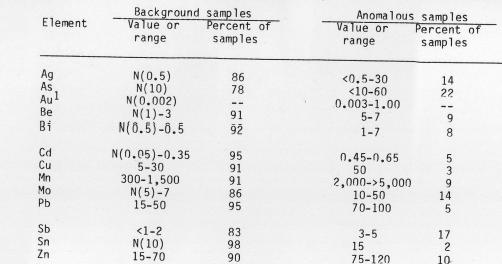
119°30′

Base from U.S. Geological Survey

Bridgeport, Pine Grove Hills, 1958

Desert Creek Peak, Fales Hot Springs, 1956;

Only 78 samples were analyzed for gold.



Concentration value or range in parts per million, except for Fe, which is in percent. N, not detected at the lower limit of determination shown in parentheses; <, detected but in a concentration below that shown; >, greater than value shown]

Those samples for which Co=50 and Ni<50 are considered anomalous; those samples for which Co=50 and Ni>50 are considered background; see text.

Table 4.--Anomaly scores for 13 selected elements in 59 samples minus-60-mesh stream sediment, Sweetwater Roadless Area, California 0.003 0.01 - 1.00

D. F., Cather, E. E., Zilka, N. T., and Leszcykowski, A. M., 1983

1929, Silver; in California mineral production for 1928: 1935, Silver; in California mineral production and directory of 1936, Silver; in California mineral production and directory of 1937, Silver; in California mineral production and directory of _1938, Silver; in California mineral production and directory of 1939, Silver; in California mineral production and directory of

Mining Bulletin 117, p. 49-52. Division of Mines and Mining, p. 374-406. annual report of the State Mineralogist: San Francisco, California State Mining Bureau. p. 357-363. 1938, Silver; in California mineral production and directory of mineral producers for 1937: California Division of Mines and Mining Bulletin 116, p. 46-47. 1939, Silver; in California mineral production and directory of mineral producers for 1938: California Division of Mines and Mining Bulletin 117, p. 49-52.

Whiting, E. M., 1888, Patterson mining district [Mono County]; in Eighth

annual report of the State Mineralogist: San Francisco, California

anomalous for elements in all three concentrate groups $(KN_1, KN_2, and$ KN₃), reflecting the known precious-metal and molybdenum mineralization in this area, as well as the strong visible alteration, particularly of the volcanic units. The total SCORESUMS (circled numbers on map C) for the drainage basins in area A show a general systematic increase in values from the outermost drainage basins toward that of Silverado Canyon, suggesting that mineralization is at its maximum in or adjacent to Silverado Canyon. The suites of elements and their concentrations. which are reflected in area A by the individual and total SCORESUMS, are the most significant observed in any of the wilderness and roadless areas studied in nearby parts of the Sierra Nevada or in the Walker Lake 1° x 2° quadrangle. Area B is defined by two drainage basins in Swauger Creek, in the south-central part of the roadless area. The area is underlain predominantly by granitic plutonic rocks. These plutons include remnants of altered metasedimentary roof-pendant rocks (skarns). The rhyolite of Sweetwater Mountains and the Relief Peak Formation overlie the plutonic rock suite. Samples contain generally weakly anomalous concentrations of elements in the SS group (Bi), KN₁ group (Pb), and the KN₂ group (Be, Bi, Sn, W). in the Deep Creek and Cottonwood Creek drainage basins. The area is underlain mostly by altered metasedimentary and metavolcanic rocks. The granite of Deep Creek, as well as volcanic units in the rhyolite of Sweetwater Mountains, the Relief Peak Formation, and the Stanislaus Group are present locally. Samples of stream sediment and concentrate

Area, large areas were found to contain significant anomalies in samples of rock, stream sediment, and (or) concentrate. Three general areas are of particular interest. Area A contains mostly moderate to very high concentrations of a large suite of elements that may indicate preciousmetal, molybdenum, and (or) tungsten resources. Areas B and C contain generally low element concentrations of a suite of elements that may

Brem, G. F., 1975, Petrogenesis of latites, Little Walker Center, Mono with Program, v. 7, p. 1008. Calif., University of California, Ph. D. thesis, 361 p. ploration, v. 19, nos. 1-3, p. 361-381. Survey Open-File Report 80-881, 235 p., 1 plate.

