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AEROMAGNETIC MAP OF THE ALBANY-NEWPORT AREA, OREGON AND ITS GEOLOGIC INTERPRETATION

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Introduction

An aeromagnetic survey of the Albany-Newport area in western Oregon was made by the U.S. Geological Survey in September, 1954. The surveyed area, approximately 1,200 square miles, includes the Lebanon, Albany, Corvallis, Marys Peak, Toledo, and Yaquina quadrangles (see index map) (Bromery, 1962a). Interpretation of the aeromagnetic data in the Lebanon quadrangle has been published (Bromery, 1962b). The geology of the Albany, Corvallis, Marys Peak, Toledo, and Yaquina quadrangles is described by Vokes and others (1949 and 1954) and by Baldwin (1955).

Thirty-four east-west traverses, spaced one-half mile apart, were flown approximately 750 feet above the ground. The total-intensity magnetic measurements were made with a continuously recording AN/ASQ-3A airborne magnetometer installed in a twin-engined aircraft. Topographic quadrangle maps were used for pilot guidance, and the flight path of the aircraft was recorded by a gyrostabilized 35-mm continuous-strip-film camera. The distance from plane to ground was measured with a continuously recording radar altimeter. These data have been compiled as the accompanying total-intensity magnetic contour map.

The airborne-magnetometer survey was flown as part of a geophysical support program to aid geologic field mapping in and adjacent to the survey area and to provide information useful in the interpretation of subsurface geology.

The author is indebted to P. D. Snavely, Jr., for his assistance and cooperation during the course of the field work and in the preparation of this report.

General geology

The Albany-Newport area extends westward from the Willamette Valley, the southern part of the Puget-Willamette structural trough, across the central part of the Oregon Coast Range anticlinorium to the Pacific Ocean. The Siletz River Volcanic Series of early to middle Eocene age (Snavely and Baldwin, 1948; Snavely and Wagner, 1964) is exposed in places in the axial parts of the uplift which appears to have a gentle plunge to the northeast (Vokes and others, 1954). According to Vokes, little is known of the structure of these volcanic rocks, but the structure is believed to be complicated by many small faults and superimposed folds. The volcanic sequence, composed mostly of basalt flows and breccia, and the overlying middle Eocene sedimentary rocks have been folded into many gentle flexures. Upper Eocene and lower and middle Oligocene marine strata dip homoclinally off the western flank of the uplift. Marine upper Oligocene and Miocene rocks are present along the coast in the western part of the uplift.

In the eastern part of the mapped area the lower and middle Eocene volcanic rocks and the younger Tertiary sedimentary rocks are downdropped beneath the alluvium of the Willamette Valley along the Corvallis fault zone (Vokes and others, 1954). This major northeast-trending fault zone can be traced for more than 20 miles from the northwest corner of the Monroe quadrangle to the central part of the Corvallis quadrangle, where it passes beneath the valley alluvium southeast of Coffin Butte. The amount of vertical displacement along the fault is believed to be several thousand feet (Vokes and others, 1954).

The west edge of the exposed Siletz River Volcanic Series is bounded by the Kings Valley fault. This normal fault trends in a northeast direction and is offset by a smaller fault near the center of the map area (Vokes and others, 1954).

In the western part of the map area small basaltic intrusive bodies and larger gabbroic and dioritic dikes and sills are present (Baldwin, 1955; Vokes and others, 1949). Some of these intrusive bodies were feeders to the lower and middle Eocene flows, and others were emplaced later. The largest sill caps Marys Peak and is approximately 1000 feet thick (Baldwin, 1955, Roberts, 1953).

In the extreme western part of the map area, geologic data indicate a former marine embayment in the vicinity of Newport, where middle Eocene and younger marine sedimentary rocks are more than 12,000 feet thick (Snavely and Wagner, 1964).

Magnetic interpretation

In general, interpretation of the magnetic data of the Albany-Newport area involves the comparison of magnetic anomalies over exposed magnetic volcanic rocks with magnetic anomalies observed in areas where it is assumed that similar rocks are covered by essentially nonmagnetic sedimentary rocks. Quantitative methods of analysis of the magnetic data are as follows: (1) estimation of depths to the upper surface of magnetic rock units by comparison of observed profiles with suitable computed profiles for rectangular-prismatic models as described by Vacquier and others (1951); (2) an approximation of the depth to the top of magnetic rocks through the application of the method of upward continuation developed by Henderson and Zietz (1949) in which a magnetic profile along a flight line over exposed magnetic rocks may be projected upward until the anomaly amplitudes and gradients compare favorably with similar anomalies along a profile over an area believed to be underlain by the same magnetic rocks at depth; and (3) a method described by Zietz (1961) for estimating the horizontal direction and dip of the remanent magnetization vector by analyzing maximum and minimum anomaly amplitudes.

In this method a line drawn between the maximum and minimum anomaly amplitudes is approximately parallel to the horizontal direction of the remanent magnetization vector, and the dip of the vector is estimated from the ratio between the maximum and minimum anomaly amplitudes measured from the average magnetic level of the surrounding area. The larger the ratio the steeper the dip of the remanent magnetization vector.

In this report, depth estimates are based on the assumptions that the anomaly-producing rocks extend to infinite depth and that the presence of anomalous remanent magnetization does not affect the magnetic anomaly gradients (Zietz, 1961).

