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INFLATED LAVA

Lawrence A. Chitwood

1400-1500 words

Introduction

Overpriced lava? No. Overfed and obese lava? Yes! Inflated lava has overindulged in several areas of central and eastern Oregon. The swelled-up and bloated results make up a remarkable landscape of pressure plateaus, pressure ridges and tumuli. The odd thing is that these overstuffed lavas began as thin, runny lava flows of basalt before they fattened up.


Cracked tumulus

Many of the younger lava fields of basalt in central and eastern Oregon, those less than about a million years old, show distinctive landforms that have resulted from inflation, or swelling, of lobes and sheets of initially thin lava flows. These highly fluid lavas erupted onto landscapes of very low gradient, usually less than 2 degrees, and spread from vents into wide sectors of land. Excellent examples of inflated lava forms can be seen at Badlands Volcano (the Badlands about 15 miles southeast of Bend), the Potholes lava flow (between East Butte and Pine Mountain southeast of Bend), the Devils Garden lava flow (along the north edge of the Fort Rock Basin), Diamond Craters (40 miles southeast of Burns), and Cow Craters (west of Jordan Valley). Inflated lava is common at Craters of the Moon, Idaho, and at Lava Beds National Monument, California.

Very little has been written about inflated lava (Holcomb, 1981) but it is now known to be common under certain conditions. A few geologists have observed lava inflating in Hawaii (J. Lockwood, D. Peterson, pers. comm.) and applied the name, inflated lava. But the process of its formation has not been understood or described until recently (Chitwood, 1987).

PROCESSES

As lava spreads like an expanding puddle over an increasing area on relatively flat land, the rate of advance slows. A situation is reached when the strength of the cooling and thickening crust overwhelms the ability of the flow to continue advancing. These outer regions then slowly inflate, rising vertically like giant loaves of leavened bread. Initial thicknesses of 1 to 5 feet can increase to 10 to 70 feet; that is, lava can swell up typically 5 to 10 times its original thickness. Badlands Rock on Badlands Volcano is an exceptional example. It inflated to a height of 100 feet high having swelled 10 to 20 times its original thickness. Inflated lava ceases to inflate when the feeding distribution system of channels and tubes backfills and overflows, or when a tube freezes. The inflated regions usually remain under pressure until

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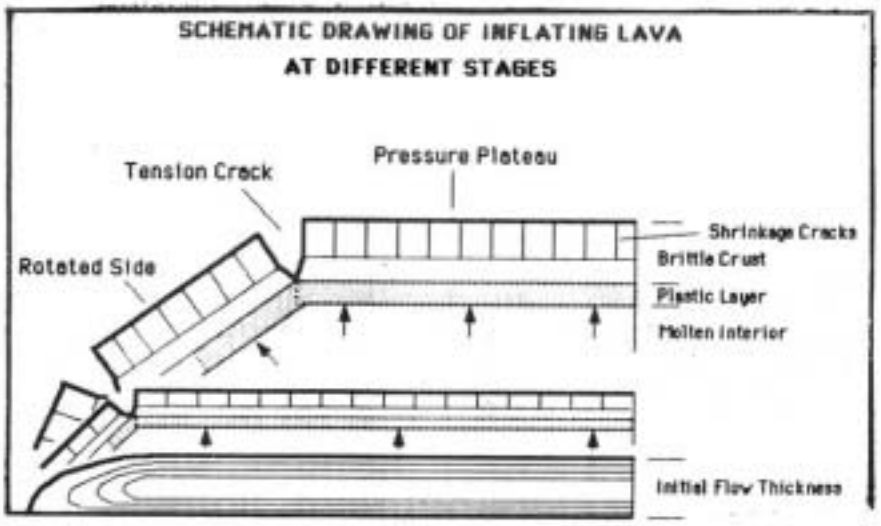
they freeze (crystallize), thus preserving the inflated forms.

Field observations and laboratory experiments show that a plastic membrane of high strength develops and encloses the stagnated lava. This plastic layer develops between the outer brittle crust and the liquid interior of the lava flow. It behaves like very stiff taffy that does not change its shape unless forced.

The plastic layer begins to grow and thicken as molten lava cools and crystals begin to grow. The inner, hotter part of the lava contains mostly liquid with only a few crystals. The outer part close to the surface contains mostly a strong, brittle network of interlocking crystals with some liquid. With further cooling, this outer region completely crystallizes, shrinks, and breaks into blocks and columns. But the middle part of the region, the plastic layer, is a crystal-liquid mush that behaves as a stretchable, taffy-like material. This plastic layer allows basaltic lavas to inflate without rupturing.

During inflation, the brittle crust above the plastic layer breaks into separate slabs which tilt this way and that. Cracks, some of them quite large, open up between slabs. These and several other features develop during inflation.



THE LANDFORMS OF INFLATED LAVA

Distinctive forms develop during inflation of basaltic lava. Some of the most important are tension cracks, pressure plateaus, plateau pits, pressure ridges, and cracked tumuli.

Tension Crack. A tension crack is an elongated opening or trench on the surface of lava that opens during swelling. The columns and blocks of the walls on opposite sides of the crack match each other except where they have broken off and in the deeper parts of the crack where widening took place in the plastic layer. Sometimes, wedge-shaped squeeze-ups of plastic material (the crystal-liquid mush) have been extruded from the bottom of a tension crack. Long after the lava cools, tension cracks and other low places in the lava field slowly fill with windblown soil and volcanic ash.

