DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Magnetic susceptibilities of modally analyzed granitic rocks from the southern Sierra Nevada, California

by

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Open-File Report 89-204

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1989

CONTENTS

ILLUSTRATIONS

Tables

1. Magnetic susceptibility averages and ranges for each granitic unit from the southern Sierra Nevada, California. Compilation includes all samples listed on Table 2 plus some samples with no mode, and some modal samples collected in 1987 and 1988 that are not listed in Ross (1987b).

2. Magnetic susceptibilities in 10^{-5} siu for individual modal samples of granitic rocks from the southern Sierra Nevada, California. Samples located on index maps in Ross, 1987b.

3. Comparison of modal magnetite with measured magnetic susceptibility for selected granitic samples in the southern Sierra Nevada.

INTRODUCTION

Magnetic susceptibility was measured on more than 1400 samples of granitic rocks to supplement a regional study of the basement rocks of the southern Sierra Nevada, California. The magnetic susceptibility studies, made long after most geologic mapping and petrographic studies were completed, would have been helpful in delineating some granitic units, particularly those major units that magnetic susceptibility results suggest are composite. Perhaps the main point to be gained from these measurements is that they are an easily obtainable tool that can in some places aid field mapping, especially in granitic terranes. In addition, magnetic susceptibility measurements also help in the interpretation of aeromagnetic data in terms of thicknesses of granitic plutons and the internal structure of the Sierra Nevada batholith at depth (Oliver, 1970, 1977, 1982).

MEASUREMENTS

Magnetic susceptibility is essentially a measure of the amount of magnetite present. One per cent magnetite produces a magnetic susceptibility of about $4000 \; x \; 10^{-5}$ siu (International standard units) which is approximately $3000 \; x \; 1^{-6}$ emu/cm^3 (cgs units), and the relation between susceptibility per cubic centimeter and the percentage of magnetite is nearly linear. Although the relation is relatively constant, coarse magnetite gives somewhat higher susceptibility readings for the same amount of magnetite (Nettleton, 1976, p. 360-364; Nagata, 1961, p. 127-131; Dobrin and Savit, 1988, p. 650-652). For a discussion on siu, see Goldman and Bell (1981, p. 15).

For the Sierra Nevada granitic rocks the susceptibility determinations were made from the same slab surfaces from which the modes were determined. The measurements were made with a hand-held susceptibility meter (JH-8 Geoinstruments) which operates according to the following description from the JH-8 operation manual:

> The function of the JH-8 is based on electromagnetic induction. There are two coils placed orthogonally to each other in the detector head, which is mounted in the bottom of the instrument case. In non-magnetic environment the voltage induced from transmitter coil to receiver coil is zero. When a sample is brought near the coils, a voltage which is proportional to magnetic susceptibility of the sample is induced to the receiver coil. This signal is detected by ----- an analog panel meter, which is ----- directly calibrated for susceptibility.

The magnetic susceptibility is read directly from a dial on the meter in 10^{-5} siu. Several readings are normally taken from each slab surface at different orientations and an average reading is recorded. Magnetic susceptibility can vary considerably even in a small hand specimen, and more so between samples, so a large number of samples will naturally give a more meaningful average value for a given granitic unit. However, despite these variations that probably result from the sporadic distribution of magnetite, it is found that for most granitic units in the southern Sierra Nevada there is a relatively distinctive susceptibility signature if several tens of samples are measured.

DISCUSSION

Regional pattern

In this report the average magnetic susceptibility of each granitic unit was used to show the regional pattern for the southern Sierra Nevada. These average values combined arbitrarily into three groups, 0-200, 200-1000, and >1000 x 10^{-5} siu, are the basis for Figure 1, on which the geology is generalized from Ross (1987a). The susceptibility groupings correlate to about <0.05, 0.05 to 0.25, and >0.25 per cent of magnetite, respectively. The unit averages are based on as many as 100 or more samples for the more extensive units such as Bear Valley Springs and Castle Rock and range down to only a few samples for some of the smaller units (Table 1). In addition, Table 2 lists all individually measured samples. Sample locations can be obtained from index maps in Ross (1987b).

The pattern of magnetic susceptibility for the southern Sierra Nevada (Fig. 1) shows a rather magnetically quiet southern tip and western flank, contrasted with northwestern trending belts of intermediate to high susceptibility in the central and eastern part of the range. The northwest-trending grain of the magnetic susceptibility belt is at least in part dictated by the general northwest elongation of the plutons, but there is a notable increase in magnetic susceptibility tò the north and east in this area.

For the major (more extensive) plutons, histograms were prepared that show the ranges of magnetic susceptibilities (Fig. 2). These histograms show the plutons have essentially three kinds of distribution patterns: (1) low agnetic susceptibility units, where almost all values are 0-200 x 10^{-5} siu (for example, Bear Valley Springs, Whiterock, and Gato-Montes), (2) an intermediate group with many readings below 200 x 10^{-5} siu, but a spread of values to 1000 x 10^{-5} siu (Cyrus Flat, Walt Klein, and Pine Flat), and (3) those bodies with a wide range of magnetic susceptibility where values range to several thousand x 10^{-5} siu (Castle Rock, Sacatar, Carver-Bowen, and Peppermint Meadow). These distribution patterns may be somewhat arbitrary as the sporadic distribution of a few grains of magnetite can cause significant variations between individual samples in the more magnetic units. However, in the plutons with overall low magnetic susceptibility (category 1), even the large bodies such as Bear Valley Springs are consistently low, although they may have abundant hornblende and biotite, the common hosts of magnetite grains.

Relation of normative magnetite to magnetic susceptibility

Ford and others (1988) observed a positive correlation between magnetic susceptibility and normative magnetite (CIPW) in tonalitic rocks and gneisses of the Glacier Peak area of Washington. To test this correlation for the southern Sierra Nevada, a similar plot was made using 94 chemically analyzed rocks for which there is also susceptibility data (Fig. 3). A gross positive correlation of susceptibility and CIPW normative magnetite is evident, but normative magnetite does vary considerably in rocks of about the same magnetic susceptibility. That variation is more apparent for the higher susceptibility values producing a fan-shaped field. For any single chemically analyzed sample, however, normative magnetite may be a very poor predictor of susceptibility and *vice versa.* Unfortunately, no good data on modal magnetite abundance were available from petrographic studies in the southern Sierra Nevada to compare with susceptibility values. For a few samples the amount of modal metallic opaques has been reported, but with no distinction made between magnetite and other metallic opaques. Possibly an approximate estimate of modal magnetite can be obtained from the easily measured magnetic susceptibility.

The supposition that magnetic susceptibility may be an easily acquired measure of modal magnetite was tested for 17 selected samples with high magnetic susceptibility (Table 3). Modal estimates were made by counting the metallic opaque grains on the same stained slab surface from which readings were made with the susceptibility meter. One thousand points were counted with a grid of points with approximately 1.5 mm centers. All metallic grains were assumed to be magnetite and 1 percent of magnetite was taken to equal about $4000 \, x \, 10^{-5}$ siu for the calculated susceptibilities listed in Table 3. Generally this calculated siu (modal) was lower than the measured siu (meter), but there is much scatter and no consistency. Reasons for this scatter probably include, modal inaccuracy of such a minor constituent, the meter reading may be influenced by magnetite concealed beneath the slab surface, and non-magnetic opaque grains may be present. Most suspicious as the cause of the scatter is the assumption that all metallic opaque grains are magnetite.

Petrographic study of the metallic opaque minerals on stained slabs of selected samples with a high magnetic susceptibility confirmed that almost invariably the opaque grains are silvery, magnetic magnetite. Further study of stained slabs with low magnetic susceptibility showed absence or very sparse presence of magnetite, and only rarely the presence of any non-metallic opaque grains. Those identified were mostly "hematitic" alterations of magnetite. This was especially noted in sample 4414 of the granite of Bishop Ranch (Table 3), a visibly altered rock. Particularly closely examined were samples with low magnetic susceptibility containing abundant biotite and hornblende. These latter rocks, suspected of harboring ilmenite, were almost without opaque minerals. Presumably in southern Sierra Nevada granitic rocks, magnetite is the only significant metallic opaque mineral. Further north in the Sierra Nevada, magnetite is also the predominant metallic opaque mineral; in reduced rocks the iron goes into mostly hornblende and biotite, and does not crystallizes as ilmenite (F.C.W. Dodge, oral communication, 1989).

The limited data of Table 3 suggest caution in using magnetic susceptibility as a fast and easy way to determine total magnetite, particularly for individual samples. Averages, however, do show a fair correspondence between amount of modal magnetite and percent of magnetite based on magnetic susceptibility readings.

Magnetic susceptibility as a geologic mapping aid

The magnetic susceptibility values for some units point out certain discrepancies that suggest some rocks were not correctly mapped. This is particularly true of the large Castle Rock unit. In my early mapping in the southernmost Sierra Nevada (Ross, in press), the rocks that later were correlated with the Castle Rock were divided into three "facies": Claraville, Whiterock, and Bootleg Canyon. The Claraville rocks, commonly porphyritic, were easily accommodated into the Castle Rock unit to the north. The Whiterock and Bootleg rocks, modally similar, were later defined together as the Whiterock facies of the Castle Rock unit (Ross, 1987a). The Whiterock facies is somewhat darker, relatively non-porphyritic, has less K-feldspar, and generally crops out southwest of the main Castle Rock unit. However, no obvious contacts were seen, and the Whiterock was considered to be closely related to the main Castle Rock unit. Magnetic susceptibility of the modal samples, made long after most field studies, revealed strong magnetic differences between Castle Rock and Whiterock. The Whiterock sample measurements were universally low, with susceptibilities on average about 25×10^{-5} siu, whereas the porphyritic Castle Rock averaged more than 1600×10^{-5} siu. Furthermore, there was a "buffer zone" of rocks originally mapped as Castle Rock, but with the low magnetic susceptibility pattern of

Whiterock, that extends north of the originally defined Whiterock facies (Fig. 4). Also, a small number of samples with low susceptibility in the "Castle Rock" adjacent to bodies of the granites of Bishop Ranch and Sherman Pass may instead belong to those bodies (Table 2). This further suggests that a portable susceptibility meter might be a useful adjunct to field studies. It provides an easily obtainable measurement that may aid in distinguishing subtly different bodies, especially in poorly exposed terranes where contacts are rarely seen.

The granodiorite of Rabbit Island has relatively high magnetic susceptibility (average of over 1300 x 10^{-5} siu), but includes two large areas of rocks to the southwest where magnetic susceptibilities are much lower (Fig. 5). These anomalous rocks, in part separated from the main Rabbit Island mass by other units, may not be Rabbit Island. The easternmost of these suspect rocks are generally somewhat lighter than typical Rabbit Island exposures, were controversial in the field, and were only somewhat grudgingly mapped as Rabbit Island. The magnetic susceptibility contrast (less than 50 x 10^{-5} siu for the suspect rocks, compared to more than 1300 x 10^{-5} siu for the rest of the mass) now suggests that these eastern exposures may be related to the Whiterock mass, or, even more likely, may be a separate intrusive body.

The north-south elongated body of suspect Rabbit Island further to the west (Fig. 5) has contrastingly lower but variable magnetic susceptibility. It has only been sampled at its north end, and was referred to in the field as "dark Rabbit Island." The sparse samples indicate the elongate body is darker with a color index averaging 26.5 as contrasted to the average of the rest of Rabbit Island with 18. The biggest difference is that "dark Rabbit Island" samples have about twice as much hornblende. However, one sample at the northernmost tip of the body is normal Rabbit Island, both in texture and mineral content.

Rubidium/strontium systematics also suggest this westernmost body is somewhat different. A sample from the "dark Rabbit Island" mass has $^{87}Sr/^{86}Sr = .7065$, whereas several samples from other Rabbit Island outcrops all have ratios above .7071 (R.W. Kistler, written commun., 1987). The dark sample is also lower in both total Rb and Sr. One anomalous Rb/Sr sample may not be definitive, but it is at least suggestive of a difference. These dark rocks are not like the Whiterock, either texturally or mineralogically, and also they are more variable magnetically than the Whiterock. Probably this north-south elongated body is separate from both the Whiterock and Rabbit Island units, though more closely related to the Rabbit Island.

Miscellaneous anomalous samples and their possible meaning

Some variation in magnetic susceptibility is normal in these heterogeneous rocks, but the following especially anomalous samples are worth some discussion.

Perhaps the most anomalous single sample is in the granodiorite of Alder Creek that has otherwise rather consistent magnetic susceptibility values of 10-50 x 10^{-5} siu, but the one anomalous sample is 2000 x 10^{-5} siu (Table 2). This sample near the west edge of the Alder Creek mass is adjacent to outcrops of the tonalite of Carver-Bowen, of high susceptibility. Very likely the suspect Alder Creek sample is from a mismapped outcrop of Carver-Bowen.

One Kern River sample (4648) is a hypabyssal-looking or quench-textured rock that is modally similar to other Kern River samples, but the mode has one per cent metallic opaques. The magnetic susceptibility (2500 x 10^{-5} siu) which is 10 times the unit average appears to result from a fortuitous concentration of magnetite.

One Tejon Lookout sample (3752A) from the easternmost mass of the unit has a magnetic susceptibility much higher (1400 x 10^{-5} siu) than the unit average (140 x 10^{-5} siu). This is a modally atypical sample with 50 per cent K-feldspar and about 0.5 per cent metallic opaques -- about the right amount to account for the high susceptibility if the opaques are magnetite. Although the sample is atypical, other samples from the same mass that are relatively high in magnetic susceptibility are not modally unusual, suggesting this eastern mass is not a separate body but part of the variable Tejon Lookout unit.

The granodiorite of Wagy Flat has a great range of magnetic susceptibility ($10\text{-}2400 \times 10^{-5}$ siu). This distinctly textured unit, however, is one coherent body (though offset by the Kern Canyon fault) that appears to be characterized by the sporadic occurrence of magnetite.

Pine Flat generally has a relatively high susceptibility with an average of 500×10^{-5} siu with many samples above 1000×10^{-5} siu. Scattered through the mass are samples as low as 10×10^{-5} siu, including four samples of dikes into the Dunlap Meadows unit that texturally resemble Pine Flat rocks, but have somewhat lower color indices (particularly low in hornblende). These dikes were used as evidence that the Pine Flat unit intruded, and was younger than, the Dunlap Meadows (Ross, 1987a). The fact that there are similar low susceptibility samples within the main Pine Flat body that are texturally and mineralogically similar to the rest of the Pine Flat, suggests the dikes are indeed Pine Flat, just somewhat lighter than most other parts of the unit.

The granodiorite of Poso Flat has generally low magnetic susceptibility (average about 60×10^{-5} siu), not much different from the tonalite of Bear Valley Springs (average about 50×10^{-5} siu), which it is probably related to. Three samples[1], only questionably part of the Poso Flat unit, are anomalously high (500, 700, and 800×10^{-5} siu). Two are close to rocks that are texturally like the Walt Klein, and near the main Walt Klein body and the other is mixed in with an assortment of dike rocks. Both Walt Klein and the dike rocks have generally higher magnetic susceptibilities than Poso Flat and tend to confirm field suspicions that the three samples are not Poso Flat. Another sample, collected in 1987[2], mapped as part of the Walt Klein mass but some distance from other Walt Klein outcrops, lacks the distinctive Walt Klein texture, although the mode is compatible with other Walt Klein samples. It also has a magnetic susceptibility (1600×10^{-5} siu) much higher than average Walt Klein (150×10^{-5} siu) and may be part of a separate mass.

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[1]Samples 66227, 6628, from near the Granite Road about 6 kilometers southwest of Glennville, and sample 6644, from abouy 4 kilometers SSE of Glennville, were collected after publication of Ross (1987b).

[2]Sample 6581, from about 7 kilometers southwest of Woody, was collected after publication of Ross (1987b).

These samples point out how markedly anomalous samples may be used to recheck field mapping. Normally, no one sample is definitive as all units have some range in magnetic susceptibility, locally as much as one order of magnitude in a small outcrop. However, if a unit is, on average, consistently low, or high, a group of distinctly anomalous samples may be reason to suspect the original mapping, especially if the anomalous samples are near a contact with a body with which their magnetic susceptibility is more compatible.

