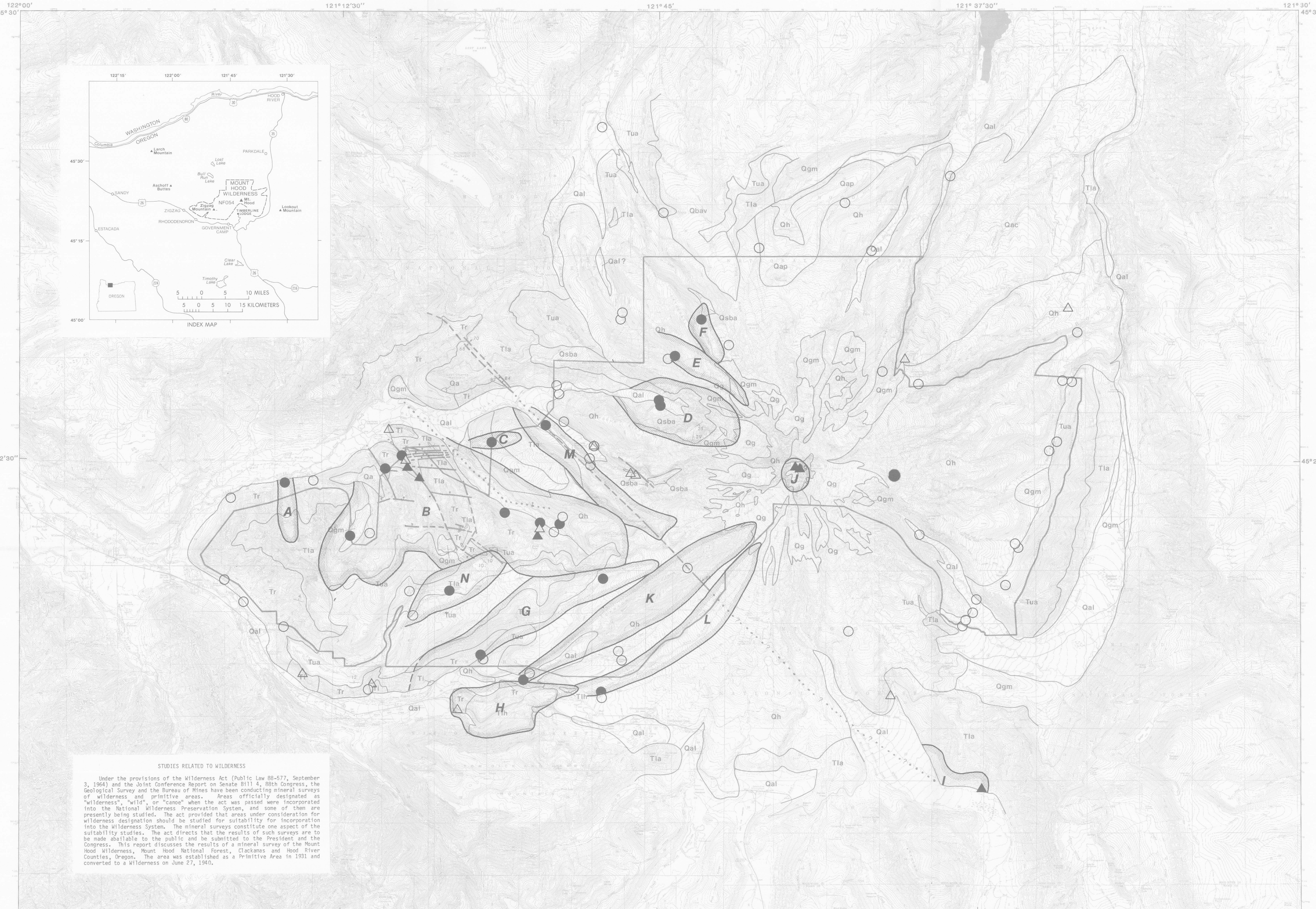
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1379-C



STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the Geological Survey and the Bureau of Mines have been conducting 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, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Mount Hood Wilderness, Mount Hood National Forest, Clackamas and Hood River Counties, Oregon. The area was established as a Primitive Area in 1931 and converted to a Wilderness on June 27, 1964.

