# Gravity and Magnetic Anomalies in the Ely Quadrangle, Nevada, and Anomalies related to Granitic Plutons

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Gravity and magnetic anomalies of the Ely quadrangle, Nev., reveal structural information and help to define the extent of known, as well as inferred, plutons. Data from over 4,000 gravity stations were compiled (Ponce and others, 1984) and used to prepare complete Bouguer and isostatic gravity maps of the Ely quadrangle. Data from about 400 of these stations were recently collected by the U.S. Geological Survey. Data from about 500 gravity stations include manually estimated inner-zone and computer-calculated outer-zone terrain correctons, while the remaining data only include computer-calculated terrain corrections. Complete Bouguer gravity anomalies were reduced for a density of 2.67 g/cm$^3$ and terrain-corrected to a radial distance of 167 km. Isostatic gravity anomalies were computed to remove long-wavelength variations of the gravity field using an assumed upper-crust density of 2.67 g/cm$^3$, a crustal thickness of 25 km, and a density contrast between the lower crust and upper mantle of 0.4 g/cm$^3$. A regional total-intensity aeromagnetic map of the Ely quadrangle was compiled and merged from surveys available in digital form and downward continued, as necessary, to 305 m (1,000 ft) above the ground (Hildenbrand and Kucks, 1988).

The isostatic gravity map of the Ely quadrangle (Fig. 1) shows the lowest gravity values over thick alluvial

