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Abstracts of Papers

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Porosity and Permeability in Silurian Carbonate Rocks of Hunton Group, Anadarko Basin, Oklahoma

Ninety Hunton cores have been studied, from which 82 Silurian samples from 22 wells were tested for porosity and permeability. Each sample was examined in thin section and was chemically analyzed for $CaCO_3$, $MgCO_3$, and HCl insolubles. The specimens range from limestone and calcareous mudstone having less than 1% $MgCO_3$ to crystalline dolomite with more than 43% $MgCO_3$. Porosity ranges up to 21%, and permeability to 305 md. Rocks with appreciable porosity and permeability have a circumscribed range in texture and composition—specimens with more than 5% porosity are confined to crystalline dolomites with more than 35% $MgCO_3$ (65% dolomite), and those with more than 10% porosity to dolomites with more than 37% $MgCO_3$ (80% dolomite). Much of the pore space is in the form of fossil molds and vacuities in the matrix surrounding oolites. The fossil molds are due to leaching, and the porous oolites probably result from a primary porosity increased by dissolution. Not all dolomites have high porosity, and several specimens with more than 35% $MgCO_3$ have less than 1% porosity; the latter condition appears to result at least in part from preservation of the fossils by calcspar and dolospar rather than as molds. Leaching of fossils and preservation by spar are confined to crystalline dolomite, thus indicating a genetic relation to dolomitization. A suggested sequence of events in the development of porosity is dolomitization and leaching, followed by some secondary cementation of pore space by spar.

Present information indicates a geographic concentration of these porous Silurian dolomites in the north-central and western parts of the Anadarko basin in Oklahoma.

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Stratigraphic Analysis of Cherokee Group, Pennsylvanian (Desmoinesian), North-Central Oklahoma

Cherokee rocks in an area of approximately 14,000 sq mi of north-central Oklahoma were investigated utilizing 1,850 mechanical logs and 110 sample logs. Correlations were established from stratigraphic profiles, constructed so as to form a control network throughout the area.

The Cherokee "genetic sequence" of strata can be defined at its base by a regional unconformity and at its top by the base of the Oswego or Fort Scott Limestone. The Oswego disappears southward into the Calvin Formation and the top of this latter unit (although slightly higher in the section) was used for the top of the sequence in the southeastern part of the area. Based on marker beds the sequence was subdivided into 6 "genetic increments" of strata—Gilcrease, Booch, Bartlesville, Red Fork, Skinner, and Prue-Calvin. These were named, in ascending order, for a prominent sandstone body therein. Isopach maps were constructed for each increment. These showed a general thickening toward the Cherokee, Arkoma, and Anadarko basins, and also indicated that an old drainage system was developed on the underlying eroded surface which flowed into these basins. Isolith maps were constructed for the sandstone bodies within each increment. These showed a general elongated and branching pattern that trends into the Arkoma basin.

It is concluded that the Cherokee sequence was an onlapping, cyclical unit that was deposited on an eroded, stream-dissected surface formed on southeasterly and southwesterly tilted older rocks, and that the sandstone bodies constituted a part of a sediment dispersal system that contributed to the alluviation of parts of the Cherokee, Arkoma, and Anadarko basins.

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Reconstructing a Pennsylvanian Delta System

The Coffeyville interval within the Missourian Series of the Pennsylvanian System in northeastern Oklahoma was studied to determine its origin. The interval is an isochronous unit underlain by the Checkerboard limestone key bed and overlain by the Hogshooter limestone. Through most of the area these transgressive limestone marker beds define a time-rock unit.

Stratigraphic characteristics within the interval are illustrated by cross sections, and specific data obtained from more than 500 well logs were used to make isopachous, sandstone-shale ratio, and isolith maps. Core, E log, and outcrop observations provided information on sedimentary structures, textures, and vertical sequences.

The primary depositional framework is deltaic. From the available data it is possible to delineate 8 separate environmental facies within the delta complex, and to correlate each facies with particular S.P. curve shapes. Outcrop and core studies of trace fossils, textures, and sedimentary structures were correlated to individual facies. Criteria were established to recognize ancient deltaic deposits and methods of environmental analysis.

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Prospecting for Reefs by Gravity

A gravity survey conducted in 1951 by the Panhandle Eastern Pipeline Company resulted in the discovery of gas in the Boyd reef, St. Clair County, Michigan. Subsequent drilling shows that 29 reef discoveries in Michigan are attributed to gravity prospecting between 1952 and 1967. The Wapella East reef in Illinois and the Redwater reef in Alberta, Canada, are other reefs discovered by gravity surveys. Gravity maps have been made of recent discoveries in Ingham and Eaton Counties, Michigan.

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Algal Bank Complexes of Mid-Continent

Algal banks are widely distributed, are important in late Paleozoic carbonate provinces, and commonly are good reservoirs for accumulation of hydrocarbons. The term ""bank" as used herein indicates an unusually thick sequence of carbonate mudstone built by in-place organisms.

Algal banks are formed primarily by phylloid algae; other organisms may also contribute to the development of the banks. Other than algae, fenestrate bryozoans and crinoids are the major contributors. Other organisms are commonly present but probably contributed little to the development of the banks.

