Mineral Resources of the Devil Canyon–Bear Canyon Primitive Area, California

GEOLOGICAL SURVEY BULLETIN 1230-G

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By DWIGHT F. CROWDER

STUDIES RELATED TO WILDERNESS

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An evaluation of the mineral potential of the area

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STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, Sept. 3, 1964) and the Conference Report on Senate bill 4, 88th Congress, direct the U.S. Geological Survey and the U.S. Bureau of Mines to make mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe," when the act was passed, were incorporated into the National Wilderness Preservation System. Areas classed as "primitive" were not included in the Wilderness System, but the act provided that each primitive area should be studied for its suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. This bulletin reports the results of a mineral survey in the Devil Canyon-Bear Canyon primitive area, California. The area discussed in the report corresponds to the area under consideration for wilderness status. It is not identical with the Devil Canyon-Bear Canyon Primitive Area as defined because modifications of the boundary have been proposed for the area to be considered for wilderness status. It should be noted that the U.S. Forest Service has recommended that the area be renamed the San Gabriel Wilderness if incorporated into the National Wilderness Preservation System. In this report, however, the area is referred to as the Devil Canyon-Bear Canyon primitive area.

This bulletin is one of a series of similar reports on primitive areas.

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MINERAL RESOURCES OF THE DEVIL CANYON–BEAR CANYON PRIMITIVE AREA, CALIFORNIA

By Dwight F. Crowder

SUMMARY

The Devil Canyon–Bear Canyon primitive area in Los Angeles County, Calif., is underlain by a variety of massive and gneissic granitoid rocks, dominantly of igneous origin, that are cut by a few dark-colored dikes. The San Gabriel fault zone cuts these rocks along the south border of the area and appears to have displaced the rocks within the area to the east relative to rocks on the south side of the fault zone. Along a part of the fault zone, the rocks are friable and easily eroded over a belt a quarter of a mile wide. Other faults are common, but their displacements are unknown. The often flooded streams of the area locally flow in gorges; that some stream gravels lie perched above them indicates recent uplift of the San Gabriel Mountains.

Analyses of broken, altered, and mineralized rocks, of soils over such rocks, of stream sediments, and of heavy minerals from stream sediments reveal no significant concentration of valuable mineral commodities. Slightly sheared lenses in gneiss and some fractures contain traces of antimony, copper, molybdenum, silver, and gold, but the quantities are of no commercial consequence. Quartz veins are rare in the primitive area, and the potential for lode or placer gold is correspondingly low. Only one prospect was found in the area. This is a 60-foot adit driven along a quartz vein which is less than 1 inch wide at the face of the adit and which contains only trace amounts of molybdenum and no detectable gold. Deposists of sand, gravel, and stone are present but are small in quantity and more readily available in nearby areas. The Cogswell Dam on the San Gabriel River near the south border of the area is built of gneiss from within the area, but no other construction materials have been produced and none are known that could be quarried economically at present (1966).

INTRODUCTION

The Devil Canyon–Bear Canyon primitive area is in the Angeles National Forest in Los Angeles County, Calif., about 10 miles northeast of Pasadena (fig. 1). It is a roadless area chiefly underlain by granitic rocks, on the south slope of the San Gabriel Mountains overlooking the Los Angeles metropolis. The area studied for this report

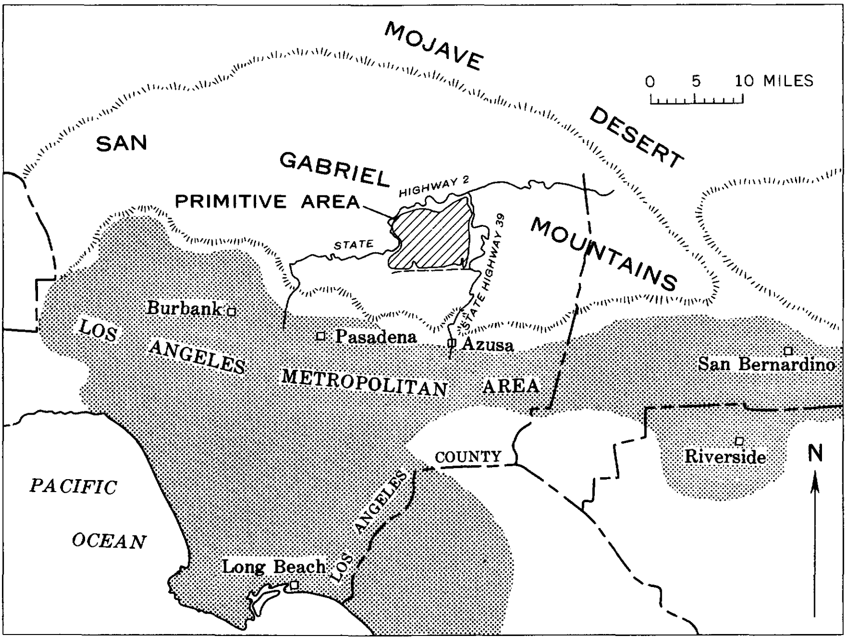

FIGURE 1.—Location of the Devil Canyon–Bear Canyon primitive area.

is roughly coincident with the Devil Canyon–Bear Canyon primitive area as defined by the U.S. Forest Service, but it differs by certain inclusions and exclusions.

To evaluate the mineral potential of the area, a reconnaissance geologic map (pl. 1) was prepared at a scale of 1 : 62,500 to show the distribution of rock types and structures. The map is based on geologic examinations made in March 1966 by foot traverses along improved trails, main streams, some ridge crests, and the boundary, including roads close to the boundary (pl. 2). Samples of fresh, altered, and mineralized rocks were collected as shown on plate 2 for laboratory study and analysis of mineral and metal content. Sand, gravel, and other sediments in the major stream valleys were also sampled, and some were panned to obtain heavy metallic mineral concentrates which were then examined and analyzed.

The character and amount of construction material—particularly sand, gravel, garden rock, and building stones—were also noted; however, these materials are readily available in more accessible deposits outside the area, and no laboratory tests were made to establish their properties.

William R. Raymond capably assisted in the collection and preparation of many of the samples. During the course of the fieldwork,

T. W. Dibblee, Jr., of the U.S. Geological Survey, made available unpublished geologic maps of the primitive area and surrounding region and discussed geologic interpretations in the field; both were of great value in evaluating the mineral potential. Staff members of the U.S. Forest Service and the Los Angeles Flood Control District and Mr. and Mrs. B. J. Bierke of Falling Springs Lodge were also helpful in many ways.

The U.S. Bureau of Mines made a thorough search of the records of mining claims in the primitive area but found evidence of only one recorded claim, known as the Boatwright. No records of any mineral production were disclosed from the Boatwright prospect or from any other areas within the entire primitive area. Paul V. Fillo, mining engineer from the U.S. Bureau of Mines, accompanied the author on a reexamination of the Boatwright prospect and on examinations of other localities that showed some evidence of mineralization. No mineral deposits of commercial grade were found.

