UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

# MINERAL RESOURCE POTENTIAL OF THE DESCHUTES CANYON ROADLESS AREA, JEFFERSON AND DESCHUTES COUNTIES, OREGON

By
George W. Walker
U.S. Geological Survey
and
Richard A. Winters
U.S. Bureau of Mines

Open-File Report
83-375

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By George W. Walker[1]
and
Richard A. Winters[2]

## STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577), September 3, 1964) and related acts, the U.S. Geological Survey and the U.S. 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 Deschutes Canyon Roadless Area (6321), Crooked River National Grassland, Jefferson and Deschutes Counties, Oregon. The area was classified as a further planning area during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

## SUMMARY

The Deschutes Canyon Roadless Area, southern Jefferson County and northern Deschutes County, Oreg., is devoid of mines and active mineral prospects or claims. The two prospects recognized in the area contain no identifiable potential for mineral resources. Furthermore, the results of this mineral appraisal indicate little likelihood that deposits of metallic or nonmetallic minerals are present; natural materials for construction purposes are present, but better and more accessible deposits are available elsewhere and are closer to the markets.

There is no evidence to indicate that mineral fuels are present in the area. Nearby parts of central Jefferson County on the Warm Springs Indian Reservation are characterized by higher than normal heat flow and by numerous thermal springs, some of which have been partly developed. This may indicate that the region has some as yet undefined potential for the development of geothermal energy. Available data indicate that this higher than normal heat flow extends from the Warm Springs area into the Deschutes Canyon area; lack of thermal springs or other evidence of localized geothermal anomalies within the area, however, suggests that it probably has a low potential for geothermal energy.

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

## INTRODUCTION

This report describes briefly the geology and mineral resource potential of the Deschutes Canyon Roadless Area. The area incorporates a largely undeveloped section of the canyon of the Deschutes River and smaller tributary canyons of creeks that drain eastward from the Cascade Range and Green Ridge, 15 to 20 miles to the west.

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 were done in areas contiguous to the roadless area in order to better understand the distribution of rock units and their lithologic variations so as to make more meaningful inferences regarding the mineral resource potential. Mines and prospects in and near the area were examined and sampled.

A review of County records indicates that from 1906 to 1975 a total of 707 placer claims were filed, virtually covering the study area and vicinity; all but 6 were filed prior to 1947. Only 63 mention "gold and other valuable minerals."

Prior to the present study, the geology of the Deschutes Canyon Roadless Area was partly mapped in reconnaissance by Hodge (1932, 1941), Williams (1957), and Waters (1968) as part of regional studies of the Bend and Madras quadrangles. Stensland (1970) prepared a geologic map and report of an area in the northern part of the Bend quadrangle and subsequently has extended his mapping into adjacent areas. Lithologic units shown on these different geologic maps are readily equated with units shown on the geologic map prepared for this study (Walker, 1981), although some terms and age assignments have been modified and a few additional rock units delineated. Armstrong and others (1975) obtained potassium-argon ages on a few of the volcanic units in and near the Deschutes Canyon Roadless Area. Drysmid (1954), Wagner (1969a), and Peterson and others (1976) described the formerly productive, but now inactive, deposits of diatomite located about 2 mi south of the southeast corner of the area.

### Location and geography

The Deschutes Canyon Roadless Area, located in central Oregon (fig. 1), includes part of the Crooked River National Grassland, under the jurisdiction of the Ochoco National Forest, which is headquartered in Prineville, Oreg., 25 mi southeast of the area, some lands under jurisdiction of the U.S. Bureau of Land Management, and several blocks of privately owned land. It is an irregular-shaped area of about 29 $mi^2$ that is characterized by flat to gently sloping upland surfaces between steep canyon walls along the north- to northeast-trending major drainages. The most prominent upland surface (The Peninsula), is a large flat-topped ridge or plateau between the Deschutes River on the west and the precipitous Crooked River canyon on the east. Arms of Lake Billy Chinook extend southward from the confluence of Deschutes and Crooked Rivers along both sides of The Peninsula. The study area is bounded on the south by county roads or privately owned land. It is bounded on the west principally by county roads.

