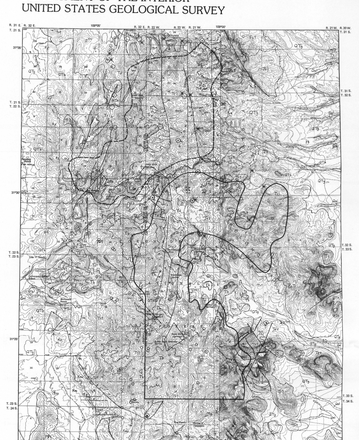
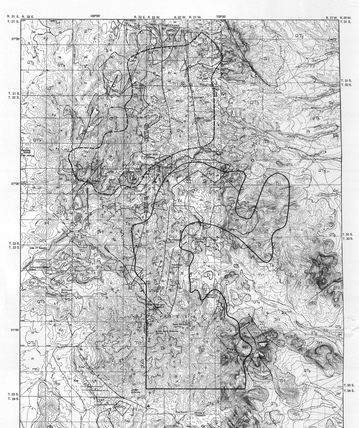
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

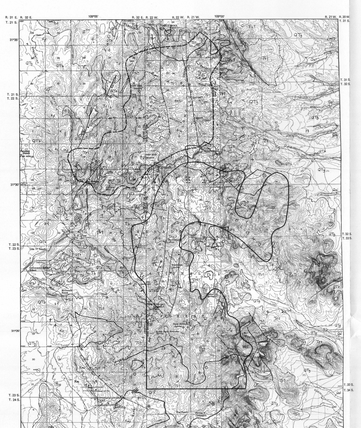
MISCELLANEOUS FIELD STUDIES
MAP MF-1425-C



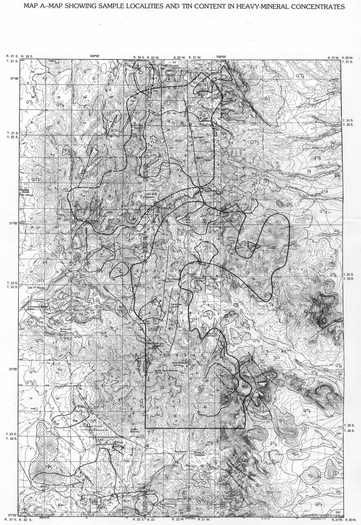
MAP A.--MAP SHOWING SAMPLE LOCALITIES AND TIN CONTENT IN HEAVY-MINERAL CONCENTRATES



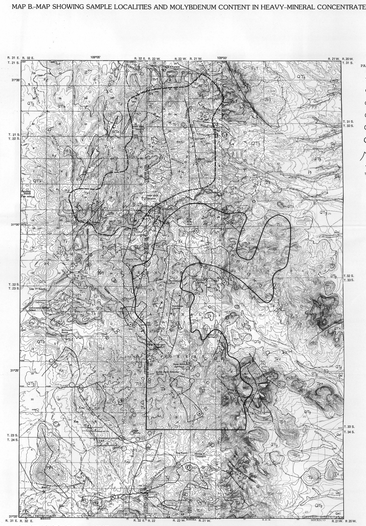
MAP B.--MAP SHOWING SAMPLE LOCALITIES AND MOLYBDENUM CONTENT IN HEAVY-MINERAL CONCENTRATES



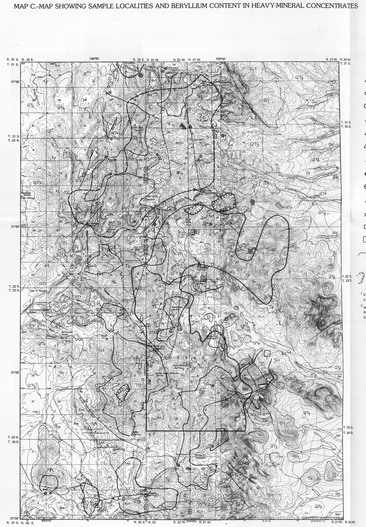
MAP C.--MAP SHOWING SAMPLE LOCALITIES AND BERYLLIUM CONTENT IN HEAVY-MINERAL CONCENTRATES