Magnetic susceptibility data to support a reconstruction model of part of southern California

For many years there has been a continuing controversy as to whether the Salinian block originated a few hundred kilometers to the south in southern California, at least in part connected to the southern Sierra Nevada, or originated a couple thousand kilometers south of its present position and bears no relation to southern California. Isotopic data (Kistler, in press) supported by petrographic and chemical data (Ross, 1984) suggest a tie between the northern part of the Salinian block and the southernmost Sierra Nevada. A reconstruction based on these data (Fig. 6) juxtaposes the northern Salinian block against the southern Sierra Nevada, juxtaposes the Gabilan Range of the Salinian block with the Neenach area, and places the La Panza Range near the Thermal Canyon locality, if the right-lateral offset of a postulated mid-Tertiary fault (Smith, 1977) is restored along with offsets of the San Andreas and San Gabriel faults (Fig. 7). Correlation of the Thermal Canyon and La Panza areas has been suggested by the petrographic and isotopic similarity of porphyritic granodiorite and distinctive "polka-dot granite" dikes at both localities (Joseph and others, 1982). The correlation of Miocene volcanic rocks of the Neenach area with those of the Pinnacles in the Gabilan Range is well established (Matthews, 1976). However, the correlation of granitic rocks near these volcanics is much more tentative, although the granitic rocks are petrographically grossly comparable (Ross, 1984).

These suspected correlations, indicating a few hundred kilometers of offset on the San Andreas and related faults, fly directly in the face of paleomagnetic data which suggest that the

Salinian block may have originated as much as 2500 kilometers south of its present position (Champion and others, 1984). If these paleomagnetic data are valid, the petrographic, chemical, and isotopic similarity of the Salinian block to relatively nearby basement could be a string of unrelated coincidences.

Magnetic susceptibility patterns may have something to say about these problematic rocks. Magnetic susceptibility was measured on about 100 granitic samples from a reference collection composed of representative samples from the Salinian block, the Neenach area, and the Thermal Canyon area near Palm Springs (Fig. 8). The reference collection is only a small sample of a much more extensive collection that was made during the study of the Salinian block, but still may provide some meaningful regional magnetic data.

In the Salinian block, the magnetic susceptibility increases to the south (Fig. 9). A rather arbitrary three-fold split of the Salinian block shows a northern belt (including the north part of the Santa Lucia Range and most of the Gabilan Range) with an average value of 85×10^{-5} siu (32 samples). A central belt (most of the Santa Lucia Range and the southernmost Gabilan Range) has an average value of 260×10^{-5} siu (12 samples). Further south, the La Panza Range and the correlative Adelaide mass average 975×10^{-5} siu (4 samples).

In the Neenach area (Fig. 10) there is a marked magnetic susceptibility difference between the two major granitic rock types. The more easterly, and more extensive, Fairmont Reservoir body averages 1650×10^{-5} siu (35 samples) whereas the Burnt Peak body to the west averages only 130×10^{-5} siu. Felsic variants scattered through both units have a wide range of magnetic susceptibility from 0-2000 $\times 10^{-5}$ siu. The Fairmont Reservoir body has fewer mafic minerals than the Burnt Peak body, but does have more modal opaque minerals (presumably predominantly or entirely magnetite), accounting for the higher susceptibility of the more felsic rock.

The porphyritic granodiorite of Thermal Canyon (Fig. 8) has a rather high magnetic susceptibility of 2000-2200 x 10^{-5} siu based on only three samples. These Thermal Canyon samples are somewhat higher in magnetic susceptibility than the presumed correlatives of the La Panza Range. Nevertheless, considering that one La Panza sample is as high as 1600 x 10^{-5} siu, and the small number of samples, I would suggest that the sparse magnetic susceptibility data don't rule out a correlation, especially in view of the petrographic and isotopic similarities and the presence of unusual polka-dot dikes in both areas.

In the largely isotope data-based reconstruction of part of southern California (Fig. 6) the best match is between the low magnetic susceptibility areas of the northern Salinian block and the southern Sierra Nevada. Both these rather extensive granitic areas are anomalously low in magnetite and "magnetically" certainly support the isotopic reconstruction.

Perhaps the biggest problem in matching magnetic susceptibility to the Kistler reconstruction (Fig. 6) is the juxtaposition of the Fairmont Reservoir body of rather high magnetic susceptibility (as high as 3000 x 10^{-5} siu for some samples) against the lower values from the central Salinian belt. The sparse exposure of granitic basement rock in the central and southern Salinian block between the Gabilan Range and the La Panza Range (Fig. 9) precludes any meaningful comparison of this area with the Fairmont mass. However, the southern Gabilan Range sample (500 x 10^{-5} siu) and the Adelaide sample (900 x 10^{-5} siu) are both within the range of some Fairmont Reservoir samples (Fig. 10). In conclusion, the magnetic susceptibility patterns across the San Andreas and San Gregorio-Hosgri faults in general support the isotopic reconstruction of Kistler (*in press*). Further magnetic susceptibility studies are needed though, particularly of the exposed granitic basement east of the San Andreas fault between the Fairmont Reservoir area and Thermal Canyon.

Some indirect evidence that the basement has a relatively high magnetic susceptibility between the Neenach area and Thermal Canyon is found in aeromagnetic data. An aeromagnetic high over the Fairmont Reservoir granitic rocks of the Neenach area is comparable (High Life Helicopters, Inc./QEB, Inc., 1980) to magnetic highs northeast of the San Andreas fault in the Holcomb Ridge-Wrightwood area (Hanna and others, 19872; High Life Helicopters, Inc./QEB, Inc., 1980), suggesting that these basement rocks also have relatively high magnetic susceptibility. A belt of similar aeromagnetic highs (High Life Helicopters, Inc./QEB, Inc., 1980) extends along the northeast side of the San Andreas fault and on the south flank of the San Bernardino Mountains from Cajon Pass east to the Banning Pass area, and approaching the latitude of the Thermal Canyon exposures. These aeromagnetic data sample an area of various granitic and metamorphic rock types and provide only suggestions of overall high magnetic susceptibility. Individual samples of the various basement rock types still need to be sampled to determine a truly meaningful picture of the amount and variability of the magnetic susceptibility in this area.

Somewhat more direct evidence of the high magnetic susceptibility of the Holcomb Ridge-Wrightwood area is afforded by modes of samples of the granodiorite of Holcomb Ridge and associated gneissic rocks. Modal analyses (Ross, 1972) show samples of the granodiorite contain up to 1 percent metallic opaque minerals (probably mostly, if not all, magnetite); the gneissic rocks also contain probable magnetite. Unfortunately petrographic work on these samples was done before magnetic susceptibility meters became the rage. The samples have since been discarded except for a few representatives that are in the Smithsonian Institution, so further sampling will be necessary to confirm the relatively high magnetic susceptibility of this area.

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APPENDIX

Comparison of magnetic susceptibility readings from two different meters

More than 600 granitic samples collected between lat 35°30' and 36°00'N in the southern Sierra Nevada were measured for magnetic susceptibility both by a "Bison" meter that records in emu (electromagnetic units in the cgs system) and a JH-8 Geoinstruments ("Helsinki") meter that records in siu (International standard units). Readings in the cgs system can be converted to siu by multiplying by 4π (12.57). When this simple conversion factor was applied to the Bison (cgs) readings the results were not the same as the Helsinki (siu) meter readings from the same samples. The readings between the two meters, though not equivalent, were nevertheless consistent (the relative ranking of magnetic susceptibility values from high to low was generally similar for both meters).

Samples of relatively low magnetic susceptibility ($<150 \times 10^{-5}$ siu) gave readings lower (in part much lower) on the Helsinki meter than on the Bison meter (Fig. 11). For practical purposes this difference is probably not significant as rocks in this range are relatively non-magnetic. The "bunching" of the values on Figure 11 for samples of low magnetic susceptibility is somewhat artificial as the Bison (cgs) meter is read in much broader categories than the Helsinki (siu) meter.

In the samples with higher magnetic susceptibility ($>150 \times 10^{-5}$ siu) the results were reversed between the two meters (Fig. 11). Readings on the Bison (cgs) meter were invariably lower than readings on the Helsinki (siu) meter. The ration Bison:Helsinki ranged from 0.6 to 0.9 with 0.63 the most prevalent ratio. The reasons for the difference between the two meters is at present moot and needs to be investigated.

Figure 1. Southern Sierra Nevada, California

A. Index to location.

B. Generalized geologic map showing magnetic susceptibility in siu for granitic rocks. Uncolored areas within patterned portion of the map are various non-granitic units (Mesczoic metamorphic rocks, Cenozoic sedimentary and volcanic rocks, and alluvial deposits). Compilation based on granitic unit averages from Table 2.

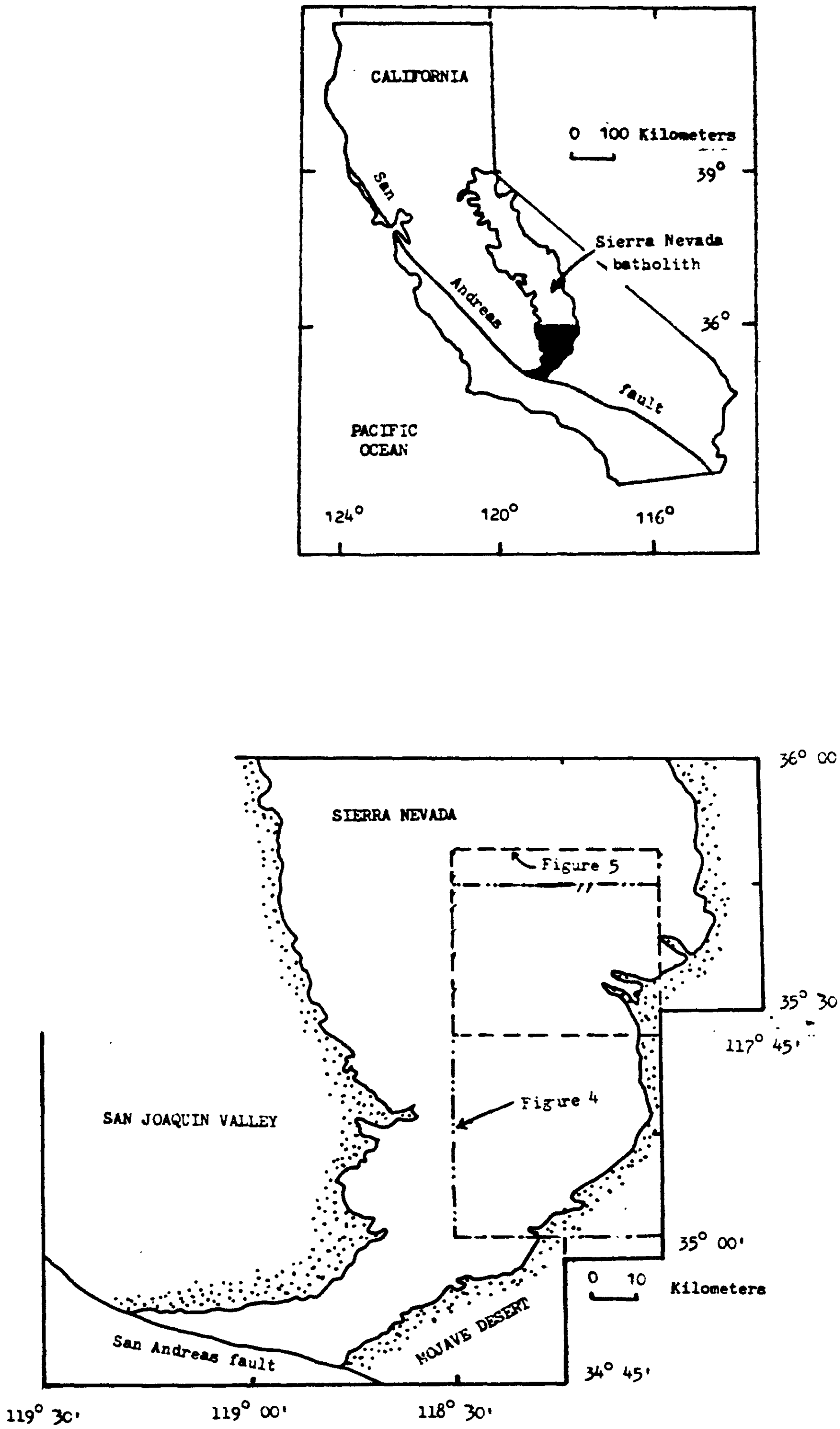

CALIFORNIA
0 100 Kilometers
39°
San Andreas fault
Sierra Nevada batholith
36°
PACIFIC OCEAN
124°
120°
116°
36° 00'
SIERRA NEVADA
Figure 5
35° 30'
117° 45'
SAN JOAQUIN VALLEY
Figure 4
35° 00'
0 10 Kilometers
MOJAVE DESERT
San Andreas fault
34° 45'
119° 30'
119° 00'
118° 30'

Figure 1A

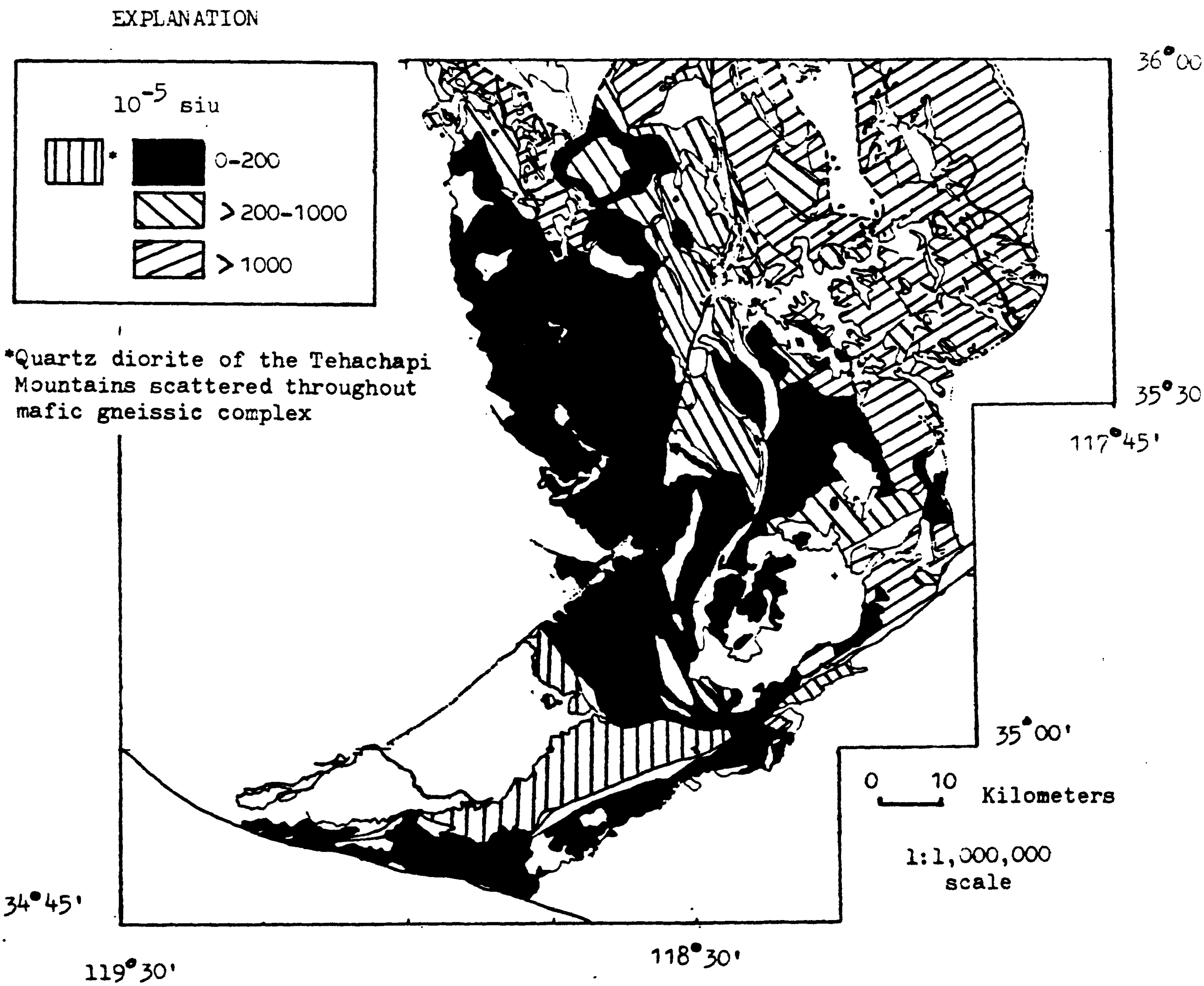

EXPLANATION
10^{-5} siu
0-200
>200-1000
>1000
*Quartz diorite of the Tehachapi Mountains scattered throughout mafic gneissic complex
36°00'
35°30'
117°45'
35°00'
0 10 Kilometers
1:1,000,000 scale
34°45'
119°30'
118°30'

Figure 1B

Figure 2. Histograms showing range of magnetic susceptibility for major granitic units of the southern Sierra Nevada, California (Ross, 1987a). Arrows indicate average for each unit. Both the Sacatar and Carver-Bowen units show one sample whose susceptibility is beyond the scale of the histogram.

