the Paleozoic rocks, continues westward across the range, and is offset by the Crescent fault; still farther west, it crosses the Shoshone Range at Wilson Pass. The outcrops of Paleozoic rocks at the head of Grass Valley, on the projected trace of the Copper fault, show that a fault must be concealed there beneath the alluvium, for the thick body of volcanics all disappears within a mile and a half. Gravity surveys by the Geological Survey in this place also indicate a major break. Since the volcanics are missing on the upthrown sides of both the Wenban fault and the Copper fault, the throw of each of these faults must have been more than 8,000 feet.

The Crescent fault cuts and repeats the entire volcanic sequence, crosses Grass Valley, and marks the northwest boundary of the Cortez Range. Gravity measurements and displacement of basalt sheets in the Shoshone and Cortez Ranges indicate that it has a throw of more than 10,000 feet along a 60 degree dipping surface. The accordance of the range front with the Crescent fault and the many scarplets in the alluvium show that this fault and a branch of it, the Cortez fault, are still active.

The interbedded gravels that pinch out and become finer grained away from the faults are probably fans deposited at the feet of active scarps. The east-trending Wenban and Copper faults thus appear to have bounded a linear trough, or volcano-tectonic depression (Williams, 1941, p. 246), that was actively sinking during the deposition of the volcanics, probably in Oligocene time.

The extreme lenticularity of the individual units in the welded tuff here described, and their extraordinary total thickness and absence from the surrounding area, are evidence of their having been deposited originally in a local basin. That is, they are not remnants of a formerly extensive cover preserved in a graben. Other deposits of welded tuff in eastern Nevada and western Utah (Cook, 1957; Mackin, 1960) are very thin and very widespread, and they must have been deposited in a manner analogous to flood or plateau basalts in contrast to the local tectonic basin fills described here. Much later, probably during Pliocene and Pleistocene time, the Crescent and Cortez faults blocked out the present basin ranges almost at right angles to the earlier fault system.

REFERENCES

Cook, E. F., 1957, Geology of the Pine Valley Mountains, Utah: Utah Geol. Mineralog. Survey Bull. 58, 111 p.

Fenner, C. N., 1923, The origin and mode of emplacement of the great tuff deposit in the Valley of Ten Thousand Smokes: Natl. Geog. Soc. Contr. Techn. Papers, Katmai ser., no. 1, 74 p.

Mackin, J. H., 1960, Structural significance of Tertiary volcanic rocks in southwestern Utah: Am. Jour. Sci., v. 258, no. 2, p. 81–131.

Marshall, P., 1935, Acid rocks of the Taupo-Rotorua volcanic district: Royal Soc. New Zealand Trans., v. 64, p. 323–366.

Nockolds, S. R., 1954, Average chemical compositions of some igneous rocks: Geol. Soc. America Bull., v. 65, no. 10, p. 1007–1032.

Roberts, R. J., Hotz, P. E., Gilluly, James, and Ferguson, H. G., 1958, Paleozoic rocks of north-central Nevada: Am. Assoc. Petroleum Geologists Bull., v. 42, no. 12, p. 2813–2857.

Williams, Howel, 1941, Calderas and their origin: California Univ. Dept. Geol. Sci. Bull., v. 25, no. 6, p. 239–346.

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130. REGIONAL GRAVITY SURVEY OF PART OF THE BASIN AND RANGE PROVINCE

By Don R. Mabey, Menlo Park, Calif.

For several years the U.S. Geological Survey has been conducting gravity studies in the Basin and Range province in Utah, Nevada, and California. Gravity measurements have been made to determine local structure in several areas where geologic mapping was going on; these surveys, however, cover only a small part of the total area. In the areas not covered by the local surveys, gravity observations have been made at bench marks, at triangulation stations, and along major highways. All the gravity data collected by the Survey have been tied to a common datum through a network of base stations. This network is referred to four airport base stations established by Woollard (1958).