ACCESS AND PHYSICAL FEATURES

The Devil Canyon–Bear Canyon primitive area is approximately 8 miles long and 6 miles wide. It is bounded on three sides by California Highways 2 and 39, both paved, and on the fourth side by an improved but unpaved road (closed to the public) to the Cogswell flood-control reservoir. Most of the area is without trails.

On the north border of the area, the crest of the San Gabriel Mountains rises to an altitude of 8,038 feet at Waterman Mountain. Devils Canyon and Bear Creek run south around Twin Peaks, the dominant crags in the north-central part of the area; 6,000 feet below, these canyons join the master stream of the area, the West Fork of the San Gabriel River. The streams are rapidly incising channels into the rocks of the rising San Gabriel Mountains; the highly vigorous West Fork has cut down more rapidly than its branches, so that such tributaries as Bobcat, Big Mermaids, Little Mermaids, and Chileno Canyons near their mouth descend over waterfalls and through narrow gorges. Locally, as in parts of Devils Canyon, dikes of resistant rock cause falls and rapids. Because of the rapid erosion, the rock exposures in all stream valleys are excellent.

Like similar arid and sparsely forested areas, the primitive area is periodically subject to intense floods, slope wash, and brush fires. As a result, rock outcrops are clean and soils thin; it is therefore doubtful that mineral deposits have gone unrecognized. Fires in the late 1950's swept most of the area, so that much rock previously obscured by brush could be observed during this study.

GEOLOGY

Most of the Devil Canyon–Bear Canyon primitive area is underlain by a variety of old crystalline rocks similar to those that form much of the rest of the San Gabriel Mountains. These rocks are cut locally by dark-colored dikes of probable Tertiary age and are overlain near streams by Recent sands and gravels. The old crystalline rocks consists chiefly of three lithologic varieties: (1) dark-colored gneiss, (2) dark-colored quartz diorite, and (3) a suite of younger light-colored granitic rocks that underlie the greater part of the area. The age of these rocks is uncertain, but the light-colored granitic rocks may be Mesozoic and the older darker rocks perhaps Precambrian (Dibblee, oral commun., 1966).

The primitive area lies between two major fault zones—the well-known and active San Andreas fault zone, 5 miles to the north and well outside the area, and the San Gabriel fault, near the south boundary of the area. Broken and altered rocks associated with the San Gabriel fault received particular attention during this survey.

GNEISS

The gneisses, which occur in the southwest corner of the area, are characterized chiefly by the presence of either hornblende or biotite. In the northern part of the gneissic terrain, particularly along Devils Canyon, the rocks are well layered and similar in general aspect to bedded sedimentary rocks, but to the south homogeneous unlayered gneiss prevails. No layers of marble or quartzite or other rock of definite sedimentary origin were found in the gneisses, although marble does occur in gneisses elsewhere in the San Gabriel Mountains (Dibblee, oral commun., 1966). The prevalence of crushed and streaked-out crystals recrystallized to mosaiclike aggregates suggests that much of the banding is not inherited from layering of the parent sediments but is due to a crushing of the massive granitoid rocks. Many of the white quartz-feldspar layers in the hornblende gneiss that look like sedimentary beds are believed to be later injections or segregations, because they slightly crosscut the foliation of the gneiss and, in some places, branch into irregular seams and pods of medium-grained hornblende diorite.

Lenses of slightly oxidized and somewhat sheared gneiss are sparsely but widely distributed. They are as much as 20 feet wide and 100 feet long and are parallel or subparallel to the layering and foliation. These lenses are folded and faulted as is the enclosing gneiss, but close inspection shows that shearing and oxidation locally crosscuts the layering of the gneiss. The late quartz-feldspar layers are blemished with splotches of iron oxides.

QUARTZ DIORITE COMPLEX

Complexly interpenetrating bodies of dark-colored hornblende diorite, quartz diorite, and a variety of associated rocks crop out in the San Gabriel fault zone and in the northeast corner of the primitive area. This quartz diorite complex is, in turn, intricately cut by masses of light-colored granite far too small and numerous to delineate on the map (fig. 2). Near the mouth of Bear Creek and near Islip Saddle, the branching granitic bodies are nearly absent, and the quartz diorite is homogeneous; but in most places the quartz diorite complex includes a wide variety of rock types and textures. The most abundant rock is a medium-grained biotite-hornblende quartz diorite, but fine-grained varieties also occur. Gneissic quartz diorites are common, and there is a little layered gneiss. The quartz diorites are locally spotted with larger late-formed crystals of hornblende or plagioclase. Pods of hornblendite, amphibolite, and irregular masses of fine- to medium-grained hornblende diorite are widespread but small in volume. Contacts between many of these various rocks are gradational. The abundant metamorphic features, the absence of rocks formed near the surface, and the abundant granitoid igneous rocks in it suggest that the quartz diorite complex formed at considerable depth. From this deep zone, mineralizing emanations may possibly have risen into overlying rocks, but any deposits that may have formed were removed by the deep erosion that has since exposed these rocks.

GRANITIC ROCKS

Underlying most of the primitive area are white to gray medium-grained granitic rocks that consist principally of quartz monzonite containing quartz, plagioclase, and potassium feldspar. These granitic rocks are part of a once-molten mass that solidified deep in the earth and that may have produced mineralizing emanations. In the northern parts of the area, especially on Waterman Mountain, biotite flakes are numerous, and the quartz monzonite is typically massive. Dikes of a nearly identical, but slightly darker, phase of quartz monzonite make up the Twin Peaks massif and parts of Smith Mountain. The plagioclase in the typical quartz monzonites is partly altered to epidote and sericite, and the biotite is chloritized.

Between Devils Canyon and the west boundary of the primitive area, the quartz monzonite is commonly gneissic and is spotted with large pink crystals of potassium feldspar. The large feldspar crystals are rounded and the biotite attenuated. In many places the porphyritic quartz monzonite is conspicuously light colored because dark minerals are sparse and because the large potassium feldspar crystals are difficult to see. In the lower part of the area along the San Gabriel

FIGURE 2.—Roadcuts near Islip Saddle showing light-colored granitic dikes cutting the quartz diorite complex. Primitive-area boundary is on the fill slope below the highway.

fault zone, this light-colored quartz monzonite is the dominant rock; here it is commonly friable and forms white gravelly soil and poor outcrops.

In the southwest part of the area on the border of the granitic mass is a gneissic granodiorite in which hornblende or epidote-biotite-hornblende aggregates form conspicuous black spots or streaks. An identical spotted hornblende granodiorite also occurs in several places in the San Gabriel fault zone and in an area just west of Islip Saddle on the west contact of a quartz monzonite body. Near the contact with the gneiss the rock has a strikingly banded appearance where the spots and streaks are concentrated in layers an inch or so thick. In Devils Canyon the contact of the gneissic granodiorite and the gneiss is discordant on a small scale and is faulted. Northward, the gneissic granodiorite grades into quartz monzonite as large potassium feldspar crystals increase in abundance.

