Vitrinite reflectance readings are significantly higher in wells that penetrated thin intrusions, and this increase in vitrinite reflectance to values of around 1% is evident in one well at least 500 m above a 156-m thick doleritic dike where fission tracks have also been reset. The intrusions have thus heated a considerable volume of regionally immature rocks to temperatures equating to the oil window for a short period of time. Whether this relatively short-lived temperature increase has led to significant generation of hydrocarbons is unknown; however, oil recovered from one well that penetrated a doleritic dike had a sterane:aromatic sterane ratio suggestive of generation during a rapidly cooling heat pulse.

REEL, CHRISTOPHER L., RPI/Colorado, Boulder, CO, and CLARENCE V. CAMPBELL, RPI/Canada Ltd., Calgary, Alberta, Canada

Chin Coulee Field—a Stratigraphic Trap in Lower Cretaceous Fluvial Valley-Fill Sandstones

Hydrocarbons, stratigraphically trapped in fluvial valley-fill sandstones, constitute some of the more important oil fields in North America. The Chin Coulee field in southeastern Alberta, Canada, has produced over 4.4 million bbl of oil since its discovery in 1960, with an estimated 1 million bbl still to be produced via secondary recovery. The field covers approximately 80 km^2 with an average net pay thickness of 3 m. The hydrocarbons are stratigraphically trapped in the fluvial Sunburst Sandstone, which records the Early Cretaceous transgression of the Boreal Sea.

These lower Mannville aggradational sequences accumulated in an incised drainage system in Jurassic marine shales, which provide the bottom seal for the reservoir sandstones. Following deposition of the Sunburst Sandstone, an accelerated rise in base level led to the accumulation of argillaceous limestones and calcareous shales commonly referred to as the "ostracod zone." These fine-grained strata provide an effective seal above the porous sandstones.

Postdepositional tilting of the strata to the west, due to subsidence in the foreland basin east of a rising orogene (Nelson uplift), resulted in migration of hydrocarbons in an easterly updip direction. Stratigraphic trapping of these hydrocarbons occurred in sandstones pinching out in the upper reaches of tributary valleys to the east of the main drainage system (Chin Coulee and Taber Southeast fields).

Regional paleoenvironmental reconstructions suggest that the Sunburst Sandstone is equivalent to the Cut Bank Sandstone of the Cut Bank field area in northwestern Montana. The Cut Bank field lies along the same Late Jurassic drainage system (Fox Creek escarpment), and similar tributary valleys situated east of the escarpment may exist between these two producing field areas. This suggests the presence of additional untested hydrocarbon reservoirs exhibiting stratigraphic characteristics similar to those described in the Chin Coulee field.

REES, M. N., Univ. Kansas, Lawrence, KS

Processes of Sedimentation Associated with Fault-Controlled Trough Across a Shelf

Western North America was a rapidly subsiding, passive continental margin during the Cambrian. During the Middle Cambrian, a belt of carbonate deposition dominated the central shelf. It was bounded by fine-grained terrigenous sediments that accumulated in deep water to the west and in shallow water to the east. Movement along a high-angle fault that extended across the shelf produced a conspicuous embayment into the carbonate belt in Nevada and Utah during the middle Middle Cambrian. This fault movement controlled basin geometry and distribution of carbonate and shale lithofacies on the shelf for at least the next 40 m.y.

The embayment was an asymmetrical trough that deepened and widened as it extended some 400 km westward toward the edge of the continent. South of its abrupt southern margin, which marked the position of the fault, shallow subtidal and peritidal sediments accumulated throughout the Middle Cambrian. The northern flank of the embayment was a drowned platform that sloped gently southward into the trough axis. On this ramp, a carbonate platform was rapidly reestablished through vertical accretion and progradation. In the trough axis, which lay near the faulted margin, sediments representing anoxic and deep-water environments accumulated throughout the middle and late Middle Cambrian. Sedimentation rates in this axial region were inadequate to reestablish a shallow-water depositional setting because of reactivation of faulting and because the trough acted as a sediment bypass zone.

REITSEMA, R. H., Marathon Oil Co., Littleton, CO

Gas Compositions in a Well Column

An onsite mud-logging system was developed to avoid possible alterations in gas samples during shipment to laboratories. Compensation was made for the large gas contribution of the drilling mud entering the hole, for the rate of drilling, and for lag time of the drilling mud. Location of gas anomalies is more apparent with the modified system.

Several wells in the DJ basin were compared to establish a pattern of sediment gas vs. lithology or geologic formation. Gas content of the drilling mud throughout the hole showed that large changes occur in the absolute concentrations of methane through butanes and also showed an erratic pattern of the component ratios. These compositional changes should be taken into account in surface exploration for gas.

Other gases in the well column were also monitored. Hydrogen and helium were found in most wells. Their concentrations varied widely from well to well and in a single well. Carbon dioxide also showed large variations. Carbon isotope ratios of carbon dioxide did not correlate with the carbon isotope ratios of carbonate cements in the same samples.

REVETT, LOWELL W., Welex, Lafayette, LA, and BRIAN E. LOCK, Univ. Southwestern Louisiana, Lafayette, LA

Resistivity Curves from Complex Reservoirs: Under-Utilized Tools for Exploration and Production Geologists

Most geologists regard resistivity curves simply as sources of information concerning lithology and degree of water saturation of subsurface strata; however, other important geologic information can also be obtained. For example, water saturation is related both to pore characteristics and to the buoyancy pressures that lead to water expulsion from those pores by a hydrocarbon column. Thus, resistivity response is indirectly modified by a complex of factors including pore size, pore geometry, and grain-surface characteristics (including presence of clays). The combined effect of these pore characteristics is revealed most directly by capillary pressure curves. Because these same factors also determine permeability, resistivity itself can be regarded as responding to permeability.

This approach to resistivity interpretation has several important consequences. For example, true oil-water contacts encountered in the well bore display transitional resistivity values as upwardly increasing buoyancy pressures approach those necessary to produce irreducible water saturation. Complex reservoirs with inclined permeability barriers (such as shale drapes along lateral accretion cross-bedding in point-bar sands or shale interbeds in tilted turbidite sand sequences) may include false water levels where vertically adjacent but separated beds may have different fluid contents and may lack transition zones. Recognition of the distinction between these two types of oil-water contact may profoundly affect reserve calculations and help avoid passing over of viable reservoirs.

Correctly interpreted resistivity curves may also permit recognition of water production resulting from leading permeability barriers, may aid in distinguishing different types of oil show (leading, trailing, and residual) and may aid in explaining and predicting early water production, etc. Proper use of this readily available tool can have an important impact on successful exploration and production.

REYNOLDS, ROBERT C. JR., Dartmouth College, Hanover, NH

Thermal Transformation of Smectite to Illite

The diagenetic transformation of smectite to illite, with an intermediate series of mixed-layered compositions, has been documented by numerous studies of surface and subsurface rocks. Shales from typical Gulf Coast wells show compositions greater than 50% illite at approximately 100°C; the composition stabilizes at about 80% illite at the greatest depths sampled where the temperature is or has been as high as 130°C.

These findings are difficult to reconcile with data from oil (lower Paleozoic) rocks if it is assumed that illite-smectite compositions are equilibrium phases at specific temperatures. Potash bentonites (Ordovician)