MAP D.-MAP SHOWING SAMPLE LOCALITIES AND LEAD CONTENT IN HEAVY-MINERAL CONCENTRATES



MAP E.-MAP SHOWING SAMPLE LOCALITIES AND BARIUM CONTENT IN HEAVY-MINERAL CONCENTRATES



MAP F.-MAP SHOWING SAMPLE LOCALITIES AND BISMUTH, ZINC, TUNGSTEN AND ARSENIC CONTENT IN HEAVY-MINERAL CONCENTRATES

SCALE 1:125 000

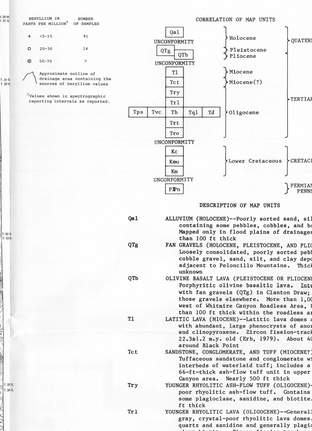
GEOCHEMICAL MAPS OF BUNK ROBINSON PEAK AND WHITMIRE CANYON ROADLESS AREAS, HIDALGO COUNTY, NEW MEXICO, AND COCHISE COUNTY, ARIZONA

By

Kenneth C. Watts, Jerry R. Hassemer, and Gordon W. Day

1983

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qal ALLUVIUM (HOLOCENE)--Poorly sorted sand, silt, and clay containing some pebbles, cobbles, and boulders. Mapped only in flood plains of drainages. Less than 100 ft thick

QTg FAN GRAVELS (HOLOCENE, PLEISTOCENE, AND PLIOCENE)--Loosely consolidated, poorly sorted pebble and cobble gravel, sand, silt, and clay deposited adjacent to Peloncillo Mountains. Thickness unknown

QTh OLIVINE BASALT LAVA (PLEISTOCENE OR PLIOCENE)--Porphyritic olivine basaltic lava. Interlayered with fan gravels (QTg) in Clanton Draw; underlie those gravels elsewhere. More than 1,000 ft thick west of Whitmire Canyon Roadless Area, but less than 100 ft thick within the roadless areas

Tl LATITIC LAVA (MIOCENE)--Latitic lava domes and flows with abundant, large phenocrysts of sanidine and clinopyroxene. Zircon fission-track age 22.3±1.2 m.y. old (Deb, 1979). About 400 ft thick around Black Point

Tct SANDSTONE, CONGLOMERATE, AND TUFF (MIOCENE?)--Tuffaceous sandstone and conglomerate with interbeds of water-laid tuff; includes a 35- to 66-ft-thick ash-flow tuff unit in upper Skeleton Canyon area. Nearly 500 ft thick

Trry YOUNGER RHYOLITIC ASH-FLOW TUFF (OLIGOCENE)--Crystal-poor rhyolitic ash-flow tuff. Contains quartz and some plagioclase, sanidine, and biotite. About 500 ft thick

Trl YOUNGER LATITIC LAVA (OLIGOCENE)--Generally light-gray, crystal-poor rhyolitic lava domes. Contains quartz and sanidine and generally plagioclase and minor biotite. Zircon fission-track age 25.8±1.2 m.y. old (Deb, 1979). May be as much as 1,000 ft thick

Tpa PYROCLASTIC ROCKS AND SANDSTONE (OLIGOCENE)--Air-fall tuff, ash-flow tuff, and tuffaceous sandstone. Locally about 600 ft thick

Tvc VOLCANICLASTIC CONGLOMERATE AND SANDSTONE (OLIGOCENE)--Indistinctly bedded to well-bedded conglomerate and sandstone derived from rhyolitic tuff (Trt), quartz latitic lava and tuff (Tql), volcanic breccia (Tb), and dacitic lava (Td). Locally as much as 500 ft thick