The rounding and streaking out of large crystals, evident in outcrops of gneissic quartz monzonite and gneissic granodiorite, were evidently due to a late differential movement in a rock that was originally massive. The ruptures are completely healed by recrystallization of the crushed material into mosaiclike aggregates that surround and cut unaffected crystals. The absence of alteration associated with these mosaiclike aggregates indicates that the deformation and recrystallization were not accompanied by any significant mineralization.

Most of the granitic bodies that cut the dark-colored quartz diorite complex (fig. 2) consist of light-colored and rather fine grained quartz monzonite. However, other types of granitic rocks are also present, especially in the west half of the area, and the fine-grained quartz monzonite both cuts and grades into them. These fine-grained bodies are the youngest of the rocks related to the granitic mass.

DIKES

In a few places in the primitive area, steeply dipping dark-colored dikes are fairly numerous (fig. 3). Much less common are flat-lying siliceous dikes of light color, some of which resist erosion and form rapids and falls in Devils Canyon. Other dikes consist of basalt, rhyolite, and quartz diorite. The dikes cut the granitic rocks with sharp contacts and have not altered or oxidized their host. Their age is presumably Tertiary, though pre-Tertiary dikes may be included. Many of the dark-colored dikes weather a rusty red on hillsides; this is especially conspicuous near the south boundary. Along streambeds the dense unfractured unweathered character of the dikes is readily apparent.

SURFICIAL DEPOSITS

The gulches and stream valleys in the primitive area are partly floored by sand and gravel deposits composed of a heterogeneous mixture of rocks and mineral grains from the rock now exposed within the area. The steep gradients, as well as periodic flooding of the streams, produce poorly sorted and very irregularly stratified accumulations. The larger deposits are along Devils Canyon and on lower Bear Creek.

Because of recent uplift of the San Gabriel Mountains, the streams have cut into older but otherwise identical sand and gravel deposits. These are rapidly being removed by erosion, but patches remain as flat-topped terraces or steep alluvial fans in many stream valleys. The largest areas of perched sands and gravels (and the only ones mapped) occur along Bear Creek. These deposits are very recent, almost as recent as the sand and gravel being actively transported by the present streams, and are composed of rocks and minerals derived from very near the present surface.

STRUCTURE

A dominant structural element in the primitive area is the foliation and layering of the gneiss that dips northeasterly under the granitic rocks, which also display a northeast-dipping sheeted structure. The

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FIGURE 3.—Dark dikes cutting porphyritic quartz monzonite on Devils Canyon.

gneissic granodiorite grades upward and northeast through gneissic porphyritic quartz monzonite and on up into massive quartz monzonite. The quartz diorite complex of upper Bear Creek appears to finger out into northerly dipping sheets of quartz monzonite, as viewed on Twin Peaks (fig. 4). Thus the entire area seems to have a sheeted structure with a northerly dip.

The origin of this structure is not clear. Intrusion of sheets of molten granitic rocks accompanied or followed by differential movements parallel to them could have produced the layering, foliation, and gneissic structure. Differential movements along the south border of a single granitic mass could also have produced such a structure. The deformation, in either alternative, does not appear to be closely related to the faults, which are a more recent structural element of the primitive area.

Near Cogswell Reservoir the east-trending San Gabriel fault places gneiss in contact with the quartz monzonite and quartz diorite com-

FIGURE 4.—Steep south face of Twin Peaks, the one extensive area of cliffs in the primitive area. Note vague horizontal layering.

plex. Eastward movement of the rocks north of the fault could have dragged the gneiss into the flexure, marked by layering and foliation, that lies between Chileno and Devils Canyons. East of Chileno Canyon the fault is marked by a belt of shattered and sheared quartz monzonite a quarter of a mile wide in which the hills are rounded and the streams are rather close together. As suggested by these features, movement on the San Gabriel fault is believed to be large, but its exact displacement is unknown.

Most of the other faults shown on the map cut granitic rocks, and their magnitudes are unknown; they may or may not be related to the San Gabriel fault.

MINERAL RESOURCES

No significant deposits of metallic or nonmetallic minerals were found in the Devil Canyon–Bear Canyon primitive area, and the possibility of discovering such deposits is considered to be slight. This conclusion is based on many factors, including: (1) evaluation of the geology of the area, (2) the absence of significant concentrations of metals and ore minerals in the surficial deposits as well as in sheared, broken, and altered rocks, and (3) the evaluation of mineral production and occurrences in nearby areas.

A slight and spotty mineralization that includes antimony, copper, gold, molybdenum, and silver was found in the southwestern part of the area, but it is economically insignificant. Copper amounting to several percent occurs in a few widely scattered pods just outside the primitive area at Cogswell Dam, but the pods are small and scattered, and none were observed within the primitive area itself.

PLACER DEPOSITS

The only significant mining activity in the vicinity of the primitive area has been placer mining for gold along the East Fork of the San Gabriel River, a few miles from the southeast corner of the area (Gay and Hoffman, 1954, p. 495–496). Debris laws, lack of water, catastrophic floods, and exhaustion of the deposits have ended all mining activity. Gold prospectors doubtlessly have panned the West and North Fork drainages, yet little if any gold seems to have been mined on them. Absence of placer deposits on the West Fork is significant inasmuch as this stream drains the entire primitive area. Careful panning of the stream gravels in the area produced no visible gold, and the analyses of the panned concentrates indicate that the stream gravels contain an average of not more than 0.0002 ounce of gold per ton, equal in value to seven-tenths of a cent, or less, per ton of gravel. Inasmuch as the patches of perched gravels, such as those above Bear Creek, were derived from very near the present erosion level, they also can be expected to be as barren of placer gold as the present stream deposits; hence they were not sampled. Even if placer gold in some quantity occurred in the primitive area, the size of the deposits would be small because of the trivial amount of sand and gravel that is present.

The stream sediments and panned concentrates were also examined under the binocular microscope, under ultraviolet light, and analyzed by chemical and by spectrographic methods (table 1). These tests showed no significant quantities of other heavy metallic minerals of economic interest.

VEIN DEPOSITS

The source of the placer gold on the East Fork of the San Gabriel River, outside the primitive area, is probably quartz veins that cut old crystalline rocks. These veins, which are generally less than 3 feet wide, are discontinuous, and the gold in them is irregularly distributed. They have yielded about 50,000 ounces of gold and some silver (Gay and Hoffman, 1954, p. 496). Small tonnages of silica (Gay and Hoffman, 1954, p. 566) and garden rock have also come from some quartz veins in the East Fork area. A lead-silver-gold vein is reported a few miles south of the primitive area (Gay and Hoffman, 1954, p. 635, pls. 5, 6).