KN₁ - Ag, As, Au, Cd, Cu, Pb, Sb, and (or) In in concentrate KN₂ - Be, Bi, Mo, Sn, and (or) W in concentrate samples KN3 - Ba, Co, Fe, and (or) Sr in concentrate samples. The elements in the stream-sediment samples (group SS) are mainly related to precious-metal mineralization and to molybdenum mineralization, both of which overlap in many parts of the study area. The elements in group KN₁ are mainly associated with precious-metal mineralization but may also be associated with base-metal, tungsten, and (or) molybdenum mineralization. The elements in group KN_2 are thought to be mainly associated with molybdenum porphyry deposits and (or) contact-metasomatic tungsten deposits. Group KN2 comprises elements Eakle, A. A., and McLaughlin, R. P., 1917, Patterson district; in Mono that are commonly enriched, particularly in volcanic rocks, where hydrothermal alteration (silicification, argillization, and Mineralogist, v. 15, p. 160-167 pyritization) has occurred with or without other types of mineralization. Because of the processing procedures used to produce the concentrate samples, high cobalt concentrations (>50 ppm), particularly where the corresponding nickel concentrations are low (<50 ppm), seem to indicate the presence of pyrite--the cobalt in this case is substituting for iron in pyrite. All cobalt concentrations greater than 50 ppm are shown on map B; those cohalt concentrations equal to 50 ppm that are low in nickel are also shown on map B and are evaluated for

After the anomaly scores were assigned to all of the selected elements, the scores for each group of elements were summed for each sample type at each site (SCORESUM) and plotted on the map for each drainage basin containing a sample with one or more anomalous elements. In addition, the total of all of the stream-sediment and concentrate SCORESUMS was also determined and plotted as a circled number in each appropriate drainage basin. The higher the individual or total SCORESUM is for the samples from one site, the more anomalous and signficant is the associated drainage basin in terms of mineral potential. If the SCORESUM for a given sample was zero, then the associated drainage basin was not outlined on map C. Those drainage basins whose samples have SCORESUMS equal to or greater than 3 for any of the four element groups shown on map C (SS KN1, KN2, or KN3) were deemed to be the most significant in terms of mineral potential. Patterning has been added to these drainage basins on the map to identify the types of mineralization suspected of causing

All the samples were analyzed for 31 elements (Ag, As, Au, B, Ba,

Se, 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) by six-step semiquantitative emission

spectroscopy. All of the rock and stream-sediment samples were also

analyzed for arsenic by colorimetry and for bismuth, cadmium, antimony,

and stream sediment were analyzed for gold, also by atomic-absorption

and zinc by atomic-absorption spectrometry. Selected samples of rock

Further details concerning the collection, preparation, and

been published (Sutley and others, 1983).

in or near the Sweetwater Roadless Area.

calcium, thus may also indicate barite.

elements in the concentrate samples (table 3).

(3) porphyry-type molybdenum deposits.

analytical values.

groups are as follows:

1982; Seitz and others, 1983

analysis of the samples, as well as a tabulation of the analyses, have

EVALUATION PROCEDURES

Element maps

and unmineralized localities in this and other roadless and wilderness

areas in the Sierra Nevada region, a suite of 18 elements (Ag. As. Au.

