



Laramide Sierra uplift--Evidence for major prerift uplift in central and southern New Mexico

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LARAMIDE SIERRA UPLIFT: EVIDENCE FOR MAJOR PRE-RIFT UPLIFT IN CENTRAL AND SOUTHERN NEW MEXICO

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INTRODUCTION

Eardley (1962) proposed the existence of a Laramide positive area adjacent to the eastern margin of the Colorado Plateau in southern New Mexico and termed it the Sierra uplift. Large portions of this uplift subsided to form basins of the Rio Grande rift during middle and late Tertiary time, thus documentation of a Laramide positive area in this region must depend upon evidence derived from synorogenic sediments,

regional stratigraphic relations, and the structural style of remaining, unsubsided portions of the uplift. This paper briefly reviews structural and stratigraphic evidence for the Sierra uplift, and discusses sedimentologic data from the Baca Formation (Eocene) which indicate that the uplift extended northward into the Socorro area, approximately 70 km beyond the northern boundary of the uplift as depicted by Eardley (fig. 1).

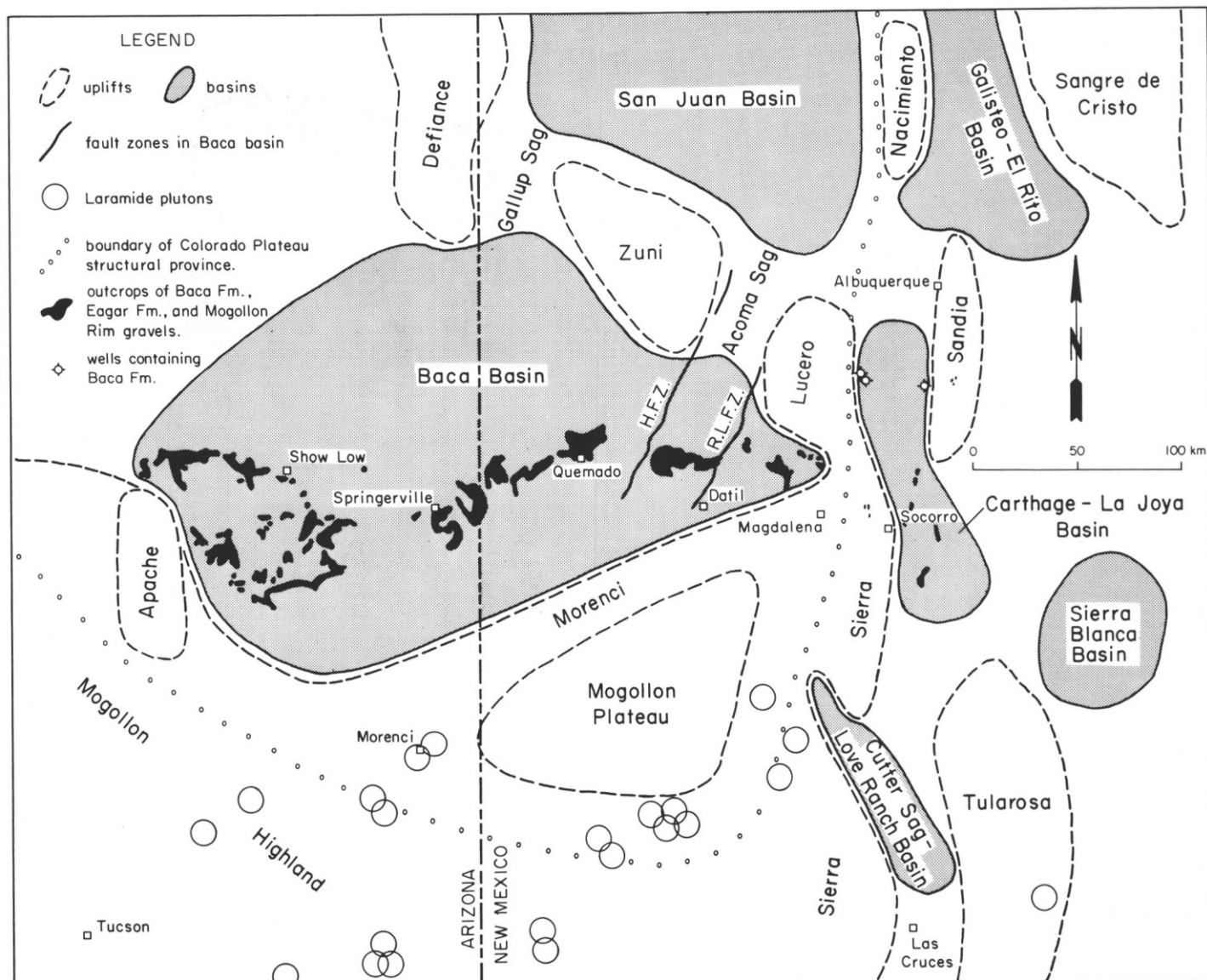


Figure 1. Map showing distribution of Eocene uplifts and basins in western New Mexico and eastern Arizona (from Cather and Johnson, in prep.). Base map and outcrop data from Dane and Bachman (1965) and Wilson and others (1969), Laramide pluton data from Chapin and others (1978), Apache uplift data from Davis and others (1982), Red Lake fault zone (R.L.F.Z.) and Hickman fault zone (H.F.Z.) simplified from Wengerd (1959) and Chamberlin (1981).

EVIDENCE FOR SIERRA UPLIFT

The only detailed sedimentologic studies and facies analyses of sediments derived from the Sierra uplift are those of the Baca Formation by Snyder (1971), Johnson (1978), and Cather (1980; ongoing research). Upper Cretaceous to Eocene deposits of the Cutter Sag—Love Ranch basin (McRae and Love Ranch Formations; Seager, 1975, 1981) are present adjacent to the central and southern parts of the uplift; to date, however, no systematic study of these rocks has been attempted. Data from the Baca Formation clearly demonstrate that the northern portion of the Sierra uplift encompassed much of what is now the Socorro Basin (fig. 2) of the Rio Grande rift. The evidence includes:

1. Paleocurrent and facies data from Baca outcrops east of the Rio Grande near Socorro indicate generally eastward paleoflow in proximal- and mid-fan environments, thus suggesting a source nearby to the west (see Cather, 1983, this guidebook, fig. 2).
2. Paleoflow was dominantly southwest-directed during Baca deposition in the Bear Mountains vicinity and presumably represents drainage off the western flank of the Sierra uplift and the south end of the Lucero uplift.
