

UNITED STATES DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

Analytical results and sample locality map  
of stream-sediment, heavy-mineral-concentrate, and rock sample  
from the Fish Creek Rim (OR-1-117) and Guano Creek  
(OR-1-132) Wilderness Study Areas,  
Lake County, Oregon

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This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards and stratigraphic nomenclature. Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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## STUDIES RELATED TO WILDERNESS

### Bureau of Land Management Wilderness Study Areas

The Federal Land Policy and Management Act (Public Law 94-579, October 21, 1976) requires the U.S. Geological Survey and the U.S. Bureau of Mines to conduct mineral surveys on certain areas 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 geochemical survey of the Fish Creek Rim (OR-1-78) and the Guano Creek (OR-1-132) Wilderness Study Areas (WSA's), Lake County, Oregon.

### INTRODUCTION

In August 1986, the U.S. Geological Survey conducted reconnaissance geochemical surveys of the Fish Creek Rim (OR-1-78) and Guano Creek (OR-1-132) Wilderness Study Areas, Lake County, Oregon (figs. 1 and 2).

The Fish Creek Rim Wilderness Study Area comprises about 18.6 mi<sup>2</sup> (48.4 km<sup>2</sup>) in the southern part of Lake County Oregon, and lies about 19 mi (30 km) east of Lakeview, Oregon. The town of Adel is at the southeast corner of the study area. Access to the study area is provided on the south by Oregon State Highway 140, and on the east by the all-weather highway linking Adel to Plush. Access to the west and north sides of the study area is provided by unimproved dirt roads and jeep trails.

The Guano Creek Wilderness Study Area comprises about 16.2 mi<sup>2</sup> (42.1 km<sup>2</sup>) in southeastern Lake County, Oregon, about 38 mi (61 km) east of Lakeview, Oregon and 13 mi (21 km) east of the Fish Creek Rim Wilderness Study Area. Access to the study area is provided on the east by an unimproved dirt road leading off of Oregon State Highway 104. Unimproved dirt roads joining that road provide access to the north, west, and south parts of the study area.

The Fish Creek Rim and Guano Creek Wilderness Study Areas are in a region mostly underlain by extensive flood basalts and associated airfall tuffs and sedimentary rocks of Tertiary age. At least three separate periods of volcanism are recorded within the Fish Creek Rim Study Area. Rock units include, from oldest to youngest, a sequence of nearly flat-lying andesite, a sequence of basalt flows, a sequence of tuffaceous sedimentary rocks, and airfall tuffs, capped by a sequence of basalt flows. Rocks of the Guano Creek Study Area consist of a lower unit of basalt, a middle unit of ash-flow and air-fall rhyolitic tuff and tuffaceous sediments, and an upper cap basalt. Both study areas are included in reconnaissance geologic maps at a scale of 1:250,000 (Walker and Repenning, 1965) and 1:500,000 (Walker, 1977).

The topographic relief in the Fish Creek Rim Study Area is about 2,450 ft (747 m), with a maximum elevation of 6,932 ft (2,113 m). The northwestern and southwestern parts of the study area are gently sloping plateaus. A deep canyon cuts the plateau in the southeastern part of the study area. The east side of the study area is a fault escarpment over 2,000 ft (610 m) forming Lynchs Rim.

The topographic relief in the Guano Creek Study Area is about 770 ft (235 m), with a maximum elevation of 5,978 ft (1,822 m). The ground surface of most of the study area is a gently sloping plateau cut by intermittent streams. Steep slopes are common in the eastern part of the study area adjacent to Guano Valley. The climate of both study areas is semiarid.

