

LAVA CREEK VENTS, BUTTE COUNTY, IDAHO*

BY ALFRED L. ANDERSON

Dept. Geology, University of Idaho

Perched high above the north margin of the Snake River Plains of southern Idaho in Butte county are some volcanic vents from which basaltic lava has cascaded down the mountain sides into the valleys and from one of the valleys out upon the vast lava plain that covers such a large part of southern Idaho. These vents are of interest, not only because they have such a unique position high on the flanks of the mountains, but also because they are an extension of a line of craters on the Snake River Plains which are grouped along a great fissure or rift. The lavas have issued from along this "Great Rift", building up a line of lava and cinder cones some of them so recent and exhibiting such a remarkable freshness that the United States Government has set part of the area aside as a National Monument. (1.)

The Lava Creek vents are four and one half to six miles distant from the apparent termination of the rift at the base of the mountains where the latest volcanic activity has occurred and it was not until the adjoining region was studied and mapped by the writer during 1928 that a relation of the Lava Creek vents to the line of craters in the Monument was

established. As the Lava Creek vents are several miles back in the mountains, it was possible to definitely relate the great rift or fissure which has controlled the grouping of the lava vents to structural lines in the mountains and thus determine also the probable relation of the line of craters to concealed structural lines beneath the Snake River lava plain.

The occurrence of volcanic vents on the flanks of the mountains from which lava has cascaded down the steep slopes below has been mentioned by Russell (2) who referred to the flow as the Martin Lava Stream from the name of the post-office at the mouth of the valley. This feature has later been mentioned by Umpleby (3) who applies the name "Lava Creek" for the flow as well as for the district.

GEOLOGIC SETTING

The Lava Creek Vents are perched near the summits of ridges of a maturely dissected mountainous group known locally as the White Knob Mountains that has been carved in Pennsylvanian sandstones, shales, and limestones, and in Miocene volcanics including rhyolites, latites, and andesites. The Paleozoic formations have been deformed by folding and faulting, probably first in the late Mesozoic, and then again together with the volcanic series, which filled ancient valleys carved in the older sedimentaries, in the mid-Tertiary, or perhaps at a little later time. The second period of deformation was accompanied by igneous intrusion and the subsequent erosion has brought to view several bodies of a pink-

*Presented at the Fifth Annual Meeting of the Northwest Scientific Association, Spokane, Wash., December 27-28, 1928.

1. For a description of the many interesting volcanic features in the Craters of the Moon National Monument, the reader is referred to:

I. C. Russell, "Geology and Water Resources of the Snake River Plains of Idaho," U. S. Geol. Survey Bull. 199 (1902) pp. 72-110.

"Notes on the Geology of Southeastern Idaho and Southeastern Oregon," U. S. Geol. Survey Bull. 217 (1903) pp. 38-47.

