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Laramide and Neogene Structure of Northern Sangre de Cristo Range, South-Central Colorado

The Sangre de Cristo Range, from Blanca Peak northward to the Arkansas River in Colorado, is composed mostly of Precambrian crystalline rocks and upper Paleozoic clastic sedimentary rocks. These rocks were folded and faulted by Laramide compressional forces from the Late Cretaceous to Eocene. Laramide structures are large arcuate thrust plates that intersect and overlap one another to form a northwest-trending belt that extends across the range from Huerfano Park to Valley View Hot Springs. All of the thrust plates within the range are bounded by west-dipping faults, some of which extend into the basement of Precambrian crystalline rocks. Along the east side of the range, the Alvarado fault is interpreted tentatively as an east-dipping thrust, bringing Precambrian crystalline rocks west over Paleozoic rocks. Thrust plates were folded internally before and during thrusting; some plates of Paleozoic rock contain folds that tighten and decrease in amplitude toward the leading edge of the plate. Stacked plates consisting of Precambrian and Paleozoic strata have been folded concordantly after thrusting. Thrust faults are mainly high to medium-angle reverse faults along the leading edge of thrust plates, but they flatten to about 30° at depth. Total shortening within the range is at least 8 km (5 mi) at the latitude of Westcliffe and at least 14 km (9 mi) farther south near the latitude of the Great Sand Dunes.

During the Neogene, the Sangre de Cristo Range was uplifted, and the adjoining San Luis and Wet Mountain Valleys were downdropped by extensional rift faulting. Rifting followed late Oligocene intrusion of stocks, sills, and dikes of mafic to felsic igneous rock into the Precambrian and Paleozoic rocks of the range. The horst of the Sangre de Cristo Range probably began to rise in the late Oligocene, rose rapidly in the early Miocene, and rose rapidly again in the late Miocene and Quaternary. Flows of mafic lava were erupted from faults along the southwest side of the Wet Mountain Valley and in the San Luis Valley. Zones of Laramide thrusts along the east and west sides of the range were reactivated to form the Sangre de Cristo and Alvarado normal faults, respectively. The floor of the Neogene sedimentary and volcanic fill of the San Luis Valley has been downdropped 2,000-7,000 m (6,600-23,000 ft) below the top of the range, and the floor of the Wet Mountains Valley has been downdropped about 2,000 m (6,600 ft) below the range. Rifting is still in progress in the San Luis Valley, west of the range, but may have ceased in the Wet Mountain Valley.

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Tectonic Development of Southwestern Montana and East-Central Idaho

The region of southwestern Montana and east-central Idaho, north of the Snake River plain and east of the Idaho batholith, has been affected by a complex sequence of orogenic events from the Proterozoic through Holocene time.

Deposition of Proterozoic Belt Supergroup rocks and rocks of similar age in east-central Idaho occurred in basins that were clearly fault controlled. Many of these faults were reactivated repeatedly at later times and controlled or affected the development of younger tectonic features.

This study encompasses the entire width of the Sevier orogenic belt in this part of the Cordilleran fold and thrust belt. The thrust belt comprises several major eastward-transported thrust plates that are successively younger to the east. These plates juxtapose distinct stratigraphic packages that were deposited in eugeoclinal, miogeoclinal, and continental platform settings. As a consequence, the thrust plates can be distinguished on the basis of facies and thickness distribution as well as, to some extent, structural style. In southwest Montana, Sevier-type structures overlap with, and butt against, basement-involved Laramide structures. The extension of southwest Montana basement trends into Idaho suggests that this overlap may extend into east-central Idaho.

Superimposed on these older structures are mid-Tertiary to Holocene normal faults that formed present-day basins and ranges. Many of these are reactivated older fault zones, some of which can be shown to have Precambrian ancestry.

The region has excellent oil and gas potential, because reservoir and source rocks and trapping mechanisms are all clearly present. However, an understanding of the effect of overlapping tectonic elements is necessary to predict accurately where favorable rock packages are preserved.

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Cyclic Deposition and Sea Level Changes: Record in Twin Creek Limestone (Jurassic), Northern Utah

The Twin Creek Limestone in northern Utah was deposited in a shallow sea during the Middle Jurassic. Paleocurrent patterns determined from study of ripple marks and cross-stratification, and the distribution of facies, indicate that the average shoreline orientation was northeast-southwest.

Two major transgressive-regressive cycles, which are correlated with sea level curves proposed by P. R. Vail and others for the Jurassic, are delineated. The lower cycle in the Twin Creek Limestone unconformably overlies the Lower Jurassic Nugget Sandstone. The Twin Creek Limestone is represented by deposits of the Gypsum Springs, Sliderock, Rich, and Boundary Ridge Members. Lithofacies in this cycle sequence grade upward from reworked Nugget Sandstone at the base into oosparite, micrite, and silty ripple-marked micrite, to an overlying discontinuous red siltstone unit. The cycle is correlative with the J2.1 global cycle of relative change of sea level.

The upper cycle is separated from the lower one by a hiatus of unknown duration. This boundary is recognized on the basis of the thin discontinuous red bed at the top of the Boundary Ridge Member. The cycle consists of the Watton Canyon, Leeds Creek, and Giraffe Creek Members. Lithofacies grade from oosparite at the base up into micrite, silty micrite interbedded with sandy oosparite, and sandstone. The upper boundary is marked by the base of the Middle Jurassic Preuss Sandstone. The cycle is correlative with the J2.2 global cycle.

Duration of these global cycles is about 8-10 m.y. Recognition of the cycles leads to improvement in stratigraphic and structural interpretation incorporating the effects of sea level changes.

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Gravity and Magnetic Survey of Portneuf River Valley Between McCammon and Lava Hot Springs, Idaho

The study was made to determine the subsurface shape and extent of faulting in the section of the Portneuf River valley between Lava Hot Springs and McCammon, Idaho. A series of roughly north-south-trending faults cuts the valley, leading to a stepped bed-rock surface. These steps are downdropped going west from Lava Hot springs to McCammon. Gravity readings were taken on a Worton Gravimeter and adjusted to latitude, terrain, and free air corrections. These final values were plotted and contoured on a 1:24,000-scale topographic map. Cross sections through the contours were then made and the resulting picture interpreted using Nealson's method. Magnetics were conducted to determine the extent of the valley-filling basalt.

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Post-Burn Mineralogic and Trace Element Relationships from an In-Situ Oil Shale Experimental Retort

Twenty post-burn and two control (unburned) core holes were drilled into a horizontal in-situ oil shale retort at the Geokinetics field site, Uinta basin, Utah. The object of the investigation was to study the mineralogic changes and trace element partitioning resulting from a true in-situ burn of Green River oil shale under field conditions. Minerals were examined by x-ray diffraction and optical microscopy; elemental determinations were performed utilizing x-ray fluorescence, neutron activation analysis, and other analytical chemical techniques. The complex mineral assemblage created was a result of rapid intense heating coupled with fluctuating temperatures, gas and fluid pressure, cooled at a shallow depth,