Mineral Resources of the Mount Jefferson Primitive Area, Oregon

GEOLOGICAL SURVEY BULLETIN 1230-D

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By GEORGE W. WALKER *and* ROBERT C. GREENE, U.S. GEOLOGICAL SURVEY, *and*
ELDON C. PATTEE, U.S. BUREAU OF MINES

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 Mount Jefferson primitive area, Oregon. The area discussed in the report corresponds to the area under consideration for wilderness status. It is not identical with the Mount Jefferson Primitive Area as defined because modifications of the boundary have been proposed for the area to be considered for wilderness status. The area that was studied is referred to in this report as the Mount Jefferson primitive area.

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

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STUDIES RELATED TO WILDERNESS

MINERAL RESOURCES OF THE MOUNT JEFFERSON PRIMITIVE AREA, OREGON

By GEORGE W. WALKER and ROBERT C. GREENE, U.S. Geological Survey, and ELDON C. PATTEE, U.S. Bureau of Mines

SUMMARY

The Mount Jefferson primitive area is in the Cascade Range of Oregon, in Linn, Marion, and Jefferson Counties. It is part of an elongate north-trending volcanic plateau surmounted by several large steep-sided volcanoes that are extinct or possibly dormant. The rocks in the area are predominantly of volcanic origin and include (a) a series of flows, breccias, and sedimentary rocks that are correlative with the volcanic rocks of the Western Cascade Range and (b) a younger series of flows and pyroclastic deposits that range in composition from rhyolite(?) to basalt and belong to the volcanic rocks of the High Cascade Range. The extrusive rocks are all cut by dikes and plugs that formed the eruptive centers for many of the flows and pyroclastic deposits. Most of the rocks are little changed from their original attitudes, but one normal fault with more than 1,000 feet of displacement locally follows part of the east border of the area along Jefferson Creek. Other faults occur but have minor displacements.

Several areas, chiefly near extinct volcanic vents, are weakly mineralized with alunite and native sulfur, but neither is present in sufficient quantity to have commercial importance. Semiquantitative spectrographic analyses of samples collected from these mineralized areas and from panned concentrates of stream sediments indicate no concentrations of potentially valuable metallic minerals or metals.

Small scattered deposits of windblown pumice, probably derived from vents in the Broken Top and Three Sisters area or Crater Lake area south of the Mount Jefferson area, are neither large enough nor pure enough to sustain profitable exploitation in 1966 or in the foreseeable future. Cinders, in cones and as thin discontinuous layers, are widely distributed in the primitive area; they probably are suitable for use as road ballast or surfacing and possibly as lightweight aggregate, but because cinders are widely available in large quantity elsewhere in Oregon, the largely inaccessible deposits in the Mount Jefferson primitive area are not economically suitable for exploitation. No minerals have been produced from the primitive area, and no mineral commodities known to occur within the boundaries can be mined economically at present (1966).

Of the many springs in the area, some discharging large volumes of water, none had a temperature above that of normal ground water; hence, they have no potential for the production of thermal power.

GEOLOGY AND MINERAL RESOURCES

By George W. Walker and Robert C. Greene, U.S. Geological Survey

INTRODUCTION

LOCATION AND GEOGRAPHY

The Mount Jefferson primitive area extends about 25 miles along the crest of the central part of the Cascade Range. It is an irregular area approximately 3 to 4 miles wide near Mount Jefferson and more than 10 miles wide a few miles to the south. It contains slightly more than 150 square miles and occupies parts of Jefferson, Linn, and Marion Counties in the Willamette, Deschutes, and Mount Hood National Forests.

Within the primitive area, as elsewhere in central Oregon, the main crest of the Cascade Range rises to an average altitude of slightly more than 5,000 feet and consists of an elongate north-trending volcanic plateau surmounted by several large steep-sided and snow-covered volcanic cones that are chiefly andesitic in composition. The Mount Jefferson primitive area contains two such surmounting cones, Mount Jefferson (alt 10,497 ft) in the north part and Three Fingered Jack (alt 7,841 ft) in the south part. Many smaller volcanic cones are also present within the area; some are highly modified by erosion, but other younger cones, such as Forked Butte, South Cinder Peak, and Red Butte, retain much of their original constructional form.

The lower slopes of the area are mantled with talus and deposits of pumice and glacial debris on which dense conifer forests are growing. These slopes are dissected by stream valleys, which are V-shaped below altitudes of 2,500 to 3,000 feet and U-shaped above as a result of glacial erosion. The heads of the U-shaped valleys terminate in bare rocky and bouldery cirque basins, many of which are filled with small lakes, some partly confined by glacial moraines. A few cirques high on Mount Jefferson and Three Fingered Jack still contain small remnant glaciers.

Several roads provide access to the primitive area. U.S. Highway 20 extends along the southern border of the area and State Highway 22 parallels the west side. Good U.S. Forest Service roads extend from the highways to the west, north, and east boundaries of the primitive area. Some of the roads are impassable during periods of deep snow. The nearest rail shipping points are at Gates, 36 miles west of the area, and at Redmond, 34 miles east of the area.

PRESENT STUDIES

The Mount Jefferson primitive area (fig. 1) was examined by the U.S. Geological Survey during July and August 1965. Reconnaissance geologic traverses were made on all improved trails, along most stream drainages, and along many ridge crests (fig. 2). Examination of the more rugged and inaccessible parts of the area was made by helicopter, which was also used for low-level overflights of areas between traverse routes.

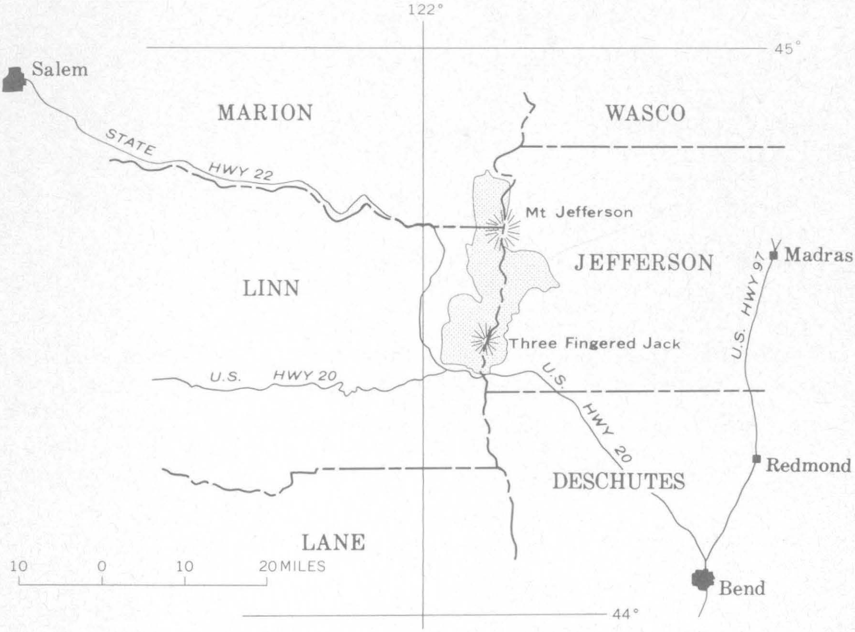

FIGURE 1.—Location of Mount Jefferson primitive area, Oregon.

For evaluation of present and potential mineral resources, a reconnaissance geologic map, at a scale of 1:62,500, was prepared (pl. 1), and many rock and alluvium samples were collected for laboratory study and determination of mineral and metal content. Recent sediments in all the major stream channels were panned (with a standard gold-prospecting pan) to determine whether any valuable heavy metallic minerals were present. Also, because the area is characterized by recent volcanic activity, springs were checked to determine whether any had sufficiently high temperature to suggest a potential value for the production of thermal power.

The distribution and quantity of natural construction materials—notably pumice, cinders, and building stone—were also determined during the field mapping; however, these materials are readily available in more accessible deposits outside the primitive area, and as they are low in value, no laboratory tests were made to establish their physical and chemical properties.