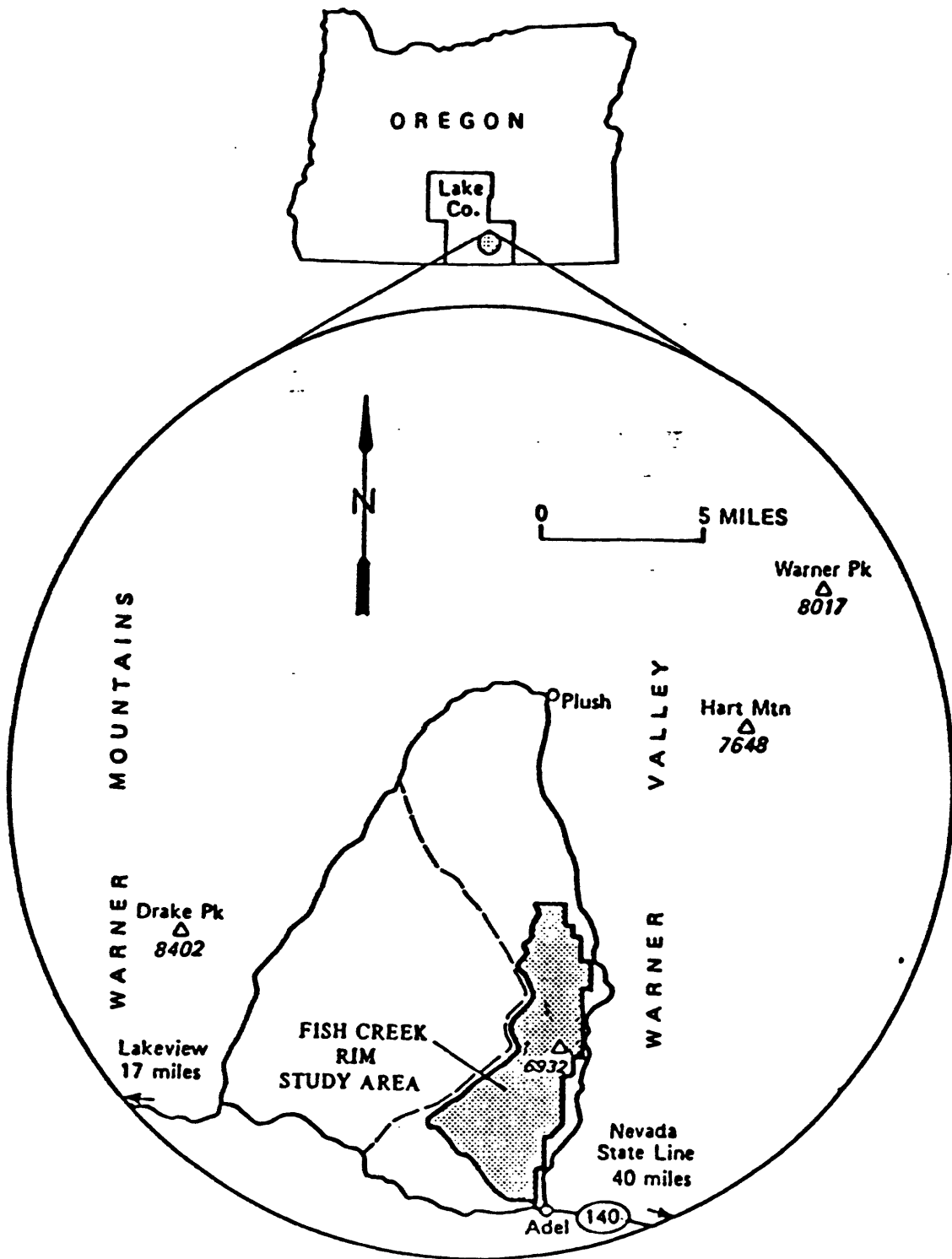


Figure 1. Index map showing location of the Fish Creek Rim Wilderness Study Area, Lake County, Oregon.

