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MAP SHOWING DISTRIBUTION OF Cu IN STREAM SEDIMENTS AND HEAVY-MINERAL CONCENTRATES IN THE GOLDEN TROUT WILDERNESS, CALIFORNIA

By

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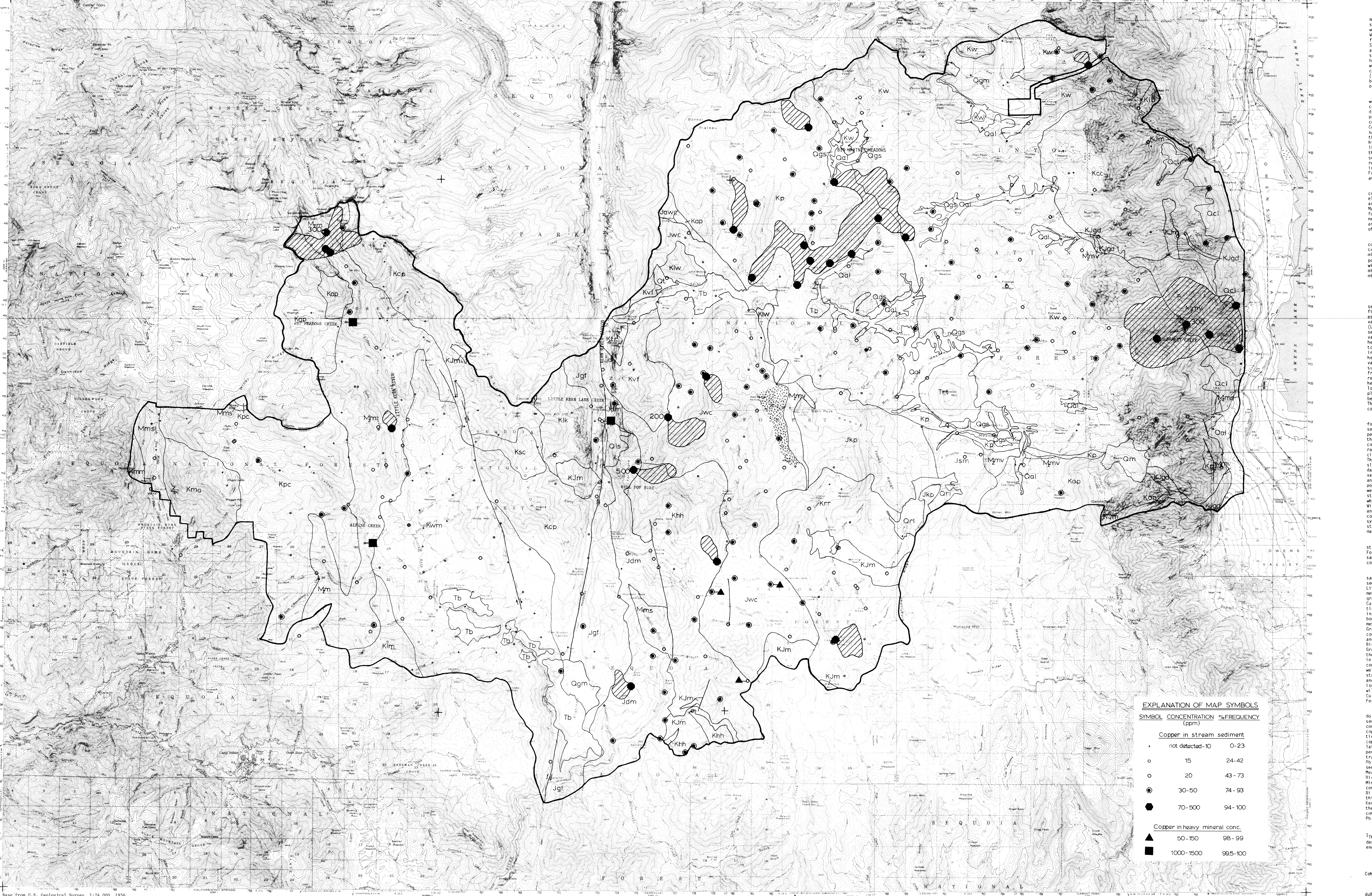
1981