selected as being indicative of mineral deposits expected to be present

In the area studied for this report, the elements silver, gold,

native gold, barite, chalcopyrite, molybdenite, galena, cassiterite, and

Ba, Be, Bi, Cd, Co, Cu, Fe, Mn, Mo, Pb, Sb, Sn, Sr, W, and Zn) was

barium, copper, molybdenum, lead, tin, and zinc are most commonly

associated with the ore or ore-related minerals argenite-acanthite,

sphalerite (or their oxidation products), respectively. The most

important mineral residences of the other selected elements are not

known. Arsenic is commonly found as arsenopyrite or in arsenic-rich

sulfosalts; beryllium in beryl; bismuth in bismuthinite or in lead or

stibnite or sulfosalts; and tungsten in scheelite, hueberite, or

as sphalerite. Cobalt can substitute for Fe²⁺ in minerals such as

rare-earth minerals; manganese in various manganese oxides; antimony in

wulfenite. Cadmium commonly substitutes for zinc in zinc minerals such

pyrite. Cobalt, particularly in concentrate samples low in nickel, thus

often indicates the presence of pyrite. Iron in a concentrate sample

minerals. Strontium in a concentrate, particularly in a sample low in

The range of background and anomalous concentrations for each

distribution histograms for these elements, the spatial distributions of background and anomalous element concentrations relative to known rock

types in the study area, and similar information developed for mineral

appraisals in other areas in the Sierra Nevada. (See, for example,

Chaffee and others, 1980; Chaffee and others, 1983a,b,c; Huber and

others, 1983; John, Armin, Plouff, Chaffee, Federspiel, and others,

1983; John, Armin, Plouff, Chaffee, Peters, and others, 1983; John,

Chaffee, and Stebbins, 1983; Keith and others, 1983; McKee and others,

were not found in anomalous concentrations in any three media sampled,

Twelve elements were found to have anomalous concentrations in the rock

samples (table 1). In a similar manner, 13 elements were found to have

SCORESUM map

and concentrate were evaluated in terms of three types of deposits

vein-associated or disseminated precious-metal deposits in altered

volcanic or plutonic rocks; (2) contact-metasomatic base- and (or)

for each sample were evaluated using a technique called SCORESUM

following manner. First, the threshold value for each element was

determined, as described above. All background concentrations were

assigned an anomaly score of 0. Next, the anomalous concentrations for

tables 4 and 5. Anomaly scores of 1 (weakly anomalous), 2 (moderately

anomalous), or 3 (strongly anomalous) were substituted for all of the

of mineral deposits in other areas studied in the Sierra Nevada, the

Zn in stream-sediment samples

selected elements for each sample type were assigned to groups. These

each element of interest were divided into three categories, as shown in

Next, as a result of element associations seen for different types

SS - Ag, As, Au, Be, Bi, Cd, Cu, Mn, Mo, Ph, Sh, Sn, and (or)

suspected or known to exist in or near the study area. These are (1)

precious-metal deposits or tungsten deposits in roof-pendant rocks; and

To emphasize the relative importance of the stream-sediment and

concentrate anomalies for each sample site, the anomalous concentrations

(Chaffee, 1983). The SCORESUM values shown on map C were created in the

The suite of 18 selected elements in the samples of stream-sediment

anomalous concentrations in the stream-sediment samples (table 2) and 17

For the Sweetwater Roadless Area, some of the selected elements

selected element was determined by studying percent-frequency

minerals. Strontium can substitute for calcium and barium in their

commonly indicates pyrite or arsenopyrite or oxidized products of these

On the basis of analyses of samples collected in both mineralized

DISCUSSION OF ELEMENT ANOMALIES IN ROCK SAMPLES

Anomalous concentrations of the selected elements in rock samples (table 1) are shown on map A. A majority of the samples were collected from outcrops and mine dumps in the area between Sweetwater Canyon on the north end and Fryingpan Canyon on the south, within and east of the east-central part of the roadless area. Most of this area is shown enlarged at the top of the map. Most of the samples collected in this enlarged area are biased; that is, they were collected from highly altered and mineralized outcrops of the rhyolite of Sweetwater Mountains, of andesites of the Relief Peak Formation, or of the granite of East Fork. Analyses from these samples, commonly strongly anomalous for one or several elements, clearly confirm the intense pyritization, argillization, bleaching, and silicification seen in hand specimens. fairly consistent suite of anomalous elements is present in most of these samples. This suite commonly consists of silver (locally with gold), arsenic, antimony, bismuth, molybdenum, and, locally, beryllium, ead, and tungsten. This suite of elements corroborates geological observations (Brem and others, 1984) that indicate the presence of veinassociated and disseminated precious-metal and molybdenum mineralization Most of the rock samples collected in the rest of the roadless area were not collected near areas of obvious alteration and (or) mineralization; thus, these samples are more objective in nature and generally contain normal or only weakly anomalous concentrations of the elements selected for study. The weakly anomalous samples are thought to represent higher than usual background concentrations unrelated to mineralization. The only strongly anomalous sample in this greater part of the roadless area is from a mineralized part of the Relief Peak Formation from a mine dump in lower Water Canyon, near the extreme eastcentral part of the study area. This sample contains anomalous silver, gold, arsenic, antimony, and bismuth. The similar geologic environment and element suite suggest that the mineralization at this site is

