# MINERAL RESOURCE POTENTIAL OF THE GEARHART MOUNTAIN WILDERNESS AND ROADLESS AREA (6225), LAKE AND KLAMATH COUNTIES, OREGON

## SUMMARY REPORT

By George W. Walker[1] and James Ridenour[2]

## 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 U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitve 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 Congress. This report discusses the results of a mineral survey of the Gearhart Mountain Wilderness and adjacent Roadless Area (6225), Fremont National Forest, Lake and Klamath Counties, Oregon. The Wilderness was established by Public Law 88-577, September 3, 1964 and the Roadless Area was classified as Proposed Wilderness during the second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

## SUMMARY

The Gearhart Mountain Wilderness, Lake and Klamath Counties, Oreg., is devoid of mines and mineral prospects and there are no known mining claims within the area. Furthermore, the results of this mineral appraisal indicate that there is little likelihood that commercial deposits of metallic minerals will be found in the area. Commercial uranium deposits, like those at the White King and Lucky Lass mines about 16 mi (≈25 km) to the southeast of the wilderness, and deposits of mercury, like those near Quartz Mountain about 10 mi (≈16 km) south-southeast of the wilderness, are not likely to be found within the wilderness, even though all of these areas are characterized by middle and late Cenozoic intrusive and extrusive volcanic rocks. Rock of low commercial value for construction purposes is present, but better and more accessible deposits are present in adjacent regions.

There is no evidence to indicate that mineral fuels are present in the area.

Higher than normal heat flow characterizes the region containing Gearhart Mountain, indicating that it may have some, as yet undefined, potential for the development of geothermal energy. Data are not available to determine whether this higher than normal heat flow is meaningful in terms of a potential energy source or as a guide to possible future exploration; lack of thermal springs or other evidence of localized geothermal anomalies within the Gearhart Mountain suggest, however, that the potential for the development of geothermal energy is probably low.

## INTRODUCTION

This report describes briefly the geology and mineral resource potential of the Gearhart Mountain Wilderness and some immediately adjacent lands. The area incorporates a remote and undeveloped, partly forested, andesitic volcano within the Fremont National Forest, south-central Oregon.

The U.S. Geological Survey was responsible for geologic mapping of the area and for geochemical investigations and the U.S. Bureau of Mines for determining the mineral potential of any existing mines, prospects, or mineralized areas.

A reconnaissance geologic map was made of the area, and stream-sediment and bedrock samples were collected for both thin-section and X-ray diffraction studies and for chemical analysis. Additional geologic mapping and sampling of rock units was done in areas marginal to the wilderness, including two small areas designated as RARE II area 6225, in order to make more meaningful inferences regarding the mineral resource potential.

Prior to the present study, the geology of the Gearhart Mountain Wilderness was mapped partly in broad reconnaissance by Walker (1963) as part of a regional study of the eastern half of the Klamath Falls, 2-degree quadrangle. Subsequently, some additional reconnaissance was completed by Peterson and McIntyre (1970) in preparing an evaluation of the regional geology and mineral resources of eastern Klamath and western Lake Counties, Oreg. Neither of these studies does more than indicate that the Gearhart Mountain Wilderness is confined mostly to a large andesitic volcano of late Cenozoic age.

### Location and geography

The Gearhart Mountain Wilderness is in the south-central part of the Fremont National Forest, the major part in western Lake County and a smaller part in eastern Klamath County, Oreg. (fig. 1). It is about 40 mi (≈65 km) northwest of Lakeview, Oreg., the county seat of Lake County, and consists of about 19,000 acres (7,690 ha) essentially all on Gearhart Mountain (elev 8,364 ft). Inclusion of the RARE II lands immediately adjacent to the wilderness comprises a total area of 22,823 acres (9,236 ha). The lower timbered slopes of Gearhart Mountain on the south and west are outside the boundary of the wilderness area.

Several major stream drainages, including Sprague River and Dairy Creek, a main tributary of Chewaucan River, originate in springs on the slopes of Gearhart Mountain.

Access to the area is principally by partly oiled and graded gravel roads and ungraded poor-quality dirt roads from State Highway 140, either from Bly or Quartz Mountain, Oreg. The area is somewhat less accessible via U.S. Forest Service roads from State Highway 31, about 22 mi (airline) to the northeast. Most of the roads bordering the wilderness are

