The C zone dolomite of the Red River is the major oil-producing zone in Richland County. This dolomite occurs immediately beneath the "C" zone anhydrite as concentrated lenses of: (1) tight cryptocrystalline anhydritic dolomite, (2) porous fine to very fine-grained dolomite, and (3) relatively tight partly dolomitized limestone. The dolomitized lenses are typically one to two km in diameter and up to 50 m thick. They apparently formed beneath "holes" in the C anhydrite through which dense Mg-rich brines (formed during precipitation of the subtidal anhydrite) seeped. These "holes" formed almost randomly, probably by hydraulic fracturing as interstitial waters from compacting sediments beneath the anhydrite escaped upward, but minor faulting may have created more linear "holes" locally.

The D zone dolomite along the eastern edge of Richland County also formed by gravitational seepage, but the absence of a D zone anhydrite allowed for relatively laterally persistent dolomitization. Distribution of D zone dolomite was controlled mainly by paleo-topography of the basin floor; the brines filled in lows whereas dolomitization was minor or nonexistent over paleo-highs.

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Low-^{18}O Authigenic Clays and Calcite in Shallow Cretaceous Sandstones of Alberta

$\delta^{18}O$ values of authigenic minerals in shallow (<1,500 m) Cretaceous rocks from Alberta suggest that ground water exerts an important control upon the diagenesis of sandstones. In Alberta, ground waters are significantly depleted in ^{18}O relative to seawater.

Minerals precipitated in equilibrium with ground water should have $\delta^{18}O$ values predictably lower than similar phases formed from more ^{18}O-rich fluids. The $\delta^{18}O$ values of 150 clay samples from the Milk River, Belly River, and Viking formations range from 6 to 20‰ (SMOW). An equally large variation in $\delta^{18}O$ (+11 to +28‰, SMOW) and $\delta^{13}C$ (−10 to +2‰, PDB) is shown by over 125 carbonate samples. Detrital clays from the Milk River have $\delta^{18}O$ values of +16 to +20‰ (SMOW). The $\delta^{18}O$ (+24 to +28‰, SMOW) and $\delta^{13}C$ (−3 to +1‰, PDB) values of dolomite clasts are typical of platform carbonates. The much lower $\delta^{18}O$ values of the authigenic kaolinite, smectite (+10 to +15‰, SMOW), and calcite (+15 to +19‰, SMOW) in the sandstone aquifer reflect neoformation from low-^{18}O ground waters at temperatures as low as 5°C. Involvement of organically derived CO_2 during calcite formation is indicated by low $\delta^{13}C$ values (−10 to −3‰, PDB). In sandstone of the Belly River Formation, early pore-lining chlorite and later pore-filling kaolinite and calcite have quite low average $\delta^{18}O$ values of 6.3, 12.0, and 13.1‰ (SMOW) respectively. The kaolinite and calcite approach oxygen isotope equilibrium at a temperature of 55±10°C with ground waters of about −8 to −10‰(SMOW). The chlorite is out of isotopic equilibrium and formed either at lower temperatures and(or) from more ^{18}O-rich fluids. The $\delta^{18}O$ values of <2μm clays from the Viking Formation (18-20‰ SMOW) may reflect a detrital origin. Illite-smectite, however, which is concentrated in the <0.2μm fraction, has lower $\delta^{18}O$ values (+12 to 16‰), perhaps suggesting ground-water involvement in its genesis.

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Channels and Chimeras: Coastal vs. Fluvial Deposition of Mannville Group, Lloydminster Area, Saskatchewan

Examination of nearly 4,000 m of core from more than 180 wells clearly demonstrates that fluvial processes were insignificant in deposition of the Mannville Group (Lloydminster member and above) in the Lloydminster area of Saskatchewan (R18W3-28W3, T44-54). Previous fluvial models are based primarily on the presence and geometry of channels interpreted from geophysical well logs. With rare exceptions, however, well spacing and core data are inadequate to prove a fluvial origin of such features, if they exist at all. A notable exception is an unequivocal channel deposit in the Waseca Formation in the Pikes Peak–Lashburn area. However, the nature of adjacent strata, the presence of numerous clay drapes within the deposit and its dimensions (≤40 m thick, 1.6 to 2.7 km wide, but only 30 km long) are inconsistent with fluvial deposition in a terrestrial setting. The most compelling argument against a fluvial origin of the Mannville is the presence in every core studied of numerous sedimentary structures that are extremely difficult to reconcile with fluvial deposition and the paucity of possible fluvial structures or sequences of structures. The former include swash-zone cross lamination; oscillation ripples; and hummocky cross-stratification; and flaser, wavy, lenticular, and pin-stripe bedding. Cored intervals of strata which can be equivocally interpreted to represent fluvial or other channels (such as massive or ripple cross-laminated sands) are nearly everywhere less than 5 m thick. Even if such an interpretation is applied in every example, channel deposits are volumetrically insignificant. Finally, many undoubtedly marine or brackish assemblages of foraminifera and dinoflagellates have been recovered in the study area. Ubiquitous wave-generated sedimentary structures, essentially tabular geometries of sand bodies, and microfossils in the Mannville Group clearly demonstrate deposition in a coastal, rather than fluvial, setting.

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Subsurface-Derived Secondary Oomoldic Porosity, Smackover Formation (Upper Jurassic), South Texas

Subsurface-derived secondary oomoldic porosity is an important factor in reservoir development in the south Texas Smackover Formation. Much of the section penetrated is impermeable; however, reservoirs as thick as 33 ft (10 m), with porosity ranging from 4 to 26% and permeabilities ranging from 0.1 to 6.5 md, have been cored at depths below 18,000 ft (9,486 m).

In the grainstone facies, four general stages of diagenesis affected porosity: Stage 1 (marine-phreatic environment), precipitation of an isopachous carbonate cement and extensive grain micritization; Stage 2 (shallow-meteoric environment), precipitation of very coarse-crystalline syntaxial calcite and fine-crystalline equant calcite, dissolution of aragonitic skeletal grains, and incipient solution-compaction; Stage 3 (regional fluid-mixing environment), intrapore precipitation of and grain/matrix replacement by fine to medium-crystalline rhombic dolomite; and Stage 4 (subsurface environment associated with basinal fluid expulsion), dissolution of ooids and dolomite resulting from decarboxylation of kerogen, microstylolitization by solution compaction, and precipitation of coarse-crystalline calcite and baroque dolomite. The magnitude of each general diagenetic stage varies regionally.

Oomoldic porosity is present only in the updip, highly dolomitized grainstone facies. The dolomite formed a chemically rigid matrix that allowed the calcite ooids to be dissolved without solution compaction between grains. In the downdip, poorly dolomitized facies there was no chemically rigid framework, and dissolution proceeded by solution compaction resulting in loss of