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187. GRAVITY AND MAGNETIC ANOMALIES IN THE NORTHERN OQUIRRH MOUNTAINS, UTAH

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The northern Oquirrh Mountains (fig. 187.1), about 20 miles west of Salt Lake City, Utah, extend from the vicinity of the Utah Copper mine at Bingham to Great Salt Lake. Several peaks in the northern part of the range reach 9,000 feet above sea level, about 4,500 feet above the surrounding valleys.

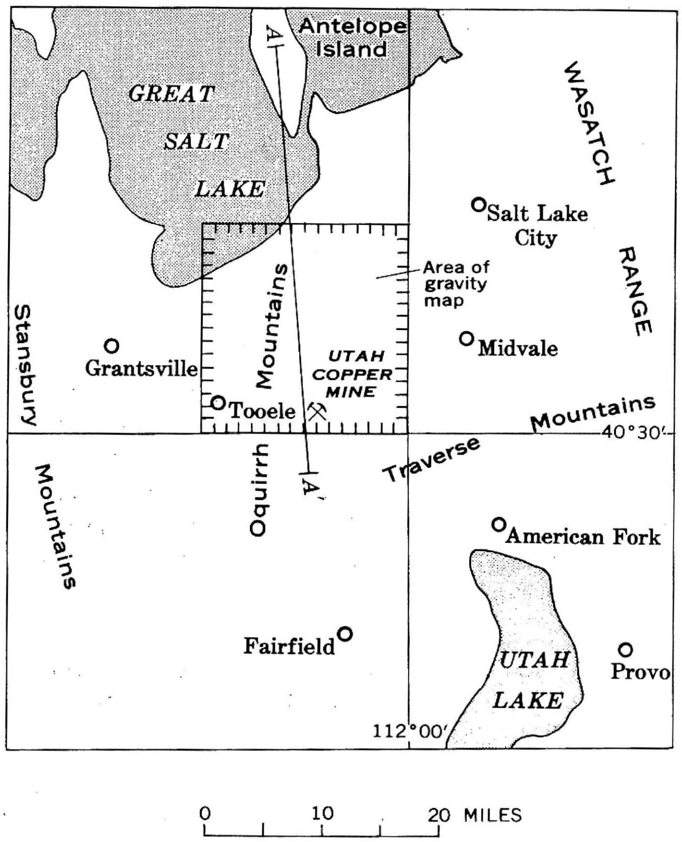

Figure 187.1.—Index map of part of north-central Utah showing area of gravity map (fig. 187.2). *A–A′*, generalized location of gravity and magnetic profiles shown in figure 187.3.

The northern Oquirrh Mountains are composed mostly of sedimentary rocks of Mississippian to Permian age. Small intrusive bodies cut these rocks near Bingham; sedimentary and volcanic rocks of Tertiary age crop out on the east side of the range.

The rocks at the north end of the range (Tooker and Roberts, 1961) and their correlatives in the Bingham area (Welsh and James, 1961) are now recognized as two different sequences that are juxtaposed along the North Oquirrh thrust fault (Art. 188). The thrust fault dips north and strikes east across the range south of Nelson Peak. The upper plate is composed of rocks assigned to the Rogers Canyon sequence, which is about 10,000 feet thick. Rocks in this sequence are folded along northeast-trending axes and are complexly faulted. The plate is broken into two blocks by a major north-trending tear fault, the Garfield fault. The lower plate of the North Oquirrh thrust is composed of rocks assigned to the Bingham sequence, which is about 21,000 feet thick. These rocks are folded along northwest-trending axes and at Bingham are intruded by granitic stocks. This sequence is correlated with rocks in the upper plate of the Charleston thrust, which is exposed in the Wasatch Range and assumed to underlie this area.

Antelope Island, about 8 miles north of the Oquirrh Mountains and on the projected trend of the range, is largely composed of metamorphosed Precambrian and Cambrian rocks which Crittenden (1961) believes are authochthonous.

GRAVITY DATA

Only a few measured densities are available for rocks exposed in the Oquirrh Mountains and on Antelope Island and concealed at depth. The average density of nine representative samples of Paleozoic rock in the Oquirrh Mountains is 2.65 g per cm^3 No important density difference was measured for the two sequences of Mississippian, Pennsylvanian, and Permian rocks. The average density of the Precambrian rocks cropping out on Antelope Island and in the Wasatch Range has not been accurately determined but is estimated to be about 2.85 g per cm^3, on the basis of measurements made on 2 of the more abundant rock types and on densities estimated from descriptions of other units.

