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Anonymous

INTRODUCTION

In 1954 V. C. Kelley graphically summarized the results of geological mapping by many individuals in the upper Rio Grande area, New Mexico. However, because of lack of time it was impractical to write an accompanying text. In addition, it probably would have been unwise to have attempted to analyze and explain many of the puzzling structural features. Even now this is to a considerable extent still the case. Hence this title, "Structural Problems of the Rio Grande Trough in the Albuquerque Country."

MAJOR STRUCTURAL ELEMENTS

As shown on the tectonic map[1] in the pocket, the limits of the Albuquerque country are approximately defined by the 36° parallel on the north and the 34° 36' on the south. To the east the arbitrary boundary is quite irregular but in the vicinity of Albuquerque and Bernalillo and from there north it is approximately defined by the 105° 50' meridian, while to the west the limits of the map are 107° 10' on the southern margin and 107° on the northern margin. This area in fact emcompasses the broad valley of the Rio Grande and either all or marginal parts of the adjacent structural uplifts. This great valley, in this area, is a major and complex structural trough or graben. The marginal uplifts are also the margins of the trough and many of them are structurally very complex. Structural elements and major basins are enumerated and briefly described below.

The northernmost basin area (Fig. 1) has been referred to as the Espanola basin (Kelley, 1954). In or adjacent to it are the Penasco and Abiquiu embayments, only portions of which are included on the map, and the Santa Fe embayment. The northern margin is vague but as indicated on the small-scale tectonic map it is limited by the Embudo channel, a constriction between the Espanola and San Luis basins. Similarly much of the southern margin is vague but locally the La Bajada escarpment defines the margin on the southwest. On the east the margin is the great fault escarpment of the Sangre de Cristo uplift, while on the west the Espanola basin is limited by the Pajarito fault in an area considered in detail in this Guidebook.

The Espanola basin (Fig. 1) is a complex graben. Much of the evidence for its complexity lies in the vicinity of the Embudo channel where a series of Precambrian blocks constitutes an arcuate trend from the Picuris Mountains on the southeast to the Petaca and Ortega Mountains on the northwest. These Precambrian elements are horsts in the major graben.

Direct evidence of internal complexities in that part of the Espanola basin here discussed is primarily a series of inferences because of the difficulty of identifying structural features within the Rio Grande trough. However, some evidence of these may be seen along the eastern margin north of Santa Fe and in the area between Espanola and Los Alamos on the western margin. Adjacent to the Espanola basin is the eastwardly thrust and tilted Sangre de Cristo Mountains with a most complex fault zone along its western margin. The Jemez uplift, which is limited on the east by the Pajarito fault, is the western margin of the Espanola basin and is a volcanic plateau surmounted by the Jemez caldera. This topographically high feature is believed to be a part of the Rio Grande trough.

It seems most likely that the approximate western margin of the Rio Grande trough is in fact the Jemez fault zone and its possible continuation under the Jemez volcanic plateau. This fault zone, which approximately defines the eastern structural margin of Sierra Nacimiento, is a series of faults dominantly down to the east and appears to be en echelon with the Puerco fault zone which lies farther south.

Sierra Nacimiento (map in pocket) is a rather narrow but long uplift characterized by a rather steep thrust or reverse fault along its western margin.

Southwest of the large Espanola basin is the apparently en echelon Santo Domingo basin (Fig. 1). To the northeast its margin is the La Bajada fault escarpment while to the west it is limited by the San Felipe fault belt. Its southeastern margin is the Hagan fault. In consequence a feature that has been called the Hagan embayment has been recognized. The northern and northwestern margins of the Santo Domingo basin are the continuations of the Pajarito fault and farther southwest the approximate margin of the Jemez volcanic series is the Jemez Plateau.

Marginal uplifts are the domical northern part of the Ortiz porphyry belt and the relatively high Hagan basin in which pre-Tertiary rocks are exposed. The Ortiz porphyry belt actually extends from South Mountain north to the Cerrillos Hills, a short distance south of Santa Fe.

The Ortiz Mountains and Cerrillos Hills (map in pocket), which are the two intrusive features marginal to the Santo Domingo basin, are laccolithic and stocklike and were emplaced prior to deposition of the Santa Fe. The La Bajada fault escarpment is dominantly down to the west while the San Felipe fault belt consists of one or more grabens extending from the Jemez uplift south towards the Sandia Mountains.

The Albuquerque-Belen basin (Fig. 1), which by arbitrary definition includes the remainder of the Rio Grande trough in the Albuquerque country, extends as far south as approximately the 34° 15' parallel. However, only that portion of it that lies north of the approximate latitude of Belen is here discussed. This large late Tertiary sedimentary basin is limited on the east by the San Felipe fault belt, the fault margin of the eastwardly tilted Sandia uplift, and farther south by the fault margins of the eastwardly tilted Manzano and Los Pinos uplifts.

