DEPARTMENT OF THE INTERIOR
UNITED STATED GEOLOGICAL SURVEY

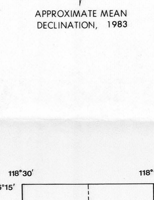
MISCELLANEOUS FIELD STUDIES
MAP MF-1395-B

Base from U.S. Geological Survey, 1:62,500, Hockett Peak, Kernville, Lamont Peak, Monache Mtn., 1956; 1:24,000, Onyx, Weldon, 1972.

SCALE 1:48 000

CONTOUR INTERVAL 40 AND 80 FEET
DATUM IS MEAN SEA LEVEL

Geology from Bergquist and Nitkiewicz (1982)



AEROMAGNETIC MAP

AEROMAGNETIC SYMBOLS

51800 — MAGNETIC CONTOURS-- Showing residual magnetic intensity in nanoteslas (gammas). Contour intervals 20 and 100 nanoteslas. Hachures indicate direction of decreasing intensity

X 51594 — MAXIMUM OR MINIMUM INTENSITY--Location measured within closed high or closed low

FLIGHT PATH-- Showing location and spacing of data

GEOLOGY SYMBOLS

CONTACT--Dotted where concealed, hachured where gradational

FAULT--Arrows indicate relative horizontal movement

STRIKE AND DIP OF INCLINED BEDDING

STRIKE AND DIP OF FOLIATION

Inclined

Vertical

STRIKE AND DIP OF JOINTS

Inclined--Measured in field

Steeply dipping to vertical--Mapped from aerial photographs

Vertical--Measured in field

Horizontal--Measured in field

DRAG FOLDS--Arrow in direction of axial plunge

SCHLIEREN--Arrows in direction of elongation, dip indeterminate

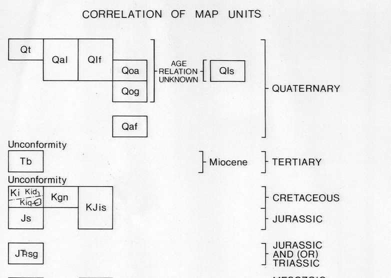
DIKE--Arrow in direction of dip

SAMPLE LOCATION--Modal analysis

SAMPLE LOCATION--K-Ar dating

BOUNDARY--Domeland Wilderness and contiguous roadless areas

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qt	TALUS (QUATERNARY)
Qal	ALLUVIUM (QUATERNARY)
Qlf	LACUSTRINE AND FLUVIATILE DEPOSITS (QUATERNARY)
Qoa	OLDER ALLUVIUM (QUATERNARY)
Qog	OLDER GRAVEL (QUATERNARY)
Oaf	ALLUVIAL FAN DEPOSITS (QUATERNARY)
Qls	LANDSLIDE DEPOSITS (QUATERNARY)
Tb	BASALT (TERTIARY)
Ki	ISABELLA GRANODIORITE OF MILLER (1931) (CRETACEOUS)--Locally includes:
Kid	Dikes
Kiq	Quartz
Kgn	GNEISS (CRETACEOUS)
KJis	ISABELLA GRANODIORITE OF MILLER (1931) AND SACATAR QUARTZ DIORITE OF MILLER AND WEBB (1940), UNDIVIDED (CRETACEOUS AND JURASSIC)
Js	SACATAR QUARTZ DIORITE (JURASSIC)
JTR sg	SUMMIT GABBRO OF MILLER AND WEBB (1940) (JURASSIC AND (OR) TRIASSIC)
MzPzk	KERNVILLE SERIES OF MILLER (1931) (MESOZOIC AND (OR) PALEOZOIC)
MzPzm	MIXED ROCKS (MESOZOIC AND (OR) PALEOZOIC)

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts required the U. S. Geological Survey and the U. S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of geophysical surveys of the Domeland Wilderness and Woodpecker (02506) and Domeland Addition Roadless Areas (02507) in the Sequoia National Forest, Kern and Tulare Counties, California. The Domeland Wilderness was established by Public Law 88-577, September 3, 1964. The Woodpecker and Domeland Addition Roadless Areas were classified as further planning areas during the second Roadless Area Review and Evaluation (RARE II) by the U. S. Forest Service, January 1979.