---

[1]U.S. Geological Survey
[2]U.S. Bureau of Mines

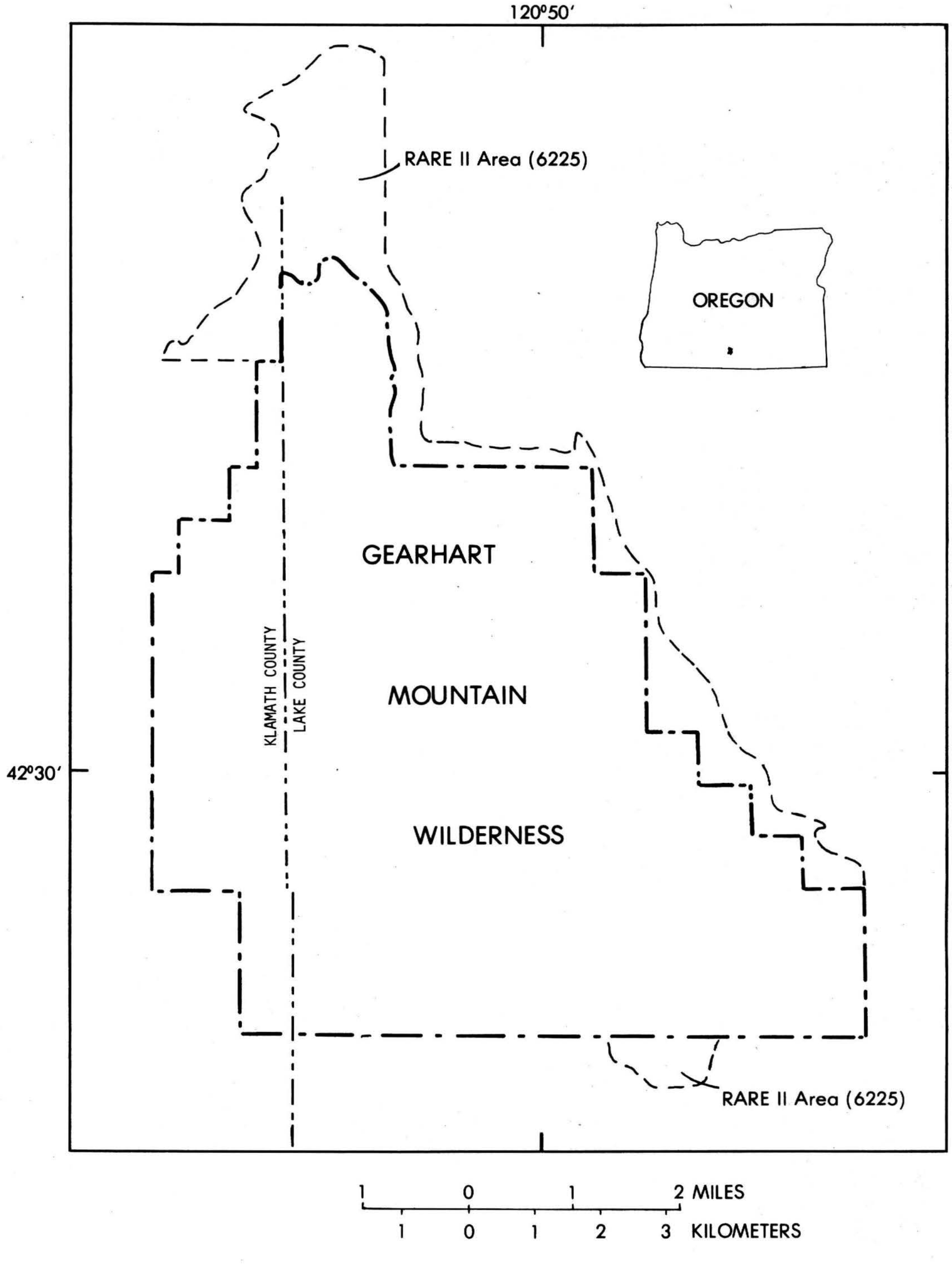


Figure 1.--Index map showing location of Gearhart Mountain Wilderness, Roadless Area (6225).

similarities in age and lithology to those in the Gearhart Mountain Wilderness; however, there are important differences. All of the rocks in the region are Cenozoic in age and relate directly or indirectly to volcanic activity. Most of the mineralization is associated with areas that contain silicic intrusions, whereas the Gearhart Mountain Wilderness contains no highly silicic intrusions, although andesitic and basaltic intrusions are common. Evidence of hydrothermal alteration, including bleaching and the development of clays and secondary silica minerals, is present in the bedrock in all of the mineralized areas, whereas no such bleaching or alteration was found in the Gearhart Mountain area. Furthermore, samples of bedrock, and stream-sediment samples from areas downstream from major outcrops of the andesites and basalts that characterize the wilderness were analyzed and show no anomalous amounts of any of the metals present in the adjoining mineralized areas. Also, reconnaissance radiometric surveys of major rock units in the wilderness show no abnormal concentration of radioactive minerals.

Volcanic rock suitable for some construction purposes is present in parts of the Gearhart Mountain Wilderness, but better quality material is abundant elsewhere and is more readily accessible.