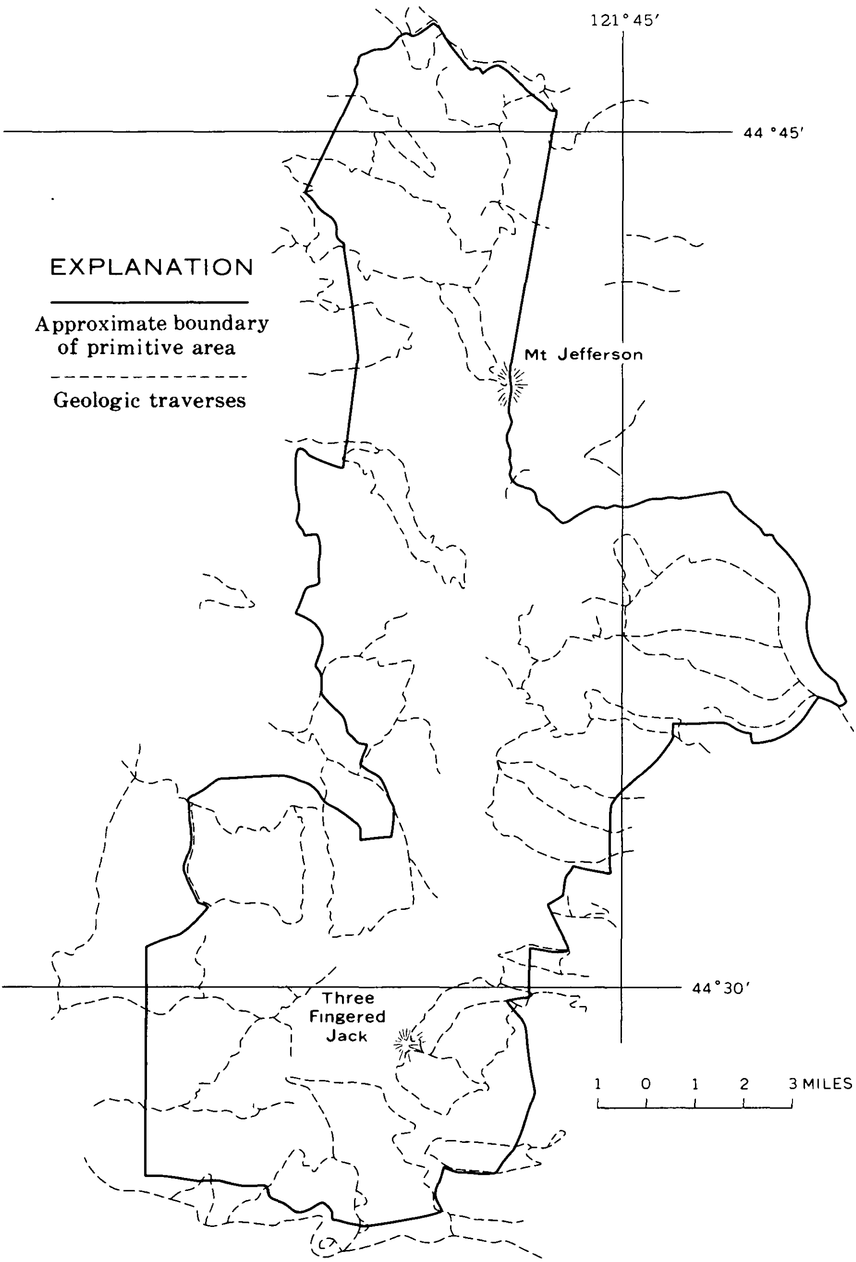

FIGURE 2.—Geologic traverses in the Mount Jefferson primitive area, Oregon.

ACKNOWLEDGMENTS

Prof. Aaron C. Waters, University of California at Santa Barbara, kindly made available unpublished geologic maps of areas in the northeastern part of the primitive area and aided in solving several problems in regional stratigraphy. G. W. Williams, E. B. Price, Jr., and W. L. Jones of the U.S. Forest Service made valuable suggestions for conducting the investigation, and, along with other staff members of the U.S. Forest Service, were helpful in many ways during the fieldwork.

GEOLOGY

In common with adjoining parts of the Cascade Range, the rocks of the Mount Jefferson primitive area are predominantly of volcanic extrusive origin, but they include many plugs and dikes and a few continental sedimentary deposits. Geologically, the rocks are rather young, all being middle Tertiary to Recent in age. Previous workers in the region (Callaghan, 1933; Thayer, 1936, 1937; Callaghan and Buddington, 1938; Williams, 1944, 1957; Peck and others, 1964) have divided these rocks into two main sequences, which are overlain locally by alluvium, fluvioglacial deposits, and pumice. The older of the two main sequences is altered and structurally deformed, and is commonly termed "the volcanic rocks of the Western Cascade Range"; the younger is termed "the volcanic rocks of the High Cascade Range." According to Thayer (1937), these two sequences of rocks are separated by a marked unconformity. Most of the rocks exposed in the primitive area are part of the High Cascade series. However, some rocks exposed in deep canyons in the northwest part of the area are slightly altered and deformed, and differ lithologically from the High Cascade series; they are considered to be correlative with volcanic units of the Western Cascade Range.

The volcanic rocks of the area are composed mostly of very fine crystals and glass, and their identification and classification are difficult. The rocks have been classified according to methods outlined by Peck and others (1964, p. 5–7), using principally the mineral composition of the rock and the refractive index of fused beads as an indication of the approximate silica content.

OLDER VOLCANIC AND SEDIMENTARY ROCKS

Slightly altered flows, flow breccias, agglomerates, volcanic conglomerates, and interbedded finer grained sedimentary rocks crop out in deep canyons in the western and northwestern part of the primitive area and more extensively in regions just west of the primitive area. These rocks are poorly exposed, being largely covered by talus and forest. Along the forks of the Breitenbush River, they consist almost entirely of flows and breccias, but farther south, along the west border of the area on Minto, Nan, and Whitewater Creeks, they include a few beds and lenses of sedimentary rocks.

Most of the lavas are finely crystalline; some have platy jointing. All are either dark to medium gray or olive gray, and commonly are mottled with gray and olive gray. All samples examined in the laboratory are either andesite or basaltic andesite. A few of the individual flows or breccia layers contain small crystals or phenocrysts of plagioclase and a little olivine.

The volcanic conglomerate layers are composed chiefly of boulders and cobbles of basaltic andesite and andesite, probably derived from neighboring flows and flow breccias. The conglomerate is interbedded with finer grained sedimentary rocks and with flows and breccias. The conglomerate beds are poorly sorted, containing some large blocks at least 1 foot in diameter and abundant cobbles in a matrix of coarse sand and small pebbles. Thin discontinuous beds that are characterized by well-rounded pebbles and cobbles are exposed a few miles west of Marion Lake, apparently at the upper contact of the unit directly beneath andesite flows of the High Cascade volcanics.

The fine-grained sedimentary rocks consist of well-sorted sandstone and siltstone made up of volcanic debris and diatomaceous ash. Most of these rocks are thinly laminated; they are very pale orange, pinkish gray, moderate yellowish brown, gray, or grayish orange in color.

These flows, breccias, and sedimentary rocks underlying the High Cascade andesites and basalts are possibly correlative with parts of the Miocene Sardine or Pliocene Troutdale Formations (Peck and others, 1964) on the west side of the Cascade Range and with older parts of the Pliocene Dalles (Wells and Peck, 1961) and Madras (Williams, 1957) Formations on the east side of the range. On the basis of stratigraphic position, lithologic character, and degree of deformation, they are clearly younger than the Little Butte Volcanic Series of Oligocene and early Miocene age (Wells, 1956; Peck and others, 1964).

YOUNGER VOLCANIC ROCKS

ANDESITE AND BASALT

Most of the Mount Jefferson primitive area is underlain by andesite, basaltic andesite and basalt flows, flow breccia, and pyroclastic deposits belonging to the volcanic rocks of the High Cascade Range (Peck and others, 1964, p. 36). These rocks have been described in some detail in adjoining areas (Thayer, 1936, 1937; Williams, 1942, 1944, 1957; Peck and others, 1964).

In and near the primitive area, the High Cascade volcanics can in places be divided into a lower unit dominated by olivine-bearing basalt in widespread sheets 10 to 20 feet thick and an upper unit of andesite and basaltic andesite flows that range in thickness from a few feet near vents to more than 100 feet on the flanks of the volcanoes. None of the vents from which the olivine-bearing basalt issued were found during the present investigation; presumably they are all buried under the younger overlying andesites. In contrast, numerous widely distributed source vents or eruptive centers for the andesites and basaltic andesites of the upper unit were found. Examples are Mount Jefferson (fig. 3), Three Fingered Jack (fig. 4), North Cinder Peak, Goat Peak, Turpentine Peak, Saddle Mountain, Marion Peak, and Maxwell Butte (pl. 1).

The olivine-bearing basalt flows, which are exposed sporadically in the westernmost part of the area (but more continuously to the east and west of the area), are medium to dark gray, or, where altered, olive gray to grayish olive green or grayish red. Most of the flows are massive, showing little flow or columnar jointing. A minor amount of fragmental material is associated with the flows, and, as noted by Williams (1957), suggests a highly fluid lava that erupted quietly in contrast to the more explosive eruptions associated with some of the younger andesites.

The flows, flow breccias, and interbedded scoria deposits of the upper andesite and basaltic andesite unit commonly contain 55 to 64 percent of silica, as determined from fused-bead tests. Thin flows and the margins of some thick massive flows commonly have well-developed platy flow jointing. At higher altitudes near vents, the flows are interstratified with flow breccia and cinders. The flow rocks are mostly medium to light gray or, locally, bluish or greenish gray; where cinders are abundant, they are grayish pink or grayish orange. Most of them are porphyritic, containing phenocrysts consisting of small tablets of plagioclase and crystals of olivine, hypersthene, augite, or, rarely, hornblende.

The High Cascade sequence of andesite and basalt is Pliocene, Pleistocene, and Recent in age (Williams, 1957; Peck and others, 1964, p. 36). In places, these rocks overlie unconformably the older volcanic rocks of the Western Cascade Range with angular discordance, but elsewhere, as for example on Nan Creek just west of the primitive area, the relationships appear to be accordant or nearly so. A few miles to the south of the area, some of the olivine-bearing basalt flows fill old canyons (E. M. Taylor, oral commun., 1965), indicating a rather profound unconformity.