On the south the Albuquerque-Belen basin is terminated by a constriction that has been called the Socorro channel. On the west the margin of the Albuquerque-Belen basin is defined by the Puerco fault zone, the Lucero uplift, and in the extreme southwest by the Sierra Ladron.

[1]Tectonic map of a part of the upper Rio Grande area, New Mexico, by V. C. Kelley, 1961.

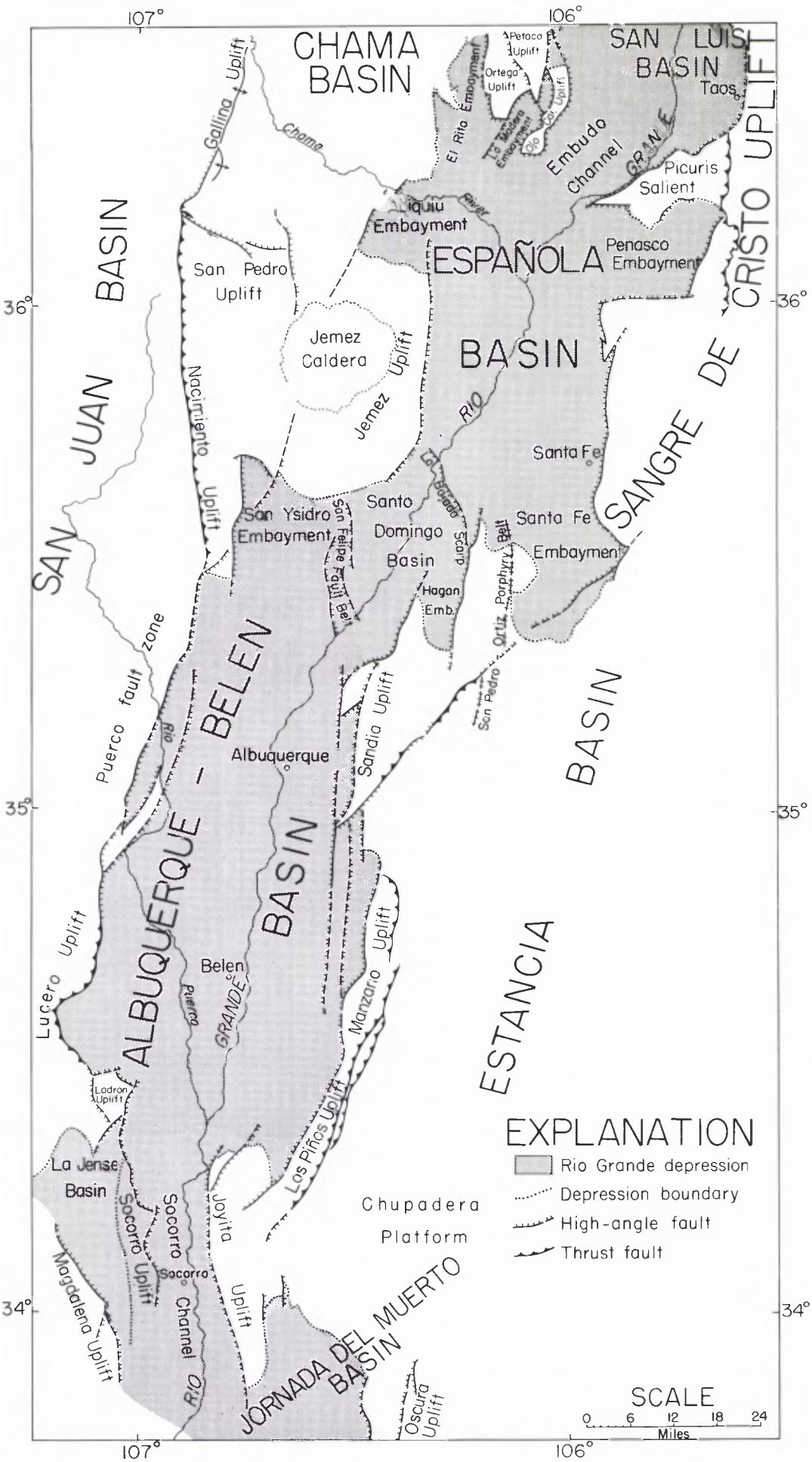

Figure 1. Tectonic map of the middle Rio Grande depression (modified from U. S. Geol. Survey Map OM-157 by V. C. Kelley)

The Puerco fault zone, as indicated on the maps (Fig. 1 and map in pocket), is a broad zone of complex normal faults. Some of these faults are structurally down to the east, others to the west. In consequence the belt is characterized by numerous grabens and horsts. However, despite these complications, the dominant deformation is down to the east.