The data thus collected have been useful in studying the structural geology in the basins and in parts of some of the mountain ranges. Over most of the region the dominant local Bouguer gravity anomalies are produced by the density contrast between the pre-Tertiary rocks and the generally less dense younger volcanic and sedimentary rocks. These local anomalies, which have amplitudes up to 60 milligals, are usually

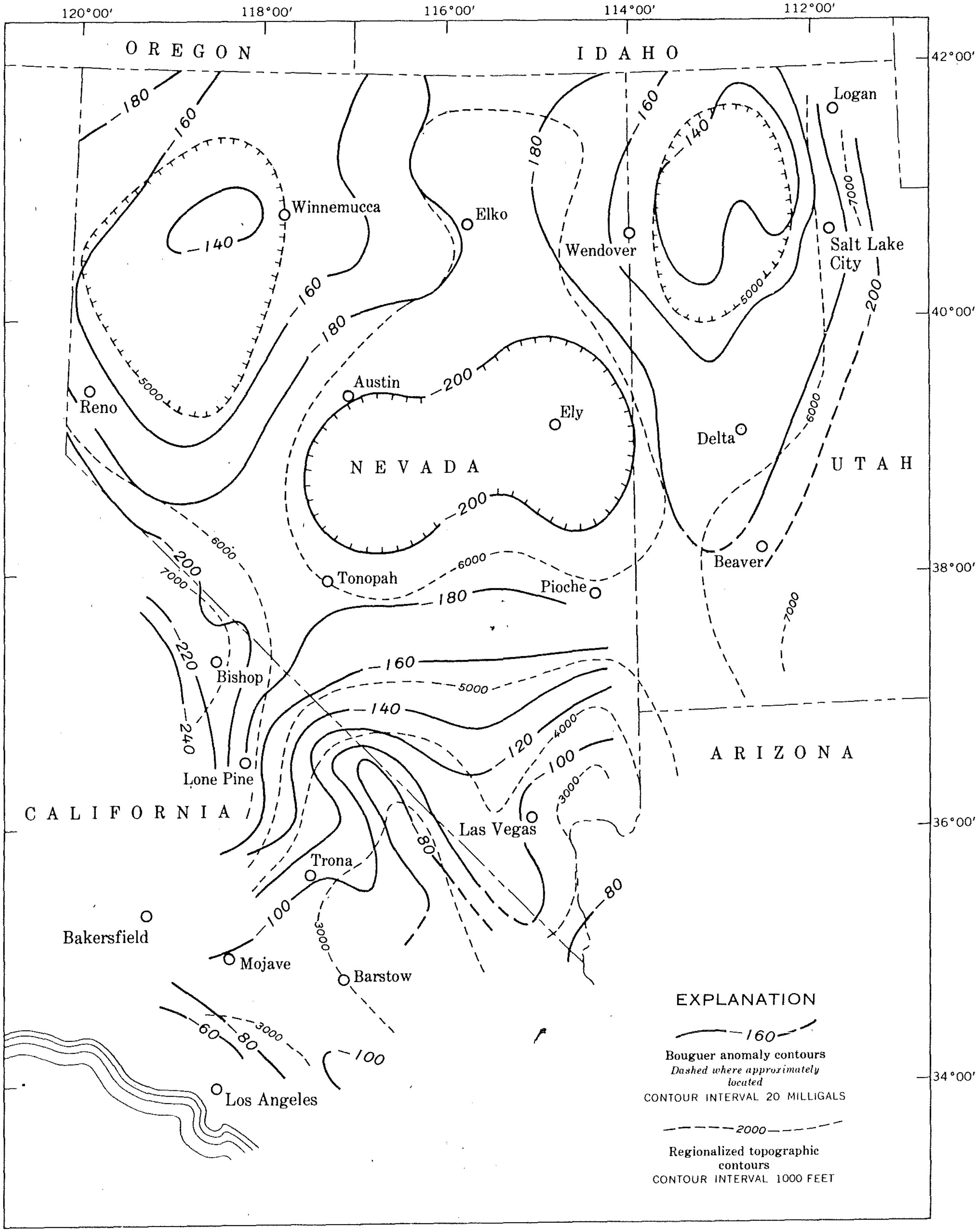

FIGURE 130.1.—Regionalized Bouguer anomaly and topographic map of part of the Basin and Range province. The gravity contours are based on representative stations in the ranges. The topography is averaged over circles 128 km in diameter. The gravity data are from surveys made under the supervision of K. L. Cook, R. W. Decker, D. L. Healey, M. F. Kane, D. R. Mabey, L. C. Pakiser, S. W. Stewart, and G. A. Thompson.

