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THE RIO GRANDE TROUGH NEAR ALBUQUERQUE, NEW MEXICO[1]

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Gravity and aeromagnetic surveys have been made of part of the Rio Grande trough and adjoining areas near Albuquerque, New Mexico, to learn more about the structural boundaries and configuration of the trough. The area covered by the gravity and aeromagnetic surveys is shown on Figure 1.

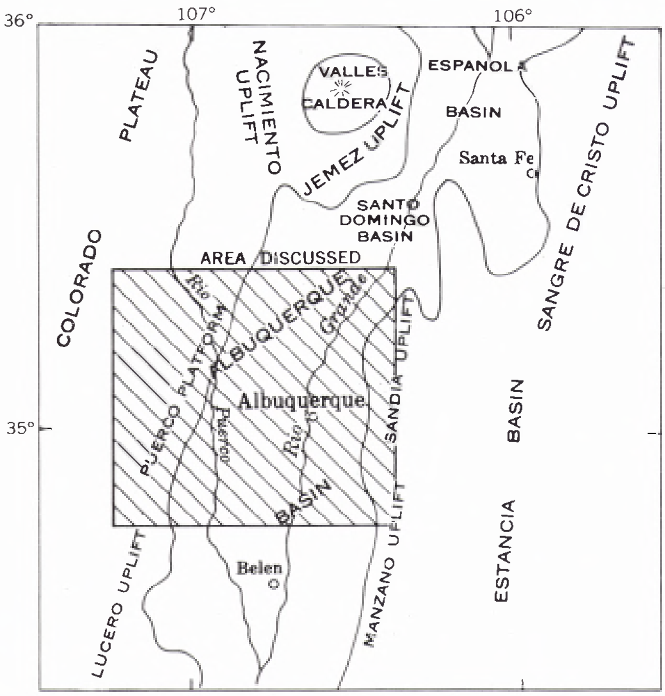

Figure 1.—Sketch map of part of Rio Grande trough and associated structures in north-central New Mexico. Area studied crosshatched; Rio Grande trough shown by stippled pattern. Structural boundaries from Kelley (1952).

The Rio Grande trough (Kelley, 1952, 1954; Fitzsimmons, 1959) is a series of complexly faulted troughs or basins, arranged **en echelon.** It extends from the northern end of the San Luis valley in Colorado, southward 450 miles along the course of the Rio Grande in New Mexico, to near El Paso, Texas. The trough is bounded on the west by the Colorado Plateau and on the east by uplifts of the southern Rocky Mountains.

The Albuquerque basin, the largest basin of the Rio Grande trough, is about 90 miles long and 30 miles wide. It is bounded by the Sandia, Manzanita, and Manzano uplifts on the east, by the Lucero uplift and Puerco platform on the west, and by the southern end of the Nacimiento uplift on the northwest. Small volcanoes and fissure flows mark the boundaries at several localities. The basin is filled with poorly consolidated Cenozoic deposits whose constituents were eroded from the uplands. Older sedimentary rocks doubtless underlie the valley fill. The thickness of sedimentary rocks is unknown, but Precambrian rocks may lie 10,000 feet below sea level in parts of the basin, whereas they are about 9,000 feet above sea level in the Sandia uplift and about sea level in the Puerco platform.

Gravity map. — A large gravity low shown on Figure 2 is associated with the valley fill (density about 2.3 g per cm^3), and prominent highs with the denser sedimentary

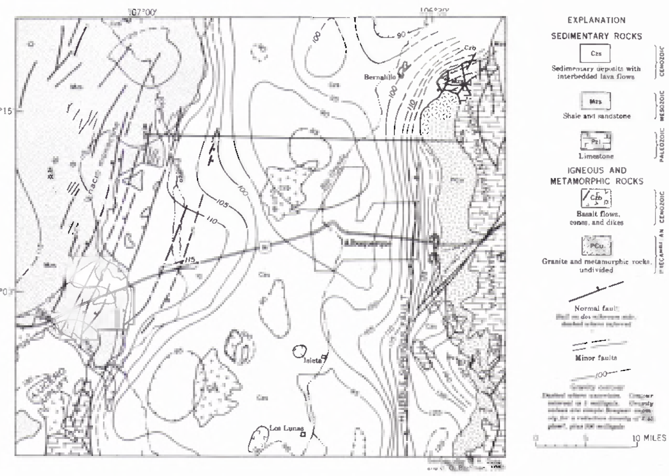

Figure 2—Preliminary gravity map and generalized geologic map of Rio Grande area near Albuquerque, New Mexico.

and crystalline rocks of the bordering uplifts (densities about 2.45 to 2.7 g per cm^3). Steep gradients between the low and the highs mark major bounding fault zones.

East of the trough, steep gravity gradients coincide in part with scarps along the mountain fronts, and with the projection of the Hubble Springs fault (Kelley, 1954). As some of the steeper gradients are several miles farther west, parts of the main fault zone are evidently covered by consolidated material.

