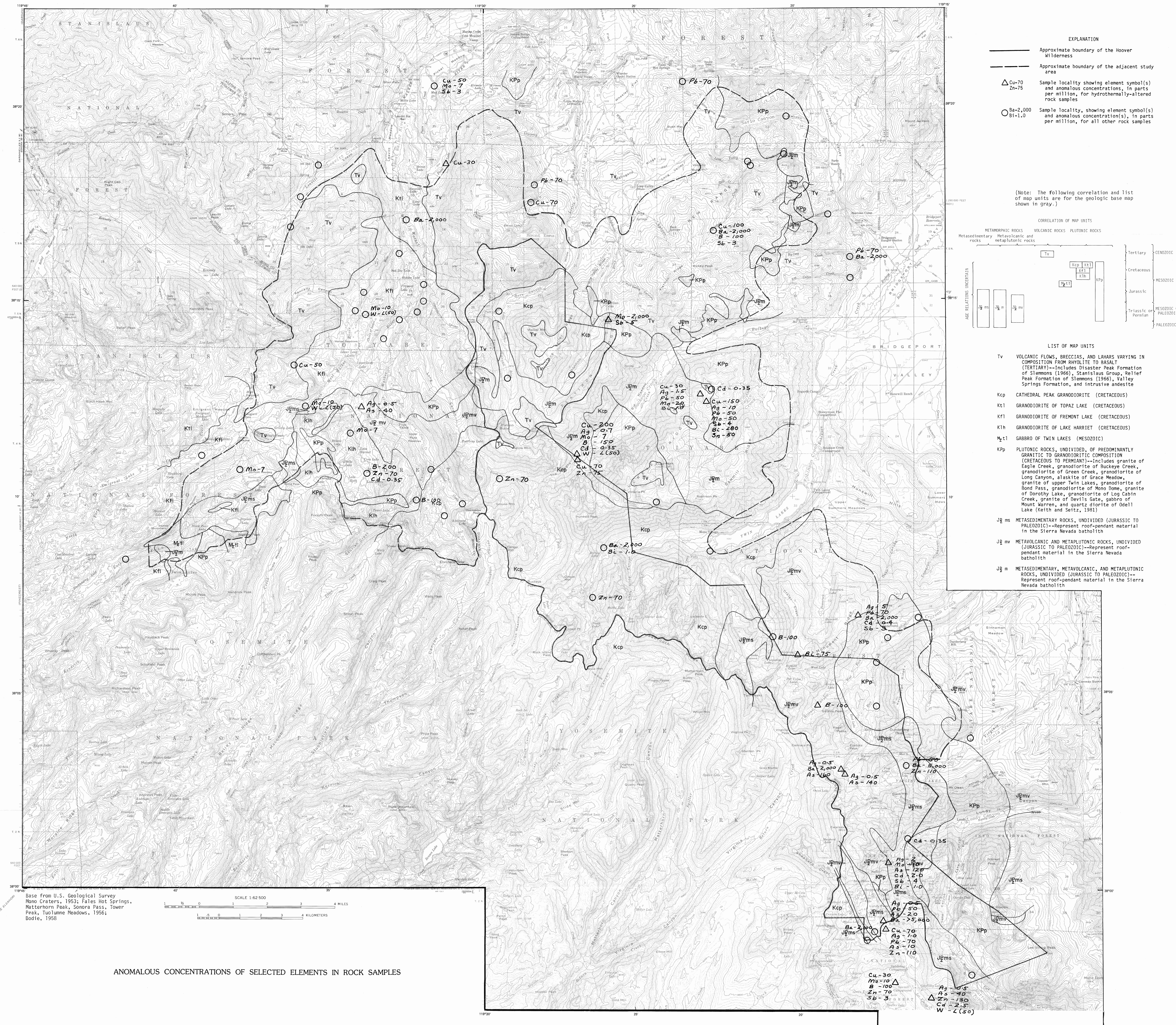


Base from U.S. Geological Survey
Mono Craters, 1953; Fales Hot Springs,
Matterhorn Peak, Sonora Pass, Tower
Peak, Tuolumne Meadows, 1956;
Bodie, 1958

SCALE 1:62 500

Geology modified from
Keith and Seitz (1981)

EXPLANATION

Approximate boundary of the Hoover Wilderness

Approximate boundary of the adjacent study area

△ Cu-70 Zn-75 — Sample locality showing element symbol(s) and anomalous concentrations, in parts per million, for hydrothermally-altered rock samples

○ Ba-2,000 Bi-1.0 — Sample locality, showing element symbol(s) and anomalous concentration(s), in parts per million, for all other rock samples

(Note: The following correlation and list of map units are for the geologic base map shown in gray.)

