One or more major gravity-slide thrusts have been documented in the Eola, Southeast Hoover, and Southwest Davis oil fields, and in the western Arbuckle Mountains, Garvin and Murray Counties, Oklahoma. The gravity-slide area initially covered portions of at least nine townships; it was more than 30 mi (50 km) long and 5-6 mi (8-10 km) wide. It involved a stratigraphic sequence greater than 5,000 ft (1,500 m), extending from the lower Springer Formation into the upper portion of the Arbuckle Limestone. The major slides moved to the northeast and northwest, probably in the Middle Pennsylvanian. Slides and faults were subsequently isoclinally folded in the Late Pennsylvanian. The tensional updip segment of the major folded slide fault now coincides with the trace of the Washita Valley fault. The compressional end of the slide coincides with the Reagan fault in the east and the frontal Eola fault in the west. In the Lake Classen area the latest folding has turned all formations involved in the slide—and the associated faults—to a near-vertical position. Thus, the slide is exposed in a "profile view" on the south limb of the overturned Washita Valley syncline. On the north normal limb of the Washita Valley syncline, the slide is exposed in "plan view," with the Dougherty anticline and related folds representing compressional folding at the toe of the slide. Several tectonic breccias near the top of the Kindblade Formation of the Arbuckle Group probably mark the orogenic event.

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Clinton Gas Field: A Significant Stratigraphic Discovery

Clinton gas field has developed into one of the most significant stratigraphic discoveries in Oklahoma. This field is important not only for the magnitude of its hydrocarbon reserves, but also for the model it provides for finding similar fields.

The Clinton field is part of the Clinton-Geary trend, which is productive from upper Red Fork sandstones of Desmoinesian age. This trend is a 65-mi long, 0.5-2-mi wide incised fluvial channel that runs through Blaine, Caddo, Canadian, and Custer Counties. The Geary field at the northeastern end of the channel was discovered and subsequently developed in the 1970s. In 1979, the Clinton field was discovered, and since that time no less than 50 productive wells have been drilled. Development of the field is still continuing at a rapid pace.

The Clinton-Geary channel developed on a pre-Pink limestone erosional surface and eroded a 200-ft deep valley, which was subsequently filled by stream deposits, predominantly sands, silts, and clays. Sandstones in the channel range from a few feet in thickness to almost 200 ft.

Individual wells in the Clinton field have had flow rates exceeding 10 MMCFGD, with calculated open flow in excess of 40 MMCFGD. Estimated reserves are 30-40 bcf of gas and 0.6-0.8 million bbl of oil for the best wells in the field. Ultimate recoveries for the field are estimated to be 0.75 tcf of gas and 15 million bbl of oil.

The Clinton field is the most prolific Red Fork gas field in Oklahoma. A thorough understanding of its depositional history may help us discover similar significant fields.

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Use of Airborne Magnetics in Overthrust Areas

Detailed airborne magnetic surveys have been useful in exploring overthrusts containing magnetic, igneous rocks. The structural configuration of these rocks can be closely approximated. The most important information is the thickness of igneous material overlying sediments and the dip of the overthrust base. Thicknesses and dips of magnetic rocks in overthrusts can be highly variable. Thickness variations of 20,000 ft have been found to occur over the course of 5 mi parallel with the toe of the thrust. The igneous to sedimentary rock contact can range from vertical to horizontal in the same distance.

Interpretations can be used to guide the exploration program in overthrust areas. Seismic surveys can be located in areas of thin granite cover so prospective structures in the underlying sediments might be located at shallower depths.

The Arbuckle Mountain Range is an example of an overthrust that can be explored in this fashion. This overthrust covers a large surface area; in places it is very thin and in others, very thick, being in contact with the basement. The thrust covers a large surface area in an intensely drilled basin. The sediments below the thrust cover an area large enough to "hide" several major oil fields.

Undrilled areas large enough to contain major oil reserves are becoming increasingly scarce. The use of magnetics to detect and map igneous overthrusts can find undrilled sedimentary areas large enough to contain major reserve prospects.

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Dry Creek Field, Nebraska: Subsurface Methods Case History

Dry Creek field produces oil from thin Lansing (Pennsylvanian) limestone beds at a depth of about 4,000 ft (1,200 m) in central Hitchcock County, Nebraska. This subtle oil accumulation was discovered in 1963 by good fortune and weakly quantified subsurface geology; it remains geologically ill-defined. Conventional subsurface studies have been of little value in explaining the oil accumulation at Dry Creek field.

We have developed a method for evaluating thin Lansing reservoir beds that incorporates careful analysis of cuttings and logs of early vintage. This method facilitates mapping Lansing reservoir distribution, thereby permitting a better understanding of the subtle trap at Dry Creek. We believe this method can be used as an additional subsurface exploration tool in the northern Mid-Continent.

Subsequent to original publication of the methods described in this study, additional wells have been drilled at Dry Creek field. Some of these wells supported our original interpretation of reservoir distribution at Dry Creek, while others did not. Recently, the geologic techniques developed at Dry Creek field have been used successfully in exploration drilling in Decatur County, Kansas.

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Tectonic and Sedimentation Model for Morrow Sandstone Deposition, Sorrento Field Area, Denver Basin, Colorado

Pennsylvanian Morrow sandstones are oil and gas productive throughout a large area in southeast Colorado. The Sorrento field is a recent major Morrow discovery with recoverable reserves estimated at over 10 million bbl of oil from an area of 3,200 ac (1,295 ha.) at depths of 5,400 to 5,600 ft (1,646 to 1,707 m). Minor production also occurs from the Mississippian Spergen and Saint Louis, and the Pennsylvanian Marmaton.

Productive Morrow sandstones are interpreted on the basis of subsurface mapping to be fluvial valley-fill deposits, consisting mainly of channel sandstone. These deposits are encased in marine shale and range in thickness from 5 to 55 ft (1.5 to 16.7 m); net pay ranges from 5 to 30 ft (1.5 to 9.1 m). Porosities average 19%, and permeabilities range from 1 to 4,000 md.

Isopach maps of the Morrow and associated stratigraphic intervals indicate that paleostructure influenced Morrow depositional patterns. Morrow channel sandstones accumulated in paleostructural low areas created by movements on basement fault blocks. Structural nosing is present in the same location and trend as the Morrow channels, indicating structural inversion. Analyses of stratigraphic intervals above the Morrow indicate that the structural inversion occurred during the Early and Middle Pennsylvanian. The field is regarded as a combination structural-stratigraphic trap.

Knowledge of paleostructural control on reservoir facies provides a new idea for exploration for Morrow reservoirs in southeast Colorado.

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Furgerson Field: A Lesson in Serendipity

Serendipity is the aptitude for making desirable discoveries by accident. The development of the Arkoma basin's Furgerson field in Pope County, Arkansas, is an excellent example of this.

Although it was discovered in 1965, little development occurred in this field until 1981 when Texas Oil & Gas drilled the 1 Beard (Sec. 32, T9N, R20W). This well encountered two pay sands within the Pennsylvanian Atoka and one within the Pennsylvanian Morrow for total reserves of 4-5 bcf of gas. The TXO 1 Forehand (Sec. 33, T9N, R20W) was then drilled as an offset, supposedly aimed at encountering the same sands. Unfortunately, the Atoka pays present in the 1 Beard were faulted out, and the