trolled by the total thicknesses of sediment deposited within the Mississippian lows, the varying types of lithologies deposited within the lows, the lithologic variations in the overlying sediments, the angle at which the seismic is shot across the Mississippian "channels," and the geometry of the Mississippian channel cut.

Accumulations of the Norcan-Fager type are subtle traps that are difficult to discover using only wireline logs. The key to successful exploration for Norcan-Fager-type reservoirs is geologic interpretation of seismic data.

DAVIS, HAROLD G., Tenneco Oil, E & P., Oklahoma City, OK

Wrenching and Oil Migration, Mervine Field Area, Kay County, Oklahoma

Since 1913, the Mervine field (T27N, R3E) has produced oil from 11 Mississippian and Pennsylvanian zones, and gas from two Permian zones. The field exhibits an asymmetric surface anticline, with the steeper flank dipping 30° east, maximum. A nearly vertical, basement-controlled fault occurs immediately beneath the steep flank of the surface anticline. Three periods of left-lateral wrench faulting account for 93% of all structural growth: 24% in the post-Mississippian to the pre-Desmoinesian; 21% in the Virgilian; and 48% in the post-Wolfcampian.

The Devonian Woodford Shale—and possibly the Desmoinesian Cherokee and Ordovician Simpson shales—locally generated oil in the Mesozoic through the early Cenozoic, which should have been structurally trapped in the Ordovician Bromide sandstone. This oil may have joined oil previously trapped in the Bromide, which had migrated to the Mervine area during the Early Pennsylvanian from a distant source. Intense post-Wolfcampian movement(s) fractured the competent pre-Pennsylvanian rocks, allowing Bromide brine and entrained oil to migrate vertically up the master fault and accumulate in younger reservoirs.

Pressure, temperatures, and salinity anomalies indicate that vertical fluid migration presently continues at Mervine field. Consequently, pressure, temperature, and salinity mapping should be considered as a valuable supplement to structural and lithologic mapping when prospecting for structural hydrocarbon accumulations in intracratonic provinces.

DICKAS, ALBERT B., Univ. Wisconsin–Superior, Superior, WI

Comparative Precambrian Stratigraphy Along Mid-Continent Rift Trend

In 1983, leasing agents representing several major exploration corporations appeared in the Lake Superior district of northern Wisconsin, an area best known for its exposures of Duluth gabbro and Mellen "black granite," and not for its hydrocarbon potential. The geologic column of interest is the 7,620+ m (25,000+ ft) thick clastic sequence termed the Keweenawan Supergroup (Precambrian), a basal shale that has been Rb-Sr–age dated at 1,075 ± 50 billion years. Within the past decade, this sequence has been recognized as having been deposited in response to tensional processes resulting in the development of a rift system. This Mid-Continent rift is best outlined by gravity and can be traced from the Keweenawan Peninsula of Michigan across northern Wisconsin, Minnesota, Iowa, and Nebraska into northeastern Kansas, a distance of 1,290 km (800 mi).

An organic-rich shale source unit is known in the Lake Superior area, where it creates intermittent subsurface oil seeps in the White Pine copper mine of Michigan. To the southwest along the trend of the rift, the extent of Keweenawan-equivalent sediments are masked by Paleozoic and younger sediments, increasing from a feather edge in central Minnesota to a reported 1,524 m (5,000 ft) in southwestern Iowa. In the mid-1960s, a natural-gas-storage drilling program centered on Dakota County, Minnesota, cored extensive thicknesses of Precambrian clastics, subsequently named the Solor Church Formation. This subsurface unit, together with surface exposures of the younger Hinckley Sandstone and Fond du Lac Formation, constitutes the Keweenawan section of Minnesota. Less is known of the Keweenawan-equivalent lithology of Iowa, where the Minnesota terminology is being used in geophysical studies of the Mid-Continent gravity high. Here, a late Precambrian "red clastic" sequence is known, apparently similar to that termed the Rice Formation in Kansas—a carbonate subordinate sequence of sandy shales and feldspathic sandstones.