CORRELATION OF MAP UNITS

LIST OF MAP UNITS

Tv	VOLCANIC FLOWS, BRECCIAS, AND LAHARS VARYING IN COMPOSITION FROM RHYOLITE TO BASALT (TERTIARY)--Includes Disaster Peak Formation of Slemmons (1966), Stanislaus Group, Relief Peak Formation of Slemmons (1966), Valley Springs Formation, and intrusive andesite
Kcp	CATHEDRAL PEAK GRANODIORITE (CRETACEOUS)
Ktl	GRANODIORITE OF TOPAZ LAKE (CRETACEOUS)
Kfl	GRANODIORITE OF FREMONT LAKE (CRETACEOUS)
Klh	GRANODIORITE OF LAKE HARRIET (CRETACEOUS)
$M_z$tl	GABBRO OF TWIN LAKES (MESOZOIC)
KPp	PLUTONIC ROCKS, UNDIVIDED, OF PREDOMINANTLY GRANITIC TO GRANODIORITIC COMPOSITION (CRETACEOUS TO PERMIAN?)--Includes granite of Eagle Creek, granodiorite of Buckeye Creek, granodiorite of Green Creek, granodiorite of Long Canyon, alaskite of Grace Meadow, granite of upper Twin Lakes, granodiorite of Bond Pass, granodiorite of Mono Dome, granite of Dorothy Lake, granodiorite of Log Cabin Creek, granite of Devils Gate, gabbro of Mount Warren, and quartz diorite of Odell Lake (Keith and Seitz, 1981)
J$P_z$ms	METASEDIMENTARY ROCKS, UNDIVIDED (JURASSIC TO PALEOZOIC)--Represent roof-pendant material in the Sierra Nevada batholith
J$P_z$mv	METAVOLCANIC AND METAPLUTONIC ROCKS, UNDIVIDED (JURASSIC TO PALEOZOIC)--Represent roof-pendant material in the Sierra Nevada batholith
JP_zm	METASEDIMENTARY, METAVOLCANIC, AND METAPLUTONIC ROCKS, UNDIVIDED (JURASSIC TO PALEOZOIC)--Represent roof-pendant material in the Sierra Nevada batholith

ANOMALOUS CONCENTRATIONS OF SELECTED ELEMENTS IN ROCK SAMPLES

STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require 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 a geochemical survey of the Hoover Wilderness (NF-036) and adjacent Hoover Extension (East) (E-4662), Hoover Extension (West) (W-4662), and Cherry Creek A (5662) Roadless Areas in the Inyo, Stanislaus, and Toiyabe National Forests, Mono and Tuolumne Counties, California. The Hoover Wilderness was established by Public Law 88-577, September 3, 1964. The Hoover Extension (East) was classified as a further planning area and the Hoover Extension (West) and Cherry Creek A were classified as wilderness areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

INTRODUCTION

Area Description

The Hoover Wilderness and the adjacent Hoover Extension (East), Hoover Extension (West), and Cherry Creek A Roadless Areas (the adjacent study area) encompass approximately 153,900 acres (241 mi^2; 623 km^2) in the Inyo, Stanislaus, and Toiyabe National Forests, Mono and Tuolumne Counties, Calif. These two areas lie along and mostly east of the crest of the Sierra Nevada, along the north and east sides of Yosemite National Park. Elevations vary from a high of 12,446 ft (3,793 m) on the crest of the Sierra Nevada to a low of about 6,500 ft (1,981 m) near the Bridgeport Ranger Station. Access to the Hoover Wilderness and adjacent study area is by U.S. Highway 395, California State Highways 108 (Sonora Pass) and 120 (Tioga Pass), and by other paved and graded roads that lead off of these U.S. and State highways.

GEOLOGY

The geology of the Hoover Wilderness and adjacent study area is typical of many parts of the Sierra Nevada. A batholithic complex, including plutons of Permian(?) to Late Cretaceous age, has intruded a sequence of Paleozoic and Mesozoic rocks to form what are now metasedimentary, metavolcanic, and metaplutonic roof-pendant and bounding wall rocks. Overlying these units locally are Tertiary volcanic rocks consisting of flows, breccias, lahars, and intrusive dikes and sills (Keith and Seitz, 1981). A generalized geologic map is shown in gray on this geochemical map and on sheets 2 and 3. A more detailed geologic map of the entire area is also available (Keith and Seitz, 1981).

