DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

GEOPHYSICAL INVESTIGATIONS
MAP GP-422

EXPLANATION

Qs — Quaternary sedimentary deposits

Ts — Tertiary sedimentary rocks

Tv — Tertiary volcanic rocks

TKi — Cretaceous(?) and Tertiary intrusive rocks

pTs — Pre-Tertiary sedimentary rocks

pCm — Precambrian metamorphic rocks

Contact
Dashed where approximately located

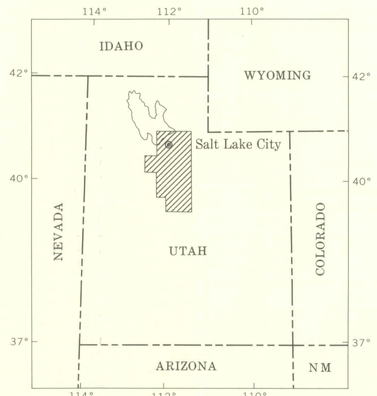
Magnetic contours showing total intensity magnetic field of the earth in gammas relative to arbitary datum
Hachured to indicate closed areas of lower magnetic intensity; dashed where data are incomplete

+1718 — Measured maximum or minimum intensity within closed high or closed low

Flight path
Showing location and spacing of data

NOTE

Aeromagnetic data are obtained and compiled along a continous line, whereas ground magnetic surveys are made at separate points. Errors within the normal limits of any magnetic measurement may cause slight discrepancies between flight lines in an aeromagnetic map, which would be more obvious than similar discrepancies between points in a ground magnetic map. For this reason as much care should be exercised in evaluating magnetic features that appear as elongations along a single aeromagnetic traverse as in interpreting an anomaly indicated by a single ground station



INDEX MAP SHOWING LOCATION OF AREA MAPPED

INTRODUCTION

The aeromagnetic and generalized geologic map covers about 4,000 square miles in the eastern part of the Basin and Range province and along the southwestern edge of the Middle Rocky Mountain province in north-central Utah. The map area extends southward from Farmington to Levan and from a few miles east of the crest of the Wasatch Range westward for about 40 miles. It includes the western part of the central Wasatch Range, all of the Oquirrh Mountains, and the northern two-thirds of the East Tintic Mountains. Cook and Berg (1961) made a gravity survey of about the same area.

The aeromagnetic study was undertaken to define the regional magnetic anomalies that are related to intrusive igneous rocks of Mesozoic and Tertiary age, and to provide data concerning the depth and configuration of the basement rock. Of particular interest was the magnetic expression of the groups of intrusive rocks with which the major mining districts in the Bingham, Cottonwood, and Tintic regions are related. Although no correlation is evident between the magnetic highs and individual ore bodies, the aeromagnetic anomalies reveal the subsurface extensions of the intrusive centers and indicate other areas that may contain intrusive rocks at depth.

The present report is a brief qualitative discussion of the major magnetic anomalies and their relation to larger rock masses or structures; it does not include exhaustive examination of any of the anomalies.

GENERAL GEOLOGY

The oldest rocks in the area surveyed are in a Precambrian metamorphic complex consisting largely of gneiss and schist. This unit, which Eardley (1939) has named the Farmington Canyon Complex, crops out on Antelope Island at the north end of the map, and in the Wasatch Range east of Bountiful. Similar rocks are exposed in a small area just north of Little Cottonwood Canyon. These metamorphic rocks are overlain by sedimentary rocks of younger Precambrian, Paleozoic, Mesozoic and Cenozoic age. Both the metamorphic and sedimentary rocks are intruded by bodies of granitic and porphyritic igneous rock, chiefly within two east-trending belts that cross the northern and southern halves of the map. These belts also contain volcanic rock of Tertiary age that are closely related to the porphyritic intrusives. Quaternary sedimentary deposits cover most of the valleys.

The eastern boundary of the Basin and Range province is generally drawn at the western face of the Wasatch Range; it therefore lies about a third of the way in from the eastern edge of the map for its full length. For most of this distance the western front of the Wasatch Range is delineated by the complex Wasatch fault zone. Gravity surveys have shown that this fault zone is bounded on the west by several deep depressions (Cook and Berg, 1961). The deepest and most impressive of these underlies the area of Utah Lake; steep gravity gradients indicate that these depressions are locally bounded by high-angle faults with vertical displacements of several thousand feet. In other places the gradients are more gentle and could be produced by step faulting or by relatively steep dips on the bedrock surface.

