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# STRUCTURAL FRAMEWORK OF THE SOUTHERN RATON BASIN NEW MEXICO

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## INTRODUCTION

This paper is a discussion to accompany the "Tectonic map of the southern Raton Basin, New Mexico" (in pocket).

The Raton Basin extends about 300 km northward from Las Vegas, New Mexico into southern Colorado; that part of the basin in New Mexico is about 160 km long and is 100 km wide at the Colorado border (Fig. 1). This is one of the easternmost basins of the Laramide Rocky Mountain foreland

and its eastern limb merges with gentle arches on the western edge of the craton.

There are two parts to the southern Raton Basin, the Las Vegas sub-basin at the south end and the main part of the Raton Basin extending northward from Cimarron, New Mexico. For the purposes of this report both parts are referred to as the Raton Basin.

## ROCK UNITS

Preorogenic rocks range in age from Precambrian to Late Cretaceous. The basement is composed of crystalline Precambrian rocks that deform by fracturing; these rocks are exposed in the Sangre de Cristo and Cimarron uplifts that bound the west side of the Raton Basin.

The sedimentary cover is composed of Paleozoic and Mesozoic strata. Paleozoic sandstone and limestone units are more ductile than the Precambrian rocks, but are more competent than the thick shale intervals of the Mesozoic. Cretaceous shales in particular tend to deform plastically.

Synorogenic rocks are latest Cretaceous and early Tertiary in age (Raton and Poison Canyon Formations). These clastic rocks were derived from the Sangre de Cristo uplift which began to rise in Laramide time. Downwarping of the Raton Basin continued during deposition of these strata and probably ceased in latest Eocene or Oligocene time (Baltz, 1965).

Postorogenic rocks and sediments are late Tertiary to Quaternary in age. The Pliocene Ogallala Formation occurs on the Sierra Grande arch, resting unconformably on Mesozoic strata. Widespread volcanic rocks, mainly andesitic and basaltic, are found in the southern and eastern parts of the Raton Basin. Numerous sills and laccoliths occur on the Sierra Grande arch and may be responsible for many of the small domes found there.

Alluvium fills much of the Moreno Valley near Eagle Nest in the Sangre de Cristo uplift.

## STRUCTURE

Because the limits of a basin are defined by bounding uplifts or positive areas, we will briefly discuss the structurally high areas adjacent to the Raton Basin.

### Sangre de Cristo and Cimarron Uplifts

The Raton Basin is bounded on the west by the large Sangre de Cristo uplift and the smaller Cimarron uplift. The Sangre de Cristo uplift is one of the largest positive elements of the Rocky Mountain foreland, as it is nearly 320 km in length with an arcuate northerly trend, and is up to 30 km in width. The western edge of the uplift is marked by normal faults of late Cenozoic age bordering the Rio Grande rift.

The eastern margin of the uplift is characterized by reverse and upthrust faults (Schowalter, 1968; Prucha and others,

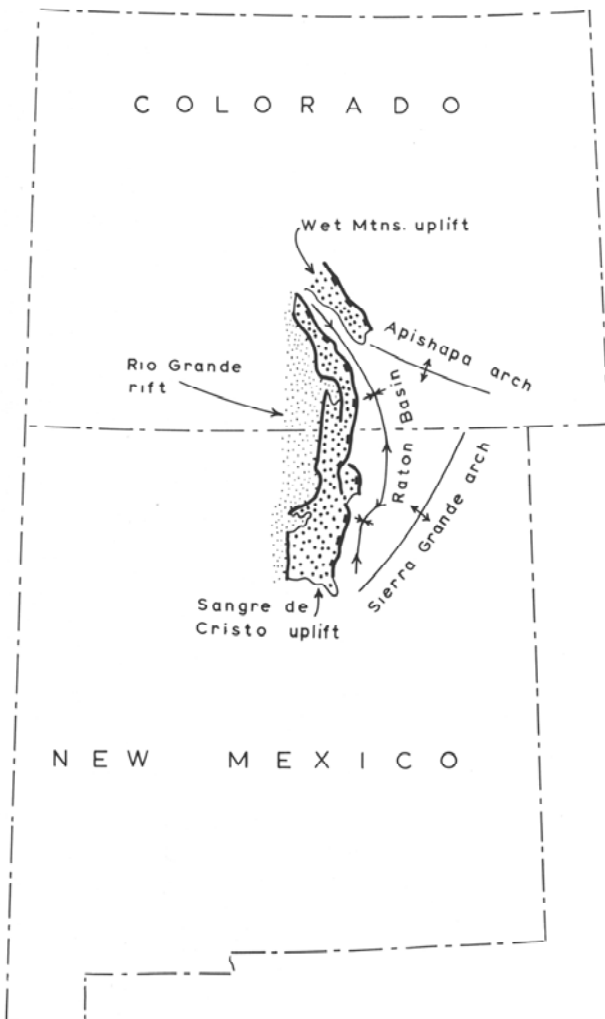


Figure 1. Index map showing Raton Basin and other tectonic features.

1965; Goodknight, 1973) that are steep at depth but tend to flatten upward. Precambrian crystalline rocks are exposed in the core of the uplift and are in fault contact with sedimentary rocks along much of the eastern edge of the uplift.

