States—Prospect for 1980s

The potential for commercial development of shale oil in the United States exists principally within the vast acreages of publicly owned oil shale lands in Colorado, Utah, and Wyoming. The resource that formed as varves in four lake beds during the Tertiary occur today as oil shale deposits in the Piceance basin, Colorado, the Uinta basin, Utah, and the Green River–Washakie basin, Wyoming. It is estimated to be a resource that could yield approximately 1.2 trillion bbl of shale oil from the Piceance basin alone. The authority to lease these public lands for development is defined by the Mineral Leasing Act (MLA) of 1920.

In addition to technologic breakthroughs to support more effective and less environmentally stressful development, the future development of commercial quantities of oil from this publicly owned resource is dependent on (1) administrative decisions to lease oil shale lands for development and (2) amendment of the MLA that would modify existing development practices.

Appropriate legislative and policy decisions can provide strong incentives for the commercial development of publicly owned oil shale deposits in the 1980s.

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Depositional Environments and Petroleum Potential of Miocene Lacustrine Deposit, West-Central Nevada

The lacustrine Esmeralda Formation (Miocene) of Nevada was studied with the purpose of determining the depositional environment of petroliferous laminated rocks that are interbedded with volcaniclastic sands and localized carbonate units.

Fine-grained petroliferous shales make up a 40-m section at the inferred depositional center of the basin and interfinger laterally with volcaniclastic mudstones, sandstones, and breccias. The areal extent and geometric shape of this unit were determined by detailed geologic mapping and measurement of stratigraphic sections. This unit and other units of the Esmeralda Formation have undergone extensive folding and faulting which produced possible reservoir structures.

The depositional environment is interpreted as beginning as a freshwater lake that evolved through time into a saline lake environment. This basin received volcaniclastic sediments from surrounding volcanic highs. Influx of these sediments slowed during periods of carbonate deposition. Unusual stromatolites and large tufa mounds with pseudomorphs of evaporite minerals are associated with dolostone and limestone layers.

This study provides a depositional and structural context for evaluating the petroleum potential of the Esmeralda Formation in Stewart Valley, as well as an aid in understanding similar Tertiary deposits in the Basin and Range province of Nevada.

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Permian Evaporites, Western Colorado Plateau, Southwestern Utah and Northwestern Arizona

Permian rocks of the western Colorado Plateau contain five evaporite units that are separated by one marine sandstone and four limestones in a cyclic relationship. These evaporites were deposited during regressions in the Permian seas that allowed sabkhas to develop between the shallow-marine shelf of the Cordilleran geocline and the nonmarine sediments that were being deposited along the transcontinental arch during Early Permian time. The lowest Permian unit containing gypsum is the Pakoon Formation which represents the first regressive cycle in the Lower Permian. Above the Pakoon Formation is the Quantoweap Sandstone deposited in a shallow-marine environment. Overlying the Quantoweap Sandstone is gypsum and gypsiferous siltstone of the Seligman Member of the Toroweap Formation, representing the second regression. During this regression a sabkha developed along what is now the western margin of the Colorado Plateau. A marine transgression followed depositing the limestone of the Brady Canyon Member in shallow-marine conditions. The third and largest marine regression produced the gypsum of the Woods Ranch Member of the Toroweap Formation while an eolian environment was depositing the Coconino Sandstone on the east. The last major transgression partly dissolved the gypsum of the Woods Ranch Member, locally generating the erosional unconformity between the Toroweap and Kaibab Formations. Along the present margin of the Colorado Plateau the regression of the Permian sea, which deposited the limestone of the Fossil Mountain Member, marked the development of the final sabkha represented by the gypsum of the Harrisburg Member in the area north of Grand Canyon. The deposition of gypsum in the Harrisburg Member was interrupted by a minor transgression that destroyed some of the underlying gypsum by dissolution and deposited a marine limestone. Alternating gypsum and limestone units are present between the limestone deposited by the minor marine transgressions and the Permo-Triassic boundary, suggesting that fluctuations between sabkha and tidal flat environments occurred before the final regression of the Permian sea.

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Localization of Tabular, Sediment-Hosted Uranium-Vanadium Deposits of Henry Structural Basin, Utah

Tabular uranium-vanadium mineralization characteristic of the Colorado Plateau occurs in fluvial sandstones of the Salt Wash Member of the Morrison Formation (Jurassic) within the Henry structural basin, south-central Utah. The ore consists of a mineralized interval (MI) of two closely spaced uranium and vanadium-rich zones separated by one barren of uranium but enriched in vanadium. No known stratigraphic feature controls the position of this MI which occurs at successively higher stratigraphic levels toward the interior of the basin. The dominant clay mineral throughout the MI is an unusual vanadium-rich di,trioctahedral chlorite. Laterally continuous with and below the MI, mixed-layer chlorite/smectite and illite/smectite (greater than 75% expandable layers) predominate. Above the MI, kaolinite in sandstone beds and illite/smectite plus kaolinite in bentonitic beds are the dominant authigenic clay minerals. The MI and its unmineralized lateral extensions are bounded, both above and below, by zones rich in authigenic dolomite cement. Petrographic evidence places the dolomite as pre-ore to contemporaneous with ore, and the chlorite contemporaneous with ore. Geochemical and mineralogical data, $\delta^{18}O$ to δD values of clay minerals and $\delta^{18}O$ to $\delta^{13}C$ values of dolomite indicate the presence of an interface between two isotopically and chemically distinct fluids. The lower fluid was typical of closed-basin evaporated brines with a high Mg/Ca ratio and high SO_4^{2-} content. The upper fluid was meteoric water. Elemental zoning patterns and isotopic data suggest that the upper (meteoric) fluid carried the uranium and vanadium to the solution interface, but that ore grade mineralization occurred only where the brine–meteoric water interface intersected horizons with anomalous concentrations of organic matter (dominantly detrital plant debris).