deposition of shelf clastics and dolomitic carbonates was interrupted by several long erosional hiatuses. Major recognizable tectonism first appeared in the Devonian with at least one depositional basin formed west of the Defiance-Zuni uplift. Thin Early Mississippian shelf carbonates and evaporites covered nearly the entire region.

The most significant tectonic activities started in the late Chesterian and extended with increasing magnitude until the end of Wolfcampian time. Local basins and uplifts date from this interval and occurred in two belts. One belt was about 80 mi (130 km) wide along the western sides of the Hueco and Pedernal uplifts and along both sides of the Uncompahgre uplift. Another belt extended northwest from the Pedregosa basin into southeastern Arizona. Major tectonic events initiated the Morrowan, Atokan, and Missourian Epochs and occurred twice within the Wolfcampian Epoch. Leonardian, Guadalupian, and Ochoan Epochs were times of tectonic stability. During the Leonardian, sediments from the Uncompaghre uplift gradually covered all the other uplifts.

The timing of these Paleozoic tectonic events suggests a cause-effect relationship with plate-tectonic histories that brought North American and northern Europe together in the Late Devonian (Acadian orogeny) and Euramerica and northwestern Gondwana together in the Late Mississippian through Early Permian (Appalachian orogeny).

RUPPEL, EDWARD, T., U.S. Geol. Survey, Denver, CO

Lemhi Arch, a Late Proterozoic and Early Paleozoic Landmass, Central Idaho

The northwest-trending Lemhi arch of central Idaho first formed in late middle Proterozoic time, and as much as 4,500 m (14,760 ft) of middle Proterozoic clastic rocks were eroded in later Proterozoic time. The west flank of the arch was partly covered in late Proterozoic(?) and Early Cambrian time by the Wilbert Formation. On the east flank, westward-thinning marine sedimentation began with deposition of the Middle Cambrian Flathead Formation, and continued through the Late Cambrian. During Ordovician and Silurian times, the east flank of the arch was dry. The west flank was submerged in the Ordovician, and the Summerhouse Formation, Kinnikinnic Quartzite, and Saturday Mountain Formation were deposited. The west flank of the arch was briefly exposed after deposition of the Saturday Mountain Formation, but was partly submerged later in the Silurian, when the Laketown Dolomite was deposited. During the Middle and Late Devonian, deposition was renewed on the west flank of the arch, where the Jefferson Formation indicates eastward transgression. The east flank was exposed until the Late Devonian, when a thin sequence of the Jefferson and Three Forks Formations was deposited across the top of the arch, and marine sedimentation was continuous from the miogeocline far onto the craton.

The Lemhi arch continued to influence marine deposition even after it was submerged, separating shelf deposits in southwest Montana and east-central Idaho from miogeoclinal deposits in central Idaho. The arch was overridden by the Medicine Lodge thrust in late Early and Late Cretaceous times.

RYER, THOMAS A., and EDMUND R. GUSTASON, RPI/Colorado, Boulder, CO

Stratigraphy and Depositional History of Coyote Creek-Miller Creek Trend, Lower Cretaceous Fall River Formation, Powder River Basin, Wyoming

The Coyote Creek-Miller Creek trend produces high-gravity, low-sulfur oil from a series of Fall River fields in an area generally characterized by west-southwestward monoclinal dip. The trend includes, from south to north, the Coyote Creek South, Coyote Creek, Donkey Creek, Kummerfeld, and Miller Creek fields. The Wood and West Moorcroft fields produce oil from very similar Fall River traps located several miles east and northeast, respectively, of Miller Creek. Only Donkey Creek includes structural closure; all of the other fields produce from purely stratigraphic traps. The reservoir sandstones are characterized by upward-fining sequences. These sequences locally replace and are generally easily distinguishable from two regionally correlative upward-coarsening sequences. Analyses of cores and nearby outcrops indicate that the upward-fining sequences accumulated on point bars of a meandering river; the upward-coarsening sequences were deposited on the fronts of northwestward-prograding deltas. Detailed mapping of the fluvial and delta-front facies demonstrates that the Coyote Creek-Miller Creek trend, together with the Wood and West Moorcroft fields, represents a meander-belt system that was contemporaneous with the younger of the two delta-front units. Each of the stratigraphic-type fields occurs at a convexity along the eastern edge of the irregularly shaped meander belt; each consists of numerous point bars. Clay plugs, which resulted from infilling of abandoned meander loops, were preferentially preserved along the margins of the meander belt, where they now serve as updip permeability barriers between the oil-bearing fluvial and water-wet delta-front sandstones.