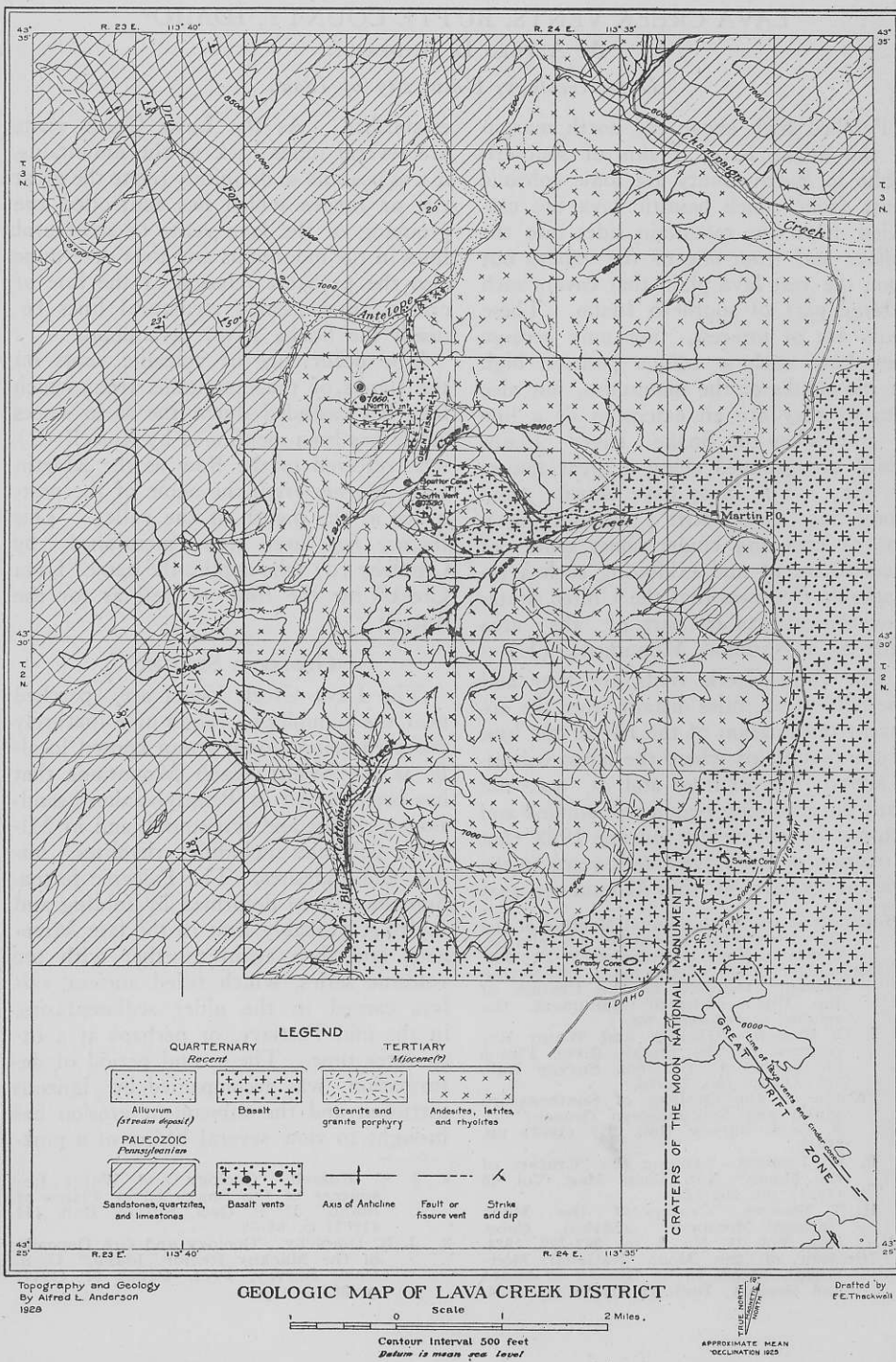
R. W. Limbert, "Among the 'Craters of the Moon,'" Nat. Geog. Mag. Vol. 45 (1924) pp. 303-328.

H. T. Stearns, "Craters of the Moon National Monument (Idaho)," Geog. Rev. Vol. 14, No. 3, pp. 362-372, 1924.

"Craters of the Moon National Monument, Idaho, Idaho Bureau of Mines and Geology, Bull. 13, (1928) pp. 5-24.

2. I. C. Russell, "Geology and Water Resources of the Snake River Plains of Idaho," U. S. Geol. Survey Bull. 199 (1902) p. 68-69.

3. J. B. Umpleby, "Geology and Ore Deposits of the Mackay Region, Idaho," U. S. Geol. Survey, Prof. Paper 97 (1917) p. 36.



ish porphyritic granite and granite porphyry which cut both the Paleozoic rocks and the Miocene volcanic series. The physiographic development is not clearly decipherable within the area, but erosion has produced a maturely dissected mountainous mass with a maximum relief of about 3770 feet from where Lava Creek flows upon the Snake River Plain to the top of Blizzard Mountain, the highest peak. The structural features of the mountains and their relation to the recent volcanic activity will be considered in another place.

THE VENTS

Only two of the vents are of consequence, one of them being the source of a great quantity of lava that flowed into the valley of Lava Creek and out upon the Snake River Plains. This vent, the most southerly and nearest the National Monument, is designated as the South Vent. The second is nearby, but the quantity of lava from this vent is small and flowed into the valley of Dry Fork of Antelope Creek on the north. This vent is designated as the North Vent. Between the two is a small spatter cone that is worthy of description though it did not contribute to the lava flows.

SOUTH VENT: This, the most interesting as well as the greatest of the vents, is perched near the terminus of a ridge at an elevation of about 7580 feet. This vent has a small cone of explosive material. The cone is composed largely of black to reddish cinders and of reddish scoria, but lava breached the side of the cinder cone near its base on the north and east and poured into the valley of Lava Creek, the two streams which united as one some distance lower of the valley side. The cinder cone lacks a distinct crater and is essentially a rounded hill of loose cinders with some larger volcanic bombs resting 120 feet and more about the fissure from which the lava issued. There are no mounds or cones

where the lava comes to the surface. Small pine trees cover parts of the cinder cone, but much of the cone is free from vegetation and appears remarkably fresh showing little or no evidence of erosion. The cone rests in part on an eroded surface of tilted Pennsylvanian limestone and in part on Tertiary acid volcanics. The base of the cone covers about one-fourth of a square mile.