DISCUSSION OF ELEMENT ANOMALIES IN STREAM-SEDIMENT AND CONCENTRATE SAMPLES The anomalous concentrations of the 13 selected elements in the stream-sediment samples (table 2) and of the 17 selected elements in the concentrate samples (table 3) are shown on map B. The threshold values for the elements were picked as described in the text for map A. As was the case with the rock samples, the most significant anomalies for the stream-sediment and concentrate samples were from samples collected in the east-central part of the study area, between Sweetwater Canyon on the north and Fryingpan Canyon on the south. Elements commonl occurring in anomalous concentration in the stream-sediment samples are silver, gold, arsenic, antimony, zinc, beryllium, and molybdenum. Manganese and cadmium concentrations are less commonly anomalous. In the concentrate samples from this same area silver, copper, lead, beryllium, molybdenum, and barium concentrations are commonly anomalous; iron and strontium concentrations are less commonly anomalous. In addition, arsenic, antimony, cadmium, gold, zinc, bismuth, tin, and tungsten concentrations are locally anomalous. Anomalies of many of these same elements are also present just to the west of the abovementioned area, in the East Fork of Desert Creek, indicating that the effects of the same mineralizing event continue westward over the top of the Sweetwater Range. Other sites having anomalous samples are present in scattered locations throughout the study area. One concentrate sample collected just south of Water Canyon, at the extreme east-central part of the roadless area, contains anomalous silver. Most remaining samples contain only one or two anomalous elements and thus suggest that these scattered anomalies are probably not related to the major mineralizing

probably closely associated genetically with that in the highly

mineralized Sweetwater Canyon-Fryingpan Canyon area.

events that occurred in the central part of the roadless area. More details concerning the stream-sediment and concentrate samples are given DISCUSSION OF ANOMALIES BASED ON SCORESUMS For purposes of discussion the drainage basins containing anomalous samples have been divided into three areas, labelled A, B, and C on Area A consists of the east-central part of the Sweetwater Roadless Area from Sweetwater Canyon on the north to an unnamed canyon south of Water Canyon on the south. Part of the east side of this area extends outside the roadless area. Area A also extends into the west side of

the Sweetwater Mountains along the East Fork of Desert Creek. Area A

generally is underlain by strongly altered and mineralized volcanic

mineralized, also crops out in several localities in area A. Scattered

outcrops of metamorphosed roof-pendant rocks are present along the north

Samples of both stream sediment and concentrate generally contain

ocks of the rhyolite of Sweetwater Mountains and the Relief Peak Formation. The granite of East Fork (Kef), which is also locally

significant anomalies throughout area A. Many sample sites are

side of the Sweetwater Canyon drainage basin.

Area C is just west of the west-central boundary of the study area, contain generally weakly anomalous concentrations of elements in all four groups of elements but especially those of the KN2 group. SUMMARY AND CONCLUSIONS As a result of the geochemical survey of the Sweetwater Roadless indicate tungsten and base-metal mineralization.

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Tucker, W. B., 1927, Lead, silver, and zinc [Mono County]; in Report XXIII of the State Mineralogist: San Francisco, California Whiting, E. M., 1888, Patterson mining district [Mono County]; in Eighth Tucker, W. B., 1927, Lead, silver, and zinc [Mono County]; in Report XXIII of the State Mineralogist: San Francisco, California Division of Mines and Mining, p. 374-406.

