widely scattered, nondescript small deposit-feeder trace fossils. The Nugget, however, is distinguished by distinctive traces, which hold promise for environmental interpretation. Vertical and horizontal light-colored sand-filled tubes averaging about 0.7 to 1.0 cm diameter are abundant in one or more relatively thin zones in practically all exposed sections in the western Uinta Mountains and Wyoming-Idaho thrust belt. Well-preserved examples show delicate spreiten, which seem to necessitate moist, if not saturated, sand. Some Nugget traces occur in planar-bedded units that might have been subaqueously deposited, but they also occur in medium-scale to large-scale cross-bedded units with eolian lamination. The apparent restriction of this distinctive trace to the western part of the Nugget, which has been suggested to be at least partly marine, seems environmentally significant. Apparently the trace-making organism required moisture, but was capable of burrowing into dry or nearly dry (moist) dunes.

Although no modern burrowing analog can be designated confidently, the burrows of scarab beetles recognized by G. W. Hill on Padre Island are very similar. There the beetles burrow from moist interdunes into dry dunes.

AAPG SOUTHWEST SECTION MEETING
May 9-11, 1979
Fort Worth, Texas

Abstracts of Papers

BERG, ROBERT R., Texas A&M Univ., College Station, Tex.

Turbidite Channel Reservoirs in Canyon Sandstone, Roundtop Area, Fisher County, Texas

Thin sandstones in the Canyon Group produce oil from stratigraphic traps in the Roundtop area, Fisher County, Texas. Cores from Tolar Canyon field show that the sandstones are turbidites of channel and overbank origin. Channel sandstones are composites of stacked AE and ABE turbidite sequences. Overbank sandstones represent more complete sequences of the ABCE and ACE types. Interbedded sections of basinal shale contain thin ripple lenses of sandstones representing CE sequences.

The sandstones are fine grained (0.18 mm) and consist of 72% quartz, 2% feldspar, 19% rock fragments, and 6% clay matrix. Cement is present in a total amount of 11% and is mostly calcite with some silica overgrowths. Thicker channel sandstones have the best average permeability, about 12 md, and thinner channels have lower permeabilities of 2 to 4 md, whereas rippled sandstones have very low permeability because of clay matrix and interbedded shale.

Massive channel sandstones are closely bounded laterally by thinly bedded levee deposits which change abruptly to basinal shale. Channel reservoirs are 10 to 30 ft (3 to 10 m) thick, only about 500 ft (150 m) wide, and form narrow, sinuous, dip-trending bodies at several stratigraphic levels within the Canyon interval of about 300 ft (92 m). The abrupt lateral change from channel to overbank and then to basinal deposits suggests that channels were of the "constructional" type and composed of successive flow units, each of which consisted of contemporaneous channel-fill and levee facies.

This depositional system is distinctly different from submarine-fan deposits which are also composed of channel and overbank sediments but form thicker, composite sandstone bodies of greater areal extent and broadly lobate morphology. In contrast, the "constructional" channel sandstones are thin units isolated in a dominant basin-shale sequence. Recognition of these reservoir types may be important in exploration and field development in other turbidite sections.

DUTTON, SHIRLEY P., Bur. Econ. Geol., Austin, Tex.

Depositional Models and Resource Potential of Pennsylvanian System, Palo Duro Basin, Panhandle Texas

The Palo Duro basin of the Texas Panhandle is a relatively sparsely drilled interior basin. Sediments of Pennsylvanian age were deposited in a variety of clastic and carbonate environments. From 0 to 2,400 ft (0 to 732 m) of sediment was deposited with greatest accumulation along a northwest- to southeast-trending basin axis.

Erosion of Precambrian basement in the Amarillo and Sierra Grande uplifts supplied arkosic sand and gravel to alluvial fans and fan deltas along the northern margin of the basin. Distal-fan sandstones are interbedded with thin shelf limestones, and basinward of clastic deposition, shallow-shelf limestone was deposited across most of the Palo Duro basin. Basinal shales were deposited only in a small area just north of the Matador arch.

Increased subsidence deepened and enlarged the basin throughout the Late Pennsylvanian. Ultimately, the basin axis trended east-west with a narrow northwest extension. A carbonate-shelf-margin complex with 200 to 400 ft (70 to 120 m) of depositional relief developed. High-constructive elongate deltas prograded into the Palo Duro basin from the east in the Late Pennsylvanian. Prodelta mud and sands entered the basin through breaks in the carbonate-shelf margin.

Porous dolomitized limestone is present in belts 10 to 20 mi (16 to 32 km) wide along the shelf edge. Potential hydrocarbon reservoirs are the dolomitized limestone, fan-delta sandstones, and deltaic bar-finger sandstones. However, the thermal history of the basin may not have allowed hydrocarbons to mature or migrate into reservoir facies.

EDWARDS, H. S. GUS, Consulting geologist, Abilene, Tex.

Atoka Gas in Southern Cottle and Northern King Counties, Texas

The 330-sq-mi (855 sq km) area includes nine gas fields on the flanks of the pre-Pennsylvanian northwest-southeast feature known as the "Masterson arch." This arch originates on the Masterson Ranch in the extreme western part of the Baylor basin near the Knox and King county line and becomes progressively deeper as it continues to the northwest through the Juniper A and

B, North Juniper, JY, Providence, Prudence, Stescott, and Tippen gas fields, and Prothro (Ramsey structure) and Wilie oil fields where it joins the east-west Matador arch at the structure known as "Narcisso" on the Cottle and Motley county line.