3. Local, lenticular exposures of limestone-clast conglomerates, which are correlative with the Baca Formation (Chamberlin, 1982), crop out along the western margin of the Socorro Basin in the Lemitar Mountains. Pebble imbrication indicates westward paleoflow and

these deposits are interpreted as local fill in paleocanyons which drained the western slope of the Sierra uplift (Cather and Johnson, in prep.).

4. The presence of a large, persistent, closed lacustrine system in the Bear-Gallinas Mountains area indicates the presence of a damming element to the east (see Cather, 1983, this guidebook).

Stratigraphic relations suggest that the western part of the rift south of Socorro was a Laramide positive area (the central and southern portions of the Sierra uplift). In the ranges bounding portions of the west flank of the rift (Magdalena Mountains, San Mateo Mountains, and Sierra Cuchillo), early Oligocene volcanic rocks typically overlie strata of Late Paleozoic age (Krewedl, 1974; Blakestad, 1978; Farkas, 1969; Jahns and others, 1978). In the Black Range, similar relations exist but are complicated by the local presence of a suite of older volcanic and hypabyssal rocks, some of which are as old as Late Cretaceous (Hedlund, 1974; Elston and others, 1976). Along the east shoulder of the Palomas Basin, volcanic rocks of late Eocene to early Oligocene age unconformably overlie Paleozoic strata in the southern Caballos Mountains (Kelley and Silver, 1952; Kottowski and others, 1969; Seager, 1975), and deposits possibly correlative to the McRae Formation overlie Precambrian gneiss in the northern Fra Cristobal Mountains (Kelley and McCleary, 1960). These stratigraphic relations differ greatly from those in adjacent Laramide basins, where thick deposits of early Tertiary sediments typically overlie strata of Late Cretaceous age.

The Sierra uplift implies a Laramide compressional phase prior to the onset of middle and late Tertiary extension. This early phase of compressive tectonism has been noted by Kelly and Clinton (1960, p. 55). They state:

... there is much evidence along the Rio Grande trough of an early tectonic compressional history. The structures of the Caballos Mountains (Kelley and Silver, 1952, p. 136-146) are clearly early Tertiary and compressional. Low-angle (15°) faults in which gneiss rests on Cambrian limestone are clearly displayed within a few hundred yards of the Rio Grande trough in Fra Cristobal Range of Sierra County, New Mexico (Jacobs, 1957, p. 257). Thrusts and overturns have been mapped in many places in the Sandia and Manzano uplifts. . . .

