Volcanic stratigraphy and alteration mineralogy of drill cuttings from EWEB 1 drill hole, Linn County, Oregon

by

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Open-File Report

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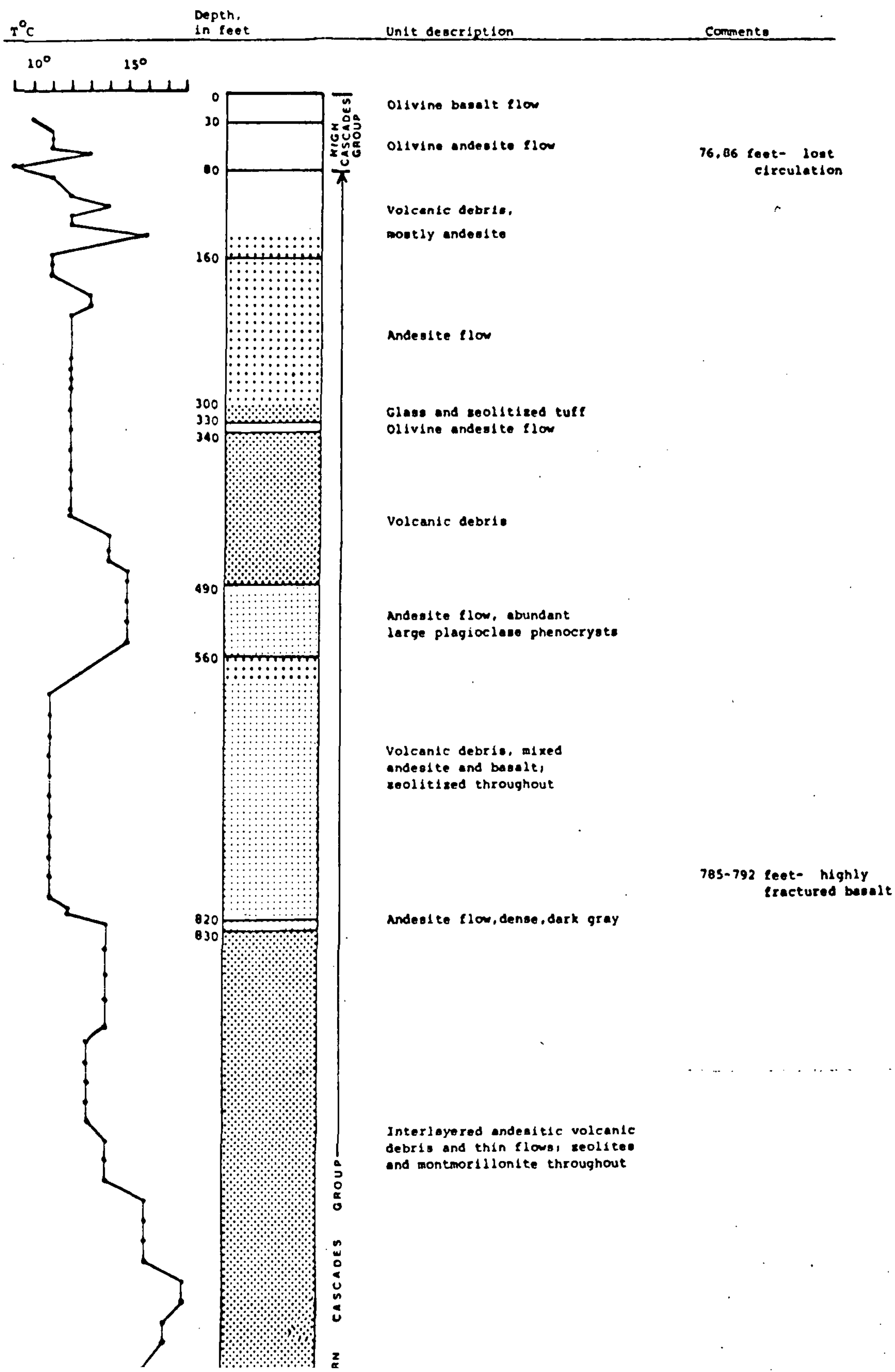
T°C
Depth, in feet
Unit description
Comments
10°
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HIGH CASCADES GROUP
CASCADES GROUP
Olivine basalt flow
Olivine andesite flow
76,86 feet- lost circulation
Volcanic debris, mostly andesite
Andesite flow
Glass and zeolitized tuff
Olivine andesite flow
Volcanic debris
Andesite flow, abundant large plagioclase phenocrysts
Volcanic debris, mixed andesite and basalt; zeolitized throughout
785-792 feet- highly fractured basalt
Andesite flow,dense,dark gray
Interlayered andesitic volcanic debris and thin flows; zeolites and montmorillonite throughout