A gravity map of the valleys west and north of the Oquirrh Mountains by Cook and Berg (1961), which suggested that a major gravity anomaly exists in the range, has been supplemented by additional gravity stations within the Oquirrh Mountains and in the valley on the west side of the range. These gravity data are reduced to the Bouguer anomaly assuming the standard density of 2.67 g per cm^3 for the material in the range. Terrain corrections were made through zone N on the Hayford charts. These new data and those of Cook and Berg are compiled in figure 187.2 and contoured at a 5-mgal interval.

The Bouguer anomaly values include corrections for large elevation differences and terrain effects, but uncertainties in these corrections are introduced by possible deviations from the assumed rock density

(2.67 g cm ³) used to make elevation corrections and from errors in making terrain correction. A density change of 0.03 g per cm ³ would change the Bouguer anomaly difference between the highest and lowest station by a factor of about 2 mgals. The largest terrain correction is about 45 mgals, but most are much smaller. The maximum error for these corrections is about 10 percent, thus the maximum error in the Bouguer anomaly values could be about 7 mgals; however, most of the stations are believed accurate to about 2.5 mgals, or one-half the contour interval on figure 187.2.

Bouguer anomaly values show two features of special interest: (1) a marked increase of values north of the surface trace of the North Oquirrh thrust, and (2) higher values west of the Garfield fault. Values are nearly constant south of the North Oquirrh thrust, varying over a range of 5 mgals. At the north end of the range the values decrease toward a gravity low over Quaternary sediments beneath Great Salt Lake.

The anomaly values on the south end of Antelope Island (Cook and Berg, 1961) are about 18 mgals higher than the highest values found in the Oquirrh Mountains (fig. 187.3) and increase northward to the north end of the island. If a correction is made for the Quaternary sediments, the anomaly values continue to rise northward over the interval between the Oquirrh Mountains and Antelope Island. The total Bouguer anomaly difference between the Oquirrh Range south of Nelson Peak and the highest values on Antelope Island is about 45 mgals (fig. 187.3). Anomalies of this amplitude over pre-Tertiary rocks in the Basin and Range province are usually associated with regional topographic features and are believed to indicate isostatic compensation for regional topography; they generally are not associated with individual ranges as narrow as the Oquirrh Mountains (Mabey, 1960).

A major discontinuity in regional topography occurs along a west-trending line at the north ends of the Oquirrh and Stansbury Mountains. The eleva-

