compahgre Plateau of Colorado, on the south by the Defiance Plateau of Arizona and New Mexico, and on the west by the San Rafael swell of Utah. Approximately 20,000 feet of sediments are preserved within the Permo-Pennsylvanian basin. Surface exposures are mostly sediments of the Mesozoic System, represented by a few thousand feet of clastics. The La Plata, Carrizo, Abajo, and La Sal Mountains are Tertiary intrusives within the Paradox basin.

The thin early Paleozoic sediments transgressed easterly onto the northeast-southwest trending transcontinental arch with the Cambrian sandstones separated from the Devonian-Mississippian shelf carbonates by an Ordo-Silurian hiatus. Exposure of the Mississippian carbonates resulted in a karst-like regolith, the Molas Formation of Atokan and/or earliest Pennsylvanian age. Tectonic influence then gave a northwest-southeast structural grain to the Paradox basin, in which Pennsylvanian cyclic or rhythmic shelf carbonates, sapropelic "black shale" dolomites, evaporites and arkose-redbeds were deposited. Approximately 2,000 feet of shelf carbonates were deposited on edges of the basin where highlands were not present. Evaporites were deposited in the center and distal northwest end of the basin and reach a present thickness of 10,000+ feet as the result of salt flowage in the cores of the intrusive salt anticlines. The many thin sapropelic dolomites are widespread throughout the basin and are the "time-markers" used for correlation. Clastics shed from the Uncompahgre and San Luis uplifts resulted in several thousand feet of arkose and redbeds ("Pennsylvanian" Cutler Formation) being deposited on the northeast and east flanks of the basin. These highlands persisted through Permian time and similar clastic deposition ("Permian" Cutler Formation) continued, depositing a thick wedge of arkose near the Uncompahgre front, which thins to the southwest to 2,000 feet of continental redbeds and eolian and marginal marine sandstones of the Cedar Mesa, Organ Rock, and De Chelly Formations.

Approximately 3,000 feet of Jurassic-Triassic continental shales and eolian sandstones were deposited over the Permo-Pennsylvanian basin and highlands. These sediments are exposed over the western two-thirds of the Paradox basin. Upper Cretaceous marine clastics, exposed at the eastern edge of the basin, are equivalent to a continental facies in western Utah.

The primary structural grain of the Paradox basin is a northwest-southeast lineation paralleling the Uncompahgre uplift of Permo-Pennsylvanian time. This alignment is illustrated best by the several salt anticlines. Laramide tectonics both rejuvenated the older trend and developed new structural lineations such as the north-south striking Monument upwarp. Regional uplift, coupled with the development of peripheral Tertiary basins, has placed the Permo-Pennsylvanian Paradox basin in a high structural and topographic position incised by deep superimposed drainage.

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GEOLOGIC HISTORY OF PICEANCE—EAGLE BASIN

The Piceance and Eagle basins represent the present expression of the Maroon trough or basin that started to develop in Early Pennsylvanian time. It extended across northwest Colorado and was bounded by the positive elements of the Front Range on the northeast and the Uncompahgre on the southwest. The early sediments are clastics, carbonates, and evaporites resulting from cyclic marine transgressions and regressions in the narrow trough. The evaporites are of the basin-center type, according to Sloss, but strongly affected by contemporaneous clastic deposition. The growth of the Front Range in Morrowan time and the uplift of the Uncompahgre in Desmoinesian time contributed large volumes of sediments to the trough during the regressions, which became interbedded with the evaporites.

The coarse clastics from the Front Range and Uncompahgre continued to strongly influence the sedimentary types of the Maroon basin throughout the Triassic and Jurassic deposition, with the predominant type being arkoses and redbeds. In Cretaceous, the area was inundated by the Cretaceous sea where the sedimentation was black shales, marine sands, bars and beach deposits. In Upper Cretaceous the entire basin became a shallow sea with paludal and lagoonal sediments, such as coals, shales, and underclays being interbedded with shoreline sands in response to fluctuations of the sea. Some of the older structural features, such as the Douglas arch, began to influence sedimentation during Upper Cretaceous, as evidenced by thinning in the Mancos Shale over the arch.

After prolonged sedimentation, the Maroon basin was uplifted at the end of Mesozoic time, and folded and faulted by the Laramide orogeny. The Sawatch Range, White River uplift, and the Uinta Mountains came into being in successive stages of the orogeny to separate the Maroon basin into the present tectonic basins; namely, the Piceance basin, the Eagle basin, the Axial basin, the Coyote basin, and the Sand Wash basin. Many of the present-day structural features were formed during the long period of orogeny from Late Cretaceous to early Tertiary time.

Sedimentary types have been most important in determining the reservoirs for the accumulation of oil and gas following the Laramide period of orogeny. Virtually all the oil and gas in the Paleozoic in the Maroon basin has been produced from the Weber Sandstone. It is a lithologic facies having some permeability and effective porosity, that was at the same time sufficiently brittle to fracture. The porosity and permeability alone are insufficient in many of the fields to support commercial rates of production. In addition to the sedimentary type, folding has been all important in establishing substantial reserves with respect to the Paleozoic accumulations.

The same control of the fracturing and sedimentary type applies to Cretaceous and Tertiary reservoirs in the Piceance basin, even though the role of folding is not a prime prerequisite to accumulation. All the important Cretaceous and Tertiary oil and gas fields are related to the local improvement of porosity and permeability above and beyond that normal to the marine shales encasing the reservoirs.

In contrast to the normal relationships of gas, oil, and water found in the Paleozoic reservoirs, many of the same relationships are reversed in the Cretaceous and Tertiary reservoirs. The relationships are similar to those in the San Juan basin and may have a similar explanation. More realistically, the explanation may be the indigenous nature of the oil and gas, where the migration has been limited to reservoirs in juxtaposition with the source beds.

Successful exploratory programs must be cognizant of the fact that the location of the areas of improved porosity and permeability became the primary reason for success. That success can be frustrated by inappropriate drilling and completion methods.