A. Granite
- Brush Mountain
- Five Fingers
- Kern River
- Onyx
- Sherman Pass
- Tejon Lookout

B. Granodiorite
- Alder Creek
- Alta Sierra
- Castle Rock
- Gato-Montes
- Hatchet Peak
- Keene
- Lebec
- Peppermint Meadow
- Pine Flat
- Poso Flat
- Rabbit Island
- Sacatar
- Wagy Flat
- Whiterock

C. Tonalite
- Bear Valley Springs
- Carver-Bowen
- Dunlap Meadows
- Fountain Springs
- Hoffman Canyon
- Mount Adelaide
- Walt Klein

D. Quartz diorite
- Caliente
- Cyrus Flat
- Tehachapi Mountains
- Walker Pass

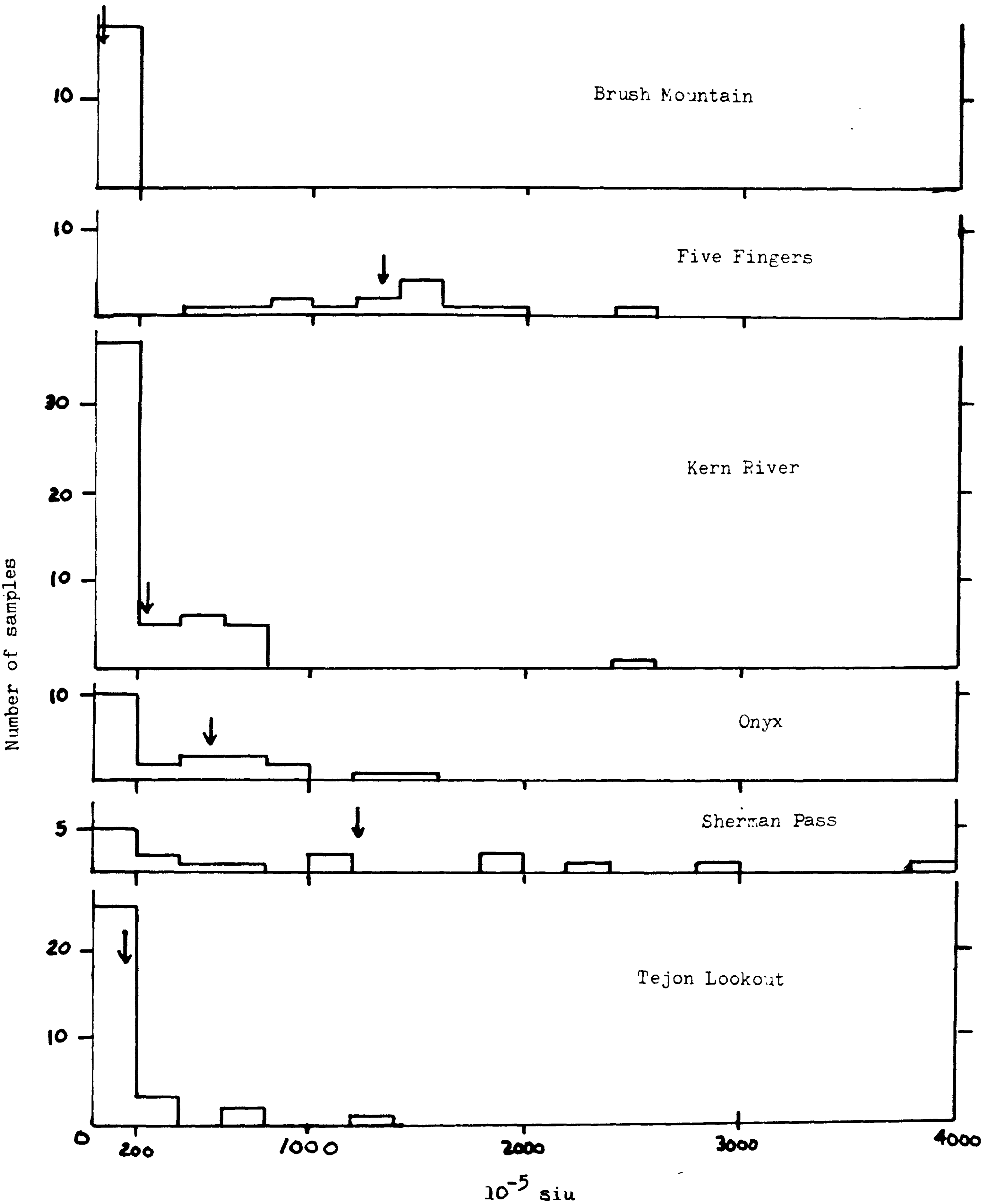
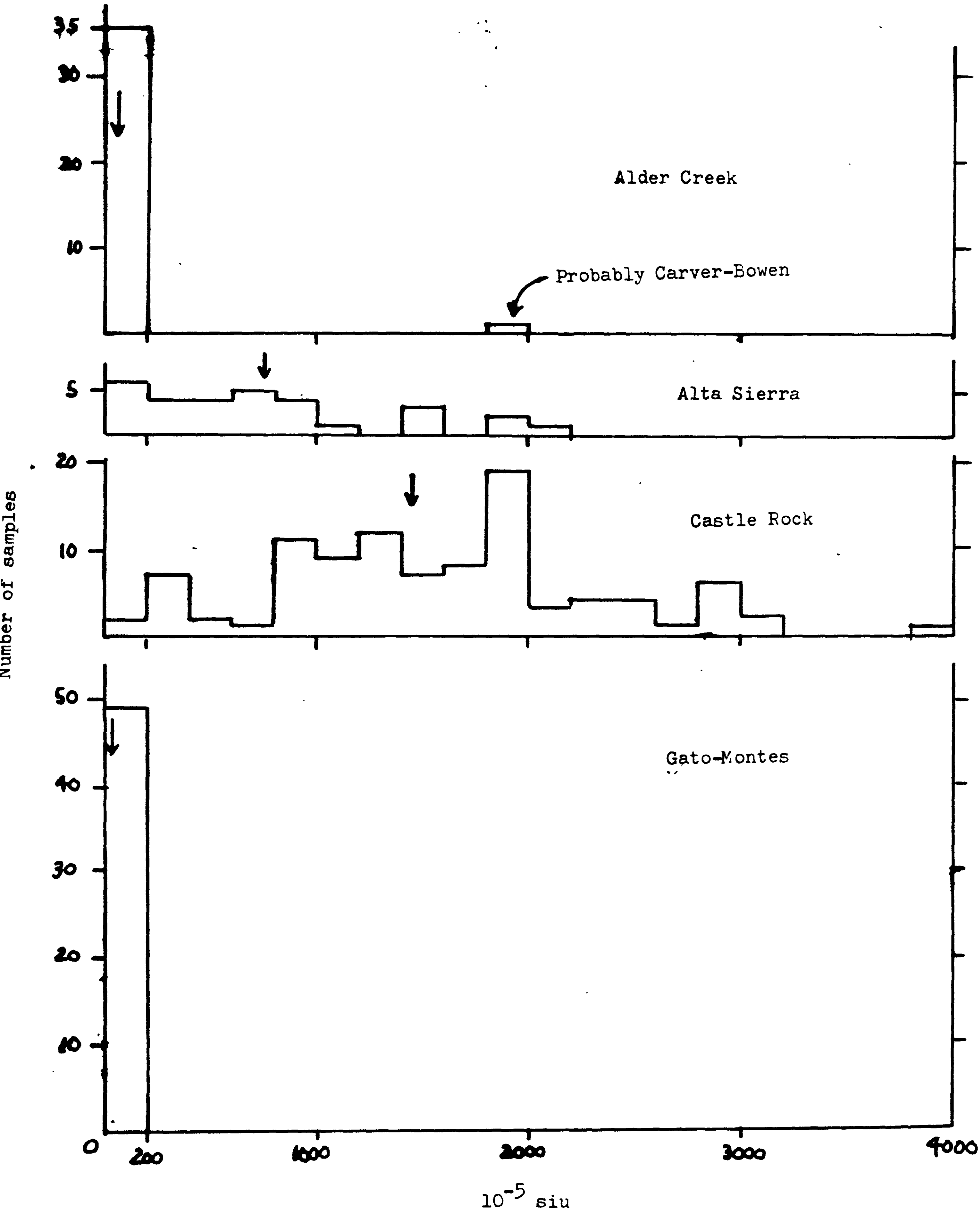

Brush Mountain
Five Fingers
Kern River
Onyx
Sherman Pass
Tejon Lookout
Number of samples
10
10
30
20
10
10
5
20
10
0
200
1000
2000
3000
4000
10^{-5} siu

Figure 2 A.



Number of samples
35
30
20
10
Alder Creek
Probably Carver-Bowen
5
Alta Sierra
20
10
Castle Rock
50
40
30
20
10
Gato-Montes
0
200
1000
2000
3000
4000
10^{-5} siu

Figure 2 B.

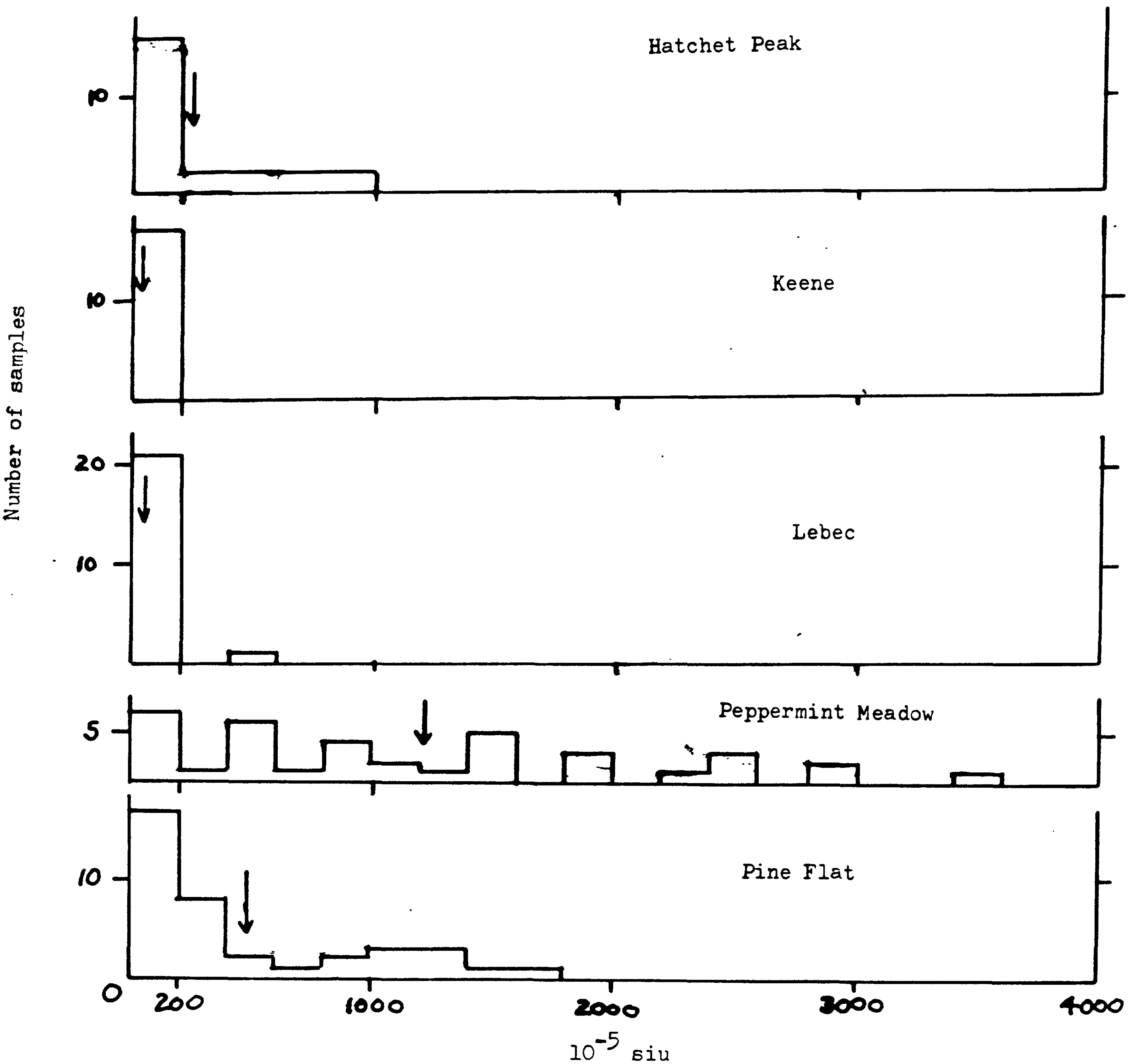


Figure 2 B(cont.).

