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AEROMAGNETIC AND GENERALIZED GEOLOGIC MAP OF THE AUSTIN AREA, LANDER COUNTY, NEVADA

By
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INTRODUCTION

An aeromagnetic survey of the Austin area was made as part of a geologic study of Lander County, Nev. The magnetic work was done primarily to delineate igneous rocks and to determine the relation of intrusive masses to structural features and mineral deposits. Metalliferous mineral deposits are commonly associated with intrusive rocks; therefore, knowledge of the igneous rock masses that intruded Paleozoic strata would be helpful in searching for new deposits.

The area surveyed is between lat 39°15′ N. and 39°39′ N. and long 116°52′ W. and 117°14′ W. in the southern part of Lander County, Nev., and includes the central part of the Toiyabe Range, upper Grass Valley, the northern part of Big Smoky Valley and upland to the north, and part of the Reese River Valley. Austin, the county seat of Lander County, is on the west side of the mountain range in the central part of the area. The mountains rise to altitudes of 8,000 to 11,500 feet and the bordering upland to the northeast reaches altitudes near 7,000 feet. Valley floors, about 5,500 to 6,000 feet above sea level, rise gradually toward the base of surrounding hills and mountains.

GENERAL GEOLOGY

The region is underlain by a thick sequence of intensely folded and faulted lower Paleozoic sedimentary rock that has been intruded by Jurassic igneous rock and buried in places by a thin cover of Tertiary volcanic rock. These rocks are fairly well exposed in the uplands but are concealed in the major valleys by thick deposits of late Tertiary and Quaternary gravel and silt.

The Paleozoic rock consists of Cambrian, Ordovician, Silurian, and Devonian strata that occur in several thrust plates which juxtapose strata of different facies. Three major thrust plates (lower, middle, and upper) are recognized (Stewart and McKee, 1968a, p. 3) in the Toiyabe Range south of Austin. Strata in the lower plate consist of Lower Cambrian quartzite and phyllite, Middle Cambrian to Lower Ordovician black phyllite and limestone, a Lower and Middle Ordovician massive limestone, and a Silurian platy limestone. The middle plate contains Lower Cambrian quartzite and phyllite that is similar to that in the lower plate, Middle and Upper Cambrian strata consisting mostly of light-gray limestone in contrast to the black phyllite and limestone of similar age in the lower plate, Ordovician strata composed of massive limestone and minor amounts of shale and thin-bedded limestone, and Silurian platy limestone. The upper plate in the Toiyabe Range consists of black chert and minor amounts of dark-gray shale and quartzite of probable Ordovician age and is in marked contrast to the Ordovician strata in the other two plates.

The lower and middle plates in the Toiyabe Range are separated by the Kingston Canyon thrust, a fault at present recognized only in this part of the Toiyabe Range; the middle and upper plates are separated by the Roberts Mountains thrust, which is of regional extent. Along the Roberts Mountains thrust in the central and north-central Nevada, siliceous and volcanic (western) assemblage rocks have been thrust eastward for perhaps as much as 100 miles over carbonate (eastern) or transitional assemblage rocks (Roberts and others, 1958; Gilluly and Gates, 1965; Roberts, 1960, 1966).

The Paleozoic strata have been intruded by quartz monzonite of the Austin pluton in the central and northern parts of the mountains and locally by felsic or rhyolitic rock masses of Jurassic or Tertiary age.

Andesite flows of probable Oligocene age occur in the northern and western parts of the area and are overlain by thin Oligocene and Miocene welded tuff. These volcanic rocks as well as older rocks have been cut by many north-northeast-trending high-angle faults. High-angle faults of large vertical displacement border the Toiyabe Range both on the east and west.

The magnetic properties of several samples of igneous and sedimentary rocks were determined by means of an induction bridge and a spinner magnetimeter. Samples of plutonic rock collected from 18 localities have magnetic susceptibilities ranging from 0.04×10^{-3} to 1.47×10^{-3} emu/cc. In four of these localities the granitic rock has remanent magetization intensities of 0.34×10^{-3} to 5.92×10^{-3} emu/cc. Oriented samples from six of the andesite flows and related intrusive rocks have a susceptibility range of 0.36×10^{-3} to 1.14×10^{-3} emu/cc and possess a remanent intensity ranging from 0.25×10^{-3} to 8.03×10^{-3} emu/cc. The intensity of remanent magnetization measured for six samples of welded tuff near the crest of the mountains ranges from 10.0×10^{-3} to 33.00×10^{-3} emu/cc. These samples have susceptibilities of 0.07×10^{-3} to 0.51×10^{-3} emu/cc. Data from samples of pre-Tertiary sedimentary rocks indicate that these rocks have relatively low magnetic susceptibility and negligible remanent magnetization and, as far as the interpretation of magnetic data is concerned, the sedimentary rock may be considered to be essentially nonmagnetic.