SAMPLING DESIGN

This summary geochemical map shows the distributions of anomalous concentrations of 13 selected elements in 74 rock samples collected during 1978 in the Hoover Wilderness and adjacent study area. Each rock sample was composited from outcrops considered to be representative of exposures in the vicinity of the plotted locality. Most of the samples are of unaltered rock. These samples provide information on chemical abundances in typical rocks that have not been hydrothermally altered or mineralized. In addition, some altered and(or) mineralized rocks were collected to characterize anomalous areas and to test for ore-related elements in minerals that might not be identified by a visual examination. Although each sample was selected to be representative of the rocks exposed in the vicinity of its plotted locality, the actual areal extent of applicability of the chemical information provided by a specific sample is not known; the sampling program was designed only to provide some general information of the geochemical nature of the rock units present.

Because the sampling program was designed and executed on a reconnaissance scale, exposed areas of chemically anomalous rock may not have been detected. Mineral deposits not exposed at the surface would also not likely be identified even if part of the deposit system, such as an alteration aureole, were exposed. Additional detailed geochemical surveys, as well as other types of studies, would be necessary to identify and delineate specific mineralized areas.

SAMPLE COLLECTION, PREPARATION, ANALYSIS, AND EVALUATION

Rock samples were composited from chips from outcrops, and the sample material was hand cobbed where necessary to remove any obviously weathered material. The samples were crushed, pulverized, and then analyzed for 36 elements. Five of the elements (As, Bi, Cd, Sb, and Zn) were determined by using atomic-absorption spectrometry or colorimetry; the other 31 elements (Ag, As, Au, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, La, Mg, Mn, Mo, Nb, Ni, Pb, Sb, Sc, Sn, Sr, Th, Ti, V, W, Y, Zn, and Zr) were determined using a six-step semiquantitative emission spectrographic method. Further details of the procedures for collecting, preparing, and analyzing the samples, as well as a complete listing of all of the analyses, are given in Chaffee, Banister, and others (1980).

From the 36 elements determined in the rock samples, 13 were selected as those most likely to be related to hydrothermal alteration and(or) mineralization. Table 1 summarizes, for these 13 elements, the background and anomaly ranges used in constructing the map. The percent of samples in each category is also given for each element so that differences between the elements can be compared.

Table 1.--Summary of background and anomaly ranges for 13 selected elements in 74 samples of rock, Hoover Wilderness and adjacent study area, Mono and Tuolumne Counties, California

[All concentrations are in parts per million. N = not detected at lower limit of determination shown in parentheses. AA following the element symbol indicates atomic absorption analysis. CM following the element symbol indicates colorimetric analysis. All other analyses are spectrographic]

	Background samples		Anomalous samples	
Element	Range of values	Percent of samples	Range of values	Percent of samples
Ag	N(0.5)-<0.5	85	0.5-10	15
Cu	N(5)-20	86	30-200	14
Pb	N(10)-30	88	50-70	12
Zn-AA	<5-65	89	70-130	11
Cd-AA	N(0.05)-0.30	91	0.35-2.5	9
As-CM	N(10)-<10	89	10-160	11
Sb-AA	1-2	91	3-5	9
Bi-AA	N(0.5)-0.5	93	1.0-280	7
B	N(10)-70	88	100-200	12
Mo	N(5)-5	85	7->2,000	15
W	N(50)	93	<50-50	7
Sn	N(10)	99	<10-50	1
Ba	50-1,500	86	2,000->5,000	14

For the rock samples the threshold value (highest background value) for each selected element was first assigned after a visual inspection of the respective frequency distribution plot and map plot. The anomalies for a given element based on this value were then compared to known mineralized areas and to similar plots for other elements thought to be geochemically associated with the element in question. The threshold values were also compared to those derived from samples collected for the geochemical study of the Walker Lake 1° x 2° quadrangle (Chaffee, Hill, and others, 1980), a much larger data base. The final threshold value was assigned on the basis of all of the above information.

The most significant anomalies for rock samples are those for sites containing some combination of (1) hydrothermal alteration; (2) samples with more than one anomalous element, particularly silver, copper, lead, and(or) zinc; and(or) (3) unusually high concentrations for each anomalous element. The rock samples all represent a relatively restricted source; any evaluation of the geochemical information in the Hoover Wilderness and adjacent study area must also take into account the analyses of the samples of minus-60-mesh stream sediment and nonmagnetic heavy-mineral concentrate, which are shown on sheets 2 and 3.

DISCUSSION OF THE GEOCHEMICAL MAP

The chemical analyses of the rock samples indicate that most of the Hoover Wilderness and adjacent study area does not seem to contain significant mineral deposit-related anomalies. As shown in table 1, about 10 percent of the samples contain anomalous concentrations of at least one element. Anomalous concentrations for many of the selected elements are generally low in relation to concentrations expected of samples from highly mineralized exposures; thus, many of these anomalies probably only represent high but normal concentrations for the rock types sampled.