INTRODUCTION

Geophysical maps were compiled and constructed from gravity and aeromagnetic surveys of the study area in order to assist the geologic mapping and the mineral resource assessment of the Domeland Wilderness and contiguous roadless areas. The isostatic residual gravity map (fig. 1) primarily reflects lateral density variations within the upper crust beneath the region studied. The aeromagnetic map reflects the distribution of magnetization in the underlying rocks. Because different rock types are often characterized by different densities and magnetic properties, the geophysical maps can be used to extend the geologic mapping into areas covered by surficial deposits and to help determine the subsurface locations and attitudes of contacts between rock units with contrasting properties.

GRAVITY DATA

Gravity data over the Domeland Wilderness and contiguous roadless areas were obtained from Snyder and others (1982). The observed gravity data had been reduced to Bouguer anomalies using a density of 2.67 g/cm^3 and were corrected for the effects of terrain out to a radius of 103.6 mi (166.7 km). Uncertainties in the Bouguer anomalies arising from uncertainties in station elevations, terrain corrections and gravimeter drift probably are less than 1-2 mGal for most of the gravity data although larger errors could exist for data in areas of extreme topographic relief.

The Bouguer gravity field over the study area and surrounding regions reflects both shallow crustal density distributions and variations of crustal thickness consistent with the concept of isostasy (Oliver, 1980). In order to isolate that part of the gravity field that arises from near-surface density distributions, the isostatic residual gravity map (fig. 1) was constructed from the Bouger gravity data by removing a regional field computed from a model of the crust-mantle interface (Roberts and others, 1981). The geometry of the Moho was determined from topography averaged over 3' X 3' compartments by assuming complete local Airy-type isostatic compensation with a topographic density of 2.67 g/cm^3, normal sea level crustal thickness of 15.6 mi (25 km) and density contrast across the Moho of 0.40 g/cm^3. The gravity effect of the model Moho out to a radius of 103.6 mi (166.7 km) was calculated at each station using a computer program by Jachens and Roberts (1981). The effects of topography and isostatic compensation for all regions at distances greater than 103.6 mi (166.7 km) were taken from the maps of Karki and others (1961).

INTERPRETATION OF GRAVITY DATA

The most prominent feature of the residual gravity field (fig. 1) in the vicinity of the Domeland Wilderness and the contiguous Roadless Areas is the inverted L-shaped gravity high that lies just north and east of the study area boundaries. Along its crest, outlined by the -5 mGal contour, the gravity high attains maximum values slightly greater than 0 mGal. The magnitude of the anomaly is 25 ± 5 mGal. Because the residual gravity field over more than 80 percent of the study area is dominated by the southern and western flanks of this gravity high, an understanding of its source is crucial to the interpretation of the gravity data within the study area.

Oliver and Robbins (1981), in their interpretation of the Bouguer gravity map of California, Fresno sheet, discuss a number of possible shallow and deep-seated sources for the gravity high. They suggest as possible shallow sources high density plutonic rocks such as tonalite, quartz diorite, diorite, and anorthosite. For deep-seated sources they include mafic residual rocks and (or) huge xenoliths of country rock within the batholith, high density topography on the floor of the batholith, remnants of subducted slabs beneath the batholith, and an inter-mantle plume. In order to differentiate between these possible sources, detailed geologic maps of the plutonic rocks in the vicinity of the study area are required.

