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

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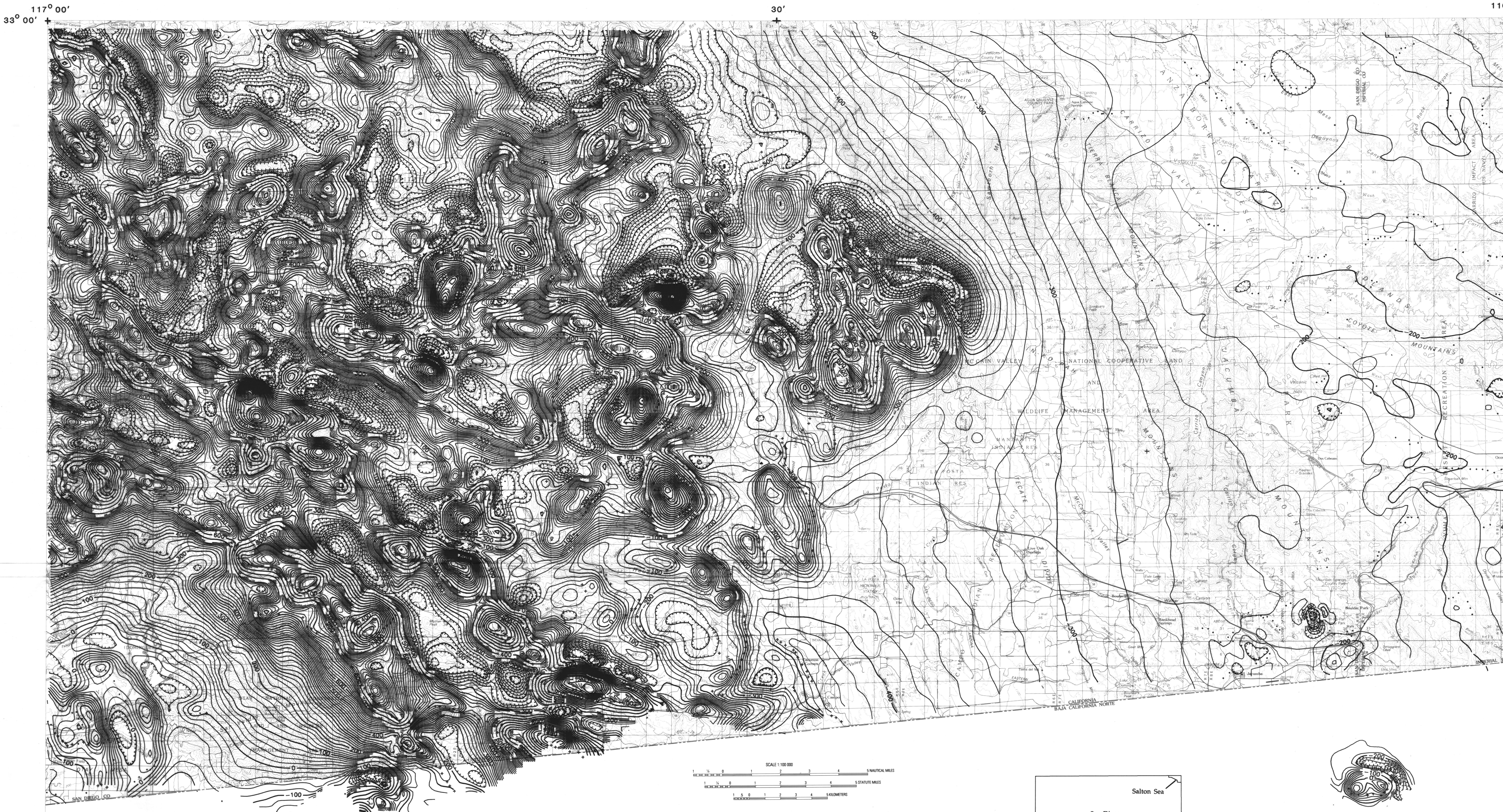


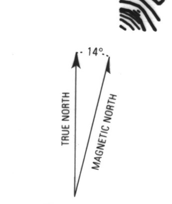


Quadrangle Location

Topographic Contour Interval 50 meters

Index map of aeromagnetic survey boundaries

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

## INTRODUCTION

The accompanying total-field aeromagnetic map is part of the Southern California areal mapping project (SCAMP) and is intended to promote further understanding of the geology in the El Cajon 1:100,000-scale quadrangle, California by serving as a basis for geophysical interpretations and by supporting geological mapping, mineral resource investigations, and topical, SCAMP-related 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. The volume content of magnetic minerals often can be related to rock type, and abrupt spatial changes in the amount of magnetic minerals commonly mark lithologic 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 are capable of causing measurable magnetic anomalies.