State Mining Bureau. p. 357-363.

Table 2.--Summary of background and anomaly concentrations for 13 selected elements in 59 samples of minus-60-mesh stream sediment,

the lower limit of determination shown in parentheses; <, detected but in a concentration below that shown; >, greater than value shown.

Only seven samples were analyzed for gold.

Table 3.--Summary of background and anomaly concentrations for 17 elements in 59 samples of nonmagnetic heavy-mineral concentrate, Sweetwater Roadless Area, California and Nevada

range N(500) <500-700 200->1,000 <50-2,000 3,000->10,000 N(2)-2N(20) 100-700 N(50) $N(10)-50^{1}$ 0.2-3 N(10)-30N(20)-100150-3,000 N(200 N(20) - 70100-1,000 N(200) - 500700-3,000 N(100)-100150-700 N(500)

Concentration value or range in parts per million. <, detected but in a concentration below that shown; >, greater than value shown. Leaders (--) indicate no data] Element Value or Percent of Score = 2 (moderate) Score=3 (strong)

Value or Percent of Value or Percent range samples range samples

¹Only seven samples were analyzed for gold.

Table 5.--Anomaly scores for 17 selected elements in 59 samples of nonmagnetic heavy-stream sediment, Sweetwater Roadless Area, California and Nevada [Concentration value or range in parts per million except those for Fe, which are in percent. <, detected but in a concentration below that shown; >, greater than value shown. Leaders (--) indicate no data] $\frac{\text{Score=1 (weak)}}{\text{Value or Percent of}} \frac{\text{Score=2 (moderate)}}{\text{Value or Percent of}} \frac{\text{Score=3 (strong)}}{\text{Value or Percent of}}$ range samples range samples range samples 200->1,000 3,000-5,000 7 7,000-10,000 >10,000 100-200 50-70 100**-**150 200-1,000 10-20 500-3,000

Those samples for which Co=50 and Ni<50 are considered anomalous: those

samples for which Co=50 and Ni>50 are considered background; see text.

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 values, if any, that may be present. Results must be made available to the public and be submitted to the President and the ongress. This report presents the results of a geochemical survey of the Sweetwater (4657) Roadless Area in the Toiyabe National Forest, Mono County, California, and Lyon and Douglas Counties, Nevada. This roadless area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest The Sweetwater Roadless Area lies between Yerington, Nevada, and Bridgeport, California, along the California-Nevada boundary. The area encompasses approximately 72,240 acres in Toiyabe National Forest in Mono County, California, and Lyon and Douglas Counties, Nevada.

This roadless area, which lies just east of the Sierra Nevada range, exhibits rugged topography. Elevations range from about 6,160 feet near Devil's Gate to 11,673 feet at Mount Patterson. Geochemical sampling was conducted during 1978, 1979, and 1980. This report summarizes the results of that investigation and provides details of the geochemical evaluation used in producing the final mineral resource assessment of the study area (Brem and others, 1984) Map A shows the locations of all sites where rock samples were collected for this report and the distributions of anomalous concentrations for 12 elements in the 127 rock samples collected. In a similar manner, map B shows the collection sites for 59 samples of minus-60-mesh stream sediment, and 59 samples of nonmagnetic heavymineral concentrate derived from stream sediment and also shows the distributions of anomalous concentrations for 13 elements in the streamsediment samples and 17 elements in the concentrate samples. Map C shows outlines of those drainage basins containing samples of stream sediment and concentrate with anomalous element concentrations and also shows weighted values for each outlined basin based on the number of elements with anomalous concentrations in each stream-sediment and concentrate sample and on the degree to which these concentrations are anomalous in each sample.