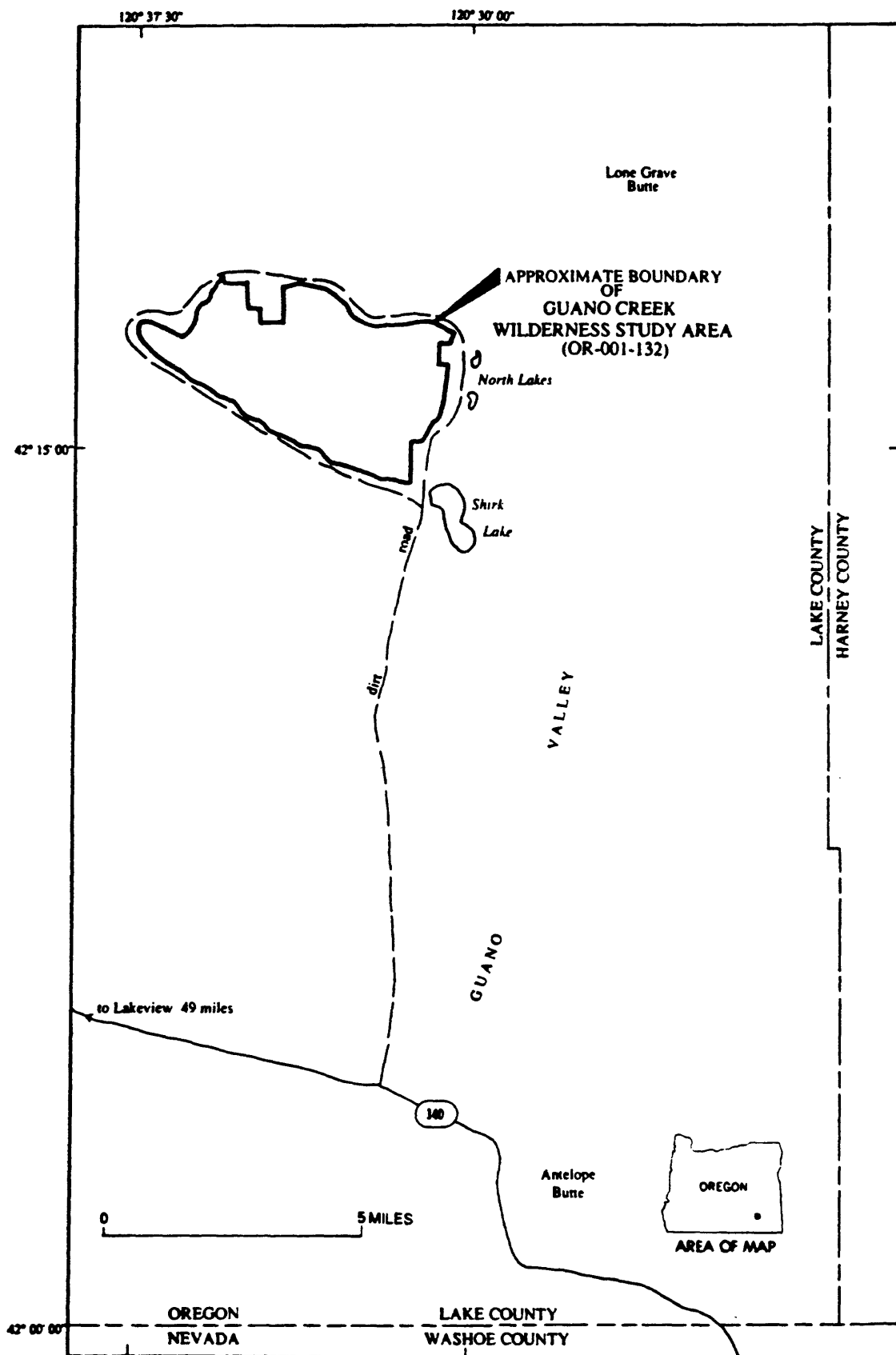


Figure 2. Index map showing location of the Guano Creek Wilderness Study Area, Lake County, Oregon.

## **METHODS OF STUDY**

### **Sample Media**

Analyses of the stream-sediment samples represent the chemistry of the rock material eroded from the drainage basin upstream from each sample site. Such information is useful in identifying those basins which contain concentrations of elements that may be related to mineral deposits. Heavy-mineral-concentrate samples provide information about the chemistry of certain minerals in rock material eroded from the drainage basin upstream from each sample site. The selective concentration of minerals, many of which may be ore related, permits determination of some elements that are not easily detected in stream-sediment samples.

Analyses of unaltered or unmineralized rock samples provide background geochemical data for individual rock units. On the other hand, analyses of altered or mineralized rocks, where present, may provide useful geochemical information about the major- and trace-element assemblages associated with a mineralizing system.

### **Sample Collection**

Samples were collected at 17 sites in and adjacent to the Fish Creek Rim Wilderness Study Area (plate 1). Results for samples collected outside the proposed boundary of the study area are considered pertinent to geology within the WSA. Samples were collected at 12 sites in the Guano Creek Wilderness Study Area (plate 2). At all but two sites (FR001H, FR006C), both a stream-sediment sample and a heavy-mineral-concentrate sample were collected. One rock sample was collected in the Guano Creek Study Area. Sampling density for stream-sediment and heavy-mineral-concentrate samples was about one sample site per 1.1 mi<sup>2</sup> for the Fish Creek Rim Study Area and about one sample site per 1.4 mi<sup>2</sup> for the Guano Creek Study Area. The area of the drainage basins sampled ranged from about 0.2 mi<sup>2</sup> to 3 mi<sup>2</sup> in both study areas; two larger drainage basins in the Guano Creek Study Area were sampled at several sites.

#### **Stream-sediment samples**

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 as shown on USGS topographic maps (scale = 1:24,000). Each sample was composited from several localities within an area that may extend as much as 20 ft from the center of the site symbol plotted on the map.

#### **Heavy-mineral-concentrate samples**

Heavy-mineral-concentrate samples were collected from the same active alluvium as the stream-sediment samples. Each bulk sample was screened with a 2.0-mm (10-mesh) screen to remove the coarse material. The less than 2.0-mm fraction was panned until most of the quartz, feldspar, organic material, and clay-sized material were removed.

## Rock samples

One rock sample of tuff with iron-oxide staining was collected from an outcrop in Guano Creek Wilderness Study area.

## Sample Preparation

The stream-sediment samples were air dried, then sieved using 80-mesh (0.17-mm) stainless-steel sieves. The portion of the sediment passing through the sieve was saved for analysis.

After the samples were air dried, bromoform (specific gravity 2.8) was used to remove the remaining quartz and feldspar from the heavy-mineral-concentrate samples that had been panned in the field. The resultant heavy-mineral sample was separated into three fractions using a large electromagnet (in this case a modified Frantz Isodynamic Separator). The most magnetic material, primarily magnetite, was not analyzed. The second fraction, largely ferromagnesian silicates and iron oxides, was saved for archival storage. The third fraction (the least magnetic material which may include the nonmagnetic ore minerals, zircon, sphene, etc.) was split using a Jones splitter. One split was hand ground for spectrographic analysis; the other split was saved for mineralogical analysis. These magnetic separates are the same separates that would be produced by using a Frantz Isodynamic Separator set at a slope of 15° and a tilt of 10° with a current of 0.2 ampere to remove the magnetite and ilmenite, and a current of 0.6 ampere to split the remainder of the sample into paramagnetic and nonmagnetic fractions.

The rock sample was crushed and then pulverized to minus 0.15 mm with ceramic plates.