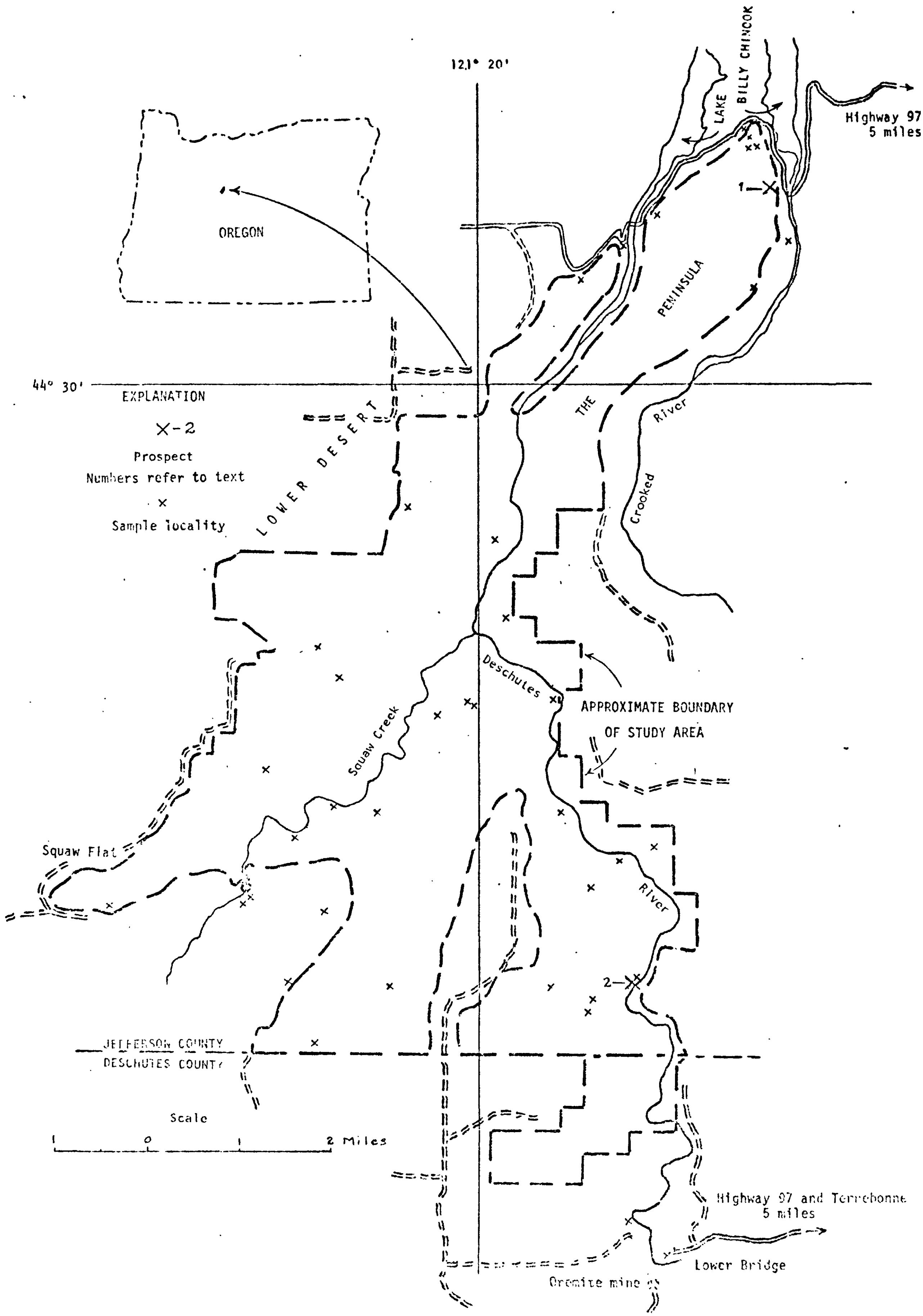


Figure 1.- Index map showing location of Deschutes Canyon Roadless Area (6321), Oregon, prospects, and sample localities.

Following completion of the geologic mapping and geochemical sampling, the U.S. Forest Service added approximately 930 acres (classified as further planning) to the roadless area that are contiguous on the south, in Deschutes County, and extend from the Deschutes River westward for about 1.5 mi.

A paved road, with several connections to U.S. Highway 97 south of Madras, Oreg., provides access to parks and campgrounds on the shores of Lake Billy Chinook, as well as to undeveloped areas to the west; it crosses both arms of the lake about at the latitude of the north end of The Peninsula and thus provides access to much of the north end of the study area. Southern parts of the study area are accessible by paved road from Terrebonne, Oreg., 6 mi to the southeast on U.S. Highway 97, and then by gravel and poor dirt roads to the margin of the area. Poor quality jeep roads lead through locked gates to several of the blocks of privately owned land.