Reconnaissance geologic maps that cover most of the region of the gravity high (Jennings and others, 1977) do not give much information about the types of plutonic rocks, because intrusive rocks with compositions ranging from granite to diorite are all shown as a single unit. Within the study area, however, Bergquist and Nitkiewicz (1982) have mapped three separate plutonic units. The most extensive unit, the Isabella Granodiorite of Miller (1931), is exposed over more than 90 percent of the study area. A more mafic unit, the Sacatar Quartz Diorite of Miller and Webb (1940), is exposed along the northern boundary of the study areas, in a triangular shaped nose that projects westward from about midway along the eastern boundary, and in a few scattered patches in the southern part of the study area. An area underlain by the Isabella Granodiorite and Sacatar Qiartz Diorite, undivided unit occurs in the northeast part of the study area and along the northern part of the eastern boundary. The eastern limit of this undivided unit is east of the study area, but its precise location is not known. Very small exposures of a third unit, the Summit Gabbro of Miller and Webb (1940), occur at five scattered locations within the study area. Densities (based on measurement of hand samples) of the three plutonic units are shown in fig. 2.

Although detailed geologic maps do not include much of the gravity high, within the study area where a detailed map is available, a good correlation exists between the geology and gravity data. The highest gravity values, present in the northern limb of the anomaly, occur where high-density Sacatar Quartz Diorite is exposed at the surface. The gravity contours in this region trend east-west, parallel to the contact between the Sacatar Quartz Diorite and the Sacatar-Isabella, undivided unit. Along the eastern boundary of the study area the triangular shaped nose of the Sacatar coincides with a similarly shaped nose in the gravity contours. The axis of the gravity nose appears to be offset slightly to the south of exposures of the Sacatar, but this probably results from the poor data distribution in this area. North of this nose the curved form of the gravity contours is quite similar to the form of the contact between the Isabella Granodiorite to the south and west and the Sacatar or the Sacatar-Isabella, undivided unit to the north and east. Detailed geologic maps do not extend as far east as the crest of the east limb of the gravity high, but numerous exposures of the Sacatar are present in this area (J. R. Bergquist, oral commun., 1980).

The spatial correlation between the location of the residual gravity high and the distribution of the Sacatar Quartz Diorite strongly suggests that this high density unit (2.83 ± 0.06 (1σ) g/cm^3) is the source of the gravity anomaly and that most of the residual gravity field over the study area reflects the distribution of the Sacatar concealed within the lower density (2.63 ± 0.04 (1σ) g/cm^3) Isabella Granodiorite. Computer modeling based on this interpretation gives some insight into the distribution of the Sacatar Quartz Diorite in the subsurface.

Fig. 3 shows two models which satisfy the gravity data along profile A-A' assuming a density contrast of 0.2 g/cm^3. These and other equally satisfactory models imply that beneath the northern axis of the gravity high the density contrast extends to a depth of at least 2.5 mi (4 km) and that the Sacatar pluton extends south, from its northern exposures, beneath the Isabella for a distance of approximately 3.75 mi (6 km).

Similar modeling (not illustrated) of the gravity data over exposures of the Sacatar along the eastern boundary implies that here the density contrast extends to depths of about 0.6 - 0.9 mi (1-1.5 km), but deepens eastward to about 2.5 mi (4 km) under the axis of the gravity high. Therefore, the model results suggest that within the study area the Isabella Granodiorite both overlies (in the north) and underlies (in the east) the Sacatar Quartz Diorite.

The cause of the southward increase in gravity values near the extreme southern end of the study area is unknown. However, the geologic map and the inferred geometric relations between the Sacatar and Isabella plutons in the north suggest that as the Isabella pluton was being emplaced, it intruded and engulfed remnants of the older Sacatar pluton. Thus the southward increase of gravity could reflect the presence of the Sacatar buried within the Isabella in this area. A few small patches of the Sacatar are exposed in the southern part of the study area.

The local gravity anomalies indicate that the density contrasts extend to a depth of about 2.5 mi (4 km), but do not yield direct information about what material lies below 2.5 mi (4 km). It is possible that comparison of the absolute values of the isostatic residual gravity in the study area with those from other parts of the Sierra Nevada batholith where deeper structures are suggested could resolve the question. However, such an investigation is beyond the scope of this report.

