DUTTON, SHIRLEY P., Bur. Econ. Geology, Univ. Texas, Austin, Tex.

Pennsylvanian Fan-Delta Sandstones, Palo Duro Basin, Texas

Pennsylvanian sedimentation in the Palo Duro basin was strongly influenced by tectonic events. Highlands surrounding the basin were uplifted early in the Pennsylvanian Period and were major sources of clastic sediment. Arkosic sandstones ("granite wash") contain abundant feldspar and granite rock fragments derived from exposed Precambrian basement rocks.

Granite wash deposits are thickest in the northeastern and northwestern parts of the basin, and lobes of sandstone extend to the southern basin margin. Individual beds, which are 10 to 40 ft (3 to 15 m) thick and are laterally discontinuous, cannot be correlated more than a few tens of miles. Granite wash deposits vary from medium sandstone to conglomerate, and upward-fining sequences are common. These sandstones contain scours and large-scale trough or foreset cross-beds. Limestone commonly is interbedded with granite wash sandstone and shale.

Thick wedges of Pennsylvanian granite wash adjacent to mountain fronts are characteristic fan-delta deposits. Coarse clastic material was carried off the uplifts to adjacent fans by high-gradient braided streams. Near the source areas, sediments are entirely terrigenous clastics, which were probably deposited in subaerial delta-plain environments. Coal and thin limestone beds are interbedded with delta-plain sandstones. Carbonates become more abundant downdip where they were deposited periodically in subaqueous, distal-fan delta environments. Periodic movement along faults may have been responsible for the initiation of major clastic cycles.

EBANKS, W. J., JR., Kansas Geol. Survey, Lawrence, Kans.

Correlation of Cherokee (Desmoinesian) Sandstones, Missouri-Kansas-Oklahoma Tri-State Area

Traditional stratigraphic classification of the sandstone-bearing Cherokee Group (Desmoinesian) in southeastern Kansas and contiguous areas has not recognized the uncertainty of correlation from type areas of the Bluejacket and Warner sandstones in northeastern Oklahoma, across poor exposures in Kansas, to outcrops of similar-appearing sandstones in Missouri. New data, logs, and cores of recently drilled shallow test holes, suggest that the "Bluejacket" of Missouri is older than the Bluejacket Sandstone Member of the Boggy Formation of Oklahoma and that the "Warner" of Missouri is younger than the Warner Sandstone Member of the McAlester Formation of Oklahoma. All four sandstones are present in some subsurface locations in Kansas. The discontinuity of these sandstones is accounted for through their origin as alluvial-deltaic sands.

EVANS, JAMES L., Apexco Inc., Tulsa, Okla.

Major Structural and Stratigraphic Features of Anadarko Basin

The Anadarko basin of western Oklahoma and the Texas Panhandle continues to be one of the most active and prolific petroliferous provinces of the continental United States. More than 150 companies and an equal number of independent geologists are actively engaged in the exploration for additional oil and gas reserves in this Mid-Continent basin.

The sedimentary sequence in the Anadarko basin is represented by a wide variety of lithologic units ranging in age from Cambrian-Ordovician through Permian. Important reservoir rocks are present and proven in each of these major systems. Regional facies changes from dense limestones to porous dolomites, from porous sandstones to tight limestones, and regional pinchouts of sandstones in sand-shale sequences all provide the necessary trapping mechanisms for the accumulation of hydrocarbons. In addition, three major unconformities truncate downdip reservoir rocks to create long regional trends of oil and gas production. The possibility of discoveries of additional trends of this nature is considered excellent as demonstrated by current industry activity.

The southern boundary of the Anadarko basin is formed by the Amarillo-Wichita Mountain front fault system. This fault system is characterized by substantial vertical block uplift and regional left-lateral strike-slip movement. The combination of these two Pennsylvanian age tectonic movements creates a complex zone of tensional block faulting, compressional overthrusting, step faulting, and vertical dipping formations.

GUNN, ROBERT D., Independent Petroleum Geologist, Wichita Falls, Tex.

Desmoinesian Depositional Systems in Knox-Baylor Trough

The western part of north-central Texas experienced unique depositional processes during the late Desmoinesian.

The early Desmoinesian–Fort Worth basin depocenter was moved toward the west after the Ouachita overthrust. Sediments were carried westward to the resultant Midland basin through the Knox-Baylor trough.

This asymmetric trough (steep on the north) possesses two distinct depositional systems. The south or Concho platform flank has a wave-dominated environment with strike-oriented strand-plain and deltaic sands similar to the upper Wilcox sands of the Gulf Coast. This system is present in Baylor, Knox, Throckmorton, and Haskell Counties. Some of the producing areas are in the Sojourner, Herren, and Weinert fields.

The deep-water environment holds low-flow-regime deposits. They are ripple bedded, lack bioturbation, and are strike oriented. A study of the composition demonstrates well-sorted, clean, fine-grained bodies which indicate significant reworking during long-distance transport. This system extends from northern Knox County southwest through Stonewall County and produces in such fields as the Anne Tandy, Katz, Juliana, and Jud, the most desirable oil fields in the area.

HANDFORD, C. ROBERTSON, Bur. Econ. Geology, Austin, Tex.

