characteristic marine structures.

An idealized vertical sequence within the veneer consists of (in ascending order) of a laminated sandstone facies (in places containing chert pebbles), cross-stratified (0.3- to 1-ft sets) sandstone facies, and an oscillation ripple sandstone facies. The upper part of the oscillation ripple sandstone facies may contain 6-sided polygonal structures filled with coarse-grained sandstone and chert pebbles, or it may be covered by a massive facies that contains abundant fluid-escape structures. Variations on the idealized veneer stratigraphy exist where some facies are absent, but the vertical sequence order is maintained. Most of the formation is interpreted to be eolian in origin. Northerly winds deposited the large cross-bed sets in an extensive dune field. This event was followed by a period of marine transgression that reworked the uppermost part of the formation and formed the thin veneer. The abundance of fluid-escape structures and oscillation ripples in the veneer indicates rapid deposition by marine processes. The distinctive stratigraphy within the veneer reflects a deepening trend with the rising transgression.

CHIDSEY, THOMAS C., JR., Celsius Energy Co., Salt Lake City, UT

Hydrocarbon Potential Beneath Paris-Willard Thrust of Utah and Idaho

The Paris-Willard thrust trends in a north-south direction parallel with the eastern edge of the Bear Lake plateau of north-central Utah and southeastern Idaho. In places along the leading edge of the thrust, formations as old as the Cambrian Brigham Quartzite have overridden the Jurassic Nugget Sandstone and various Triassic formations. Movement on the Paris-Willard thrust began in latest Jurassic or earliest Cretaceous time, displacing rocks from the west to the east over 10 mi (16 km).

Seismic surveys indicate that from the leading edge to approximately 6 mi (10 km) west, the Paris-Willard thrust is relatively thin skinned. Detailed structural cross sections suggest that shales in the Triassic Woodside or Ankhareh Formations, acted as "slab runners" for Cambrian quartzites moving on the overlying Paris-Willard plate. The thickness of this overlying thrust plate is believed to range between 3,000 and 8,000 ft (900 and 2,400 m), with a complete Paleozoic section present on the underlying Crawford thrust plate. With the exception of two wells drilled on the edge of the Paris-Willard thrust, 600 m^2 (1,500 km^2) of potential Paleozoic reservoirs beneath the thrust have never been tested. Seismic interpretations indicate the presence of several large structures in the subthrust where formations such as the Phosphoria (which tested gas on the Crawford plate at Houghback Ridge field to the east), Weber, and Madison would be the primary objectives. Recent studies by several workers suggest units in the Phosphoria and other Paleozoic formations are excellent potential source rocks.


We analyzed 70 black shale samples from the middle member of the Minnelusa Formation (Pennsylvanian) in the Powder River basin of Wyoming and South Dakota, and from equivalent rocks of Desmoinesian age in the northern Denver basin of Nebraska. Organic-carbon content of these shales ranges from less than 1 to 26 wt. % (average = 5.4 wt. %). The shales contain predominantly type II organic matter and yield an average of 27,000 ppm hydrocarbons upon pyrolysis (Sϕ yield, Rock-Eval). These data indicate that the shales are excellent potential source rocks. Thermal maturation data (vitriinite reflectance, pyrolysis, hydrocarbon geochemistry) indicate that some hydrocarbon generation has occurred, although complete generation of available hydrocarbons has not occurred for the samples analyzed in this study.