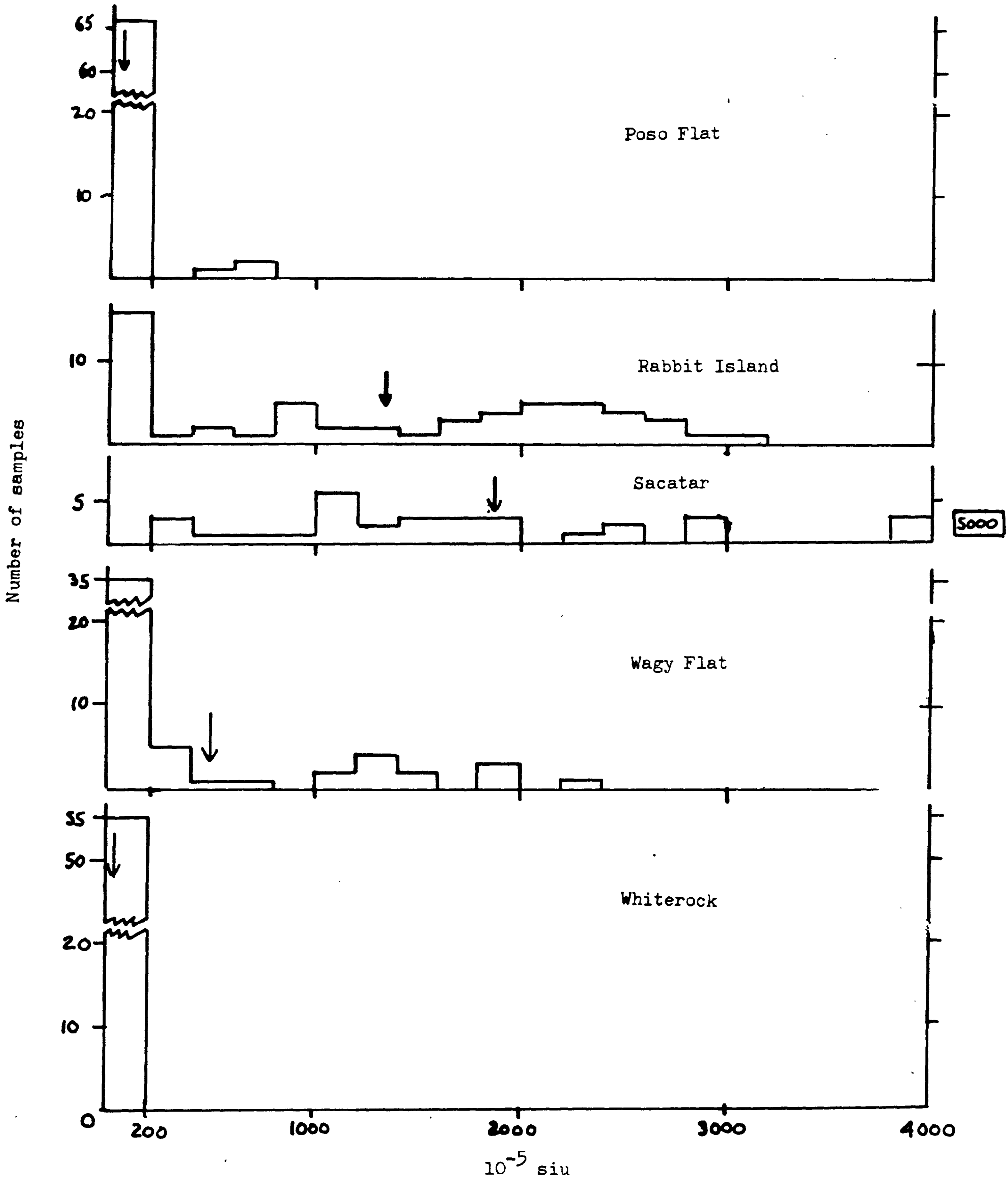
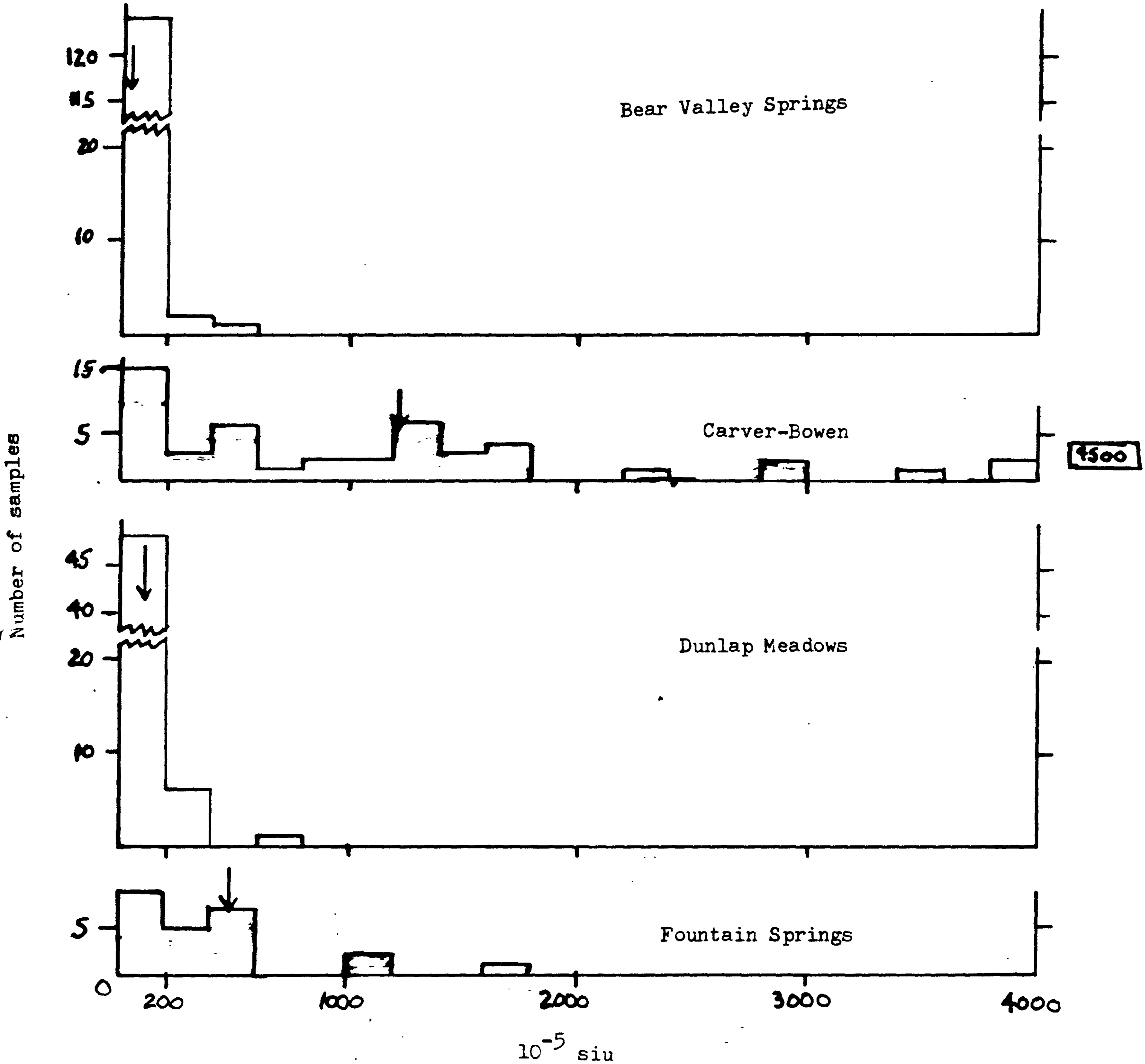


Figure 2 B(cont.).



Number of samples
120
115
20
10
Bear Valley Springs
15
5
Carver-Bowen
4500
45
40
20
10
Dunlap Meadows
5
0
Fountain Springs
200
1000
2000
3000
4000
10^{-5} siu

Figure 2 C.

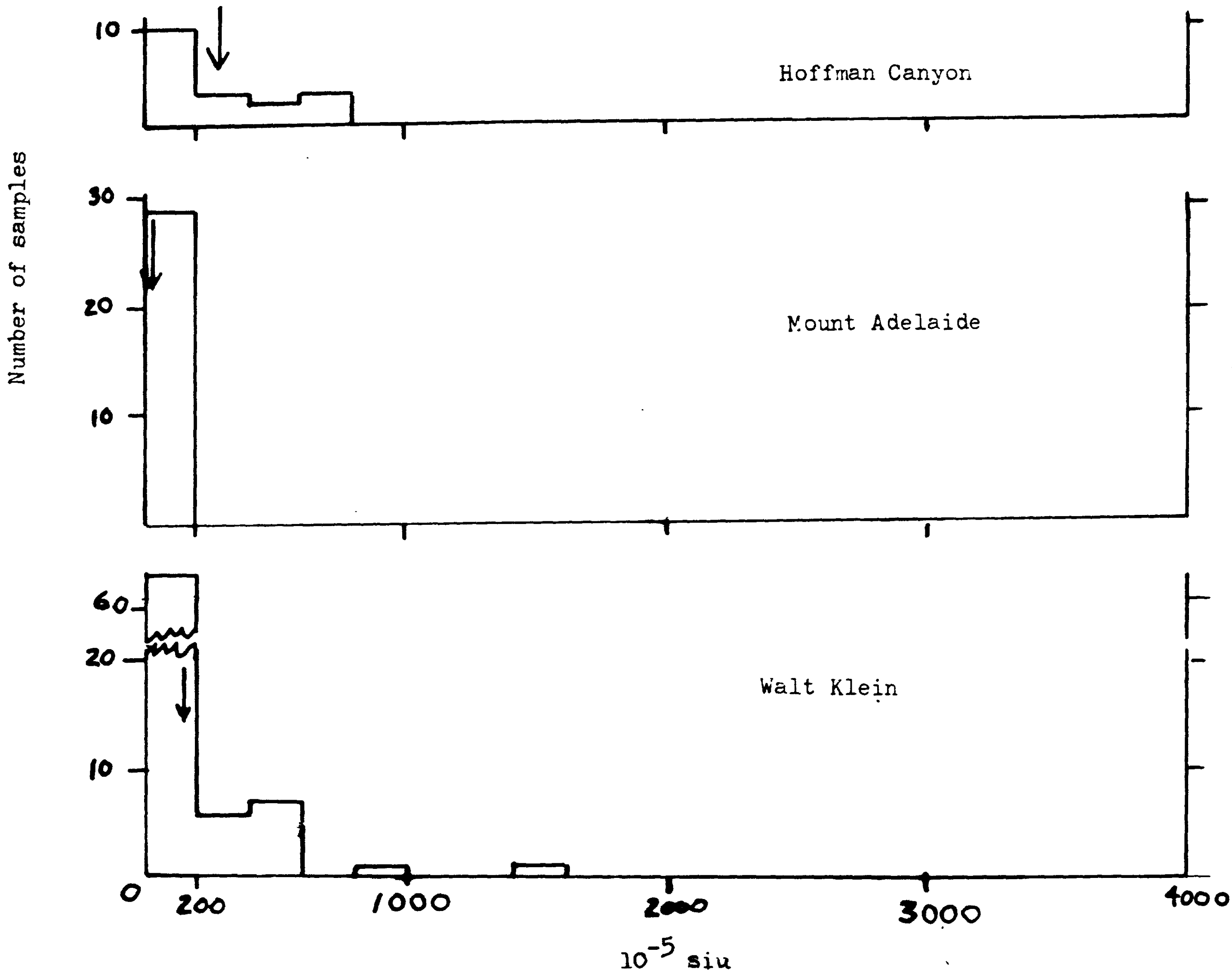


Figure 2 C(cont.).

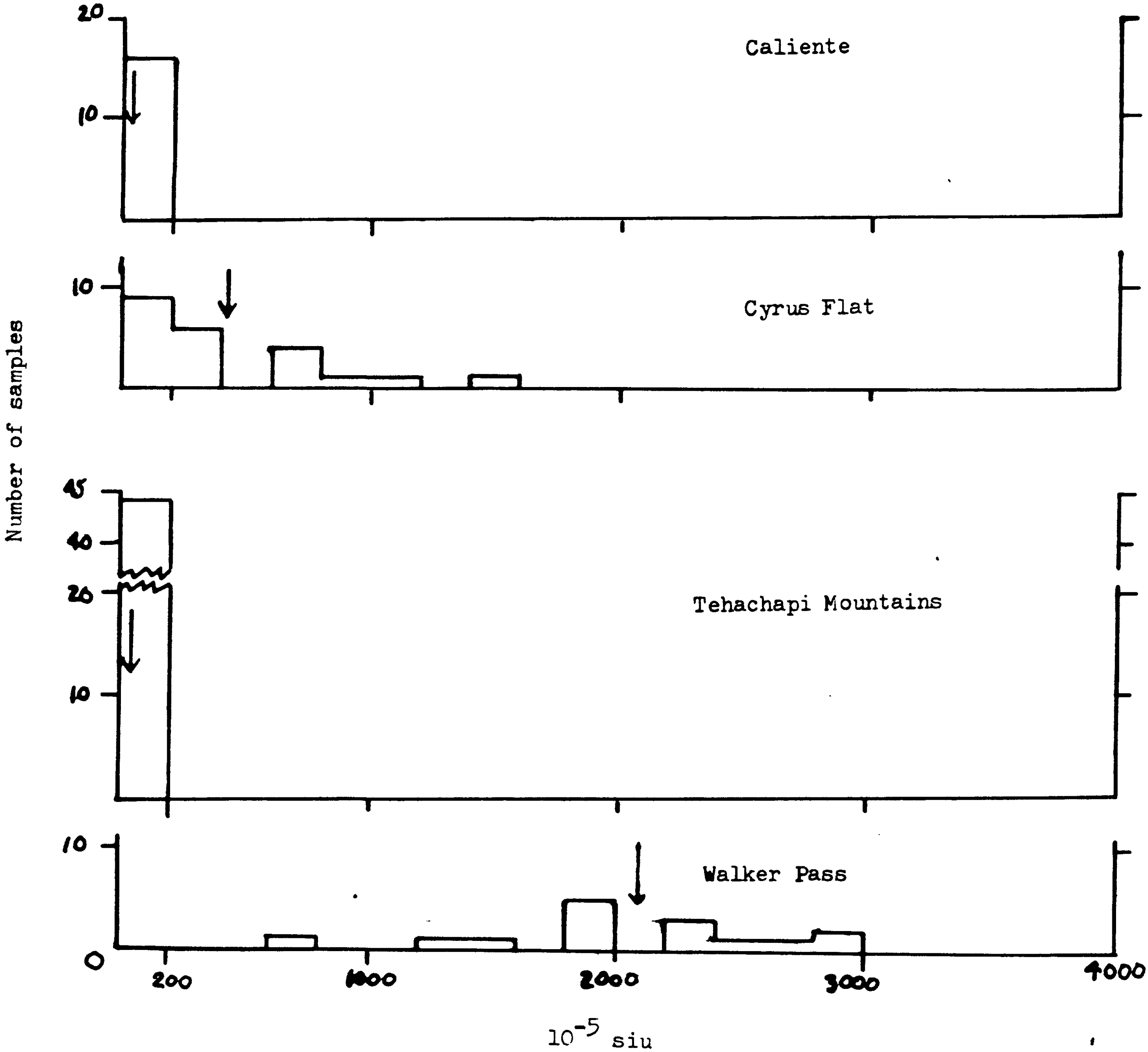

Caliente
Cyrus Flat
Tehachapi Mountains
Walker Pass
Number of samples
20
10
10
45
40
20
10
10
0
200
1000
2000
3000
4000
10^{-5} siu

Figure 2 D.

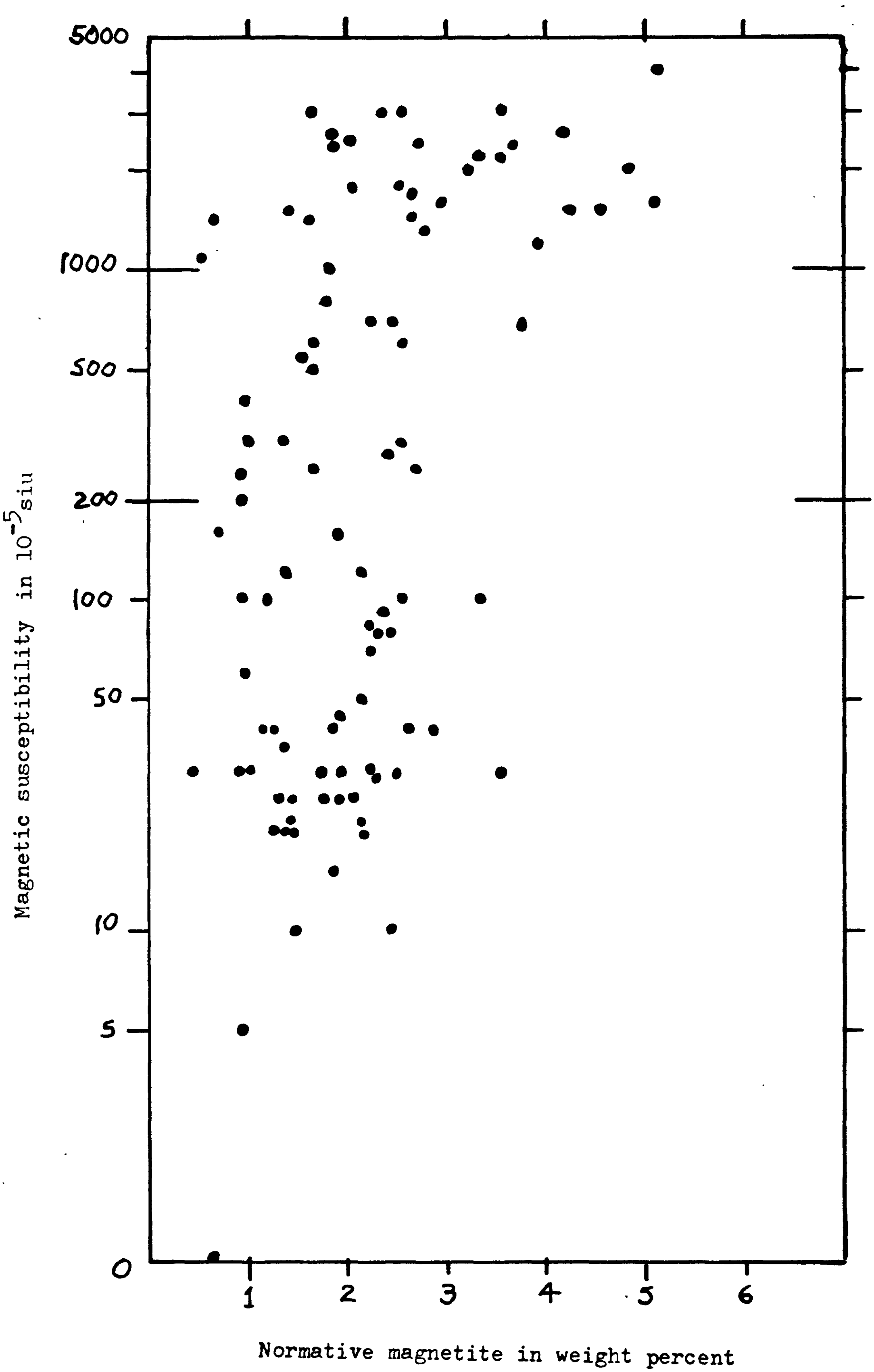


Figure 3. Magnetic susceptibility plotted against CIPW normative magnetite content for some chemically analyzed granitic rocks from the southern Sierra Nevada, California.