DONALDSON, W. ALLEN, Pioneer Production Corp., Amarillo, TX

Petrology and Diagenesis of Pennsylvanian Collier Limestone, Hitchland Field, Hansford County, Texas

The Pennsylvanian Collier limestone in Hansford County, Texas, is found at depths of 4,500 to 4,700 ft at Hitchland field, along the shelf edge in the western portion of the Anadarko basin. Lithology and geometry of the limestone can be compared with Bahamian oolite shoals.

The four major carbonate rock types or facies present within the Pennsylvanian Collier limestone are: (1) oolite grainstone, (2) fusulinid pelletal mudstone, (3) bioclastic wackestone, and (4) bioclastic grainstone. Discontinuous, thin lime mudstones and shales are found above and below the Collier limestone.

A Collier isopach map indicates a northeast-southwest depositional strike. The Collier shoal complex extends approximately 20 mi in length and 5 mi in width with a maximum thickness of 45 ft. Paleogeographic slice maps reveal that three isolated shoals, adjacent and parallel to the shelf-slope margin, prograded shelfward, coalescing to form one large oolite shoal complex. The Amarillo-Wichita uplift and basin subsidence caused a rapid rise in sea level and a northward influx of clastic sediment toward the shelf. These events finally drowned and destroyed the carbonate environment that formed the Collier limestone.

Diagenetic alteration occurred in eogenetic and mesogenetic stages. During eogenetic diagenesis, five events occurred: (1) cementation of allochems by bladed isopachous calcite and coarse, equant, spar calcite in the freshwater phreatic zone; (2) dissolution of allochems in the freshwater, phreatic zone; (3) development of micrite envelopes in the marine phreatic zone; (4) fracturing of the oolite grainstone facies; and (5) Dorag dolomitization. Mesogenetic diagenesis included: (1) partial infilling by saddle dolomite in vuggy and moldic porosity; (2) fracturing of the oolite grainstone facies; and (3) stylolitization of the fusulinid pelletal mudstone facies.

FRIEDMAN, G. M., Rensselaer Polytechnic Institute, Troy, NY, and C. A. STERNBACH, Rensselaer Polytechnic Institute, Troy, NY (present address: Shell Western E&P Inc., Houston, TX)

Dolomites Formed Under Deep Burial Conditions: Hunton Group Carbonate Rocks (Upper Ordovician to Lower Devonian) in Deep Anadarko Basin of Oklahoma and Texas

Petrographic and geochemical study of cores and cuttings from 25 boreholes ranging in depth from near surface to 30,000 ft (9.1 km) of the Hunton Group (Upper Ordovician to Lower Devonian), in the deep Anadarko basin of Oklahoma and the Texas panhandle, shows progressive burial diagenesis with increased depth. Limestone conformably overlying shale has been diagenetically altered to dolomite, commonly ferroan, chiefly below current depths of 10,000 ft (3.0 km).

The dolomite occurs as finely disseminated, 10 μm and larger rhombic crystals, and is most abundant near the base of the Hunton Group, particularly where an oolite unit overlies the thick marine Sylvan Shale inferred to be the chief source of Fe^{2+} and Mg^{2+} ions. Dolomite crystals are euhedral above about 10,000 ft (3 km). Below 10,000 ft, more complete dolomitization of the oolite produced hypidiotopic and xenotopic textures. Fluids associated with hydrocarbon migration (following dolomitization) dissolved the nonreplaced calcite, thereby creating intercrystalline and moldic porosity.

X-ray diffraction verifies a trend of higher dolomite concentrations in the same oolite horizon with increasing depth. Oolite samples from outcrop lack dolomite (100% $CaCO_3$); cores from 9,200 ft (2.8 km) are about 25% dolomite; and cores and cuttings from 15,000 ft (4.6 km) and below are +85% dolomite. Radioisotope-induced x-ray fluorescence shows that dolomites below 10,000 ft (3 km) are iron enriched relative to both nondolomitized oolite and dolomites of surface origin. We therefore conclude that dolomite has formed under deep burial conditions.

HARRIS, JOHN W., and LAWRENCE L. BRADY, Kansas Geological Survey, Lawrence, KS, and ANTHONY W. WALTON, Univ. Kansas, Lawrence, KS

Stratigraphy and Depositional Environments—Krebs Formation in Southeastern Kansas