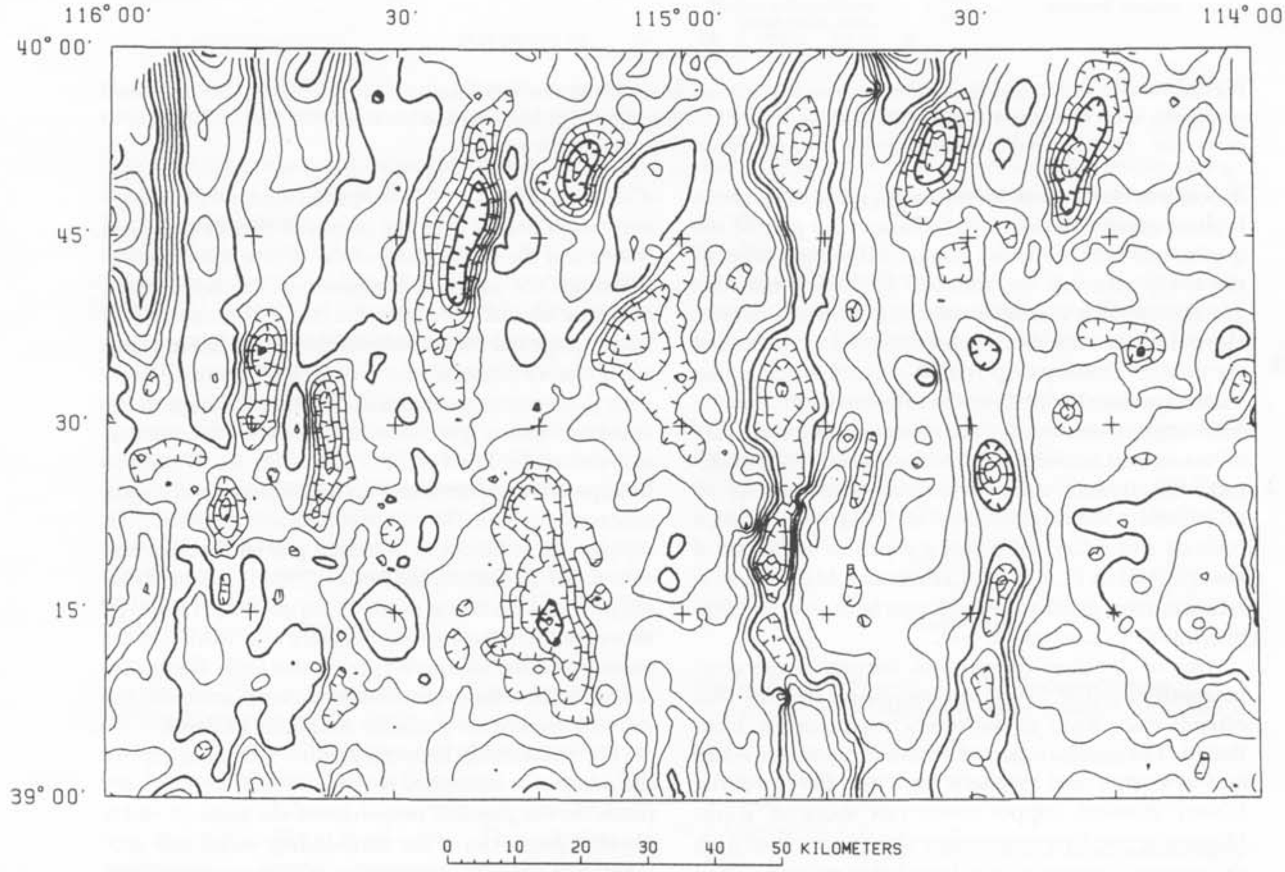


Fig. 1. Isostatic gravity map of the Ely quadrangle with an assumed upper-crust density of 2.67 g/cm$^3$, a crustal thickness of 25 km, and a density contrast between the lower crust and upper mantle of 0.4 g/cm$^3$. Contour interval 5 mGal. Hachures indicate gravity lows. See Figure 3 for geographic locations.

