

- 10:30 **William C. Dawson, Donald F. Reaser:** Trace Fossils in Middle and Upper Austin Chalk near Dallas, Texas—Paleoecologic and Economic Significance
- 10:55 **E. L. Trice, Robert C. Grayson, Jr.:** Depositional Systems and Stratigraphic Relationships of Strawn Group (Pennsylvanian), Colorado River Valley, Central Texas
- 11:20 **Robert C. Grayson, Jr., E. L. Trice, III, E. L. Westergaard:** Middle Atokan to Early Missourian (Pennsylvanian), Conodonts, Fort Worth Basin and Concho Platform, Central Texas

TUESDAY AFTERNOON, FEBRUARY 26

Gulf-Atlantic Room

- 1:30 **Clifton F. Jordan:** A Shorthand Notation for Carbonate Facies—Dunham Revisited
- 1:55 **Arthur W. Cleaves, Albert W. Erxleben:** Upper Strawn and Canyon Cratonic Depositional Systems of Bend Arch, North-Central Texas
- 2:20 **Marcus E. Staples:** Exploration of Basal Bend Bar System—Southeastern Foard County, Texas
- 2:45 **George A. Hillis:** Petrophysics of Morrow Formation, Southeast New Mexico

Abstracts

ADDY, SUNIT K., H. W. DEJONG, G. W. WHITNEY, and R. E. WORTHINGTON, ARCO Exploration Co., Denver, CO

A Fresh Look at the Marfa Basin, West Texas

The lack of production in the Marfa basin remains an enigma. Although covered with approximately 3,000 ft of thick volcanics, the basin has Paleozoic stratigraphy and lithologies similar to the prolific Delaware basin to the east. In a geologic and geophysical review, we analyzed the overall hydrocarbon potential for this basin.

The lower Paleozoic (Cambrian through Devonian) rocks, which are conducive to hydrocarbon generation in other Permian basins, have many undrilled structures, as revealed by seismic mapping, but have also pervasive fresh water and dead oil. Several fault systems are mapped on the surface. We believe that the rocks were uplifted in Late Mississippian and Pennsylvanian time and in certain areas were exposed to meteoric water. Hydrocarbons leaked out along with induction of fresh water into the formations. Recharge areas have been identified from isopach maps. In certain parts, the lower Paleozoic rocks are overmature and offer further obstacles to exploration.

During the Early Permian, arkosic sediments were deposited in a rapidly subsiding east-west graben. Tilted to the south, the graben accumulated as much as approximately 9,000 ft of Lower Permian sediments that have occasional hydrocarbon shows. Small stratigraphic traps due to pinchouts, truncations, and facies changes are to be expected in these rocks. Possible reef growths in the Late Permian offer further opportunities for trap development.

The rocks were also exposed to meteoric water during nondeposition in the Triassic, Jurassic, and post-Cretaceous periods. However, the subtle Permian traps, being small, could have escaped destruction and fresh-water flushing and thus might offer some potential for future exploration.

ANDERSON, RANDALL L., Satellite Exploration Consultants, Inc., Abilene, TX

Evaluation of Landsat Thematic Mapper Data for Hydrocarbon Exploration

The thematic mapper (TM), an advanced sensor on board Landsats 4 and 5, was designed to alleviate problems that limit applications of multi-spectral scanner (MSS) data acquired by previous satellites. This paper presents the results of studies in Texas and Illinois that demonstrate the advantages of TM data over MSS data in standard photogeologic work.

The TM and MSS both provided the synoptic, small-scale imagery essential for mapping regional geologic trends; however, the increased resolution of the TM made it possible to enlarge the imagery to a scale of 1:48,000 (and larger with high-quality bands) allowing both regional and detailed studies from the same data. Analysis of large-scale TM imagery resulted in recognition of many surface anomalies that were not visible on MSS data and more accurate delineation of those that were. The TM ther-

mal infrared band proved particularly useful in detection of faults, and in one locality showed a thermal anomaly over a linear producing sand.

