surface outcrops to the west. This interval is overlain by 410 ft (125 m) of red shale, siltstone, sandstone, and fossiliferous limestone that grades eastward into black organic shale and limestone. Capping the sequence is a 500-ft (152 m) interval of red shale, siltstone, sandstone, gypsum- and anhydrite-bearing dolomites and fossiliferous limestones that interfinger with typical Fountain coarse-grained terrigenous clastics.

This vertical succession of Fountain rocks in the subsurface suggests the following sequence of depositional systems from base to top: alluvial fan and braided alluvial plain, fan deltas, and small interfan embayments that grade eastward into a normal-salinity marine shoreface and an offshore hypersaline carbonate shelf. Normal salinity marine conditions were probably maintained in the parallic zone by the influx of ancestral Front Range runoff.

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Regional Significance of Mississippian Rocks at Pentagon Mountain, Lewis and Clark Range, Northwestern Montana

Pentagon Mountain exposes one of the best of the few sections of Mississippian rocks in the Lewis and Clark Range of northwestern Montana. This section consists of 225 m (738 ft) of marine carbonate rocks from which conodonts, ranging in age from earliest Osagean to early Meramecian, have been identified. Its stratigraphic base is well exposed, but the top has been eroded. Five units are recognized in this sequence, in ascending order: (1) phosphatized coarsely crinoidal and spiculitic wackestone, (2) dolomitic lime mudstone or wackestone, thinly interbedded with spiculitic biogenic chert, (3) partly dolomitized lime bioclastic wackestone showing much pressure-solution compaction, (4) partly dolomitized lime bioclastic packstone or wackestone, also showing much pressure-solution compaction, and (5) dolomitic mudstone.

The Mississippian sequence at Pentagon Mountain can be readily correlated lithologically, across the Lewis thrust system with Mississippian rocks that crop out to the east in the Sawtooth Range. This implies either that Mississippian units were originally widespread or that the magnitude of thrusting between the Mississippian rocks in the Lewis and Clark Range and those in the Sawtooth Range was insignificant. However, Mississippian rocks at Pentagon Mountain exhibit extreme pressure-solution compaction, which suggests greater stratigraphic or structural burial of these rocks than their Mississippian counterparts in the Sawtooth Range.

Secondary dolomite is pervasive in the lower part of the Mississippian section in the Lewis and Clark Range, and spectacular solution breccias locally disrupt the base of the section. These breccias and the adjacent dolomite are probably related, as both are thought to result from the passage of fluids through these rocks during Laramide uplift and/or post-Laramide erosion and extension.

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Morrow Fluvial and Deltaic Sandstones of Anadarko Basin in Southeastern and East-Central Colorado

Paleozoic sediments in southeastern and east-central Colorado were deposited in the northwest portion of the Anadarko basin. The primary hydrocarbon reservoirs are fluvial and/or deltaic sandstones that represent late regressive cycles of Morrowan sedimentation in the Anadarko basin. The associated transgressive cycles resulted in deposition of marine shales above and below the sandstones. These shales are the source rock in which oil was generated. Morrowan point bars, bar fingers, and the Keyes Formation are productive in the study area along with 11 other formations, both younger and older. Deeper objectives, such as the Arbuckle Limestone and Misner Sandstone, have had limited penetrations and were mostly off-structure tests.

The primary objectives of earlier wells in the area were the Mississippian reservoirs. Many of these wells were located on seismic highs or randomly drilled along the Las Animas arch. One reason that better oil production from Morrowan point bars was not found in earlier tests was a lack of understanding of the depositional history of the region.

The primary objectives of current wells being drilled in the area are the numerous Morrowan point bars, which are located by stratigraphic seismic methods along with a thorough understanding of the geologic framework in the study area. The point bars have excellent reservoir qualities, with porosities ranging from 18 to 22% and permeabilities as high as 5,500 md being reported. Point bars have been defined that cover over 3,000 ac and can be penetrated above 6,500 ft (1,981 m).

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Seam Profiling of Three Coals from Upper Cretaceous Menefee Formation near Durango, Colorado

Column samples of three separate coal seams from the Upper Cretaceous Menefee Formation near Durango were examined with reflected light and oil immersion to characterize the vertical variation in the coal petrography. In order to interpret the paleoenvironments of the coal, the macerals (microlithotypes) that make up the coal were identified and their association (whether they are in microbands or dispersed throughout), their physical condition (if they show signs of weathering or transportation), and their modal composition were observed.

The observed petrography indicates two main environments of deposition. Most of the microlithotypes are rich in vitrinite. This and the association and physical condition of the macerals indicate a terrestrial forest containing mainly woody plants and trees with a slightly fluctuating ground-water level. Less commonly, the microlithotypes have less vitrinite and more mineral matter, suggesting deposition in an open moor or deep water usually inhabited mainly by herbaceous plants. Macerals from both environments are weathered, suggesting infrequent dry periods or periods of lower water-table levels where the peat was exposed to subaerial oxidation.

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Cedar Hills Field, San Juan County, New Mexico: a Multi-Well Coal Degasification Project, San Juan Basin, New Mexico—a Case Study

Amoco Production Company is operating a multi-well coal degasification site, Cedar Hills field, in San Jaun County, New Mexico. Data presented here have been made available by Amoco at public hearings before the New Mexico Oil and Gas Commission.

The Cedar Hills field produces from the lowermost coal bed in the Cretaceous, Fruitland Formation, stratigraphically positioned above the Pictured Cliffs Sandstone. The coal bed reservoir is 18-20 ft (5-6 m) thick at a depth of 2,800 ft (853 m). The first well in this field was the Amoco 1 Cahn, completed in 1977 with an initial production of 200-300 MCFGD and 200-300 BWPD. These rates increased to 1.5 MMCFGD and 80 BWPD by January 1984. This well's production history exhibits a "negative" decline (incline) curve.

Gas analyses, water analyses, and reservoir pressure data strongly indicate that the 1 Cahn well is producing from the Fruitland coal bed rather than the Fruitland sandstones or underlying Pictured Cliffs Sandstone.

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Structural Geometry of Newly Defined Blacktail Salient of Montana Thrust Belt

Complexly imbricated Upper Devonian and Mississippian rocks in the northeastern Tendoy Mountains, Montana, form the previously unrecognized McKenzie thrust system, which is south of and structurally above the south-plunging Armstead anticline and north of the Tendoy thrust sheet. The northern margin of the McKenzie system, east of Garfield Canyon, displays a minimum of 4 mi (6 km) of eastward displacement. The southeastern margin is south of Kelmbeck Creek, near McKnight Canyon. The eastern edge of the system is buried under Quaternary to Late Cretaceous cover at or east of Red Rock Valley. East of the McKenzie system, the front of the Montana thrust belt extends north-northeast from Dell, Montana, to the eastern Blacktail Range, on the basis of unpublished mapping by J. C. Haley and W. C. Pecora, Jr. The convex eastward curvature of the thrust belt in this area, including the McKenzie thrust system, is herein designated the Blacktail salient.

Imbricates of the McKenzie thrust system comprise two duplex fault zones between Bell and McKenzie Canyons. The lower duplex involves a unique suite of platform to basinal Kinderhookian to lower Meramecian (Mississippian) carbonate rocks as well as Upper Devonian rocks. The