Tb VOLCANIC BRECCIA AND EPICLASTIC SEDIMENTARY BRECCIA (OLIGOCENE)--Largely volcanic breccia similar in composition to quartz latitic tuff of unit Tql and subordinately bedded and unbedded sedimentary breccia derived from the volcanic breccia. Unit locally also includes tuffaceous and sedimentary breccia derived from dacitic lava (Td). As much as 1,000 ft thick in places

Trc QUARTZ LATITIC LAVA AND TUFF (OLIGOCENE)--Porphyritic quartz latitic lava flows, domes, dikes, and tuffs. Contains plagioclase and sanidine and hornblende and locally also contains sanidine, biotite, and clinopyroxene. More than 700 ft thick near south end of mapped area

Td DACITIC LAVA (OLIGOCENE)--Porphyritic dacitic lava domes and flows. Contains plagioclase and hornblende and generally contains a little biotite, quartz, and clinopyroxene. About 1,000 ft thick in South Park Skeleton Canyon

Tro OLDER RHYOLITIC ASH-FLOW TUFF (OLIGOCENE)--Light- to pinkish-gray, crystal-rich to crystal-poor rhyolitic ash-flow tuff. Contains quartz, plagioclase, sanidine, biotite, and rare clinopyroxene. Zircon fission-track age 27.1±1.5 m.y. old (Deb, 1979). About 1,100 ft thick in mouth part of Skeleton Peak Roadless Area

Kc CINTURA FORMATION (LOWER CRETACEOUS)--Very light gray, crystal-poor rhyolitic lava domes. Contains quartz, sanidine, and rare plagioclase. Only in Skeleton Canyon. More than 600 ft thick

Kmu MORAL LIMESTONE (LOWER CRETACEOUS)--Light-gray-weathering, medium-gray fossiliferous limestone interbedded with some yellowish-gray sandstone, siltstone, and mudstone. About 300 ft thick

Km MORITA FORMATION (LOWER CRETACEOUS)--Interbedded, yellowish-gray to pale-reddish-brown sandstone, siltstone, and mudstone and minor medium-gray impure limestone. About 700 ft exposed in mapped area

P IPu HUECO GROUP (LOWER PERMIAN AND PENNSYLVANIAN)--Medium- to light-gray limestone and medium-gray dolomite and minor pale-red to pale-yellowish-brown siltstone and sandstone. Includes the Colina Limestone, Gerzina and Pennsylvanian Burp Formations, and Pennsylvanian Horquilla limestone, and possibly some Permian Epitaph Dolomite. About 1,000 ft exposed in mapped area

CONTACT--Dashed where approximately located

NORMAL FAULT--Bar and ball on downthrown side. Dashed where approximately located; dotted where concealed; queried where hypothetical

THRUST FAULT--Teeth on upper plate

STRIKE AND DIP OF INCLINED BEDS

APPROXIMATE BOUNDARY OF BUNK ROBINSON PEAK ROADLESS AREA AS OF APRIL 9, 1980

APPROXIMATE BOUNDARY OF WHITMIRE CANYON ROADLESS AREA AS OF APRIL 9, 1980

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 Bunk Robinson Peak and Whitmire Canyon Roadless Areas in the Coronado National Forest, Hidalgo County, N. Mex., and Cochise County, Ariz. The Bunk Robinson Peak and Whitmire Canyon Roadless Areas (U.S. Forest Service areas 3-200 and 3-110, respectively) were classified as further planning or nonwilderness in the second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January, 1979.

INTRODUCTION

Geochemical sampling of the Bunk Robinson Peak and Whitmire Canyon Roadless Areas was completed in the spring of 1980. The purpose of the geochemical sampling was to determine if certain metals, and "pathfinder" elements in heavy-mineral concentrates and stream sediments are enriched beyond normal background amounts. The enrichment of elemental contents above background amounts in these samples can be an important clue to the presence of a potential mineral deposit. These geochemical investigations are one part of an integrated mineral resource investigation of the Bunk Robinson Peak and Whitmire Canyon Roadless Areas that also includes geologic mapping (Hayes, 1982) and an evaluation of mineral resource potential (Hayes and others, in press).