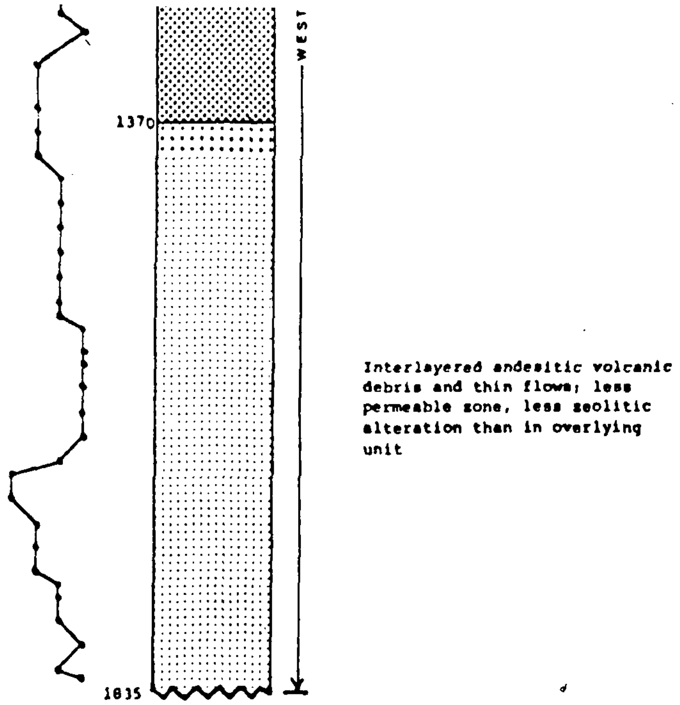

Figure 2. Stratigraphic column for EWEB 1 drill hole. Temperatures measured during drilling are shown at left. Density of dot pattern indicates relative intensity of hydrothermal alteration.

in which clay minerals were identified or suspected were glycolated at 60°C for at least one-half hour and then X-rayed again to determine structural expansion, if any. Plagioclase compositions, where indicated, were determined using the X-ray diffraction method of Smith and Yoder (1956).

A summary of volcanic stratigraphy and effects of alteration are reported here using the data obtained from the laboratory studies and the drill log. Temperatures measured during drilling are shown in figure 2. No chemistry is available on the cuttings and no geophysical logs from the drill hole are available at this time.

GEOLOGIC SETTING

The area of the EWEB 1 drill site is near the boundary between the Miocene volcanic rocks of the Western Cascade Range and the younger Pliocene to Recent volcanic rocks of the High Cascade Range (Wells and Peck, 1961; Peck and others, 1964). The western edge of High Cascades basalt and andesite flows having eruptive vents to the east, unconformably overlie a thick section of andesitic to basaltic rocks of the Western Cascade Range. The older volcanic material consists of volcanic mud flows, breccias, tuffs and thin lava flows. Old weathered surfaces and oxidized flow tops can be seen in outcrops. Much fracturing and faulting undoubtedly has been superimposed upon an already complex volcanic pile.

VOLCANIC STRATIGRAPHY

EWEB 1 drill hole penetrates two lava flows of the High Cascade Group overlying interlayered lava flows, tuffs, and volcanic debris units of the Western Cascade Group (fig. 2).

The upper lava flow of the High Cascades Group from 0-30 foot depth is black vesicular basalt with groundmass of plagioclase and clinopyroxene, and phenocrysts of olivine, orthopyroxene and plagioclase. The underlying lava flow from 40-80 feet is light to dark gray andesite with groundmass of plagioclase, clinopyroxene and hematite. Phenocrysts are mostly plagioclase, and a considerable number are olivine. Abundant red oxidized andesite is mixed with fresh andesite in the cuttings.

