PUMICE FROM HAYLMORE, BRIDGE RIVER, BRITISH COLUMBIA*

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Abstract

Dacite pumice of Recent age near Haylmore's placer mine, Bridge River district, British Columbia, is highly vesicular and also shows pronounced fluidal structure. The pumice is vitrophyric; the volcanic glass of the groundmass has a refractive index of 1.497. The principal phenocrysts are plagioclase feldspars ($Ab_{70}An_{30}$) characterized by an abundance of glass inclusions. Possible modes of origin of the inclusions are discussed. A chemical analysis of the pumice and the calculated norm are given.

Pumice forms a widespread blanket over much of the Bridge River area of western British Columbia, and its occurrence has been briefly noted in reports of the Canadian Geological Survey. Early in 1946

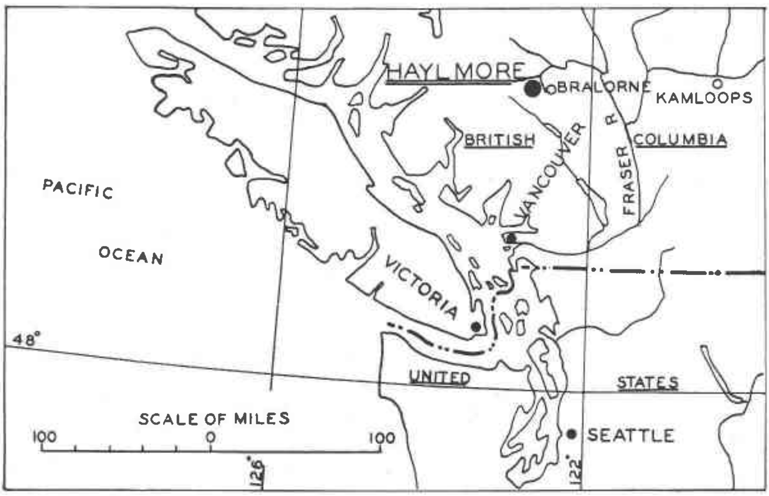

Fig. 1. Index map of British Columbia showing location of Haylmore.

Bralorne mine constructed a new wood road across the Hurley River near its confluence with the Bridge River, exposing an excellent cross-section of the pumice on the west side of the Hurley River, adjacent to the placer workings of William Haylmore (Fig. 1). The pumice rests on stream boulders and silty gravels of Recent age, and grades upward into the soil. The Bridge River pumice bed is remarkably uniform, and

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the Haylmore exposure seems to be a typical section. It is unique, however, in that part of the section shows stratified silty sand overlying the pumice, a sequence not heretofore recorded.

Bateman[1] in 1912 suggested that the source of the pumice was some volcanic vent between the headwaters of the Bridge and Lillooet Rivers, but was unable to locate a vent. McCann[2] in 1922, and Cairnes[3] in 1937, quoted this suggestion, but no vents appear to have been discovered. Lay,[4] who devoted seventeen years, from 1925 to 1941, largely to a study of the geology of the Fraser River area to the east of the Bridge River, noted the rarity of siliceous lavas and the difficulty of determining the source of acid tuff beds in that region. Recently Cummings has made some investigations of pumice along the headwaters of the Lillooet River, and found that Meagher Mountain, which is situated immediately west of the junction of the South Fork and the main Lillooet River, is at least a local source of pumice. He says, however, "It is debatable whether Meagher Mountain was the source of the Bridge River pumice or merely one of a number of local sources."[5] Thus the exact source of the Haylmore pumice remains undetermined, but it does appear to have come from the west, and to have been borne along by the prevailing westerly winds.

The Haylmore pumice bed averages two feet in thickness, and consists of a mixture of small and large particles, mostly of the size of sand and gravel, but ranging from fine dust to lumps two inches in diameter. The deposit seems to be the "granular pumice" type of Moore,[6] and the "pumice fall" of Kôzu as used by Williams.[7] The pumice is grayish-white with phenocrysts of dull white plagioclase and glistening black hornblende embedded in a highly cellular groundmass of volcanic glass.