INTRODUCTION

The geology of portions of the Sweetwater Roadless Area. particularly the economic geology of the Patterson mining district in and east of the east-central part of the study area, has been described in a number of published reports (Hanks, 1884; Whiting, 1888; Eakle and McLaughlin, 1917; Tucker, 1927; Bradley, 1927; Symons, 1928, 1929, 1935, 1936, 1937, 1938, 1939; Halsey, 1953; Slemmons, 1966; Noble and others, 1969, 1974; Brem, 1975, 1977, 1982; Priest, 1974, 1979; Schweickert, 1972, 1976; and Hunter, 1976). A detailed geologic map was prepared for the evaluation of this roadless area by Brem (1984). Further information on the geology is present in Brem and others (1984). A summary of the geology, based mainly on these last two reports, is given The oldest rocks in the study area are metamorphic rocks of Mesozoic (Triassic and (or) Jurassic, and Cretaceous) age that crop out in small areas in the upper parts of the Sweetwater Canyon and Swauger Creek drainage basins and west of Lobdell Lake on the west side of the study area. These metamorphic rocks formed from a protolithic assemblage consisting of limestone, calcareous mudstone, sandstone, and conglomerate as well as tuffs and tuff breccias. Thermal metamorphism has locally produced hornfelses from the fine-grained clastic rocks and marble or calc-silicate skarns from the calcareous rocks. A series of plutons, which are mainly granite in composition but which vary from granite to gabbro, crop out in many parts of the study area. Tertiary

Service, January 1979.

CORRELATION OF MAP UNITS

Digocene

DESCRIPTION OF MAP UNITS

SEDIMENTARY DEPOSITS

VOLCANIC ROCKS

ash-flow tuffs from Little Walker volcanic center

breccia, domes, lava flows, dikes, and ash-flow tuff;

RELIEF PEAK AND VALLEY SPRINGS FORMATIONS, UNDIVIDED (MIOCENE

AND OLIGOCENE) -- Relief Peak Formation (Miocene) is composed

of andesite lahars, lava flows, autobrecciated lava flows,

MIDDLE SISTER, AND BELFORT, UNDIVIDED (CRETACEOUS) -- Medium

hypidiomorphic granular to porphyritic granite; thermally

layered, gabbro-diorite-granodiorite complex; thermally

AND (OR) TRIASSIC) -- Thermally metamorphosed, calcareous,

SWEETWATER

10 20 30 MILES

INDEX MAP SHOWING LOCATION OF SWEETWATER ROADLESS AREA,

quadrangles: 1, Desert Creek Peak; 2, Pine Grove

Hills; 3, Fales Hot Springs; 4, Bridgeport. Dotted

ine represents approximate boundary between Sierra

CALIF. AND NEV. Numbers indicate 15-minute

Nevada and Basin and Range provinces.

ROADLESS AREA

grained, hypidiomorphic granular to porphyritic granite and

and domal rock. Valley Springs Formation (Miocene and

RHYOLITE OF SWEETWATER MOUNTAINS (MIOCENE) -- Rhyolite tuff

ntensely altered in central area of outcrop

Oligocene) is composed of rhyolitic ash-flow tuff

GRANITES OF DEVILS GATE-MACK CANYON, ROCK CREEK, TAYLOR VALLEY.

GRANITES OF EAST FORK AND GREEN CREEK, UNDIVIDED (CRETACEOUS)--

Medium-grained, hypidiomorphic porphyritic granite;

thermally metamorphosed and locally altered

GRANITE OF DESERT CREEK (CRETACEOUS) -- Medium-grained,

Ksc MAFIC COMPLEX OF SWAUGER CREEK (CRETACEOUS) -- Medium-grained,

METAMORPHIC ROCKS

KT m METASEDIMENTARY AND METAVOLCANIC ROCKS (CRETACEOUS, JURASSIC.

tuffaceous mudstone and sandstone, and

EXPLANATION FOR MAP A

FAULT--Dotted where inferred; bar and ball on downthrown

Ag=10 ANOMALOUS SAMPLE--Showing element and concentration in ppm

metamorphosed

- CONTACT

O SAMPLE SITE

felsic volcanic rocks

APPROXIMATE BOUNDARY OF SWEETWATER ROADLESS AREA

anitic aplite; generally very fresh

STANISLAUS GROUP (MIOCENE)--Latite lava flows and quartz latite

QTs SURFICIAL DEPOSITS (QUATERNARY AND TERTIARY?)--Alluvium.

landslide deposits, and glacial deposits

OUATERNARY

J AND TERTIARY(?)