The Cimarron uplift is a spur of the Sangre de Cristo uplift and extends about 20 km to the southeast. On the east and northeast the Cimarron uplift is bounded by an upthrust of Laramide age, the Fowler Pass fault. Cenozoic intrusive rocks have been injected along much of the fault. Precambrian crystalline rocks comprise most of the Cimarron uplift and occur at elevations of nearly 12,000 ft. On the west this uplift is bounded by the Moreno Valley, a faulted syncline of late Cenozoic age that is mostly covered by alluvium (Clark and Read, 1972).

### Sierra Grande Arch

The low, broad Sierra Grande arch trends northeasterly and merges through a gently dipping limb with the east side of the Raton Basin. Mesozoic strata are present at the surface along much of the arch. In addition to late Cenozoic postorogenic volcanics, strata of the Ogallala Formation occur along the northern part of the arch. Sills and laccoliths are widespread in the area east of Maxwell.

There is 4,000 to 7,000 ft of structural relief between the Sierra Grande arch and the axis of the Raton Basin to the west.

### Cimarron Arch

The Cimarron arch is a broad, east-trending extension of the Cimarron uplift. This arch forms a low saddle that separates the Raton Basin into two parts, the Las Vegas sub-basin to the south and the main part of the Raton Basin north of Cimarron and Maxwell.

### Raton Basin

The Raton Basin is about 300 km long; that part in New Mexico is approximately 160 km long and 100 km wide near the Colorado border. The basin is asymmetrical, with a steep western limb and a gently dipping eastern limb (Fig. 2).

There is at least 14,000 ft of structural relief between the Cimarron uplift and the deepest part of the Las Vegas sub-basin, which is the deepest part of the Raton Basin in New Mexico. North of the Cimarron arch there is about 12,500 ft of structural relief between the trough of the basin and the Sangre de Cristo uplift to the west and about 4,000 ft of relief between the basin and the Sierra Grande arch to the southeast.

## TECTONIC DEVELOPMENT

During Late Cretaceous time, the Sangre de Cristo uplift began to rise and the adjacent Raton Basin began to sink as thick continental sediments (Raton and Poison Canyon Formations) were deposited. By middle Tertiary time (Late Eocene or Oligocene) the Raton Basin had its present configuration.

After extensive erosion, the Ogallala Formation of Pliocene age was deposited unconformably on Mesozoic strata mainly on the Sierra Grande arch. These deposits conceal many of the structures that formed earlier.

In late Tertiary and Quaternary time, extensive volcanic rocks were extruded from vents along the Sierra Grande arch, within the Raton Basin from Ocate to Wagon Mound, and east of Raton on the eastern margin of the basin (Stormer, 1972).

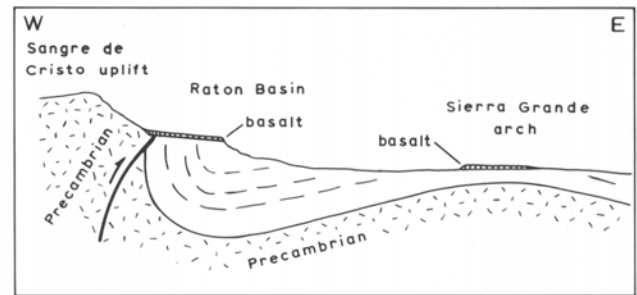


Figure 2. Diagrammatic east-west structure section through the Sangre de Cristo uplift, Raton Basin, and Sierra Grande arch.

Intrusive igneous rocks were injected during this time, forming sills and laccoliths along the Sierra Grande arch. On the west side of the basin numerous sills and laccoliths are present. A few sills are exposed in the central part of the Raton Basin near the Colorado border and drilling indicates sills or laccoliths beneath the dome at Vermejo Park. It is likely that the large Turkey Mountains dome is underlain by a laccolith (Hayes, 1957).

Deformation of the Raton Basin and Sangre de Cristo uplift during Laramide time was synchronous with westward drift of the North American plate over an eastward-dipping subduction zone, implying compressional stress in the crystalline crust of the foreland. Flexure folds associated with basin-uplift contacts in the foreland also suggest an element of compression. The geometry of the Sangre de Cristo uplift, Raton Basin, and Sierra Grande arch, however, clearly indicates that the principal movements were vertical and that crustal shortening was subsidiary.

Horizontal compression alone seems unable to bring about the Laramide vertical movements. The geometry and kinematics of basin development seem to require deep crustal or upper mantle volume changes that can best be explained by phase changes or possibly metamorphic flowage of sial in the lower crust (Woodward, 1976).

Lateral movement of large amounts of sialic crust by metamorphic flowage from the west to beneath the Colorado Plateau (Gilluly, 1973, 1973) and the southern Rocky Mountains may have occurred during the Laramide orogeny when the continent drifted westward over an eastward-dipping subduction zone. This could account for the fact that the sialic crust beneath the foreland is now much thicker than beneath the foldbelt to the west (Pakiser, 1963; Jackson and Pakiser, 1965).

When the subduction zone beneath the western United States was dissipated after the Laramide deformation, the thick sialic crust that had been formed by lateral transfer from the west was free to rise isostatically. The Cenozoic epeirogenic rise of the Raton Basin and adjacent uplifts and arches thus may have been an isostatic adjustment of the thick sialic crust that was derived during plate movement of the Laramide orogeny.

## ACKNOWLEDGMENT

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