A fault zone also bounds the west side of the trough, as shown by steepened gradients. They are less pronounced than on the east, because the comparatively dense Precambrian and Paleozoic rocks are covered by several thousand feet of less dense Mesozoic rocks; in addition, the fault zone may be wider or may dip less steeply. To the south steep gradients coincide with the faulted eastern flank of the Lucero uplift. At U. S. Highway 66 the contours bulge northeastward, indicating a buried extension of the Lucero uplift. A similar bulge on the eastern side constricts the trough. North of U. S. Highway 66 the west margin of the trough trends north, about parallel to observed and inferred faults. The Ignacio monocline is marked by a broad gravity high.

Some of the closed gravity lows within the trough may coincide with comparatively great thicknesses of low-density valley fill. If so, the ancient drainage may have been west of the present Rio Grande, except to the south near Los Lunas. Conversely, some of the prominent highs

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may represent uplifted blocks of the denser Paleozoic and Precambrian rocks and thinner valley fill. The most prominent high, in addition to the positive bulges already mentioned, is west of Bernalillo.

An analysis of the gravity anomaly across the Rio Grande trough is shown on Figure 3. A residual gravity low of about 45 milligals is superimposed on an assumed

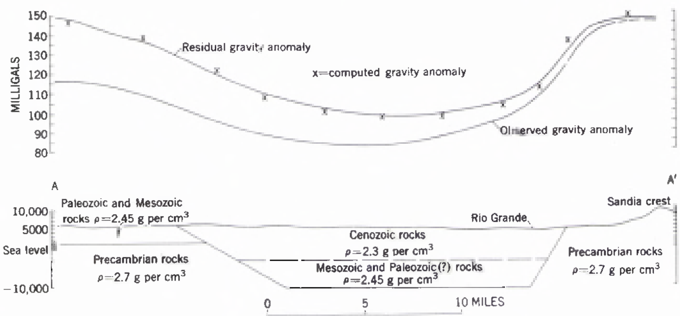

Figure 3.—An interpretation of the gravity anomaly across the Rio Grande trough north of Albuquerque, New Mexico.

linear regional gradient. The density of the Cenozoic fill probably increases with depth, but the depth at which this becomes significant is unknown. The assigned density of the Mesozoic and Paleozoic rocks (2.45 g per cm^3) may be somewhat low, especially for the deeply buried rocks in the trough.

Based on densities shown on Figure 3, the total thickness of sedimentary rocks in the trough is about 15,000 feet, and the total relief of the Precambrian basement along the Sandia front is about 20,000 feet. These values are approximations only, as they depend in part on estimated rock densities. Single fault planes were assumed along the margins of the trough, although displacement probably occurred along many steeply dipping step faults.

Aeromagnetic profiles.—Aeromagnetic profiles across the Rio Grande trough are shown on Figure 4. The large magnetic highs are associated with the uplifted, comparatively magnetic crystalline rocks bordering the trough; smaller, local highs are associated with volcanic rocks. The sedimentary rocks are virtually nonmagnetic. In general, the profiles and gravity map are in agreement.

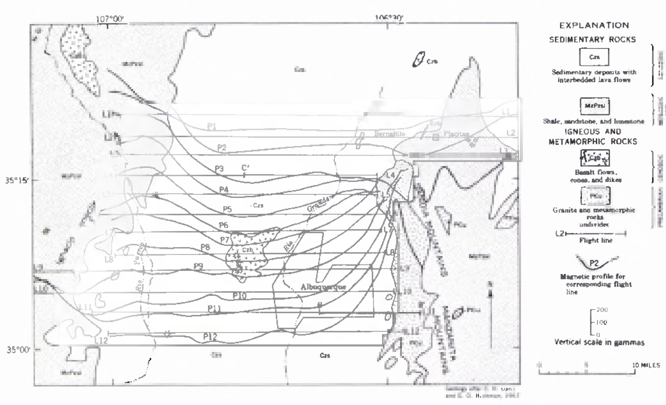

Figure 4.—Magnetic profiles, flight lines, and generalized geologic map of Rio Grande area near Albuquerque, New Mexico.