CRETACEOUS

JURASSIC, AND

SEDIMENTARY DEPOSITS

Unconformity

VOLCANIC ROCKS

Unconformity

Unconformit.

Unconformity

PLUTONIC ROCKS

Kdc

Ksc

Unconformity

METAMORPHIC ROCKS

KTR m

volcanic rocks, which are predominantly rhyolitic or andesitic in composition and consist mainly of tuffs, tuff breccias, flows, lahars, dikes, and domal rocks, crop out over about 50 percent of the study area. Late Tertiary and (or) Quaternary surficial deposits are present locally throughout the study area and consist of diatomite; landslide deposits; glacial till, moraine, and outwash deposits; and fluvial Several types of mineralization are known to exist within the Sweetwater Roadless Area. Highly calcareous units of the metamorphic rock assemblages locally contain contact-metasomatic deposits of iron, copper, and tungsten as well as deposits of precious metals and uranium in silicified shear zones. Epithermal vein and disseminated precious-

metal deposits are associated with altered rhyolitic rocks and locally also with andesitic rocks and metavolcanic units. Vein-associated an disseminated molybdenum mineralization is present in both granitic and rhyolitic rocks, particularly in the east-central part of the study

GEOCHEMICAL INVESTIGATIONS

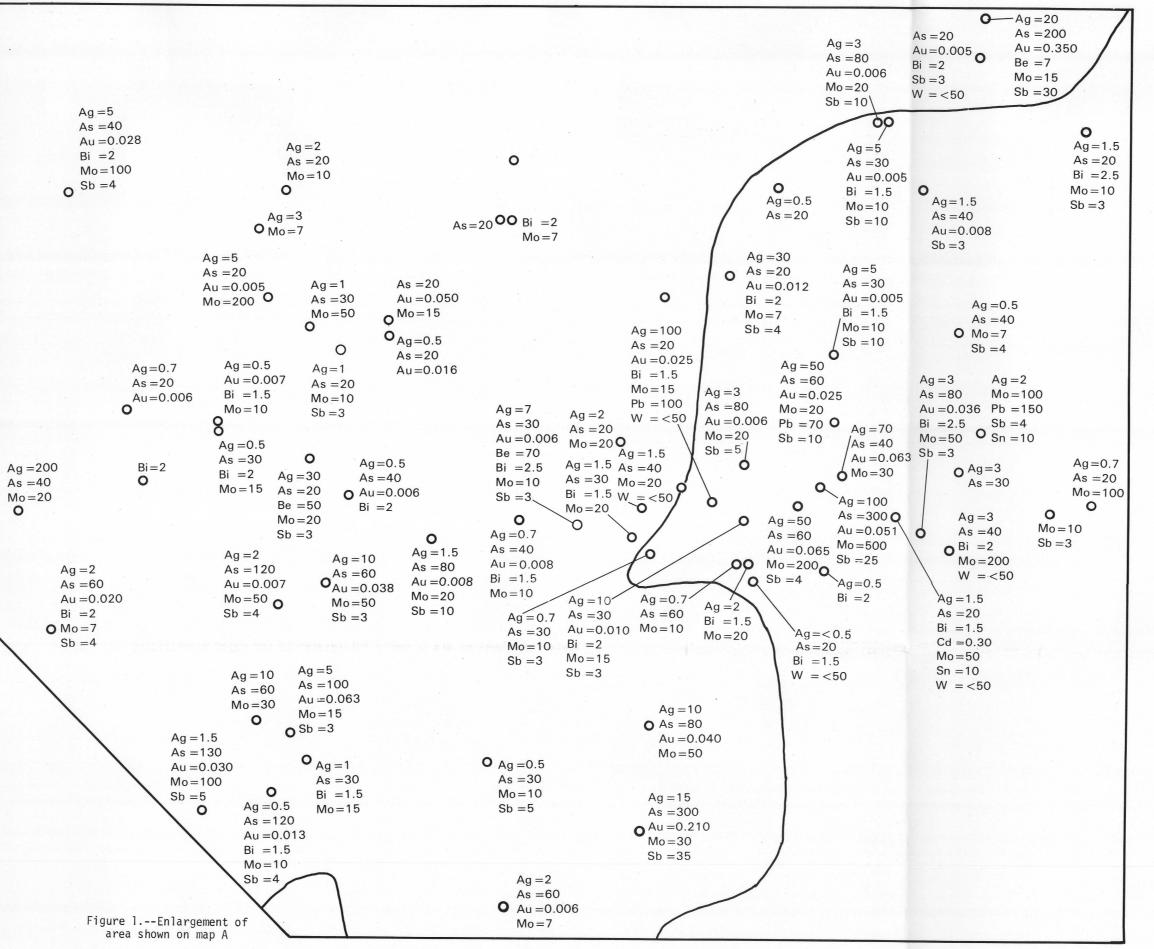
This geochemical report is based on chemical analyses of 127 rock samples, of 59 minus-60-mesh stream-sediment samples, and of 59 nonmagnetic heavy-mineral-concentrate samples processed from active The rock samples were collected as composite chips from outcrops in the vicinity of the plotted sites (map A). Many samples were of fresh rock. These samples provide background geochemical information on elements in rocks that have not been affected by alteration or mineralization In addition, altered and mineralized rocks were collected in mineralized areas to determine the abundances of specific elements present. Each rock sample was selected to represent the chemistry of the rocks present in the vicinity of the sample site; however, the actual areal extent represented by a specific sample is not The stream-sediment samples consisted of active alluvium collected primarily from first-order (unbranched) and second-order (below the