In addition to the advantages of new levels of anomaly discrimination and greater probability of successful prediction of structures, the TM has operational advantages, such as ready transfer to base maps because of evident small townsites, secondary roads, and first order drainage. TM imagery unquestionably extends the scope and effectiveness with which Landsat can be used for hydrocarbon exploration.

BEBOUT, DON G., Bur. Econ. Geology, Austin, TX, and DAVID A. LEARY, Univ. Texas, Austin, TX

Depositional Facies of San Andres and Grayburg Formations and Their Control on Porosity Distribution and Production—Dune Field, Crane County, Texas

Dune field is located on the eastern margin of the Central Basin platform on the western side of the Midland basin. Major production is from Permian (lower Guadalupian) San Andres and Grayburg porous dolomites. The southern half of Dune field (University Land, block 30) was selected for study because of the large amount of data readily available at the University Lands Office and because a cooperative operator (Mobil) provided cores and core analyses. The study centered around the Mobil University Unit 15/16, where cores were obtained from nine wells, and logs from hundreds of wells.

Cores from all wells show a similar upward-shoaling sequence with fusulinid wackestone and crinoid wackestone in the lower part, pellet and ooid grainstone near the top, and pisolite grainstone at the top of the approximately 300-ft thick section. Very thin (5 to 10-ft thick) siltstone beds occur commonly in the upper part of the section studied. Core and log correlations of the siltstones have permitted delineation of the lateral distribution of carbonate facies and recognition of a logical facies tract comprising arid island, tidal-flat, and shallow-water subtidal depositional environments.

Production is highest in the eastern third of University Unit 15/16, where porosity is best developed in 20- and 30-ft-thick pellet grainstone reservoirs; porosity also occurs in the much thicker fusulinid wackestone facies. In contrast, production in the western part of the area is from a thick section of low porosity sponge and algal framestone, equivalent to the pellet grainstone and crinoid wackestone in the lower part of the eastern sequence. Consequently, the eastern and western areas essentially function as two distinct reservoirs that are located in different parts of the San Andres and Grayburg section and have considerably different performance characteristics. The nonporous siltstones probably form barriers to vertical migration of fluids throughout the field.

BERG, ROBERT R., and JOHN T. LEETHEM, Texas A&M Univ., College Station, TX

Woodbine Reservoir Facies, Kurten Field, Brazos County, Texas

Woodbine-Eagle Ford reservoirs are productive over an area of about 55 mi² (140 km²) in Kurten field. The Woodbine "C" sandstone is its most extensive reservoir and has an average net thickness of 30 ft (9 m). The "C" sandstone shows distinctive changes in rock type from south to north: (1) a dune facies, which consists of thin-bedded, medium-grained (0.28 mm) quartzose sandstones; (2) a rippled facies, which consists of thinly interbedded shale and fine-grained (0.17 mm) sandstone; and (3) a bioturbated facies, which consists of highly churned, very fine-grained (0.12 mm) sandstone. These facies result in decreasing permeabilities from an average 17 md in the south to 0.1 md in the north.

The "C" sandstone was deposited in a middle to outer-shelf location, and sands were supplied by storm-driven or tidal currents from the "Harris delta" to the east. The southern limit of the reservoir is controlled by a deep salt dome or ridge, called Hill dome, that trends northeastward. The upper Woodbine-Eagle Ford section was truncated by erosion along this trend and unconformably overlain by lime muds of the Austin Chalk. Sandstone facies suggest that salt uplift during deposition created a bathymetric high on the sea floor that was scoured by currents. Successively finer grained sands were deposited to the north under conditions of decreasing flow regime and increasing water depths.