Base from U.S. Geological Survey 1:24,000
Badger Lake, Bull Run Lake, Cathedral Ridge,
Dog River, Government Camp, Hickman Butte,
Mount Hood South, Rhododendron, 1962

SCALE 1:62500

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

APPROXIMATE MEAN DECLINATION, 1982

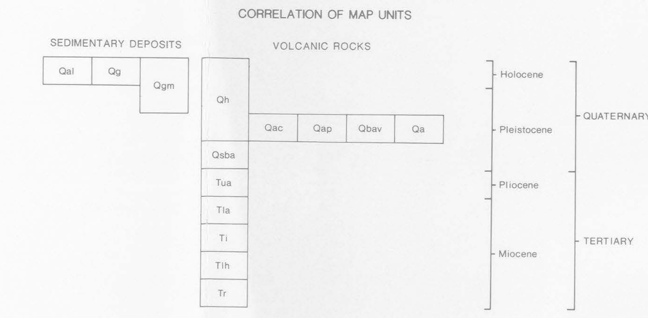
Geology mapped by W.S. Wise, 1960, 1969; T.E.C. Keith, M.H. Beeson, K.E. Bargar, 1979, 1980; H.J. Meyer, J. Hook, M.W. Gannet, 1980.

GEOCHEMICAL MAP OF THE MOUNT HOOD WILDERNESS, CLACKAMAS AND HOOD RIVER COUNTIES, OREGON

By
T.E.C. Keith, K.E. Bargar, and M.H. Beeson

1982

CORRELATION OF MAP UNITS



ABBREVIATED GEOLOGIC UNIT DESCRIPTION

SEDIMENTARY DEPOSITS

Qal ALLUVIUM (HOLOCENE)--Unconsolidated stream deposits

Qg GLACIERS (HOLOCENE)--Presently active ice bodies

Qgm GLACIAL MORAINES (HOLOCENE AND PLEISTOCENE)--Unsorted and poorly indurated glacial deposits

VOLCANIC ROCKS

Qh LAVAS OF MOUNT HOOD (HOLOCENE AND PLEISTOCENE)--Undifferentiated andesite flows and dacitic pyroclastic rocks of Mount Hood volcano

Qac ANDESITE OF CLOUD CAP (PLEISTOCENE)--Medium- to dark-gray andesite flows from vent at Cloud Cap

Qap ANDESITE OF THE PINNACLE (PLEISTOCENE)--Medium- to dark-gray andesite flows from vent at The Pinnacle

Qbav ANDESITE AND BASALT OF VISTA RIDGE (PLEISTOCENE)--Medium- to dark-gray olivine andesite flows from several vents along Vista Ridge. Dark-gray to black aphanitic basalt from Vista Ridge including red scoriaceous basalt from the cinder cone at Red Hill

Qa UNDIFFERENTIATED ANDESITES FROM SATELLITIC VENTS (PLEISTOCENE)--Medium- to dark-gray microporphyritic olivine andesite flows

Qsba SANDY GLACIER VOLCANO (PLEISTOCENE)--Black to dark-gray olivine basalt flows, pyroxene and hornblende andesite flows, and interlayered tuffs and breccias forming a partly exposed and dissected cone on the west side of Mount Hood

Tua UPPER ANDESITE FLOWS (PLIOCENE)--Medium-gray microporphyritic olivine andesite flows

Tla LOWER ANDESITE FLOWS (MIOCENE)--Light- to medium-gray olivine and pyroxene andesite flows with interlayered tuffs and breccias; characterized in places by coarse porphyritic hypersthene andesite

Ti INTRUSIVE ROCKS (MIOCENE)--Medium-gray andesite plugs

Tlh QUARTZ DIORITE OF LAUREL HILL (MIOCENE)--Medium-grained quartz diorite and quartz monzonite intrusion

Tr RHODODENDRON FORMATION (MIOCENE)--Varicolored volcaniclastic rocks and andesite lava flows

CONTACT--Approximately located

FAULT, SHOWING DIP--Dashed where approximately located; dotted where uncertain. Bar and ball on downthrown side

STRIKE AND DIP OF LAVA FLOWS AND BEDDING IN VOLCANICLASTIC LAYERS

BOUNDARY OF MOUNT HOOD WILDERNESS

A BOUNDARY OF DRAINAGE BASIN OR OUTCROP AREA CONTAINING ANOMALOUS CONCENTRATIONS OF ELEMENTS

STREAM-SEDIMENT AND PANNED-CONCENTRATE SAMPLE SITE--No anomalous concentrations of elements present