Location, size, and geographic setting

The Bunk Robinson Peak and Whitmire Canyon Roadless Areas of the Coronado National Forest straddle the Arizona-New Mexico state line in the southern Peloncillo Mountains. They are separated by a mile-wide zone containing a road (the Geronimo Trail) that crosses the mountains. The Bunk Robinson Peak Roadless Area comprises about 31 sq mi mostly in Hidalgo County, New Mexico, but has about 1 sq mi extending into Cochise County, Ariz. The Whitmire Canyon Roadless Area comprises about 19 sq mi of which about 11 lie in New Mexico and about 8 in Arizona. The terrane in both areas is characterized by cliffs and steep slopes, but the total relief is not great in either. The highest altitudes above sea level are 6,241 ft in the Bunk Robinson Peak Roadless area (on Bunk Robinson Peak) and 6,526 ft in the Whitmire Canyon Roadless Area (at Peloncillo triangulation station) and the lowest altitudes are about 4,600 ft in the Bunk Robinson Peak Roadless Area (in Guadalupe Canyon) and about 5,100 ft in the Whitmire Canyon Roadless Area (in Skeleton Canyon).

GEOCHEMICAL INVESTIGATIONS

Nonmagnetic stream-sediment concentrates, sieved stream sediment (minus 0.18-mm remaining), and spring water were collected in these geochemical investigations. The maps (maps A-F) shown here are constructed from data from the analyses of nonmagnetic stream-sediment concentrates (minerals greater than 2.8 specific gravity) which are consider the most diagnostic stream sediment component in a sparsely vegetated, dry environment such as exists in the Bunk Robinson Peak and Whitmire Canyon Roadless Areas. The data from sieved stream sediments and heavy-mineral concentrates is summarized in table 1. Iron, magnesium, calcium, and titanium values are table 1 are expressed in percent, all other values are in parts per million. Stream-sediment sampling allows rapid, systematic areal coverage because each sample ideally represents a composite of an area the size of which is a function of drainage basin. Providing the drainage basin is relatively small, the sample represents a composite of all geologic materials, including those related to metallization, that are found in the drainage basin. If the drainage area is large enough, the effects of dilution, which are cumulative as stream order increases, mask the presence of metallized mineral grains and thus geochemical anomalies. Moreover, sampling the large drainage basins does not allow the identification of specific anomaly source areas. For the reasons given, stream-sediment samples were collected from small tributaries.

The chief advantage of sampling water from springs and seepages is that this method can be used to assess the geochemical conditions at depth within the bedrock through which the water flows. Springs and seepages issuing from mineralized or surface metallized rock undergoing dissolution can be sought using this method. Water samples were collected where the opportunity presented itself. Figure 1 shows the localities where water samples were collected.

SAMPLING AND ANALYTICAL PROCEDURES

The stream-sediment samples were composited from the active sediment channels of dry, generally unbiforcated tributaries. If the active channel was narrow, the sample was collected at oblique angles to the channel; if it was wide, the sample was collected as a series of random scoops across the full width of active channel. Sample sites were chosen in such a way as to optimize the possibilities of collecting a representative suite of heavy minerals. This was accomplished by choosing sites where there was minimal sorting of the active sediment.

Two sediment samples were collected at each sample site. The first sample was large, usually weighing 9-11 lbs (4-5 kg). It was collected for the purpose of obtaining heavy minerals. Because water volumes were large, the heavy mineral fraction of the bulk samples were placed in heavy cloth bags for gold-pan concentration at available water. The second sample weighed about 1 lb (0.5 kg) and was collected for the purpose of sieving to obtain a minus-0.18-mm fraction. Samples were generally not sieved in the field. Ample material could be obtained without recourse to on-site sieving, and sampling went much faster if unsieved bulk samples were collected for later processing.

The heavy minerals from the stream sediment were obtained by a series of processing steps that began by panning the bulk sample, which after panning, contained some heavy minerals, which most likely can be attributed to recent rainfall. The high specific conductivity of the water at the time of collection indicates that levels of saturation of many species in solution were being raised by evaporation.