The Lucero uplift (see maps), the eastern margin of which may be in part a continuation of the Puerco fault zone, is a feature that was upthrust from west to east in relatively early Tertiary time after which it sustained one or more episodes of normal faulting in later Tertiary time. Still farther south along the western margin of the Albuquerque-Belen basin is the Sierra Ladron. Although somewhat indecisive, data regarding the margins of this feature suggest that it is limited on all sides by supposedly normal faults. On the northwest and northern margins the Albuquerque-Belen basin and its San Ysidro embayment are limited by the Jemez fault and the erosional margin of the Jemez uplift or plateau.

MAJOR STRUCTURAL PROBLEMS

In the preceding discussion it has been established that the Rio Grande trough is believed to be a major downwarp or graben with many internal complications. However, the details of movement along the margins remain to be determined. Is the movement primarily vertical with only minor horizontal components or is it primarily horizontal with minor vertical components? Such features as the sawtooth-like fault near the mouth of Juan Tabo Canyon in the Sandia Mountains suggest vertical displacement. On the other hand, the stratigraphic dissimilarities of such features as formational thicknesses and facies on the two margins of the trough, together with local drag effects, suggest the possibility of major horizontal components with the possibility of horizontal shift of as much as several miles.

The apparent echelon relationships of major basins such as the Espanola and Albuquerque-Belen basins are not well understood. The terminations of some of these, such as the southern margin of the Espanola basin in the Santa Fe area, are very puzzling. The eastern margin, of course, is limited by the complex fault zone in front of the Sangre de Cristo Mountains. However, south of Lamy major faulting appears to end rather abruptly and apparently the Santa Fe laps across the older rocks as it thins. The same is true in the vicinity of Cerrillos where again the relationships appear to be simple and without the structural control farther north.

What is the pre-Santa Fe or early Tertiary history of the area? Locally, at least, the Galisteo formation and farther south the Baca formation which are believed to be mainly Eocene in age occupy parts of the trough and adjacent uplifts. The Galisteo formation is as much as 5,000 feet thick while the Baca is somewhat thinner. Therefore, there must have been one or more sedimentary basins during early Tertiary episodes of orogeny. In the general area of the Rio Grande trough does this basin or series of basins approximately conform to the present outline of the trough and its margins or has the present trough been superimposed only by accident upon earlier basins of deposition that had vastly different outlines?

How much thrusting was involved in the development of the early Tertiary orogenic belts along the margins of the present Rio Grande trough? The Lucero uplift is believed by some to be thrust to the east with later superposition of a normal fault system. By contrast, the Sierra Nacimiento, which would appear to be an approximate continuation of the Lucero uplift north of the Puerco fault zone, is thrust westward along a relatively steep fault. This westward thrusting is also believed to be early Tertiary in age. Why should there be this change in direction of thrusting? On the east side of the Rio Grande trough westward-dipping thrust faults have been mapped from the Los Pinos uplift northward through the Manzanos. These are also relatively steep faults. Is it possible that the interpretation of these as high-angle thrust faults is incorrect and that they are normal faults, the apparent reversal being due to eastward tilting of the blocks during the development of the Rio Grande trough?

What is the true nature of Tijeras fault? All available data suggest that it has substantial horizontal movement. Is it possible that this feaure should be interpreted as a thrust fault?

In the vicinity of Socorro it is apparent that Paleozoic and Mesozoic rocks underlie the Tertiary sediments in much if not all of the trough. Similar relationships are suggested farther north in the vicinity of Belen where a drill hole is believed to have gone into Cretaceous rocks at a depth of approximately 9,000 feet. In the latitude of Albuquerque and farther north the presence of Mesozoic rocks at the surface in the broad Puerco fault zone suggests that pre-Tertiary sedimentary rocks underlie the Tertiary sequence of the Rio Grande trough. In the vicinity of Santa Fe, New Mexico, the Pennsylvanian rocks are locally exposed in the Santa Fe fault zone along the margin of the Rio Grande trough. This also suggests, but does not prove, the presence of a sedimentary sequence intervening between the Precambrian and the Tertiary strata in the trough at this latitude.

In the canyon of the Rio Grande from the vicinity of Dixon north to near Taos Junction, Precambrian rocks immediately underlie the Santa Fe formation. The existence of the Precambrian inlier at Cerro Azule nearly half way between the Dixon area and the margin of the Petaca and Ortega Mountains in the vicinity of Ojo Caliente suggests that the Precambrian immediately underlies the Santa Fe in the trough. Similar relationships are seen in the Picuris, Ortega, and Petaca Mountains and support this view.

If the assumption is correct that the Santa Fe formation rests on Precambrian rocks in the Dixon-Ojo Caliente area in the Rio Grande trough then there is a change that may be either abrupt or gradual in the sequence somewhere between the northern end of the Puerco fault zone and the latitude of Dixon. Where does this change take place and what is the nature of it?

The answers to many of the questions posed above should wait on considerably more detailed mapping and analysis of the local structures within the several basins as well as in the adjoining uplifts.

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