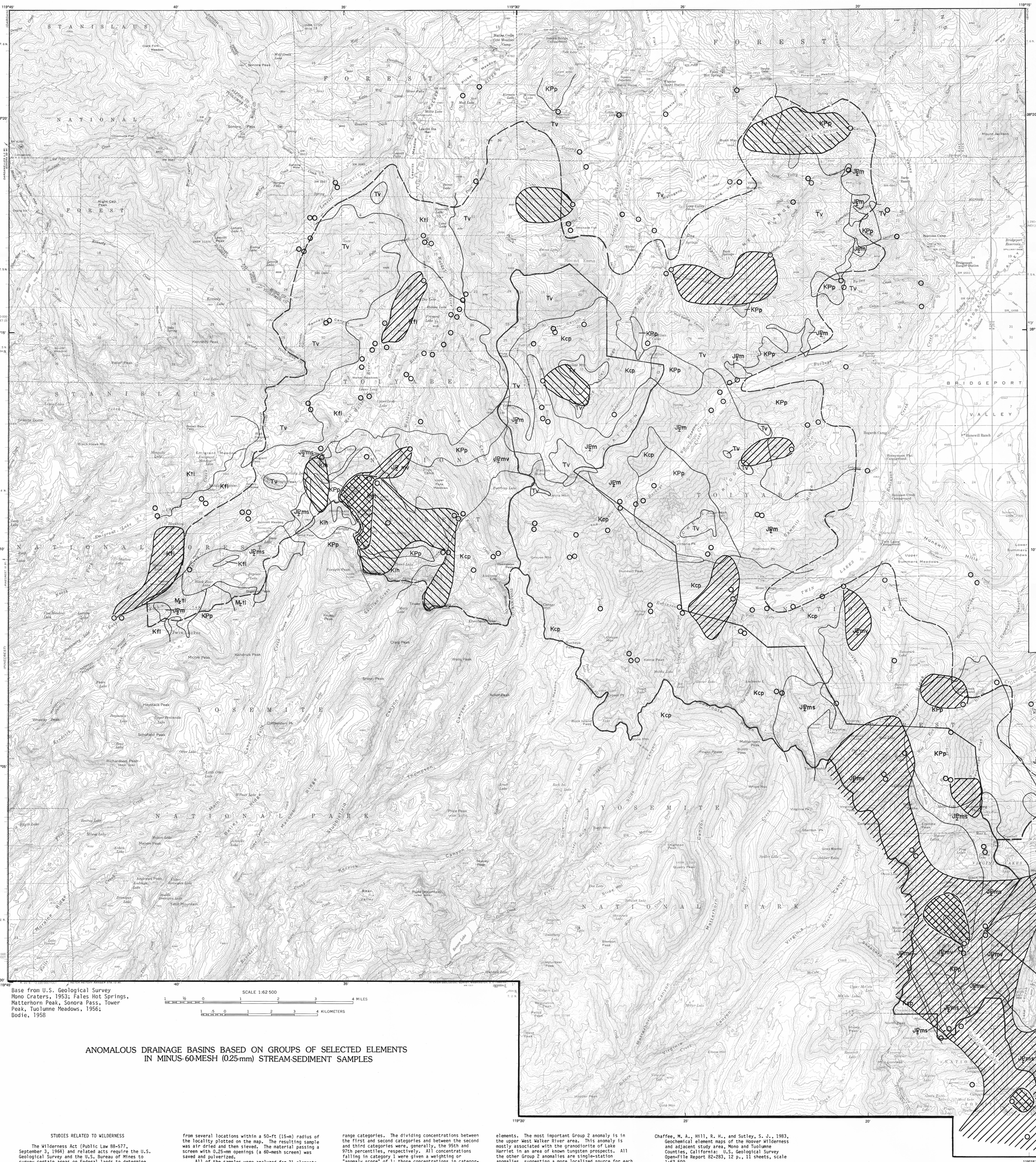


Base from U.S. Geological Survey
Mono Craters, 1953; Fales Hot Springs,
Matterhorn Peak, Sonora Pass, Tower
Peak, Tuolumne Meadows, 1956;
Bodie, 1958