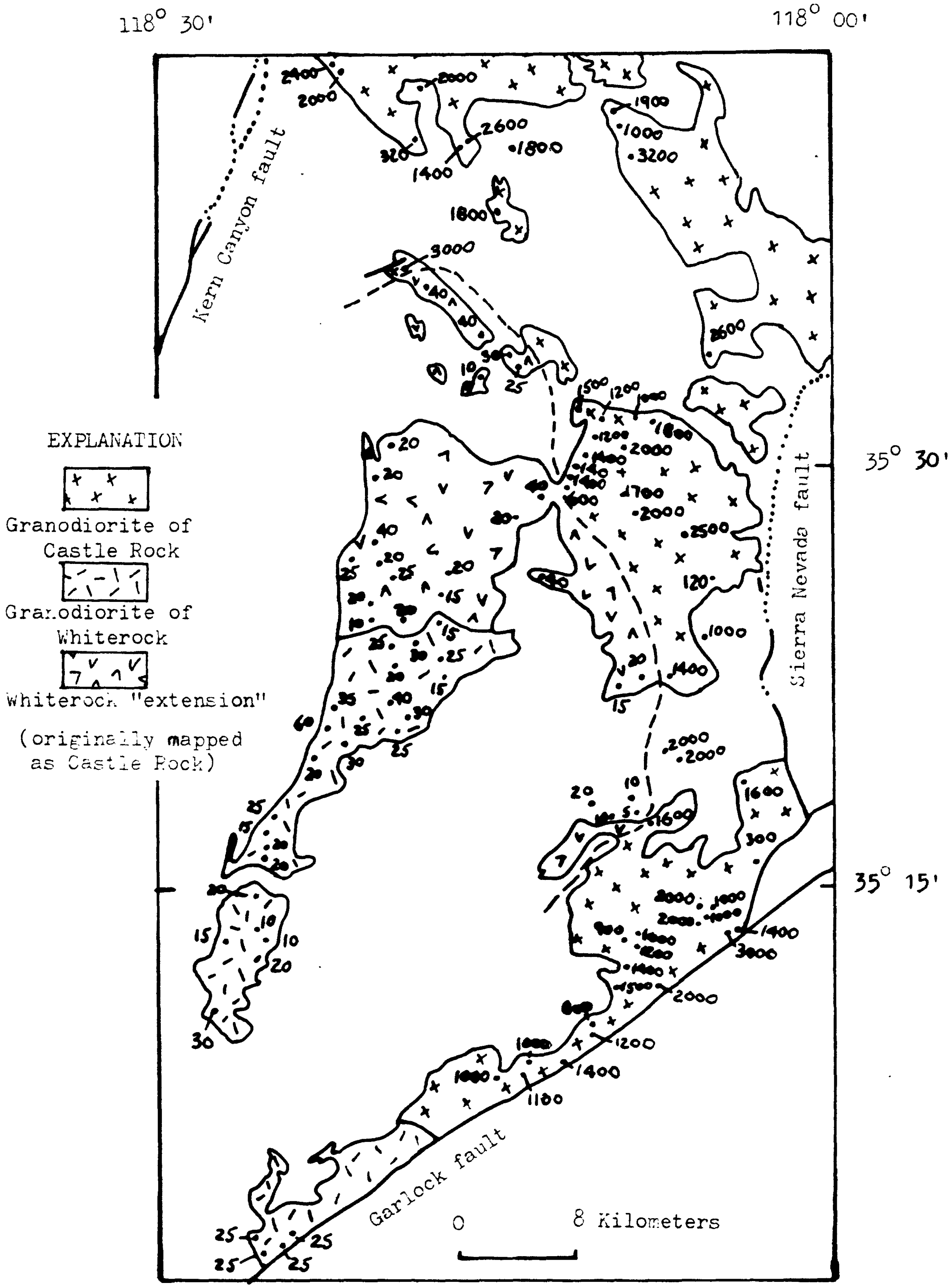


Figure 4. Map showing magnetic susceptibility values for some samples of the granodiorites of Castle Rock and Whiterock. Dashed line marks limit of possible northward extension of Whiterock body based on susceptibility data.

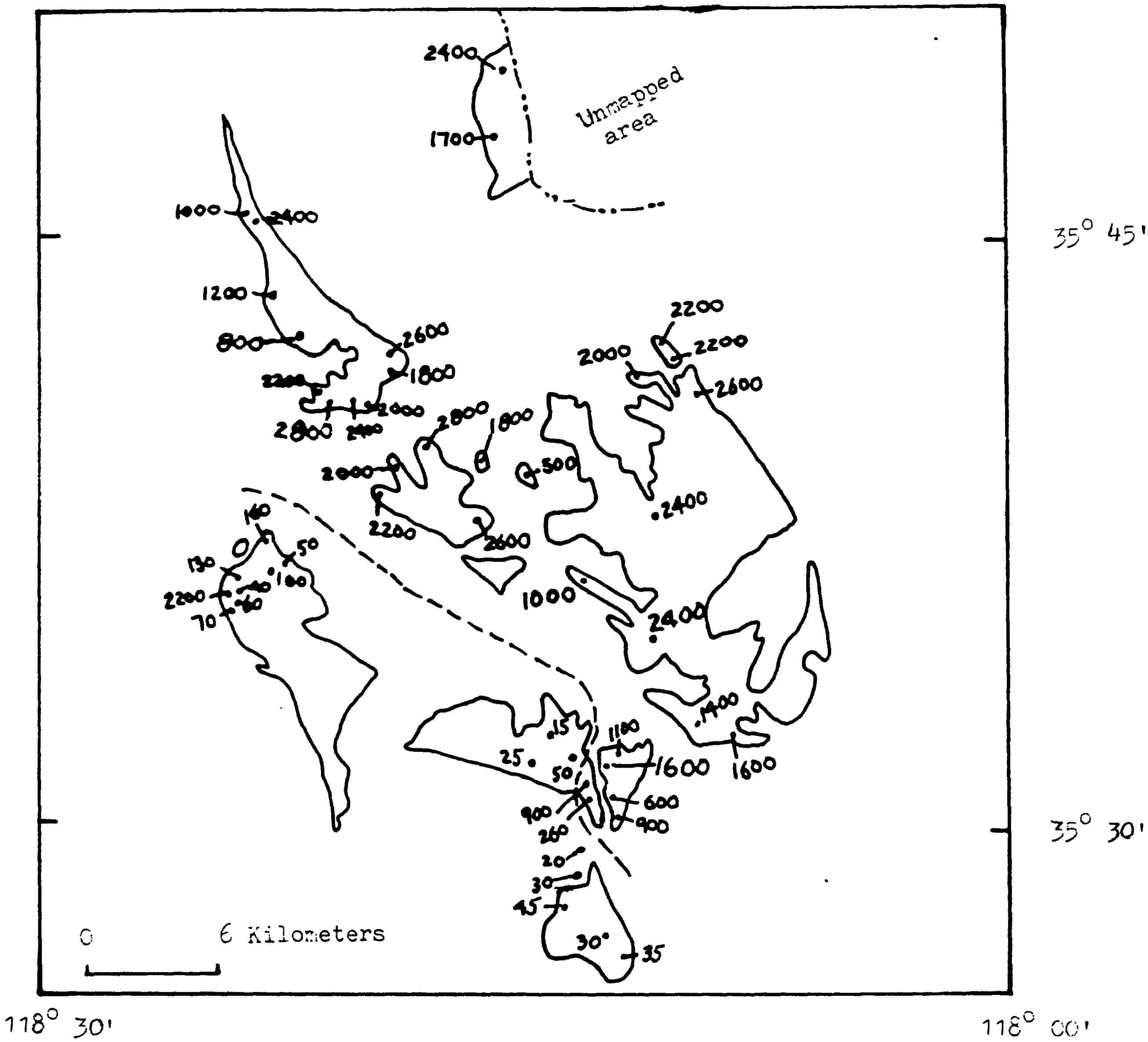


Figure 5. Map showing magnetic susceptibility values in 10^{-5} siu for samples of the granodiorite of Rabbit Island. Dashed line marks limit of low susceptibility values to southwest that may not be part of the Rabbit Island mass.

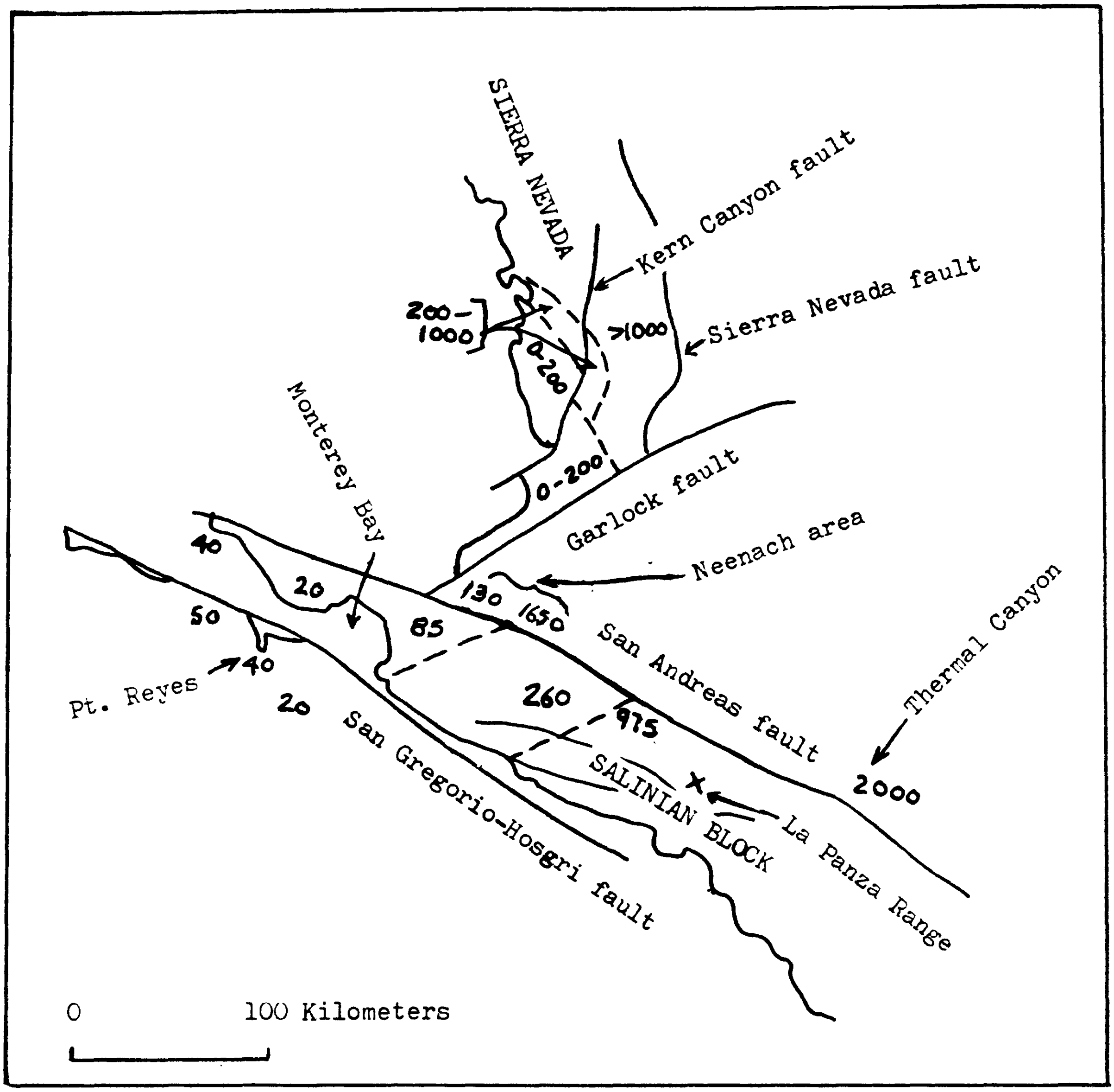


Figure 6. Palinspastic reconstruction of a part of southern California with Cenozoic displacements on major faults removed (Kistler, in press). Superimposed are generalized magnetic susceptibility values from figures 1, 8, 9, and 10.

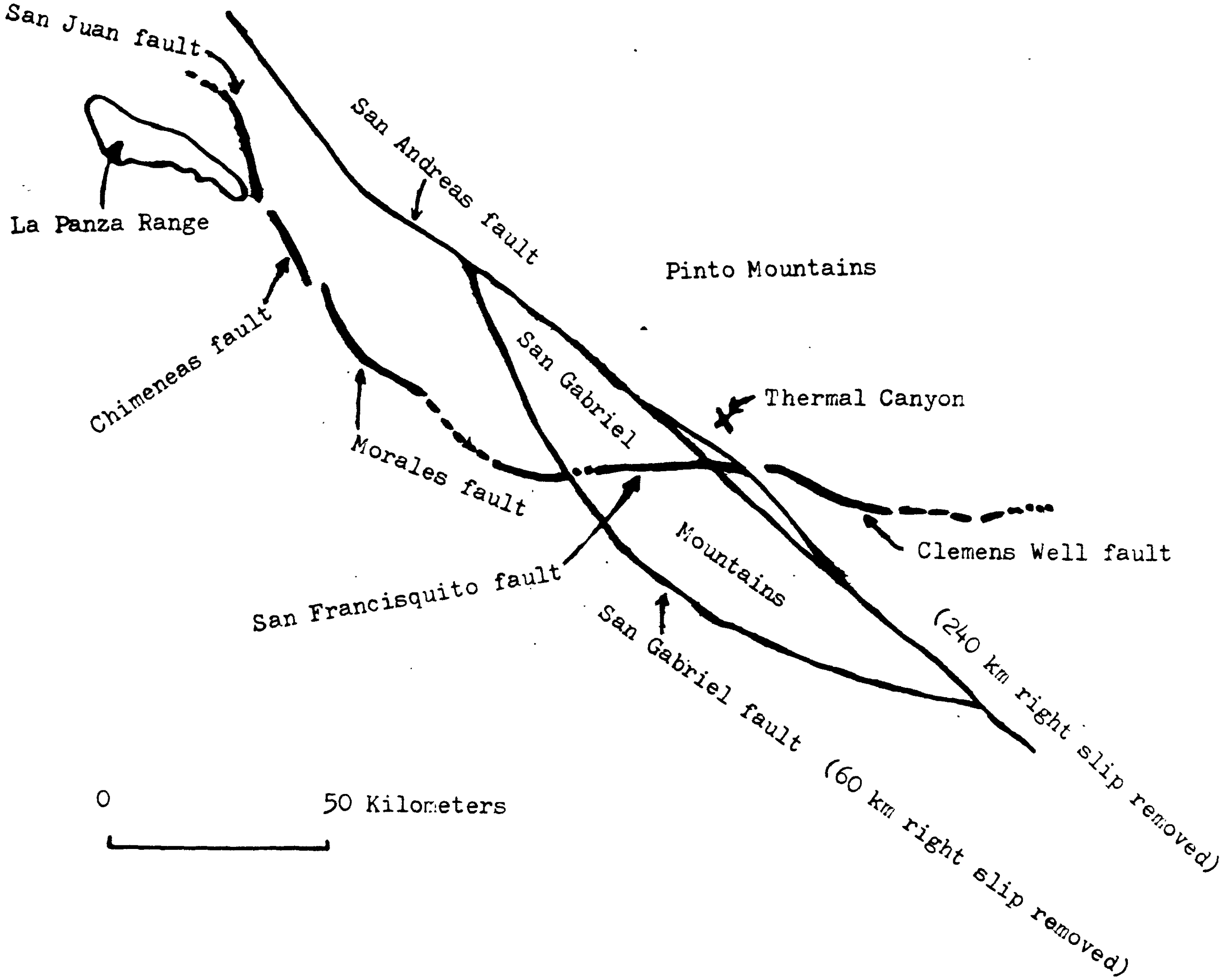


Figure 7. Hypothesized early fault (San Juan to Clemens Well) restored by reversing displacements on the younger San Andreas and San Gabriel faults. Reversal of some 150 kilometers of right slip on the hypothesized fault juxtaposes the La Panza Range and Thermal Canyon. (Simplified from Joseph and others, 1982)