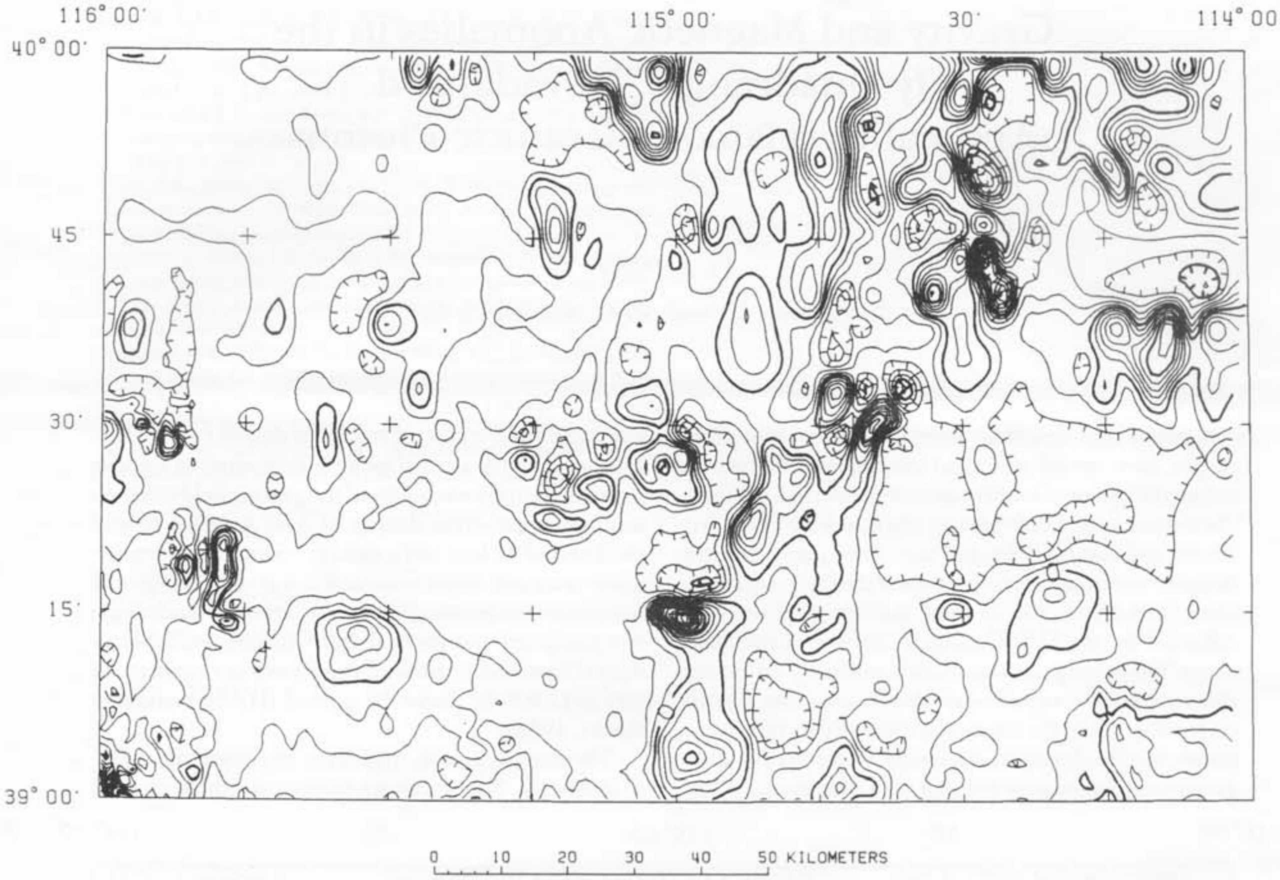


Fig. 2. Aeromagnetic map of the Ely quadrangle compiled from surveys that were available in digital form and downward continued, as necessary, to 305 m (1,000 ft) above ground. Modified from Hildenbrand and Kucks (1988). Contour interval 40 nanoteslas. Hachures indicate aeromagnetic lows. See Figure 3 for geographic locations.

deposits in the Steptoe Valley northeast of Ely and the highest gravity values in the southeastern part of the quadrangle over the Snake Range. All major valleys in the study area are characterized by high amplitude gravity lows that generally reflect intermediate to deep alluvial basins. One of the most conspicuous features of the isostatic gravity map is a 30-mGal low in Steptoe Valley, just south of McGill. On a regional scale, it is one of the highest-amplitude gravity lows in the eastern part of Nevada and extends for a distance of about 135 km (85 mi). Calculations using an anomaly amplitude of 30 mGal and a density contrast of 0.4 $g/cm^3$ between bedrock and valley fill yields a depth to basement of about 2,300 m (7,500 ft). Carlson and Mabey (1963) estimated that depth to bedrock may be as great as 3,000 m (10,000 ft) south of McGill.

One of the most conspicuous features of the aeromagnetic map (Fig. 2) is a large-amplitude anomaly that extends from Ruth to the southern part of the Egan Range. The northern part of the anomaly is characterized by a large local magnetic high near the site of the Liberty open-pit copper mine, just south of Ruth. Monzonite porphyry outcrops are closely associated with the magnetic anomaly, which probably reflects a large granitic mass concealed at shallow to intermediate depth (Carlson and Mabey, 1963). Another conspicuous magnetic high occurs over the southern part of the Egan Range and the eastern part of the White River Valley. Although the range is composed of Paleozoic rocks, magnetic anomalies suggest that the southern part of the Egan Range and the east edge of the White River Valley are probably underlain by a concealed intrusive body with moderate magnetization. A structural high in the Paleozoic rocks, geochemical anomalies (anomalous amounts of Ag, Hg, Cu, Pb, Zn, Mo, Sb, As, W, and Sn in jasperoid and iron-rich fracture fillings), and quartz monzonite dikes in the vicinity of the aeromagnetic high support the existence of a buried pluton (Brokaw and others, 1962). Carlson and Mabey (1963) estimated that the intrusive mass is at an elevation of 900 m (3,000 ft) above sea level. Because the anomaly near Ruth and the anomaly in the southern part of the Egan Range are connected by a large-amplitude magnetic anomaly, the inferred plutons are probably connected at depth.

The relationship between granitic rocks and gravity and magnetic anomalies is complex and, in part, depends on the physical properties of the granitic rocks, physical properties of the surrounding rocks, and geologic structure. Interpretation of aeromagnetic data combined with gravity and geologic data is particularly