STREAM-SEDIMENT AND PANNED-CONCENTRATE SAMPLE SITE--Anomalous concentrations of elements present

ROCK SAMPLE SITE--No anomalous concentrations of elements present

ALTERED-ROCK SAMPLE SITE--Anomalous concentrations of elements present

GEOCHEMICAL STUDY OF THE MOUNT HOOD WILDERNESS, OREGON

GEOLOGICAL SUMMARY

The Mount Hood Wilderness is on the crest of the Cascade Range in Oregon and includes the east, north, and west flanks and the summit area of Mount Hood, a Quaternary andesitic and dacitic volcano. Zigzag Mountain, composed of late Miocene and younger andesitic volcanic and volcaniclastic rocks, comprises the western part of the Wilderness. A quartz diorite intrusion of probable late Miocene age underlies rocks in at least part of the Wilderness along the south side of Zigzag Mountain (Keith and others, 1982).

GEOCHEMICAL INVESTIGATIONS

During the summer of 1979, the U.S. Geological Survey conducted a geochemical reconnaissance of the Mount Hood Wilderness. Within and adjacent to the 47,100 acre (19,061 ha) area, 12 unaltered rock samples, 25 altered rock samples, 57 stream-sediment samples, and 69 panned-concentrate samples were collected at sites selected to represent all known rock units exposed in the Wilderness. Above 7,000 ft (2,134 m) altitude on Mount Hood, there are no suitable streams for sampling because active glaciers occupy the higher valleys, the porosity of the surficial volcanic deposits (mostly block and ash flows) is high, and the flanks of the volcano are too steep for streams to form.

The unaltered rock samples were collected from representative mapped volcanic units to determine background geochemical values (Keith and others, 1980). These rocks are mostly olivine, hypersthene andesite lava flows, and some are hornblende dacite from late Mount Hood volcanic activity.

Altered rock samples were collected from areas of conspicuous hydrothermal alteration on parts of Zigzag Mountain and at the summit of Mount Hood volcano.

Stream-sediment samples were collected as close as possible to the center channels of active streams, and then screened at the site to minus 2 mm (10 mesh) using a stainless steel screen. The minus-2-mm (10-mesh) material was later air dried and sieved using a 0.177-mm (80-mesh) stainless steel screen in an aluminum frame. The minus-0.177-mm (80-mesh) fraction was saved for analysis.

To obtain panned-concentrate samples, bulk sediment from the active stream channel was passed through a 2.0-mm (10-mesh) stainless steel screen and the minus-2.0-mm (10-mesh) material was wet panned at the sample site to reduce the percentage of the lower density minerals (feldspar and quartz) and lithic fragments (volcanic glass and aphanitic groundmass). The resulting heavy concentrate was air dried, and magnetite was removed with a hand magnet. The sample was separated with bromoform (specific gravity 2.86) into two fractions, and the heavy-mineral fraction was further subdivided into magnetic and nonmagnetic fractions. The nonmagnetic fraction was pulverized in an agate mortar for chemical analysis.

The nonmagnetic panned-concentrate fraction, the minus-0.177-mm (80-mesh) stream-sediment fraction, and fresh and altered rock samples were analyzed for 30 elements by semiquantitative optical-emission spectroscopy (Grimes and Marranzino, 1968). Selected altered rock samples were analyzed, in addition, for As using a colorimetric method (Ward and others, 1963), for Au and Cu by atomic-absorption spectrometry (Ward and others, 1969), for Sb by atomic-absorption spectrometry (Welsh and Chao, 1975), and for Hg using a Hg-vapor detector (Vaughn, 1967). Lower limits of detection for these elements, in ppm, are: Au, 0.05; Cu, 5; Sb, 1; Hg, 0.02; and As, 10. Fluorimetric determinations were made for U on 32 randomly selected stream-sediment and 4 unaltered rock samples; limit of detection is 1 ppm. Complete analytical data and results are given in Keith and others (1980).

