bioturbated fossilferous wackestones and packstones; and pelmatozoan packstones and grainstones.

A complex diagenetic history has occluded virtually all primary porosity within the Viola. Petrographic evidence suggests that the following approximate sequence of diagenetic events has occurred; (1) microboring and subsequent micritization of bioclasts to form micrite envelopes; (2) very early submarine cementation that bound the loosely sorted allochems and partly occluded porosity, characterized by drusy overgrowths on trilobite and brachiopod fragments, bladed, void-filling cement, and turbid, inclusion-rich syntaxial overgrowths on pelmatozoan fragments; (3) initial compaction evidenced by local fracturing of elongate bioclasts; (4) neomorphism, including the inversion of aragonitic allochems to calcite and the recrystallization of micrite to microspar and pseudospar in the presence of low-salinity pore fluids; (5) freshwater cementation dominated by clear syntxial overgrowths on pelmatozoan fragments and pore-filling mosaic calcite that filled virtually all remaining pore space; (6) selective dolomitization; (7) silicification, including the formation of chert nodules and the replacement of bioclasts and calcite cements by microgranular quartz and/or lutecite; (8) compaction and pressure solution, probably due to deep burial, characterized by nonsutured seam stylolites, sutured seam stylolites oriented subparallel to bedding, and sutured grain boundaries; and (9) tectonically imposed pressure solution indicated by sutured seam stylolites oriented at high angles to bedding that developed during the late Paleozoic deformation of the Arbuckle Mountain.

The Viola Limestone is known as a reservoir rock and possible source unit for hydrocarbons throughout much of south-central Oklahoma. Thorough understanding of the nature and timing of diagenetic events is important for the further economic development of the Viola Limestone and other similar carbonate ramp deposits.

GRANTZ, ARTHUR, and STEVEN D. MAY, U.S. Geol. Survey, Menlo Park, CA

Geologic Framework and Petroleum Potential of United States Chukchi Shelf North of Point Hope, Alaska

A reconnaissance grid of 24-channel seismic-reflection data indicates that most of the United States Chukchi shelf north of Point Hope, Alaska, is prospective for petroleum. The prospective rocks, which consist of four stratigraphic sequences, rest on the Arctic platform, a regional erosional surface cut across mildly metamorphosed lower Paleozoic rocks in Late Devonian time. The Eo-Ellesmerian sequence, interpreted to contain mainly Mississippian nonmarine deposits, is 5+ km (16,500 ft) thick and fills local sags and faulted depressions in the Arctic platform. Mississippian to Neocomian stable shelf clastic and carbonate beds of the Ellesmerian sequence, 0 to 7.7+ km (25,000 ft) thick, underlie most of the shelf but are absent from Barrow arch and the outer shelf of the northeastern Chukchi Sea. Albian and Upper Cretaceous intradelta and prodelta deposits of the lower Brookian sequence, which thicken from 250 m (800 ft) on Barrow arch to 7.5+ km (24,500 ft) to the southwest, northwest, and north, underlie most of the shelf. The upper Brookian sequence, inferred to consist of marine and nonmarine clastic deposits of mainly or entirely Tertiary age, is 0 to 5.6+ km (18,500 ft) thick. It occurs only in Nuwuk and North Chukchi basins and locally as canyon fill beneath the central Chukchi shelf.

The northern Chukchi shelf contains seven provinces of contrasting tectonic origin and structural style. Nuwuk basin, a progradational clastic prism containing 12+ km (39,500 ft) of lower and upper Brookian strata and numerous growth faults, overlies a rifted margin of Neocomian age beneath the outer shelf and slope of the northeastern Chukchi Sea. North Chukchi basin, which underlies the outer shelf west of Nuwuk basin, contains Ellesmerian beds and 12+ km (39,500 ft) of lower and upper Brookian strata. It may also overlie a Neocomian rifted margin, but was deepened by Laramide extensional rifting. South of these basins, shelf structure is controlled by the geometry of the Arctic platform, which slopes gently southwest from a depth of 0.25 km (800 ft) on Barrow arch to about 13 km (42,650 ft) off Point Lay. In the central part of the shelf, the platform is somewhat faulted and folded and descends to a depth of 10+ km (33,000 ft) to form the north-trending Hanna trough. West of the trough the platform rises to within 1 km (3,300 ft) of the seabed and is broken by numerous normal faults. The southern part of the platform contains a thick lower Brookian section with numerous northwest-striking, northeast-verging detachment folds. The fold province is bounded on the southwest, off Cape Lisburne, by the northwest-striking Herald arch overthrust belt at which one or more southwestward-dipping thrusts brought Ellesmerian and older strata to the seabed.

The seismic and extrapolated onshore data suggest that Nuwuk and North Chukchi basins, Hanna trough, and the Arctic platform east and west of the trough could contain significant deposits of oil or gas. The potential of the fold belt, however, is modest, and of Herald arch slight. Small areas on Barrow arch and the Arctic platform west of Hanna trough lack potential because they are underlain by less than 1 km (3,300 ft) of prospective section.

GREGG, WILLIAM J., Michigan Technological Univ., Houghton, MI, and T. H. MROZ, Morgantown Energy Technology Center, U.S. Dept. Energy, Morgantown, WV

Mechanical Factors Affecting Stimulation Design in Devonian Gas Shale

Oriented core samples from 23 Devonian gas shale wells in the Appalachian basin were used to determine microscopic and mesoscopic fracture patterns. The specific objectives were to note the preferred direction and nature of natural microcracks, to determine the preferred fracture propagation direction in laboratory mechanical testing, and to outline areas in the basin that are characterized by a high natural fracture density in the gas shales. This information provides a necessary background for the development of the in-situ stimulation technology which would most effectively connect natural fracture systems to a single well bore.

Mechanical tests under zero confining pressure conditions included point load, indirect tensile, laboratory hydrofracturing, and directional ultrasonic testing. Natural fractures were measured prior to testing. The preferred orientation of both induced and natural fractures throughout the basin was generally parallel to the trend of Paleozoic tectonic structure. This parallelism, as well as the details of the microfabric, suggests an "incipient cleavage" origin for the natural crack arrays. It thus appears that the residual effects of in-situ stresses do not influence the orientation of the induced fractures in laboratory tests. Tests under zero confining pressure are therefore not useful for determining the orientation of $\sigma_{H_{max}}$ as other workers have previously suggested, nor is the orientation of the fractures produced in these tests necessarily the same as that of an induced hydrofracture in the field.

The trajectory maps for in-situ stresses in the basin clearly illustrate the lack of parallelism with the mechanical fabric of the shale. However, analysis of the two patterns has been used to outline local areas in the basin where $\sigma_{H_{max}}$ is parallel to the natural microcrack system. In these areas the natural crack array would