tions and between the Evanston and lower Wasatch Formations show the Uintas to have risen in two distinct pulses. The earliest rise may have begun by Maestrichtian time and the latest rise, forming the north flank fault system, culminated in the Eocene.

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Possible Volcanogenic Origin of Uranium at Anderson Mine, Yavapai County, Arizona

Uranium mineralization in Miocene sediments at the Anderson Mine, 70 km northwest of Wickenburg, Arizona, is interpreted to have been volcanogenic on the basis of geologic setting, absence of uranium-depleted source rocks in the vicinity, and geologic similarities to the Aurora uranium prospect in the McDermitt caldera, Nevada.

The Anderson deposit formed in moat sediments within the McLendon caldera. The caldera is identified by a sediment-filled basin coincident with a circular, −25 mgal gravity low centered 5 km (3 mi) south of the mine. A thick apron of andesite, near-source lahar, and rhyodacite forms a crescentic outcrop pattern that partially encircles the gravity low. Ash-flow tuff, interpreted to have erupted during caldera collapse, crops out approximately 30 km (18 mi) south of the mine.

Contrary to previous interpretations, the volcanic rocks of McLendon caldera are unlikely source rocks for uranium in the Anderson deposit. The lavas and ash-flow tuff from the volcano have average Th:U ratios of 4.5 and 2.4, respectively. Both ratios are close to or within the magmatic Th:U range of 2.5-5, indicating minimal uranium depletion. If the uranium did not come from volcanic rocks, it could have been provided to the sediments through hot-spring systems from a late-stage, uranium-enriched differentiated source.

The occurrence of the Anderson and Aurora deposits within caldera moat sediments strongly suggests a genetically similar, volcanogenic model. Other geologic similarities include silicified zones, fossil hot springs, thin-laminar bedding, stacked ore bodies, association of anomalous manganese and molybdenum, and the presence of carnotite and coffinite.

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Overview of Petroleum Activities in Utah, 1972-1982

After a decade (1962-72) of relatively slow petroleum activity in Utah, the past 10 years have seen a substantial increase. Although the production of petroleum has steadily declined since 1975, the number of wells drilled has generally increased from year to year.

The petroleum activity is centered mainly in four different areas within the state: the Paradox basin (southeastern Utah); the Uncompahgre uplift (central eastern Utah); the Uinta basin (northeastern Utah); and the thrust belt area (northeast central Utah).

The Paradox basin includes 43 oil and gas fields that primarily produce from the Paradox Formation. The Uncompahgre uplift includes 23 fields, most of which produce gas from the Dakota-Cedar Mountain formation. The Uinta basin includes 58 fields with over 95% of the production coming from the Green River and Wasatch Formations. The thrust belt area includes nine fields that produce condensate and gas almost entirely from the Twin Creek and Nugget formations.

Drilling activity in the first three areas has been relatively constant, with in-fill operations within known fields accounting for most of the drilling. The thrust belt has been the center of increasing activity since the initial Pineview discovery in 1975.

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Extensional Tectonics of Eastern Basin-Range/Overthrust Belt: Inferences on Structural Style from Reflection Data, Surface Geology, and Rheologic Models

Interpretations of over 1,500 km (900 mi) of industry-related reflection data in the Cordillera have revealed the following styles of late Cenozoic deformation: (1) the widespread development of asymmetric eastward-tilted basins that are bounded by low to moderate-angle planar and listric faults, and (2) five en echelon, low-angle reflections interpreted as regional detachments. Some steeply dipping planar and listric normal faults may be partly controlled by the presence of Mesozoic thrust structures, but this hypothesis is not applicable universally. In some cases, ends of normal fault segments are apparently determined by the positions of sidewall ramps and other cross-strike displacement transfer zones of Mesozoic age. Alternatively, several major normal faults, particularly those in Tertiary volcano-tectonic complexes, have no obvious relationship to Mesozoic structures. The low-angle reflections interpreted as a set of detachments extend east-west at least 200 km (125 mi) and dip gently westward from 3 km (2 mi) beneath the western Colorado Plateau to over 10 km (6 mi) at the Utah-Nevada border. The structural style of low-angle and listric faults cannot be reconciled easily with classic brittle failure theory, but the interpreted termination of normal faults at or above the frictional/quasiplastic transition may occur as shallow as ≈ 7 km (4 mi). Rheologic models of an extending upper crust suggest a vertically stratified model: brittle from the surface to as shallow as 7 km (4 mi), then variably ductile. The shallow depth of the upper ductile layer has important implication for controlling fault geometry and therefore the locations of fault-related basins.

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Paleoenvironmental Interpretation Based on Foraminifera of Coal-Bearing Almond Formation, Little Snake River Coalfield, Wyoming

The Upper Cretaceous Almond Formation (Mesaverde Group) in south-central Wyoming represents deposition in a variety of marginal marine environments. Foraminiferal assemblages recovered from cores and outcrops of the Almond in the Cow Creek area reflect this environmental diversity.

The Almond Formation is about 450 ft (135 m) thick and is divided into 2 informal members, both of which contain coal. Coals in the upper 100 ft (30 m) of the upper member are thin, but the lower member contains several thick beds. The coal-bearing parts of both members are characterized by repetitive coarsening-upward bay-fill deposits of mudstone and sandstone, commonly overlain by coal. A major coarsening-upward sequence in the lower part of the upper member is capped by sandstone interpreted to be a marine shoreface deposit. Fine-grained rocks in both members contain foraminifera.

Three foraminiferal assemblages are defined on the basis of faunal density, diversity, dominance, and taxonomic composition. A low-diversity agglutinated benthic assemblage interpreted as a hyposaline salt-marsh fauna occurs in the fine-grained rocks of the lower member. A high-diversity mixed agglutinated and calcareous benthic assemblage interpreted as a hyposaline bay to lagoon fauna occurs in shales in the lower part of the upper member. A moderate-diversity agglutinated benthic assemblage that occurs in fine-grained rocks in the upper part of the upper member is interpreted as an intermediate hyposaline salt marsh to interdistributary bay fauna.

These variations in benthic foraminifera populations provide significant insight into water characteristics in otherwise homogeneous sediments. The combination of lithologic and faunal studies provides improved paleoenvironmental interpretation over either method used independently.

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Marine Sandstone "Rolls" in a Coal Mine in Northern Wasatch Plateau, Utah

Coal seam undulations, locally called rolls, are a common but poorly understood geologic feature in underground coal mines of the Wasatch Plateau coal field of central Utah. Rolls may detract from coal mineability by: (1) creating steep grades that are difficult for mining machinery to negotiate, (2) providing low areas where mine water pools, and (3) adding diluting material which decreases coal quality. Rolls found in Skyline Mine 3 involve local, abrupt changes in elevation of the top and base of the lower O'Connor A coal seam. The change in elevation ranges from 5 to 30 ft (1.5 to 9 m) along a horizontal distance of 30-150 ft (9-46 m) and may exceed 3,000 ft (915 m) along strike. Mapping indicates the rolls are