MINERAL DEPOSITS

The Toiyabe Range and adjacent areas contain a large and varied number of mineral deposits (Stewart and McKee, 1968a, p. 1–2). The richest deposits are at Austin (Reese

River district) and have a recorded production of over $18,000,000. These deposits are mainly silver-bearing veins in quartz monzonite. Other mines in the area occur (1) about 3 miles south of Austin, (2) near Birch Creek along the east side of the Toiyabe Range about 9 miles southeast of Austin, (3) near Big Creek in the western half of the Toiyabe Range from 7 to 12 miles southwest of Austin, and (4) west of the Reese River in the northwestern part of the area. In the locality south of Austin, uranium has been mined from deposits in both intrusive rock and metamorphosed and deformed Lower Cambrian sedimentary rock along the southern edge of the Austin pluton. The deposits near Birch Creek (Birch Creek district) consist of gold-, silver-, and lead-bearing veins in granitic rocks along the southern margin of the pluton and in flanking metamorphosed lower Paleozoic strata. Concentrations of beryllium, tungsten, arsenic, and molybdenum also occur in this district. The deposits near Big Creek (Big Creek district), are of antimony and occur in dark shale and chert above the Roberts Mountains thrust, in carbonate strata below the thrust, and in a silicified fault breccia along the thrust. In the upland west of Reese River (Skookum district), small silver- and gold-bearing veins cut Ordovician siliceous sedimentary rocks.

AEROMAGNETIC SURVEY

Total-intensity magnetic measurements were made with a continuously recording AN/ASQ-10 fluxgate magnetometer installed in a Convair 240 aircraft. North-south traverses about 1 mile apart were flown at an average barometric elevation of 9,000 feet above sea level. Parts of a few traverses over the southern range crest were flown at flight elevations of 11,000 and 12,000 feet. Topographic maps were used for guidance, and the flight paths were recorded by a 35-mm camera. Ground clearance ranged from less than 1,000 feet over the crest of the range to as much as 3,000 feet over the valleys.

MAGNETIC FEATURES

The magnetic pattern consists of: a zone of high magnetic intensity over the Toiyabe Range and upper reaches of Grass Valley in the northern half of the area; low-gradient anomalies over the southern part of the range; pronounced zones of low magnetic intensity over the mountains near and east of Austin and along the east flank of the range; positive anomalies of small amplitude in the north end of Big Smoky Valley and over the hills west of Reese River; and broad features that express low magnetic relief over most of the Cenozoic sedimentary deposits in the main valleys. The anomalies are superimposed on a positive northeastward regional gradient of about 9.8 gammas per mile.

INTERPRETATION

The interpretation of magnetic features is based on results of geologic mapping and general knowledge of the magnetic properties of rocks involved. Interpretation methods described by Vacquier and others (1951) were used, and depths to disturbing bodies were estimated from measurements of the horizontal extent of the steepest magnetic gradients.

The zone of high magnetic intensity over the mountains and upper Grass Valley is attributed to the Austin pluton. The zone contains magnetic maximums of 200–300 gammas that are associated mainly with quartz monzonite but are augmented in places by the magnetic response of other rocks that lie near the surface. Samples of granitic rock near the maximums contain appreciable remanent magnetization, which combined with their induced magnetism accounts for the major part of the anomalous zone. Strong remanent magnetization observed in specimens of welded tuff exposed on Mount Prometheus near Austin and on the range crest a few miles to the south also contribute to the magnetic pattern of the intrusive body. The dominant magnetic maximum over Paleozoic sedimentary rock in the northern part of the zone is probably caused by intrusive rock satellitic to the Austin pluton that lie near the surface. High magnetic gradients west of Lake Ranch indicate that the north and northwest sides of the pluton are comparatively steep. The eastern edge of the granitic mass is mostly concealed and very likely coincides with gradients on the west flank of the bordering magnetic low. Elsewhere low gradients and small amplitude anomalies partly related to topography occur along the margin of the pluton. Parts of the intrusive body are inferred from positive anomalies to underlie Cambrian sedimentary rock near Indian Canyon about 5 miles south of Austin and sedimentary deposits near Blackbird Creek in Big Smoky Valley.