The lava which apparently issued quietly after a short period of explosive activity cascaded into the valley of Lava Creek, descending 1500 feet in about one mile and then flowing with a lesser gradient out upon the Plains three and one-half miles to the east. The total descent of the lava is about 1900 feet and the length of the flow more than six miles. On entering the main valley of Lava Creek, the flow was restricted by the narrowness of the valley to about 400 yards wide but flares toward the mouth of the valley and spreads widely where it enters the Plain. The drainage was generally deflected to the side of the valley, though in one place the stream crosses the surface of the basalt to the other side but without trenching the lava surface. The vent is recognizable from a distance by the reddish color of its rock. Otherwise, it is relatively inconspicuous.

NORTH VENT: This vent is likewise most conspicuous as a cinder cone perched or built up near the crest of the ridge about one mile to the northwest of South Vent and separated from it by the main tributary of Lava Creek. The cinder cone lies to the front or east of the lava vent and has an elevation of about 7660 feet. This cone is smaller than the South Cone, and, unlike the South Cone, the lava has issued from behind and has flowed into gullies on either side. The cinder cone is similar to the first cone, composed of loose cinders and volcanic bombs partially covered with vegetation, but clearly recognizable by its dark reddish

and black color against the background of the lighter-colored, older rocks. This cone lacks the roundness of the other and comes nearly to a point. The lava vent lies about 350 yards to the west of the cinder peak at about the same elevation, resting directly on the Tertiary volcanic formation. It is probable that the cinder cone was much larger and that the lava carried much of it away. A small crater is preserved on this vent shown by a depression several feet below the outer rim, and outlined by the reddish color of the basalt. The crater is about 80 feet in diameter.

The lava flowed steeply on both sides of the cinder cone into the valley about 960 feet below. The south edge of the lava completely obstructed a minor valley and caused the drainage to be deflected over a low saddle into the main Lava Creek Valley on the south. A tongue of basalt also extended into this depression, but none of the lava entered the main valley. Other drainage changes were inaugurated as shown on the accompanying map. The main flow, however, did not enter the Lava Creek drainage though in two places it nearly spilled over, but the basalt passed to the north for about one-half mile and entered the valley of Dry Fork, following the valley for about one-half mile. The end of the flow rises wall-like across the valley edge. The maximum length of this lava flow is about one and one-half miles.

A second vent lies about 100 yards to the northwest in direct line with the others. This vent is of the same character as the North Vent, but it furnished only a small quantity of basalt, none of which flowed down the valley side.

SPATTER CONE: This interesting little feature lies in the valley floor of Lava Creek between the two large vents. This small cone has been built up by reddish lava clots to a height of about 30 feet and is roughly circular in outline. No crater is preserved at its top. Some reddish cinders and scoria occur with larger

fragments of ejected material, but much of the cone is composed of lava clots that have fallen on its sides and of thin streams of lava that have trickled over the surface of the cone. No lava extends from its base.

This spatter cone occurs directly between the two larger vents and in line with them, and this fact also suggests that all are on the same rift or fissure.

CHARACTER OF LAVA SURFACE

The lava, in descending the steep slopes below, formed veritable cascades, and on cooling was left with an excessively rough surface. The crust first formed was broken and the fragments were cemented together by still plastic lava so as to make up in part a coarse breccia. Many masses of fragmental crust were carried far down the stream and out on to the border of the Snake River Plains. The rough surface of the lava is characteristically that of the aa type and this character is preserved throughout the entire flow even on the Plains where the movement was relatively slow and sluggish. The original rough, jagged surface was further broken by the settling of the crust where lava drained from below. The rough surface has been in part modified by an accumulation of soil which has filled in some of the crevices or cracks in the lava, but the more jagged parts still remain much the same as when the lava cooled. The flows are generously clothed with sagebrush which has gained foothold in the soil in the cracks or on small alluvial plains built on parts of the lava flow in front of some tributary valleys. The lava has lost some of its original freshness when compared with the very recent flows in the Monument, but the surface shows slight signs of weathering.

