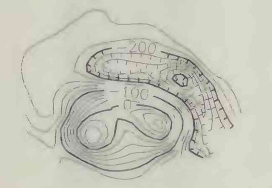
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

OPEN-FILE REPORT
97-162

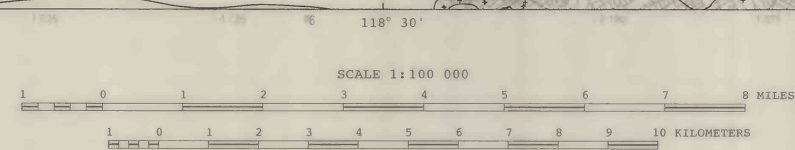
Base from U.S. Geological Survey, 1979.
Universal Transverse Mercator projection.



Contours of total magnetic field intensity relative to the International Geomagnetic Reference Field. Contour interval is 20 nanoteslas. Hachures indicate closed magnetic lows. "Plus" signs indicate possible locations of boundaries between regions of different magnetizations (see accompanying text for explanation).

DECLINATION DIAGRAM

UTM grid convergence (GN) and 1979 magnetic declination (MN) at center of map
Diagram is approximate



Contour interval of base is 50 meters
with supplementary contours at 10-m intervals

Aeromagnetic Survey
Index

QUADRANGLE LOCATION

AEROMAGNETIC MAP OF THE LOS ANGELES 1:100,000-SCALE QUADRANGLE, CALIFORNIA

By

Victoria E. Langenheim and Robert C. Jachens

1997

INTRODUCTION

This aeromagnetic map is part of the Southern California Areal Mapping Project (SCAMP) and is intended to promote further understanding of the geology in the Los Angeles 1:100,000-scale quadrangle, California, by serving as a basis for geophysical interpretations and by supporting geologic mapping, mineral resource investigations, and topical studies. Local spatial variations in the Earth's magnetic field (evident as anomalies on aeromagnetic maps) reflect the distribution of magnetic minerals, primarily magnetite, in the underlying rocks. In many cases the volume content of magnetic minerals can be related to rock type, and abrupt spatial changes in the amount of magnetic minerals can commonly mark lithologic or structural boundaries. Bodies of gabbroic or dioritic composition tend to produce the most intense magnetic anomalies, but such generalizations must be applied with caution because rocks with more felsic compositions also can cause measurable magnetic anomalies.

DATA SOURCES AND REDUCTION METHODS

Total-field aeromagnetic data from three separate surveys (table 1, index map) were used to construct the aeromagnetic map of the 1:100,000-scale Los Angeles quadrangle.

Table 1. *Summary of aeromagnetic surveys*

Survey	Year Flown	Flight elevation above ground	Flight line spacing	Flight line direction
Los Angeles (U.S. Geological Survey, 1996)	1994-6	305 m	0.8 km	N/S
Ventura Basin (U.S. Geological Survey, 1980)	1977	305 m	3.2 km	N/S
Offshore Southern California (Langenheim and others, 1993)	1961	760 m*	1.6 km	NE/SW

*flight elevation estimated

Data from the Los Angeles survey (U.S. Geological Survey, 1996) were taken directly from original digital tapes provided by the contractor (Aerodat, Inc.). The International Geomagnetic Reference Field (Langel, 1992), updated to the dates that the survey was flown, was subtracted from this survey to yield a residual magnetic field. The Ventura Basin survey was hand digitized from maps provided by Aerial Surveys to produce a digital data set. The Offshore Southern California survey was hand digitized from maps provided by Shell Oil Company to produce a digital data set (for more information, see Langenheim and others, 1993).

Data from the surveys were transformed to a Universal Transverse Mercator Projection (Base Latitude 0°, Central Meridian 117°W) and interpolated to a square grid with a grid interval of 0.4 km by means of a routine based on the principle of minimum curvature (Briggs, 1974). To insure compatibility of the three surveys during the final merging process, the Offshore Southern California survey was analytically continued downward (Cordell, 1985) to an effective height of 305 m above the land or sea surface. The magnetic base levels of the surveys were then adjusted to bring them onto a common magnetic datum. To do so, a comparison of the Offshore Southern California survey with the merged California aeromagnetic data set (Roberts and Jachens, 1993) and profile E–E' from Bromery and others (1960) (south of the quadrangle) indicated that, in addition to a base level change, a regional tilt (–1.22 nT/km north; –0.81 nT/km east) needed to be subtracted from the Offshore Southern California survey in order to approximately remove the bad join with the onshore surveys. Although removing this regional tilt brought the Offshore Southern California survey into reasonable accord with the onshore surveys south to the Mexican border, a mismatch remains in the fit between the offshore survey and the onshore surveys in the Los Angeles quadrangle. This mismatch is most obvious in the southwestern corner of the quadrangle, where it is as much as 60 nT. The Los Angeles and Ventura Basin survey grids were then merged by smooth interpolation across a 1–km-wide buffer zone along the boundary between the two surveys. The final grids were contoured at an interval of 20 nT.

"Plus" symbols indicate possible locations of abrupt lateral changes in magnetization and may represent lithologic or structural boundaries. Larger "plus" symbols indicate larger lateral changes. Locations of possible boundaries were determined as follows:

1) The total-field anomaly data were mathematically transformed into pseudogravity anomalies (Baranov, 1957); this procedure effectively converts the magnetic field to the "gravity" field that would be produced if all the magnetic material were replaced by proportionately dense material.