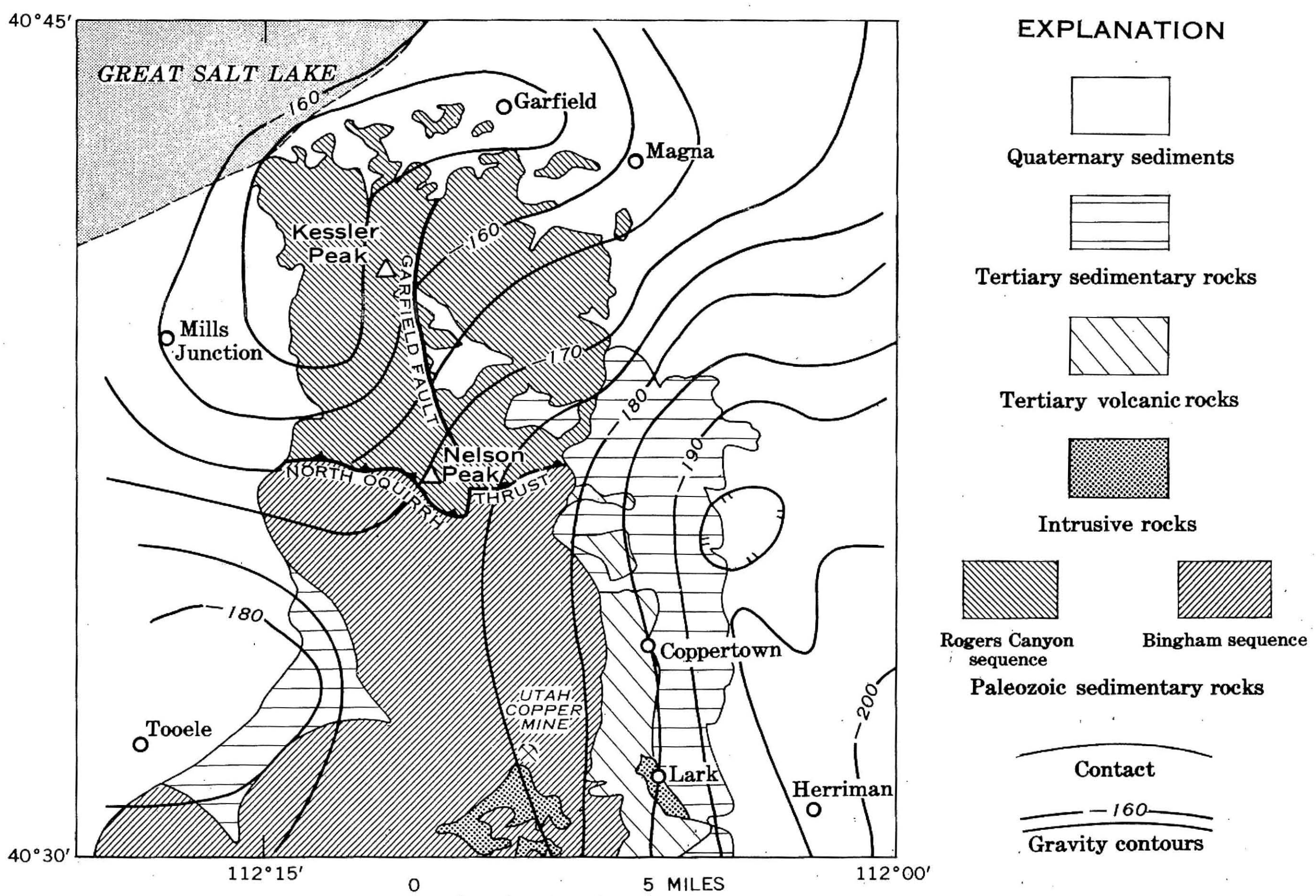

FIGURE 187.2.—Bouguer gravity anomaly map of the northern part of Oquirrh Mountains, Utah; contour interval 5 mgals. Gravity data are partly from Cook and Berg (1961). Geology modified from Cook (1961).