The producing Atoka sandstones or conglomerates consist of medium to coarse, predominately subangular, quartz grains with traces of glauconite. These stratigraphic traps were deposited as offshore sand bars on the northeast and southwest flanks of the Masterson arch. The Atoka conglomerates are erratic, as they were deposited on a steeply dipping erosional surface, with rapidly changing dips. The entire Atoka section between the base of the Caddo Limestone and the top of the Mississippian limestone consists of very hard, dark-gray to black calcareous shale and conglomerate beds. The Atoka shale is very thin on the structural axis, with no conglomerate deposition, but thickens basinward with the development of many different conglomerate lenses.

The Providence Atoka gas field in extreme southeast Cottle County was discovered in October 1973, with the successful completion for 10,200 Mcf/day of the "Gus" Edwards 1 J. J. Gibson. Development to date reveals more than 141 ft (43 m) of gas column with no indication of water, which is present at different subsea depths in other gas fields on this trend. Average absolute open flow for the 14 gas wells in the Providence Atoka field is 11,600 Mcf/day. The porosity ranges from 15 to 21% with average pay thickness of 18 ft (5.5 m).

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

Depositional Systems and Petroleum Potential of Lower Permian Strata, Palo Duro Basin, Texas

Lower Permian (Wolfcampian) strata of the Palo Duro basin consist of thick, terrigenous clastic and carbonate facies which were deposited in (1) fan-delta, (2) high-constructional delta, (3) carbonate-shelf and shelf-margin, and (4) slope and basinal systems. Lateral and vertical facies sequences across the basin indicate that these strata are regressive deposits and they document the first episodes of Permian marine retreat from the Texas Panhandle.

Terrigenous clastic sediment was derived from highlands which surrounded part of the Palo Duro basin. Exposed Precambrian granite in the Amarillo uplift, Sierra Grande uplift, and Bravo dome yielded large quantities of arkosic sand (granite wash) to fan-delta systems which emptied into shallow-marine environments in the northern part of the basin. Along the basin's southeastern margin, high-constructive deltas prograded westward from the Wichita Mountains, depositing quartz-rich sand and mud across the shelf.

Seaward of the clastic facies belt, a carbonate-shelf-margin complex, averaging 1,000 to 1,200 ft (300 to 365 m) in thickness and facing south toward the Midland basin, dominated Wolfcampian deposition in the Palo Duro basin. The western shelf margin consists of a superposed sequence of carbonate strata exhibiting limited basinward progradation. Contrarily, the eastern shelf margin is composed of several superposed, progradational carbonate sequences, individually averaging several hundred feet in thickness. During early to middle Wolfcampian time, the eastern shelf margin prograded westward 10 to 30 mi (16 to 48 m) while the western margin remained stationary. Shelf margins shifted in response to deposition of slope sediments in front of the shelf and in feeder channels, creating a foundation for subsequent carbonate buildups.

Potential hydrocarbon reservoirs are thick zones of shelf-margin dolomites, delta-front sandstones, and fan-delta arkoses. Porosity figures in those facies are as high as 10 to 20%. Each potential reservoir facies is juxtaposed with potential source beds and nonporous sealing beds.

HOUDE, RICHARD F., and DAVID E. EBY, Univ. Texas-Dallas, Richardson, Tex.

Sedimentology and Source-Bed Geochemistry of Spraberry Sandstone, Midland Basin, West Texas

The Spraberry Sandstone is a Lower Permian (Leonard) unit restricted entirely to the subsurface of the Midland basin of West Texas. Production of oil from the Spraberry reservoir began in 1949 in east-central Dawson County. Permeability of the reservoir rocks ranges from 0 to 2.5 md, and porosity averages 10%. Major production is made possible by fracture porosity.

The Spraberry Sandstone is approximately 305 m thick and consists of upper and lower sandy and silty members separated by a middle member consisting of predominantly dark argillaceous carbonate rock and calcareous shale. Detailed study of sedimentary structures, vertical sequences, and petrography suggests that the Spraberry represents sedimentation from a series of coalescing submarine-fan complexes. The dark, finer grained intervals within the Spraberry may be the source beds for the petroleum being produced from the formation, although no published data exist to support this.

Samples from the finer grained intervals in two cores from the Tex-Harvey and Pegasus fields (Midland County) were analyzed by means of various geochemical techniques to determine their source-bed potential. Total organic carbon content of the samples ranged from 0.68 to 2.42 wt. %. Soluble organic matter extracted via Soxlet ranged from 1,892 to 6,598 ppm by weight. The carbon preference index as determined from gas chromatograms of the paraffinic-napthenic fraction ranged from 1.14 to 1.22. Kerogen coloration values were between 2.0 and 3.2, with the mode being 2.3. Hydrocarbons comprised from 0.65 to 8.6% of the total organic carbon and 17 to 71% of the total extractable organic matter. Compared with criteria commonly used to judge source-bed potential, the Spraberry has most requirements and probably contained its own source beds.

LEWIS, JAMES O., consulting geologist, Houston, Tex.

Stratigraphy and Entrapment of Hydrocarbons in San Miguel Sands of Southwest Texas

The San Miguel section of the middle Taylor in the