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

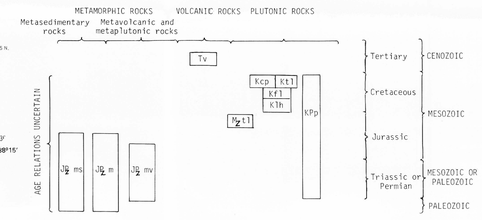
Sample locality

Approximate limits of drainage basin(s) for localities that are anomalous for Group 1 elements (probably mineralization related)

Approximate limits of drainage basin(s) for localities that are anomalous for Group 2 elements (possibly mineralization related)

(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)
MZtl	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)
JPzms	METASEDIMENTARY ROCKS, UNDIVIDED (JURASSIC TO PALEOZOIC)--Represent roof-pendant material in the Sierra Nevada batholith
JPzmv	METAVOLCANIC AND METAPLUTONIC ROCKS, UNDIVIDED (JURASSIC TO PALEOZOIC)--Represent roof-pendant material in the Sierra Nevada batholith
JPzm	METASEDIMENTARY, METAVOLCANIC, AND METAPLUTONIC ROCKS, UNDIVIDED (JURASSIC TO PALEOZOIC)--Represent roof-pendant material in the Sierra Nevada batholith

ANOMALOUS DRAINAGE BASINS BASED ON GROUPS OF SELECTED ELEMENTS IN MINUS-60-MESH (0.25-mm) STREAM-SEDIMENT 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-4462), 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.

SAMPLING DESIGN

This summary geochemical map shows the distributions of anomalous concentrations of 12 selected elements in 182 samples of minus-60-mesh (minus-0.25-mm) stream sediment collected during 1978 in the Hoover Wilderness and adjacent study area. The sediment samples provide information about the chemical elements present in rock material eroded from the drainage basin upstream from each sample locality. Such information is useful in identifying those basins that contain unusually high concentrations of elements that may be related to mineral deposits.

Because the sampling program was designed and executed on a reconnaissance scale, some small but exposed areas of chemically anomalous rock may not have been detected in the stream-sediment samples. 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

The stream-sediment samples were collected primarily from first-order (unbranched) and second-order (below the junction of two first-order) streams as shown on 1:62,500-scale topographic maps. Each sample was composited from active alluvium collected from several locations within a 50-ft (15-m) radius of the locality plotted on the map. The resulting sample was air dried and then sieved. The material passing a screen with 0.25-mm openings (a 60-mesh screen) was saved and pulverized.

All of the samples were analyzed for 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) using a six-step semiquantitative emission spectrographic method. The samples were also analyzed for As, Bi, Cd, Sb, and Zn by means of colorimetry or atomic-absorption spectrometry; the atomic-absorption and colorimetric analyses for these five elements are the ones used here. 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 sediment samples, 12 were selected as those most likely to be related to hydrothermal alteration and(or) mineralization; anomaly maps for these elements have been made (Chaffee and others, 1983). Table 1 summarizes, for the 12 selected elements, the background and anomaly ranges used in constructing this summary map. The percent of samples in the background range is also given for each element so that differences between the elements can be compared.

For the stream-sediment 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 (Chaffee and others, 1983). 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 after studying all of the above information.

On the basis of their observed associations, each of the 12 selected elements was assigned to one of two groups (table 1). Group 1 comprises those elements (Ag, As, Cd, Cu, Pb, and Zn) that are thought to most likely be related to mineralization in the overall area examined. Group 2 comprises those elements (B, Ba, Bi, Mo, Sb, and W) whose concentrations are likely to vary with rock type, but which locally may vary as a result of mineralization. Within each of these two groups the anomalously high concentrations for each element were assigned to one of three concentration-range categories. The dividing concentrations between the first and second categories and between the second and third categories were, generally, the 95th and 97th percentiles, respectively. All concentrations falling in category 1 were given a weighting or "anomaly score" of 1; those concentrations in categories 2 and 3 were assigned anomaly scores of 2 and 3, respectively. The anomaly scores for the element suites in Groups 1 and 2 were then added for each sample locality to produce a number for each group called a SCORESUM (Chaffee, 1983). In general, the higher the SCORESUM for a site, the more significant is that site in terms of mineral potential. Cross-hatched areas on the map outline drainage basins for sites with SCORESUMS of ≥2 for Group 1 elements and ≥4 for Group 2 elements. The minimum values of 2 and 4 seem to identify best the important anomalies while removing most of the anomalies based on only one element that may only be related to rock type.

