

petroliferous areas. Of these, the Cement oil field has produced the only commercial uranium deposit in Oklahoma. Less well known is a small occurrence in Kiowa County (in the Hennessey group) where uranium is associated with pyrobitumen nodules. The nodules contain between 2,225 and 10,110 ppm U. Available field, microscopic, and geochemical evidence suggest that the pyrobitumens are secondary, i.e., alteration products of crude oil. Uranium was provided by ground water.

Petroliferous areas in Oklahoma hold the greatest potential for discovery of significant uranium mineralization. Oil-field brines can, in some places, be a useful tool in exploration for such mineralization. While high radium-226 concentrations in natural waters are not a specific indicator of subsurface uranium mineralization, relatively high ratios of Ra-226/Ra-228, Ra-226/Ba, Ra-223/Ra-228, and Ra-223/Ba in such waters from sedimentary terranes may better reflect the presence of uranium accumulations in the subsurface. Available analyses of several radioactive oil-field brines and springs from various parts of Oklahoma indicate that these waters do not meet the above criteria and are not, therefore, surface expressions of buried uranium mineralization.

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#### COCORP Deep Seismic Reflection Traverse Across Southern Oklahoma Aulacogen

COCORP deep seismic reflection profiles across the width of the southern Oklahoma aulacogen, from the Hardeman basin on the south, through the Wichita Mountains and Anadarko basin on the north, reveal basement deformation that necessitates major revision of ideas about the geologic history.

The profiles south of the Wichita Mountains show that the Precambrian crust is highly layered to depths of 10 to 13 km over an area at least 2,500 km<sup>2</sup>, and probably much more. Judging by COCORP surveys elsewhere in the United States, such extensive Precambrian layering is very unusual. The layered crust can be interpreted as a large Proterozoic basin, probably filled mainly with clastic sediments and felsic volcanics since these lithologies are widespread in the Precambrian of the southern Mid-Continent region.

The layering is truncated on the south side of the Wichita Mountains, and under the mountains is either absent or only present in a highly altered form. The truncation is probably caused by Precambrian faults in conjunction with granitic intrusions. Pennsylvanian compression reactivated these faults.

The COCORP profiles across the northern flank of the Wichita Mountains and into Anadarko basin are in an early stage of processing, but preliminary results suggest that the Precambrian layering that is so distinctive south of the mountain does not extend beneath the Anadarko basin. Crystalline rocks of the Wichita Mountains appear to have thrust north along a moderately dipping fault, overlapping the basin by 8 to 9 km. The attitude of the fault at depth beneath the mountains is unclear at present.

Simple models for the southern Oklahoma area as an aulacogen must be revised to consider the complex Precambrian history revealed by the COCORP data.

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#### Horizontal Seismic Sections and Their Utility in Petroleum Exploration

Horizontal seismic sections are one type of product from a three-dimensional seismic survey. Three-dimensional surveys have been performed in every type of environment worldwide and have contributed to many exploration, appraisal and development successes.

Horizontal, or Seiscrop, sections display the spatial extent of subsurface features and are particularly valuable for direct mapping. Three dimensional data from several areas, including the Mid-Continent, will be used to demonstrate the utility of Seiscrop sections for structural mapping, and for the delineation of hydrocarbon flat spots, carbonate features, stream channels, and sand bars.

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#### Washita Valley Fault System—A New Look at an Old Fault

With the application of plate tectonic concepts to southern Oklahoma, the structural style has more recently been characterized as a wrench fault system. In particular, the Washita Valley fault (WVF) is generally considered by many geologists to be a major left-lateral strike-slip fault with an offset of approximately 40 mi (64 km).

The map most commonly used to demonstrate this magnitude of lateral offset is the basal Oil Creek sand distribution map. The zero edge of the basal Oil Creek sand provides the necessary piercing point to judge lateral offset along the WVF. However, the published basal Oil Creek map depicts the present-day distribution of the sand which is the result of cumulative movements since the deposition of the basal Oil Creek sand. Individual orogenic episodes must be sorted to determine what contribution possible strike-slip movements have made toward the present-day basal Oil Creek sand distribution.

To unravel these various orogenic episodes a palinspastic restoration must be made. In such a sequential restoration, the last movement should be restored first or the known movements restored first to determine the unknown movements. In this presentation, the observable folds along the WVF have been "unfolded" and the known reverse faults have been restored to a pre-fault position. When this has been accomplished the partly restored basal Oil Creek sand map may be used to determine the amount of lateral offset on the WVF.

The resulting restoration indicates that the commonly quoted figure of 40 mi (64 km) of lateral offset is too large. Surface and subsurface data demonstrate that the crustal shortening represented by folds and reverse faults alone can account for the present-day basal Oil Creek sand distribution and thus very little strike-slip movement is needed along the Washita Valley fault system.

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#### Petrologic Factors Controlling Internal Migration and Expulsion of Petroleum from Source Rocks: Woodford-Chatanooga of Oklahoma and Arkansas

Upper Devonian-Lower Mississippian black shales are excellent oil source rocks throughout Oklahoma and much of western Arkansas. Black shales were deposited in shallow-water shelf or epeiric sea environments in the north and deep basins in the south (i.e., Arbuckle province). Silty black shale is more common in the north whereas silicified black shale in-