Within the El Cajon quadrangle magnetic minerals mainly are concentrated in the Mesozoic plutonic rocks of the Peninsular Ranges batholith (Strand, 1962). The profound difference in map pattern between the western and eastern halves of the map reflects a fundamental east-west asymmetry in the composition of the batholith--magnetite-rich, mafic plutons are confined to the western part whereas the plutonic rocks in the eastern part are effectively nonmagnetic (Jachens and others, 1986; Gastil and others, 1990; Todd and others, 1991). The magnetic anomaly pattern of numerous local highs and lows in the western part indicates that there the igneous rocks are not uniformly magnetic, but rather have a wide range of magnetizations.

At the scale of this map, most magnetic anomalies bear a direct and somewhat intuitive relationship to the rocks beneath them, i.e. magnetic highs are associated with magnetic rock bodies. In detail, however, because the earth's main magnetic field is not vertical at the latitude of the El Cajon quadrangle (field inclination ~60°) and because almost all of the anomalies on this map are induced by the earth's main field, the precise relationship between a magnetic body and its associated anomaly is complex. Typically each magnetic body will generate a magnetic anomaly composed of a high and a low, with the high lying over the southern part of the body and the low lying just north of the northern edge of the body.

Two types of anomalies or features on this map are somewhat different from those described in the previous paragraph and therefore warrant additional explanation. First, the smooth, widely spaced, generally northwest-trending contours that occupy most of the eastern half of the map and indicate increasing field strength toward the east do not reflect a progressive eastward increase in magnetization of the underlying rocks. Rather, the increase in field strength is simply the northeast side of the deep magnetic low that lies on the northeast side of the collection of highly magnetic plutons that occupy the western half of the map area. The low extends a substantial distance northeast of the magnetic rocks because the rocks extend to mid-crustal depths and their eastern boundary dips eastward (Jachens and others, 1986). Second, and on a much smaller scale, near the southern edge of the contour map at about long. 116° 8' W. a sharp local magnetic low 1-2 km across probably reflects a body of reversely magnetized Tertiary volcanic rocks (Strand, 1962). Other local lows along the eastern part of the map, some indicated only by a single closed contour or a local deflection of a contour line, may also reflect reversely magnetized volcanic rocks.

## DATA SOURCES AND REDUCTIONS

Total-field magnetic data from two separate surveys (Table 1, index map) were used to construct the aeromagnetic map of the El Cajon quadrangle. All of the map area except that in the extreme northeast corner is covered by a single survey (U.S. Geological Survey, 1990).

TABLE 1

| Survey | Year | Flight Elev. (Above ground surface) | Flight Line Spacing | Flight Line Direction |
|---|---|---|---|---|
| Salton Sea (U.S. Geological Survey, 1983) | 1981 | 309 m | 0.8 km | E/W |
| San Diego (U.S. Geological Survey, 1990) | 1989 | 309 m | 0.8 km | NE/SW |

Data from the two surveys were taken directly from original digital tapes provided by the contractors. The International Geomagnetic Reference Field, updated to the dates that the individual surveys were flown, was subtracted from each survey to yield a residual magnetic field.

Data from the surveys were transformed to a Transverse Mercator Projection (Base Latitude 0°, Central Meridian -117°) and interpolated to a square grid (grid interval = 0.4 km) by means of a routine based on the principal of minimum curvature (Briggs, 1974). Because both surveys were flown at a nominal height of 309 m above the ground surface (309 m drape), only the magnetic base levels of the surveys were adjusted to bring them onto a common datum. The survey grids were then merged by smooth interpolation across a one-kilometer-wide buffer zone along survey boundaries and contoured at an interval of 20 nanoTesla (nT).

The small "plus" symbols indicate possible locations of abrupt lateral changes in magnetization and may represent lithologic boundaries. Their locations 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 horizontal gradient of the pseudogravity field was calculated everywhere by numerical differentiation.

3) Locations of locally steepest horizontal gradient ("plus" symbols) were determined by numerically searching for maxima in the horizontal gradient grid.

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 (>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 so the procedure described above can be used to locate these boundaries.

## REFERENCES

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BASE MAP FROM U.S. GEOLOGICAL SURVEY
TOPOGRAPHIC SERIES 1:100,000
EL CAJON 1979

# AEROMAGNETIC MAP OF THE EL CAJON 1:100,000 SCALE QUADRANGLE, CALIFORNIA

By

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1992