FIGURE 3.—Mount Jefferson, from point on Summit Trail just west of Forked Butte. Cinder cone, northwest of Patsy Lake, in left middle distance.

FIGURE 4.—Three Fingered Jack, from north shore of Marion Lake (in foreground). Matterhornlike crest of Three Fingered Jack resulted from glacial erosion of large andesitic cone.

DACITE AND RHYOLITE(?)

In the north and northwest part of the Mount Jefferson primitive area, several small masses of dacite and rhyolite(?) have been mapped separately (pl. 1), although they are considered to be part of the volcanic sequence of the High Cascade Range. These masses are steep sided and craggy, exhibiting either platy or irregular jointing. The dacite and rhyolite(?) are mostly pale reddish brown to gray orange pink, very finely crystalline or glassy, and generally strongly flow banded. The individual flow bands range from a millimeter to several millimeters in thickness, and commonly contain elongate cavities of different sizes conformable with the banding. In places, the rocks are vitrophyric and perlitic. The index of fused beads indicates a range in the silica content from about 69 to nearly 75 percent. Presumably these are near-vent late-stage differentiates of the dominantly andesitic High Cascade volcanics.

BASALTIC ANDESITE FLOWS AND ERUPTIVE FRAGMENTAL ROCKS

The late stages of volcanic activity in the Mount Jefferson primitive area are represented by several intracanyon flows of basaltic andesite or basalt and accumulations of eruptive fragmental material near the vents that produced the flows. The distribution of the flows was governed largely by topographic features that had formed during the middle(?) and late Pleistocene glaciations. Some of the more extensive intracanyon flows are confined to the large U-shaped glacial valleys of Jefferson and Cabot Creeks. The flows in the valley of Cabot Creek erupted from the south base of Forked Butte and poured southeastward over the inner canyon rim into the lower valley, continuing east-southeastward nearly to Jefferson Creek. Some of the flows from the vent at Forked Butte flowed north and northeast into Jefferson Creek and, at about the same time, other flows came from the cinder cone on the south slope of Bear Butte and filled parts of the valley of Jefferson Creek. Less extensive flows erupted from a small cinder cone on the south slope of South Cinder Peak and from cones about 1 mile west of Lost Lake. Probably all these flows are analogous in age to some of the older flows of Recent age studied and described by Taylor (1965) and, if so, are only a few thousand years old. There is no evidence of volcanic activity in the primitive area during historic times.

The Recent flows are medium to dark gray and are characterized by blocky surfaces and some local poorly developed smooth or ropy surfaces that are little modified by erosion. Most of the flows are so recent that they have little or no soil on their upper surfaces. Based on index measurements of fused beads, the silica content of these Recent flows ranges from about 52 to 58 percent, mostly being about 57 percent.

This indicates that as a group they probably are best classified as olivine-bearing basaltic andesite.

Cinder cones associated with the Recent flows are little modified by erosion and retain much of their constructional form. They are composed of differing amounts of scoriaceous cinders, blocks of more massive material, spindle bombs, and irregular layers of partly agglutinated eruptive material; in some cones, massive flows and intrusive rocks are present. The ejected material ranges from sand-sized particles to chunks and blocks at least 1 foot in diameter. Some well-bedded material near the top of the cones is brick red or, more commonly, mottled in black and shades of gray, light brown, dark yellowish orange, and yellow. Based on index measurements of fused beads, the silica content of these rocks ranges from 52.5 to 58 percent, averaging about 57 percent. Hence, most of these rocks are andesite or basaltic andesite.

INTRUSIVE PLUGS

Intrusive plugs are widely distributed throughout the Mount Jefferson primitive area. In places they occur as partly exhumed volcanic conduits forming the cores of large andesitic cones, such as Mount Jefferson and Three Fingered Jack; and in places they occur as almost completely exhumed rock masses, such as Pyramid Butte and Hogg Rock, just to the south of the primitive area. Some cones are little modified by erosion, only small parts of the intrusive plug or conduit being exposed through the mantle of eruptive flows and fragmental material (fig. 5). A few of the plugs crop out as massive bare flat-topped knobs, commonly having peripheral concentric zones of steep joints, all enclosed in an outer zone of glassy highly fragmented andesite or basaltic andesite.

Most of the plugs are texturally and mineralogically like the associated flows of the High Cascade volcanics, particularly in their chilled and more finely crystalline peripheral zones. Nearly all these finer grained rocks are composed of various types of andesite or basaltic andesite. The cores of some plugs, such as the plug at North Cinder Peak, the plugs at the northwest end of Sugar Pine Ridge, and the intrusive body in Hole-in-the-Wall Park, are more coarsely crystalline than the associated flows, contain little or no interstitial glass, and are classed as micronorite, microgabbro, or microdiorite, depending on the character and abundance of ferromagnesian minerals.

The petrography and chemistry of these and comparable intrusive rocks have been studied and described by others (Thayer, 1937; Williams, 1933, 1942, 1957; Peck and others, 1964). Most of them show little evidence of hydrothermal alteration, and no evidence of having altered the host rocks they invaded.

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FIGURE 5.—Crest of Three Fingered Jack, showing interstratified discontinuous layers of cinders, coarse blocky andesite, eruptive fragmental material, and a few thin flows. Unstratified mass of rock between snow chute and right edge of picture is part of major plug on Three Fingered Jack. Photograph taken by E. J. Parker, U.S. Forest Service.

DIKES

Only a few of the larger and more easily recognized dikes of andesite and basalt have been delineated on plate 1. Small dikes and stringers of andesite and basalt are conspicuously exposed in some cirque walls and crisscross the tremendous piles of volcanic eruptive material that constitute Three Fingered Jack (fig. 5) and Mount Jefferson. Elsewhere the cover of soil, talus, and vegetation so effectively mantles the slopes that the smaller dikes are concealed. Most of the dikes are less than 1 foot thick, although some reach a thickness of about 10 feet; even the largest are traceable for only a few hundred feet. The dikes tend to be clustered around some of the large vent areas, particularly Three Fingered Jack, in places forming a vague radial pattern. Some of the large dikes acted as conduits and vents for widespread andesite and basalt flows. None of the dikes appear to have any associated alteration or sulfide mineralization.

ALLUVIUM, GLACIAL TILL, AND FLUVIOGLACIAL DEPOSITS

Unconsolidated alluvium, stream gravels, glacial till, and glacial deposits reworked by streams, all late Pleistocene and Recent in age, are widely distributed in the primitive area (only the larger deposits are shown on pl. 1). Most of the glacial till occurs as moraines related to late Pleistocene and Recent glaciers high on Mount Jefferson and Three Fingered Jack. Most of it is unsorted and consists of angular and subangular boulders and cobbles embedded in a sparse sandy matrix composed of rock and mineral fragments locally mixed with some pumice; stratification is almost entirely lacking. At lower altitudes, streams have reworked some of the glacial till, producing gravel, silt, and sand deposits along their channels and in lake basins.

Small discontinuous patches of unconsolidated pumice sand are present in places east of the Cascade crest and probably represent material derived from such distant sources as the Broken Top and Three Sisters area 25 or 30 miles to the south, or from the Crater Lake area nearly 100 miles to the south.

STRUCTURE

Although the main mass of older rocks in the Cascade Range has been downwarped, folded, and faulted, the rocks of the Mount Jefferson primitive area are too young to have participated in much of the structural deformation. Most of them are unchanged from their original attitudes, which range from almost horizontal for some of the lava flows to as much as 35° on the flanks of some steep-sided volcanic cones. Evidence of minor deformation was found only locally, and that near the borders of the primitive area.

On Nan Creek just west of the area, thinly laminated diatomaceous ash beds and volcanic conglomerates interstratified with basalt flows and flow breccias are tilted eastward at angles less than 10°. These beds are cut by minor faults with displacements ranging from less than a foot to a few feet.

A normal fault with more than 1,000 feet of displacement locally follows the border of the primitive area along Jefferson Creek. Thayer (1936) has postulated that the High Cascade vents were localized by a north-trending fracture system, and Taylor (1965, p. 144) has called attention to a similar localization of the vents of the very young flows. No evidence for such a structural control was recognized in the Mount Jefferson primitive area except for a vague alinement of some of the major vents, and the north-trending linear arrangement of cinder cones near Lost Lake.

Most of the deformation of the region predates the volcanic rocks of the High Cascades and hence is Pliocene or older. The linear arrangement of vents of the High Cascades, including the vents of Recent flows (Taylor, 1965), suggests, however, that some minor deformation has occurred within the last few thousand years and is, perhaps, still active.