## Sample Analysis

### Spectrographic method

The stream-sediment, heavy-mineral-concentrate, and rock samples were analyzed for 31 elements using semiquantitative, direct-current arc emission spectrographic methods (Grimes and Marranzino, 1968). The elements analyzed and their lower limits of determination are listed in table 1. Spectrographic results were obtained by visual comparison of spectra derived from the sample against spectra obtained from standards made from pure oxides and carbonates. Standard concentrations are geometrically spaced over any given order of magnitude of concentration as follows: 100, 50, 20, 10, and so forth. Samples whose concentrations are estimated to fall between those values are assigned values of 70, 30, 15, and so forth. The precision of the analytical method is approximately plus or minus one reporting interval at the 83 percent confidence level and plus or minus two reporting intervals at the 96 percent confidence level (Motooka and Grimes, 1976). Values determined for the major elements (iron, magnesium, calcium, and titanium) are given in weight percent; all others are given in parts per million (micrograms/gram). Analytical data for samples from the Fish Creek Rim and Guano Creek Wilderness Study Areas are listed in tables 3-7.

### Chemical methods

Other analytical methods used on samples from the Fish Creek Rim and Guano Wilderness Study Areas are summarized in table 2.

## DATA STORAGE SYSTEM

Upon completion of all analytical work, the analytical results were entered into a computer-based file called Rock Analysis Storage System (RASS). This data base contains both descriptive geological information and analytical data. Any or all of this information may be retrieved and converted to a binary form (STATPAC) for computerized statistical analysis or publication (VanTrump and Miesch, 1977).

## DESCRIPTION OF DATA TABLES

Tables 3 and 4 list the results of analyses for the stream-sediment and heavy-mineral-concentrate samples of the Fish Creek Rim WSA, respectively. Tables 5-7 list the results of analyses for the stream-sediment, heavy-mineral-concentrate, and rock samples from the Guano Creek WSA, respectively. For the three tables, the data are arranged so that column 1 contains the USGS-assigned sample numbers. These numbers correspond to the numbers shown on the site location maps (plates 1 and 2). Columns in which the element headings show the letter "s" below the element symbol indicates emission spectrographic analyses and "aa" indicates atomic absorption analyses. A letter "N" in the tables indicates that a given element was looked for but not detected at the lower limit of determination shown for that element in table 1. For emission spectrographic analyses, a "less than" symbol (<) entered in the tables in front of the lower limit of determination indicates that an element was observed but was below the lowest reporting value. For atomic absorption analyses, a "less than" symbol (<) entered in the tables in front of the lower limit of determination indicates that an element was below the lowest reporting value. If an element was observed but was above the highest reporting value, a "greater than" symbol (>) was entered in the tables in front of the upper limit of determination. If an element was not looked for in a sample, two dashes (--) are entered in tables 3-7 in place of an analytical value. Because of the formatting used in the computer program that produced tables 3-7, some of the elements listed in these tables (Fe, Mg, Ca, Ti, Ag, and Be) carry one or more nonsignificant digits to the right of the significant digits. The analysts did not determine these elements to the accuracy suggested by the extra zeros.

## ACKNOWLEDGMENTS

A number of our colleagues also participated in the preparation and analysis of these samples: Eric Welsch and Kay Kennedy.

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**TABLE 1.--Limits of determination for the spectrographic analysis of rocks and stream sediments, based on a 10-mg sample**

[The spectrographic limits of determination for heavy-mineral-concentrate samples are based on a 5-mg sample, and are therefore two reporting intervals higher than the limits given for rocks and stream sediments.]

Elements	Lower determination limit	Upper determination limit
Percent		
Iron (Fe)	0.05	20
Magnesium (Mg)	.02	10
Calcium (Ca)	.05	20
Titanium (Ti)	.002	1
Parts per million		
Manganese (Mn)	10	5,000
Silver (Ag)	0.5	5,000
Arsenic (As)	200	10,000
Gold (Au)	10	500
Boron (B)	10	2,000
Barium (Ba)	20	5,000
Beryllium (Be)	1	1,000
Bismuth (Bi)	10	1,000
Cadmium (Cd)	20	500
Cobalt (Co)	5	2,000
Chromium (Cr)	10	5,000
Copper (Cu)	5	20,000
Lanthanum (La)	20	1,000
Molybdenum (Mo)	5	2,000
Niobium (Nb)	20	2,000
Nickel (Ni)	5	5,000
Lead (Pb)	10	20,000
Antimony (Sb)	100	10,000
Scandium (Sc)	5	100
Tin (Sn)	10	1,000
Strontium (Sr)	100	5,000
Vanadium (V)	10	10,000
Tungsten (W)	50	10,000
Yttrium (Y)	10	2,000
Zinc (Zn)	200	10,000
Zirconium (Zr)	10	1,000
Thorium (Th)	100	2,000

TABLE 2.--Chemical methods used

[AA = atomic absorption]

Element or constituent determined	Method	Determination limit (micrograms/gram or ppm)	Reference
Gold (Au)	AA	0.05	Thompson and others, 1968.
Mercury (Hg)	AA	.02	Koirttyohann and Khalil, 1976.
Arsenic (As)	AA	10	O'Leary and Viets, 1986.
Antimony (Sb)	AA	2	
Zinc (Zn)	AA	5	
Bismuth (Bi)	AA	1	
Cadmium (Cd)	AA	.1	

Table 3. Results of analyses of stream-sediment samples from the Fish Creek Rim Wilderness Study Area, Lake County, Oregon

