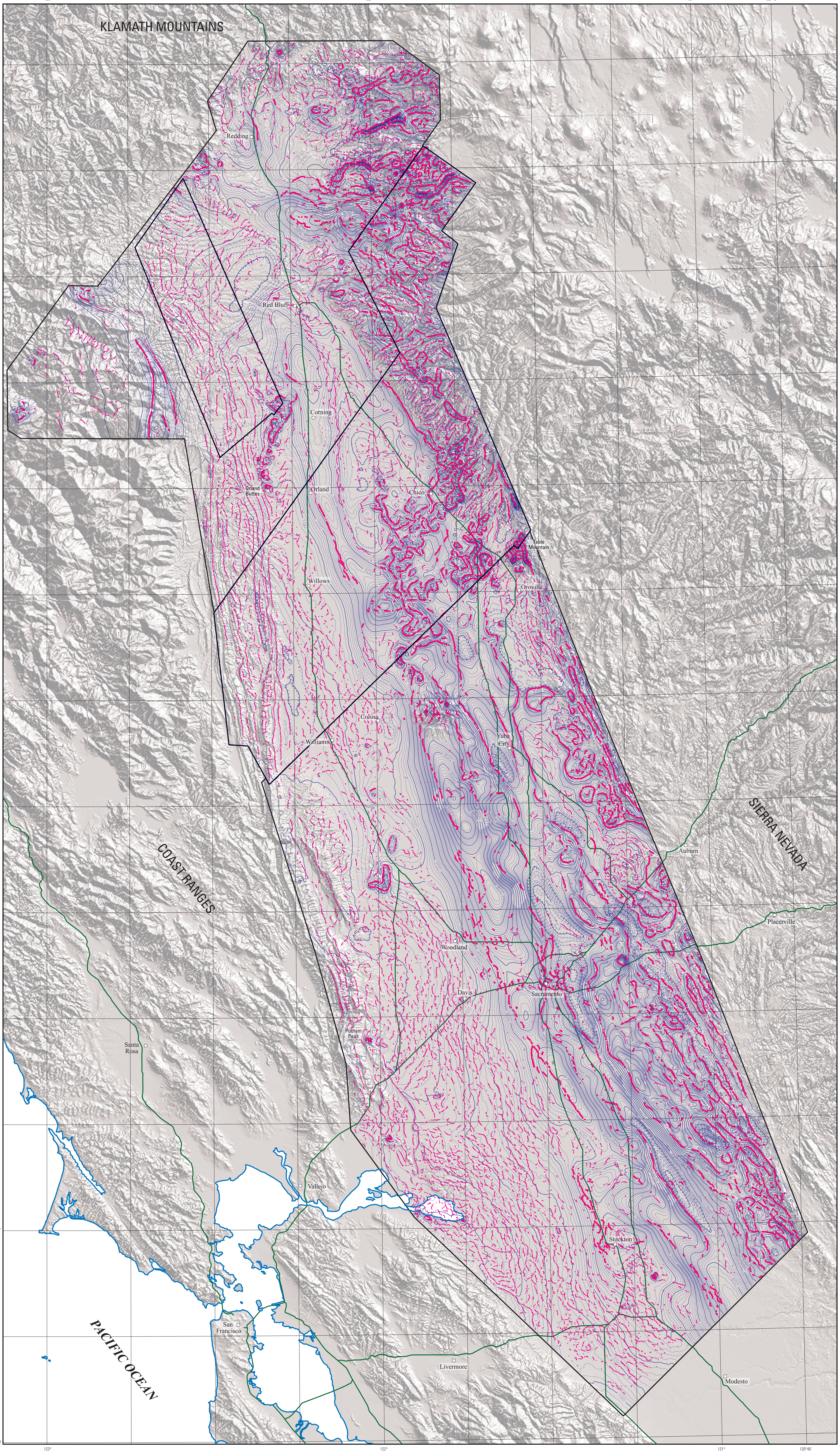

Three aeromagnetic surveys were flown to improve understanding of the geology and structure in the Sacramento Valley. The resulting data serve as a basis for geophysical interpretations, and support geological mapping, water and mineral resource investigations, and other topical studies. Local spatial 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 commonly mark lithologic or structural boundaries. Bodies of serpentinite and other mafic and ultramafic rocks tend to produce the most intense positive magnetic anomalies (for example, in the northwest part of the map). These rock types are the inferred sources, concealed beneath weakly magnetic, valley-fill deposits, of the most prominent magnetic features in the map area, the magnetic highs that extend along the valley axis (figure 1; Cady, 1975; Jachens and others, 1995). Cenozoic volcanic rocks are also an important source of magnetic anomalies and coincide with short-wavelength anomalies that can be either positive (strong central positive anomaly flanked by lower-amplitude negative anomalies) or negative (strong central negative anomaly flanked by lower-amplitude positive anomalies), reflecting the contribution of remanent magnetization. Rocks with more felsic compositions or even some sedimentary units also can cause measurable magnetic anomalies. For example, the long, linear, narrow north-trending anomalies (with amplitudes of <50 nanoteslas [nT]) along the western margin of the valley coincide with exposures of the Mesozoic Great Valley sequence (Blake and others, 1992). Note that isolated, short-wavelength anomalies, such as those in the city of Sacramento and along some of the major roads, are caused by manmade features.

Total-field aeromagnetic data were collected along flight lines spaced 800 m apart and at a nominal terrain clearance of 244 m in three surveys (table 1). Tie lines were flown 8,000 m apart. Locally the aircraft was flown higher than 244 m above ground because of safety considerations, such as over the city of Redding. Dense smoke from large nearby wildfires and high volume air traffic based in Redding to fight the fires made lower-altitude flying dangerous. Data were adjusted for tail sensor lag and diurnal field variations. Further processing included microleveling using the tie lines and correction for the Earth's main magnetic field (International Geomagnetic Reference Field [IGRF]; Langel, 1992) updated to the time period during which the data were collected (table 1).