Within the primitive area, quartz veins are also thin and discontinuous. They are so exceedingly rare, less than six having been observed, that the lack of placer gold on the West Fork is readily understood and there is little possibility of finding other commodities associated with quartz veins. The only prospect found in the area was examined in the company of Paul V. Fillo of the U.S. Bureau of Mines; it is called the Boatwright prospect and is in sec. 26, T. 3 N., R. 11 W. It consists of a 60-foot adit driven along a quartz vein that is 18 inches wide at its widest spot in the surface outcrop and less than 1 inch wide at the end of the adit. In the surface outcrop the vein occurs as a short segment between two faults. Spectographic analysis of the quartz reveals trace amounts of molybdenum and no detectable gold.

The quartz veins may be related to the granitic mass in the area; this association is common in many places, and some coarse-grained quartz-rich pegmatites that occur in the primitive area grade into the porphyritic quartz monzonite phase of the granitic mass. However, veins associated with a granitic body are generally concentrated in its outer and upper parts and in its superjacent roof, which in this area have all been removed by erosion.

DEPOSITS IN SHEARED, ALTERED, AND FRACTURED ROCKS

Except for the rare quartz veins, the only rocks in the primitive area that might possibly be mineralized by introduced metals are those that are fractured, altered, or iron stained. Samples of these rocks were analyzed to test this possibility and are presented in table 2.

The principal rocks of the primitive area also were analyzed to see if they contain anomalous concentrations of metals and to establish a standard with which the samples of fractured, altered, or iron-stained rocks could be compared. Along the north boundary of the area, soils were also collected to determine if the underlying altered, broken, or oxidized quartz monzonite was significantly mineralized (table 1).

Near Cogswell Dam, just outside the primitive area, sparce copper sulfides occur with quartz and muscovite in widely scattered pods. This occurrence of ore minerals was brought to our attention by Kenyon DeVore of the Los Angeles Flood Control District. His report of molybdenite at this locality could not be confirmed, although near some mineralized pods there are trace amounts of molybdenum in quartz monzonite (table 2, sample 589b). These pods are a few inches long by a fraction of an inch wide and occur in some of the many fractures in white quartz monzonite—most commonly in the vertical set of fractures that trend north. Traces of antimony and silver occur with the copper in these pods (table 2, samples 572b, 585b, 586a, 589a). To the north, within the primitive area, only one broken and sheared pod was found within the San Gabriel fault zone.

The weakly mineralized samples and the soils contain no anomalous concentrations of metals. The sheared and conspicuously oxidized lenses of gneiss in the southwest corner of the primitive area contain anomalous traces of molybdenum and gold (table 2, samples 64, 65a, 66, 78). The quartz vein at the Boatwright prospect also contains anomalous traces of molybdenum (table 2, sample 561a), but the amounts are economically unimportant.

The traces of antimony, copper, gold, molybdenum, and silver indicate a slight and spotty mineralization in parts of the primitive area, chiefly near the contact of the granitic rocks and the gneiss in the southwestern part of the area. This mineralization appears to predate much of the folding and faulting, inasmuch as the sheared and slightly mineralized lenses in the gneiss are folded. These lenses are also cut by numerous faults that are probably related to the major dislocations along the San Gabriel fault zone, as are mineralized fractures at Cogswell Dam.

The gneissic character of many of the rocks in the area originated from widespread differential movements possibly rendering the rocks permeable to mineralizing solutions. However, most of the ruptures were totally healed by growth of new crystals during or after the deformation and thus became relatively impervious before the period of mineralization.

NONMETALLIC DEPOSITS

The quantity of sand and gravel in the primitive area is small, and the deposits are not as accessible as those farther down the San Gabriel River and outside the area. These deposits are therefore not considered to have economic value. Most of the granitoid rocks are broken and faulted and thus unsuitable for building stone. Vein quartz for possible use as a source of silica or for decorative rock is all but nonexistent. Other nonmetallic commodities are entirely absent.

TITANIUM MINERALS

Titanium occurrences about 5 miles west of the primitive-area border have been prospected, but no production is recorded (Gay and Hoffman, 1954, pls. 5, 6, p. 503–504, 640–647). The titanium-bearing minerals are closely associated with gabbro and anorthosite (Oakeshott, 1950, p. 353); inasmuch as these rock types do not occur in the primitive area, titanium minerals are not present except for minor quantities in the panned concentrates.

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ANALYTICAL DATA

Many rock samples and stream-sediment samples, in addition to those already discussed, were collected and analyzed during the present study. Semiquantitative spectrographic and chemical analyses were made in the U.S. Geological Survey laboratories in Denver, Colo., and the results are given in tables 1 and 2. The semiquantitative spectrographic analyses are reported to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, 0.1, and so forth, which represent approximate midpoints of group data on a geometric scale. Chemical analyses for gold followed the method described by Lakin and Nakagawa (1965) ; other chemical analyses for copper, lead, zinc, cold-acid-extractable copper, and citrate-soluble heavy metals used methods described by Ward, Lakin, Canney, and others (1963).

TABLE 1.—*Analyses of panned concentrates from streams*

[For sample locations, see pl. 2. cxCu. Cold-acid-extractable copper; cxHM, citrate-soluble Re, Sb, Ta, Te, Th, Tl, U, W. Semiquantitative spectographic analyses by J. C. C. L. Whittington]