BLANCHARD, PAUL E., and JOHN M. SHARP, JR., Univ. Texas, Austin, TX

Free Convection in Gulf Coast Reservoirs

Several observed diagenetic changes in Gulf Coast sediments, such as dissolution of calcite and feldspar and pore cementation by silica and cal-

cite, require many changes of pore fluid. The number of pore volumes required is much greater than can be derived from compaction alone. Free convection, if it exists, is an attractive process in accounting for these observations. Three lines of evidence indicate that free convection is occurring in at least some Gulf Coast reservoirs. First, Rayleigh-Darcy calculations were made for a variety of reservoir thicknesses, permeabilities, and thermal gradients. Reasonable Gulf Coast values were selected and thermally sensitive parameters were allowed to vary with temperature. Critical Rayleigh numbers were exceeded for thick Gulf Coast sands. Depending on site-specific conditions, diagenetic reduction of permeability may create a preferred depth range for the occurrence of free convection. The second line of evidence includes pore-fluid density, silica content, and temperature data for Frio Formation waters. These data are consistent with a freely convecting system. Third, areal distribution of thermal gradients within a Frio reservoir exhibits a geometric pattern completely consistent with Bénard-type convection cells: central, upward-moving, heated plumes surrounded by polygonal zones of cooler, down-flowing waters. Therefore, free convection in Gulf Coast reservoirs is consistent with both field data (as demonstrated in the Frio Formation) and theoretical calculations.

BOARDMAN, DARWIN R., II, Texas Tech Univ., Lubbock, TX, and JOHN M. MALINKY, Smithsonian Inst., Washington, D.C.

Glacial-Eustatic Control of Virgilian Cyclothems in North-Central Texas

Virgilian strata in north-central Texas consist of repetitive sedimentary sequences called cyclothems. These cyclothems were caused by waxing and waning of glaciers in the southern hemisphere (Gondwana). During the transgressive phase, deltas were drowned, forming estuaries, and the oxygen-minimum zone responsible for the black shales in the Midland basin rose to a position well up on the shelf area, resulting in a sequence of lithofacies and corresponding biofacies which indicate a water column with stratified dissolved oxygen content. During early regression, the oxygen-minimum zone and the characteristic lithofacies and biofacies began retreating toward the Midland basin. Deltas began prograding well out onto the outer shelf, and the resulting lithofacies and biofacies depended upon the relationship between paleogeography and the prograding deltas. During maximum regression, the oxygen minimum zone was restricted to the Midland basin, and the shelf-edge carbonates were subaerially exposed, resulting in extensive freshwater diagenesis, which was responsible for enhancing secondary porosity.

BREYER, JOHN A., Texas Christian Univ., Fort Worth, TX

Coarsening-Upward Tidal Sequences in Wilcox Group in East Texas

Most exploration concepts for the Wilcox Group are based on paleogeographic reconstructions derived from maps of net sand or sand percent. Coarsening-upward tidal sequences exposed in the highwalls of two lignite mines in east Texas show the shortcomings of these reconstructions. In the past, the coarsening-upward sequences have been interpreted as prograding floodplain splays because they occur in an area of supposed fluvial sedimentation (conventional paleogeographic reconstructions show a large river system occupying the East Texas embayment during the deposition of the Wilcox Group). Recognition of the tidal origin of the coarsening-upward sequences suggests an embayed coast or a shoreline within the East Texas embayment at the time the coarsening-upward sequences were deposited—information which has exploration implications. Paleogeographic reconstructions based on maps of net sand or sand percent show time-averaged conditions. The search for the subtle trap requires paleogeographic maps based on smaller stratigraphic intervals than present reconstructions provide. These intervals can be defined by using the principles of sequence stratigraphy and tracing unconformities in the subsurface.

BURKE, HEIDI, Baylor Univ., Waco, TX

Structural Analysis of Southwest End of Dagger Flats Anticlinorium, Marathon Region, Texas

No abstract submitted.