We analyzed 12 oil samples from fields producing from the Minnelusa Formation, for comparison with extracts from the black shales. Two, and possibly three, genetic oil types are produced from sandstone reservoirs in the Minnelusa Formation. One type is produced from sandstone reservoirs in the upper member (Permian), and a second type is produced from the middle member Leo sandstones (Pennsylvanian). This second oil type can be subdivided into two subgroups based on chemical composition, although we cannot determine from our data whether these are genetically distinct oils. Extracts from the black-shale samples correlate well with the two or three oil types based on stable carbon isotope composition and detailed molecular hydrocarbon composition determined by gas chromatography-mass spectrometry (Cϕ alkanes and biomarkers). These results suggest that oil produced from the upper and middle members of the Minnelusa Formation in the Powder River basin is derived locally from the Pennsylvanian black shale and is not a product of long-range migration from the Phosphoria Formation in western Wyoming.
lower sequence of hemipelagic shales and submarine-fan deposits succeeded by slope-deposited silty shales and culminating in shelf and fluviodeltaic sandstones, shale, and coal. Basinal facies are expressed semicoherently as convergent bottomset reflectors of moderate to high amplitude and continuity, grading up-dip into mound dominated and channelized events of poor continuity and variable amplitude that onlap the base of the slope. This hummocky facies represents a combination of overlapping submarine fan lobes and gravity-failure deposits. The overlying slope sequences are expressed as complex sigmoid-olique clinof orm bundles of low amplitude bracketed by discrete continuous events of high amplitude. Clinoform bundles downlap over mounded facies onto bottomset events except where removed by deep incised submarine canyons. Mounded submarine fans generally onlap the base of topplaved forests, documenting their development during periods of low stand and shelf bypass. They were blanket by high-amplitude foresets during transgressive periods of relative sea level rise. Shelf and nonmarine facies are seismically expressed as prograding and aggrading topset reflectors that respond to fluctuating sea level and sediment supply. Amplitude and continuity are high in the eastern wave-dominated shelf setting, low in the west er river-dominated setting, and uniformly variable in the alluvialplain setting owing to discontinuous channels and coal measures. Maximum reservoir development parallels the wave-dominated shelf setting.

DESMOND, ROBERT J., JR., and JAMES R. STEIDTMANN, Univ. Wyoming, Laramie, WY, and DONALD F. CARDINAL, Consulting Geologist, Casper, WY

Stratigraphy and Depositional Environment of Middle Member of Min nelusa Formation, Central Powder River Basin, Wyoming

Regional correlations of the middle member of the Minnelusa Formation (middle Upper Pennsylvanian) shed new light on the stratigraphic relationships of Pennsylvanian rocks in the central Powder River basin and serve as the basis for a regional depositional model. The middle Minnelusa (Leo section) stratigraphy is best known in the southeastern part of the study area. To the north, the upper boundary (Red Marker shale) correlates with the base of the “B” dolomite interval, an upper Minnelusa marker. The underlying “C” sandstone of the upper Minnelusa is therefore Pennsylvanian in age. To the west the Red Marker becomes silty and disappears into the sand of the Tensleep Formation along the eastern Bighorn Mountains. There the middle Minnelusa is equivalent to the lower three-fourths of the Tensleep.

The two main factors influencing the depositional environments of the middle Minnelusa were paleogeography and sea level change. In the southeastern and south-central parts of the area, the proximity of the Lusk embayment and fluctuations in sea level caused frequent flooding of a broad, flat sabkha surface over which isolated dune complexes were migrating. The sediments deposited were subtidal carbonates and black shales interbedded with supratidal dolomites, evaporites, and eolian sandstones. Farther north, closer to the sand source, the dune complexes were larger, more continuous, and were affected only by major transgressive events. Laterally extensive eolian sands were also deposited to the west. The lack of black shales and presence of sandy dolomites with Skolithus burrows, however, suggests more normal marine conditions and preservation of abundant organic matter and coal measures. Maximum reservoir development parallels the wave-dominated shelf setting.