GEOCHEMICAL ANOMALIES

The purpose of the map is to show geochemical anomalies and their distribution. The Mount Hood Wilderness is a small area, and the geochemical sampling population is too small to give a meaningful statistical analysis of the element data; therefore, those element concentrations that were separated from the general values of the sample population by a wide margin were considered anomalous. Sample sites containing elements that have anomalous concentrations are indicated on the map; the drainage areas containing anomalous concentrations of elements are outlined by the surrounding ridge tops. Several small streams may be included within an outlined drainage area when the anomalous element concentrations are similar. Geochemical anomalies can thus be identified and their significance evaluated. Some areas are not drainages but outcrops of interest, specifically the altered intrusive bodies at Laurel Hill and Iron Creek, and the fumarolically altered summit area of Mount Hood volcano (areas H, I, J on map).

Several general geochemical associations were observed. Except for Hg and B concentrations at the Mount Hood volcano vent area, there are no anomalous concentrations of elements in the rocks of Mount Hood volcano; however, they contain an overall greater concentration of Mn and Y relative to the older surrounding volcanic rocks (Keith and others, 1980). Panned-concentrate samples are enriched an order of magnitude or more in Zr, Y, Sc, Cr, and Ni relative to stream-sediment samples (Keith and others, 1980). Cu and La values are variable but definitely enriched in the panned-concentrate samples. These elements are commonly contained in minerals such as olivine, orthopyroxene, clinopyroxene, apatite, and magnetite which are abundant in the andesitic and dacitic rocks, and make up the major portion of the panned-concentrate samples.

Drainage area A contains anomalous concentrations of Ni and Cr (table 1). Drainages through the pre-Mount Hood volcano rocks on the west and southwest sides of Zigzag Mountain and on the east side of the Wilderness along Bluegrass Ridge have above-background, but not anomalous, amounts of Ni and Cr as well as Co, Sc, and Y (Keith and others, 1980). The Ni and Cr must be disseminated in the mafic components that make up the volcaniclastic deposits and andesitic lava flows of the pre-Mount Hood volcanic rocks.

Drainage area B contains anomalous concentrations of Ag, As, Cd, Mo, Pb, Zn, Cu, Ba, and W (table 1). Silver and As show up consistently in the altered rock samples related to the fault systems, and Ag is present as well in the stream-sediment and panned-concentrate samples. In addition, concentrations of Mo, Cu, W, and Cd are anomalous in small drainages within area B. Barium anomalies are probably related to hydrothermal veins containing barite, although no barite has been identified in outcropping veins. Veins along the northwest-trending faults in the drainage area are filled mainly with quartz, epidote, pyrite, and iron oxides and hydroxides. The most conspicuous and extensive vein system occurs along Lost Creek, the easternmost major creek in drainage area B. Minor amounts of calcite, dolomite, gypsum, adularia, smectite, mixed-layer smectite-illite, illite, galena, sphalerite, chalcopyrite, and cerussite were identified from vein samples in the Lost Creek area (Beeson and others, 1980). Quartz, epidote, chlorite, and pyrite are disseminated in late Miocene volcanic rocks in the Lost Creek-Burnt Lake area of drainage B.

Drainage area C has an anomalous concentration of Sn in the stream-sediment sample (table 1). Because there are no other associated elemental anomalies, area C cannot be confidently combined with area B which has a distinct geochemical signature. Drainage area C is covered by glacial moraine(?) and unconsolidated Mount Hood andesitic and dacitic block and ash-flow deposits.

Drainage area D (Muddy Fork) has a high concentration of Ba that may reflect hydrothermal activity associated with Sandy Glacier volcano. The samples are from the drainage basin that includes both the central part of the erosionally dissected volcano and the west flank of Mount Hood volcano presently being eroded by Sandy Glacier. Hydrothermally altered vent breccia from the summit area of Mount Hood volcano breaks off and tumbles into this drainage area; much is incorporated in the small morainal deposits of Sandy Glacier. In other material derived from the Mount Hood summit area, the Ba concentrations are not anomalous. Therefore, the anomaly in drainage area D must be associated with hydrothermal activity of Sandy Glacier volcano rather than with Mount Hood volcano.

An isolated anomalous concentration of Mo in the panned concentrate occurs in drainage area E (McGee Creek), which drains part of Mount Hood volcano. The geologic source of this anomaly is unknown.