The resulting data from the three surveys were transformed to a Universal Transverse Mercator projection (base latitude 0°, central meridian -123° W.) and interpolated to a square grid with a grid interval of 200 m using the principle of minimum curvature (Briggs, 1974). The magnetic base levels of the surveys were then adjusted slightly by subtracting their respective means to bring them onto a common magnetic datum.

The magenta circles on the map indicate locations of abrupt lateral changes in magnetization and may represent lithologic or structural 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 pseudogravity field was continued upward a distance of 1 km and subtracted from the original pseudogravity field. This procedure emphasizes those components of the pseudogravity field that are caused by the shallow parts of the magnetic bodies, which are 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 the locally steepest horizontal gradient (magenta circles) were determined by numerically searching for maxima in the horizontal gradient grid (Blakely and Simpson, 1986). Larger circles denote gradient amplitudes greater than the mean for the study area and smaller circles denote amplitudes less than the mean.

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°), 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, the short-wavelength, prominent negative anomaly pattern highlighted by the circles coincide with exposures of reversely polarized Lovejoy Basalt at Table Mountain, Orland Buttes, and Putnam Peak (Coe and others, 2005) and can be used to map this unit beneath the valley-fill deposits (Langenheim and others, 2014).

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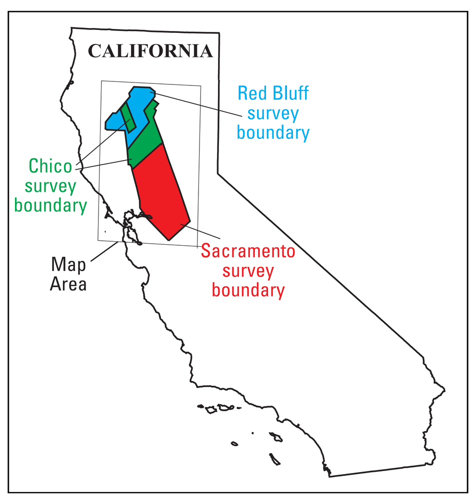
Table 1. Aeromagnetic survey specifications.

[See area of survey on color-shaded aeromagnetic map inset. IGRF, International Geomagnetic Reference Field]; m, meters; N, north; E. east.

Survey name	Date flown	Flight-line spacing in m	Flight-line direction	Flight height above average terrain in m	IGRF removed	Operator
Sacramento	04/22-5/19/2011	800	N45E	244	2010 updated to date of flight	Firefly Aviation
Red Bluff	8/15-10/6/2012	800	N45E	244	2010 updated to date of flight	Firefly Aviation
Chico	11/26-12/27/2014	800	N45E	244	2010 updated to 12/12/2014	Goldak