The unconformable flow contact between the High Cascades Group and the underlying volcanic units of the Western Cascades Group probably occurs at a depth of about 80 feet.

Cuttings of Western Cascades Group rocks between 80 feet and the bottom of the drill hole at 1,835 feet consist of varicolored basalt and andesite. The major rocks are dark to medium gray olivine basalt and andesite, red oxidized andesite, and orange-brown altered andesite. Plagioclase phenocrysts are conspicuous in all the rock types. Plagioclase composition, determined by X-ray diffraction, ranges from An_{32-35}. Zeolites, montmorillonite, chalcedony, and rarely, calcite occur in vesicles and veinlets and are clearly hydrothermal deposits. Montmorillonite is present throughout the altered interval and most is from rock alteration and not drilling material.

The section probably consists of many thin lava flows interbedded with volcanic debris; however, we generally have not attempted to differentiate individual lava flows during this study. However, several distinctive lava flows can be identified in the cuttings. A dense, medium gray andesite flow from 330-340 feet has a groundmass dominantly of plagioclase and clinopyroxene, and phenocrysts of plagioclase and olivine. An andesite flow from 490-560 feet is characterized by abundant large (± mm long) plagioclase phenocrysts. The groundmass consists of plagioclase, clinopyroxene, and hematite; most is dark gray, but quite a bit is oxidized to dark red. Low temperature hydrothermal alteration has affected this flow, as it has the rocks above and below it, resulting in deposition of minor amounts of chabazite, montmorillonite, and chlorite. A thin, dark gray, very dense, andesite flow occurs from 820-830 feet. Groundmass consists of plagioclase, clinopyroxene, and hematite.

HYDROTHERMAL ALTERATION

Hydrothermal alteration has resulted in deposition of zeolites (phillipsite, chabazite, paulingite, thompsonite), montmorillonite, chalcedony, chlorite, and possibly gibbsite throughout the rocks of the Western Cascades Group, Hammond and others (1980). There is no evidence of hydrothermal alteration in the overlying flows of the High Cascade Group (fig. 2). Alteration minerals, clearly of hydrothermal origin, are first identified at a depth of 170 feet and are most abundant between 980 and 1,370 feet. Hydrothermal minerals usually occur in vesicles and veinlets in volcanic rock fragments. Below 1,370 feet, the andesitic volcanic rocks are not noticeably different in appearance from the overlying units, but they are less affected by hydrothermal alteration and are presumed to be less permeable to circulating fluids. The flows differentiated in figure 2 are less altered, probably because they are more dense and less permeable than the surrounding units.

The dense andesite flow at 330-340 feet is overlain by fine-grained andesite with black glass and fine-grained green tuff. The glass and tuff are partly altered to phillipsite, chabazite, and montmorillonite. The rock beneath the dense flow at 340 feet is dominantly andesitic volcanic debris or tuff in which alteration is intense near the flow and decreases downward away from the flow to 480 feet. Chabazite, phillipsite, paulingite, thompsonite, calcite, and montmorillonite have been identified in this interval, and the zeolitization in this interval may have been enhanced by heat from the flow.

Gibbsite, $Al(OH)_3$, is present at 620, 680, 690 and 1,270 feet in association with montmorillonite. Gibbsite can be formed by hydrothermal alteration, but also forms with montmorillonite as a surface weathering product on basalts. Libbey and others (1945) report on gibbsite occurrences near Portland and Salem, Oregon. Kaolinite is associated with gibbsite at 1,270 feet and trace amounts of kaolinite occur at 570 and 1,040 feet. Possibly the gibbsite and kaolinite formed on surfaces exposed to weathering between periods of volcanic activity in this area.

A few flakes of native copper were observed at 780 feet. Native copper is not uncommon in mafic volcanic rocks as a product of hydrothermal activity (Bargar, 1980; Cornwall, 1956; Kleck, 1960).