Drainage area F (Ladd Creek) contains an isolated Sn anomaly in one stream-sediment sample. The area drained consists mostly of Mount Hood lavas and a small area of basaltic tuff breccia that is probably part of the Pleistocene Sandy Glacier volcano.

Drainage area G (Lady Creek) drains the south-central part of Zigzag Mountain. In the upper part of the creek, concentrations of Pb, Sn, and B are anomalous; in the lower part of the creek, concentrations of Zn, Pb, Mo, and Ag are anomalous (table 1). The rocks of this area may be related to (1) the Lost Creek faulted area, drainage area B, and (2) the quartz diorite pluton of Laurel Hill that outcrops to the south (area H).

A sample of altered rock from the western contact zone of the quartz diorite of Laurel Hill, area H, contains anomalous concentrations of Au, Ag, As, Cu, Pb, and Zn (table 1). Zeolites, calcite, epidote, and hematite are abundant in veins in the propylitically altered rocks. Sulfides are locally disseminated in the rocks. X-ray amorphous Fe hydroxides are associated with blue-green Cu silicate in the veins.

The Iron Creek area, I, is probably the top of another small diorite pluton as indicated by randomly oriented dikes that have cut and propylitically altered a late Miocene andesite lava flow. Sulfides, mostly pyrite, are disseminated in the altered andesite. Anomalous values of Ag and Cu were obtained from an altered sulfide-bearing rock sample (table 1).

Area J includes the summit of Mount Hood volcano, which has been, and is being, extensively altered by fumarolic activity in the vent area. Anomalous values of Hg and B were obtained from altered rock samples. Secondary minerals are native sulfur, iron oxide, and opal-cristobalite. The Hg and B are localized deposits from volcanic exhalations. Material from the summit of Mount Hood volcano is largely easily erodible vent breccia. Deposits including this material have been recognized in glacial moraine and rock-fall debris at lower elevations around all sides of the volcano.

Drainage area L (Little Zigzag Canyon) contains an anomalous concentration of Zn in the stream-sediment sample and apparently drains only rocks of Mount Hood volcano; however, there are no other anomalous concentrations of Zn elsewhere around the volcano. The lower part of the drainage is near a quartz diorite pluton that lies at shallow depth below Mount Hood volcanic rock at the town of Government Camp.

Uranium was found in stream-sediment samples from drainage areas K, M, and N (table 1). No other anomalous concentrations of elements were found in these drainages. Although the volcanic rocks of Mount Hood have not been specifically analyzed for U, andesites and dacites of Mount Mazama, a volcano of the Cascade Range in southern Oregon, have been found to contain 1 to 3 ppm U (Noble and others, 1980). The most probable source of the U in the stream sediments at Mount Hood is the unaltered fragments of dacites and andesites of the Mount Hood volcano.

Table 1. Anomalous concentrations of elements, in parts per million, Mount Hood Wilderness, Clackamas and Hood River Counties, Oregon
[c, panned concentrate; s, stream sediment; r, altered rock; --, not anomalous] See map for area location.