DUBEIL, RUSSELL F., U.S. Geol. Survey, Denver, CO

Sedimentologic and Tectonic Control of Uranium Mineralization, Upper Triassic Chinele Formation, Southeastern Utah

Uranium deposits in the Upper Triassic Chinele Formation of the White Canyon, Capitol Reef, and Circle Cliffs areas occur in a succession of lithofacies that formed from sediments deposited under anoxic conditions. Anoxic conditions in the depositional environments of these lithofacies are indicated by the preservation of abundant organic matter and the clast (reduced) colors of the rocks. The coincidence of facies changes and the vertical sequence of rocks associated with isopach “thicks” suggests that certain depositional environments were localized by tectonic subsidence. Lake, marsh, and bog environments adjacent to anastomosing fluvial channel systems occur in syndial areas that were actively subsiding during deposition. Deposition in these wetland environments, which had high organic productivity, high water tables, and minimal clastic input, resulted in organic-rich rocks. The vertical sequence of lithofacies indicates that initially the rate of tectonic subsidence was greater than the rate of clastic sediment influx. Subsequently, as the rate of clastic influx exceeded the rate of subsidence, sedimentation on prograding deltas buried the wetland deposits with clastic sediments that also contained abundant detrital plant debris. The subsequent decomposition of this organic matter produced anoxic conditions in the overlying clastic sediments that protected underlying marsh and bog deposits from oxidizing meteoric waters. Preservation of the organic material incorporated in the bog and marsh deposits established the reducing chemical environment necessary to precipitate uranium. Maintenance of this reducing environment also protected uranium deposits from later oxidation. Subsidence, concomitant with sedimentation, produced the hydrologic conditions conducive to plant production, accumulation, and preservation and established the reducing chemical conditions necessary to precipitate and preserve uranium. Identification of wetland environment sediments that accumulated in structurally controlled areas of subsidence is a useful guide for uranium exploration in the Chinele Formation.

DUNE, HERBERT D., Northwest Exploration, Denver, CO

Oil Generat ion and Entrapment in Railroad Valley, Nye County, Nevada

Railroad Valley is a graben block in the Basin and Range structural province. Topographically, it is basically flat with recent playa deposits on the surface. Two structural deeps exist in the valley. Five oil fields are associated with the northern deep. All oil fields are related to faulting.

Oil has been generated from Tertiary Sheep Pass and Mississippian shale. Oil generation is probably due to recent local heating of the valley by intrusive rocks. Temperature gradients are as low as 0.9°F/100 ft (16°C/km) to as high as 7.3°F/100 ft (133°C/km).

Eight million barrels of oil, with no significant quantity of gas, have been produced from the fields. The seals on the fields are imperfect and any gas generated, and much oil, has probably leaked into the overlying valley fill. Trap Spring and Eagle Springs fields are hydrostatically pressured whereas Bacon Flat, Curvant, and Grant Canyon fields are overpressured.

The concept of immature source rocks occurring near a valley with high heat flow may improve exploration success.

DU N, SANDRA L. DIMITRE, 9185 W. 45th Place, Wheat Ridge, CO

Teton Pass—A Window on Structure of a Thrust Belt—Foreland Overlap Area

Detailed geologic mapping along Teton Pass, southwest of Jackson, Wyoming, has led to a reinterpretation of the spatial and sequential relations between the Paleocene-Eocene detached Jackson thrust and foreland Cache Creek thrust in that area. Structural evidence from both thrust sheets shows that where the two faults overlap, the Jackson thrust sheet was overridden by foreland rocks during southwesterly movement along the Cache Creek thrust. Movement of the Cache Creek thrust sheet caused several anticlines along the leading edge of the Jackson thrust sheet to overturn to the southwest. Anomalously southward overturned folds elsewhere in the northern Snake River range may also be a result of this deformation. Continued movement of the Cache Creek thrust sheet sharply overturned the anticline on the leading edge of the Cache Creek thrust to the southwest and broke it along two major reverse faults that die out westward into an overturned anticline. Cretaceous rocks form a common footwall of the Jackson and Cache Creek thrusts. On Teton Pass these rocks, squeezed up between the two faults, are nearly vertical and very broken. Seismic studies oriented at right angles to the apparent movement of the thrusts are necessary to determine the subsurface structure of the footwall, thrust belt, and foreland rocks in this overlap area from west of Teton basin, Idaho, to Hoback basin, Wyoming. Although the rocks on Teton Pass appear to be too deformed to produce oil and gas, suitable prospects may exist where the interaction of thrust belt and foreland deformation was less intense.