AAPG HEDBERG CONFERENCE
"*Late Paleozoic Tectonics and Hydrocarbon Systems of Western North America – The Greater Ancestral Rocky Mountains"*
July 21-26, 2002, Vail, Colorado

Precambrian Origins and Structural Development of the Ancestral Rocky Mountain Orogenic System

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Swarms of continental-scale basement faults were widely distributed across North America by Late Precambrian time. Dating of fault movements varies by locality, but most seem to have had lateral displacement by about 1.6 Ga. The fault system, apparently mostly swarms of wrench faults, occurs in northwesterly and northeasterly orthogonal patterns. Northwesterly-trending faults generally show right-lateral movement and northeasterly faults are left-lateral, thus establishing a north-south-oriented stress field for the time. One such extensive fault zone, called the "Paradox lineament," may extend from the present-day Bahama banks westerly and northwesterly through Oklahoma, southwest Colorado and Utah to Vancouver Island in British Columbia. Several major basement uplifts and adjoining basins occur along the extent of the basement fracture zone, including the Uncompahgre uplift segment of the Ancestral Rocky Mountains and the adjacent Paradox basin situated mostly in southeastern Utah.

Segments of the "Paradox lineament" are well exposed in the crest of the San Juan Mountains of southwestern Colorado. Early movement along the major faults has been dated as between 1.78 and 1.46 Ga; later displacement was reactivated in Late Cambrian, Late Devonian, Early Mississippian, Middle Pennsylvanian, and perhaps again in Laramide time. Large blocks of highly thrust-faulted and isoclinally folded Precambrian quartzite, and some pelite, were faulted into juxtaposition with older metamorphic rocks dated at 1.78 Ga, the faults later were ingested by granite dating at 1.46 Ga. The quartzite blocks were relatively high during the Late Cambrian, and periodically through lower Paleozoic time, to become the legendary "San Luis uplift" and the sedimentary source for fine-grained sandstone of the Sandia Formation in early Middle Pennsylvanian (Atokan) time.

The most prominent segment of the Uncompahgre uplift (the present-day Uncompahgre Plateau) lies to the northwest of the San Luis uplift, extending from about Ridgeway to about Cisco, northwest of Grand Junction, CO. The uplift is bounded on the southwest and northeast by high-angle reverse faults with major amounts of displacement. The bounding faults are believed to have been near-vertical wrench faults in Paleozoic time that were modified to high-angle reverse faults by underthrusting by Laramide tectonics. The south and north ends of the fault block are terminated by northeast-trending wrench faults that display left-lateral offset. The southerly bounding fault is the northeast-trending Ridgeway-House Creek fault, and the northerly termination is at the Colorado lineament. This, the best known segment of the Uncompahgre uplift, is somewhat younger than the San Luis uplift, having become a major source of arkosic sediments of the Cutler Formation that settled in the adjoining Paradox basin in Middle Pennsylvanian (Desmoinesian) time. The uplift continued to supply copious amounts of red sediments to the Cutler Group across the Colorado Plateau into Early Permian time.

Still a third, even younger segment of the Uncompahgre uplift lies to the northwest of Grand Junction, having been offset to the west by northeast-trending wrench faults of the

Colorado (Cataract) lineament. This segment is little known, as it occurs only in the subsurface beneath and north of the Book Cliffs, having been documented by geophysical studies and a few deep wells. The northwesterly extent of this segment is only poorly known, but it may continue as far as the Wasatch Mountains thrust belt. It came into prominence as a source of arkosic sediments in latest Pennsylvanian to Early Permian time.

The Paradox basin sagged into existence along parallel faults immediately southwest of the Uncompahgre uplift. Northwest-trending basement faults dominate the structural fabric within the basin, punctuated by northeast-trending basement faults. Considerable evidence indicates that these basement faults originated in the Precambrian and were rejuvenated at various times throughout Paleozoic time, especially during the Middle Pennsylvanian. The extensional nature of the basin was controlled by this structural pattern; the basin has been interpreted to be a pull-apart basin of Pennsylvanian age. Deep-water cyclic salt deposits of considerable thickness accumulated in the deepest down-faulted basin in Middle Pennsylvanian time, with penecontemporaneous shallow-water carbonate rocks deposited along the shallow shelf margins. Where optimum conditions prevailed along the shelf regions, algal (*Ivanovia* sp. and *Kansaphyllum* sp.) banks formed that today contain significant amounts of petroleum. Many of these "subtle traps" are yet to be discovered.

Regardless of the underlying causes of the Ancestral Rocky Mountain Orogeny, structures that controlled the uplifts and basins were originally formed in Precambrian time, and rejuvenated in Middle Pennsylvanian time to produce the various segments of the Uncompahgre uplift and the adjacent contemporaneous Paradox basin.