MAGNETIC DATA

The aeromagnetic map of the Domeland Wilderness (U.S. Geological Survey, 1979) was compiled from surveys flown in January and March, 1979. Total intensity magnetic data were collected along east-west flight lines spaced approximately 0.5 mi (0.8 km) apart. Flight line positions are shown on the map as widely dashed lines and individual flight lines are identified by alpha-numeric symbols along the westen boundary of the map. The surveys were flown at a height of 1000 ft (300 m) above the average terrain. Because the area surveyed contains considerable topographic relief, actual ground clearance varied between 320 ft (100 m) and 4600 ft (1400 m).

A residual magnetic map was generated by subtracting from the data the International Geomagnetic Reference Field (1975, updated to the months flown) and then adding a constant 51300 nT (nanotesla) to all data. The data were contoured by computer using a grid with dimensions of 575 ft (175 m) east-west and 1300 ft (400 m) north-south.

The aeromagnetic map reflects the distribution of magnetization in the rocks of the survey area. Individual anomalies can arise both from variation of magnetization within the rocks and from topographic effects in areas where the surface rocks are magnetic. Both types of anomalies are present on the Domeland Wilderness aeromagnetic map. Anomalies caused by topography in this region generally show magnetic highs over mountains and ridges and magnetic lows over adjacent valleys. At high geomagnetic latitudes such as those of the Domeland Wilderness (~60°), steep boundaries between regions of differing induced magnetization are associated with magnetic gradients and, the steepest part of the gradient generally occurs above the boundary (Vacquier and others, 1951).

Examination of the aeromagnetic map and its relation to the rock units exposed at the surface indicates that the Sacatar Quartz Diorite and parts of the Isabella Granodiorite are magnetic. The pronounced magnetic high that occurs above the exposure of the Sacatar Quartz Diorite along the eastern boundary of the study area indicates that the rocks here are more magnetic than the adjacent granite and granodiorite of the Isabella Granodiorite. Similarly, in the extreme northeast corner of the magnetic map, magnetic values are highest over exposures of the Isabella-Sacatar, undivided unit.

The presence of numerous magnetic anomalies over the mapped exposures of the Isabella Granodiorite suggests that the magnetization within this unit is highly variable. This can be seen clearly along flight line P-39 by examining the correlation between the magnetic pattern and the underlying topography. Along the western quarter of this line, the two magnetic highs occur directly above ridge crests, and the low between them occurs over the intervening valley, indicating that the surface rocks are magnetic. In contrast, no such correlation exists along the eastern three quarters of this line indicating that the surface rocks are much less magnetic than those to the west. Large variability in magnetic properties also is indicated by measurements of the magnetic susceptibility of 16 samples of rocks from the Isabella Granodiorite collected from 14 widely scattered sites (fig.2). The measured susceptibilities are distributed in roughly uniform fashion over a range that spans nearly two orders of magnitude.

Most of the magnetic anomalies over the Isabella pluton probably reflect a combination of topographic effects and somewhat random variations of magnetization within the unit. However, at least three features of the magnetic field over this pluton deserve further comment.

First, the magnetic background level over the eastern part of the Isabella pluton is systematically 50-150 nT lower than that over the western part. The transition between the two regions roughly coincides with the location of the 51800 nT contour. In some places, such as the extreme southwest corner of the map, the transition is very well defined and steep. Examination of the correlation between the magnetic field and the topography indicates that, in general, surface rocks west of the gradient are more magnetic than those to the east. A computer model of data along flight line P-40 suggests that the transition reflects a near vertical boundary between bodies of differing magnetization that extends to a depth of 2-2.5 mi (3-4 km). Similar modeling along flight lines P-9, -18, and -27 gives similar results, although some shallower dips to the east are indicated along parts of the boundary. This boundary could represent the contact between plutonic rocks emplaced during two separate stages of intrusion of the Isabella pluton or it may indicate a boundary between two rock masses that crystallized under differing conditions of oxygen fugacity (Ishihara, 1977).