ALTERATION

Rocks that have been bleached and altered by fumarolic and solfataric processes during late stages of volcanism are present at several places in the Mount Jefferson primitive area. Most of these rocks are close to the vents from which the High Cascade andesites came. The altered flows and pyroclastic rocks high on Mount Jefferson, near the top of Maxwell Butte, and on Saddle Mountain, are lighter in hue than the fresh rocks, and locally are brightly stained with iron oxides. Many of the fractures and pore spaces in these rocks are filled with earthy to finely crystalline buff, white, or yellow encrustations, and in some localities with iron-stained clayey material. Analysis of these encrustations and pore fillings, chiefly by X-ray diffraction, indicates the presence of alunite, native sulfur, and kaolinite(?). Inasmuch as alunite is a common constituent of metallic ore deposits in volcanic terranes, a number of samples of the alunitized rocks were further analyzed for possible associated concentrations of base or precious metals, but none were found.

MINERAL RESOURCES

Except for common construction materials such as cinders, no deposits of metallic or nonmetallic minerals were found, and geochemical analytical data indicate that the bleached and altered rocks associated with volcanic vents are devoid of mineral value.

NEARBY PRODUCTIVE AREAS

Although no mining or quarrying operations have been conducted within the primitive area, some deposits in adjacent areas have contributed to a small local mineral economy based on metallic ore deposits prior to the 1940's and on construction materials in subsequent years. A few tens of miles west and southwest of the primitive area in the Bohemia, Blue River, Quartzville, and North Santiam mining districts, some ores of gold, silver, copper, lead, and zinc have been produced from fissure veins in Tertiary volcanic rocks. The veins probably are late Miocene in age, and are believed to be genetically related to dioritic intrusive rocks (Callaghan and Buddington, 1938). The intrusives may indicate the sites of a former north-trending chain of volcanoes (Peck and others, 1964) now mostly removed by erosion. Also, mercury has been produced from fissure veins in basalt or basaltic andesite of Miocene age in the Oak Grove Fork area (Brooks, 1963, p. 105–111), about 22 miles northwest of the Mount Jefferson primitive area. Cinders and rock have been quarried from a number of different localities peripheral to the primitive area, mostly along the southern border of the area on or near U.S. Highway 20 and a few miles to the west on State Highway 22. A lightweight-aggregate industry, utilizing principally pumice and some cinders, has been established in the Bend area (Mason, 1951, 1964, 1965; Walker, 1951), about 35 miles to the southeast of the primitive area, and some volcanic building stone has been quarried in localities north and northeast of Bend (Mason, 1951; 1964, p. 4, 6; 1965, p. 7).

COMMODITIES WITHIN THE AREA

PUMICE, CINDERS, AND BUILDING STONE

Volcanic materials potentially usable for construction, such as pumice, cinders, and stone, are present in parts of the Mount Jefferson primitive area. They have not been exploited, however, because more accessible deposits of equal or better quality and of larger size occur elsewhere in central Oregon.

Small discontinuous patches of airborne pumice as much as 5 feet thick are present in the southeast part of the Mount Jefferson primitive area; the particle size of the pumice ranges from mostly less than 1 millimeter to as much as 1.5 centimeters. A few small patches also occur northward along the eastern slope of the Cascade Range at least to the latitude of Breitenbush Lake; no pumice deposits were found west of the Cascade crest. Most of the pumice is intermixed with plant debris and soil, and occurs in deposits that are neither large enough nor pure enough to compete with other very large and more accessible deposits being exploited to the southeast in the Bend-Chemult region.

The distribution of the pumice east of the Cascade crest and its concentration, at least locally, on north (lee) slopes suggest that the vents from which it was erupted lay to the south, possibly near Broken Top and Three Sisters, or farther south at Crater Lake. In color, mineral content, and index of glass (average about 1.510), much of the pumice is nearly identical with that erupted from Mount Mazama about 6,500 to 7,000 years ago (Arnold and Libby, 1951; Rubin and Alexander, 1960).

Indistinctly bedded cinder cones composed of black, brown, gray, orange, buff, yellow, and red scoriaceous cinders, agglutinated volcanic spatter, angular and subangular blocks of scoriaceous andesite, and, locally, a few spindle bombs are associated with many of the vents in the Mount Jefferson primitive area. Most of the cones contain small to moderate amounts of rather massive andesite, either as small flows or as intrusive plugs and dikes. A few of the cones, such as South Cinder Peak, Forked Butte, Red Butte, and the coalescing cones west of Lost Lake, seem to be composed mostly of cinders and to have little or no massive andesite associated with them. Most of the cinders are andesitic. The black, gray, and yellow cinders represent, in part, deposition in a wet environment—probably melt water from glacial ice and snow. The red and orange cinders indicate subaerial deposition. Both kinds of cinders are present in some cones, the red and orange subaerial variety being less abundant than cinders of other colors.

Probably some, and perhaps most, of the cinders within the Mount Jefferson primitive area are suitable for use as road ballast or surfacing and possibly as lightweight concrete aggregate, but because of the widespread distribution of similar cinder cones outside the primitive area, these largely inaccessible deposits are not of commercial interest in 1966 or in the foreseeable future.

Platy and blocky andesite is present in large quantities in the primitive area, but because nearly all is drab shades of light to medium gray and, locally, dark gray, it is unsuited for use as facing or building stone. Furthermore, better quality material is abundant elsewhere, and is more easily available.

POTENTIAL FOR METALLIC MINERAL DEPOSITS

No metallic mineral deposits of commercial value were recognized in the Mount Jefferson primitive area during the present investigation, and evaluation of the geology indicates that such deposits are not likely to be found.

In checking the primitive area for its metallic mineral potential, all pertinent geologic factors were considered. The major streams of the area were panned to determine the presence of abnormal amounts of heavy metallic minerals, and all panned concentrates, as well as other samples, were tested in the laboratory for their metal content. Except for the discovery of weak alteration zones associated with some vent areas that are characterized by alunite, native sulfur, and kaolinite(?), the geologic examinations failed to reveal any evidence suggesting the presence of commercial ore deposits. None of the faults or fracture zones either within or just outside the primitive area are mineralized, and there is no evidence of sulfide minerals or extensive alteration associated with any of the intrusive rocks. To check further for exposed deposits of metallic minerals, the alluvial deposits in the canyons of Jefferson, Marion, Minto, Canyon, Whitewater, First, Jack, and Pamelia Creeks, Whitewater and Santiam Rivers, and forks of the Breitenbush River were panned in a number of different places both within and just outside the primitive area. Selection of sites for panning the stream sediments was based on abundance and suitability of the sediment, relation of stream junctions to the border of the primitive area, and evaluation of the geologic terrane drained by the different streams. No commercially valuable concentrations of metallic minerals were found.

Samples of bleached and altered rocks containing alunite, native sulfur, and kaolinite(?) and all panned concentrates were further studied microscopically in the laboratory and tested for mercury with a Lemaire Mercury Detector (type S1); selected samples were analyzed by semiquantitative spectrographic methods. Microscopic examination indicated that the panned concentrates are composed exclusively of rock-forming minerals—mostly magnetite, olivine, and augite and lesser amounts of hypersthene, ilmenite, hematite or martite, hornblende, and apatite. Grains of heavy metallic minerals that might indicate exposed or shallowly buried ore deposits are completely lacking in the panned concentrates. Tests for mercury on all panned concentrates and seven samples of bleached and altered rock from vent areas were negative. The mercury content is less than 2 parts per million (0.0002 percent or 0.004 pounds per ton) in all samples tested and most contain less than 1 part per million. Semiquantitative spectrographic analyses of 15 samples, including both panned concentrates and samples of alunitized rock, showed no significant concentration of potentially valuable metals (table 1). Thus, it may be concluded that analytical results show, at best, only slightly greater mineral or metal contents than those occurring in barren rock.

Table 1.--Semiquantitative (six-step) spectrographic analyses of altered and mineralized andesite and panned concentrates from Mount Jefferson primitive area, Oregon, and adjacent regions

[Results are reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, and 0.1, . . . , which represent approximate midpoints of group data on a geometric scale. The assigned group for semiquantitative results will include the quantitative value about 30 percent of the time. These data should not be quoted without stating these limitations. Symbols used are: M = major constituent--greater than 10 percent; 0 = looked for but not detected; <, with number, less than number shown--here usual detectabilities do not apply. Looked for but not detected: Ag (see footnotes), As, Au, B, Be, Bi, Cd, Ce, Ge, Hf, Hg, In, La, Li, Mo, P, Pb (see footnotes), Pd, Pt, Re, Sb, Sn, Ta, Te, Th, Tl, U, W, Zn, and Eu. Analyst: Chris Heropoulos, U.S. Geological Survey, Menlo Park, Calif.]