junction of two first-order) streams. Each sample was composited from several localities within an area that may extend as much as 100 feet from the center of each plotted site (map A). The samples were sieved and the minus-60-mesh material was retained for analysis. The chemical analyses of the stream-sediment samples reflect the chemistry of rock material eroded from the drainage basin upstream from each sample site and may reveal unusually high concentrations of elements related to mineral deposits. Some of the sediment and concentrate samples were processed from alluvium contaminated by mine dumps. It is here assumed that any such contamination in a given drainage basin was derived from dump material mined within that basin. Thus, for a reconnaissance study such as this one, the chemical effects of mining activity are not considered to complicate assessing the mineral potential of the study

The concentrate samples were prepared from the same active alluvium used to make the stream-sediment samples. The bulk sediment was panned and dried, and the resulting heavy-mineral fraction was treated with bromoform. The grains that were heavier than the bromoform were saved and separated into magnetic $_1$ and relatively nonmagnectic fractions in a Frantz Isodynamic Separator 1. The nonmagnetic fraction was analyzed for this study. The analyses of the concentrate samples provide information about the chemistry of a limited number of minerals present in rock material eroded from the drainage basin upstream from each sample site. The concentrating procedures may produce a sample rich in heavy minerals commonly associated with many types of mineral deposits. The selective concentration of ore-related minerals permits determination of some elements, such as tungsten, that are not easily detected in bulk stream-sediment samples. The chemical composition of a nonmagnetic heavy-mineral concentrate may also indicate specific minerals. For example, the barium concentration in a stream-sediment sample may be related to several different minerals, most of which normally have no relation to hydrothermal mineralization. Anomalous barium concentrations in a concentrate sample, however, often indicate the presence of only barite, a mineral that may be associated with

Any use of trade names in this report is for descriptive purposes only and does not imply endorsement by the U.S. Geological Survey.

mineralization.



119°15′

Geochemical sampling, 1978-80; geology

simplified from Brem (1984)

MAP A. ANOMALOUS CONCENTRATIONS OF SELECTED ELEMENTS IN ROCK SAMPLES

SCALE 1:62 500

NATIONAL GEODETIC VERTICAL DATUM OF 1929