most extensively exposed plate of Oquirrh strata (Pennsylvanian and Permian) with Manning Canyon Shale (Mississippian and Pennsylvanian) at its base lies discordantly on middle Paleozoic units and extends from the Albion Range 100 km east to the Bannock Range. (2) A middle plate of mainly Ordovician to Middle Cambrian strata lies on upper Precambrian quartzite and argillite of the Brigham Group in the Bannock Range between Pocatello and Utah. Ordovician strata in the Raft River and Albion Ranges lie on schist and quartzite of unknown age. (3) A lower plate of mainly upper Precambrian (Mutual and Camelback Mountain) quartzite in the Bannock Range overlies Precambrian rocks of the Scout Mountain Member of the Pocatello Formation, 3 km lower in the stratigraphic sequence. The middle plate locally overlaps the lower, placing Ordovician limestone directly on Scout Mountain strata. Scout Mountain rocks are more intensely sheared, mylonitized, and metamorphosed (greenschist) than any east of the Raft River Range, which poses the problem of whether they are autochthonous.

Prolific Mesozoic hydrocarbon reservoirs of the foreland belt are thus unlikely to be encountered by drilling farther west. Moreover, these thrust plates are cut by younger basin-and-range faults that have enormous apparent stratigraphic throws, further complicating local structure and hydrodynamic history. Reported moderate to high paleotemperatures reflect a complex thermal history with undefined implications for maturation. Nevertheless, regional stratigraphic relations suggest the presence of Paleozoic hydrocarbon source beds and reservoirs, although exploration will be difficult.

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Sedimentary and Tectonic Controls of Uranium Mineralization in Morrison Formation (Upper Jurassic) of South-Central Utah

Sedimentologic studies in the Henry basin of south-central Utah indicate that uranium deposits in sandstones of the Morrison Formation are related to the depositional environment in which the host sandstone bed and nearby mudstones were deposited and to the tectonic setting at the time of deposition. Thus, an understanding of environments of deposition and contemporaneous tectonism may be helpful exploration guides for uranium deposits in sandstones.

Discontinuous tabular uranium orebodies are present in fluvial and marginal lacustrine sandstone beds that lie just above, below, or a short lateral distance from offshore lacustrine gray mudstone beds. The mudstones are present only in the distal part of the lowermost alluvial-plain sequence of the Morrison where fluvial energy regimes and rates of sedimentation were low, allowing lakes to form while the Henry basin was slowly subsiding. The lakes were restricted to the east side of the basin where the least amount of clastic sedimentation by streams occurred. Palynomorphs, carbonized plant debris, and scarce pyrite in the mudstones indicate that the lakes were sufficiently persistent and deep during most of their lifetimes for reducing conditions to persist in the offshore muds. They also indicate that the mudstones were originally gray and are not bleached red mudstones. The gray mudstones are not present in other alluvial-plain sequences of the Morrison because little or no basin subsidence occurred after deposition of the lowermost sequence.

Plant debris and palynomorphs in the gray lacustrine mudstones suggest deposition in humus-producing lakes in which humic and fulvic acids (degradation products of plant tissues) were generated in the lake sediments. The close spatial association of the ore-bearing sandstones and the gray mudstones suggests that pore fluids containing these organic acids were expelled by compaction or seepage from the mudstones into nearby sandstones where they were fixed as tabular humate deposits. Subsequently, uranium in groundwater passing through the sandstone was concentrated by the humate to form the ore deposits.

Gray mudstones which cannot be used as exploration guides are bleached red mudstones and primary gray mudstones containing the alga *Botryococcus*. Sandstone beds adjacent to these gray mudstones are barren of uranium because (1) the gray color in bleached red mudstones is an alteration feature and does not indicate primary reducing conditions, and (2) *Botryococcus* thrives in humus-free lakes whereas humus-producing lakes are considered necessary to form ore deposits.

Thus, the requisites for mineralization appear to have been active crustal downwarping to cause ponding of fluvial sediments, and formation of humus-producing lakes on the alluvial plain, in the most sediment-starved part of the area undergoing basinal downwarping.

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Stratigraphy of Lacustrine Deposits

The major stratigraphic aspects of lacustrine rock units are geometry (thickness and lateral extent), facies patterns, and vertical sequence. Sizes and shapes of modern lakes show wide ranges, but many large ones are subcircular to elongate. In cross section most thick lacustrine units are broadly lenticular with maximum thickness near the center of the basin where subsidence is greatest.

Bottom sediments of modern lakes encompass a wide variety of lithofacies. If clastic sediments dominate, there may be concentric belts of gravel, sand, sandy marly mud, and mud, which are controlled by wave base and overall energy gradients. Facies patterns in chemical and organic sediments are not so easily predicted. However, two carbonate models are recognized, one with increasing carbonate content toward the center of the lake and the other with higher carbonate concentrations near the margins. The former results from nearshore dilution by terrigenous sediment and the latter from greater carbonate productivity in shallower water. Similarly, two organic facies patterns predominate. Offshore increase in organic matter results from deposition and preferred preservation below wave base. In contrast, nearshore concentrations of organic matter are mostly caused by in-place accumulations of organic remains.

Few ancient lacustrine sequences are either suffi-