Depositional History of High-Constructive Delta Systems (Wolfcampian), Southeastern Palo Duro Basin, Texas

In Late Pennsylvanian and Early Permian time the Palo Duro basin was part of a relatively deep seaway that extended northward from the Midland basin into the Mid-Continent. Deep, central-basin areas were surrounded by massive, carbonate-shelf margins and shallow-shelf terrane.

In the southeastern Palo Duro basin, high-constructive, elongate delta systems deposited quartzose sand derived from eastern sources (Wichita Mountains). Late Pennsylvanian and early Wolfcampian delta-front sandstones (>200 ft or 60 m thick) are present on the basinward side of the shelf margin, suggesting that deltas prograded beyond the shelf margin and into deep water. Later, as terrigenous sediment supply was sharply reduced, the shelf margin prograded basinward over deep-water delta facies. During middle Wolfcampian time, clastic input was increased and high-constructive deltas once again prograded into the southeastern Palo Duro basin. However, progradation was not so extensive as earlier episodes and most delta-front sands were deposited in shallow-shelf environments. Consequently shallow-water conditions precluded formation of thick delta-front sequences in shelf environments.

Upper Pennsylvanian-Lower Permian deltaic sandstones in the southeastern Palo Duro basin are subarkoses. Porosity ranges from 0 to 13% and averages 4.8%. Both primary and secondary (leached feldspars) porosity are present. Cementation began with clay coats, followed by quartz overgrowths. Iron-rich dolomite replaced margins of framework grains and filled most remaining pores. Timing of feldspar leaching and kaolinite cement is unknown.

HARRISON, WILLIAM E., Oklahoma Geol. Survey, Univ. Oklahoma, Norman, Okla.

Geochemical Prospecting for Stratigraphic Traps

Petroleum geochemistry has received considerable attention in recent years and has emerged as a useful tool in exploration efforts. Most of the methods currently being used find maximum benefit and application in frontier exploration areas. Such studies generally provide information on source-rock quality, maturity level, and migration history. Some techniques, however, are applicable to more mature petroleum provinces and are especially suited for stratigraphic-trap exploration efforts. One such method involves pyrolysis of samples (well cuttings) and measurement of the quantity of hydrocarbons that are volatilized. Detecting, quantifying, and mapping hydrocarbon content of samples from specific stratigraphic units help to assess proximity to oil accumulations.

As oil moves to a trap, small quantities of hydrocarbons are invariably left in the rocks which served as avenues of migration. Concentrations of these hydrocarbons are highest near an oil accumulation and become progressively lower at greater distances from an accumulation. Concentration gradients can be mapped and interpreted in much the same way as conventional subsurface data and thus can provide the exploration geologist with a quantitative tool. Data are rapidly obtained, and information derived from initial boreholes can be used to help position subsequent tests. Preliminary results from several Mid-Continent study areas have been encouraging.

HARRISON, WILLIAM E., JOSEPH A. CURIALE, and JOHN F. ROBERTS, Oklahoma Geol. Survey, Univ. Oklahoma, Norman, Okla.

Investigation of Desmoinesian Rocks in Northeastern Oklahoma for Heavy-Oil Potential

Various estimates of the heavy-oil resources of the Tri-State area of Kansas, Oklahoma, and Missouri have ranged from 30 million to several billion bbl of oil in place. During 1977-78 the Oklahoma Geological Survey, in conjunction with the state geological surveys of Missouri and Kansas and the U.S. Department of Energy, conducted an 18-hole drilling and coring program to assess the heavy-oil potential of northeastern Oklahoma. Reported bituminous material in shallow wells and the presence of asphalt-bearing sandstone in mine shafts suggested that Craig and Ottawa Counties might hold the best potential for shallow heavy-oil accumulations.

The results of our 18-hole program show that the Lower Pennsylvanian sandstones in this area are somewhat discontinuous and vary considerably in reservoir quality. Seven of the boreholes indicated the presence of oil; however, 1-mi (1.6 km) offsets from these sites commonly demonstrated lack of continuity of specific sandstones and an absence of heavy oil where adequate-quality reservoirs exist. We feel that the Oklahoma part of the Tri-State area does not contain as much heavy oil as had been estimated.

HAUN, JOHN D., Colorado School Mines, Golden, Colo.

How Many Wildcats Must We Drill?

Decline of United States oil and gas reserves could be moderated by increased exploratory drilling. In 1978 U.S. production was 3.0×10^9 bbl crude oil, 0.7×10^9 bbl natural-gas liquids (NGL), and 19.3×10^{12} cu ft natural gas ($= 3.3 \times 10^9$ bbl oil equivalent-BOE), for a total of 7.0×10^9 BOE. To continue production at this rate until 1990 (12 years) would require discovery of 84×10^9 BOE.

Annual estimates of ultimate recovery (past production + reserves) are made for each year since 1920 by API and AGA. To each of these estimates must be added an estimate of reserve growth from revisions, extensions, new-pool discoveries, in-field drilling, and enhanced recovery. From the derived annual totals and AAPG estimates of footage drilled annually in new-field wildcat wells, the oil and natural gas discovered/foot were estimated. In the late 1940s the average discovery/foot was more than 350 BOE. By the late 1970s the average discovery/foot had dropped to 52 BOE. Projections of these decline curves determined the number of feet of new-field wildcats needed to find 2×10^9 BOE/yr, approximately the present rate of discovery in the U.S. Projected average drilling depth permits calculation of the number of needed wildcats/yr (12-yr total = 388,514 wells). Estimated discoveries are 7% oil and 8% gas.