Because the acid water samples (see table 2 and map G) also contain high concentrations of aluminum (particularly site GC-100), iron, magnesium, manganese, and zinc, the subsurface flow in the water may be circulating through mineralized rock containing metal sulfides. The acid water may also have had at a higher time normal metal content of the water may be due to acid leaching of the host rock; in which case, the high sulfate content and acidity of the solutions could be from a pyritic, though metal-barren, source.

Bismuth-Zinc-Tungsten-Arsenic

Scattered anomalies of bismuth and isolated clusters of zinc, arsenic, and tungsten are found in the mapped area (map F). The scattered bismuth values are in general associated with the flow-banded rhyolite (Trl). One anomaly of bismuth is found on a tributary to Clanton Draw. This tributary also follows the easternmost, north-trending fault in the Whitmire Canyon Roadless Area, which may be the source of the bismuth. A cluster of zinc anomalies at the head of Dutchman Canyon are also near the fault.

Tungsten is detectable, but below the limit of the spectrographic method (weakly anomalous tungsten contents of 50-90 ppm), in a zone that includes upper Dutchman Canyon, upper Walnut Creek, upper Whitmire Canyon, and tributaries to Clanton Draw near Cottonwood Creek. Although the sources of the tungsten are unknown, the source areas of the anomalies may be the positions of skarn zones, possibly related to a buried igneous body or cupola.

Arsenic in 8 samples ranging from less than 500 ppm to 1,500 ppm, was found on the eastern edge of the Bunk Robinson Roadless Area. Arsenic at these levels of concentration is too high for normal bedrock (rock-accessory heavy minerals are very low in arsenic) and can only be the result of hydrothermal introduction, or perhaps, volcanic emanations.

Uranium

One sample of water (GC 230) collected at Little Bunk Robinson Spring, contains 10.75 ppb uranium in relatively alkaline ground water solution (pH 8.33, table 2). Specific conductivity and sulfate content are also elevated, which suggest that the concentration of uranium in these waters is probably caused by evaporation,yet it can be regarded as anomalous. Further investigations would be required to evaluate the significance of the anomaly with respect to possible uranium deposits. It seems likely that the uranium is the result of ground water interactions with weathered rhyolitic bedrock (particularly ash) (Rosholt and others, 1971) in which uranium is weakly mobilized and then perhaps further concentrated by evaporation.

ACKNOWLEDGMENTS

The authors thank the landowners who granted us access through their property both on and off National Forest lands. Julian Gray and Douglas Hunt, both temporary employees of the U.S. Geological Survey, provided helpful assistance with drafting and other chores in the office and laboratory.

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TABLE 1.--Summary of geochemical data from heavy-mineral concentrates and sieved stream sediments, Bunk Robinson Peak and Whitmire Canyon Roadless Areas

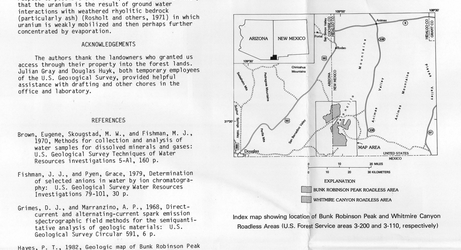
[Conc, nonmagnetic stream-sediment concentrates; Sed, sieved stream sediment; N, not detected; L, detected but below lowest value on spectrographic standard; G, greater than highest value on spectrographic standard; --- no value; Fe, Mg, Ca, and Ti concentrations in percent, all others in parts per million]