Sample No.	Si	Al	Fe	Mg	Ca	Na	K	Ti	Mn	Ba	Co	Cr	Cu	Ga
MJW-48[1]	M	10	7	2	3	2	1	0.7	0.07	0.05	0.002	0.007	0.01	0.002
MJW-103[2]	M	7	2	1	.7	1.5	.7	.3	.03	.03	.0007	.0015	.01	.0015
MJP-1	M	7	M	10	5	1.5	0	1.5	.2	.02	.007	.03	.007	.0015
MJP-2	M	5	M	10	5	1	0	1	.2	.015	.015	.07	.01	.001
MJP-3	M	5	M	10	3	1	0	1.5	.2	.015	.015	.07	.015	.001
MJP-4	M	10	10	7	5	3	.7	1	.15	.03	.007	.05	.007	.002
MJP-5	M	5	M	10	3	1	0	1.5	.2	.01	.01	.05	.01	.001
MJP-6	M	5	M	7	3	1	0	1.5	.2	.01	.007	.02	.015	.001
MJP-7	M	5	M	10	3	1	0	1.5	.2	.01	.01	.02	.015	.001
MJP-8	M	7	M	10	3	1	0	1	.15	.015	.01	.05	.01	.001
MJP-9	M	7	10	10	5	1.5	0	1	.2	.02	.01	.07	.007	.0015
MJP-10	M	7	10	10	3	1	0	.7	.15	.02	.01	.05	.005	.001
MJP-11	M	7	10	10	3	1	.5	1	.2	.02	.01	.03	.007	.0015
MJP-12	M	5	M	7	3	1	0	1.5	.2	.015	.01	.03	.01	.001
MJP-13	M	10	7	7	5	2	.5	.7	.15	.03	.007	.05	.007	.002

Sample No.	Nb	Ni	Sc	Sr	V	Y	Yb	Zr	Sample description
MJW-48[1]	0	0.005	0.002	0.1	0.03	0.002	0.0002	0.015	Altered andesite, Maxwell Butte
MJW-103[2]	0	.0015	.001	.005	.007	.0015	.00015	.01	Altered andesite, Mount Jefferson
MJP-1	.002	.03	.003	.03	.07	.002	.0002	.01	Panned concentrate, Jefferson and Cabot Creeks
MJP-2	.001	.1	.005	.03	.05	.002	.0002	.01	Panned concentrate, Marion Creek
MJP-3	.0015	.1	.005	.02	.07	.003	.0003	.015	Panned concentrate, Minto Creek
MJP-4	.001	.07	.003	.05	.05	.002	.0002	.015	Panned concentrate, Canyon Creek
MJP-5	.0015	.05	.005	.02	.07	.002	.0002	.015	Panned concentrate, Shitike Creek
MJP-6	.0015	.03	.005	.02	.1	.002	.0002	.01	Panned concentrate, Whitewater Creek
MJP-7	.002	.03	.005	.015	.1	.002	.0002	.01	Panned concentrate, Whitewater Creek
MJP-8	.002	.07	.005	.03	.07	.002	.0002	.01	Panned concentrate, North Fork Breitenbush River
MJP-9	.0015	.07	.003	.05	.05	.002	.0002	.015	Panned concentrate, First Creek
MJP-10	.0015	.07	.003	.03	.03	.002	.0002	.01	Panned concentrate, Jack Creek
MJP-11	.002	.03	.005	.03	.07	.002	.0002	.01	Panned concentrate, South Fork Breitenbush River
MJP-12	.0015	.05	.003	.02	.07	.002	.0002	.01	Panned concentrate, Pamelia Creek
MJP-13	.001	.05	.003	.07	.05	.003	.0002	.015	Panned concentrate, Santiam River

[1] Also contains 0.00007 percent of Ag and 0.005 percent of Pb.

[2] Also contains <0.00007 percent of Ag and 0.005 percent of Pb.

The volcanic plugs and near-surface intrusives of the Mount Jefferson primitive area, which lack evidence of metallic mineralization, are middle(?) to late Pliocene and Pleistocene in age, are only slightly eroded, and show little evidence of having altered the enclosing rocks. Only small areas on a few plugs and associated eruptive material are bleached and altered as a result of fumarolic and solfataric activity. At considerable depth, these plugs probably join with intrusive masses that may be somewhat analogous to the small intrusive bodies associated with metallic ore deposits in mining districts west of the Mount Jefferson primitive area, as described by Callaghan and Buddington (1938). They differ in several important aspects, however—in geologic age, depth to which they have been eroded, alteration, and evidence of mineralization. According to Callaghan and Buddington (1938, p. 21), the dioritic intrusives to the west that are genetically associated with deposits of zinc, lead, and copper sulfides and some gold and silver probably are late Miocene in age. They are deeply eroded and are accompanied by contact aureoles or zones of altered wallrock characterized by silicification and the presence of several secondary minerals, such as tourmaline, sericite, alkali feldspar, epidote, chlorite, specular hematite, magnetite, and pyrite. These features were not observed in the Mount Jefferson primitive area.

The geologic and mineral appraisal indicates that the kinds of metallic ore deposits found to the west, associated with the Miocene intrusive rocks and the mercury deposits in the Oak Grove area to the northwest, are not likely to occur in the primitive area except, possibly, at great depth. The structural downwarping and accompanying downfaulting of the central part of the Cascade Range, which depressed any sites geologically comparable to those that are mineralized in adjacent areas, and the very thick overlying pile of young andesitic and basaltic volcanic rocks, creates an environment highly unfavorable for the occurrence of valuable mineral deposits. The geology is typical of areas of young andesitic and basaltic volcanic rocks, none of which are known to contain commercial ore deposits in the entire Cascade Range.

POTENTIAL FOR THERMAL POWER

The potential for thermal power of the Mount Jefferson primitive area was investigated because of the occurrence of several groups of hot springs in nearby areas (Stearns, and others, 1937), including one group at Breitenbush only a few miles to the northwest. Furthermore, the primitive area is in a region dominated by late Cenozoic volcanism, which is geologically similar to some areas in other parts of the world that have been developed for thermal power. Many springs are present within the area, some discharging large volumes of water; none of these springs, however, are thermal, and, because of their characteristically low temperature, most are thought to be fed only from snowmelt water. Also, no sinter or tufa deposits denoting ancient hot-spring sites are present. It may therefore be concluded that no potential for thermal power exists in the area.

ECONOMIC APPRAISAL

By Eldon C. Pattee, U.S. Bureau of Mines[1 2]

INTRODUCTION

Fieldwork in the proposed wilderness area was done by U. S. Bureau of Mines personnel during the summer of 1965. Courthouse records of Marion, Linn and Jefferson Counties were examined to determine the number and location of mining claims within the proposed wilderness boundaries; a limited aerial reconnaissance was made of the area; mining claims and several ash and cinder deposits were examined; and limited mining cost and marketing studies were made of the mineral commodities of the area.

ACKNOWLEDGMENTS

Grateful acknowledgment is expressed for the cooperation and assistance of personnel of the Deschutes and Willamette National Forests; the Central Oregon Pumice Co., Bend, Oreg.; Redmond Rock Products, Redmond, Oreg.; and Cascade Pumice Corp., Bend, Oregon.

MINING CLAIMS AND DEPOSITS

MINING CLAIMS

County records disclosed that three mining claims have been located within the proposed wilderness area. One claim is near Cabot Lake, at the east edge of the area, and two claims are near South Cinder Peak, in the center of the area (fig. 6).

CABOT LAKE CLAIM

The claim is in the SE¼ sec. 27, T. 11 S., R. 8 E., Jefferson County (fig. 6). The route to the prospect from Sisters, Oreg., is 6 miles west on U.S. Highway 20, 8.5 miles north on U.S. Forest Service road 1210,

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[1] Mine Exploration and Examination Engineer, Area VII, Mineral Resource Office, Field Office, U.S. Bureau of Mines, Spokane, Wash.

[2] Assisted in the field by Ronald M. Van Noy, Geologist, and Joseph S. Coffman, Mining Engineer, Area VII, Mineral Resource Office, Field Office, U.S. Bureau of Mines, Spokane, Wash.