Microscopically the rock shows fluidal structure with a subordinate development of radial arrangement of glass out from the blowholes (Fig. 2). Approximately 95 per cent of the rock is groundmass, glassy

[1] Bateman, A. M., Lillooet Map-area, British Columbia: *Canadian Geol. Survey,* Summary Rept., 193 (1912).

[2] McCann, W. S., Geology and mineral deposits of the Bridge River Map-area, British Columbia: *Canadian Geol. Survey,* Mem. **130,** 43 (1922).

[3] Cairnes, C. E., Geology and mineral deposits of Bridge River Mining Camp, British Columbia: *Canadian Geol. Survey,* Mem. **213,** 40 (1937).

[4] Lay, Douglas, Fraser River Tertiary drainage-history in relation to placer-gold deposits: *Brit. Col. Dept. of Mines,* Bull. No. **3,** 12 (1940).

[5] Cummings, J. M., Personal communication, October 29, 1946.

[6] Moore, B. N., Nonmetallic Mineral Resources of Eastern Oregon: *U. S. Geol. Survey,* Bull. **875,** 149 (1937).

[7] Williams, Howel, The geology of Crater Lake National Park, Oregon: *Carnegie Inst., Washington,* Pub. **540,** 68 (1942).

with a few irregular spherulites and tiny microlites. Plagioclase phenocrysts make up 4 per cent of the rock, and mafic minerals account for about one per cent. Orthoclase was not found, nor was quartz. The plagioclase is oligoclase-andesine, with an average composition of $Ab_{70}An_{30}$; $\alpha=1.546$, $\beta=1.550$, $\gamma=1.553$. The plagioclase ranges in size from microlites to crystals 2.50 mm. in length, but averages about 1 mm. Some of the phenocrysts show normal zoning, occasionally as a thin skin of more albitic plagioclase surrounding the crystal. Although hornblende was more conspicuous macroscopically, pale green augite is present in

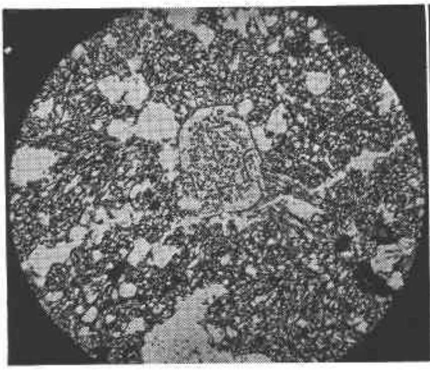

FIG. 2

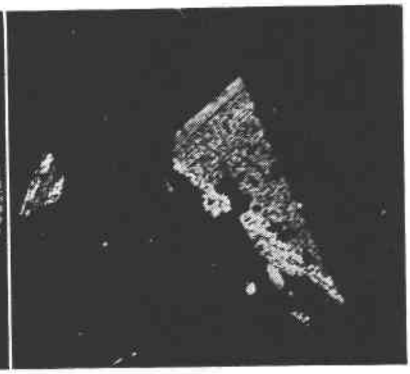

FIG. 3

FIG. 2. Thin section showing the typical rock texture, plagioclase phenocryst in center. Plane light. ×15

FIG. 3. Thin section with corroded plagioclase phenocryst, zoned. Crossed nicols. ×15

approximately equal quantity, and a few corroded flakes of dark brown biotite are also found. Hornblende, showing green to brown pleochroism, has the indices $\alpha=1.655$, $\beta=1.675$, $\gamma=1.680$. Augite has $\alpha=1.685$, $\beta=1.689$, $\gamma=1.708$. The minerals present suggest that the rock is a dacite pumice. It appears to be petrographically similar to other such pumices found along the volcanic belt of the Pacific Coast.

The most conspicuous feature of the rock, microscopically, is the abundance of glassy inclusions in the feldspars. Most of the phenocrysts have a worm-eaten appearance, and are cracked and corroded and embayed by the volcanic glass (Fig. 3). Similar glassy inclusions in feldspars have been described many times in other Western volcanic rocks, but their genesis is not readily explained. The inclusions seem to be characteristic of rocks with a glassy groundmass, and especially pyroclastics.[8]

[8] Coombs, H. A., Personal communication, Nov. 5, 1946. Williams, Howel, Personal communication, Jan. 20, 1947.