INDEX MAP SHOWING BOUNDARIES OF THREE AEROMAGNETIC SURVEYS INCLUDED IN THIS STUDY

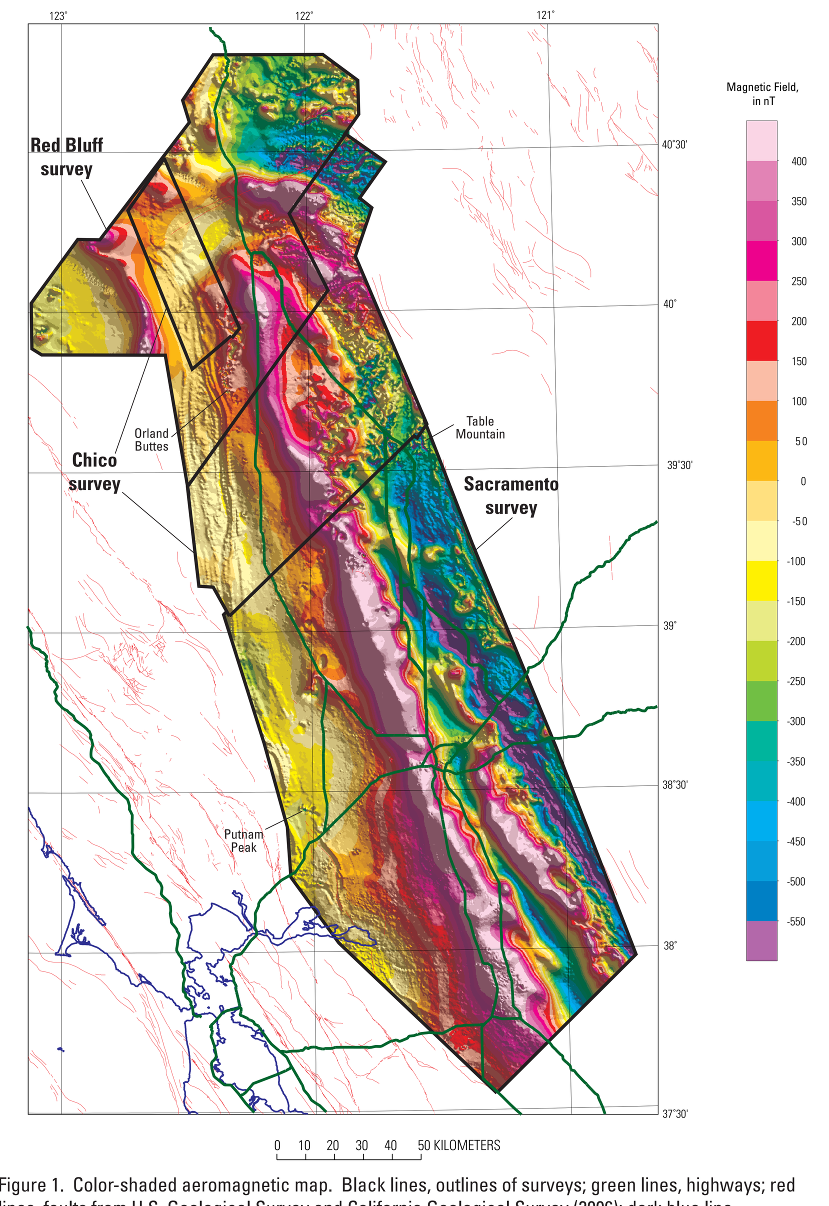
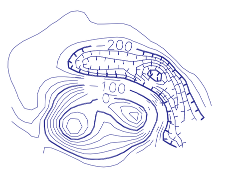


Figure 1. Color-shaded aeromagnetic map. Black lines, outlines of surveys; green lines, highways; red lines, faults from U.S. Geological Survey and California Geological Survey (2006); dark blue line, coastline.

EXPLANATION

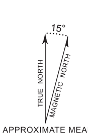


Contours of total magnetic field intensity relative to the International Geomagnetic Reference Field. Contour interval is 20 nanoteslas. Hachures indicate closed magnetic lows.

Magenta circles indicate locations of boundaries between regions of different magnetizations (see accompanying text for explanation): larger circles denote gradient amplitudes greater than the mean for the study area and smaller circles denote amplitudes less than the mean.

Highway

Shaded-relief topographic base from USGS National Elevation dataset.
http://ned.usgs.gov
North American Datum of 1927 (NAD27).



APPROXIMATE MEAN DECLINATION, 2015

SCALE 1:400 000
1 0 1 2 3 4 5 6 7 8 MILES
1 0 1 2 3 4 5 6 7 8 9 10 KILOMETERS

MAP LOCATION

GIS database and digital cartography by V.E. Langenheim
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Aeromagnetic Survey Map of the Sacramento Valley, California

By
Victoria E. Langenheim
2015

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