Sample	Semiquantitative spectrographic analyses (ppm)														
	Ba	Ce	Co	Cr	La	Mn	Nb	Nd	Ni	Sc	Sn	Sr	V	Y	Zr
	Panned concentrates from stream sediments														
3	1,500	300	15	30	150	700	50	150	15	10	1,000	500	150	70	200
20	1,000	0	30	70	50	700	30	70	50	15	150	700	200	30	200
26	500	500	30	70	200	1,000	30	300	50	30	70	500	200	50	300
29	500	1,500	50	70	500	1,500	100	700	30	20	70	500	200	100	300
30	700	500	20	70	200	1,000	30	300	30	20	50	700	100	50	200
32	150	1,000	50	70	300	3,000	50	300	30	15	30	150	200	100	1,500
34	50	200	20	50	100	2,000	30	70	15	0	0	<15	300	30	700
35	100	500	20	50	300	5,000	70	300	20	<10	20	70	300	50	1,000
36	100	<500	50	50	70	3,000	20	70	30	10	0	70	300	30	300
37	150	0	30	70	50	2,000	20	0	20	7	0	100	500	30	300
38	100	300	30	50	150	5,000	50	300	15	15	0	100	300	70	1,000
39	50	500	30	100	200	5,000	50	300	20	15	0	70	300	50	1,000
40	50	1,500	30	150	500	500	50	700	20	<20	20	70	300	100	1,500
41	150	1,500	70	200	500	3,000	70	700	50	30	20	500	300	100	1,000
42	50	2,000	20	150	700	5,000	150	700	20	<20	20	70	300	200	1,000
45	50	500	30	200	200	3,000	50	300	20	<7	0	50	300	30	700
46	30	700	20	200	300	5,000	100	300	30	<10	20	50	300	100	500
48	70	0	30	50	70	5,000	30	0	10	<7	0	70	300	30	700
51	100	0	20	30	70	3,000	30	0	15	7	0	150	200	30	700
56	150	<500	30	50	150	5,000	30	150	30	20	0	500	300	50	500
59	70	700	20	100	200	3,000	70	300	20	<10	0	100	300	50	7,000
63	150	<500	50	200	100	5,000	15	150	70	30	0	300	300	70	1,000
70	150	700	15	30	300	5,000	50	300	10	<10	0	50	200	50	500
72	150	500	20	100	150	3,000	30	300	30	50	0	300	150	150	2,000
83	70	<500	20	30	70	1,500	30	70	10	10	0	70	300	30	2,000
89	200	<500	50	300	100	7,000	20	150	70	30	0	200	300	50	1,000
94	500	<500	20	100	100	5,000	30	150	20	20	0	500	200	50	700
95	150	<300	15	70	200	2,000	30	150	15	7	0	100	200	70	150
584	150	<300	20	100	150	2,000	20	500	20	10	0	70	300	30	500
590	500	<500	30	100	300	7,000	30	300	7	50	0	700	500	150	300

in the Devil Canyon–Bear Canyon primitive area, California

heavy metals. Additional elements looked for but not found: Ag, As, P, Pd, Pr, Pt, Hamilton, Harriet Nieman, A. L. Sutton, Jr., and Barbara Tobin; chemical analyses by

	Semiquantitative spectrographic analyses (percent)								Chemical analyses (ppm)					
Sample	Si	Al	Fe	Mg	Ca	Na	K	Ti	Au	Cu	cxCu	cxHM	Pb	Zn
							Panned concentrates from stream sediments							
3	>10	>10	7	1	2	3	2	0.7	<0.05	20	1	6	<25	150
20	>10	>10	5	3	5	1.5	1.5	.7	<.05	30	6	1	25	50
26	>10	>10	7	5	7	1.5	1.5	1	<.05	60	1	1	25	50
29	>10	>10	>10	1.5	5	1.5	1.5	1	<.05	40	8	1	<25	200
30	>10	>10	7	1.5	5	2	1.5	.7	.2	20	3	.5	<25	50
32	7	2	>10	1	2	.7	1.5	1.5	<.2	20	20	1	<25	80
34	.7	2	>10	.1	.5	.15	<1.5	.5	<.05	30	<1	<1	<25	130
35	3	1.5	>10	.3	.7	.3	<1.5	1	.2	30	<1	<1	<25	130
36	7	2	>10	.5	1.5	.5	<1.5	1	.2	80	<5	<1	<25	100
37	7	2	>10	.5	1	.7	<1.5	1	<.05	80	3	1	<25	80
38	7	2	>10	.5	1.5	.7	<1.5	1	<.05	50	2	<1	<25	100
39	7	2	>10	.5	1.5	.3	<1.5	.7	.2	80	2	<1	<25	125
40	3	1	>10	.05	1.5	.2	<1.5	.7	.3	50	--	--	<25	50
41	>10	5	>10	1.5	5	1	<1.5	1.5	.2	80	--	--	<25	50
42	7	1.5	>10	.07	1	.5	<1.5	1	.3	60	--	--	<25	100
45	3	2	>10	.07	.7	.3	<1.5	.5	.3	40	--	--	<25	125
46	1.5	1.5	>10	.05	.5	.3	<1.5	.7	.3	40	--	--	<25	--
48	3	1.5	>10	.1	1	.2	<1.5	.3	.3	30	--	--	<25	500
51	3	1.5	>10	.3	1.5	.7	<1.5	.3	<.05	40	--	--	<25	500
56	>10	7	>10	1	5	.7	<1.5	.7	<.05	50	--	--	<25	300
59	7	2	>10	.3	1.5	.5	<1.5	.7	.05	40	--	--	<25	400
63	>10	7	>10	3	7	1.5	1.5	1.5	.05	100	--	--	<25	80
70	7	2	>10	.2	.7	.7	1.5	1	<.05	40	--	--	<25	400
72	>10	7	>10	2	7	.7	1	1	<.05	60	--	--	<25	50
83	3	1.5	>10	.3	1.5	.3	<1.5	.5	<.05	40	--	--	<25	400
89	>10	7	>10	3	7	.7	1.5	2	.1	50	--	--	<25	25
94	>10	>10	>10	2	7	1.5	1.5	1	.05	30	--	--	<25	50
95	3	7	>10	.3	.7	.7	0	.7	.2	40	70	--	25	300
584	7	2	>10	.5	1.5	.7	1.5	1	<.05	50	20	--	<25	250
590	>10	5	>10	1.5	1.5	1	1.5	7	.1	30	100	--	50	400
											Stream sediments			
6										30	<1	10	50	75
18										125	1	2	<25	75
21										50	2	2	<25	75
28										100	1	.5	<25	75
33										100	2	<1	<25	50
517										40	<1	<1	<25	75
518a										40	<1	<1	<25	100
519										40	<1	1	<25	100
											Soils			
535											<1	1	--	--
536											<1	<1	--	--
537											1	<1	--	--
538											1	<1	--	--
539											1	<1	--	--
540											1	<1	--	--
541											1	<1	--	--
542											1	<1	--	--
543											2	<1	--	--
544											2	<1	--	--

TABLE 2.—*Analyses of rock samples, Devil*

[Looked for but not found: As, Bi, Cd, Eu, Ge, Hf, Hg, In, Li, P, Pd, Pr, Pt, Re, Jr., Barbara Tobin, and Chris Heropoulos]