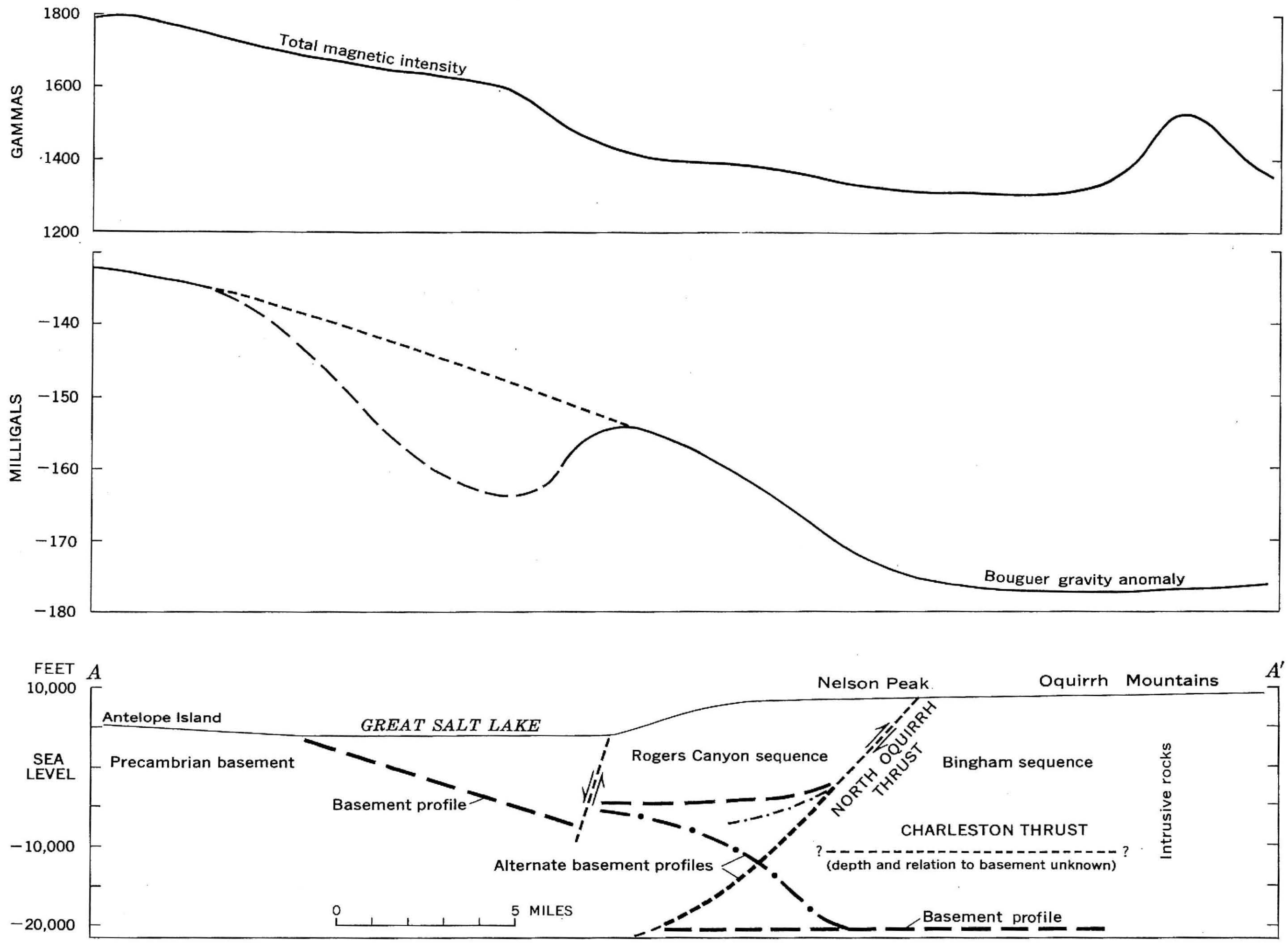

FIGURE 187.3.—Magnetic and gravity profiles from Antelope Island to the central Oquirrh Mountains with diagrammatic section showing generalized topography and inferred structure.

tion of the ranges and adjoining valley floors increases southward, and near the highest parts of the two ranges a small east-trending range nearly connects the two. The result is a west-trending regional topographic arch about 40 miles wide close to the westward projection of the axis of the Uinta arch. This regional topographic arch is superimposed on a more general southward rise in the regional elevations.

A part, but not all, of the gravity difference between the Oquirrh Mountains and Antelope Island undoubtedly reflects isostatic compensation of the regional topography, but the amount of the gravity difference that is attributed to the topography is dependent upon the type of compensation that is assumed. If a major part of the gravity difference is related directly to regional topography, it probably indicates adjustment for mass anomalies in the upper crust. This would require relatively local compensation but would be consistent with the indicated isostatic response to changes of the water depth in Lake Bonneville as reported by Gilbert (1890, p. 365–392).

The south edge of the gravity high in the Oquirrh Mountains coincides with the trace of the North Oquirrh thrust (fig. 187.3). Because no significant density contrast exists between the rock exposed at the surface along this thrust, the mass anomaly producing the gravity anomaly presumably involves a density interface at depth, such as the surface of the basement rock. The gravity data suggest that the basement rock north of the trace of the North Oquirrh thrust is closer to the surface than it is south of the thrust. The gravity anomaly increases northward to Antelope Island, reflecting a thinning wedge of sedimentary rocks under the north end of the Oquirrh Mountains and Great Salt Lake.

Alternate basement profiles that are consistent with the available gravity data are illustrated in the diagrammatic section in figure 187.3. One profile (shown by dashes) assumes that the gravity anomaly in the Nelson Peak area is produced by a displacement of the basement rock on the North Oquirrh thrust. The alternate profile (shown by dots and dashes) assumes that the North Oquirrh thrust does not penetrate basement rock and is unrelated, or perhaps indirectly related, to the gravity anomaly and the inferred relief on the basement rock. If a density contrast of 0.15 g per cm ^{3}, which is a reasonable estimate, exists between the Precambrian basement rock and the younger sedimentary rocks, the total gravity difference between the south end of Antelope Island and the Oquirrh Mountains south of Nelson Peak can be produced by about 25,000 feet of sedimentary rocks overlying the basement south of Nelson Peak.

The Garfield fault, which has been interpreted by Roberts and Tooker (1961, p. 36–45) as a tear fault, is also reflected in the gravity contours. Just north of the North Oquirrh thrust near Nelson Peak the anomaly values are higher on the west side of the fault. This gravity expression decreases northward, and is not apparent at the north end of the range. The gravity difference across the Garfield fault suggests upward displacement of the basement rocks, placing them several thousand feet higher on the west side of the fault. The mechanism of this displacement is not clear, but, if the North Oquirrh thrust penetrates basement rocks in this area, lateral movement on the Garfield tear fault could produce apparent vertical displacement of the basement surface.

MAGNETIC DATA

A magnetic profile (fig. 187.3) constructed from a regional aeromagnetic contour map of the region shows a magnetic anomaly at the south end of the profile produced by some of the post-Paleozoic intrusive rocks in the Bingham area. From this anomaly to the north end of the range the magnetic intensity increases northward at a normal rate. The absence of any magnetic anomaly essentially eliminates the possibility that concealed intrusive bodies may account for the gravity anomaly underlying the north end of the range. The magnetic gradient immediately north of the Oquirrh Mountains is probably produced by a contrast in magnetic properties in the basement rock.

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