RYER, THOMAS A., and EDMUND R. GUSTASON, RPI/Colorado, Boulder, CO

Stratigraphy, Depositional History, and Petroleum Geology of Lower Cretaceous Fall River Formation, Powder River Basin, Wyoming

The middle Albian Fall River Formation, better known to petroleum geologists as the "Dakota Sandstone," constitutes a northwestward-thinning wedge of predominantly sandy strata under and overlain by marine shale. Two major episodes of deltaic progradation can be recognized in the formation, permitting mapping of lower and upper deltaic members. Study of outcrops, cores, and subsurface relationships indicates that the Fall River consists predominantly of fluvial strata in the southeastern part of the Powder River basin; delta-front and delta-plain facies, which are cut out and replaced locally by northwest-trending meander belts, predominate in an area that trends northeastward across the central part of the basin; the delta-front facies pinches out into offshore marine shale in the northwestern part of the basin. The large majority of Fall River stratigraphic trap-type fields produce oil and gas from sandy meander-belt deposits. The largest accumulations of hydrocarbons in traps of this type, as exemplified by the Powell-Mexican Springs trend (lower member) and the Coyote Creek-Miller Creek trend (upper member), occur in the more seaward parts of the deltaic members, near the seaward termini of meander-belt systems. Mapping of meander belts and of the surrounding deltaic deposits constitutes a necessary first step in exploration for stratigraphic traps within the Fall River Formation.

RYER, THOMAS A., and JON R. LOVEKIN, RPI/Colorado, Boulder, CO

Upper Cretaceous Vernal Delta of Utah—Depositional or Paleotectonic Feature?

A conspicuous seaward bulge of the middle to late Turonian shoreline of the Cretaceous seaway in northeastern Utah and southwestern Wyoming has been identified by previous authors as the Vernal delta. Strata of the Frontier Formation and the Ferron Sandstone Member of the Mancos Shale that form the Vernal delta consist largely of fluviodeltaic facies. The delta, however, is not recognizable as a locus of Turonian sedimentation; there is no isopach thick associated with it.

The Vernal delta is a large feature, encompassing an area of at least 6,250 mi^2 (16,187 km^2). A comparison between the depositional setting and paleogeography of northeastern Utah during the Late Cretaceous and a present-day area on the east flank of the Andes in Colombia indicates strong similarities. Further comparison suggests that a feature the size of the Vernal delta could not have been produced by a single river.

The Vernal delta overlies the ancestral Uinta Mountain uplift, an area where Cenomanian marine shales were entirely removed by what appears to have been submarine erosion during early Turonian time. When the shoreline prograded eastward across this area during middle Turonian time, the sediment load caused the area to subside, but at a rate slower than rates of subsidence to the north and south. This differential subsidence is the cause of the shoreline bulge. Although it includes deltaic facies, the Vernal delta is not a delta per se, but a feature produced as the result of interaction between sedimentation and gentle tectonic movement of the ancestral Uinta Mountain uplift.

SANDBERG, CHARLES A., and RAYMOND C. GUTSCHICK, U.S. Geol. Survey, Denver, CO

Models for Hydrocarbon Accumulation and Maturation in Deep Dysaerobic Basins