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CHAPTER B

# BASEMENT STRUCTURE IN THE RAILROAD VALLEY–GRANT RANGE REGION, EAST-CENTRAL NEVADA, FROM INTERPRETATION OF POTENTIAL-FIELD ANOMALIES

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Regional gravity and aeromagnetic anomaly maps are widely used to delineate first-order structural features expressed by marked density and magnetization contrasts. In east-central Nevada and elsewhere in the miogeoclinal domain of the Basin and Range extensional province, the gravity method is especially effective for distinguishing areas where the bedrock is veneered by pediment gravels (or by Cenozoic volcanic and volcaniclastic rocks) from areas underlain by relatively thick, low-density valley fill. The density "basement" is generally rock of the miogeoclinal carbonate succession or Mesozoic and Cenozoic intrusive rock. The aeromagnetic method, on the other hand, detects magnetic crystalline rock beneath the nonmagnetic carbonates. This "basement" may be either Phanerozoic intrusives or the Precambrian igneous-metamorphic complex. Signatures of strongly magnetic volcanic rocks of the Cenozoic section are typically distinguished by their shorter spatial wavelengths, which result from greater proximity to the detector and lesser depth extent.

The original objective of recent U.S. Geological Survey (USGS) gravity and aeromagnetic investigations in east-central Nevada was to aid in mineral resource assessment of Bureau of Land Management Wilderness Study Areas. Later, the scope of investigation was expanded to include a study of the structural framework of sedimentary basins with known or potential hydrocarbon deposits. Studies of basement structure in the Railroad Valley–Grant Range region (fig. 1) focus on both objectives and involve integration of potential-field, seismic, drilling, and geologic-map data. Railroad Valley has a strike length of nearly 175 km, with an average north-northeasterly trend. Its maximum width of about 25 km occurs where it is flanked on the east by the Grant Range. This central sector is the locus of oil production in the valley. The nearby Troy district, in the southern Grant Range, achieved prominence in the past as a producer of gold, silver, and tungsten.

Figure 2 shows the complete-Bouguer gravity anomaly field of the Railroad Valley–Grant Range region. The color interval on the map is 2 milligals (mGal), and the absolute anomaly level at Currant is –210 mGal. Primary gravity data were obtained from files of the National Center for Geophysical and Solar-Terrestrial Data (Boulder, Colorado 80303), supplemented by several dozen stations recorded by the USGS in conjunction with current programs. A reduction density of 2.67 g/cm$^3$ was employed, and all stations have been terrain-corrected out to a radius of 167 km (see Cordell and others, 1982, for a description of standard USGS gravity-reduction procedures). Stratiform geologic units shown on the figure are: Paleozoic sedimentary rocks, chiefly miogeoclinal carbonates (Pz), Tertiary volcanic and sedimentary rocks (T), and Quaternary surficial deposits (Qa). Granitic intrusive rocks of Cretaceous and Tertiary age (KTi) are represented by a diagonal pattern; the largest such body exposed is the Troy pluton. Also shown is the Shell No. 1 discovery hole in Railroad Valley, which intersected quartz monzonite at a depth of 10,330 ft (3.15 km). Quartz monzonite has been intersected in several other drill holes at shallower depths in the valley.

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**Figure 3.** Residual aeromagnetic total-field intensity map of Railroad Valley–Grant Range region, east-central Nevada. Color interval 10 nT. Symbols are the same as for figure 2.

gravity gradients, which nearly bisects it. Therefore, the range-front fault must be listric with respect to, or terminate at, a low-angle structure at or near the surface of the magnetic body. This structure may be the low-angle normal fault north of the Troy pluton that is interpreted from seismic data. Mississippian Chainman Shale, a source rock for the hydrocarbons (Barker and Peterson, 1991), could locally have served as the zone of detachment. The question of whether the low-angle fault passes beneath the Grant Range at depth or connects with a low-angle fault exposed on the west side of the Grant Range (as inferred by Lund and others, 1991, and Potter and others, 1991) is not likely to be resolved from the potential-field data.

Because no strongly magnetic Paleozoic or Late Proterozoic strata are known from geologic mapping in the region, possible sources of the broad aeromagnetic anomaly are limited to the Precambrian igneous-metamorphic crystalline basement complex and Phanerozoic intrusive bodies. The most likely source is considered to be a Phanerozoic granitic batholith. Granitic plutons are exposed in the southwestern White Pine Range, in the southern Grant Range, and in the northern Quinn Canyon Range, and, as noted above, quartz monzonite has been penetrated in several drill holes in Railroad Valley. All of these occurrences are spatially associated with the broad anomaly, although typical rock of the Troy pluton (two-mica granite) is known to be only very weakly magnetic (M.R. Hudson, oral commun., 1992). Potassium-argon ages for biotite of the plutons range from 23 to 36 Ma, according to Kleinhampl and Ziony (1985), who cite Schilling (1965) and Armstrong (1970). Yet a 70-Ma minimum age of crystallization has been determined for the Troy pluton by Fryxell (1988) on the basis of whole-rock Rb/Sr analysis. These apparently contradictory results can be reconciled by postulating that the aeromagnetic anomaly source is a composite body consisting of weakly magnetic granite that was emplaced during Late Cretaceous time and strongly magnetic monzonitic rock emplaced during an episode of renewed heating and magmatism in the Tertiary.

The batholith, if present, must have had a major role in the tectonic evolution of the Railroad Valley–Grant Range region. Initial emplacement would have occurred during a late stage of synkinematic regional metamorphism that is recorded in lower Paleozoic rocks of the southern Grant Range (Kleinhampl and Ziony, 1985). Renewed magmatism in Oligocene-Miocene time may have contributed to arching of the range, as well as to high heat flow in Railroad Valley. Also, a structural parallelism indicates that the batholith may have influenced the configuration of youthful extensional structures, such as the Railroad Valley graben.

Some implications of the batholith for mineral resource exploration have been discussed in detail elsewhere (Lund and others, 1987, 1988). Of special interest are the prominent anomaly crestal areas north of the Troy pluton and north of the Shell No. 1 discovery hole (fig. 3). Such highs superimposed on the broad positive anomaly could be expressions of structural relief, or locally enhanced magnetization, or both. (A third prominent high on the broad anomaly, centered 15 km west of Currant at the north edge of the map, is much more intense and sharply bounded than the other two and could be due to a buried mafic volcanic complex. Unlike the others, it has no apophysis beneath Paleozoic rocks.) If these highs are produced by intrusive rock, they flag potential loci of hydrothermal alteration and mineralization. Moreover, the gravity data strongly suggest that much of the area beneath the two aeromagnetic highs is pedimented bedrock and is therefore possibly accessible for exploitation, should mineral deposits be proved.

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