Sample	Latitude	Longitude	Fe-pct. S	Mg-pct. S	Ca-pct. S	Ti-pct. S	Mn-ppm S	Ag-ppm S	As-ppm S	Au-ppm S	B-ppm S	Ra-ppm S
FR001HS	42 10 43	119 54 42	7	3.0	5.0	>1	1,000	N	N	N	15	500
FR002HS	42 10 37	119 57 33	10	3.0	3.0	>1	1,000	N	N	N	10	500
FR003HS	42 10 58	119 58 4	10	5.0	5.0	>1	1,500	N	N	N	15	500
FR004HS	42 11 0	119 58 8	7	5.0	5.0	1	1,000	N	N	N	10	300
FR005HS	42 11 30	119 54 2	5	5.0	3.0	>1	1,000	N	N	N	<10	300
FR006CS	42 13 57	119 52 53	7	7.0	3.0	1	1,000	N	N	N	<10	150
FR007CS	42 15 34	119 52 47	3	2.0	2.0	1	700	N	N	N	10	300
FR008CS	42 16 23	119 52 48	5	2.0	3.0	>1	700	N	N	N	20	500
FR009CS	42 17 30	119 52 28	5	1.5	2.0	>1	1,000	N	N	N	20	500
FR010CS	42 11 55	119 59 37	10	2.0	2.0	>1	1,500	N	N	N	20	300
FR011CS	42 12 3	119 57 57	10	5.0	3.0	>1	1,000	N	N	N	20	700
FR012CS	42 12 3	119 57 48	10	5.0	3.0	>1	1,500	N	N	N	20	300
FR013CS	42 13 26	119 57 24	5	1.5	2.0	>1	1,000	N	N	N	20	500
FR014CS	42 14 26	119 56 20	10	2.0	2.0	>1	1,500	N	N	N	20	500
FR015HS	42 18 52	119 56 19	5	1.5	2.0	>1	1,500	N	N	N	20	500
FR016HS	42 18 44	119 56 22	7	1.5	2.0	>1	2,000	N	N	N	20	500
FR017HS	42 19 39	119 55 34	10	2.0	1.5	>1	2,000	N	N	N	15	300

Sample	Be-ppm S	Bi-ppm S	Cd-ppm S	Co-ppm S	Cr-ppm S	Cu-ppm S	La-ppm S	Mo-ppm S	Nb-ppm S	Ni-ppm S	Pb-ppm S	Sb-ppm S	Sc-ppm S	Sn-ppm S
FR001HS	1	N	N	50	200	100	N	N	N	100	<10	N	30	N
FR002HS	1	N	N	30	200	50	50	N	<20	70	15	N	30	N
FR003HS	<1	N	N	50	200	100	N	N	N	100	<10	N	50	N
FR004HS	<1	N	N	30	100	70	N	N	N	50	10	N	20	N
FR005HS	<1	N	N	30	300	150	N	N	N	100	<10	N	20	N
FR006CS	1	N	N	50	200	150	N	N	N	150	<10	N	15	N
FR007CS	1	N	N	20	200	70	N	N	N	50	10	N	20	N
FR008CS	1	N	N	30	150	50	30	N	<20	50	15	N	20	N
FR009CS	1	N	N	30	100	50	20	N	<20	30	10	N	15	N
FR010CS	1	N	N	50	200	50	N	N	<20	50	10	N	30	N
FR011CS	1	N	N	50	200	50	N	N	N	70	10	N	30	N
FR012CS	1	N	N	50	200	70	N	N	N	100	10	N	30	N
FR013CS	1	N	N	20	100	30	30	N	<20	20	20	N	15	N
FR014CS	1	N	N	50	100	50	30	N	N	30	20	N	20	N
FR015HS	1	N	N	50	200	50	N	N	N	30	20	N	15	N
FR016HS	1	N	N	50	150	50	N	N	N	50	15	N	20	N
FR017HS	<1	N	N	50	150	50	N	N	N	50	15	N	20	N

Table 3. Results of analyses of stream-sediment samples from the Fish Creek Rim Wilderness Study Area, Lake County, Oregon--Continued

Sample	Sr-ppm S	V-ppm S	W-ppm S	Y-ppm S	Zn-ppm S	Zr-ppm S	Th-ppm S	Au-ppm aa	Hg-ppm aa	As-ppm aa	Bi-ppm aa	Cd-ppm aa	Sb-ppm aa	Zn-ppm aa
FR001HS	500	200	N	20	<200	70	N	<.1	.26	N	N	.1	N	65
FR002HS	500	200	N	20	<200	50	N	<.1	.10	N	N	.1	N	100
FR003HS	500	200	N	30	<200	50	N	<.1	.04	N	N	.1	N	85
FR004HS	200	150	N	20	<200	50	N	<.1	.02	N	N	.1	N	70
FR005HS	300	150	N	15	<200	50	N	<.1	.04	N	N	.1	N	65
FR006CS	300	100	N	15	<200	50	N	<.1	.02	N	N	.1	N	85
FR007CS	300	150	N	15	<200	50	N	<.1	.04	N	N	.1	N	80
FR008CS	500	150	N	30	<200	100	N	<.1	N	N	N	.1	N	60
FR009CS	500	150	N	20	<200	100	N	<.1	.02	N	N	.2	N	60
FR010CS	200	200	N	20	<200	100	N	<.1	N	N	N	.1	N	130
FR011CS	500	200	N	20	<200	100	N	<.1	.02	N	N	.1	N	70
FR012CS	300	200	N	20	<200	100	N	<.1	.02	N	N	.1	N	110
FR013CS	700	100	N	20	<200	70	N	<.1	.20	N	N	.1	N	50
FR014CS	500	150	N	20	<200	100	N	<.1	.04	N	N	.1	N	55
FR015HS	500	100	N	20	<200	100	N	<.1	.06	N	N	.2	N	45
FR016HS	500	150	N	20	<200	100	N	<.1	.02	N	N	.2	N	55
FR017HS	300	150	N	10	<200	100	N	<.1	.02	N	N	.2	N	115