Near the southeast corner of the magnetic map, a 2 x 2.5 mi (3 x 4 km) elliptical magnetic high occurs over the eastern low magnetic part of the Isabella pluton. The source of the anomaly is buried as indicated by the fact that one of the highest magnetic values (51787 nT) occurs over alluvial fill in the valley of the South Fork Kern River and by the fact that the nearly 2000 ft (600 m) of relief between the bottom of the valley and the adjacent ridges to the northwest are not reflected in the magnetic map. This anomaly could be the magnetic expression of a large buried block of the Sacatar Quartz Diorite, an interpretation that is compatible with the gravity increase toward the southern part of the study area. Along the northern edge of the magnetic map, a deep magnetic low occurs over Woodpecker Meadow. The low is adjacent to and just east of an exposure of metasedimentary rocks of the Kernville Series of Miller (1931), and could be caused by a large buried mass of non-magnetic metasedimentary rocks or possibly by non-magnetic rocks of the Isabella pluton that resulted from their interaction with the metasedimentary rocks during intrusion.

The steepest parts of the magnetic gradients that flank the magnetic high over the Sacatar pluton exposed along the eastern edge of the magnetic map correspond reasonably well with the mapped contact between the Sacatar Quartz Diorite and the Isabella Granodiorite along most of the contact. This relation indicates that the geologic contact also is the magnetic boundary. However, along flight line 20 the steepest part of the magnetic gradient lies about 2300 ft (700 m) west of the mapped contact suggesting that here the Sacatar Quartz Diorite extends westward beneath the Isabella Granodiorite for about 2300 ft (700 m).

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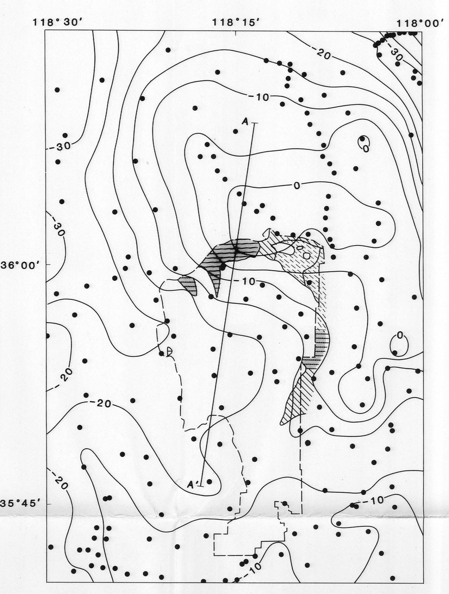


Fig. 1. Isostatic residual gravity map of the Domeland Wilderness and vicinity, California. Simplified geology after Bergquist and Nitkiewicz (1982) is shown only within or immediately adjacent to the study area.

EXPLANATION

Isabella Granodiorite of Miller (1931) (Cretaceous)

Isabella Granodiorite of Miller (1931) and Sacatar Quartz of Miller and Webb (1940), undivided (Cretaceous and Jurassic)

Sacatar Quartz Diorite of Miller and Webb (1940) (Jurassic)

Kernville Series of Miller (1931) (Mesozoic and (or) Paleozoic)

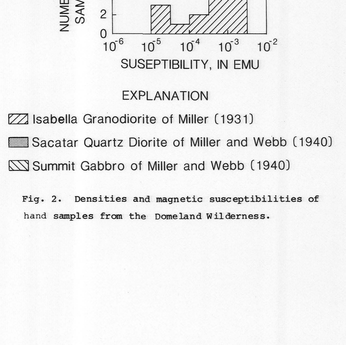
Contact

Gravity contour-Contour interval 5 mGal

Gravity observation point

A — A' Cross section line see figure 3

Boundary of wilderness and contiguous roadless areas



EXPLANATION

Isabella Granodiorite of Miller (1931)

Sacatar Quartz Diorite of Miller and Webb (1940)

Summit Gabbro of Miller and Webb (1940)

Fig. 2. Densities and magnetic susceptibilities of hand samples from the Domeland Wilderness.