located in basin areas underlain by thick accumulations of Tertiary rocks and valley fill. They can be interpreted in terms of the thickness of the low-density rocks and the configuration of the basins in which they occur. The local anomalies associated with density contrasts within the pre-Tertiary rocks are generally of smaller amplitude, but significant local anomalies associated with bedrock features have been observed.

A knowledge of the broad regional variations in Bouguer anomaly values is of great use in the study of the large-scale variations in the thickness and composition of the crust. It is also helpful in isolating the local gravity anomalies superimposed on the regional variations. In the Basin and Range province the preparation of a contour map to illustrate the regional gravity anomalies is complicated by numerous local anomalies of large amplitude. The anomaly value for an individual gravity station may not be even approximately representative of the anomaly values over an area of even a few square miles, particularly if the station is near the margin of a basin underlain by several thousand feet of low density Cenozoic rocks. To prepare an anomaly map that will show the regional gravity anomalies some method of averaging values or selecting stations must be used. The map in figure 130.1 was prepared by contouring the anomaly values for representative stations located in the ranges.

The regional Bouguer anomaly values range from about −60 milligals to −240 milligals, and show an inverse correlation with the regional topography. The highest anomaly values are at the southwest edge of the map. Here the anomaly values rise abruptly where the regional elevation decreases toward the Pacific Ocean. Over the western Mojave Desert, where the surface relief is small, the regional gravity relief is small. North of the western Mojave Desert the anomaly values decrease as the surface rises to a high over the Sierra Nevada and White Mountains. Relatively high anomaly values occur in topographically low areas around Death Valley and the Colorado River. Northward from these areas the general level of the surface rises and the anomaly values decrease. In east-central Nevada the surface is higher, and the Bouguer anomaly values are lower than in any other part of the State.

Along the west-central border of Nevada the anomaly values decrease as the surface rises toward the Sierra Nevada. In northwestern Nevada the main gravity feature is a high, which is in the topographic low containing the Smoke Creek and Black Rock Deserts, Desert Valley, the lower Humboldt River valley, and the Carson Sink. Northwest of this area the anomaly values decrease over a topographic highland. A strip in which gravity is low and the surface is high extends northward from the Ely area to the Idaho-Nevada State line. East of this low trend there is a gravity high in the Lake Bonneville basin. East of the Lake Bonneville basin the anomaly values are lower over the Wasatch Range.

The correlation between low Bouguer anomaly values and high regional topography clearly shows that there is a relative mass deficiency under the regional highlands. Although the gravity data do not indicate the nature of the mass deficiency, which can occur anywhere within the crust or in the upper mantle, the correlation with topography suggests that some form of regional isostatic compensation exists.

REFERENCE

Woollard, G. P., 1958, Results for a gravity control network at airports in the United States: Geophysics, v. 23, no. 3, p. 520–536.

131. MESOZOIC AGE OF ROOF PENDANTS IN WEST-CENTRAL NEVADA

By James G. Moore, Menlo Park, Calif.

Work done in cooperation with the Nevada Bureau of Mines

In an area of roughly 3,000 square miles in the western Great Basin, lying mainly in Lyon, Douglas, and Ormsby Counties, Nev. (fig. 131.1), about 430 square miles are underlain by Cretaceous(?) intrusive rocks, largely granitic, related to the Sierra Nevada batholith, and about 180 square miles by partly metamorphosed rocks older than the batholith. The metamorphic rocks occur in irregular roof pendants and septa, which have