Element	Limit of detection (ppm)	Sample type	Drainage area A	Drainage area B	Drainage area C	Drainage area D	Drainage area E	Drainage area F	Drainage area G	Area H	Area I	Area J	Drainage area K	Drainage area L	Drainage area M	Drainage area N
Cr	10	c	5,000	--	--	--	--	--	--	--	--	--	--	--	--	--
		s	500	--	--	--	--	--	--	--	--	--	--	--	--	--
Ni	5	s	300	--	--	--	--	--	--	--	--	--	--	--	--	--
		c	100	--	--	--	--	--	--	--	--	--	--	--	--	--
Ag	.5	c	--	1-30	--	--	--	--	1	--	--	--	--	--	--	--
		s	--	0.3-1	--	--	--	--	--	--	--	--	--	--	--	--
		r	--	0.3-15	--	--	--	--	--	200	1.5	--	--	--	--	--
As	200	c	--	500	--	--	--	--	--	--	--	--	--	--	--	--
		r	--	700	--	--	--	--	--	500	--	--	--	--	--	--
B	10	c	--	30	--	--	--	--	500	--	--	--	--	--	--	--
		r	--	--	--	--	--	--	--	20	--	15-20	--	--	--	--
Ba	20	c	--	5,000->10,000	--	>10,000	--	--	--	--	--	--	--	--	--	--
Be	1	c	--	3	--	--	--	--	--	--	--	--	--	--	--	--
Cd	20	c	--	20-100	--	--	--	--	--	--	--	--	--	--	--	--
		r	--	200	--	--	--	--	--	--	--	--	--	--	--	--
Cu	5	c	--	5,000	--	--	--	--	--	--	--	--	--	--	--	--
		r	--	5,000	--	--	--	--	--	16,980	170	--	--	--	--	--
Mo	5	c	--	15-50	--	--	30	--	15	--	--	--	--	--	--	--
		s	--	5	--	--	--	--	--	--	--	--	--	--	--	--
		r	--	50	--	--	--	--	--	--	--	--	--	--	--	--
Pb	10	c	--	100-2,000	--	--	--	--	50-1,000	--	--	--	--	--	--	--
		s	--	100	--	--	--	--	--	--	--	--	--	--	--	--
		r	--	7,000	--	--	--	--	--	500	--	--	--	--	--	--
W	50	c	--	100	--	--	--	--	--	--	--	--	--	--	--	--
Zn	200	c	--	1,000-15,000	--	--	--	--	--	--	--	--	--	--	--	--
		r	--	>10,000	--	--	--	--	2,000	1,000	--	--	--	--	--	--
		s	--	200	--	--	--	--	300	--	--	--	--	500	--	--
Sn	10	c	--	--	--	--	--	--	30	--	--	--	--	--	--	--
		s	--	--	10	--	--	20	--	--	--	--	--	--	--	--
		r	--	--	--	--	--	--	--	50	--	--	--	--	--	--
Sr	100	r	--	--	--	--	--	--	--	1,000	--	--	--	--	--	--
Au	.05	r	--	--	--	--	--	--	--	.1	--	--	--	--	--	--
U	1	s	--	--	--	--	--	--	--	--	--	--	3	--	2	1
Hg	.02	r	--	--	--	--	--	--	--	--	--	.04-.55	--	--	--	--

REFERENCES

Beeson, M. H., Keith, T. E. C., and Bargar, K. E., 1980, Secondary mineralization in the Mt. Hood area, Oregon [abs.]: Geological Society of America Abstracts with Programs, v. 12, no. 3, p. 96.
Grimes, D. J., and Marranzino, A. P., 1968, Direct-current arc and alternating-current spark emission spectrographic field methods for the semiquantitative analysis of geologic materials: U.S. Geological Survey Circular 591, 6 p.
Keith, T. E. C., Beeson, M. H., and Bargar, K. E., 1982, Geologic map of the Mount Hood Wilderness, Clackamas and Hood River Counties, Oregon: U.S. Geological Survey Miscellaneous Field Studies Map MF-1379-A, scale 1:62,500.
Keith, T. E. C., Beeson, M. H., Bargar, K. E., and Marsh, S. P., 1980, Geochemical data for rock, stream sediment, and panned concentrate samples, Mount Hood Wilderness area, Oregon: U.S. Geological Survey Open-File Report 80-839, 37 p.
Noble, D. C., Rose, W. I., Jr., and Zielinski, R. A., 1980, Uranium contents of glassy and devitrified andesites and dacites, Mount Mazama, Oregon: Economic Geology, v. 75, p. 127-129.
Vaughn, W. W., 1967, A simple mercury vapor detector for geochemical prospecting: U.S. Geological Survey Circular 540, 8 p.
Ward, F. N., Lakin, H. W., Canney, F. C., and others, 1963, Analytical methods used in geochemical exploration by the U.S. Geological Survey: U.S. Geological Survey Bulletin 1152, 100 p.
Ward, F. N., Nakagawa, H. M., Harms, T. F., and VanSickle, G. H., 1969, Atomic-absorption methods of analysis useful in geochemical exploration: U.S. Geological Survey Bulletin 1289, 45 p.
Welsch, E. P., and Chao, T. T., 1975, Determination of trace amounts of antimony in geological materials by atomic absorption spectrometry: Analytica Chimica Acta, v. 76, p. 65-69.

Interior—Geological Survey, Reston, Va.—1982
For sale by Branch of Distribution, U.S. Geological Survey, Box 25286, Federal Center, Denver, CO 80225