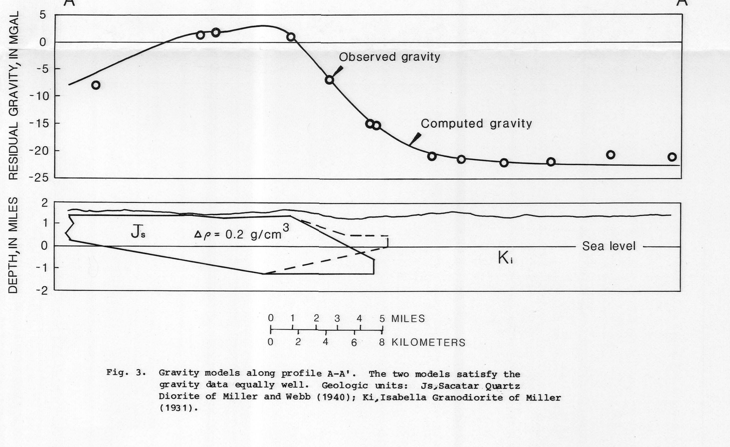
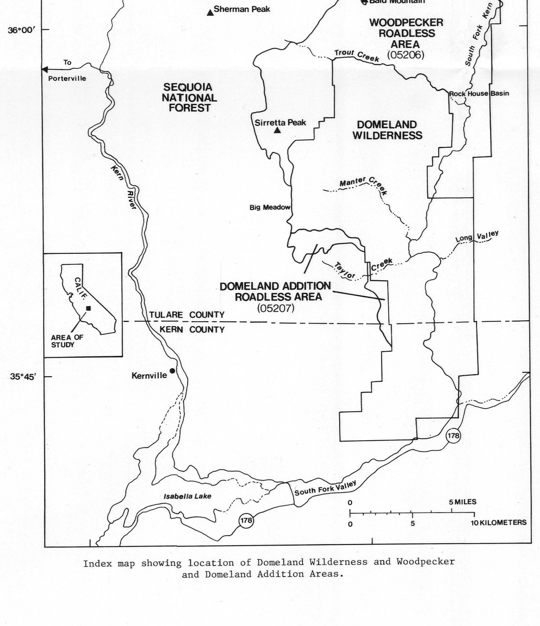
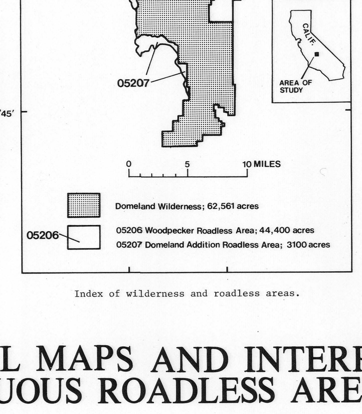


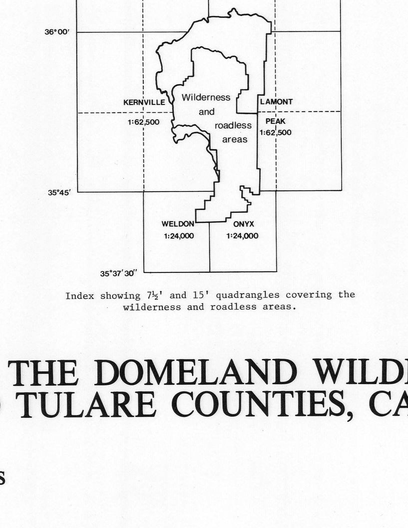
Fig. 3. Gravity models along profile A-A'. The two models satisfy the gravity data equally well. Geologic units: Js, Sacatar Quartz Diorite of Miller and Webb (1940); Ki, Isabella Granodiorite of Miller (1931).



Index map showing location of Domeland Wilderness and Woodpecker and Domeland Addition Areas.



Index of wilderness and roadless areas.



Index showing 7½' and 15' quadrangles covering the wilderness and roadless areas.

GEOPHYSICAL MAPS AND INTERPRETATION OF THE DOMELAND WILDERNESS AND CONTIGUOUS ROADLESS AREAS, KERN AND TULARE COUNTIES, CALIFORNIA

By
Robert C. Jachens
1983

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