Table 4. Results of analyses of heavy-mineral-concentrate samples from the Fish Creek Rim Wilderness Study Area, Lake County, Oregon  
[N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

Sample	Latitude	Longitude	Fe-pct. S	Hg-pct. S	Ca-pct. S	Ti-pct. S	Mn-ppm S	Ag-ppm S	As-ppm S	Au-ppm S
FR002HC3	42 10 37	119 57 33	.7	.7	3	.30	200	N	N	N
FR003HC3	42 10 58	119 58 4	.7	.7	7	.30	300	N	N	N
FR004HC3	42 11 0	119 58 8	1.0	1.0	7	.30	200	N	N	N
FR005HC3	42 11 30	119 54 2	.7	.7	7	.15	200	N	N	N
FR007CC3	42 15 34	119 52 47	.7	.5	7	.30	150	N	N	N
FR008CC3	42 16 23	119 52 48	1.0	1.5	10	.50	300	N	N	N
FR009CC3	42 17 30	119 52 28	.7	.3	10	.15	200	N	N	N
FR010CC3	42 11 55	119 59 37	.5	.5	7	.15	200	N	N	N
FR011CC3	42 12 3	119 57 57	.7	.3	7	.15	200	N	N	N
FR012CC3	42 12 3	119 57 48	.7	.5	10	.10	200	N	N	N
FR013CC3	42 13 26	119 57 24	1.0	1.0	10	.50	200	N	N	N
FR014CC3	42 14 26	119 56 20	3.0	1.0	10	.70	300	N	N	N
FR015HC3	42 18 52	119 56 19	1.0	.7	7	.50	200	N	N	N
FR016HC3	42 18 44	119 56 22	.5	.2	7	.30	150	N	N	N
FR017HC3	42 19 39	119 55 34	1.0	.7	5	.70	200	N	N	N

Sample	B-ppm S	Ba-ppm S	Be-ppm S	Bi-ppm S	Cd-ppm S	Co-ppm S	Cr-ppm S	Cu-ppm S	La-ppm S	Mo-ppm S	Nb-ppm S
FR002HC3	50	700	<2	N	N	N	100	20	70	<10	N
FR003HC3	70	700	<7	N	N	N	200	30	100	<50	N
FR004HC3	30	700	<2	N	N	N	100	20	50	<10	N
FR005HC3	30	700	<2	N	N	N	50	15	<50	<10	N
FR007CC3	50	500	<2	N	N	N	50	15	N	<10	N
FR008CC3	50	700	<2	N	N	N	100	20	70	<10	N
FR009CC3	30	700	<2	N	N	N	20	10	50	<10	N
FR010CC3	50	700	<2	N	N	N	20	10	N	<10	N
FR011CC3	50	500	<2	N	N	N	20	10	N	<10	N
FR012CC3	30	700	<2	N	N	N	20	15	N	<10	N
FR013CC3	50	500	<2	N	N	N	150	15	50	<10	N
FR014CC3	70	700	<7	N	N	N	70	30	100	<50	N
FR015HC3	50	500	<2	N	N	N	70	10	50	<10	N
FR016HC3	50	500	<2	N	N	N	20	10	50	<10	N
FR017HC3	50	500	<2	N	N	N	150	70	50	<10	N

Table 4. Results of analyses of heavy-mineral-concentrate samples from the Fish Creek Rim Wilderness Study Area, Lake County, Oregon--Continued

Sample	Ni-ppm S	Pb-ppm S	Sb-ppm S	Sc-ppm S	Sn-ppm S	Sr-ppm S	V-ppm S	W-ppm S	Y-ppm S	Zn-ppm S	Zr-ppm S	Th-ppm S
FR002HC3	20	100	N	<10	N	700	100	N	500	N	>2,000	N
FR003HC3	30	30	N	<50	N	1,000	200	N	200	N	>3,000	N
FR004HC3	20	100	N	<10	100	1,000	100	N	100	N	>2,000	N
FR005HC3	15	N	N	<10	N	1,500	30	N	70	N	>3,000	N
FR007CC3	15	20	N	<10	N	1,000	30	N	20	N	>3,000	N
FR008CC3	20	70	N	<10	N	700	100	N	500	N	>3,000	N
FR009CC3	10	300	N	<10	N	1,000	30	N	100	N	>3,000	N
FR010CC3	10	N	N	<10	N	1,000	30	N	150	N	>3,000	N
FR011CC3	30	N	N	<10	N	1,000	50	N	70	N	>3,000	N
FR012CC3	20	N	N	<10	N	1,000	50	N	100	N	>3,000	N
FR013CC3	30	N	N	<10	N	1,500	100	N	100	N	>3,000	N
FR014CC3	70	200	N	<50	N	2,000	200	N	300	N	>3,000	N
FR015HC3	20	N	N	<10	N	1,000	70	N	150	N	>2,000	N
FR016HC3	10	N	N	<10	N	1,500	50	N	200	N	>2,000	N
FR017HC3	30	N	N	<10	N	1,000	100	N	500	N	>2,000	N