Within the ranges, the pre-Tertiary rocks have been faulted and folded, and locally are complexly deformed. Overthrust faults with large displacement are found in the Wasatch Range and the East Tintic and Oquirrh Mountains. But because most of the magnetic anomalies are related to rock type rather than structure, the geology has been generalized to show only the major rock types.

MAGNETIC MAP

The aeromagnetic data were obtained with a modified AN/ASQ-3A airborne magnetometer towed about 75 feet below a DC-3 aircraft. East-west flight lines spaced about 2 miles apart were flown at a barometric elevation of 12,000 feet.

The most prominent features on the magnetic map are three zones of anomalies. One zone is over Antelope Island in the northwest corner of the map and extends over the alluvium- and water-covered area to the east. A second zone trends eastward from the Tooele-Stockton area to Park City at the east edge of the map and probably beyond. A third zone covers most of the area south of Payson.

Between the zones of magnetic anomalies the magnetic intensity increases northeastward at about 9 gammas per mile. In these areas of near-normal geomagnetic gradient, a few anomalies are apparent; however, at the flight level of 12,000 feet (generally 5,000 to 8,000 feet above the surface but locally within 1,000 feet) their amplitude is only a few gammas. These small anomalies do not permit quantitative analysis which might indicate the depth to basement rock.

The zone of magnetic anomalies over Antelope Island and the adjoining area to the east consists of three locally closed magnetic highs superimposed on a regional high. The magnetic high over Antelope Island is produced by the Precambrian rocks that crop out there. The other two local highs about 7 miles to the east, are interpreted to be produced by rocks similar to those exposed on the island. A depth analysis of the northernmost magnetic high 7 miles east of the island indicates that the rocks producing the anomaly are within about 2,000 feet of the surface.

There is correlation in the Antelope Island area between the magnetic anomalies and the Bouguer gravity anomalies (Cook and Berg, 1961). The magnetic high about 7 miles east of the south end of the island coincides with a gravity high. Although the gravity field has not been defined in sufficient detail to fully evaluate this correlation, the local magnetic highs and perhaps part of the local gravity relief are probably produced in part by variations in the composition of the Precambrian rock. The highest gravity values within the area of the magnetic survey are associated with the regional high centered over Antelope Island. The regional gravity high probably reflects both relief on the basement rock and isostatic compensation for the regional topography. The character of the magnetic anomalies in the Antelope Island area is distinct. No similar anomalies are apparent over the Precambrian metamorphic rock exposed in the Wasatch Range nor is there evidence of similar anomalies produced by basement rock underlying the sedimentary rocks to the south. The magnetic properties of the basement rock in the Antelope Island area appear to differ from those in other areas of the survey.

The zone of magnetic anomalies extending from Park City to Stockton coincides with a belt of Tertiary intrusive and extrusive igneous rocks. The largest of these anomalies is over the Little Cottonwood and Alta granitic stocks in the Wasatch Range. The magnetic expression of the stocks is strong local relief superimposed on a large magnetic high. The continuity of this high indicates that the stocks are continous at depth.

An elongate magnetic nose extends across the south end of Jordan Valley from Corner Creek in the Wasatch Range to Lark in the Oquirrh Mountains. Although this nose is aligned with the anomaly over the Little Cottonwood and Alta stocks, and could be produced by an extension of these stocks at depth, surface and low-level airborne surveys (Books, 1954) and data from drill holes indicate that it is, at least in part, a generalized expression of local anomalies of a different origin produced by volcanic rocks. Drill holes in the area of these anomalies on the Utah State Prison farm and southwest of Draper are reported by Cook and Berg (1961) to have penetrated volcanic rocks at a depth of about 300 feet that are similar to andesitic flows and breccias that crop out in the Traverse Mountains. The displacement of the high level anomaly from the outcrop of these volcanic rocks in the Traverse Mountains suggests that the local anomalies over the valleys may be related to strongly magnetic flows, which are mostly concealed, or to near-surface intrusives similar to those that crop out under the anomaly on the east side of the Oquirrh Mountains.

The positive anomaly south of Bingham Canyon is over the Last Chance stock. The Bingham stock, which contains commercial amounts of disseminated copper and other minerals, does not have appreciable magnetic expression. This may be the result of destruction of original iron-bearing minerals by hydrothermal alteration. The possible existence of another intrusive body near the west edge of the range about 9 miles southwest of the Last Chance stock is indicated by a magnetic anomaly with less than 100 gammas of relief. The magnetic data suggest that the Oquirrh Mountains between Bingham Canyon and Ophir are underlain by a greater volume of intrusive rock than is indicated by the surface exposures.