PETROGRAPHY OF THE BASALT

The surface of the basalt is generally glassy or scoriaceous, but this shell is relatively thin and a well defined crys-

tallinity may be detected in broken fragments of the lava crust. The crystals are of minute size near the surface but even a very short distance inward the basalt becomes relatively coarse grained and the crystals of plagioclase are recognizable. A few large crystals of glassy feldspar are scattered as phenocrysts in some of the rock. These were carried up in the molten magma from below and did not develop at the time the basalt crystallized at the surface. The basalt is generally vesicular, especially near the upper surface and the vesicles range from microscopic sizes to cavities several inches across. The basalt shows little sign of alteration by weathering and the broken surface is dark gray, nearly black.

Thin sections of the rock examined microscopically show that it is a normal, olivine-free, basalt. The basalt has a pronounced ophitic or diabasic texture with small crystals of augite and a dark glass filling the spaces between the acid labradorite laths. The laboradite is the most abundant constituent, though closely followed by augite and glass. Parts of augite crystals tend to merge with some of the glass and it is probable that the glass represents the augite that did not have the time or opportunity to properly crystalize. Magnetite in minute cubes is an abundant accessory, comprising several per cent of the mineral constituents.

RELATION OF THE LAVA CREEK VENTS TO THE CRATERS OF THE MOON NATIONAL MONUMENT

An inspection of the map will show clearly that the Lava Creek vents are in direct line with a continuation of the chain of cones and craters in the Monument which are grouped along the Great Rift. Mention has been made heretofore of the arrangement of the Lava Creek vents in a straight line which suggests their grouping along a fissure or rift. The Monument cannot be seen from the Lava Creek vents nor can the Lava

Creek vents be seen from the Monument because of a high intervening ridge and it is probably for this reason that the relationship between the two had not been established previously, until both had been accurately mapped. The South Vent is four and one-half miles from the most northern vent in the Monument. The rift or fissure cannot be traced between them, probably because erosion on the high intervening ridge is too rapid to permit such a fracture to remain unfilled nor is the nature of the rift such as to form a topographic expression or influence erosion. Curiously, eruption occurred at these two rather widely spaced localities.

NATURE OF THE RIFT

The rift along which volcanic activity has occurred shows but little displacement where it is exposed at the surface. In the Monument the rift is not a continuous fracture so far as can be determined, but occurs as a great rift zone comprising several parallel fractures along which several rows of craters now trend. These fissures have been reopened several times and where the lava failed to well up in them remain as more or less open clefts. These fissures may be traced across some of the older flows and in such places show very little displacement. They are more truly great cracks in the earth's crust.

The Lava Creek vents show no definite fissure connecting them. Erosion of the Tertiary volcanics is particularly rapid in the high mountainous region and fissures could not remain open long. An exception to this is an open fissure that crosses the limestone ridge between the South Vent and the North Vent. This fissure, a great open vertical crack crosses the low ridge, forming in part a gaping chasm 4 to 6 feet wide and undetermined depth. This crack may be traced for several hundred yards, but lower on the valley sides it has been filled with erosional products and in the valleys by silts. However, this open fissure is not

in line with the two vents, but occurs nearly at right angles to the line that connects them, striking approximately N. 35°E. It is, however, in direct line with the South Vent and it is not at all improbable that the location of the South Vent has been determined by the intersection of this fissure with the main structural rift and that this open fissure represents a complimentary set unfilled by lava.

AGE OF THE LAVA

The basalt from the Lava Creek vents is reasonably young, perhaps only a few thousand years old. Weathering has scarcely affected the surface, if at all. The cinder cones have not been dissected, the cinders have not been cemented, nor have the streams cut into the lava. The flows are covered in part by a thin mantle of soil though great patches of barren lava also occur. Sage brush grows nearly everywhere on the flows. This lava is older than the very recent lava of the Monument which Stearns (4) intimates was poured out more than 250 years ago and probably less than 1000 years ago. But in the Monument Stearns distinguishes three main epochs of eruption, the earliest "long before Egypt had a name" produced a long line of cinder cones and thick jagged flows, consisting largely of broken blocks. Much of the lava and most of the cinder cones in the Monument belong to a younger, second epoch, which was followed soon after by the very youngest flows of the third epoch. The basalt from the Lava Creek vent is greatly similar to some of the older flows in the Monument and was probably poured out during the first great epoch.