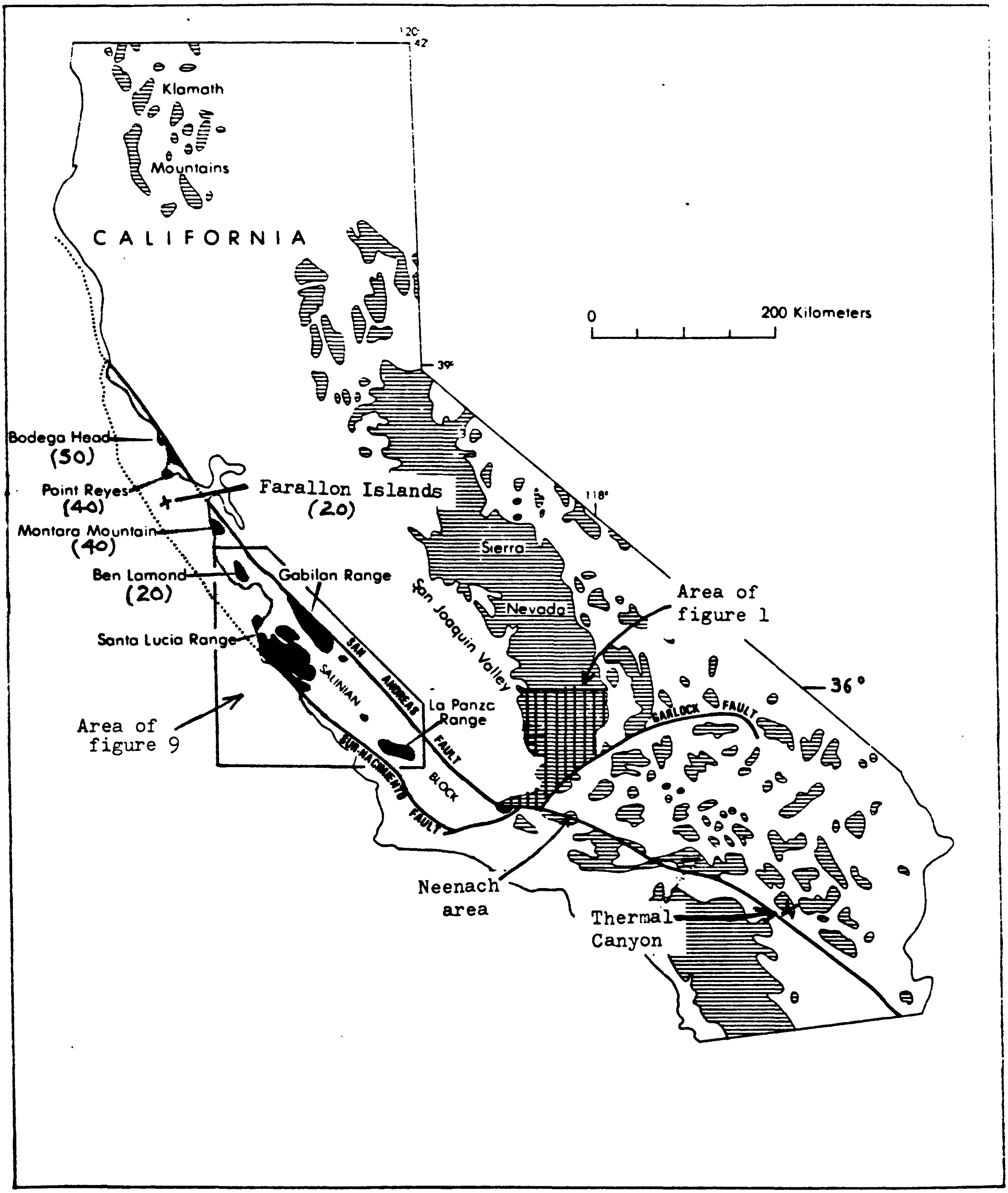


Figure 8. Index map showing Salinian block, Neenach area, and Thermal Canyon in relation to the southern Sierra Nevada, California. Average magnetic susceptibility in 10^{-5} siu units shown for northern Salinian block localities.

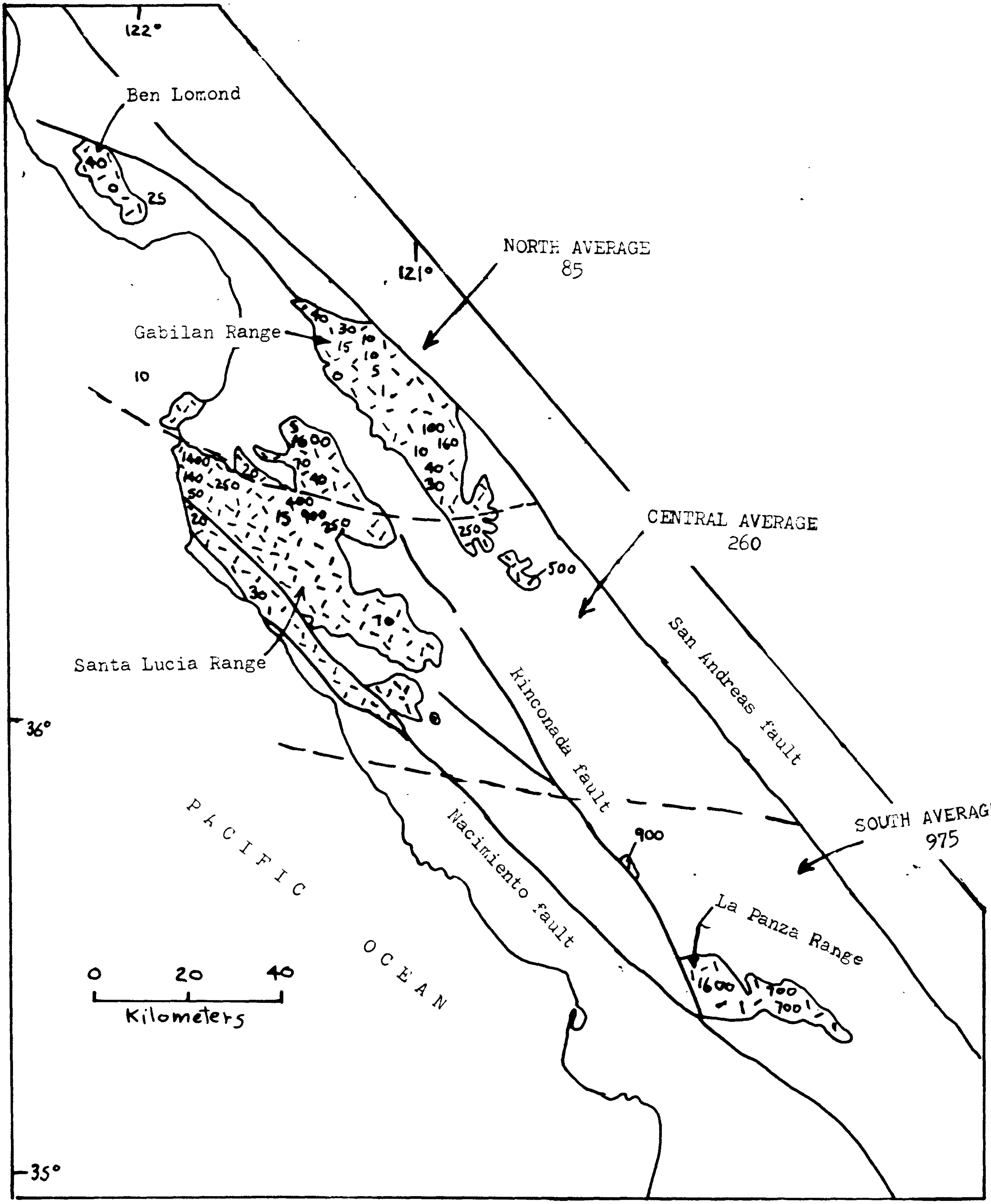


Figure 9. Index map showing location and magnetic susceptibility in 10^{-5} siu for reference samples from the central Salinian block. Averages shown for tentative north, central, and south subdivisions.

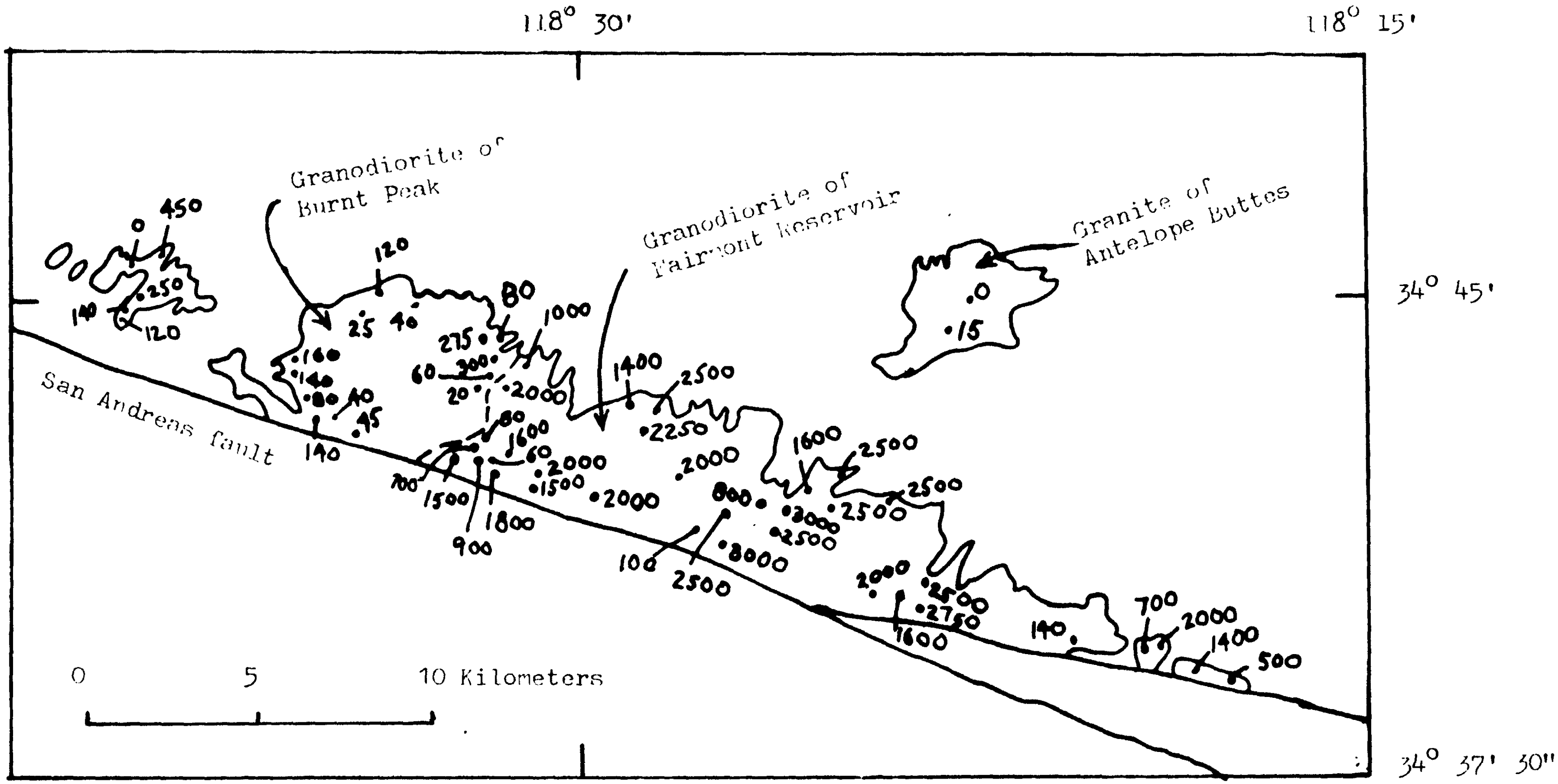


Figure 10. Index map showing magnetic susceptibility in 10^{-5} siu for selected granitic samples in the Neenach area.

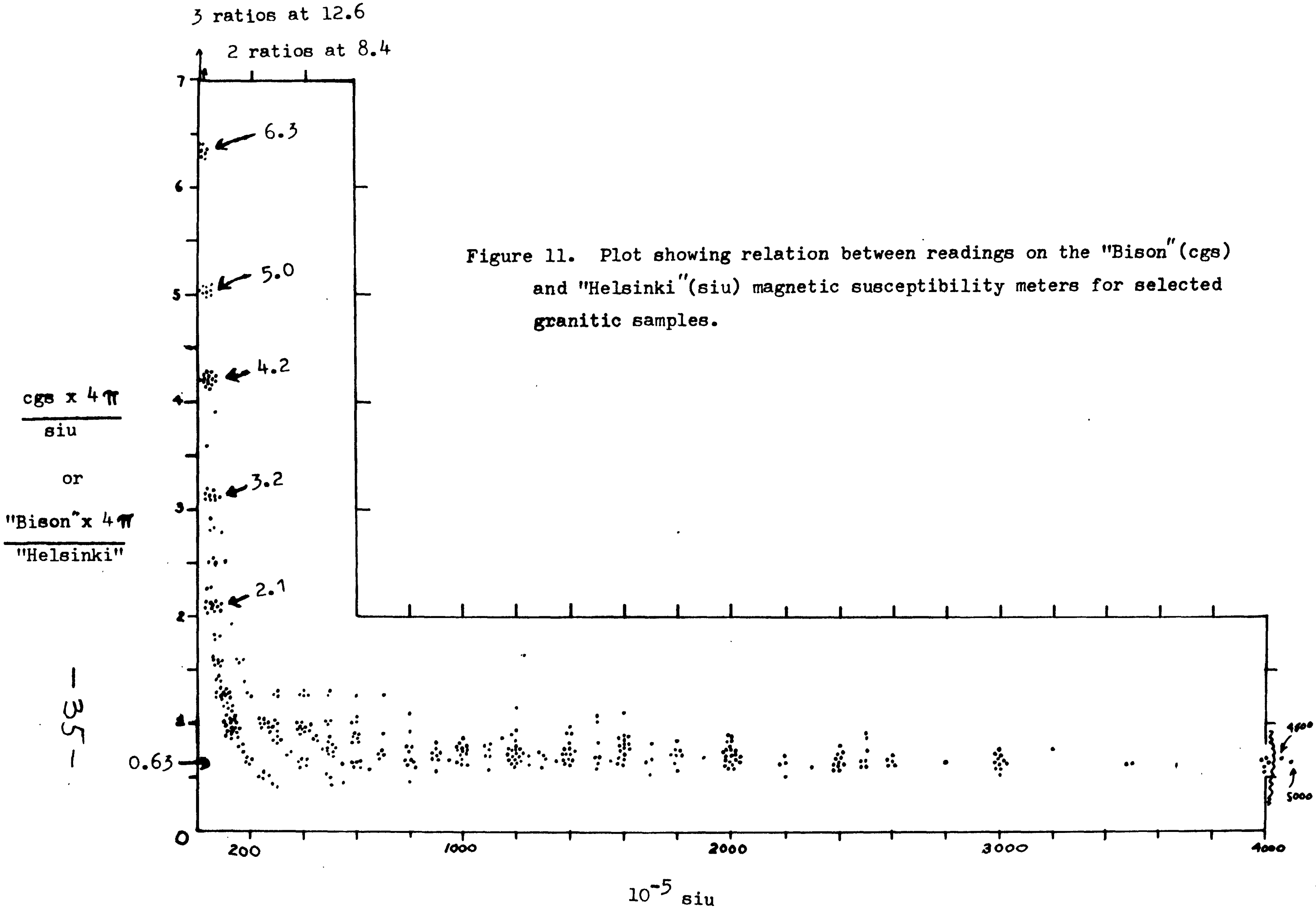


Figure 11. Plot showing relation between readings on the "Bison" (cgs) and "Helsinki" (siu) magnetic susceptibility meters for selected granitic samples.