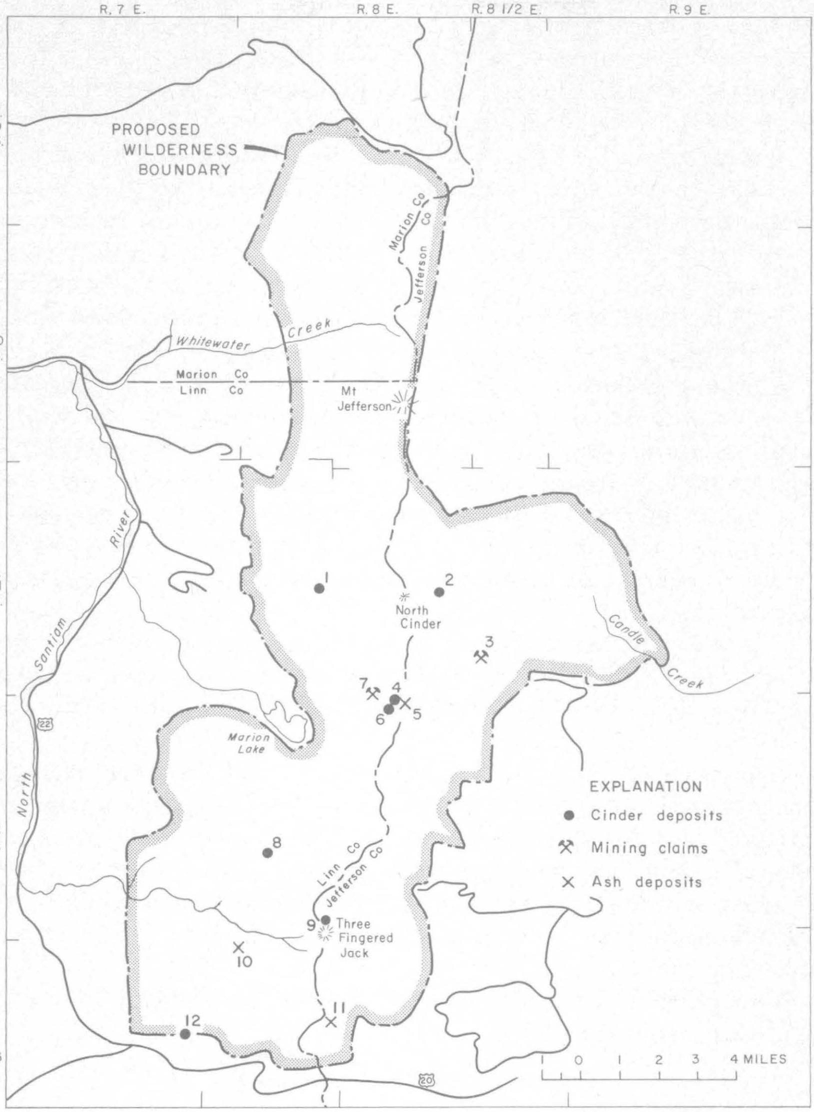


FIGURE 6.—Mining claims and deposits in the Mount Jefferson primitive area. 1, Bingham Ridge cinder cones. 2, Forked Butte. 3, Cabot Lake claim. 4, South Cinder Peak. 5, South Cinder ash deposit. 6, Breached cone. 7, South Cinder Peak claims. 8, Red Butte. 9, Three Fingered Jack. 10, Santiam Lake ash deposit. 11, Black ash deposit. 12, Lost Lake deposit.

2 miles west on Cabot Lake road, and 2 miles farther west by trail. Four prospect trenches are near Cabot Lake Creek, about 400 feet northeast from the lake. The area is densely forested and underbrush is thick at points along the stream.

The claim was located in 1964 by Charles Houston of 713 South 13th Street, Redmond, Oreg. Houston stated that he had become interested in the property because there had been an old cabin in the area and information indicated that sluice boxes had been operated on the stream. He also stated that one sample from the area assayed $1.40 in gold per ton. Assessment work on the claim has been discontinued.

The prospect trenches have been dug in glacial debris and stream sediments on the steep slope below Cabot Lake (fig. 7). Four small trenches were found and examined, but only one exposed bedrock; the main ones are partly filled with surface debris. Soil overlying the glacial debris is from 1 to 4 feet deep. The glacial debris was exposed to a maximum depth of 10 feet in one trench. The debris is composed of equal amounts of sand and angular fragments of purple vesicular andesite larger than 1 inch in diameter; a small amount of red scoria is also present.

The trench exposing bedrock is 140 feet south of the main workings. The exposed bedrock is agglomerate or breccia which has been altered or partly decomposed by weathering. It is stained with limonite and hematite.

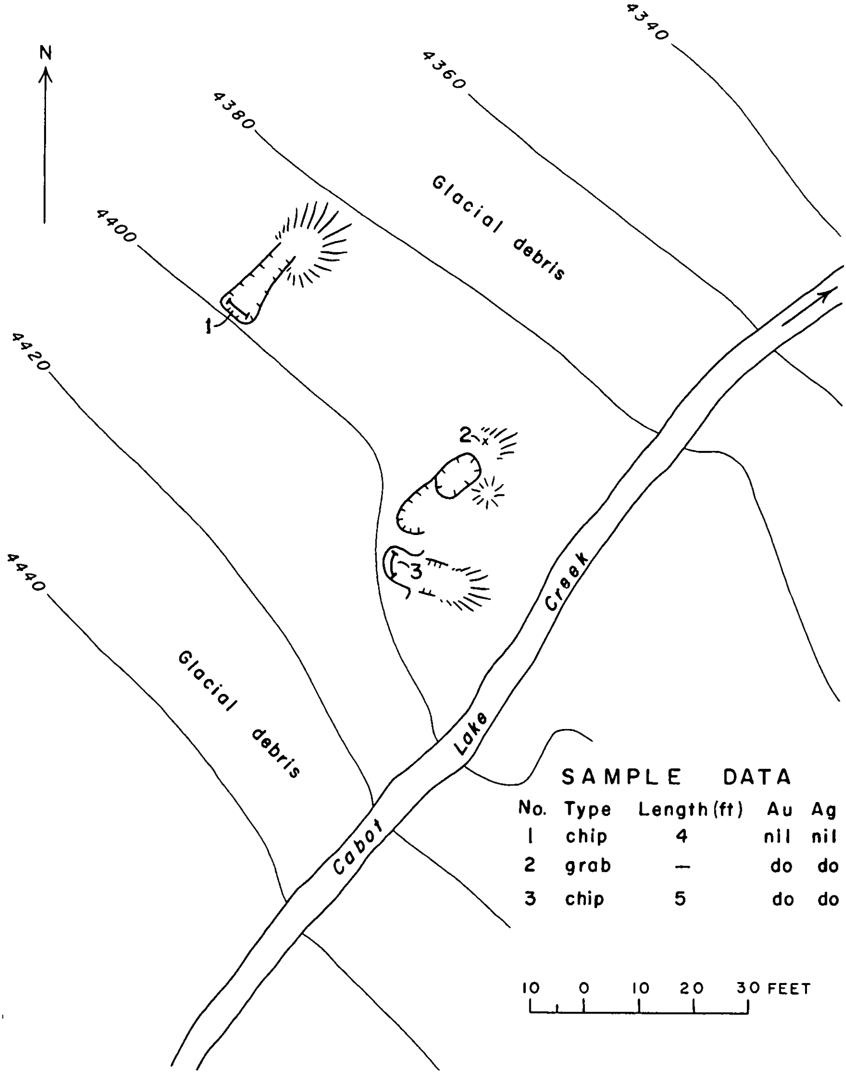
Samples of fine material from the trenches and from the streambed were panned, but gold was not detected. Stream gravel was panned for gold at intervals to a point approximately 1,000 feet downstream from the trenches, but none was detected. Three samples of fine-grained material from the sloughed trenches and one sample of bedrock from the fourth pit were assayed for gold and silver; none was detected.

The available information indicates that the property has no potential as a gold deposit.

SOUTH CINDER PEAK CLAIMS

The position of the claims as given in the Marion County records is the unsurveyed SE¼SE¼ sec. 31, T. 11 S., R. 8 E. (fig. 6). This location is in Linn County approximately 0.5 mile west of the summit of South Cinder Peak and 2.4 miles northeast of Marion Lake. No evidence of mining or prospecting activity was found in the area.

The two claims were located and recorded in the Marion County records by Willard M. Howell in 1955. No record of annual assessment work has been recorded in either Marion or Linn County. Howell's present address could not be determined; therefore, no additional information on the location of the claims could be obtained.



SAMPLE DATA

No.	Type	Length (ft)	Au	Ag
1	chip	4	nil	nil
2	grab	—	do	do
3	chip	5	do	do

FIGURE 7.—Cabot Lake claim area.

The claimed area is sparsely timbered and is underlain by andesite. Bedrock is well exposed, but no deposits of valuable minerals could be identified in the claimed area.

CINDER (SCORIA) AND VOLCANIC CINDER

The terms "cinder," volcanic cinder," and "scoria" are used to indicate virtually the same material. All are cellular material from volcanoes. Unsized material from pyroclastic cones usually is termed "cinder" or "scoria" whereas the term "volcanic cinder" indicates a particular size limit of 4 to 32 millimeters.

Cinder (scoria) produced in Oregon is used for road construction, lightweight concrete aggregate, railroad ballast, highway sanding, base for campgrounds, reservoir riprap, athletic running tracks, roofing granules, and ornamental stone. The market for cinder is quite competitive. Most of the firms upgrade the cinder prior to marketing to consumers, contractors, or distributors. Yearly production of cinder in Oregon increased from about 422,000 tons in 1963 to 566,000 tons in 1964. This production increase was due to greater noncommercial requirements, such as road construction and local surfacing by the U.S. Forest Service. Road construction consumed the major part of the cinder produced in 1964.

Direct mining and processing costs in central Oregon vary but are estimated to range from $0.10 per yard for loading of pit-run material to about $0.60 per yard for road or lightweight-aggregate use. Processing for lightweight aggregate involves crushing, screening, color grading, and blending. Road surfacing involves crushing, grading, and rolling. Hauling cost is about $0.10 per cubic yard mile.

The price paid for cinder near the primitive area is from $1.50 per cubic yard for road metal delivered locally to $2.50 per cubic yard for lightweight-aggregate material f.o.b. rail shipping point, and $3.00 per cubic yard for sized roofing granules f.o.b. rail shipping point. U.S. Forest Service contracts for mining and processing cinder for road metal are about $0.60 per yard; $0.10 per cubic yard mile for hauling is generally added. Cinder is shipped to markets as distant as Spokane, Wash., and Vancouver, British Columbia.