Table 5. Results of analyses of stream-sediment samples from the Guano Creek Wilderness Study Area, Lake County, Oregon

Sample	Latitude	Longitude	Fe-pct. S	Mg-pct. S	Ca-pct. S	Tl-pct. S	Mn-ppt. S	Ag-ppt. S	As-ppt. S	Au-ppt. S	B-ppt. S	Ba-ppt. S		
GC001CS	42 15 39	119 32 51	5	1.5	2.0	>1	1,500	N	N	N	30	500		
GC002HS	42 16 57	119 30 23	20	2.0	1.5	>1	3,000	N	N	N	50	500		
GC003CS	42 15 39	119 32 41	5	1.5	2.0	>1	1,000	N	N	N	30	500		
GC004HS	42 17 8	119 32 5	5	1.0	3.0	>1	700	N	N	N	70	500		
GC005CS	42 15 29	119 31 46	5	1.5	2.0	>1	1,000	N	N	N	70	300		
GC006HS	42 17 28	119 32 51	7	1.5	3.0	>1	2,000	N	N	N	50	500		
GC007CS	42 15 24	119 31 47	7	1.5	2.0	>1	1,000	N	N	N	20	500		
GC008HS	42 15 43	119 35 46	10	1.5	2.0	>1	3,000	N	N	N	50	500		
GC009CS	42 15 5	119 31 42	20	2.0	1.0	>1	3,000	N	N	N	30	200		
GC010HS	42 15 23	119 34 21	5	1.0	2.0	>1	1,000	N	N	N	50	500		
GC013CS	42 15 32	119 34 15	5	1.5	3.0	1	1,000	N	N	N	50	500		
GC011CS	42 14 22	119 31 41	7	2.0	2.0	>1	1,500	N	N	N	50	500		
Sample	Be-ppt. S	Bi-ppt. S	Cd-ppt. S	Co-ppt. S	Cr-ppt. S	Cu-ppt. S	La-ppt. S	Mo-ppt. S	Nb-ppt. S	Ni-ppt. S	Pb-ppt. S	Sb-ppt. S	Sc-ppt. S	Sn-ppt. S
GC001CS	1.0	N	N	30	100	50	50	N	<20	30	30	N	20	N
GC002HS	<1.0	N	N	70	150	50	100	N	<20	20	20	N	50	N
GC003CS	1.0	N	N	20	100	30	50	N	<20	30	30	N	15	N
GC004HS	<1.0	N	N	15	150	50	30	N	<20	20	50	N	20	N
GC005CS	1.5	N	N	20	50	30	70	<5	<20	20	50	N	20	N
GC006HS	1.0	N	N	50	150	70	20	N	<20	50	30	N	20	N
GC007CS	<1.0	N	N	20	150	50	30	N	<20	30	50	N	20	N
GC008HS	1.0	N	N	30	100	50	N	N	20	15	20	N	30	N
GC009CS	1.0	N	N	50	50	50	N	N	20	20	30	N	30	N
GC010HS	1.0	N	N	20	100	20	N	N	N	20	20	N	15	N
GC013CS	1.0	N	N	30	150	50	50	N	<20	50	30	N	20	N
GC011CS	1.0	N	N	20	50	50	30	5	20	20	50	N	20	N
Sample	Sr-ppt. S	V-ppt. S	W-ppt. S	Y-ppt. S	Zn-ppt. S	Zr-ppt. S	Th-ppt. S	Au-ppt. aa	Hg-ppt. aa	As-ppt. aa	Bi-ppt. aa	Cd-ppt. aa	Sb-ppt. aa	Zn-ppt. aa
GC001CS	1,000	100	100	20	N	150	N	N	.04	N	N	N	.2	45
GC002HS	300	300	300	30	N	50	N	N	.02	N	N	N	.2	700
GC003CS	500	100	100	30	N	150	N	N	.02	N	N	N	.2	55
GC004HS	500	100	100	50	N	200	N	N	.02	N	N	N	.1	30
GC005CS	300	100	100	20	N	200	N	N	.02	N	N	N	.1	65
GC006HS	500	150	150	30	N	200	N	N	.04	N	N	N	.2	55
GC007CS	500	100	100	15	N	150	N	N	.06	N	N	N	.6	65
GC008HS	500	100	100	30	N	100	N	N	.04	N	N	N	<.1	40
GC009CS	200	200	200	20	<200	200	N	N	N	N	N	N	.1	400
GC010HS	700	70	70	20	N	200	N	N	.02	N	N	N	<.1	40
GC013CS	700	100	100	20	N	200	N	N	.02	N	N	N	.1	40
GC011CS	500	150	150	30	N	200	N	N	N	N	N	N	.1	80



Table 6. Results of analyses of heavy-mineral-concentrate samples from the Guano Creek Wilderness Study Area, Lake County, Oregon  
 [N, not detected; <, detected but below the limit of determination shown; >, determined to be greater than the value shown.]