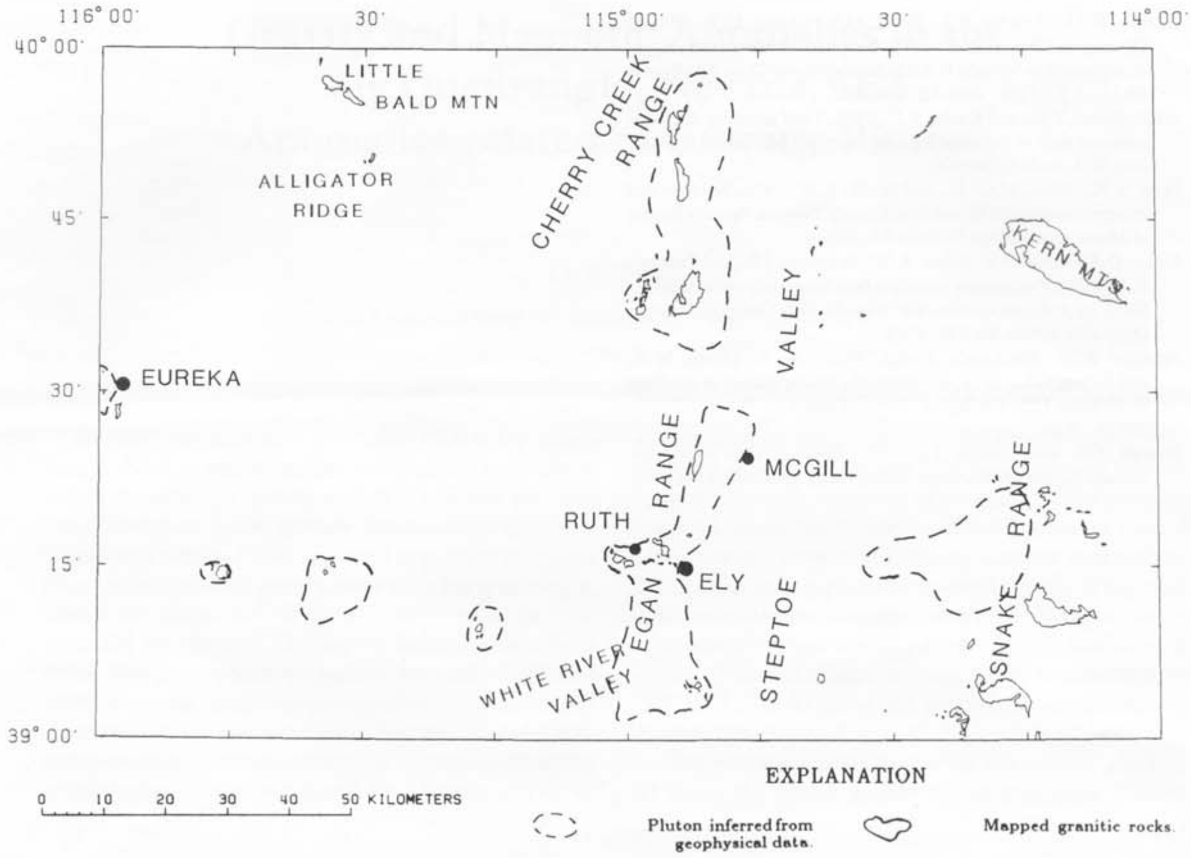


Fig. 3. Mapped granitic rocks (modified from Hose and others, 1976; Stewart and Carlson, 1977; and Spengler and others, 1979) and inferred granitic pluton boundaries based on geophysical data (modified from Grauch and others, 1988).

useful for delineating the extent of known, as well as, inferred plutons in Nevada (Grauch and others, 1988). The extent of a pluton can be inferred from aeromagnetic data by first transforming the magnetic field into the equivalent gravity field (pseudogravity transformation) that would be observed assuming a density distribution proportional to the magnetization distribution and then by determining the maximum horizontal gradient of the pseudogravity anomalies (Blakely and Simpson, 1986). Because maximum horizontal gradients of gravity anomalies overlie the edges of shallow bodies, they can be a useful tool for locating the edges of magnetic sources from transformed magnetic-anomaly data.

Except for weakly magnetic rocks in the eastern part of the study area, inferred boundaries of granitic plutons correlate well with mapped granitic rocks (Fig. 3). The weakly magnetic plutonic rocks are of Jurassic and Cretaceous age and are chiefly composed of quartz monzonite. They include a two-mica granite exposed in the northern part of the Snake Range and a granitic pluton in the Kern Mountains, one of the largest intrusive bodies in eastern Nevada (Hose and others, 1976). Intrusive rocks of Lower Cretaceous age span an east-west region from Ely to Eureka, Nev. These plutons are moderately to strongly magnetic, and aeromagnetic data are particularly useful in delineating their horizontal extent. Plutons of Tertiary age have variable aeromagnetic expressions. Tertiary plutons in the eastern part of the Cherry Creek Range are relatively magnetic and their horizontal extent can be inferred from aeromagnetic data, whereas two Tertiary plutons in the northwestern part of the study area, one at Alligator Ridge and the other at Little Bald Mountain, have little or no aeromagnetic expression. Near Ruth, pluton edges inferred from aeromagnetic data indicate that this area may be underlain by a pluton that extends from the southern part of the Egan Range almost to McGill. Similarly, aeromagnetic anomalies indicate that the northern part of the Egan Range and the Cherry Creek Range may be underlain by a large pluton.

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