Base from U.S. Geological Survey, 1:24,000, 1956
Camp Nelson; Hockett Peak; Kern Peak;
Mineral King; Monache Mtn; Olancha

Geology from E. A. duBray, D. A. Dellinger, and J. G. Moore, 1977-79

SCALE 1:62500

CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

INTRODUCTION

This map shows the distribution of Cu in the minus 80-mesh (<180 μm) fraction of composited stream sediments and in samples of heavy-mineral concentrates with anomalous Cu concentrations from the Golden Trout Wilderness, California. These samples were collected from the wilderness in the summers of 1979 and 1980. Sites were chosen on first- or second-order drainages as defined by 1:62,500 topographic maps. All sites on second-order drainages were chosen at least 100 m below any first-order-stream junction. Sample sites were selected at a density of one site per cell, each cell having an area of approximately one square mile (2.6 km^2). Some cells may not contain a sample site because of various factors such as lack of small-order-stream drainage or extreme relief.

At each site five grab samples of stream sediment were collected along 10 m of active stream channel and composited into a single sample. The samples were air dried and the minus 80-mesh (<180 μm) fraction was pulverized prior to analysis. A heavy-mineral concentrate was collected using a standard gold pan. Commonly, 3 to 4 kg of composited sediment were necessary to yield the desired amount of concentrate. At the laboratory, the sample was air dried, and the highly magnetic material was removed by a magnet. Any light-weight material remaining in the concentrate was then separated by allowing the heavier fraction to settle through bromoform (specific gravity 2.82). The resulting heavy-mineral fraction was then separated into a nonmagnetic and magnetic fraction using a Frantz Isodynamic Separator[1] at a setting of 0.6 ampere, with 15° forward and 15° side setting.

The sediments and nonmagnetic heavy-mineral concentrates were analyzed semiquantitatively for 31 elements using an optical emission spectrograph, according to the method outlined by Grimes and Marranzino (1968). A complete tabulation of the data for each sample collected in the Golden Trout Wilderness, a more detailed discussion of the sampling and analytical methods, as well as statistical summaries of the data are given in Leach and others (1981).

The Cu content of the nonmagnetic heavy-mineral concentrates reflects the distribution of Cu sulfides, carbonates, sulfosalts, oxides, and various heavy minerals capable of carrying Cu in lattice positions. The Cu content of the stream sediments will also reflect the presence of Cu-bearing heavy minerals as well as Cu in various rock-forming minerals and sorbed Cu on weathering products.

RESULTS

Histograms of the Cu concentrations in the stream sediments and heavy-mineral concentrates are shown in figures 1 and 2, respectively, and some statistical estimates are given in table 1. An analysis of variance performed on the Golden Trout Wilderness data (Leach and others, 1981) shows that Cu in stream sediments has significantly greater intercell variation (2.6 km sample cell) than does Cu in the heavy-mineral concentrates. Sixty-six percent of the total variance for Cu in stream sediments was at the intercell level compared to 23 percent for Cu in heavy-mineral concentrates. The low intercell variance for Cu in the heavy-mineral concentrates is suggested in the histogram (fig. 2) by the high frequency of concentrations in a few spectrographic reporting intervals (7 ppm to 30 ppm). Copper in the heavy-mineral concentrates apparently reflects a more local sphere of influence. Therefore, we have only plotted the heavy-mineral concentrates we consider to be anomalous that is 50-150 ppm and 1000 - 1500 ppm. These data represent the top 2 percentile concentrations of the heavy-mineral concentrate data.