Zeolitization occurs during hydrothermal alteration at temperatures generally between 20 and 150°C. Montmorillonite, chalcedony, and calcite are common associated minerals. Evidence of two possible causes of alteration is exhibited in EWEB 1. The flow at 330-340 feet between glassy tuffaceous units has probably provided local heat to the volcanic glass, which is much more reactive than crystalline volcanic rocks, resulting in zeolite and clay alteration from the glass. On a larger scale, most of the zeolitization is in permeable volcanic debris units which permitted access and circulation of hydrothermal fluids. Present structural controls of the alteration, such as the faulting in the vicinity of EWEB 3, 4, 5, and 6 drill holes in the Clackamas River drainage area to the north of this area (Hammond and others, 1980), could also be effective in localizing hydrothermal fluids. Data other than cuttings are necessary, however, to determine the source of the fluids and when they were active. Temperatures measured during drilling (fig. 2) are not conclusive as the system had not equilibrated before the measurements were taken.

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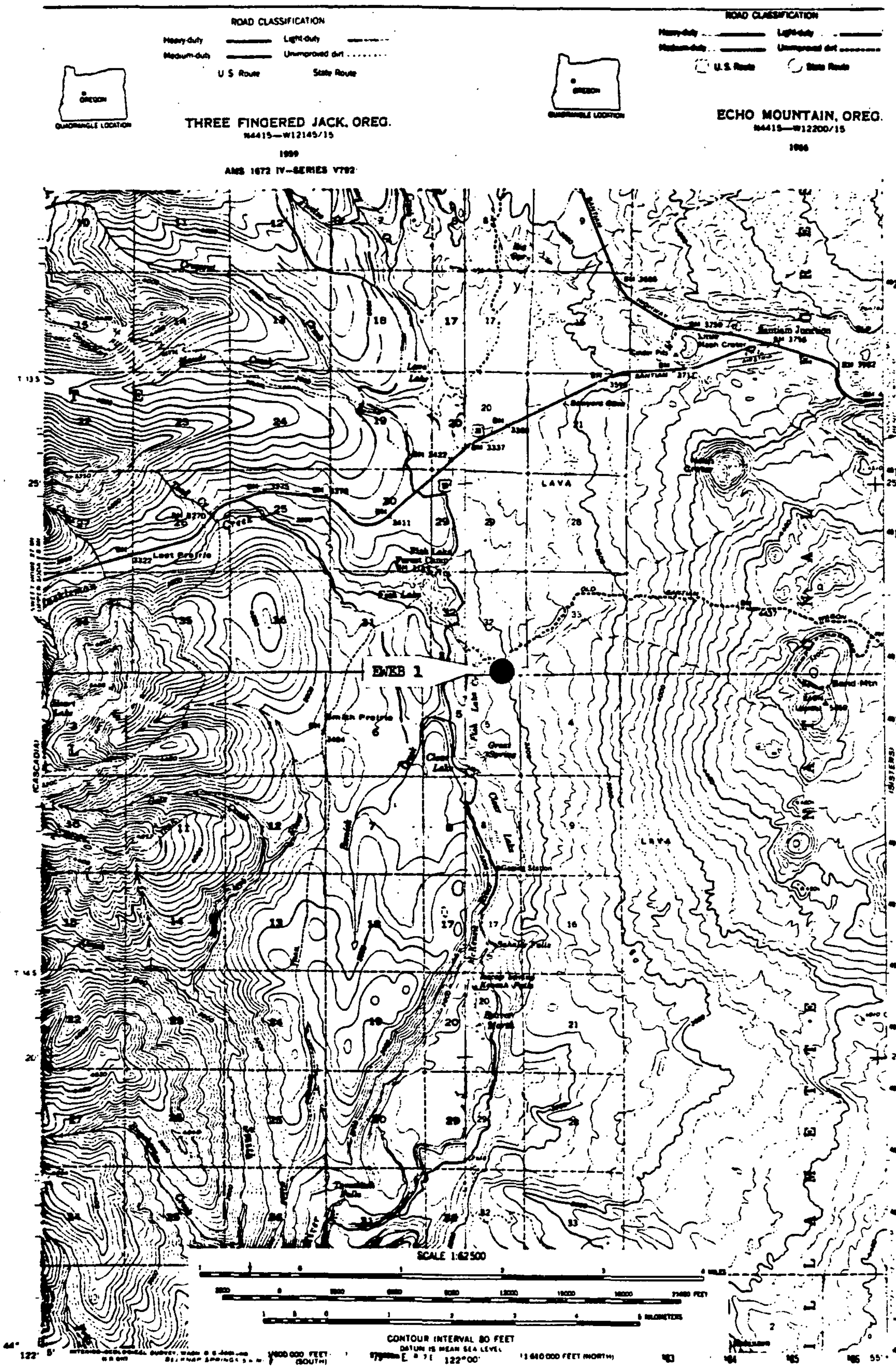
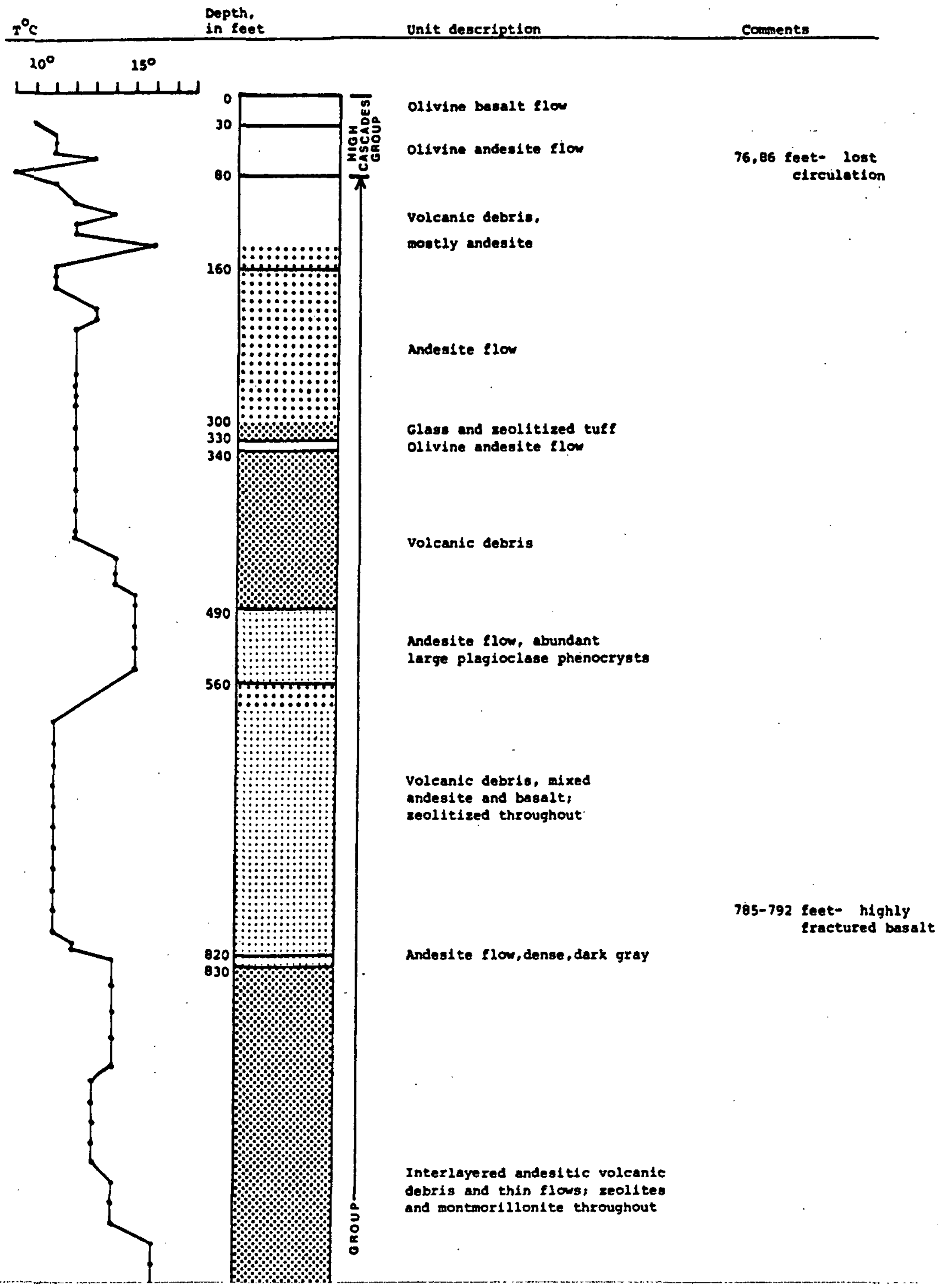


Figure 1. Location of EWEB 1 drill hole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