DISCUSSION OF THE GEOCHEMICAL MAP

The chemical analyses of the stream-sediment 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 10-15 percent of the samples contain anomalous concentrations of at least one element.

In terms of mineral resource potential, significant geochemical anomalies are present in several localities. The most significant anomaly for the Group 1 elements is in the southern part of the Hoover Wilderness, generally between the Green Creek drainage basin and the Saddlebag Lake-Warren Fork area. The rocks in this area are mostly 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 known in this general area (Tooker and others, 1983).

Other anomalies for Group 1 elements are present in the Cherry Creek, upper West Walker River, Molybdenite Creek, Sarto Canyon, Buckeye Creek, and Robinson Creek drainage basins. These anomalies are not associated with any one rock type; consequently, some of the anomalies may only represent high but normal element concentrations for the rock type(s) present. Other anomalies may, in fact, be related to hydrothermal activity. More detailed studies would be necessary to determine the possible sources of most of these anomalies.

Anomalies for Group 2 elements are generally smaller and more scattered than those for Group 1 elements. The most important Group 2 anomaly is in the upper West Walker River area. This anomaly is mostly associated with the granodiorite of Lake Harriet in an area of known tungsten prospects. All the other Group 2 anomalies are single-station anomalies, suggesting a more localized source for each anomaly. Several different rock types are associated with these anomalies; consequently, as noted above for Group 1 elements, further studies would be necessary to determine the sources of these anomalies.

A locality with only one anomalous element in one type of sample may be significant as a mineral deposit indicator; however, those localities with more than one anomalous element in more than one sample type are clearly more significant. Consequently, the geochemical maps for all three types of samples collected for this study should be consulted as part of any mineral assessment of the Hoover Wilderness and adjacent study area.

Many of the localities that show anomalies for one or more elements in the stream-sediment samples also show anomalies for elements in one or both of the other two sample types used in this study. Most significant are those localities in and south of the Robinson Creek drainage basin, which show common anomalies at many sites for both sediment and concentrate samples and locally also for rock samples.

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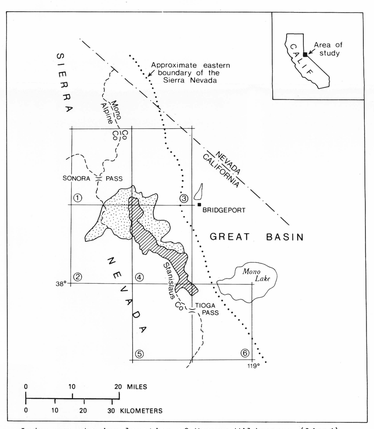
Table 1.--Summary of background and anomaly ranges for 12 selected elements in 182 samples of minus-60-mesh (0.25-mm) stream sediment, Hoover Wilderness and adjacent study area, Mono and Tuolumne Counties, California

[All concentrations are in parts per million. N = not detected at the lower limit of determination shown in parentheses. Leaders (--) indicate no samples in that category. 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	Anomaly score = 1	Anomaly score = 2	Anomaly score = 3
Group 1 (probably mineralization related)					
Ag	N(0.5)-<0.5	90	0.5	0.7-1.5	3-5
As-CM	N(10)-<10	88	10-40	60-80	100-160
Cd-AA	N(0.05)-0.35	90	0.4-0.6	0.7-0.8	0.9-2.8
Cu	N(5)-50	96	70	100	200
Pb	15-50	95	70	100	500
Zn-AA	20-80	85	90-140	160	180-200
Group 2 (possibly mineralization related)					
B	N(10)-50	84	70-100	150	200
Ba	200-1,500	94	2,000	--	--
Bi-AA	N(0.5)-0.5	85	1	2-3	4-5
Mo	N(5)-7	84	10	15	20
Sb-AA	<1-3	95	4	5	10
W	N(50)	91	<50	50	--



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

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1984

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