	Semiquantitative spectrographic analyses (ppm)															
Sample	Au	Cu	Pb	Ag	B	Ba	Be	Ce	Co	Cr	Ga	La	Mn	Mo	Nb	Nd	Ni
Broken, altered, or mineralized rocks																	
2	0	15	20	0	0	3,000	0	200	15	30	20	100	500	0	0	70	7
4	0	15	20	0	0	2,000	0	0	20	20	30	50	300	0	0	0	10
7	0	15	20	0	0	1,500	0	150	20	3	70	100	1,500	0	0	150	0
17	0	5	20	0	20	1,500	0	0	0	0	30	30	500	0	0	0	0
19	0	100	0	0	0	700	0	0	0	0	10	0	30	0	0	--	10
43	0	10	50	0	0	1,000	0	0	3	10	30	0	700	0	0	0	10
44	0	1.5	70	0	0	150	0	0	0	0	20	0	150	0	0	0	0
64	0	200	20	0	0	700	0	150	30	150	30	100	7,000	5	15	70	50
65a	0	150	15	0	0	500	0	0	15	100	30	30	2,000	5	0	0	20
65b	[1]0.1	[1]100	[1]25	0	0	70	0	500	15	100	--	70	20,000	15	5	150	10
66	0	200	0	0	0	200	0	0	30	70	30	0	3,000	7	0	--	50
74	0	5	20	0	0	1,500	0	0	0	0	20	0	150	0	0	--	0
78	0	200	10	0	0	1,500	0	200	20	10	30	100	1,000	7	15	100	50
501	0	30	15	0	0	2,000	0	0	15	30	30	50	1,000	0	10	0	15
502	0	15	0	0	0	1,500	0	0	20	3	30	0	700	0	0	--	20
503	0	20	0	0	0	1,500	0	0	20	10	50	30	1,000	0	0	0	20
504a	0	50	0	0	0	1,500	0	200	10	7	50	150	700	0	0	150	0
504b	0	30	0	0	0	500	0	0	70	1,000	20	0	1,500	0	0	--	300
505	0	50	0	0	0	2,000	0	0	20	10	50	0	500	0	0	--	20
506	0	30	20	0	0	2,000	0	200	10	7	50	150	1,000	0	20	0	0
507	0	30	15	0	0	1,000	0	0	20	50	30	70	1,000	0	0	150	20
508	0	50	15	0	0	2,000	0	0	20	15	50	0	700	0	0	--	15
509	0	50	0	0	0	1,000	0	0	30	200	30	0	1,000	0	0	--	150
510	0	20	15	0	30	1,000	0	0	15	20	50	0	500	0	0	--	20
511	0	30	15	0	30	700	0	0	15	20	30	0	300	0	0	--	30
513	0	20	0	0	0	200	0	0	50	1,000	20	0	1,500	0	0	--	200
514	0	30	0	0	0	1,500	0	0	50	50	30	0	700	0	0	--	70
515	0	100	0	0	0	1,000	0	0	30	10	30	0	700	0	0	--	20
516	0	30	0	0	0	500	0	0	50	30	30	0	500	0	0	--	30
518b	0	50	0	0	0	1,000	0	0	20	20	30	0	700	0	0	--	30
520	0	50	0	0	0	700	0	0	30	300	20	0	1,000	0	0	--	150
521	0	70	0	0	0	700	0	0	30	30	50	30	1,000	0	0	0	50
523	0	20	30	0	0	1,500	0	0	15	50	20	30	700	0	0	0	30
524	0	15	20	0	0	2,000	0	0	10	7	30	50	700	0	0	0	7
526	0	15	20	0	0	700	0	0	7	10	20	30	500	0	0	0	15
527	0	50	15	0	0	1,500	0	0	20	20	30	30	700	0	0	0	30
528	0	100	0	0	0	500	0	0	30	70	20	0	1,000	0	0	--	70
530	0	50	0	0	0	1,500	0	0	30	70	30	0	1,000	0	0	--	50
533	0	50	0	0	0	700	0	0	50	50	30	30	700	0	0	0	50
545	0	15	0	0	0	2,000	0	0	20	70	20	0	1,500	0	15	0	30
546	0	70	0	0	0	700	0	0	30	150	20	30	1,500	0	15	0	50
547	0	70	30	0	0	1,500	0	0	30	100	30	30	1,500	0	10	0	70
548	0	15	20	0	0	3,000	0	0	10	70	30	0	1,500	0	0	0	20
549	0	15	20	0	0	5,000	0	0	0	0	30	0	700	0	10	0	0
550a	0	70	0	0	0	700	0	0	50	700	50	30	2,000	0	10	0	300
550b	0	10	15	0	0	1,500	0	150	15	150	30	100	1,000	0	10	70	70
551	0	10	15	0	0	3,000	0	0	0	0	20	0	300	0	0	0	0
552	0	15	20	0	0	3,000	0	0	0	0	20	0	700	0	0	0	0
553	0	5	15	0	0	3,000	0	0	0	3	30	0	1,000	0	10	0	0
556	0	30	0	0	0	500	0	0	0	0	20	0	1,500	0	10	0	0

[1]Chemical analyses by C. L. Whittington, using techniques described by Lakin and Nakagawa (1965) for Au and by Ward, Lakin, Canney, and others (1963) for Cu, Pb, and Zn.

Canyon–Bear Canyon primitive area, California

Sm, Ta, Te, Th, Tl, U, W. Analyses by J. C. Hamilton, Harriet Neiman, A. L. Sutton,