Element	Sample type	Qualified values N	L	G	Number of reported values	Range Minimum	Maximum	Mean	Standard deviation	Percentile distribution 25	50	75	80	85	90	95	99
Fe	Conc	---	---	---	116	0.5	30	7.4	6.4	---	5.9	9.8	10	13	18	25	10
	Sed	---	---	---	122	.7	15	3.6	2.5	2.3	3.0	3.6	4.5	5.3	6.6	8.4	10
Mg	Conc	---	---	---	116	.07	5	.93	.85	---	.63	1.3	1.3	1.6	1.9	2.1	3.0
	Sed	---	---	---	122	.2	2	.54	.23	.37	.54	.66	.67	.69	.71	.73	1.1
Ca	Conc	---	1	---	115	.1	3	4.6	4.4	---	3.6	6.1	6.9	7.6	8.6	9.9	20
	Sed	---	---	---	122	.1	10	1.1	1.1	.39	.91	1.3	1.5	1.8	1.8	2.6	5.2
Ti	Conc	---	---	---	90	.5	2	1.0	.38	---	---	---	---	---	---	---	---
	Sed	---	---	---	122	.1	2	.36	.22	.18	.25	.44	.47	.51	.60	.74	.99
Mn	Conc	---	---	---	116	300	10000	3400	2200	1600	3000	4400	4700	5000	5300	6600	9900
	Sed	---	---	---	122	150	1500	750	220	560	670	780	840	900	960	1000	1400
Ag	Conc	---	---	---	116	---	1	1	1	---	---	---	---	---	---	---	---
	Sed	---	---	---	122	.5	.5	.5	---	---	---	---	---	---	---	---	---
As	Conc	101	4	---	11	200	1500	540	200	---	---	---	---	---	---	750	1400
	Sed	122	---	---	1	200	200	200	---	---	---	---	---	---	---	---	---
Au	Conc	116	---	---	20	20	20	---	---	---	---	---	---	---	---	---	---
	Sed	122	---	---	20	20	20	---	---	---	---	---	---	---	---	---	---
B	Conc	24	27	---	65	20	150	31	21	---	---	34	36	40	50	66	130
	Sed	---	8	---	114	10	50	17	8.4	---	---	20	21	24	26	29	31
Ba	Conc	---	---	---	116	200	15000	3800	53000	---	---	---	---	---	---	---	---
	Sed	---	---	---	122	150	1000	320	160	---	230	360	400	450	490	540	710
Be	Conc	---	2	---	114	2	70	13	12	7.4	9.6	14	15	17	21	37	51
	Sed	---	---	---	119	1	15	3.9	3.6	2.1	3.0	3.9	5.2	6.0	7.1	11	15
Bi	Conc	105	5	---	6	20	50	21	4.0	---	---	---	---	---	---	---	40
	Sed	122	---	---	1	20	20	20	---	---	---	---	---	---	---	---	---
Cd	Conc	116	---	---	50	50	50	---	---	---	---	---	---	---	---	---	---
	Sed	122	---	---	20	20	20	---	---	---	---	---	---	---	---	---	---
Co	Conc	25	---	---	91	10	70	15	---	---	17	20	30	35	41	47	51
	Sed	15	---	---	106	5	30	9.6	5.3	---	8.5	12	14	15	16	19	26
Cr	Conc	9	1	---	92	20	3000	190	370	---	---	---	---	310	460	700	1800
	Sed	61	35	---	61	10	150	17	17	---	---	---	---	17	19	28	130
Cu	Conc	---	---	---	95	10	100	33	22	---	26	43	47	51	60	69	89
	Sed	---	21	---	101	5	70	24	17	---	19	24	27	30	34	51	70
La	Conc	---	---	---	116	50	3000	960	900	270	600	1400	1700	1800	2000	2600	3100
	Sed	15	---	---	107	20	300	58	61	---	---	66	78	99	120	150	280
Mo	Conc	65	---	---	42	10	70	16	19	---	---	---	---	20	27	---	46
	Sed	10	3	---	1	10	10	10	---	---	---	---	---	---	---	---	---
Nb	Conc	15	5	---	96	50	1000	140	120	---	---	190	210	220	240	280	540
	Sed	46	62	---	15	10	70	25	19	---	---	26	30	35	38	50	70
Ni	Conc	1	15	---	100	10	500	53	50	---	---	---	---	46	57	68	90
	Sed	---	42	---	80	5	30	7.9	5.4	---	---	---	---	7.0	8.0	13	21
Pb	Conc	31	9	---	76	20	7000	190	790	---	---	---	---	---	---	---	4500
	Sed	1	4	---	117	10	70	28	12	18	24	31	33	35	42	48	54
Sb	Conc	113	---	---	3	500	1000	210	91	---	---	---	---	---	---	---	700
	Sed	122	---	---	1	100	100	100	---	---	---	---	---	---	---	---	---
Sc	Conc	---	7	109	20	200	140	61	93	130	180	190	200	210	220	240	280
	Sed	30	---	92	1	6.0	6.0	6.0	---	---	---	---	---	---	---	---	---
Sn	Conc	13	6	---	97	20	3000	600	950	---	---	660	1100	1600	2000	2600	3100
	Sed	119	3	---	1	10	10	10	---	---	---	6.0	6.5	7.0	7.0	7.0	7.0
Sr	Conc	71	5	---	40	200	7000	810	1300	---	---	770	1100	1700	1900	3400	3100
	Sed	4	---	---	118	100	700	180	100	---	180	220	230	260	300	330	530
V	Conc	---	---	---	116	10	500	90	90	140	50	120	150	160	170	250	480
	Sed	---	---	---	122	10	300	83	63	40	70	110	120	140	160	180	270
W	Conc	86	25	---	5	50	100	100	4.6	---	---	---	---	---	---	---	89
	Sed	122	---	---	1	50	50	50	---	---	40	---	---	---	---	---	---
Y	Conc	---	---	---	116	150	5000	1900	1400	580	1900	2500	2700	2800	3000	4200	5000
	Sed	---	---	---	122	10	100	34	16	21	28	38	42	46	49	59	75
Zn	Conc	88	13	---	15	200	1000	500	110	---	---	---	---	---	---	---	390
	Sed	100	13	---	9	200	500	200	31	---	---	---	---	---	---	---	310
Zr	Conc	---	---	112	4	1500	2000	2000	80	---	---	---	---	---	---	---	---
	Sed	122	---	---	1	120	120	120	---	180	230	320	390	460	560	750	1100
Th	Conc	62	24	---	30	200	1000	240	140	---	---	---	---	---	---	---	---
	Sed	122	---	---	1	100	100	100	---	---	180	---	---	---	---	---	---