Specifications for cinder depend on the use. Pit-run cinder is often adequate for road metal, but at some deposits clinkers and blocks must be screened out or crushed. Screening of cinder is required for hard oil surfaces. Color-graded red cinder is required for lightweight aggregate; however, other colors would be structurally satisfactory. Cinder must have high strength and contain only small amounts of iron or other impurities. In general, only 10 to 20 percent of the material in a cinder cone meets present specifications for lightweight aggregate.

The value of an individual cinder deposit depends on its nearness to a railroad or place of use because transportation is the largest cost of exploitation. Cinder is frequently substituted for other road-construction materials, such as sand and gravel, because of ready availability and ease of mining and processing. Some inherent properties, such as color, make it more valuable for other uses. Other factors bearing on exploitation are cinder particle size; strength; impurities, such as iron and clay; and deposit size and accessibility. Lightweight aggregate requires the cinder to have special properties; many deposits contain some material that meets the requirements.

Although projections of marketing conditions are tenuous, some predictions can be made. Moderate increases are expected in commercial use. The increased use probably will be in concrete aggregate, highway sanding, athletic tracks, roofing granules, and ornamental stone. The noncommercial use, such as U.S. Forest Service and county road metal, probably will not change greatly, but may expand moderately for a short period and then decline and level off as adequate road systems are established. Annual production will probably fluctuate and be subject to administrative decisions affecting road construction.

CINDER DEPOSITS

In the vicinity outside the proposed wilderness area are enormous resources of cinder, approximately 40 percent of which is estimated to be red cinder. There also are enormous resources of cinder within the proposed wilderness area. Many cinder pits and undeveloped cinder deposits to the south and east of the area are much more favorably located with respect to truck and railroad transportation than are the cinder deposits of the Mount Jefferson primitive area.

Deposits of cinder examined within the proposed wilderness area are composed of pyroclastic ejecta from volcanic vents. They were deposited as pyroclastic or composite cones. Several smaller cinder deposits are excluded from the following description of individual deposits.

LOST LAKE GROUP

The Lost Lake group of four pyroclastic cones is 1 mile east of Santiam Junction and is 48 miles northwest of Bend, Oreg., by way of U.S. Highway 20 (fig. 6). Part of the northern cone is within the proposed wilderness area.

The four cones form a north-trending ridge across the glaciated valley of Lost Lake Creek. The ridge is 1 mile long and its maximum base width is more than 0.6 mile. Lost Lake has formed behind the dam of volcanic material. U.S. Highway 20 is at the south edge of the lake and the ridge. The ridge is densely forested. Overburden and vegetation obscure most of the cinders.

The northern cone overlaps the rim of a lower cone. The two cones share a common rim that separates a shallow crater on the north from a symmetrical deep crater to the south. The total length of these two bodies is 2,100 feet, and the maximum width 1,800 feet. The larger crater is 400 feet in diameter and over 80 feet deep. Its rim is 300 feet above the base.

The cones are composed of red cinder. Although there are few exposures of red cinder, the composition is probably similar to that in Little Nash Crater nearby, which is being exploited for highway sanding and surfacing material. Total potential exploitable cinder in the ridge is estimated to be 50 to 60 million cubic yards, but only 3 million cubic yards at the north end are within the proposed wilderness area. In place, 1 cubic yard of compacted cinder weighs approximately 1 short ton.

Cinder in the ridge, for production of sanding cinder, has an economic advantage over other unexploited deposits in the area because of accessibility to U.S. Highway 20. Most of the deposit is suitable also for other uses.

RED BUTTE

Red Butte is in the unsurveyed SW¼ sec. 23 and NW¼ sec. 26, T. 12 S., R. 7½ E., Linn County (fig. 6). It is 7 miles north from Santiam Pass on U.S. Highway 20 by way of the Skyline Trail. This trail is relatively level and road construction would not be difficult.

Red Butte is a symmetrical cone; the north and west slopes are forested by conifers, and the south and east slopes are bare. The base of the butte averages 2,640 feet in diameter. The summit, 5,843 feet in elevation, is 480 feet above the base. The surface of the cone is composed of approximately equal amounts of cinder and ash; most of the fragments are less than 2 inches in diameter. The cinder on the west slope is reddish purple, but other sides contain gray or black cinders.

A sample of the reddish-purple cinder assayed 4.75 percent soluble iron. The resource potential in the cone is estimated to be 30 to 33 million cubic yards.

The color of the cinder does not meet the requirements for lightweight aggregate. It would, however, be suitable for most other uses.

BREACHED CONE

A breached pyroclastic cone is in the unsurveyed NW¼ sec. 5, T. 12 S., R. 8 E., in Linn County (fig. 6). It is 2.2 miles from Marion Lake on the west boundary of the proposed area. The best road-

FIGURE 8.—South Cinder Peak (1) and South Cinder ash deposit (2).

construction route to the deposit extends 5 miles eastward from the end of a road 1.5 miles northwest of Marion Lake.

The pyroclastic cone has been breached on the south side by lava that formed a lava bed 2.5 miles long to the west. The cone averages 1,400 feet in diameter at the base, and is 400 feet high. The base is at an altitude of 5,900 feet. A thin cover of cinder extends several hundred feet downslope from the southwest side of the base. The pyroclastic material is estimated to be 75 percent cinder (scoria) and 25 percent ash; most fragments are under 1 inch in diameter. Some large blocks and volcanic bombs are present. The west side of the cone contains considerable red cinder, but black, gray, and tan predominate. A sample of red and black cinder from the top of the deposit contained 5.28 percent soluble iron.

The potential resource is estimated to be 11 to 14 million cubic yards. The hue of the red cinder is not suitable for lightweight-aggregate use but would be suitable for most other uses.

SOUTH CINDER PEAK

South Cinder Peak borders the north side of the breached cone and is mostly in the S½ sec. 32, T. 11 S., R. 8 E., Linn County (figs. 6, 8). The access route is the same as that to the breached cone.

The south and west sides of the peak are sparsely forested, but the east and north sides are mainly bare. The north side is precipitous, containing massive blocks of volcanic breccia and a massive rock core. The base is ellipsoidal in shape and averages 1,500 feet in diameter. The summit, at an altitude of 6,746 feet, is 350 feet above the base.

The peak is a pyroclastic cone and has a massive core of andesite. The cinder is composed of material ranging from dust to blocks that are mostly between 1¼ and 8 inches in diameter. The material is predominantly black, but red cinder is present on the northeast slope and summit. A sample of red cinder from the summit contained 5.28 percent soluble iron.

Potential resource is estimated to be 5 million cubic yards. The material is not suitable for use in concrete aggregate because of the color, but it is usable for road construction and most other applications.

FORKED BUTTE

Forked Butte is in the unsurveyed NE¼ sec. 21, T. 11 S., R. 8 E., Jefferson County, 8 miles by trail from the end of the Cabot Lake road. This route is probably the best for road construction; however, a section, about 1 mile long, would be fairly difficult to construct.

The butte is a breached cone. The base of the cone is at the top of the 400- to 800-foot-high cirque wall, but cinders on the north slope extend downward over the wall. The cone is virtually bare, but small timber and brush cover the material extending down the wall. It has been breached by lava flowing southeastward from the south base. There are remnants of two craters at the summit and a lava vent at the south side. The base of the butte averages 2,460 feet in diameter, and the butte is 600 feet high.

Forked Butte is a composite cone containing red, black, and yellow cinder; lava beds; and ash. Fragments of red cinder (scoria), covering an area 300 feet wide in the north crater, extend 500 feet down the north slope. This scoria is exposed to a depth of 150 feet in the crater. The fragments are as much as 10 inches in diameter, but most average less than 3 inches. Some lava flows or consolidated red cinder were noted in the crater. An area of a few hundred square feet on the southwest slope of the butte contains massive red scoria but is too small to have importance. The east side of the butte is covered with tan cinder and volcanic ash. This cinder is more vesicular than scoria and resembles pumice. Most of the south and west sides of the butte are black basaltic scoria. The material on the south side averages less than 5 inches in diameter. Massive basalt crops out on the south side, indicating that the cone has a massive basalt core.

The potential resource of cinder (scoria) is estimated to be 25 to 30 million cubic yards. It does not have suitable color for lightweight aggregate, but would be usable for many other applications.

BINGHAM RIDGE CINDER CONES

Two cinder cones in the unsurveyed NE¼ sec. 24, T. 11 S., R. 7½ E., Linn County, are on Bingham Ridge. The deposits are 4 miles by trail from the Bingham Ridge road. A road could be fairly easily constructed along the ridge to the deposit.

The cones are on the north side of the ridge and overlap, but their two summits are about 500 feet apart. Their common base averages 820 feet in diameter and their average height is 150 feet. They are composed of fragments of red and black scoria ranging from fine ash to blocks 2 feet in diameter. Approximately 25 percent of the material is ash. Blocks of scoria and volcanic bombs are abundant on the surface.

The resource is estimated to be 1 to 1.5 million cubic yards. Most of the material would require crushing before it could be used for surfacing roads. The cinder is suitable for most other applications; however, the dull hue of the red cinder renders it inadequate where a bright red hue is required.