Table 1. Magnetic susceptibility averages and ranges for each granitic unit from the southern Sierra Nevada, California. Compilation includes all samples listed on table 2 plus some samples with no mode, and some modal samples collected in 1987 and 1988 that are not listed in Ross (1987b)

Unit	No. of samples	Average (10^{-5} s.i.)	Range (Histograms for larger units)	Comments
GRANITE				
Arrastre Creek	3	330	300-400	
Baker Point	5	130	10-500	
Bishop Ranch	15	145	0-1200	Most 0-15
Black Mtn	7	36	10-100	
Bob Rabbit	9	486	0-1700	Most 0-30
Bodfish Canyon	14	92	0-600	
Brush Mtn	18	5	0-25	
Cannell Creek	7	397	10-1200	
Five Fingers	14	1377	550-2500	
Kern River	57	243	10-2500	
Lone Tree Canyon	6	867	0-1500	Only 1 below 800
Long Meadow	13	770	10-3000	
Old Hot Spr. Rd.	3	123	0-300	
Onyx	30	558	0-1600	
Portuguese Pass	15	263	10-1300	
Robbers Roost	2	1000	400-1600	
Saddle Spr. Rd.	6	16	0-35	
Sherman Pass	16	1211	0-4000	
Tehachapi Airport	5	13	0-60	Only 1 above 5
Tejon Lookout	32	140	0-1400	
Bean Canyon	2	5	0-10	
Noname Canyon	9	34	0-160	Most are 0
Brown	2	1250	1000-1500	
Sand Canyon	3	150	40-300	
Msc. into Sacatar	4	875	800-1000	
GRANODIORITE				
Alder Creek	36	25 (Does not include 2000 value)	10-2000	Only one above 50 (probably Carver-Bowen)

Table 1 (cont.)

Unit	No. of samples	Average (10^{-5} s.i.)	Range (Histograms for larger units)	Comments
GRANODIORITE (cont.)				
Alta Sierra	36	737	10-2200	
Brush Creek	17	564	20-1000	
Cameron	4	225	40-600	
Castle Rock	99	1650	120-3200	
Deer Creek (formerly Deer Creek--west)	15	1393	600-3000	
Democrat Springs	3	24	20-25	
Evans Flat	11	17	10-30	
Gato-Montes	49	25	5-120	
Hatchet Peak	24	260	10-1000	
Hershey Ranch (formerly Deer Creek--east)	22	536	200-1400	Only one above 800
Keene	18	23	10-50	
Lebec	23	42	10-600	
Lime Point	3	15	5-20	
Peppermint Mdw.	37	1210	10-3500	
Pine Flat	37	500	10-1800	
Poso Flat	69	63	10-800	
Rabbit Island	57	1354	15-3200	Average includes several samples with low magnetic susceptibility, mostly below 100 x 10^{-5} s.i. Average without these samples is nearly 2000 x 10^{-5} s.i. (see fig. 5).
Sacatar	33	1895	300-5000	
Sorrell Peak	10	115	15-600	Only 2 above 30
Wagy Flat	54	480	10-2400	
Whiterock	29	24	10-40	

Table 1 (cont.)

Unit	No. of samples	Average (10 $^{-5}$ s.i.)	Range (Histograms for larger units)	Comments
TONALITE				
Antimony Peak	18	31	10-120	Only one above 60
Bear Valley Springs	126	47	20-450	
Carver-Bowen	47	1148	40-4500	
Dunlap Meadow	56	103	20-700	
Fountain Springs	24	423	20-1800	
Hoffman Canyon	17	290	30-800	
Mount Adelaide	29	21	5-70	
Walt Klein	79	149	5-1600	Only 2 (1600, 1000) above 600
Wofford Heights	10	673	40-3000	
Zumwalt Ranch	12	1400	600-4500	Only one above 2000
QUARTZ DIORITE				
Caliente	16	35	20-60	
Cyrus Flat	22	428	30-1600	
Freeman Junction	10	1514	300-3000	
Long Valley	2	2100	2000-2200	
Rhymes Campground	2	--	150-1000	
Tehachapi Mountains	44	42	15-120	
Walker Pass	15	2100	800-3000	
Hypersthene-bearing	13	48	10-100	
QUARTZ MONZODIORITE				
Erskine Creek	6	108	30-400	Only 1 above 100

Table 2. Magnetic susceptibilities in 10^{-5} siu for individual modal samples of granitic rocks from the southerm Sierra Nevada, California. Samples located on index maps in Ross (1987b).

Unit	Sample	10^{-5} siu
GRANITE		
Arrastre Creek	5992	300
	6081B	400
	6093	300
Baker Point	4625R	120
	4626	10
	5281	500
	5283	10
Bishop Ranch	3798A	5
	3799	0
	3851	0
	4053	0
	4053F1	5
	4068	400
	4075A	10
	4085B	40
	4414	1200
	4473C	700
	4474	0
	4475	0
	4476	140
	4478A	5
	4563C	600
Black Mountain	5097	40
	5098	60
	5099	20
	5103	10
	5506	10
	5512	100
	5556	10
Bob Rabbit Canyon	5599	20
	5600	30
	5602	1400
	5604	10
	5606A	1700
	5641	0
	5643	1200
	5648A	0
	5648B	10
Bodfish Canyon	4770	0
	4773	0
	4814A	100
	4815	300
	5050	0
	5051	10
	5052	15
	5053	10
	5067B	0
	5069B	600
	5071	240
	5090	10
	5155	0
	5158	0
Brush Mountain	646	5
	676	5
	681	0
	710	15
	3035	0
	3037	0
	3046	0
	3087A	0
	3089	0
	3102A	5
	3110	5
	3113	5
	3130A	5
	3146	25
	3221	0
	3881	15
	3882	0
	3887	5
Cannell Creek	4619	600
	4620	700
	4630	160
	4841	10
	4914	10
	4940	1200
	5139	100

Unit	Sample	10^{-5} siu
GRANITE (cont.)		
Five Fingers	6204	1550
	6207	1500
	6208	1500
	6209	1200
	6380	700
	6387	550
	6388	1300
	6405	1000
	6407	1300
	6415	1800
	6417A	1600
	6420B	2000
	6493A	900
	6535	2500
Kern River	4623	30
	4624	20
	4627	500
	4637	700
	4642	160
	4643	700
	4644A	50
	4646	450
	4648	2500
	4672	400
	4673	400
	4734	10
	4737A	15
	4738	40
	4742F1	500
	4750	60
	4762C	20
	4763	25
	4764	10
	4766	15
	4811	40
	4814B	100
	4816	70
	4817	10
	4818	60
	4819A	300
	4819B	400
	4859-1	15
	4884A	15
	4887	30
	4888	10
	4892	15
	4894	15
	4896	20
	5005	600
	5006	600
	5009	45

Unit	Sample	10^{-5} siu
Kern River(cont.)	5013	800
	5013R	600
	5013-1B	700
	5113	15
	5117C	30
	5120B	200
	5266	30
	5268	25
	5272	70
	5274	25
	5279	100
	5286C	100
	5286R	100
	5288	160
	5290R	30
	5297	400
	Isa-1	800
Lone Tree Canyon	4077	800
	4088	1000
	4090	1000
	4478B	1500
	4481	0
Long Meadow	4962	500
	4963	20
	4964	3000
	4967	700
	4970	10
	5024	500
	5025	350
	5397	800
	5408	180
	5410	1200
	5411	500
	5413	2000
	5414	300
Old Hot Springs Rd.	6048	70
Onyx	4557A	0
	4558	5
	4563A	0
	5161B	700
	5315C	500
	5328	700
	5332	0
	5678	900
	5682F1	45
	5700	1400
	5708	80
	5710	10
	5719A	400
	5719B	300

Table 2 (cont.)

Unit	Sample	10^{-5} siu
GRANITE (cont.)		
Onyx (cont.)	6131	800
	6152	1600
	6195	10
	6198	450
	6236	500
	6238	30
	6241	10
	RWK-6B	900
Portuguese Pass	5014	500
	5016	25
	5017	40
	5059	600
	5060	500
	5061	400
	5062	40
	5063	10
	5289	50
	5571B	1300
	5574	25
	5582	130
	5595	80
Robbers Roost	6392	1600
	6395	400
Saddle Springs Rd.	4289	25
	4292	5
	5143	0
	5152	0
Sherman Pass	4953D	10
	5121	4000
	5122	3000
	5123	2400
	5128A	2000
	5133	400
	5133R	160
	5350	200
	5382	800
	5383	160
	5384	0
	5384-1	1200
	5387	1200
	5390	2000
	5393A	600
	5400	300
Tehachapi Airport	3804A	0
	4097	0
	4098	60
	4101	5
	4106	0

Unit	Sample	10^{-5} siu
Tejon Lookout and Bean Canyon	647	10
	666	20
	667B	10
	3307A	25
	3308	10
	3309	10
	3313A	30
	3315	5
	3323	160
	3329	800
	3330	300
	3339	45
	3457A	0
	3458	140
	3465	250
	3467	10
	3469A	250
	3473	700
	3475	120
	3476A	10
	3480	0
	3493	10
	3495	0
	3509	60
	3512	5
	3514	0
	3741	20
	3752A	1400
	3763A	0
	3769	5
	3771	0
	3828	0
	4032	10
Noname Canyon	6442A	10
	6448B	140
	6451	0
	6457	0
	6468	0
	6536C	0
	6538	0
	6543B	0
Brown	6430	1500
	6446	1000
Sand Canyon	6448A	110
	6450	300
	6454B	40
Msc. into Sacatar	6465A	1000
	6475B	900
	6478	800
	6483C	800

Table 2. (cont.)

Unit	Sample	10^{-5} siu
GRANODIORITE		
Alder Creek	5203	40
	5210	20
	5213	20
	5214	10
	5229	30
	5230	30
	5231	20
	5235	50
	5236	40
	5256	30
	5259	20
	5261	20
	5427	40
	5492	30
	5499	30
	5503	50
	5527	20
	5530	20
	5562	30
	5586	20
	5587	20
	5591	30
	5705	30
	5987 **	2000
	6242	10
	6245	10
	6249	20
	6254	30
	6269	10
	6272A	20
	6272B	20
	RWK-4	30
	RWK-5	35
	A-22	15
	**Carver-Bowen?	
Alta Sierra	4268	10
	4286	70
	4780	1600
	4781	800
	4782	240
	4791	300
	4793	800
	4794	600
	4795B	1000
	4796-1	700
	4798	1000
	4856	500
	5055A	1000
	5056	800
	5058	800
	5064	2000

Unit	Sample	10^{-5} siu
Alta Sierra (cont.)	5095	400
	5105	20
	5107A	600
	5225	600
	5226	1600
	5251	1600
	5422	10
	5423	100
	5536	300
	5539	2000
	5541	1200
	5543	900
	5566	2200
	5567B	40
Brush Creek	4659	140
	4660	1000
	4661	800
	4662	160
	4663	50
	4703-2	20
	4704	800
	4705	800
	5031	2400
	5547A	1000
	5550	900
	5553	700
Cameron	4038	60
	4047	600
	4062A	200
Castle Rock	3848	2000
	3849B	2000
	4049F1	1100
	4051	1400
	4052	1000
	4059A	800
	4059B	1200
	4064	1000
	4065A	2000
	4067	1000
	4070	900
	4073	1200
	4080	1400
	4086	1500
	4087	2000
	4092	1000
	4093	3000
	4093-1A	1400
	4094	2000
	4131F1	1000
	4328*	25
	4335*	40

Table 2. (cont.)

Unit	Sample	10^{-5} siu
GRANODIORITE (cont.)		
Castle Rock (cont.)	4336*	20
	4341*	20
	4348*	25
	4351*	20
	4352*	10
	4353*	20
	4359*	40
	4360	1400
	4363A*	20
	4365*	15
	4398A*	10
	4398C*	20
	4402	1400
	4403*	40
	4404	600
	4406	1700
	4409	2000
	4411A	2500
	4413**	120
	4470B**	5
	4470C**	10
	4473A	1000
	4477A	1600
	4485A**	60
	4486**	0
	4487A**	0
	4489	300
	4496B	400
	4497A	250
	4498C	1600
	4500*	10
	4505*	10
	4508*	20
	4518*	5
	4519	900
	4622F1	1400
	4634	1600
	4635A	3000
	4635B	1700
	4640	1400
	4640-1	2000
	4652	2000
	4667B	2200
	4669	1500
	4670A	2200
	4671A	3000
	4873	2400
	4874	2400
	4875	2000
	4954A	3000
	4958	2800

Unit	Sample	10^{-5} siu
Castle Rock (cont.)	4960	2000
	4961	3000
	4965	2000
	4966	3200
	4971	1900
	4972	2000
	4985	1800
	5019	300
	5021	1800
	5026A	2000
	5027	320
	5028	1400
	5129	1800
	5130	1400
	5131	1400
	5135	4000
	5141	2000
	5193-1A*	25
	5324	1500
	5327	1800
	5329*	40
	5336*	10
	5355	1400
	5356	3000
	5360 *	40
	5381***	20
	5391	2600
	5394	2000
	5395	2200
	5403	2400
	5605*	20
	5609*	20
	5644*	15
	5647*	20
	5654	1400
	5656	1200
	5658	1200
	5659	2000
	5665	2400
	5669	2000
	5672	140
	5675	400
	5689	1000
	5691	1800
	5711	1000
	5716A	1900
	5727	1200
	5730	400
	5732	1200
	6144A	3200
	6184A	1200
	6196	2600
	6212	600

Table 2. (cont.)

Unit	Sample	10^{-5} siu
GRANODIORITE (cont.)		
Castle Rock (cont.)	6237	2600
	6239	1800
	6401	1600
	6513	900
	6539	1100
	RWK-6A*	40
	RWK-6-1*	15
*Whiterock?		
**Bishop Ranch?		
***Sherman Pass?		
Deer Creek	6030	600
	6031	400
	6032A	400
	6032B	300
East body	6050	400
	6051	200
	6052	600
	6053	500
West body	6113	2000
	6115	1000
	6116	1400
	6117	1000
	6118	1000
Democrat Springs	6372	25
	6374	20
	6375	25
Evans Flat	5241	30
	5494	10
	5495	15
	5496	10
	5497	20
	5524	20
	5526	10
	5532A	20
	5563	20
	A-77	10
	A-98	10
Gato-Montes	662	25
	663	20
	664	15
	667A	20
	3310C	5
	3316	10
	3317	15
	3322	10
	3340	25
	3357	15
	3371B	25
	3372	30

Unit	Sample	10^{-5} siu
Gato-Montes (cont.)	3373	30
	3377	20
	3389	10
	3390	10
	3481A	20
	3483A	25
	3492	20
	3498	20
	3499	20
	3502	30
	3505	15
	3508	15
	3515	15
	3517	25
	3521	20
	3523	120
	3534A	25
	3733A	25
	3762B	20
	3763B	30
	3766	25
	3830	10
	4004A	30
	4004C	60
	4005A	20
	4006	30
	4013	10
	4014	15
	4018	5
	4026	25
	4028	40
	4029	30
	4031	30
	4034	20
Hatchet Peak	5809A	100
	5810A	15
	5811A	10
	5816	30
	5846	140
	5863	140
	5865A	60
	5867	250
	5868	700
	5869A	1000
	5880A	20
	5881	30
	5890	900
	5913	800
	5914	40
	5915B	140

Table 2. (cont.)