Some of the anomalies based on rock samples do seem to be related to hydrothermal alteration and mineralization. A comparison of the regional geology with those sites having anomalies indicates that the most significant of these anomalies occur south of the Buckeye Creek drainage basin and that they are all associated with the metamorphosed sedimentary and igneous roof-pendant rocks. Hydrothermally altered (mainly silicified and pyritized) outcrops are present locally in these formations. Numerous mines and prospects are also present in the southern part of the area sampled (Tooker and others, 1983).

Weaker anomalies and anomalies that consist of fewer samples are located in several different formations that crop out north of the Buckeye Creek drainage basin. Not surprisingly, anomalous molybdenum was detected in a sample collected in the vicinity of a molybdenum prospect on Molybdenite Creek. This anomaly is associated with a Cretaceous granodioritic unit. No other molybdenum anomalies of this magnitude (2,000 ppm) were detected in the overall study area. Minor anomalies are scattered in the upper West Walker River and Little Walker River drainage basins and in other isolated localities. The significance, if any, of these anomalies is not known.

REFERENCES

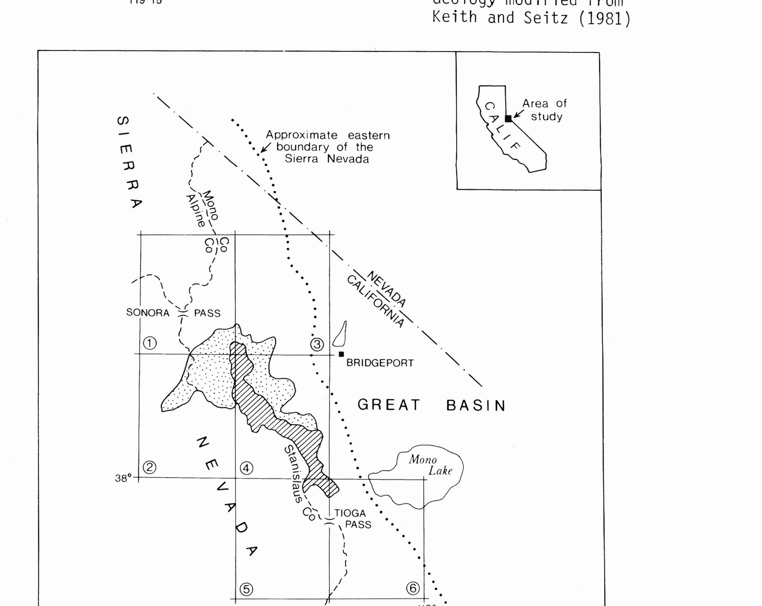
Chaffee, M. A., Banister, C. A., Barnard, J. B., Giusso, J. R., Hill, R. H., Keith, W. J., Seitz, J. F., Speckman, W. S., and Sutley, S. J., 1980, Geochemical analyses of samples of rock, stream sediment, and panned heavy-mineral concentrate, Hoover Wilderness and adjacent study areas, California: U.S. Geological Survey Open-File Report 80-79, 39 p., 1 plate.

Chaffee, M. A., Hill, R. H., and Speckman, W. S., and Sutley, S. J., 1980, Preliminary data set containing geochemical analyses of samples of rock, stream sediment, and nonmagnetic heavy-mineral concentrate, Walker Lake 2° quadrangle, California and Nevada: U.S. Geological Survey Open-File Report 80-881, 235 p., 1 plate.

Keith, W. J., and Seitz, J. F., 1981, Geologic map of the Hoover Wilderness and adjacent study area, Mono and Tuolumne Counties, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1101-A, scale 1:62,500.

Slemmons, D. B., 1966, Cenozoic volcanism of the central Sierra Nevada, California, in Bailey, E. H., ed., Geology of northern California: California Division of Mines and Geology Bulletin 190, p. 199-208.

Tooker, E. W., Zilka, N. T., Chaffee, M. A., Plouff, Donald, Brem, G. F., Keith, W. J., Seitz, J. F., and Leszcykowski, A. M., 1983, Mineral resource potential map of the Hoover Wilderness and adjacent roadless areas, Central Sierra Nevada, California: U.S. Geological Survey Miscellaneous Field Studies Map MF-1101-D, scale 1:62,500.



Index map showing location of Hoover Wilderness (lined) and adjacent study area (stippled), California. Numbers indicate 15-minute quadrangles: (1) Sonora Pass, (2) Tower Peak, (3) Fales Hot Springs, (4) Matterhorn Peak, (5) Tuolumne Meadows, and (6) Mono Craters.

SUMMARY GEOCHEMICAL MAPS, HOOVER WILDERNESS AND ADJACENT STUDY AREA, MONO AND TUOLUMNE COUNTIES, CALIFORNIA

By

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1984

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