Sample	Latitude	Longitude	Fe-pct. S	Hg-pct. S	Ca-pct. S	Ti-pct. S	Mn-ppm S	Ag-ppm S	As-ppm S	Au-ppm S	
GC001CC3	42 15 39	119 32 51	1.0	.70	7.0	2.00	300	N	N	N	
GC002HC3	42 16 57	119 30 23	1.0	1.00	7.0	.70	300	N	N	N	
GC003CC3	42 15 59	119 32 41	.7	.30	5.0	.20	200	N	N	N	
GC004HC3	42 17 8	119 32 5	.5	.20	5.0	2.00	150	N	N	N	
GC005CC3	42 15 29	119 31 46	1.0	1.00	5.0	.20	500	N	N	N	
GC007CC3	42 15 24	119 31 47	2.0	2.00	10.0	1.50	700	N	N	N	
GC008HC3	42 15 43	119 35 46	.7	.20	7.0	.30	150	N	N	N	
GC009CC3	42 15 5	119 31 42	.7	.50	5.0	.15	200	N	N	N	
GC010HC3	42 15 23	119 34 21	.5	.30	5.0	.50	200	N	N	N	
GC011CC3	42 14 22	119 31 41	.5	.15	1.5	.30	150	N	N	N	
GC013CC3	42 15 32	119 34 15	1.0	.50	10.0	.50	200	N	N	N	
Sample	B-ppm S	Ba-ppm S	Be-ppm S	Rb-ppm S	Cd-ppm S	Co-ppm S	Cr-ppm S	Cu-ppm S	La-ppm S	Mo-ppm S	Nb-ppm S
GC001CC3	30	500	<2	N	N	N	70	10	100	N	N
GC002HC3	30	500	<2	N	N	N	70	15	150	N	N
GC003CC3	30	700	<2	N	N	N	50	10	50	N	N
GC004HC3	20	300	<2	N	N	N	70	10	100	N	N
GC005CC3	70	700	<2	N	N	N	100	15	200	N	N
GC007CC3	30	500	<2	N	N	15	200	15	150	N	N
GC008HC3	20	700	<2	N	N	N	20	<10	N	N	N
GC009CC3	50	500	2	N	N	N	20	10	200	N	N
GC010HC3	50	700	<2	N	N	N	20	10	N	N	N
GC011CC3	30	200	3	N	N	N	30	10	300	N	N
GC013CC3	30	500	<2	N	N	N	30	15	N	N	N
Sample	Ni-ppm S	Pb-ppm S	Sb-ppm S	Sc-ppm S	Sn-ppm S	Sr-ppm S	Y-ppm S	Zn-ppm S	Zr-ppm S	Th-ppm S	
GC001CC3	20	N	N	<10	N	2,000	100	<100	N	N	
GC002HC3	30	70	N	<10	70	1,500	70	<100	>2,000	N	
GC003CC3	15	N	N	<10	500	2,000	50	<100	>2,000	N	
GC004HC3	50	N	N	<10	20	1,500	100	<100	>2,000	N	
GC005CC3	30	N	N	<10	N	2,000	100	<100	>2,000	N	
GC007CC3	50	50	N	<10	N	3,000	150	<100	>2,000	N	
GC008HC3	<10	N	N	<10	150	2,000	30	<100	>2,000	N	
GC009CC3	15	N	N	<10	N	3,000	20	<100	>2,000	N	
GC010HC3	10	N	N	<10	N	2,000	50	<100	>2,000	N	
GC011CC3	30	N	N	100	N	1,000	50	<100	>2,000	300	
GC013CC3	20	N	N	<10	N	2,000	70	<100	>2,000	N	

Table 7. Results of the analysis of the rock sample from the Guano Creek Wilderness Study Area, Lake County, Oregon

Sample	Latitude	Longitude	Fe-pct. S	Mg-pct. S	Ca-pct. S	Ti-pct. S	Mn-ppm S	Ag-ppm S	As-ppm S	Au-ppm S	R-ppm S	Ba-ppm S
GC005CP	42 15 29	119 31 46	3	.5	.3	.07	>5,000	N	N	N	70	700

Sample	Re-ppm S	Bi-ppm S	Cd-ppm S	Co-ppm S	Cr-ppm S	Cu-ppm S	La-ppm S	Mo-ppm S	Nb-ppm S	Ni-ppm S	Pb-ppm S	Sb-ppm S	Sc-ppm S	Sn-ppm S
GC005CR	3	N	N	50	20	7	70	5	N	15	30	N	5	N

Sample	Sr-ppm S	V-ppm S	W-ppm S	Y-ppm S	Zn-ppm S	Zr-ppm S	Th-ppm S	Au-ppm aa	Hg-ppm aa	As-ppm aa	Bi-ppm ma	Cd-ppm aa	Sb-ppm aa	Zn-ppm aa
GC005CR	200	70	N	50	N	300	N	N	.03	10	N	.2	N	30