The general alignment of the magnetic anomalies indicates that a series of intrusive rocks extends westward from Park City at least to the limit of the magnetic survey on the west side of the Oquirrh Mountains. This middle zone of magnetic anomalies coincides approximately with the Uinta-Gold Hill Arch (Roberts, 1960).

The southern zone of magnetic anomalies is approximately coextensive with areas of Tertiary volcanic rocks exposed in many of the ranges. The principal intrusive bodies cropping out in this zone are a group of monzonite stocks of Eocene age in the East Tintic Mountains south of Eureka. These stocks underlie the north-trending nose of an extensive magnetic high which is centered over the west flank of the range a few miles to the south of the stocks. This part of the range has not been mapped in detail but under the center of the magnetic high it is known to consist of volcanic rocks with local exposures of pre-Tertiary sedimentary rocks and a few narrow dikes and sills. The magnetic anomaly, however, does not appear to be produced by the extrusive rocks which are dominantly pyroclastic and presumably are relatively non-magnetic; instead, the magnetic anomaly indicates a large intrusive body several thousand feet below the surface. The steep magnetic gradients along the west side of the anomaly generally parallels the Oquirrh-Boulter-Tintic fault zone along the east border of Tintic Valley, inferred from the gravity data (Cook and Berg, 1961).

Over the volcanic rocks in Long Ridge the magnetic relief is generally low, as would be expected, since these rocks are largely volcanic conglomerates, agglomerates, and tuffs, but in Juab Valley to the east, a magnetic high, which appears to be an extension of the high over the Tintic Mountains, is centered over the alluvium at Mona. The magnetic gradients on the east side of this local high indicate that the top of the body producing the anomaly is several thousand feet below the surface. A gravity low (Cook and Berg, 1961) in the valley indicates about 2,000 feet of sedimentary or volcanic rocks overlying the pre-Tertiary bedrock. The magnetic high is probably produced by an intrusive body in the bedrock underlying the valley-fill deposits. This intrusive body may be continuous at depth with the inferred body in the East Tintic Mountains.

Several local magnetic anomalies occur over the Wasatch Range and Cedar Hills east of Juab Valley The magnetic high on the edge of the map southeast of Levan is probably related to the monzonite porphyry that occurs as small intrusive bodies in the Mesozoic sedimentary rocks just south of the map area. The west-southwest-trending magnetic high in the Wasatch Range north and west of Mount Baldy is approximately coextensive with the Tertiary volcanic rocks, and is probably produced by them. Smaller magnetic highs along Nebo Creek, east of Dry Mountain, and in the Cedar Hills east of Fountain Green also are probably produced by volcanic rocks.

The two magnetic highs in the valley near Fountain Green are both in areas underlain by valley-fill deposits. These anomalies are larger than any observed over the exposed volcanic rocks in the Cedar Hills to the east. Perhaps a much greater thickness of volcanic material underlies the valleys. The possibility that these two anomalies are produced by intrusive bodies below the valley fill cannot be ruled out on the basis of the geophysical evidence. Such bodies, if they exist, may have been local sources for the volcanic rocks in this area of Wasatch Range.

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Eardley, A. J., 1939, Structure of the Wasatch-Great Basin region: Geol. Soc. America Bull., v. 50, p. 1277–1310.

Roberts, Ralph J., 1960, Paleozoic structure in the Great Basin: [abs.] Geol. Soc. America Bull., v. 71, p. 1955.

Base map from Utah State general highway county maps

Aeromagnetic survey by V. L. Meuschre, 1955, at a barometric elevation of 12,000 feet. Geology modified from Cook and Berg (1961)

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—G63103

AEROMAGNETIC AND GENERALIZED GEOLOGIC MAP OF PART OF NORTH-CENTRAL UTAH

By

D. R. Mabey, M. D. Crittenden, Jr., H. T. Morris, R. J. Roberts, and E. W. Tooker

SCALE 1:250 000

4 2 0 4 8 12 16 MILES

4 2 0 4 8 12 16 KILOMETERS

CONTOUR INTERVALS 10 AND 50 GAMMAS

1964

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For sale by U. S. Geological Survey, price 50 cents