf Coast basin. This heterogeneity is a product of a complex history of diagenetic modification. The diagenetic history can be divided into five separate stages: (1) marine—extensive grain micritization and precipitation of minor amounts of fibrous cement; (2) meteoric vadose—extensive dissolution of aragonitic grains; (3) meteoric phreatic—precipitation of granular and blocky cements; (4) brine reflux—extensive dolomitization and sulfate emplacement associated with refluxing of Buckner brines; and (5) burial—grain-to-grain compaction of lithologies not stabilized by early cements, stylolitization, precipitation of poikilotopic calcite and dolomite cements, minor dissolution of calcite associated with the introduction into the formation of undersaturated fluids, hydrocarbon migration, and sulfate replacement and cementation. The diagenetic sequence varies dramatically over short distances in southwest Alabama, reflecting variation in paleotopography.

The products of this complex diagenetic history are heterogeneous reservoirs that consist of primary interparticulate, moldic, dolomitic intercrystalline, or vuggy porosity, or some combination of these. Primary interparticulate porosity is less common in southwest Alabama than in the central and western portions of the Gulf Coast basin, largely because of extensive compaction or early cementation. Where present, however, interparticulate reservoirs are characterized by moderate to high porosity and good permeability. Moldic porosity is produced by early, fabric selective dissolution of aragonitic allochems and is associated with areas of subaerial exposure. Moldic reservoirs commonly have high porosity but low permeability, and are generally productive only where permeability is enhanced by other pore types. Dolomitic intercrystalline porosity is common in the Smackover of southwest Alabama. However, intercrystalline porosity alone is seldom of reservoir quality, and hydrocarbon production from dolomitized lithologies is generally dependent on the coexistence of moldic or vuggy porosity. Vuggy porosity is the product of late, nonfabric selective dissolution of calcite. Vuggy pores are produced by solution enlargement of earlier formed interparticulate, moldic, or intercrystalline pores. Vuggy reservoirs are by nature composite and are characterized by moderate to high porosity and good permeability.

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Origin of Woodbine-Eagle Ford Reservoir Facies, Kurten Field, Brazos County, Texas

Woodbine-Eagle Ford reservoirs are productive over an area of about 55 mi^2 (140 km^2) in Kurten field. The Woodbine "C" sandstone is the most extensive reservoir and has an average net thickness of 30 ft (9 m). The "C" sandstone shows distinctive changes in rock type from south to north: (1) a cross-bedded facies consists of thin-bedded, medium-grained