The concentration ranges used to plot the Cu data for samples of stream sediment were arbitrarily selected to approximate the top 5 percentile, 95-75 percentile, 75-50 percentile, 50-25 percentile, and the lower 25 percentile. Because the spectrographic concentrations are reported as geometric midpoints of ranges in concentration, it is not possible to precisely divide the data into the desired percentiles. Therefore, the five symbols used on the map represent slightly different percentile ranges. Because the data consist of a number of populations derived from a variety of rock types, we arbitrarily chose the anomalous samples to approximate as closely as possible the top 5 percentile of the data. Therefore, we have defined the anomalous Cu concentrations in stream sediments to include the 70 to 500 ppm range which represents the top 4 percentile of the data. Within these data, we have shown on the map the highly anomalous sites (200-500 ppm Cu) indicated by the concentration of Cu adjacent to the concentration symbols. For these samples we have outlined the stream catchment area that may have contributed material for the anomalous Cu concentrations.

The highest concentration of copper (500 ppm) in stream sediments is located in a drainage near Hell For Sure underlain by alaskite of Hell's Hole. This sample does not contain any other anomalous metal concentrations.

There are three areas that contain several samples with anomalous concentrations of Cu in stream sediments. The first area is located in the upper Little Kern River watershed and is underlain by metamorphic rocks of the Mineral King roof pendant, granodiorite of Quinn Peak, and granodiorite of Pecks Canyon. This area also contains anomalous concentrations of Ag, Pb, and Zn. The second anomalous area, in the Braley Creek catchment area at the eastern boundary of the wilderness, is underlain by metavolcanic roof pendant and the Cretaceous Whitney Granodiorite. The Braley Creek catchment area also contains samples with anomalous concentrations of Pb and Ag. The third anomalous area is located south of Big Whitney Meadows and is underlain by the Whitney Granodiorite and Paradise Granodiorite. This area and the several isolated anomalous stream catchment areas in the southern part of wilderness area contain high concentrations of Fe in the stream sediments. It is well known that Cu will sorb onto Fe-oxyhydroxides in stream sediments; therefore, it is possible that the anomalous areas near Big Whitney Meadows and the isolated drainages in the southern part of the wilderness are related to weathering of disseminated Cu minerals in the granitic rocks and sorption onto Fe-oxyhydroxides.

The heavy-mineral concentrates with anomalous Cu do not correlate with the anomalous stream sediments. However, there are three heavy-mineral concentrates with highly anomalous concentrations of copper together with other anomalous metal concentrations. The sample with the highest concentration of copper (1500 ppm) is located in Alpine Creek, underlain by metamorphic rocks of the Mineral King roof pendant. This sample also contains anomalous concentrations of B (700 ppm), Ag (15 ppm), As (3000 ppm), Pb (700 ppm), W (200 ppm), and Sn (100 ppm). The second highly anomalous sample is located in Wet Meadows Creek in the northern part of the Little Kern River drainage, underlain by metamorphic rocks of the Mineral King roof pendant. Anomalous metal concentrations in this sample include Cu (1000 ppm), Bi (700 ppm), W (500 ppm), and Sn (100 ppm). The third highly anomalous sample is located near Little Kern Lake Creek in the Kern River Canyon, underlain by the granite of Grasshopper Flat. Anomalous metal concentrations in this sample include Cu (1000 ppm), Pb (3000 ppm), Mo (70 ppm), and W (100 ppm).

[1]The use of trade names in this report is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

REFERENCES CITED

Cohen A. C., 1959, Simplified estimators for the normal distributions when samples are singly censored or truncated: Technometrics, V. 1, no. 3, p. 217-237.

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Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternationg-current spark emission spectrographic field methods for semi-quantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.

Leach, D. L., Goldfarb, R. J., and Domenico, J. A., 1981, Basin data report and geochemical summary for stream sediments, heavy-mineral concentrates, rocks, and waters from the Golden Trout Wilderness, California: U.S. Geological Survey Open-File Report 81-752.

Table 1.--Statistical summary of Cu concentrations. Calculations were made using qualified data by Cohen's (1959) method. Details of the calculations are given in Leach and others, 1981.