RELATION OF THE GREAT RIFT TO TECTONIC LINES

When the direction of the "Great Rift" is compared with the direction of the trend lines of the older rocks in the

region a striking parallelism is noted. The direction of the "Great Rift" is approximately N. 35°W. and this about corresponds to the strike of the Paleozoic formations some distance from fault lines or intrusive contacts. It is about parallel to the axis of an overturned fold that is shown to the northwest of the Lava Creek vents and about one and one-fourth mile west of the extension of the rift up Dry Fork Valley. It is nearly parallel to an anticlinal axis in a broad fold of the Tertiary volcanics. The rift is also parallel to many faults in the older formations that are not shown on the map. Other faults occur at approximately right angles to the rift or about parallel to the complimentary fissure across the limestone ridge. An alignment is also shown with the Tertiary intrusives, for most of the stocks and dikes are elongated in a direction which approximately parallels the "Great Rift", though a few smaller dikes occur nearly at right angles to this direction.

Thus the Great Rift bears an obvious relationship to earlier trend lines, and this direction has been one of weakness from the first recognizable folding and faulting in the Mesozoic to the present day. Whether the forces that have produced the folds and fractures have been always from the same direction is not so clear, and there is some evidence to the contrary, but the early trend lines have exerted a control in subsequent movements.

CONCLUSION

The Lava Creek vents perched high and well back in the White Knob Mountains of Idaho are an extension of a line of cones and craters on the Snake River Plains that are grouped along a great rift or fissure. This great fracture of relatively recent date follows earlier lines of weakness and is approximately parallel to the trend lines in the older rocks developed in Mesozoic and Tertiary time. Thus this direction has been one of weakness from the Mesozoic to

4. Op. Cit. pp. 19-21.

the present day and has served to localize the recent volcanic activity of the region.

AN EFFICIENT LABORATORY OZONIZER*

ARTHUR A. LEVINE

Department of Chemistry, State College of Washington

In an investigation of the effect of ozone upon unsaturated organic compounds undertaken in this laboratory, it was found necessary to construct an ozonizer yielding a high concentration of ozone in order to bring about certain reactions. This paper is a description of an apparatus that will yield nearly 18% of ozone, and can be easily assembled.

Chemical literature contains numerous descriptions of ozonizers, but many can be assembled by expert glass blowers only, and hence become quite expensive. The apparatus described in this paper cost about \$100. It is similar to those described by Briner, Patry, and de Luserna [*Hel. Chim. Acta*, 7, 62 (1924)] and by L. I. Smith [*J. Am. Chem. Soc.* 47, 1844 (1925)] with some modifications. The ozonizing tubes consist of three Berthelot tubes of the same dimensions and type as described by Smith and illustrated in Fig. 1. The outside tube A is 4.5 cm. in internal diameter and 45 cm. in length, into which is sealed an inner tube B 3.9 cm. in external diameter and 48 cm. long, in such a way that the annular space between the two tubes is 3 mm. Into the outside tube are the intake tube I, and the outlet tube O of 0.5 mm. glass tubing extending about two centimeters above the top of the inner tube. The glass is about 0.8 to 1.0 mm. in thickness. These tubes were constructed by the Central Scientific Company of Chicago.

The electrical transformer is a Thorndarson 1 K. V. A. radio transformer operating on a 110 volts, 60-cycle current, rated to deliver a 25,000 volts current in the secondary. This voltage was found to be too high so a resistance consisting of seven carbon filament lamps connected in parallel was inserted in the primary circuit. This reduced the voltage in the primary to 50-52 volts, and presumably reduced in the secondary to about 11,000 volts. The current consumption was practically constant amounting to 1.32-1.34 amperes.

The container for the Berthelot tubes consists of a galvanized iron tank 12x16x21 inches provided with a wooden cover 5x16 inches. There is soldered to the bottom of the container a piece of galvanized iron, bent thus  provided with three holes about 3 cm. in diameter having a side slit to fit the intake tube and spaced in such a way that a two-holed rubber tube stopper will accommodate the intake of one and the outlet tube of the next Berthelot tube.

This serves as a support for the ozonizing tubes. The cover is provided with holes about 4.2 cm. in diameter, spaced the same as the support, serving to hold the upper ends of the tubes in place, and a set of smaller holes to accommodate the inlet and outlet tubes.

The apparatus is assembled as in the accompanying diagram (Fig. 2). A circular piece of rubber, having a hole in the center sufficient to fit the intake tube is used as a cushion for the Berthelot tubes. The cover is held in place by a galvanized iron bracket soldered to the side of the tank. After the Berthelot tubes have been placed in position, the projecting inlet and outlet tubes are inserted through a two-holed rubber stopper. The tubes should project two or three centimeters through the stopper. A piece of glass tubing of sufficient diameter to fit the stopper and about three cm.

*Presented at the Meeting of the Northwest Scientific Association, Spokane, Wash., Dec. 28, 1927.