### Energy resource potential

As far as can be determined from surface geologic features, there is no evidence that the Gearhart Mountain area contains deposits of mineral fuels or a potential for the development of geothermal energy. There are no thermal springs within the area, although it lies in a region characterized by slightly higher than normal heat flow[3] (Riccio, 1978). Numerous thermal springs and wells are present in adjoining areas.

The normal geothermal gradient worldwide is approximately 30°C per kilometer of depth. According to Riccio (1978), the gradient in and near the Gearhart Mountain area is above this norm, apparently on the order of 60° to 80°C per kilometer, and even higher gradients occur a few tens of kilometers to the west at Klamath Falls and to the east near Lakeview.

[3]Heat flow is the product of the geothermal gradient measured in a drill hole and thermal conductivity measured on rock samples taken from the drill hole.

## CONCLUSIONS

No metallic deposits of commercial value were recognized in the Gearhart Mountain Wilderness during the present investigation. Evaluation of the geology and of analyses of samples indicates that the area is devoid of mineral fuels and, although the heat flow apparently is slightly above normal, there is no evidence of a potential for the development of geothermal energy.

## REFERENCES CITED


Cohenour, R. E., 1960, Geology and uranium ccurrences near Lakeview, Oregon: U.S. Atomic Energy Commission RME-2070, 33 p.

Peterson, N. V., 1958, Oregon's uranium picture: The Ore Bin, v. 20, no. 12, p. 111-118.

Peterson, N. V., and McIntyre, J. R., 1970, The reconnaissance geology and mineral resources of eastern Klamath County and Western Lake County, Oregon: Oregon Department of Geology and Mineral Industries, Bulletin 66, 70 p.

Powers, H. A., and Wilcox, R. E., 1964, Volcanic ash from Mount Mazama (Crater Lake) and from Glacier Peak: Science, v. 144, no. 3624, p. 1334-1336.

Riccio, J. F., 1978, Preliminary geothermal resource map of Oregon: Oregon Department of Geology and Mineral Industries, Geologic Map Series Map GMS-11, scale 1:500,000.

Walker, G. W., 1963, Reconnaissance geologic map of the eastern half of the Klamath Falls (AMS) quadrangle, Lake and Klamath Counties, Oregon: U.S. Geological Survey Field Studies Map MF-260, scale 1:250,000.

——— 1980, Preliminary report on the geology of the Lakeview uranium area, Lake County, Oregon: U.S. Geological Survey Open-File Report 80-532, 33 p.

Williams, Howel, 1942, The geology of Crater Lake National Park, Oregon, with a reconnaissance of the Cascade Range southward to Mount Shasta: Carnegie Institute of Washington Publication 54, 162 p.




☆U.S. GOVERNMENT PRINTING OFFICE: 1982-361-614/17

maintained for forest maintenance, log haulage, and recreation.

## Geology

All the rocks in and near the Gearhart Mountain Wilderness are of Cenozoic age and consist principally of andesite and basalt in the form of flows and flow breccias, agglomerate, small intrusions, vent breccias, and some tuffs. These are locally and discontinuously overlain by glacial and glacio-fluvial deposits, alluvium, and air-fall pumice.

Gearhart Mountain is a large volcanic edifice about 12 mi (≈20 km) in diameter and 3,000 ft (≈1,000 m) high of late Miocene or Pliocene age. The edifice is built on a basement apparently locally consisting of olivine and pyroxene basalt flows of middle to late Miocene age. The exact geologic age of the volcanic pile that comprises Gearhart Mountain is not known but it is lapped on the north by basalt flows that appear to correlate with flows that cap several rims in the region; these flows have been dated by potassium argon methods at about 6 to 8 m.y. Deep glaciation and stream erosion, as well as local alteration and deep weathering of some of the rocks on Gearhart Mountain, also support a Pliocene or older age. Rocks of this large volcanic edifice consist of extensive flows and flow breccias, agglomerate, numerous dikes and small intrusive bodies, and andesitic or basaltic tuff. Many of the andesitic rocks are strongly flow banded and jointed. Banding and jointing generally slope outward from the central and highest part of the mountain. Much of the banding and jointing is so contorted along flow margins and as a result of local ramping that many strikes and dips obscure this general outward inclination of flow units.

Compositionally, these rocks range from olivine basalt or basaltic andesite with $SiO_2$ contents of about 52.5 percent to highly porphyritic, olivine- and hypersthene-bearing flows and intrusions with $SiO_2$ contents of about 61 percent. Depending on which rock classification is used, the most silicic rocks recognized on Gearhart Mountain probably would be identified as silicic hypersthene andesite, mafic hypersthene dacite, or possibly hypersthene tonalite porphyry. Rocks of this type are somewhat anomalous to the Gearhart Mountain region, and they, therefore, probably represent an eastern outlier of Cascade Range petrographic affinities.