TABLE 2.--Selected analytical values and physical measurements of spring and seepage waters collected from Bunk Robinson Peak and Whitmire Canyon Roadless Areas

[Analyses by J. R. Hassemer, S. M. Smaglik, J. M. Motooka, and J. R. McHugh]

Sample number	pH (pH units)	Conductivity (umhos/cm)	SO_4 (ppm)	Al (ppb)	Cu (ppb)	Fe (ppb)	Mn (ppb)	Mo (ppb)	U (ppb)	Zn (ppb)	Remarks
GC 100	3.66	2200	3180	83,400	15	2860	14,700	4.0	2.4	1040	Seepage, upper Cottonwood Creek
GC 121	7.03	340	45	46	<5	22	10	7.0	.37	14	Seepage, upper Baker Canyon
GC 127	7.99	220	19	<31	<5	35	14	0.6	.23	1	Maverick Spring
GC 139	7.31	400	32	162	<5	55	<2	12.0	4.39	2	Contention Spring
GC 141	7.77	170	24	<31	<5	96	87	<0.5	.21	3	Seepage, tributary to Clanton Draw
GC 210	6.56	1750	1170	323	<5	<22	1,780	5.5	5.6	87	Seepage, tributary to Cottonwood Creek
GC 211	6.74	1520	1040	133	<5	<22	129	5.0	2.26	16	Do.
GC 221	6.19	280	33	32	<5	<22	140	139	0.9	.93	3	Lee Howard Spring
GC 230	8.33	870	180	54	<5	<22	7	0.9	10.75	4	Little Bunk Robinson Spring
GC 232	6.65	740	204	81	<5	<22	10	1.1	3.75	4	Seepage, Cottonwood Creek
GC 237	5.86	360	152	<31	<5	<22	2	0.9	.24	2	Seepage, South of Maverick Mountain
GC 243	6.50	350	93	<31	<5	<22	15	1.0	.77	1	Bunk Robinson Spring



Index map showing location of Bunk Robinson Peak and Whitmire Canyon Roadless Areas U.S. Forest Service areas 3-200 and 3-110, respectively)

Figure 1.--Map showing water sample localities

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