	Stream sediments	Heavy-mineral concentrates
Detection ratio*	0.96	0.99
Geometric mean (ppm)	18	13
Geometric deviation (ppm)	2.2	1.7
Expected range for 95% of data (ppm)	2.8-85	4.2-39
Arithmetic mean (ppm)	24	15

* Number of uncensored values divided by total number of samples.

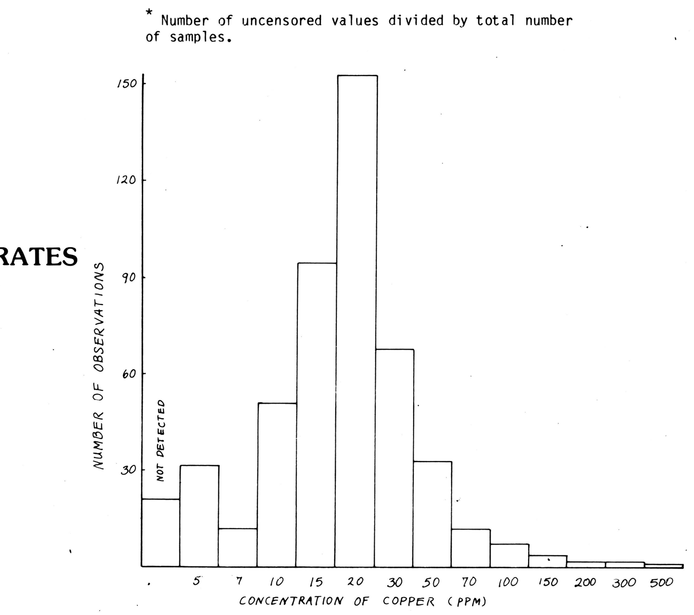


FIGURE 1: HISTOGRAM OF COPPER IN STREAM SEDIMENT

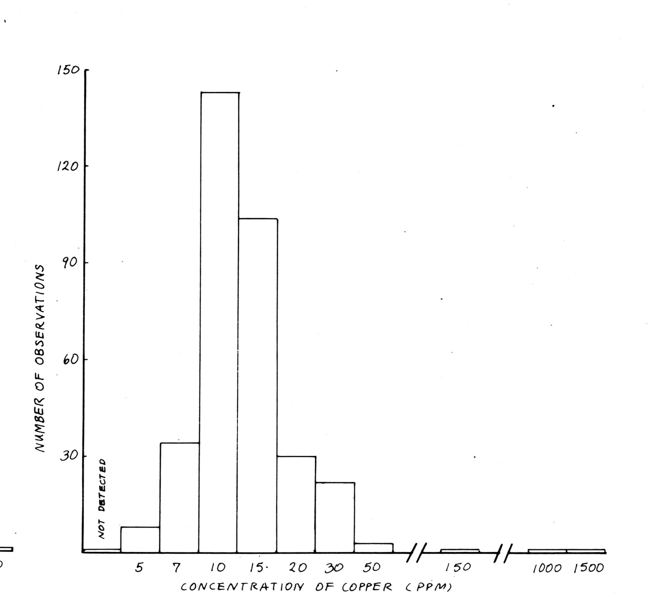


FIGURE 2: HISTOGRAM OF COPPER IN HEAVY-MINERAL CONCENTRATES

LIST OF MAP UNITS

SURFICIAL DEPOSITS

- Qal — Alluvium
- Qcl — Colluvium
- Qgm — Glacial Moraine
- Qt — Talus
- Qg — Gravel
- Qls — Landslide Deposit
- Qgs — Grus and Sand

VOLCANIC ROCKS

- Qrl — Rhyolite of Long Canyon
- Tb — Basalt
- Trt — Rhyolite of Templeton Mountain

GRANITOID ROCKS (WESTERN REGION)

- Kmm — Alaskite of Moses Mountain
- Kma — Alaskite of Maggie Mountain
- Kqp — Granodiorite of Quinn Peak
- Kpc — Granodiorite of Peck's Canyon