## GEOLOGY

All of the rocks in and near the Deschutes Canyon Roadless Area are of Cenozoic age and consist of an older assemblage of porphyritic andesite flows and breccias and an overlapping sequence, representing part of the Madras Formation (Deschutes Formation of most authors), of volcanic, volcaniclastic, and sedimentary deposits. Erosion of the volcanic and clastic rocks along the major drainages produced precipitous canyons which localized younger basalt and andesite flows erupted from vents in areas adjoining the roadless area.

### Stratigraphy

The oldest rocks are exposed in the southeastern part of the study area (Walker, 1981) in a steep-sided pile composed largely of hypersthene-bearing porphyritic andesite flows and flow breccias. The flows, which are poorly exposed, are mostly unaltered and only slightly weathered; a few flows show slight alteration of the hypersthene and clinopyroxene to a greenish-brown clay mineral, probably nontronite. No evidence was found to indicate that there is a vent for these rocks within the study area.

The precise age of the porphyritic andesites is unknown, although Stensland (1970) considered them to be part of the Clarno Formation of late Eocene or Oligocene age, which is exposed extensively about 10 mi to the east (Robinson and Stensland, 1979). Because the porphyritic andesites exposed in the study area are less altered and weathered than most typical rocks of the Clarno Formation, it is possible they may be younger than the Clarno Formation. Rocks older than the Clarno Formation are exposed in the Hay Creek anticline about 20 mi east-northeast of the study area (Peck, 1964; Swanson, 1969) and consist of sedimentary and metasedimentary rocks, chiefly slate with less abundant graywacke and chert granule conglomerate, and meta-andesite of either Paleozoic or, more likely, Mesozoic age; if rocks of these types underlie the roadless area, they are buried by a considerable thickness of Cenozoic volcanic and clastic rocks.

In the study area, the porphyritic andesites unconformably underlie sedimentary, volcanic, and volcaniclastic rocks of the Madras Formation, of Miocene and early Pliocene age. The formation consists largely of poorly bedded to moderately well bedded, coarse- to fine-grained clastic sediments composed entirely of basaltic, andesitic, and rhyodacitic debris derived from volcanic terranes to the south and west. Interstratified in this sedimentary sequence are basalt and basaltic andesite flows, which commonly form prominent rims or ledges, and a number of partly bedded pumice-rich layers representing ash flows and mudflows (lahars); the lithologic, bedding, and textural features of some of these pumiceous layers suggest that they were initially rhyolitic to dacite ash flows that became mudflows after combining with water and, locally, unconsolidated sediments. In addition to their abundant pumice fragments and lapilli as much as 1 in. in size, most of these pumiceous layers contain some, and locally abundant, fragments, pebbles, and cobbles of basalt, andesite, and dacite or rhyolite. The pumice fragments are commonly hydrated and partly devitrified. Many of the different lithologic units within the formation are exposed discontinuously on canyon walls and appear to represent elongate, shoestring deposits in north- to northeast-trending paleodrainages.

Upper parts of the Madras Formation are exposed in the study area; here its total exposed thickness is about 670 ft. Lower parts of the formation are exposed in canyon walls of the Deschutes and Metolius Rivers, several miles to the north, where the formation rests on middle Miocene basalt flows of the Columbia River Basalt Group.

Armstrong and others (1975) obtained potassium-argon dates for several of the basalt flows interstratified in the Madras Formation. The oldest age is $15.9 \pm 3.0$ m.y. for an olivine basalt flow exposed north of Round Butte Dam, about 7 mi north of the study area, that is considered by them to be near the stratigraphic base of the formation. An age of $5.8 \pm 1.0$ m.y. was obtained for a basalt flow exposed both in roadcuts and the wall of Deschutes River canyon immediately west and southwest of the bridge across the southwest arm of Lake Billy Chinook on the northwest border of the study area. This flow is interstratified in some of the older parts of the formation exposed within the study area, although there are some undated rocks exposed beneath the flow. The rim basalt west of the bridge yielded an isotopic age of $4.9 \pm 0.5$ m.y., indicating that that part of the Madras Formation exposed within the study area apparently ranges in age from slightly less than 5 m.y. to perhaps as much as 6 or 7 m.y.