Phylloid (leaflike) algae aid in formation of banks in 3 major ways: by baffling, trapping sediments, and binding sediments. Phylloid algae may have grown free on the substrate, may have locally attached to the substrate, or may be encrusting.

Algal banks may occur in the shape of a simple mound, a broad lense, or a complex combination of the two forms. Thicknesses of banks or bank complexes range from about 10 to 115 ft; horizontal distances range from less than 0.1 mi to more than 40 mi. The banks stood slightly above the surrounding sea floor. Algal banks occur in shallow, well-illuminated waters along the flanks of structures, along shelf margins, adjacent to deltas, and in shallow epicontinental seas.

There are 4 major types of porosity associated with algal banks: (1) between algal leaves, (2) within algal leaves, (3) beneath algal leaves (umbrella structure), and (4) as a result of dolomitization of algae and/or matrix.

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INTERPRETIVE TECHNIQUES USING EXPLORATION DATA BASE/APPLICATION PROCESSING SYSTEMS

Over the past 5–10 years several significant developments have taken place involving the use of computers in support of the exploratory process, particularly relating to the search for new oil and gas reserves. Digital seismic processing is one obvious example, and the development of large geologic well data bases is another.

Both of these areas have developed somewhat independently of the other for very valid reasons; however, it is now becoming apparent that new interpretive techniques could benefit from selective integration of these and other related areas, particularly from the data base standpoint.

For example, seismic interpretation methods could be enhanced in many cases if selected geologic information could be incorporated into certain phases of digital seismic processing. Conversely, the utility of well data files might be greatly enhanced if selected seismic data could be incorporated and utilized in a geologic data base. There are numerous problems involved in extensions of this type; however, through proper design of integrated exploration data bases and related application processing programs, it is possible and practical to develop new systems which can greatly enhance the interpretive phases of exploration both from a geophysical and geological standpoint.

Illustrations are given showing several possible ways to create an integrated exploration data base containing selective seismic and geologic information. Techniques for the retrieval of data for subsequent processing by application programs in support of geophysical and geologic interpretation are also shown.

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STRUCTURAL RELATIONS OF ARBUCKLE AND OUACHITA FACIES

Rocks of the Ouachita facies are thrust out over the Arkoma basin. As expected, part of the crustal shortening is taken up in the Arkoma basin by folding parallel with the strike of the thrust faults. This shortening can be observed in the outcrops. Unfortunately, the intersection of the Ouachita front with the Arbuckle Mountains, the Ardmore basin, and the Marietta-Sherman basin is covered by the Cretaceous overlap. Therefore, the relation of the Ouachita facies with the Arbuckle facies can be determined only by subsurface information.

There is a regional southwest trend to the Ouachita front from where it disappears beneath the Cretaceous northeast of the Arbuckle Mountains to the Llano uplift in central Texas, indicating, in general, that the Ouachita facies was thrust from the southeast.

In the Ardmore and the Marietta-Sherman basins there are no indications of thrusting from the southeast. Rocks of the Ouachita facies are in contact with the Arbuckle facies by means of northwest-trending, high-angle reverse faults. The trend of folding in these basins is also northwest, with no northeast trending folding as one would expect in front of a thrust from the southeast. The Ardmore and Marietta-Sherman basins are characterized by large northwest-trending strike-slip faults. The best examples of these are the Reagan and Washita Valley faults which bound the Tishomingo uplift on the northeast and southwest, and the Mannsville-Madill-Aylesworth fault which parallels the Washita Valley fault.

It is concluded that in the Ardmore and Marietta-Sherman basins, the Ouachita facies is not in contact with Arbuckle facies by means of low-angle thrusting, but instead the Ouachita rocks have been shoved from the southeast in northwest-trending wedges. This action drove blocks of Arbuckle facies into confined spaces on the northwest and caused great crustal shortening along a southwest-northeast line resulting in the northwest trending structures of the Ardmore and Marietta basins.

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COMPARATIVE LITHOSTRATIGRAPHY OF WORLD'S MAJOR CARBONATE RESERVOIRS

Although it has been said that "oil is where you find it," yet any regional or worldwide comparative evaluation of producing carbonate lithologies will show that certain lithostratigraphic units have proved to be more prospective than others. Furthermore, it can be demonstrated that certain important time-equivalent reservoir rocks are remarkably similar in lithologic composition on a worldwide basis. This paper focuses on these worldwide time-equivalent developments of lithologically similar or identical reservoir facies.

The following different lithofacies constitute the most important types of carbonate reservoir rocks: reefs and banks (*i.e.* biogenic structures); oolites and calcarenites; detrital accumulations; conglomerates and breccias; and shallow-water shelf limestones.

These may occur in the form of unaltered limestones, recrystallized or dolomitized limestones, and replacement dolomites. On a worldwide basis, reefs and banks, together with oolite and calcarenite deposits, form by far the most productive carbonate reservoir facies.

At certain periods of geologic time certain specific lithofacies dominate in forming potential reservoir rocks. During Ordovician and Silurian times, replacement dolomites and dolomitized biogenic limestones prevailed. The Devonian System exhibits major reservoir potentials in unaltered or dolomitized reefoid facies. Mississippian, Pennsylvanian, and Lower Permian carbonate reservoirs represent primarily different types of biogenic bank deposits. Middle to Upper Permian producing lithologies encompass reef facies, as well as