CALAVAN, CHUCK W., Baylor Univ., Waco, TX

Depositional Environments and Basinal Setting of Cretaceous Woodbine Sandstone, Central and Northeast Texas

The Upper Cretaceous (Cenomanian) Woodbine Sandstone of central

and northeast Texas has long been one of the largest oil and gas producers in Texas. North of the Angelina-Caldwell flexure, production is at moderate depths of 3,000-6,000 ft from fluvial and subaqueous deltaic facies. South of the flexure, the undifferentiated Woodbine-Eagle Ford interval produces from depths between 10,000 and 15,000 ft from fractured turbiditic channel siltstones and sandstones.

This investigation (1) more precisely defined environments of deposition, (2) determined their relationships to development of the East Texas basin, and (3) related these environments to hydrocarbon production. Much greater control was used than in previous studies, including an extensive core study (approximately 70 cores), close well control (approximately 1,200 electric logs), and an outcrop study.

In general, the depositional environments of the updip Woodbine change progressively from a complex fluvial system in the northeastern portion of the study area to delta plain, delta front, and prodelta shelf in a southwestward direction. Major fluvial axes are oriented north-northeast to south-southwest. The fluvial system includes (1) a braided stream facies, (2) a distributary channel facies, and (3) a meander belt facies. The two principal recognizable facies of the delta front are coastal barrier sands and progradational channel-mouth bar sands.

Woodbine deposition ended with transgression of Eagle Ford seas and subsequent deposition of marine shales. These shales provide a potential hydrocarbon source and seal for Woodbine reservoirs.

CARDWELL, LYNN, Cardwell Exploration Co., Midland, TX

Petroleum Source Rock Potential of Arbuckle and Ellenburger Groups, Oklahoma and North Texas

Oil and gas have been produced from the Cambro-Ordovician Arbuckle and Ellenburger Groups in Oklahoma and Texas for more than 50 years, but as yet no studies have addressed the question of petroleum source beds within these units. The solution of this problem is important in determining whether significant petroleum accumulations can be expected to be found deep within this thick and relatively unexplored section of carbonate rocks.

Detailed studies of the composition of oils produced from Arbuckle fields compared with those from Pennsylvanian fields show no discernible differences. These studies, which include determination of the composition of gasoline-range and C_{15+} saturate hydrocarbons and also saturate/aromatic/asphaltic ratios, strongly suggest that very similar source beds generated all the oils. Similar analyses of the bitumen present in nonreservoir Arbuckle and Ellenburger rocks show that very distinct differences exist between the oils and the rock bitumens. Arbuckle and Ellenburger rocks apparently were not the source beds for any of the oils investigated in this study.

Further studies of thermal maturity and organic richness of Arbuckle and Ellenburger rocks by use of pyrolysis-gas chromatographic methods reveal that this part of the section is thermally mature, and has generated at least some hydrocarbons; however, hydrocarbon and organic carbon contents are very low, indicating that commercially significant amounts of petroleum have not been generated or expelled. The lack of adequate amounts of organic matter is interpreted to be the reason that these rocks have not acted as significant petroleum sources. Based on this geochemical evidence, other, younger, rocks have generated the oils found in the Arbuckle and Ellenburger Groups.

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Upper Strawn and Canyon Cratonic Depositional Systems of Bend Arch, North-Central Texas

Terrigenous clastic and carbonate depositional systems comprising the upper half of the Strawn Group and the complete Canyon Group (Pennsylvanian) were deposited within the Fort Worth basin and on the Bend arch of north-central Texas. The stratigraphic interval involves 12 major format cycles of deltaic progradation and marine transgression. These units subdivide the outcrop and subsurface section into mappable genetic units. Variations in the rate of subsidence for the Fort Worth basin, Knox-Baylor trough, and Bend arch, as well as the initiation of subsidence to form the Midland basin, were responsible for the lithofacies geometry of individual depositional systems and gave rise to the "cyclothemic" cyclic sedimentation pattern. The effects of eustatic sea level changes have not been recognized from facies-derived evidence in north-central Texas.