Sample	Semiquantitative spectrographic analyses (ppm)--Continued								Semiquantitative spectrographic analyses (percent)					
	Sb	Sc	Sn	Sr	V	Y	Yb	Zr	Fe	Mg	Ca	Na	K	Ti
							Broken, altered, or mineralized rocks							
2	0	10	0	1,000	100	20	3	150	3	0.5	1.5	3	3	0.2
4	0	7	0	1,000	150	15	2	100	3	.7	2	3	3	.2
7	0	30	0	1,500	150	30	--	300	7	5	7	5	3	.2
17	0	0	0	500	0	20	2	50	1	.15	.5	3	3	.05
19	0	0	0	70	0	0	0	30	1	.05	.1	1.5	1.5	.02
43	0	5	0	500	50	10	<1.5	100	2	.5	1.5	3	5	.2
44	0	0	0	700	0	10	<1.5	100	.7	.1	.7	3	5	.03
64	0	20	0	150	200	30	<5	100	10	3	1	2	5	.7
65a	0	20	<10	1,500	150	30	3	50	10	3	7	1.5	1.5	.2
65b[2]	0	50	0	500	150	100	--	300	10	3	7	.15	0	2
66	0	20	<10	50	200	30	3	300	10	3	2	.7	2	.3
74	0	0	0	700	15	0	0	70	1	.05	.5	3	3	.03
78	0	15	0	500	150	30	5	100	7	3	.7	2	3	.5
501	0	10	0	700	150	30	5	100	5	1.5	1.5	3	3	.5
502	0	15	0	500	200	10	1	50	5	2	3	2	2	.5
503	0	15	0	1,500	200	10	1.5	50	7	3	5	3	2	.7
504a	0	15	0	1,000	100	10	1	300	5	1	2	3	2	.5
504b	0	0	0	300	200	15	1.5	70	7	10	7	1.5	1.5	.3
505	0	20	0	1,500	200	10	1	100	5	3	5	3	3	.5
506	0	7	0	1,500	1,500	70	7	200	3	1	2	3	3	.5
507	0	15	0	1,500	200	10	1	50	5	3	5	2	2	.3
508	0	10	0	1,000	200	15	1.5	70	5	2	1.5	2	3	.5
509	0	10	0	1,000	300	20	2	30	7	5	5	2	2	.3
510	0	20	0	1,000	150	15	1.5	70	3	2	2	3	3	.3
511	0	5	0	700	150	15	1.5	70	3	1.5	1.5	2	2	.3
513	0	7	0	200	200	20	2	20	5	10	7	1	2	.15
514	0	20	0	700	500	10	1.5	0	7	5	5	1.5	2	.7
515	0	5	0	1,500	200	10	1	50	7	1	7	2	2	.5
516	0	20	0	500	300	10	1.5	30	5	3	3	1	2	.5
518b	0	15	0	1,500	200	20	2	70	5	3	10	2	2	.3
520	0	20	0	700	200	20	2	100	7	5	5	1.5	2	.5
521	0	15	0	500	200	30	3	100	7	3	7	2	3	.5
523	0	7	0	500	150	15	1.5	100	5	1.5	1.5	2	3	3
524	0	7	0	300	70	30	3	150	3	.7	1	2	3	.2
526	0	5	0	500	70	15	1.5	30	2	.5	1.5	2	3	.15
527	0	15	0	700	200	30	3	100	5	1.5	3	2	2	.5
528	0	20	0	500	200	15	2	70	7	3	5	1.5	1.5	.3
530	0	20	0	1,000	200	30	3	100	7	2	5	1.5	2	.5
533	0	15	0	1,500	300	10	1.5	50	7	5	7	2	2	.5
545	0	10	0	1,500	200	15	3	100	5	.7	2	5	3	.5
546	0	30	0	1,500	200	30	<5	150	7	3	7	3	3	1
547	0	30	0	1,500	300	20	<3	150	10	2	3	3	3	.7
548	0	7	0	2,000	150	10	2	50	5	.7	3	3	3	.3
549	0	0	0	2,000	100	10	1.5	100	3	.3	3	3	5	.15
550a	0	30	0	1,000	500	30	<5	100	10	7	5	2	2	1
550b	0	10	0	1,500	150	50	7	50	5	1.5	1	3	2	.3
551	0	0	0	1,500	15	0	0	50	1.5	.2	2	3	2	.07
552	0	0	0	1,500	15	10	1	0	1.5	.15	1.5	3	3	.05
553	0	0	0	2,000	50	15	1.5	100	3	.3	3	3	3	.15
556	0	5	0	2,000	100	20	5	100	5	.5	5	3	1.5	.3

[2] Chemical analysis of sample 65b gave 25 ppm Zn. No zinc found in other samples listed in table.

TABLE 2.—*Analyses of rock samples, Devil Canyon–Bear*

Sample	Semiquantitative spectrographic analyses (ppm)															
	Au	Cu	Pb	Ag	B	Ba	Be	Ce	Co	Cr	Ga	La	Mn	Mo	Nb	Nd	Ni
	Broken, altered, or mineralized rocks--Continued																
557	0	2	0	0	0	30	0	0	0	2	0	0	30	0	0	0	0
558	0	15	30	0	0	1,500	0	0	10	50	30	0	500	0	10	0	30
559	0	5	50	0	0	1,500	0	0	7	15	50	50	500	0	0	0	10
561a	0	50	20	0	0	10,000	0	0	0	0	30	0	500	7	0	0	0
561c	0	15	0	0	0	1,500	0	0	50	500	30	30	2,000	0	15	0	100
562	0	7	70	0	0	700	0	0	0	7	30	0	700	0	20	0	10
564	0	70	20	0	0	1,500	0	100	20	70	30	50	1,500	0	15	0	30
565	0	20	20	0	0	2,000	0	0	10	15	30	30	1,500	0	10	0	10
567	0	70	15	0	0	1,500	0	0	50	300	30	30	2,000	0	10	0	150
568	0	0	15	0	0	1,500	0	0	0	3	20	0	1,500	0	0	0	0
569	0	100	20	0	0	700	0	0	50	500	20	0	2,000	0	0	0	200
571a	0	70	20	0	0	500	0	0	50	300	20	0	1,000	0	30	--	200
571b	0	2	0	0	0	3,000	0	0	0	2	30	0	1,000	0	0	--	0
572a	0	70	150	0	0	700	0	0	30	500	30	0	1,500	0	0	--	150
572b	0	>100,000	5	15	20	500	0	0	0	3	30	0	300	0	0	--	5
575	0	100	200	0	0	300	0	0	50	500	30	0	1,000	0	15	--	200
578	0	15	20	0	0	1,500	0	0	10	20	30	0	500	0	0	--	20
581	0	50	200	0	0	500	0	0	50	500	20	0	1,000	0	0	--	200
583	0	10	0	0	50	700	0	0	0	3	20	0	200	0	0	--	0
585b	0	50,000	20	30	0	2,000	0	0	150	30	70	0	2,000	0	0	--	20
585c	0	70	0	0	0	2,000	0	0	0	0	50	0	200	0	0	--	0
586a	0	1,500	10	3	0	1,500	0	0	5	7	30	0	2,000	0	15	--	10
587a	0	150	0	0	0	1,000	0	0	0	0	20	0	150	0	0	--	0
588	0	70	50	0	0	1,500	0	0	30	100	50	0	1,500	0	15	--	50
589a	0	20,000	10	70	0	1,000	0	0	0	5	<15	0	100	0	10	--	10
589b	0	150	3	0	0	1,500	0	0	0	2	30	0	300	5	0	--	3
	0																
	Representative rocks from mapped units on Plate 1																
597	0	3	50	0	0	2,000	1	70	7	1	20	30	1,000	3	15	0	1.5
566	0	15	30	0	0	2,000	0	0	5	3	20	30	1,000	5	15	0	3
60	0	7	20	0	0	3,000	1	0	3	1	15	30	700	0	10	0	1.5
5	0	3	50	0	0	700	1.5	0	2	7	20	20	200	0	0	0	7
27	0	7	50	0	0	3,000	1	0	15	15	20	50	150	0	0	0	1
583	0	3	50	0	50	1,500	1.5	0	0	1	15	0	150	0	0	--	0
576	0	3	50	0	0	1,500	1.5	0	0	0	15	0	200	0	0	--	0
50	0	5	20	0	0	5,000	0	0	0	1	30	0	150	0	0	--	1.5
69	0	3	50	0	0	3,000	1	0	0	1	20	0	200	0	0	--	1
534	0	15	50	0	0	1,000	2	70	5	10	20	50	200	0	10	0	15
67	0	20	30	0	0	1,000	0	100	10	20	20	50	300	3	10	0	10
58	0	2	50	0	7	700	0	0	0	3	15	20	200	0	7	0	2
11	0	15	30	0	7	2,000	0	0	0	15	20	0	500	0	0	--	1.5
53	0	2	30	0	0	3,000	0	0	0	1	20	30	700	0	0	0	1
552	0	15	20	0	7	5,000	0	0	0	0	15	0	700	0	0	--	0
556	0	15	20	0	7	700	1.5	0	15	0	20	20	500	0	10	0	0
71	0	7	30	0	0	1,000	3	150	7	7	20	70	700	0	20	0	3
52a	0	100	15	0	0	1,000	0	0	50	70	20	30	1,000	0	10	0	70
25	0	50	0	0	0	300	0	0	30	70	20	0	700	0	10	--	50
75	0	2	30	0	10	1,000	2	0	3	15	20	20	200	0	10	0	5
15a	0	50	20	0	0	700	0	0	20	30	20	50	700	0	10	0	50
82	0	70	50	0	0	700	0	150	15	70	20	70	500	0	10	0	30
79a	0	50	20	0	0	300	0	0	15	50	15	0	700	0	0	--	15
84	0	50	10	0	0	1,000	0	0	30	30	20	30	1,500	0	10	0	20
88	0	15	20	0	0	1,000	2	0	15	15	20	30	700	0	10	0	7
76	0	50	10	0	0	150	0	0	50	30	20	30	1,000	0	10	0	10
79b	0	10	15	0	0	300	0	0	10	30	15	0	700	0	0	--	15

