composed primarily of solid solutions of silicates plus cations, primarily Ca^{2+}, Mg^{2+}, and to a lesser degree Fe^{2+}. Distinct zones observed correspond to temperature thresholds, which can be distinguished by increasing degrees of silicification of the carbonate-rich raw oil shale. Trace element partitioning parallels closely the mineral assemblages, with the synthesis of insoluble minerals in the hottest most intensely altered zones, minimizing the extractability of potentially detrimental materials from the residue of in-situ combustion.

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Sedimentology and Depositional Environments of Emery Sandstone, Emery and Sevier Counties, Utah

From a sedimentologic study of the Emery Sandstone Member of the Mancos Shale (Upper Cretaceous) in southern Castle Valley, Utah, it is possible to determine depositional environments, paleogeography, textural and mineralogical characteristics, and possible sediment sources.

Tidal-flat deposits are dominant in the Emery, but subtidal (shoreface) and offshore deposits also occur. The paleotidal range is estimated to have been 1.3-1.7 m (4.3-5.6 ft). Many asymmetric, transgressive-regressive cycles of two different magnitudes and periods are present. They formed in response to minor fluctuations in sea level combined with slight variations in the subsidence rate.

The Emery Sandstone was deposited in the foreland of the Sevier orogenic belt. The average orientation of the paleoshoreline, as determined by paleocurrent analysis, was N9°W. Sediment was probably transported southward from the Utah-Idaho-Wyoming border area by longshore currents.

Well-sorted, subrounded to subangular, very fine-grained subarkose is the dominant rock type in the Emery. Dolomite and calcite are the major cements. Average porosities, based on thin section analysis, are less than 2%.

Abundant chert grains and reworked authigenic quartz overgrowths suggest a sedimentary source terrane. The observed amounts of feldspar could have been derived from Mesozoic sedimentary rocks exposed in the Sevier orogenic belt.

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Geologic Setting of Petroleum Source Rocks in Permian Phosphoria Formation

The Permian Phosphoria Formation in the northwestern interior United States contains two phosphatic and organic-carbon-rich shale members—the Meade Peak Phosphatic Shale Member and the Retort Phosphatic Shale Member. These rocks were formed at the periphery of a foreland basin between the Paleozoic continental margin and the North American cratonic shelf. The concentration, distribution, and coincidence of phosphorite, organic carbon, and many trace elements within these shale members probably were coincident with areas of optimum trophism and biologic productivity related to areas of upwelling. Upwelling is indicated to have occurred in the Phosphoria sea by the presence of sapropel that was deposited adjacent to shoals near the east flank of the depositional basin.

Maximum organic-carbon concentration is as much as 30 wt. % in the organically richest beds in the shale members and the maximum average in each member is about 10 wt. %. A close association occurs in the distribution of the organic carbon, silver, chromium, molybdenum, nickel, titanium, vanadium, and zinc. Phosphorous differs slightly from the distribution of organic carbon and by contrast seems typically associated with copper, lanthanum, neodymium, strontium, yttrium, and ytterbium.

Burial of the sapropelic muds by Triassic and younger sediments and the consequent rise in ambient temperature has led to catagenesis of hydrocarbons from the kerogen in these rocks. In some areas of southwestern Montana, hydrocarbons have not been generated; however, burial has been minimal and temperatures have remained low. Consequently, these rocks remain organic-rich shales that have the potential for producing synthetic oil and gas.

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Stratigraphic Relationships and Distribution of Hydrocarbon Source Rocks in Greater Rocky Mountain Region

"Hydrocarbon Source Rocks of the Greater Rocky Mountain Region" is the title of the Rocky Mountains Association of Geologists 1984 contribution to its annual symposium-guidebook series. This volume is comprised of over 25 papers that describe Precambrian through lower Tertiary source rocks and their associated maturation, migration, and accumulation patterns.

Placement of source rocks within a regional depositional framework indicates that they are generally associated with specific depositional environments associated with recognizable cycles of transgression and regression. When placed in a framework of depositional sequences, the source rocks can easily be related to the geometry of the associated reservoirs that they charge and to the seals that restrict hydrocarbon migration and control accumulation.

A series of maps shows distributions of source rocks for each critical stratigraphic sequence, and places the data and concepts of individual symposium papers in a regional context.

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Applied Depositional Modeling for Developing Western Coal Deposits

Geologic data from Mesaverde Group (Upper Cretaceous) strata in the Rocky Mountain region indicate that two major depositional models can be used to evaluate the geology and mining conditions of many western coal deposits. Marine and continentally deposited strata that enclose coal seams are characterized by physical and chemical characteristics which, if recognized, will permit more efficient mine planning and development. These characteristics impact selectively and differently on underground coal mining including longwall and room-and-pillar methods.

Continentally deposited strata in the roof and floor of coal seams require closely spaced data points for predicting geologically related mining conditions due to the lenticularity of the component beds. Fluvial sandstones are commonly associated with "wants," rolls, water inflows, and thinned coal. Channel-margin strata are notorious for roof control problems. Mudstones deposited in interchannel areas are prone to rapid decomposition with the introduction of water, humidity, and stress release.

Marine-deposited strata enclosing coal seams require less closely spaced data points than continentally deposited strata for predicting mining conditions because of the lateral continuity of such strata. Roof and floor strata and mining conditions are characteristically uniform over wide areas except near the termination of strata. Shoreline sandstones form very competent roofs and floors although they are locally associated with reduced seam thicknesses. The immediate association of marine-deposited strata and coal commonly results in higher sulfur values at the contacts of these strata.

Where marine and continental strata interfinger, the prediction of mining conditions becomes complex and requires an understanding of the depositional and erosive capabilities of the associated facies.

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Geology of Scipio Pass Quadrangle, Millard County, Utah

The Scipio Pass quadrangle is comprised of three separate packages of stratigraphy: (1) the Canyon Range Precambrian and Cambrian allochthonous section, (2) the Pavant allochthon of Paleozoic carbonates and quartzites, and (3) a thick Cretaceous to Quaternary blanket of coarse clastics that unconformably overlies the other packages. A fourth package, the Pavant autochthon, is inferred in the subsurface. Mesozoic rocks of this package crop out farther south where the Jurassic Navajo Sandstone is overlain in thrust contact by the Cambrian Tintic Quartzite.

Based on lithology and biostratigraphic evidence, the heretofore undivided Cambrian section of the Pavant allochthon correlates well with the