Thrust faults of Laramide age have also been reported along the eastern margin of the rift in the vicinity of Socorro (Wilpolt and Wanek, 1951), and Seager (1975, 1981) documents Laramide compressive structures and uplifts in the Las Cruces area.

Baca sediments derived from the northern part of the Sierra uplift are arkosic and contain locally abundant clasts of Precambrian granite, schist, and metaquartzite. Only a few small exposures of Precambrian rocks are present today along the Rio Grande rift near Socorro. Thus, Precambrian detritus in the Baca Formation in this area must have been derived largely from source terranes which were subsequently down-

faulted and buried in the rift. In the Chupadera Mountains, the southern part of an intrarift horst adjacent to the Socorro Basin, Precambrian rocks are locally overlain by early Oligocene volcanic and volcanoclastic deposits (Eggleston, 1982), indicating at least 1.5 km of Laramide uplift and erosional stripping in that area.

In the Laramide Cutter Sag—Love Ranch basin to the south, Precambrian-derived detritus is present in the McRae Formation (Kelley and Silver, 1952; Bushnell, 1953, 1955) and in an unnamed early Tertiary(?) sandstone overlying the Love Ranch Formation (Seager, 1981). Clasts of Precambrian lithologies also occur in deposits possibly equivalent to the McRae Formation in the northernmost part of the Fra Cristobal Mountains (Kelley and McCleary, 1960). Although these deposits may have been largely derived from the Sierra uplift, determination of the provenance and precise dating of these units awaits further study.

CONCLUSIONS

Detailed analysis of the structural style and geometry of the Sierra uplift is not possible with the data available at present. However, on

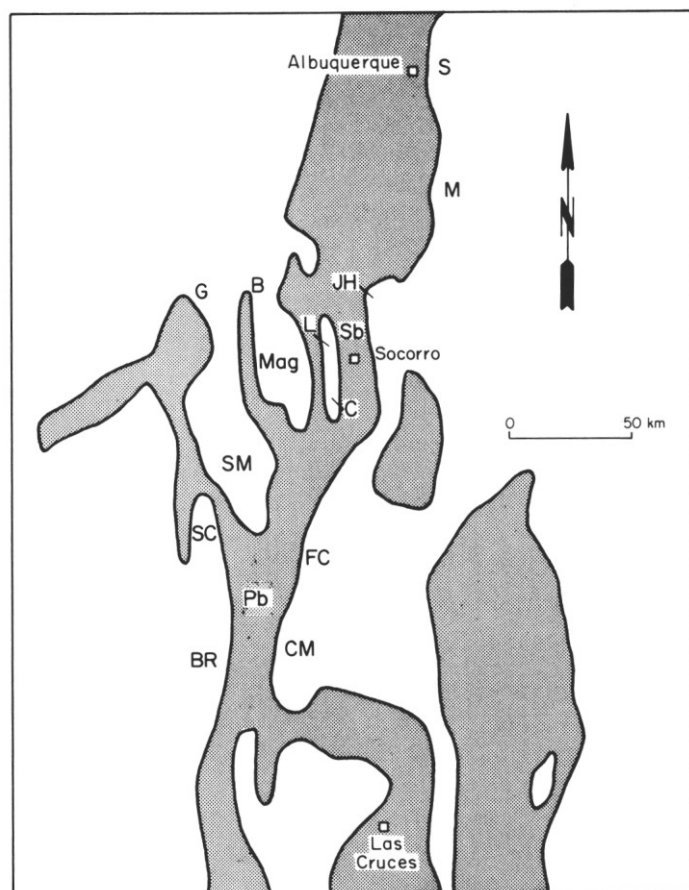


Figure 2. Map showing basins of Rio Grande rift (shaded) and localities mentioned in text. S = Sandia Mountains, M = Manzano Mountains, JH = Joyita Hills, G = Gallinas Mountains, B = Bear Mountains, Sb = Socorro Basin, L = Lemitar Mountains, C = Chupadera Mountains, Mag = Magdalena Mountains, SM = San Mateo Mountains, SC = Sierra Cuchillo, FC = Fra Cristobal Mountains, Pb = Palomas Basin, BR = Black Range, CM = Caballos Mountains. Base map after Chapin and others (1978).