Unit	Sample	10^{-5} siu
GRANODIORITE (cont.)		
Keene	3538	10
	3539	30
	3544B	25
	3590C	30
	3612	15
	3648A	50
	3653	25
	3689	25
	3704	30
	3724A	10
	3782	10
	3787	15
	3788A	20
	3859A	20
	3970	10
	4121	50
	4468	15
Lebec	673	10
	680	15
	687	15
	692	20
	696	20
	700	20
	702	20
	713	25
	FM-1	10
	3047	20
	3054	25
	3056	10
	3078	15
	3088	20
	3195	20
	3203	15
	3208	10
	3211	10
	3217	10
	3222	20
	3263	20
	721	10
	3136	0
	3164	10
	3186	0
	3225	0
	3010	0
	3138A	10
Lime Point	4833	20
	4847	5
	4847-RA	20

Unit	Sample	10^{-5} siu
Peppermint Meadow	4703	1000
	4995	3000
	4996	1600
	5000	3000
	5001	2000
	5033	1600
	5034	1300
	5302B	60
	5811B	10
	5819	600
	5820	1000
	5823	600
	5827	1500
	5829	700
	5831	3500
	5834	20
	5838	450
	5839	1600
	5841	2400
	5849	1100
	5852	2500
	5854	1150
	5855	1600
	5862	120
	5866	2000
	5873	2500
	5875	2500
	5877	10
	5883	2000
	5915A	350
Pine Flat	5801	1400
	5801R	1800
	5802	1600
	5803	1400
	5804	1400
	5885B	20
	5885R	10
	5887-3	40
	5895A	300
	5895B	400
	5897	600
	5898	1200
	5900	400
	5901B	900
	5902	400
	5926	400
	5927	800
	5929	200
	5937-1	10
	5941	300
	5942	20
	5945A	200
	5946	200

Table 2. (cont.)

Unit	Sample	10^{-5} siu
GRANODIORITE (cont.)		
Pine Flat (cont.)	5948	40
	5949	10
	5950	10
	5957B	30
	5959	20
	5960	25
	5964	500
	5965	400
	5967	1100
	5969	1000
	5973	80
	5993	1100
	5995	110
Poso Flat	4255	30
	4258	30
	4260	20
	4261	25
	4263	25
	4863A	35
	5237	40
	5238	55
	5239	40
	5264	40
	5265	30
	6276	50
	6277A	40
	6278A	40
	6279A	110
	6287	30
	6290	30
	6292	30
	6297	70
	6357	45
	6359	30
	6361	35
	6364	40
	6365A	15
	6366A	20
	6368	15
	6373	20
	A-31	20
	A-34	10
	A-46	15
	A-50	10
	A-90	30
	A-92	40
	RWK-3B	80

Unit	Sample	10^{-5} siu
Rabbit Island	4343A*	30
	4345*	30
	4346*	45
	4356*	20
	4415*	30
	4417*	35
	4848	2200
	4849	2800
	4870	1000
	4871	2400
	4900	1200
	4928A	800
	4934	2000
	4935	2800
	4936	2400
	4955A	3000
	4955B	2600
	4956A	3200
	5134	2000
	5159	600
	5160	1600
	5161A	1100
	5172**	2200
	5172-RA**	40
	5181-1	1800
	5182	2600
	5184	2200
	5186	2000
	5187	2800
	5188	1800
	5189	2600
	5218	900
	5314	260
	5315A	900
	5317**	50
	5320**	25
	5323**	15
	5326	500
	5338	1000
	5404	2400
	5407	1700
	5416**	160
	5419A**	50
	5421**	100
	5623**	70
	5624A**	60
	5625B**	130
	5687	1400
	5690	1600

Table 2. (cont.)

Unit	Sample	10^{-5} siu
GRANODIORITE (cont.)		
Rabbit Island (cont.)	5713	2200
	5715A	2200
	5721	2000
	6142	2600
	6157A	2400
	6166A	2400
*Whiterock?		
**separate body?		
Sacatar	6420A	300
	6423	2400
	6425	1500
	6431	4000
	6443	2500
	6452A	1400
	6456A	400
	6459	900
	6462A	1800
	6464	1800
	6467	1200
	6472A	1500
	6472B	3000
	6473A	3000
	6475A	3000
	6477	2000
	6480	800
	6481	2000
	6482A	2500
	6483A	4000
	6491A	250
	6491B	1700
	6492	600
	6499A	4000
	6500A	1200
	6501A	2000
	6504	5000
	6507	1200
	6522A	1200
	6523A	1200
	6526	1400
	6536B	1200
	6537	1600
Sorrell Peak	4363B	30
	4368	15
	4369	400
	4372	20
	4373	20
	4376B	15
	4377	30
	4381	600
	4567	15
	4570	5
Wagy Flat	4265	50
	4266	1500
	4273	1400
	4275A	25
	4275B	25
	4282	70
	4283	100
	4285	30
	4287	1200
	4294	30
	4304A	200
	4315	80
	4319	50
	4745A	160
	4745B	15
	4745C	25
	4751	15
	4774	20
	4777	40
	4795A	1400
	4797	400
	4797-1A	150
	4799	140
	4802	300
	4858	40
	5077B	20
	5082	140
	5148	25
	5196	800
	5197	50
	5198	25
	5201	10
	5207	140
	5208	400
	5209	30
	5211A	30
	5211D	40
	5242	25
	5244	40
	5246	1400
	5247	2000
	5248	2400
	5249	2000
	5253	2000
	5254	1600
	5255	25
	5538	35
	A-5	1400
	A-5-1	1100
	A-61A	20
	A-61B	20
	A-61-1A	600
	A-61-1B	300
	A-61-2	300

Table 2. (cont.)

Unit	Sample	10^{-5} siu
GRANODIORITE (cont.)		
Whiterock	3735A	25
	3737	25
	3738A	25
	3739A	25
	4102A	20
	4103A	10
	4104B	10
	4119F1	15
	4126	30
	4309	35
	4310	60
	4312	20
	4314	30
	4370	15
	4371	30
	4374	25
	4376A	15
	4447	15
	4448	20
	4449	20
	4454	20
	4467	25
	4531A	25
	4534	40
	4538	25
	4541	30
	4565-1	20
	4568-1	20
	4569A	25
TONALITE		
Antimony Peak	3000B	120
	3007	25
	3111	30
	3022A	25
	3029B	10
	3133	25
	3150D	40
	3152B	30
	3153	60
	3158	30
Bear Valley Springs	3412	35
	3413	30
	3429A	35
	3444	35
	3557	40
	3559	50
	3565	20
	3571	40
	3573	20
	3576	100
Bear Valley Springs (cont.)	3578A	40
	3582A	30
	3586A	30
	3600B	25
	3621	180
	3628	25
	3638-RA	25
	3638-RB	20
	3638-1A	45
	3638-3	40
	3650A	25
	3656	40
	3664	45
	3667	40
	3668	50
	3669	45
	3672	40
	3674	50
	3678	45
	3683	50
	3690A	40
	3691	55
	3693	45
	3694	40
	3698	45
	3699	45
	3715	85
	3718	30
	3728A	120
	3791	30
	3792	40
	3795	30
	3816	30
	3831	45
	3833A	30
	3835	40
	3838	25
	3839	30
	3840	40
	3852	30
	3853	45
	3854	40
	3860	45
	3863	50
	3865	30
	3869	25
	3871A	30
	3872	20
	3872-4	30
	3925	20
	3927	25
	3937	30
	3945	45

Table 2. (cont.)

Unit	Sample	10^{-5} siu
TONALITE (cont.)		
Bear Valley Springs (cont.)	3962A	30
	3963	40
	3973	30
	3975C	25
	3980A	40
	3991	45
	4110A	20
	4111	30
	4113A	40
	4114	40
	4115	40
	4135	30
	4138A	30
	4141	30
	4142	25
	4154	25
	4185	25
	4186	35
	4191B	45
	4194A	30
	4195	40
	4202	140
	4203	140
	4204	25
	4205	400
	4210A	30
	4213	50
	4226	40
	4228A	450
	4228B	50
	4229	250
	4235	30
	4239	25
	4240	40
	4243	45
	4250	45
	4277	50
	4305	40
	4422	30
	4425	50
	4443A	25
	4458	35
	4565A	25
	5430	25
	5432	40
	5435	30
	5438	30
	5440	25
	5445	20
	6296	30
	6300	30
	6302	30

Unit	Sample	10^{-5} siu
Bear Valley Springs (cont.)	6322R	40
	6329	40
	6332	20
	6335	30
	6336	30
	6340	40
	6341	20
	6342	40
	6356	80
	6369	20
	6371	30
	6376	20
Carver-Bowen Ranch	5976A	45
	5978	600
	5979	1250
	5980	550
	5981	250
	5983A	55
	5988	250
	5989	650
	5990	40
	5991	50
	6014	4000
	6017	120
	6019A	4000
	6020A	950
	6028	1000
	6029	3500
	6033A	1350
	6036	600
	6037A	1600
	6039	3000
	6040A	500
	6078	4500
	6079A	70
	6080	1100
	6082	2300
	6094	1250
	6101	40
	6110	1350
	6111	1700
	6114A	1100
	6275	95

Table 2. (cont.)

Unit	Sample	10^{-5} siu
TONALITE (cont.)		
Dunlap Meadow	5007	90
	5008	700
	5010	110
	5015	25
	5015R	20
	5285	300
	5291	20
	5292	30
	5293	30
	5295	40
	5304	300
	5305	25
	5573	30
	5575	100
	5577	40
	5581	50
	5584	80
	5805	60
	5807	40
	5870A	60
	5870B	60
	5871	250
	5872	50
	5884	50
	5885A	60
	5885-1	80
	5886A	250
	5887	275
	5916A	160
	5918	120
	5920	130
	5922	120
	5924	60
	5930	40
	5931	120
	5932	200
	5933	250
	5937	45
	5938A	80
	5939A	90
	5939B	60
	5940	100
	5952	45
	5953	30
	5954	40
	5962	80
	5974	50
	5975A	45
	5994	120
	5996	80

Unit	Sample	10^{-5} siu
Dunlap Meadow (cont.)	5998	80
	5999	130
	6000	80
	6002	130
	6004	80
	6005A	20
Fountain Springs	6024	600
	6055A	45
	6056	350
	6058A	600
	6059	20
	6062	120
	6065	1800
	6066	1200
	6084	500
	6085	500
	6105	500
	6106	160
	6107	250
Hoffman Canyon	3843A	800
	3844	400
	3845	800
	3846A	600
	3849A	500
	4379	40
	4382	40
	4390	40
	4392	30
	4393	30
	4395	30
	4398B	40
	4400	400
	4401	700
	4509A	400
	4554	30
	4555A	30
Mount Adelaide	3631	15
	3631-2	5
	4144A	25
	4145	15
	4145-2	20
	4145-4	15
	4148A	10
	4197	20
	4220	10
	4236	10
	4238	20
	4246	15
	4253A	10
	4419	10
	4420	10
	4564	40
	4567	25
	4569	15

Table 2. (cont.)

Unit	Sample	10^{-5} siu
TONALITE (cont.)		
Walt Klein Ranch	6061	250
	6067	120
	6069A	120
	6070	250
	6072	20
	6073	30
	6074B	30
	6075	20
	6076	10
	6077	600
	6088	5
	6096	25
	6280	15
	6281A	90
	6283	500
	6285	80
	6308	300
	6309	60
	6312	110
	6314-1	120
	6320	20
	6321	100
	6345	300
	6346A	170
	6353	20
	6354	100
	6355	50
	RWK-1-RA	100
	RWK-2(125)	500
Wofford Heights	5054	600
	5055B	3000
	5456	300
	5457B	1200
	5458B	50
	5460	80
	5507	600
	5513	40
	5514	60
	5534	800
Zumwalt Ranch	6120	1200
	6121	1400
	6123	1600

Unit	Sample	10^{-5} siu
QUARTZ DIORITE		
Caliente	3634R	50
	3634-1B	40
	3635R	40
	3638-2	40
	3866-3A	30
	3866-3B	30
	3866-7C	40
	5441A	60
	5787A	40
	5790B	30
	5791	20
	5793	25
	5797A	20
	5798	20
	5799B	30
	5800	40
Cyrus Flat	4840	700
	4850	60
	4850-1	50
	4865A	50
	4897A	240
	4897B	50
	4898A	320
	4899	400
	4904A	700
	4905	700
	4920	800
	4922	400
	4923	400
	4926	1000
	4930	30
	4938	260
Freeman Junction	6202	3000
	6205A	2000
	6398A	800
	6433	2000
	6434	2500
	6438A	1600
	6439	2200
	6532A	140
Long Valley	6508	2200
	6509A	2000
Rhymes Campground	6255	1000
	6262	150

Table 2. (cont.)

Unit	Sample	10^{-5} siu
QUARTZ DIORITE (cont.)		
Tehachapi Mountains	3098B	40
	3100	45
	3246	40
	3252	35
	3254A	50
	3266B	30
	3270	35
	3283	15
	3285A	30
	3285B	25
	3304A	50
	3333	40
	3345	35
	3359A	30
	3360A	40
	3400B	30
	3407A	40
	3430	45
	3431	60
	3432A	120
	3435A	60
	3439A	50
	3448A	50
	3572A	45
	3605	45
	3651	30
	3709	40
	3710	30
	3729	40
	3730A	35
	3777	45
	3793	45
	3895B	35
	3899A	40
	3950	35
	4009	25
	4045A	30
	4192A	70

Unit	Sample	10^{-5} siu
Walker Pass	5735A	800
	5735B	2000
	5735C	1400
	6136	3000
	6149	2000
	6169	2400
	6171	2400
	6178A	2000
	6179	3000
	6193A	1500
	6220	2600
	6226	2400
	6391	2000
	6402	2000
	6498	2800
Hypersthene-bearing	3352C	30
	3353	40
	3441	40
	3593	50
	3594	60
	3595	40
	3702	70
	3999C	50
	4428B	40
	4429	60
QUARTZ MONZODIORITE		
Erskine Creek	5612	400
	5614	40
	5617	30
	5618B	40
	5618C	40

Table 2. (cont.)

Table 3. Comparison of modal magnetite with measured magnetic susceptibility for selected granitic samples in the southern Sierra Nevada.

Sample	Modal magnetite (volume percent)	Magnetic susceptibility in $10 \times^{-5}$ s.i. units	
		Calculated from modal magnetite	Measured with meter
GRANITE			
Bishop 4414	0.5	1885	1200
Bob Rabbit 5602	0.1	380	1400
Five Fingers 6420B	0.5	1885	2000
Long Mdw 4964	0.7	2640	3000
Sherman 5121	0.8	3015	4000
" 5122	0.7	2640	3000
GRANODIORITE			
Alta Sierra 5566	0.7	2640	2200
Castle Rock 4966	0.2	755	3200
Peppermint 5000	0.9	3395	3000
Rabbit Is. 5184	0.7	2640	2200
Sacatar 6499A	0.6	2265	4000
Wagy Flat 5247	0.7	2640	2000
TONALITE			
Fountain Spr 6065	0.4	1510	1800
Zumwalt 6121	0.4	1510	1400
QUARTZ DIORITE			
Freeman Jct 6434	1.0	3770	2500
Long Valley 6508	0.6	2265	2200
Walker Pass 5735B	0.3	1130	2000
Average	0.6	2200	2400
Calculated values for 1% magnetite		3700	4000