[3]/Light-colored dike of quartz monzonite in quartz diorite.

Canyon primitive area, California—Continued

Sample	Semiquantitative spectrographic analyses (ppm)--Continued								Semiquantitative spectrographic analyses (percent)						Mapped Unit
	Sb	Sc	Sn	Sr	V	Y	Yb	Zr	Fe	Mg	Ca	Na	K	Ti	
							Broken, altered, or mineralized rocks--Continued								
557	0	0	0	0	0	0	0	0	1	0.005	0.02	0	0	0.005	
558	0	10	0	500	100	10	1.5	150	5	.7	1.5	3	3	.2	
559	0	5	0	500	100	10	1	100	3	.7	1	3	5	.2	
561a	0	0	0	2,000	50	15	1.5	50	3	.3	1.5	5	7	.15	
561c	0	50	0	2,000	500	30	<5	200	>10	5	7	2	2	.5	
562	0	0	0	1,500	15	10	1	50	1	.1	1	3	5	.07	
564	0	20	0	2,000	200	30	<3	100	7	1.5	5	3	3	1	
565	0	15	0	2,000	150	30	<5	30	7	.5	5	3	3	.5	
567	0	30	0	2,000	300	15	<5	100	>10	5	5	3	3	1	
568	0	0	0	1,500	70	15	<3	50	5	.5	5	3	3	.3	
569	0	30	0	700	300	30	<5	50	7	5	5	2	3	.7	
571a	0	30	0	1,500	300	20	2	150	7	>10	7	1.5	1	.7	
571b	0	0	0	2,000	30	10	1	50	15	.2	1.5	3	3	.15	
572a	0	20	0	1,500	150	30	3	70	5	5	5	2	2	.5	
572b	0	0	0	200	30	15	1.5	30	3	.2	.2	3	3	.07	
575	0	30	0	1,500	200	20	2	100	7	>10	7	1.5	.7	.7	
578	0	7	0	1,000	100	10	1	50	3	.7	1.5	3	3	.2	
581	0	20	0	1,000	200	20	2	70	7	>10	7	1.5	2	.5	
583	0	0	0	300	20	0	0	100	1	.2	.7	2	2	.07	
585b	0	10	0	2,000	100	20	0	50	>10	1.5	.7	2	3	.2	
585c	0	0	0	700	10	0	0	100	.7	.1	1	3	5	.05	
586a	0	5	0	1,000	70	0	0	0	7	.7	7	1.5	1.5	.2	
587a	0	0	0	15	15	0	0	10	.5	.1	.7	3	5	.02	
588	0	15	0	300	300	20	0	150	7	3	3	3	3	.5	
589a	1,000	0	0	30	30	10	0	20	>10	.15	.15	1.5	2	.05	
589b	0	0	0	15	15	10	0	100	1	.1	1.5	3	5	.05	
							Representative rocks from mapped units on Plate 1								
597	0	7	0	2,000	100	20	2	100	3	0.5	3	3	2	0.2	gg
566	0	7	0	1,500	70	30	3	150	3	.5	3	3	2	.2	gg
60	0	7	0	2,000	50	20	2	100	3	.3	3	3	2	.2	gg
5	0	0	0	300	30	0	0	50	1	.2	.7	3	3	.1	qm
27	0	0	0	1,000	20	10	1	200	1.5	.2	1.5	3	3	.15	qm
583	0	0	0	500	7	0	0	30	.5	.07	.5	2	2	.05	qml
576	0	0	0	700	10	15	1.5	150	.7	.05	.7	2	3	.05	qml
50	0	0	0	2,000	15	0	0	100	.5	.05	1.5	3	1	.05	qml
69	0	0	0	1,000	7	0	0	70	.5	.03	1	3	2	.05	qml
534	0	3	0	700	30	10	.7	50	1	.3	1	2	3	.15	qm
67	0	5	0	1,000	70	10	1	150	2	.7	2	3	2	.3	qmg
58	0	3	0	700	10	20	2	50	.7	.1	1.5	2	3	.07	Dike 3/
11	0	0	0	1,500	10	10	1	50	.5	.07	1	3	3	.05	Dike
53	0	0	0	2,000	15	15	1.5	150	1.5	.1	2	2	3	.1	qmp
552	0	0	0	2,000	10	10	1.5	100	.7	.07	1.5	3	2	.05	qmp
556	0	2	0	2,000	30	15	1.5	100	1.5	.15	2	3	1.5	.15	qmp
71	0	10	0	1,000	50	50	5	500	3	.7	2	3	3	.5	qmg
52a	0	30	0	2,000	200	30	3	150	7	2	5	2	1.5	.5	Dike
25	0	20	0	1,500	150	20	2	150	5	2	5	2	1	.7	Dike
75	0	7	0	1,000	50	10	1	150	1.5	.5	1	3	2	.2	Dike
15a	0	20	0	1,500	150	30	3	100	5	1.5	5	2	1.5	.5	qd
82	0	15	0	500	100	20	2	300	3	.7	2	2	1.5	.5	bg
79a	0	50	0	700	200	1.5	1.5	500	5	1.5	5	1.5	1	.2	bg
84	0	30	0	1,500	200	5	5	100	7	2	5	2	1	.5	dg
88	0	20	0	1,000	100	30	3	200	5	1	2	2	2	.3	dg
76 4/	0	70	0	500	200	70	7	50	7	5	7	1	0	.3	bg
79b	0	20	0	1,500	150	15	1.5	100	3	1	3	1.5	.7	.2	bg

4/ Additional elements looked for but not found: Gd, Tb, Dy, Ho, Er, Tn, and Lu.

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