Subsequent to deposition of the Madras Formation, erosion by the Deschutes and Crooked Rivers and by tributary streams cut precipitous canyons in the gently northward dipping, largely homoclinal sequence. Intracanyon flows erupted from vents to the south, southwest, and east poured down these canyons at different stages in the erosion cycle. A few restricted flows, high on the canyon walls of Squaw Creek, are thought to be either Pliocene or early Pleistocene in age, but most of the intracanyon flows apparently are of middle to late Pleistocene age. Flows that poured down the canyon of Crooked River engulfed the area of its confluence with the Deschutes River and flowed back up the Deschutes River canyon for several miles. Most of these intracanyon flows are less than 30 ft thick, but locally they ponded, and near the confluence of Deschutes and Crooked Rivers, sections many tens of feet thick are present.

Poorly consolidated materials include chaotic mixtures of basalt rubble and sedimentary rocks in landslides at the north end of The Peninsula, along the shores of Lake Billy Chinook, and alluvium at Squaw Flat. A thin and discontinuous veneer of pumiceous sand, probably wind-reworked Mazama ash, covers parts of upland surfaces in the northwestern part of the study area, particularly in and adjacent to the Lower Desert.

## MINERAL DEPOSITS

There are no mining activities or active mining claims in the Deschutes Canyon Roadless Area, although 707 placer claims that cover much of the area were filed in the period from 1906 to 1975. All but six of the claims were filed prior to 1947, and only 63 mention "gold and other valuable minerals." The large majority of the claims is in 120- to 160-acre blocks, generally located by the same group of claimants. None of the claims were being worked in 1982.

The area contains two small prospects that have no identified potential for mineral resources. An unnamed prospect, at the north end of The Peninsula (fig. 1, No. 1), has a 10-ft-long adit which trends west in horizontal reddish-purple pebbly sandstone of the Miocene and early Pliocene Madras Formation. The sandstone is poorly consolidated and contains seams of pumice and ash 0.25 to 1.0 in. thick. A 6-ft vertical chip sample from the adit face contained no significant metal concentrations.

The Black Bear prospect, in the southeastern part of the area (fig. 1, No. 2), has an open-cut in horizontal reddish-gray fine-grained unconsolidated sandstone of the Madras Formation. The sandstone contains a purple pebble conglomerate bed over 100 ft thick and interbedded thin pumice layers. A volume of rock 70 ft high, 50 ft wide, and 6 ft thick was broken from the cliff face and remains as rubble. A random chip sample from the face and a sample of rubble contained no significant metal concentrations.

## MINERAL RESOURCE POTENTIAL

The Deschutes Canyon Roadless Area is in a region of low mineral potential for metallic mineral resources, but lies only about 2 mi north of the large diatomite deposits (Oremite mine, fig. 1) operated in the past by the Dicalite Division of Great Lakes Carbon Corporation. Also near Bend, Oreg., 18 to 22 mi to the south, pumice deposits have been mined extensively since about 1940 for light-weight aggregate and pozzolanic additive to hydraulic cement. There is no past record of either mining or quarrying within the study area, however, two prospect pits were recognized during the present investigation.

The nearest metallic mineral-producing deposits are the silver-bearing Oregon King mine (Libbey and Corcoran, 1962; Ojala, 1964), located about 31 mi northeast of the study area near Ashwood, and mercury deposits of both the Horse Heaven area, also many miles to the northeast, and the Ochoco district (Brooks, 1963), east of Prineville, Oreg. In both of these mineralized areas, altered and faulted rocks of the Clarno Formation, as well as some tuffs and sedimentary rocks of the John Day Formation, are intruded by partly contemporaneous plugs and dikes of andesite and rhyolite that locally altered and mineralized the country rock. Although the Clarno-like rocks in the southeast corner of the study area are partly similar lithologically to some of the host rocks exposed in these mineralized areas, they are neither as altered nor faulted, and, furthermore, intrusions appear to be lacking.