GRANITOID ROCKS (CENTRAL REGION)

- Kwm — Granite of White Mountain
- Ksc — Granodiorite of Sheep Creek
- Kvf — Granodiorite of Volcano Falls
- Ktr — Granodiorite of Tower Rock
- Klm — Granodiorite of Loggy Meadow
- Kcp — Alaskite of Coyote Pass
- Klk — Granite of Little Kern Lake Creek
- Khh — Alaskite of Hell's Hole
- Jgf — Granite of Grasshopper Flat
- Jdm — Granodiorite of Doe Meadow
- Jwc — Granite of Window Cliffs

GRANITOID ROCKS (EASTERN REGION)

- Klw — Granite of Little Whitney Meadow
- Kw — Whitney Granodiorite
- Kib — Intrusion Breccia of Timosea Peak
- Kp — Paradise Granodiorite

GRANITOID ROCKS (EASTERN REGION (CONT'D))

- Kcc — Granite of Carroll Creek
- Krr — Granodiorite of Redrock Meadow
- Kop — Alaskite of Olancha Peak
- Jawc — Alaskite of Window Cliffs
- Jwc — Granite of Window Cliffs (patterned area is a mafic phase)
- Jkp — Alaskite of Kern Peak
- Jsm — Granodiorite of Schaeffer Meadow

IGNEOUS ROCKS (OF UNCERTAIN TEMPORAL & GENETIC AFFINITIES)

- Kap — Aplite
- KJm — Mafic Plutonic Rock
- KJgd — Granodiorite

METAMORPHIC ROCKS

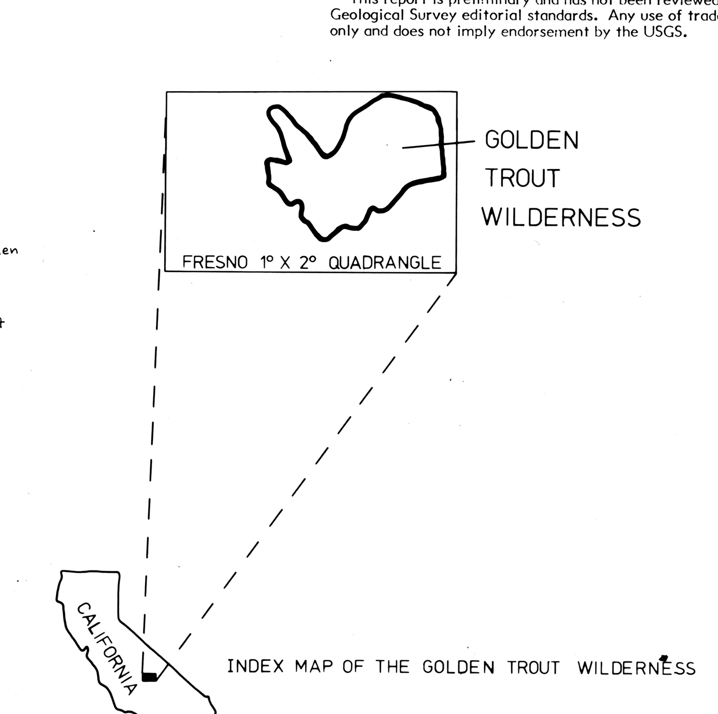
- Mzms — Metasedimentary Rocks
- Mzm — Metamorphic Rocks, Undifferentiated
- Mzmv — Metavolcanic Rocks

(Geology from duBray and Dellinger, 1981)

Boundary of Golden Trout Wilderness

Geologic Contact

Fault



INDEX MAP OF THE GOLDEN TROUT WILDERNESS

Studies Related to Wilderness

The Wilderness Act (Public Law 88-577, Sept. 3, 1964) and related Acts require the U.S. Geological Survey 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 a geochemical survey of the Golden Trout Wilderness, California.