A magnetic high occurs along the south crest of the range, in an area underlain by Cambrian and Ordovician sedimentary rocks. The high corresponds to topography, but inasmuch as the sedimentary rocks are comparatively nonmagnetic, it may be caused by a concealed extension of the plutonic rock. Superimposed on the feature are small pronounced maximums near Toiyabe Peak and Bunker Hill. The magnetic gradients and shape of these anomalies indicate that their sources lie near the surface and probably consist of narrow intrusive igneous rock bodies such as northward-trending dikes.

The prominent magnetic low that extends eastward from Austin occurs over quartz monzonite, which is concealed locally by volcanic rocks and alluvium. The anomaly may be augmented by topography and by the masking effect of alluvium in Grass Valley. Mount Prometheus, capped by welded tuff and marked by a small magnetic maximum, lies within the area of low magnetic intensity. Samples of granitic rock in the area have magnetic susceptibility values below average and indicate that some of the plutonic rocks are essentially nonmagnetic. Rocks in the western part of the low are known from mining operations to be intensely altered (Ross, 1953, p. 61). Extensive alteration and concomitant destruction of magnetic minerals in the quartz monzonite could account for the anomaly. If this is true, the steep gradients along the eastern and northern parts of the magnetic low suggest that the boundary between altered and unaltered rocks may be relatively sharp.

Negligible magnetic susceptibility of the alluvium and older sedimentary rocks is expressed by the magnetic low along the east flank of the mountain range. This feature also indicates the nonmagnetic response of siliceous tuffs between Rye Patch Canyon and Grass Valley.

Northeastward are small anomalies that appear to be caused by magnetic contrasts between tuffs and andesite or dacite flows. The northeast positive anomaly probably marks a concealed body of andesitic rock.

A positive anomaly of about 70 gammas lies over the upland west of Reese River in the northwest part of the area. The anomaly occurs over sedimentary and volcanic rocks in the central part of the upland and includes intrusive rocks exposed on the northeast and southwest slopes. Magnetic properties of rock samples from the anomalous locality indicate that the anomaly is probably caused by induced and remanent polarizations in the intrusive rock. From the shape of the anomaly we infer that the intrusive bodies connect at depth and underlie more extensive parts of the upland slopes.

MAGNETIC FEATURES AND MINERAL DEPOSITS

The ore deposits occur mainly in anomalous parts of the area but are not indicated directly by specific magnetic features.

Most of the silver ore produced in the Reese River district came from mines near Austin in the western part of an extensive magnetic low. The deposits are silver-bearing veins in joints in the quartz monzonite which is intensely altered locally. Widespread alteration of magnetic minerals in the plutonic rock could account for their low-induced magnetization. The possibility that the magnetic low represents an extension of the zone of alteration and silicification observed in the mines would seem worth investigating.

Some silver ore was produced from mines in Paleozoic strata about 5 miles north of Austin. Here the deposits are veins parallel to bedding in quartzite along the margin of the pluton. Most veins strike westward and dip to the north at low angles (Ross, 1953, p. 61). Magnetic gradients that mark the northwestern side of the pluton correspond with the trend of veins in this part of the district.

The uranium deposits 3 miles south of Austin occur in a deformed belt; here, a moderately steep magnetic gradient trends northwestward. This gradient may be caused by a concealed undulation in the pluton surface.

Over the Birch Creek district on the east side of the range are small magnetic features that are probably caused by susceptibility contrasts in surface rocks. These features do not seem to be related to known ore deposits. Some of the ore production in this district very likely came from mines near Blackbird Creek about 3 miles to the north. The deposits are near the contact between Ordovician and granitic rocks. This contact is indicated by a high magnetic gradient.

The antimony deposits near Big Creek in the southern part of the range are in a weak magnetic low that occurs over Ordovician sedimentary rocks and seems to be related mostly to topography.

West of Reese River, the small silver- and gold-bearing veins in Ordovician strata are near, and may be related to, Tertiary intrusive masses that were not crossed by flight lines and apparently are too small to be reflected in the magnetic pattern. If these veins are related to the intrusive rocks, similar deposits may occur in strata near the magnetic maximum to the northwest.

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