Diatomaceous deposits that produced good-quality filter-grade material, are located about 2 mi south of the southeast corner of the area near Lower Bridge on the Deschutes River. They were mined extensively during the 1930's and 1940's and operations continued until 1961 when filter-grade diatomite was mined out (Peterson and others, 1976, p. 47). Examination of the geology in and near the deposit indicates that the diatomite, which is locally as much as 38 ft thick, appears to be stratigraphically higher than any of the sedimentary rocks of the Madras Formation exposed in the study area; these diatomaceous beds may represent stratigraphically higher parts of the Madras Formation, as indicated by Peterson and others (1976), or they may be younger than the Madras Formation. Whatever their stratigraphic relations, they thin laterally from the area where they have been mined and do not extend to the boundary of the Deschutes Canyon Roadless Area. No other diatomaceous beds were found in the sedimentary section exposed in the study area, except for two thin and discontinuous beds at the Black Bear prospect.

Pumiceous ash-flow and mudflow deposits exposed on canyon walls of the Deschutes Canyon Roadless Area are superficially like some of the pumice beds that have been quarried since about 1940 near Bend and Tumalo, about 20 mi south of the area. The commercial lump pumice is characterized by thick beds of fresh, glassy pumice fragments and few, if any, impurities. Most of this pumice has been used as light-weight aggregate in the manufacture of concrete building blocks and some has been used in acoustic plaster and as a soil conditioner (Wagner, 1969b; Peterson and others, 1976); some apparently has been used as a pozzolanic additive to hydraulic cement. Like these commercial deposits, the pumiceous layers in the study area are composed dominantly of rather poorly sorted pumice fragments, mostly less than an inch in diameter, in discontinuous lenslike or shoestring-shaped beds; generally the beds in the study area are thinner and more highly indurated than those in the Bend and Tumalo areas. They differ significantly from the commercial deposits in that they are older, late Miocene versus early Pleistocene or possibly latest Pliocene, are thinner and less continuous, and they commonly contain a comparatively large amount of extraneous fragments of andesite, basalt, or rhyodacite. Also, the pumice fragments (or lumps) are commonly hydrated and partly devitrified rather than glassy, which changes the physical properties of the pumice and greatly reduces the commercial potential. The presence of abundant rock fragments and the hydration and devitrification of pumice fragments, as well as the inaccessibility of these discontinuous thin beds on steep canyon walls, restricts exploitation of the deposits in the study area, particularly in light of the very large quantity of better quality and more accessible deposits near Bend and Tumalo.

Some volcanic rock suitable for construction purposes is present in parts of the Deschutes Canyon Roadless Area, but better quality material is abundantly available elsewhere and is more readily accessible.

## ENERGY RESOURCE POTENTIAL

Insofar as can be determined from surface geologic features, there is no evidence that the Deschutes Canyon area contains deposits of mineral fuels or a potential for geothermal energy. There are no thermal springs within the area, although hot springs are present about 22 mi to the north on the Warm Springs Indian Reservation (Mariner and others, 1974; Robison and Laenen, 1976). There, the hot-spring waters (as much as 83.5°C) emerge directly from fractures in rhyolite or welded tuff of the John Day Formation near its contact with volcanic rocks of the underlying Clarno Formation. An apparent N. 75° W. alinement of the springs along Warm Springs River suggested to Norman MacLeod and Edward Sammel (written commun., 1973) that the thermal waters may be rising along a single fault near this contact. Although similar geologic conditions are not present in the study area, both areas occur in a region characterized by heat flow that is 2 to 3 times normal (Riccio, 1978). The geothermal resource potential or exploration significance, if any, of this higher than normal heat flow has yet to be determined.

## CONCLUSIONS

No metallic deposits with resource potential were recognized in the Deschutes Canyon Roadless Area during the present investigation, and evaluation of the geology and analyses of samples indicate that such deposits are not likely to be found. Although more than 700 claims, all placer, were located in and around the area between 1906 and 1975, workings at only two prospects were found in the Deschutes Canyon Roadless Area during field investigations. One prospect (Black Bear) contains discontinuous beds of diatomite less than 1.0 in. thick interbedded in clastic sedimentary rocks. The diatomite is too thin and discontinuous to be of resource interest. A rock sample from each prospect was analyzed, but no anomalous metal content was detected. Pumice and diatomite deposits that have been mined extensively in nearby areas do not extend into the study area nor does the surface geology indicate that similar deposits are likely to be found in the subsurface. Furthermore, surface manifestations indicate that the area is devoid of mineral fuels. Heat flow in the roadless area is above normal, but it is unlikely that this anomalous condition signifies a potential for geothermal energy.

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