2) The pseudogravity field was continued upward a distance of 1.0 km and subtracted from the original pseudogravity field (this procedure emphasizes those parts of the pseudogravity field that are caused by the shallow parts of the magnetic bodies, thus those parts most closely related to the mapped geology).

3) The horizontal gradient of the pseudogravity field difference was calculated everywhere by numerical differentiation.

4) Locations of locally steepest horizontal gradient ("plus" symbols) were determined by numerically searching for maxima in the horizontal gradient grid (Blakely and Simpson, 1986).

Boundaries between bodies having different densities are characterized by steep gradients in the gravity field they produce and if the boundaries have moderate-to-steep dips (greater than 45°), locally the maximum horizontal gradients will be located over the surface traces of the boundaries (Blakely and Simpson, 1986). Similarly, boundaries between bodies having different magnetizations are characterized by steep gradients in the pseudogravity field and therefore the procedure described above can be used to locate these boundaries. For example, "plus" symbols coincide closely with strands of the Verdugo, Sierra Madre, and San Gabriel Faults.

DESCRIPTION OF AEROMAGNETIC ANOMALIES

In general, the magnetic field over the western two-thirds of the quadrangle is characterized by long-wavelength (greater than 2 km) anomalies, except for short-wavelength (widths of 1–2 km) anomalies caused by oil fields, manmade structures or exposed Tertiary volcanic rocks. Prominent anomalies associated with oil fields include the northwest-trending anomaly over the Inglewood field (lat 34° 0.0' N., long 118° 22.5' W.), and the east-trending anomaly over the Montebello (lat 34° 1' N., long 118° 7' W.) field. The closely spaced, deeply-penetrating well-casings present in these oil fields are likely the dominant source of these anomalies, but contributions from other anthropogenic or natural sources associated with the oil fields cannot be ruled out. Examples of strong anomalies over manmade structures include those over gravel pits in the San Fernando Valley (lat 34° 14' N., long 118° 23' W.) and the substation and debris dam along the southern extent of the Santa Monica Mountains (lat 34° 7' N., long 118° 22' W.). Anomalies associated with exposed Tertiary volcanic rocks tend to be linear and trend west-northwest; see, for example, the anomalies at lat 34° 7' N., long 118° 45'W. and at lat 34° 15' N., long 118° 50'W.

The magnetic field of the east third of the sheet is characterized primarily by large-amplitude, short-wavelength anomalies caused by strongly magnetic crystalline rocks exposed in the San Gabriel and Verdugo Mountains (Jennings. 1962). The west edge of the magnetic high over the Verdugo Mountains coincides closely with the inferred location of the Verdugo Fault (Langenheim and others, 1994) whereas the northeast edge of the magnetic high coincides with the location of the Sierra Madre Fault (lat 34° 18.0'N long 118° 20.0'W to lat 34° 9.0'N long 118° 05.0' W). The San Gabriel Fault is marked by a northwest-trending magnetic gradient extending across the quadrangle from lat 34° 30.0'N long 118° 37.0'W to lat 34°15.0'N long 118° 04.0'W).

REFERENCES

Baranov, V.I., 1957, A new method for interpretation of aeromagnetic maps: Pseudo-gravimetric anomalies: Geophysics, v. 22, p. 359-383.

Blakely, R.J., and Simpson, R.W., 1986, Approximating edges of source bodies from magnetic or gravity anomalies: Geophysics, v. 51, p. 1494-1498.

Briggs, I.C., 1974, Machine contouring using minimum curvature: Geophysics, v. 39, p. 39-48.

Bromery, R.W., Emery, K.O., and Balsley, J.R., Jr., 1960, Reconnaissance airborne magnetometer survey off southern California: U.S. Geological Survey Geophysical Investigations Map GP-211, scale 1:1,000,000.

Cordell, Lindrith, 1985, Techniques, applications, and problems of analytical continuation of New Mexico aeromagnetic data between arbitrary surfaces of very high relief [abs.]: Proceedings of the International Meeting on Potential Fields in Rugged Topography, Institute of Geophysics, University of Lausanne, Switzerland, Bulletin no. 7, p. 96-99.

Jennings, C.W., 1962, Geologic map of California, Los Angeles sheet: California Division of Mines and Geology, scale 1:250,000.

Langel, R.A., 1992, International geomagnetic reference field: the sixth generation: Journal of Geomagnetism and Geoelectricity, v. 44, p. 679-707.

Langenheim, V.E., Halvorson, P.F., Castellanos, E.L., and Jachens, R.C., 1993, Aeromagnetic map of offshore southern California borderland east of the Patton Escarpment: U.S. Geological Survey Open-File Report 93-520, scale 1:500,000.

Langenheim, V.E., Griscom, Andrew, and Jachens, R.C., 1994, Gravity and magnetic data help image the regional tectonic setting of the 1994 Northridge earthquake, California [abs.]: The 89th Annual Meeting of the Seismological Society of America, Program for Northridge Abstract, abstract no. 42.

Roberts, C.W., and Jachens, R.C., 1993, Draped aeromagnetic map of California--A new tool for regional structural and tectonic analysis [abs.]: Eos, Transactions, American Geophysical Union, v. 74, no. 16 supplement, p. 379.

U.S. Geological Survey, 1996, Aeromagnetic map of parts of the Los Angeles, Long Beach, and adjacent 1° x 2° quadrangles, California: U.S. Geological Survey Open-File Report 96-550, scale 1:250,000.

U.S. Geological Survey, 1980, Aeromagnetic map of the Ventura Basin, Ventura and Los Angeles counties, California: U.S. Geological Survey Open-File Report 80-64, scale 1:62,500.