From an inspection of the magnetic map three distinct anomaly patterns are evident: (1) a zone of high-amplitude anomalies which trends northeast through the east-central part of the area and is bounded on the east by the Corvallis fault-zone and on the west by the Kings Valley fault (Vokes and others, 1954), (2) a zone of relatively low magnetic gradients and small anomalies in the eastern part of the area, and (3) a zone of moderate-to low-amplitude magnetic anomalies in the western two-thirds of the area. The east-central zone of high-amplitude anomalies is underlain by the Siletz River Volcanic Series exposed in the axial portion of the major fold. In the northeast corner of this zone, the abrupt change to a relatively flat magnetic pattern suggests that magnetic rocks are deeply buried or absent. In the other parts of the zone, numerous pronounced magnetic lows observed over these volcanic rocks are characteristic of rocks possessing a strong, anomalous remanent magnetization. Examples of the anomalous remanent magnetization are: the large Y-shaped reversed or negative magnetic anomaly in the northwest corner of the east-central zone, and the linear magnetic low lying just within the eastern boundary of the same zone. This area in general consists of alternating northeast-trending belts of positive and negative magnetic anomalies. The orientation of these belts indicates a general east-west direction of the horizontal component of the remanent magnetization vector. The ratios of the maximum and minimum anomaly amplitudes, often more than 2 to 1, suggest that the remanent magnetization vector is steeply dipping, and possibly, in some places reversed. Remanent magnetic studies made in the basalt sequence in this and adjacent areas by Cox (1957) show that the remanent magnetization vector in general is steeply dipping and that the horizontal component has an east-west direction.

The contact between the high-amplitude anomalies of the east-central zone and the relatively smooth magnetic patterns of the eastern zone coincides with the mapped Corvallis fault zone (Vokes and others, 1954). Analysis of magnetic anomalies near the town of Albany, using the upward-continuation profile comparison method, indicates that the magnetic volcanic rocks are buried 10,000-15,000 feet below the surface. The four small, steeper-gradient magnetic anomalies that lie to the east of the Corvallis fault zone are correlated with exposed basaltic intrusive rocks. They are located as follows: the S-shaped anomaly with the peak amplitude of 1725 gammas in the northeast corner of the eastern zone, the two magnetic anomalies located one mile northwest of Corvallis, with peak values of 1820 and 1735 gammas, and the anomaly just east of the Corvallis fault zone with peak amplitude of 1875 gammas located 5 miles north of Corvallis.

The Kings Valley fault bounds the west edge of the east-central anomalous zone. Three additional faults are inferred from the aeromagnetic data along this west edge. The aeromagnetic data show changes in magnetic gradients across these inferred faults indicating that the magnetic rocks are downdropped to the west.

The western part of the survey area can be subdivided into two parts with contrasting magnetic patterns. The eastern part is located between the Kings Valley fault and longitude 123°50' and is characterized by numerous low-amplitude magnetic anomalies. The western part is located between longitude 123°50' and the west edge of the surveyed area and is characterized by a relatively flat magnetic pattern except for the extreme south edge. Analysis of the amplitudes and gradients of the anomalies across the Kings Valley fault suggests that the volcanic rocks west of the fault are downdropped approximately 1000-2000 feet. The magnetic anomalies decrease in amplitude and gradient westward from the Kings Valley fault, indicating a general thickening of the overlying nonmagnetic sedimentary rocks. Numerous gabbroic intrusive bodies are found in the area between the Kings Valley fault and longitude 123°50'. These gabbroic rocks in general produce low-amplitude magnetic anomalies, too small to be shown in the 50-gamma contour interval of the map. A pronounced magnetic anomaly is, however, produced by the thick gabbro sill that caps Marys Peak at the southern boundary of the map area between longitudes 123°30' and 123°35'.

The western half of the eastern part between longitudes 123°40' and 123°50' contains two north-trending linear anomaly belts. Depth analysis of the anomalies located along 123°40', using the method of Vacquier and others (1951), indicates that the anomaly-producing rocks are buried 2,000-3,000 feet below the surface. A similar analysis of the magnetic anomalies located along 123°45' gives depths of 5,000-6,000 feet below the surface. The two linear anomaly belts join along the southern map boundary, suggesting that they represent the same magnetic unit. An offset in these anomaly belts along latitude 44°40' is interpreted as having been produced by a fault with a left lateral movement of approximately two miles. The amplitudes and gradients of the magnetic anomalies north and south of the inferred fault do not show any appreciable change, which may indicate little or no vertical displacement. The direction and magnitude of the magnetic anomaly offset are coincident with a surface fault with left lateral separation mapped by Snavely (oral communication, 1961) south of the town of Siletz.

The flat magnetic patterns in the western part of the map area show several relatively steep gradient magnetic anomalies along the southern border. These anomalies are interpreted to be produced by rocks buried 3,000-4,000 feet below the surface. An east-trending inferred fault based on the abrupt change in magnetic anomaly gradients and amplitudes in this area is shown on the map. The pronounced magnetic lows in the southwest corner of the survey area and two miles north of the southern map boundary along longitude 123°50' are likely produced by rocks having a strong remanent magnetization. The magnetically flat area in the vicinity of Newport and south of Siletz indicates that magnetic rocks are deeply buried.

A regional gravity profile was made by the author along the coast at the western boundary of the map area. Interpretation of the gravity data suggests that low-density sedimentary rocks in the vicinity of Newport are approximately 10,000 feet thick and that high-density, probably volcanic rocks are at relatively shallow depths in the southwestern part of the survey area (Bromery and Snavely, 1964).

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