THREE FINGERED JACK DEPOSIT

Three Fingered Jack is the second largest peak in the primitive area. The cinder deposits are in unsurveyed sec. 36, T. 12 S., R. 7½ E., Jefferson County (fig. 6). They are exposed in the cliff on the northeast side of the peak. A talus slope below the cliff is about 3 miles from the end of the Jacks Lake road. Road construction to this large talus slope at the base of the mountain would be fairly easy. A road, however, could be constructed nearer to the deposit from the west side. This route would extend southward for 6 miles to the Santiam Pass on U.S. Highway 20.

Several scoria beds, exposed in the headwall of a cirque at the northeast side of the peak, strike northeastward and dip 25° to 40° NW. They interfinger and pinch out parallel to the strike. The main beds crop out in the cliff for 1,900 feet along their strike, but a few extend 800 feet farther northward. The thickness of the main beds of scoria and intercalated lava flows exceed 200 feet. Approximately 30 to 50 percent of this thickness in lava. The dip length of the beds is obscured by overburden but would not exceed 2,200 feet, which is the distance to the base of the peak. Roughly 80 to 200 feet of rock overlies the scoria. The beds of red scoria are composed of partly cemented cinder and compacted fragments as much as 10 inches in diameter.

The resources of red scoria are indicated to be from 8 to 20 million cubic yards. The rugged nature of the peak would make mining extremely expensive. The cinders are probably not suitable in color for lightweight-aggregate use. They would be adequate for most other uses.

VOLCANIC ASH DEPOSITS

Two types of volcanic ash deposits in the primitive area were examined to determine their suitability for pozzolan. Analysis of samples indicate they are not suitable. One type, composed of black eolian ash, occurs near the south border of the primitive area; the black ash deposit in figure 6 is an example. The other type, composed of small cinder and ash, occurs near South Cinder Peak (fig. 6). Small deposits of black ash are not discussed in this report.

BLACK ASH DEPOSIT

The deposit is in the E½ sec. 13, T. 13 S., R. 7½ E., Linn and Jefferson Counties (fig. 6). It is on the crest of the ridge that extends southward from Three Fingered Jack, and is 1.3 miles north of the Santiam Pass on U.S. Highway 20.

This black eolian ash deposit is 720 feet long and 450 feet wide. The estimated average depth is between 5 and 10 feet, although some dunes may be 15 feet deep. A 5.5-foot-deep sample was taken from an augered hole near the center of the deposit. It contained fine rounded particles of basalt and plagioclase feldspar crystals. The particles are less than 1 millimeter in diameter. Approximately 1 percent of the sample was glass.

The ash has no value as a pozzolan because of the low glass content.

SANTIAM LAKE ASH DEPOSIT

The deposit is in unsurveyed sec. 3, T. 13 S., R. 7½ E., Linn County, 0.25 mile southwest of Santiam Lake. The Skyline Trail crosses the deposit at a point 4.5 miles north from the Santiam Pass (fig. 6).

This area of eolian black ash is 540 feet long and averages 180 feet wide. The maximum depth is probably 10 feet, the average being about 3.5 feet. The ash from this deposit is similar in composition to the ash from the black ash deposit.

The ash has no value as a pozzolan material.

SOUTH CINDER ASH DEPOSIT

The deposit is mostly within the NE¼ sec. 5, T. 12 S., R. 8 E., Linn and Jefferson Counties, and is at the base of the southeast side of South Cinder Peak (fig. 6). Access to the deposit is similar to that for the breached cone and South Cinder Peak cinder deposits.

The deposit covers an irregular area that is about 1,400 feet long and averages 400 feet in width. The depth is estimated to average 4 feet. Three samples were augered from the deposit. They were predominately decomposed cinder, although some ash is present. The material is composed of less than 40 percent glass and has no value as a pozzolan material.

CONCLUSIONS

The work by the U.S. Bureau of Mines included the determination of the potential of mining claims, cinder deposits, ash deposits, and geothermal steam sites within the proposed wilderness area. This involved consideration of resources, substitutes, and markets.

The Cabot Lake and South Cinder Peak claims are the only recorded mineral claims within the proposed area. The evidence indicates that the Cabot Lake claim, located for gold, has no potential as a gold deposit. The exact site of the South Cinder Peak claims could not be determined, but the area is underlain by volcanic rocks. No deposits of valuable minerals were identified at this site.

Volcanic cinder (scoria) deposits in the high inaccessible places within the Mount Jefferson primitive area cannot compete economically with the almost unlimited resources of similar material in the surrounding readily accessible area. At the present rate of consumption, exploitable resources outside the primitive area are adequate for an indefinite period. The major uses for cinders are road construction and commercial use, such as lightweight aggregates. The cost of hauling to the nearest boundary from deposits within the proposed area would equal or exceed the cost of hauling to that point from deposits outside the area, with the exception of fairly small tonnages from the Lost Lake group. Another deterrent is that other materials such as basalt, which has equal or better inherent qualities for road construction, are readily available in many places near the proposed wilderness area. The most important deterrent for commercial use is haulage to railroads or centers of population. There are large resources of cinder much nearer to railroads or population centers than are those in the wilderness area.

The ash deposits have no value for pozzolan. Materials of this type require more than 60 percent glass, with refractive index in the range of 1.490 to 1.507 to develop satisfactory mortar strength. The ash deposits contain less than 40 percent glass, and the refractive index of the glass is not in the required range.

REFERENCES

Arnold, J. R., and Libby, W. F., Jr., 1951, Radiocarbon dates [list 1]: Science, v. 113, no. 2927, p. 111–120.

Brooks, H. C., 1963, Quicksilver in Oregon: Oregon Dept. Geology and Mineral Industries Bull. 55, 223 p.

Callaghan, Eugene, 1933, Some features of the volcanic sequence in the Cascade Range in Oregon: Am. Geophys. Union Trans., 14th Ann. Mtg., p. 243–249.

Callaghan, Eugene, and Buddington, A. F., 1938, Metalliferous mineral deposits of the Cascade Range in Oregon: U.S. Geol. Survey Bull. 893, 141 p.

Mason, R. S., 1951, Lightweight aggregate industry in Oregon: Oregon Dept. Geology and Mineral Industries Short Paper 21, 23 p.

——— 1964, Oregon's mineral production increases sharply: The Ore Bin, v. 26, no. 1, p. 1–8.

——— 1965, Oregon's mineral industry in 1964: The Ore Bin, v. 27, no. 1, p. 1–10.

Peck, D. L., Griggs, A. B., Schlicker, H. G., Wells, F. G., and Dole, H. M., 1964, Geology of the central and northern parts of the Western Cascade Range in Oregon: U.S. Geol. Survey Prof. Paper 449, 56 p.

Rubin, Meyer, and Alexander, Corrine, 1960, U.S. Geological Survey radiocarbon dates, [pt.] 5: Am. Jour. Sci., Radiocarbon Supp., v. 2, p. 129–185.

Stearns, N. D., Stearns, H. T., and Waring, G. A., 1937, Thermal springs in the United States: U.S. Geol. Survey Water-Supply Paper 679–B, p. 59–206.

Taylor, E. M., 1965, History of volcanic activity, Pt. 1 *of* Recent volcanism between Three Fingered Jack and North Sister, Oregon Cascade Range: The Ore Bin, v. 27, no. 7, p. 121–147.

Thayer, T. P., 1936, Structure of the North Santiam River section of the Cascade Mountains in Oregon: Jour. Geology, v. 44, no. 6, p. 701–716.

——— 1937, Petrography of later Tertiary and Quaternary rocks of the north-central Cascade Mountains in Oregon, with notes on similar rocks in western Nevada: Geol. Soc. America Bull., v. 48, no. 11, p. 1611–1651.

Walker, G. W., 1951, Pumice deposits of the Klamath Indian Reservation, Klamath County, Oregon: U.S. Geol. Survey Circ. 128, 6 p.

Wells, F. G., 1956, Geology of the Medford quadrangle, Oregon-California: U.S. Geol. Survey Quad. Map GQ–89, scale 1:96,000.

Wells, F. G., and Peck, D. L., 1961, Geologic map of Oregon west of the 121st meridian: U.S. Geol. Survey Misc. Inv. Map I–325, scale 1:500,000.

Williams, Howel, 1933, Mount Thielsen, a dissected Cascade volcano: California Univ. Dept. Geol. Sci. Bull., v. 23, no. 6, p. 195–213.

——— 1942, The geology of Crater Lake National Park, Oregon, with a reconnaissance of the Cascade Range southward to Mount Shasta: Carnegie Inst. Washington Pub. 540, 162 p.

——— 1944, Volcanoes of the Three Sisters region, Oregon Cascades: California Univ. Dept. Geol. Sci. Bull., v. 27, no. 3, p. 37–83.

——— 1957. A geologic map of the Bend quadrangle, Oregon, and a reconnaissance geologic map of the central portion of the High Cascade Mountains: Oregon Dept. Geology and Mineral Industries, in coop. with U.S. Geol. Survey, scale 1:125,000 and 1:250,000.

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