Upper slopes of Gearhart Mountain are deeply scarred by glacial cirques and several major drainages on the north and east side of the mountain follow extensive glaciated, U-shaped canyons. Glacial moraines are present in and adjacent to cirques and canyons and Blue Lake, in the northern part of the wilderness, appears to be partly confined by an end (or terminal) moraine. Several eroded end moraines in the canyons of Dairy and Cougar Creeks have been breached by subsequent stream action. The glacial deposits consist of poorly sorted blocks of andesite or basalt in a matrix of rock flour. Glacio-fluvial deposits, in which there has been some small amount of sorting and the development of crude bedding, are present in all canyons at lower elevations on Gearhart Mountain. In places small outcrops of the underlying andesitic rocks project through the glacial and glacio-fluvial deposits. Alluvium, in the form of sand, silt, gravel, and boulders is present along lower segments of all of the creeks originating on the mountain. Because the alluvium was difficult or impossible to distinguish from glacio-fluvial deposits, talus, and, in most places, erosionally modified moraines, it was not mapped separately.

Discontinuously present in the area, particularly on the north and east sides of Gearhart Mountain, is a veneer of moderately well-sorted pumice sand, mostly less than 4 feet thick, but locally drifted into piles 10 or more feet thick. Isolated outcrops of underlying andesitic bedrock project through the veneer in places, but where it rests on the poorly sorted glacio-fluvial deposits, as for example south and southwest of Blue Lake, it obscures all but the largest erosional blocks of andesite. Uniformity of particle size 0.05 in (≈1 mm diameter) of the pumice sand suggests that it is an air-fall deposit. It most likely is Mazama ash (Williams, 1942; Powers and Wilcox, 1964) related to the climactic eruptions about 6,500 to 6,700 years ago of Mount Mazama, now occupied by Crater Lake, and transported to the Gearhart Mountain area by high altitude winds. Much of it is in areas of dense vegetation so that its precise distribution is not known. Thicker and more continuous patches have been shown by stipple pattern on a geologic map of the wilderness area.

## MINERAL RESOURCES

The Gearhart Mountain Wilderness is in a region of low mineral potential for both metallic and non-metallic mineral resources. There is no past record of either mining or quarrying in the area nor were any metallic mineral occurrences or prospect pits recognized during the present investigation. There are no known lode or placer claims. Analysis of stream-sediment and rock samples collected from areas in and immediately adjacent to the Wilderness also indicate a low level of metal concentration. Panned concentrates from the area are composed almost entirely of common rock-forming minerals, principally olivine, pyroxene, hornblende, hypersthene, and magnetite. Some reddish and dark-reddish-gray grains in the panned concentrates are probably either hematite or martite. One stream sediment-sample collected on Brownsworth Creek (next stream east of Leonard Creek) on the south side of Gearhart Mountain was reported by Peterson and McIntyre (1970) to contain an anomalous amount (250 ppm) of zinc. This value does not appear to be particularly anomalous as most stream-sediment samples in and near the wilderness contain between 200 and 500 ppm of zinc. Furthermore, the limit of sensitivity for Zn by semiquantitative spectrographic analytical methods for stream sediments is on the order of 200 ppm and for panned concentrates 500 ppm.

Although no prospects or mineralized or hydrothermally altered ground were recognized, the bedrock of the Gearhart Mountain area is somewhat similar to that found in nearby areas characterized by small deposits of mercury, base and precious metals, and uranium. A small amount of mercury production is recorded for deposits near Quartz Mountain, 10 mi (≈16 km) south-southeast of Gearhart Mountain. Most of the production was from opalized silicic volcanic and volcaniclastic rocks at the Angel Peak mine between 1956 and 1959; apparently all properties in the district have been idle during the past several decades. In the Paisley Hills, 17 mi (≈27 km) to the northeast of Gearhart Mountain, small amounts of lead, zinc, and copper with some associated gold and silver have been explored on a small scale. Underground workings include several shafts and tunnels, but apparently there are no records of any production (Peterson and McIntyre, 1970, p. 51). Mineralization in these occurrences is associated with small stock and dikelike bodies of diorite and quartz monzonite that intrude Oligocene? volcanic and volcaniclastic rocks. The White King and Lucky Lass mines, which have yielded several hundred metric tons of uranium, are located about 16 mi (≈25 km) southeast of the Gearhart Mountain Wilderness area. Uranium minerals, locally associated with arsenic, molybdenum, and minor mercury minerals, occur in partly altered rhyolite domes and in the hydrothermally altered wallrocks that they intrude (Cohenour, 1960; Peterson, 1958, Walker, 1980). The wallrocks consist mostly of Oligocene or Miocene tuffs, tuffaceous sediments, and mudflow deposits.

Bedrock in these mineralized areas show some