Buerger[9] has suggested that the glassy inclusions may be an expression of lineage structure in the original crystallization of the phenocrysts. In recent work in growing certain synthetic minerals, he has found that under conditions of slow crystallization a mineral will form completely, but with rapid crystallization lineage structure develops and uncrystallized glass blebs remain in the crystal (in a pattern similar to that shown in the phenocryst in Fig. 2).

This hypothesis would seem to explain why such inclusions are far more common in the rapidly-chilled glassy rocks than in more crystalline volcanic rocks. It would also explain the occurrence of the glass sometimes found in the center of the phenocrysts as true inclusions not connected with the inward projections of the glassy groundmass of the rock.

However many of the so-called inclusions show strong evidence of having formed in a late stage and appear to be an extension of the glass base of the groundmass into the phenocryst. Coombs has noted a similar appearance in the Nisqually glacier flows on Mount Rainier: "The phenocrysts have ill-defined margins which seem to grade insensibly into the groundmass. On further examination almost all the feldspars showed this effect; an amount out of all proportion to the percentages expected in tapering wedges. Williams has figured a similar effect from the Mt. Harkness lavas."[10] Williams has recently observed: "That the inclusions develop at a late stage is clear. Often I have noticed that the glassy base of a lava is traceable into the cores of feldspars."[11]

It would appear that the phenocrysts had become more and more out of equilibrium with the molten material, and that violent ejection with accompanying fracturing of the phenocrysts assisted the hot and gas-rich residual liquid in working its way into and along the cracks of the crystals, with subsequent reaction. Retrograde boiling processes appear to have been at work.

It would be expected that these later reactions would be most effective along natural zones of weakness in the crystal, so that it is difficult to differentiate between true lineage structure effects and later corrosion. Also, many phenocrysts are crowded with glass inclusions that show no discernible arrangement within the feldspar.

Coombs[12] has suggested that more than one type or generation of glass may occur. The Haylmore pumice offers no positive optical evidence here, for no differences in refractive index of the glass have been

[9] Buerger, M. J., Personal communication, Dec. 27, 1946.

[10] Coombs, H. A., The geology of the Mount Rainier National Park: *Univ. Washington Publ. Geol.*, **3**, No. 2, 180 (1936).

[11] Williams, Howel, Personal communication, Jan. 20, 1947.

[12] Coombs, H. A., Personal communication, Nov. 5, 1946.

observed. Nevertheless, there are examples of zoned phenocrysts in which a glass-filled zone is surrounded by a clear shell of more albitic plagioclase, with some embayment of the outer zone by the glassy groundmass; in such cases an earlier and a later formation of glass seem to be represented. In the many phenocrysts which are completely riddled with glassy inclusions, more than one process may well have been at work; but the formation of glass has been so extensive that evidence of the nature of these processes has been destroyed.

The following analysis of the Haylmore pumice was made in the Rock Analysis Laboratory of the University of Minnesota, E. V. Kerr, Analyst; Lee C. Peck, Chief Chemist:

SiO_2	66.05
Al_2O_3	15.48
Fe_2O_3	1.31
FeO	2.00
MgO	1.38
CaO	3.30
Na_2O	4.30
K_2O	2.21
H_2O+	2.25
H_2O-	0.36
TiO_2	0.50
P_2O_5	0.23
MnO	0.07
Total	99.44

The calculated norm is as follows:

q	23.34
or	12.69
ab	36.16
an	15.29
c	0.51
en	3.50
fs	1.98
mt	1.86
il	0.91
ap	0.34

C.I.P.W.: I424.

The chemical analysis reaffirms the dacitic composition of the rock. This analysis is very similar to that of a dacite pumice from Sun Creek Canyon, Crater Lake,[13] and further suggests the possibility of regional kinship.

[13] Williams, Howel, The geology of Crater Lake National Park, Oregon, *op. cit.*, p. 152.

Acknowledgment

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