tions. Absaroka and Zuni rocks have more clastic content, but carbonates are locally important. Clastics of the Zuni sequence contain abundant lignite. Tejas sequence rocks are not significant in the production of minerals or energy, although glacial sediments cover much of the region.

Depositional environments throughout Sauk, Tippecanoe, and Kaskaskia deposition were largely shallow marine. Clastic sediments were transported into the southern part of the basin during Absaroka sequence deposition, a product of erosion of Ancestral Rocky Mountain orogenic structures. Continental and shallow-marine clastic sediments were deposited during Zuni sedimentation until Cretaceous deeper marine environments were established. Laramide orogenesis to the west provided detritus that was deposited in fluvial, deltaic, and marginal-marine environments, regressing to the east.

Major structures in the basin, and the basin itself, may result from left-lateral shear along the Colorado-Wyoming and Fromberg zones during pre-Phanerozoic time. Most structures probably resulted from renewed movement or "tensing" of pre-Phanerozoic faults.

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Heat Flow in Geophysical Exploration of Sedimentary Basins

In continental heat-flow studies, sedimentary basins are usually avoided because of difficulties in obtaining thermal conductivity measurements and because temperature gradients may contain advective signals caused by moving ground water. These problems are superimposed in the Denver and Williston basins where complex geothermal gradients derive both from large contrasts among thermal conductivities of strata and from regional ground-water flow. Detailed heat-flow studies may solve these problems and provide data relevant to basin hydrology: the occurrence and nature of geothermal resources, oil source rock maturation and secondary migration of petroleum, and formation and deposition of strata-bound ores.

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Diagenetic Destruction of Primary Reservoir Porosity in Viola Limestone, South-Central Oklahoma

The Viola Limestone in south-central Oklahoma is a Middle and Upper Ordovician carbonate unit interpreted as being deposited on a carbonate ramp within and peripheral to the southern Oklahoma aulacogen. Depositional environments within the study area ranged from anaerobic deep ramp through aerobic middle and shallow-ramp environments. Total organic carbon analyses of the lower anaerobic deep-ramp facies suggest that, at least locally, the Viola is a potential hydrocarbon source rock. Detailed petrographic examination of the Viola indicates that primary porosity in the shallow-ramp skeletal packstones and grainstones was initially quite high. This combination of source potential and original porosity should make the Viola an attractive target for hydrocarbons in southern Oklahoma. The Viola, however, has been subjected to a complex sequence of diagenetic events that have extensively altered the sediments and occluded much of the primary porosity. A thorough understanding of the timing and nature of these events can be critical in evaluating the economic potential of the Viola.

Petrographic evidence combined with the use of cathodoluminescence indicates that several generations of calcite cementation occurred within the shallow-ramp packstones and grainstones. An initial phase of very early, possible synsedimentary marine cementation is evidenced by cloudy, inclusion-rich syntaxial cements on echinoderm fragments. This early phase of cementation was followed by several generations of clear syntaxial calcite, prismatic calcite, blocky mosaic calcite, and bladed mosaic calcite, all of which indicate changes in the pore-water chemistry from the inclusion-rich cements. This phase of meteoric phreatic cementation occurred soon after the marine cementation and occluded virtually all remaining primary reservoir porosity.

GRIES, ROBBIE R., Independent, Lakewood, CO

Oil-Bearing Sediments Beneath San Juan Volcanics—Colorado's Newest Frontier

During the Tertiary, the western part of the northern Sangre de Cristo Range dropped 16,000 ft (4,877 m) to become what is now known as the San Luis basin. The foreland basin formerly adjacent to and west of the range remained intact but was subsequently concealed by 10,000 ft (3,048 m) of volcanic deposits. The existence of this concealed basin, a northeastern arm of the San Juan basin, was first suggested by Vincent Kelly who named it the San Juan sag.

Oil, which was generated in the underlying Mancos Shale, migrated upward into vesicles and fractures in volcanic rocks. In at least two places, oil is currently seeping onto the volcanic surface or into overlying soil. These oil occurrences encouraged geologic and geophysical exploration and have led to confirmation by drilling that the basin exists.

Porous reservoirs in both Tertiary sedimentary rocks and volcanic rocks overlie a 2,000 ft (610 m) Cretaceous Mancos Shale source rock. Within the Mancos Shale are fractured reservoirs, volcanic sills that have reservoir potential where fractured or porous, and stray sandstones. The Dakota Formation underlies the Mancos Shale and is about 200 ft (61 m) thick in this area. In addition, the Jurassic section has potential for source rocks in the Todilto Formation and reservoir rocks in the Entrada and Junction Creek Sandstones.

The San Juan sag, a newly discovered basin of 2,600 mi^2 (6,734 km^2) is a frontier for Colorado oil and gas exploration.

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Seismic Exploration in Rocky Mountain Region

Structurally and stratigraphically, modern exploration in the Rocky Mountain region depends increasingly on seismic delineation of prospective targets. In many areas an integration of geology and geophysics is required for a viable prospect today.

Structurally, the unique Rocky Mountain foreland deformation would have remained an enigma without modern seismic efforts and its pursuant drilling. This recent work resulted in several dramatic discoveries beneath thrusted Precambrian rocks. Continual drilling success in the Overthrust belt (where structure is largely masked by Tertiary sediments) has been the result of integrating new subsurface data with improved seismic work. Basin and range deformation, in many places superimposed on the complexities of low-angle thrusts or hidden by volcanic cover is severely testing seismic acquisition technology and interpretation skills. The challenge to acquire good seismic data from beneath thick volcanic fields has been successful in Colorado and Wyoming.

Angular unconformities are often clearly visible on seismic sections where they were difficult or impossible to recognize because of the absence of paleontologic data or because the strata above and below the erosional surface are too similar. Detection of angular discordance not only sets up the potential for locating truncation or pinch-out traps, but also enlarges our understanding of the tectonics and timing of Rocky Mountain deformation. Pennsylvanian deformation was as consequential in the Rocky Mountains as Laramide deformation, but is commonly masked by undisturbed Mesozoic rocks. Detection of these faults and folds has been greatly enhanced by seismic data, as well as deep-seated basement faults whose recurrent movement has controlled overlying stratigraphy.

Stratigraphic exploration in Rocky Mountain basins has challenged both geologists and geophysicists and they have joined in an increasingly sophisticated search for traps in sand dunes, fluvial channels, incised valley, delta fans, salt-solution structures, carbonate banks and reefs, karst topography, and sometimes in poorly understood, but equally prolific, simple porosity and/or permeability barriers.

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Exploration Tectonics and Vitrinite Reflectance, South Park Basin, Colorado

The southernmost of three intermontane basins was reevaluated in the late 1970s by Amoco. Geophysical data indicated a deeper and more structurally complex basin than expected. Reinecker Ridge is a large anticlinorial structure in the center of the basin, which was unsuccessfully drilled in 1978. The well deviated away from the structure and the Dakota Sandstone objective. Vitrinite reflectance data indicate the structure is unlikely to be oil productive because it was formed after oil generation; therefore this portion of the basin has low exploration potential.