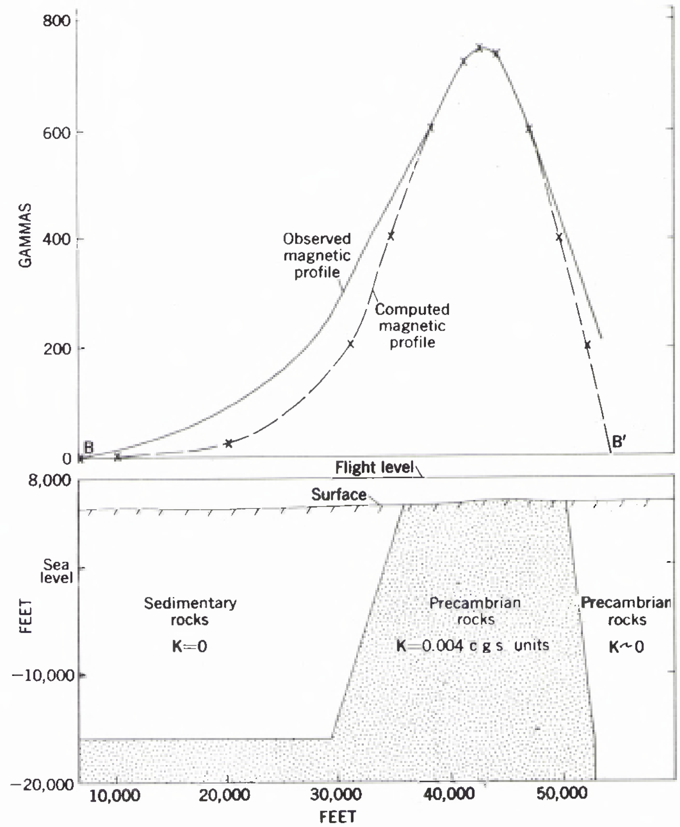

Figure 5.—An interpretation of the magnetic anomaly across the eastern boundary of the Rio Grande trough, southeast of Albuquerque, New Mexico.

The magnetic anomalies are related to variations in both the magnetization and uplift of the Precambrian rocks. For example, the magnetic susceptibility of the eastern part of the exposed Precambrian rocks near Albuquerque is quite low, whereas along the western edge it is moderately high (about 0.004 cgs units). The remanent magnetization is generally low throughout. The magnetic contrast is reflected in the peak and the sharp eastward decrease of profiles 11 and 12. The profiles also show that the more magnetic rocks continue westward some 2 miles from the mountains under outwash material. The main fault zone near Albuquerque therefore coincides approximately with the Hubble Springs fault (shown on Figure 2).

At the north end of the Sandia uplift the smaller amplitude of the profiles is probably related primarily to lower magnetization of the Precambrian rocks. Still farther north they reflect the apparent right-lateral offset of the Rio Grande trough, which is shown more clearly by the gravity contours.

At the west ends of lines 9 to 12 there is little magnetic expression of the buried structural boundary of the trough. The small anomalies on profiles 10 and 12, southwest of the large area of volcanic rock, agree in position with the bordering gravity anomalies, but they may be caused by shallow volcanic rocks rather than displacement of the basement. Volcanoes, however, are commonly alined along the borders of the trough. North of line 9 the basement rocks are more magnetic and appear to

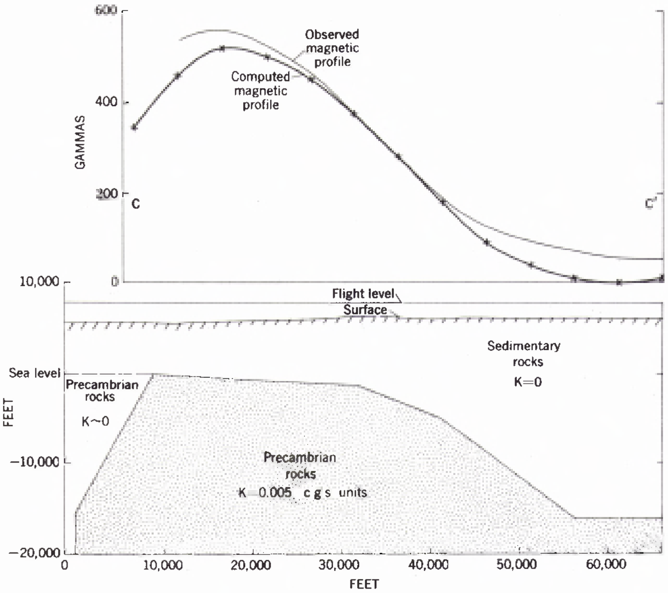

Figure 6.—An interpretation of the magnetic anomaly across the western boundary of the Rio Grande trough, northwest of Albuquerque, New Mexico.

delineate clearly the western edge of the trough. The fault zone is probably defined by the inflection points on the profiles.

Analyses of two aeromagnetic profiles based on the polar chart of Pirson (1935) are shown on Figures 5 and 6. The shapes and magnetic susceptibilities of the Precambrian rocks were arbitrarily chosen so that the computed and observed effects are in reasonable agreement. Reasonable fits were obtained when the Precambrian rock in the trough was placed at -16,000 feet, sea level datum. Assuming a lesser depth would have required flattening of the fault planes, or assigning more than one susceptibility. On Figure 5 the departure of computed and observed profiles along their west flank indicates that either the susceptibility of the down-faulted basement increases westward, or the slope of the fault decreases, perhaps step-fashion. The indicated displacement of the basement is nearly 22,000 feet along the Sandia front, and 16,000 feet on the west side. These estimates are in reasonable agreement with those based on gravity interpretations; but the correctness of both depends on the degree of correctness of the assigned magnetic susceptibilities and densities.

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