the basis of trend, geographic location, the presence of thrust faults and associated compressional structures along its east flank, and evidence for significant exposures of Precambrian rocks along its crest, the Sierra uplift probably represents a basement-cored, anticlinal uplift (or series of uplifts) similar in structural style to the classic Laramide Front Range uplifts of Colorado and southern Wyoming. Chapin and Cather (1981) have recently proposed that north-northeastward translation of the Colorado Plateau, culminating during early Eocene time, resulted in the creation of an en echelon series of uplifts and basins along its eastern margin (including the Sierra uplift and Carthage-La Joya and Cutter Sag-Love Ranch basins) and caused the severe crustal shortening in the Wyoming province to the north.

ACKNOWLEDGMENTS

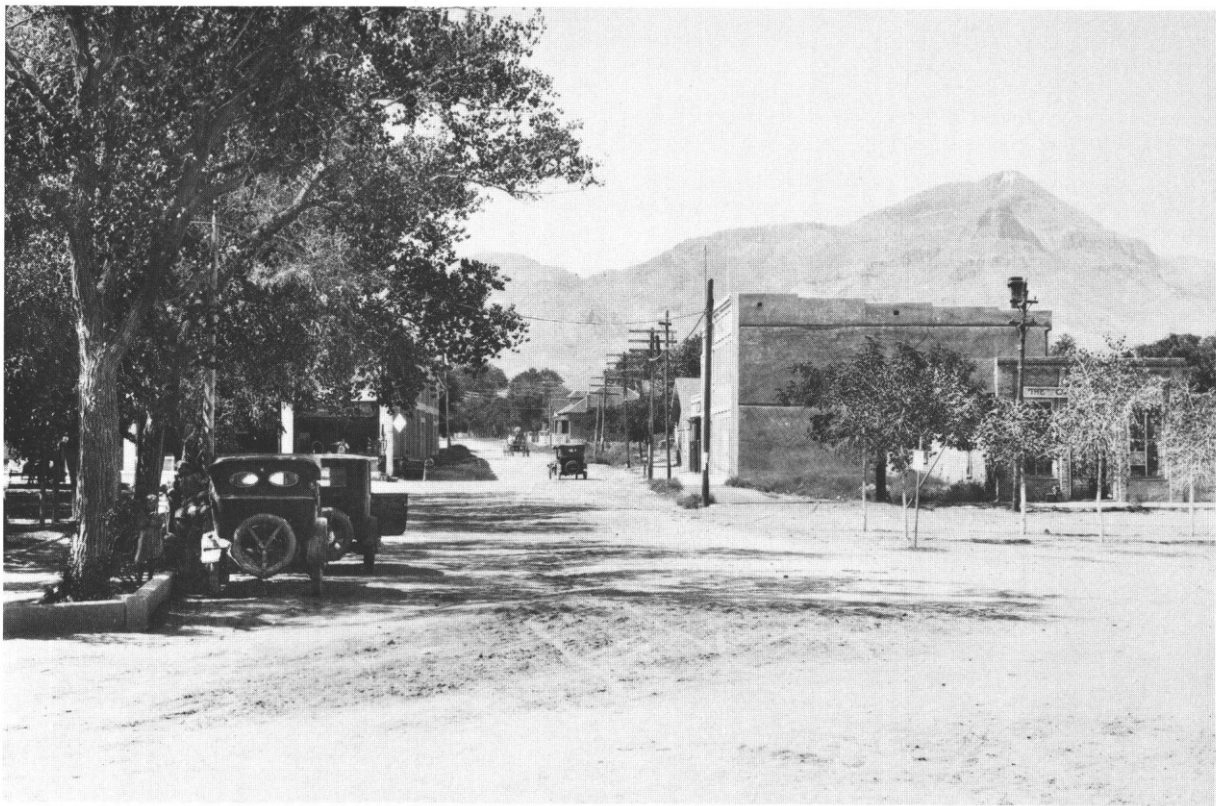
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An early day 4-wheel-drive vehicle in the sand-dune country north of Socorro (photo courtesy of Socorro County Historical Society).



Socorro Plaza during the early 1900's. The Ocean-to-Ocean Garage is visible on the corner at left center. From the Plaza, the highway went west to the foot of Socorro Peak, then up Blue Canyon on the old freight route (photo courtesy of Socorro County Historical Society).