Pressure Plateau. A pressure plateau is a broad, horizontal, elevated surface with steeply sloping sides. Its outline, seen from above, is something like that of an amoeba, with irregular curving edges. Tension cracks usually develop around the perimeter of the elevated surface. The horizontal surface, like that of a water bed, represents hydrostatic equilibrium when the pressure plateau possessed a molten interior. Pressure plateaus can extend over areas of a few hundred square feet or hundreds of acres. Their thickness is usually 10 to 70 feet.

Plateau Pit. A plateau pit is a circular or irregularly-shaped depression or crater in the elevated surface of a pressure plateau. The bottom of the pit was not flooded by the lava of the pressure plateau, or not flooded to a sufficient depth to inflate with the rest of the lava.

Pressure Ridge. A pressure ridge is a relatively narrow but long lobe of inflated lava with sides that have been uplifted and tilted outward. One or more tension cracks may have developed lengthwise along the top. Some pressure ridges develop in a process of "unfolding", such that the sides are continuously underplated as they tilt outward.

Cracked Tumulus. A cracked tumulus is a short pressure ridge, usually an oval feature with tilted sides and a tension crack running down the middle. These are perhaps the most common features in fields of inflated lava. They represent the swollen wide spots ("aneurysms") or terminations of small, elongated lobes of lava.

Other Features. The sides of nearly all inflated features have tilted outward and are called tilted or rotated sides. They often tilt 30 to 60 degrees from horizontal. Occasionally, tilted sides have been rotated to vertical positions. The sides of pressure ridges, tumuli, and pressure plateaus all possess tilted or rotated sides.

Certain important features are related to the shape of the edge of the lava. The slopes above the edge react differently to inflation depending on whether they are concave, straight, or convex.

During inflation at a concave edge, the slabs, blocks, and columns of crust that make up the uplifting and tilting sides of pressure plateaus and ridges compress to form a more or less rigid, curved block or slab that rises as a unit.

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COMING EVENTS

Jan 17 Monthly Meeting at the new Natural Resource Center, 1005 N.W. Newport (The old Scandia House, just east of Food Towne market)
6:00-Board of Directors meeting
7:00-Social time/refreshments
7:30-General meeting-The program will be a slide presentation of BLM Areas of Critical Environmental Concern, conservation report by Don Tryon and discussion of conservation projects for the year.

Jan 28-Field trip to Squaw ridge area. See details on page 4.

April 21,22,23 Desert Conference at Malhuer. Mark your calendar now. More details later.

A big change is in the offing. If you have been receiving complimentary copies of The Rambler, we invite you to join ONDA today. We are computerizing our mailing list and if a renewal date appeared on your mailing label, we have you listed as a member. If one did not, we do not show you as a paid-up member. Remember as a member, not only will you continue to receive The Rambler, but you will be supporting an ambitious program of conservation projects.

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Alpha. order ??
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NATIONAL WILDLIFE REFUGES

In November of 1976 the US Fish and Wildlife Service published an Environmental Impact Statement on the management of the National Wildlife Refuges. Now, more tha a decade later a new Draft Statement has been released.
The Refuge System includes 442 refuges and 88,431,841 acres. The programatic Draft EIS just released provides broad management direction for the system. There are four alternatives presented. To give you an example, Alternative B states "... compatible recreational and economic uses would be encouraged and permitted whether or not they are wildlife-oriented or part of a wildlife management scheme."

The document has a lot of good information about the National Wildlife Refuge System. If you want to respond to the document you must do so by March 6 th.

You may obtain a copy of the document from:

Division of National Wildlife Refuges
Environmental Impact Statement Coord.
U.S. Fish and Wildlife Service
18th and C Streets, NW, Room 1306
Washington, DC 20240

Many thanks to Larry Chitwood, geologist for the Deschutes Forest, for writing our feature article. The article is an adaptation from a paper he presented to the Dec. '87 meeting of the American Geophysical Union, on his original work with inflated lava formations. It was satisfying answer for those of us who have always wondered how these many lava domes could have been formed.

A cavern, called a liftup cave, opens up under the rising block. The back wall of the cave, sometimes 30 feet from the cave opening, and other parts of the cave are slowly extruded at a steep angle out of the crystal mush of the plastic layer. This wall is called an extrusion wall. In circular plateau pits where the edge of the lava is continuously concave, these caves may completely encircle the pits.

Along straight edges, one or more tension cracks develop approximately parallel to the edge of the flow at the top of the tilted sides of pressure plateaus and ridges.

Above straight edges, one or more tension cracks develop approximately parallel to the edge of the flow at the top of the tilted sides of pressure plateaus and ridges.

Above convex edges, the slabs, blocks, and columns of crust are pulled apart and fanned out during inflation to form a cracked fan lobe. Pie-shaped wedges of crust alternate with tension cracks.

PLACES TO VISIT

To appreciate the rugged beauty of fields of inflated lava, spend awhile walking through the Badlands (see Badlands Rock and the two large features to the west: The Castle, and Flatiron), the Potholes (especially the area along the west base of Pine Mountain), Diamond Craters (superb examples everywhere) or Devils Garden. Look for tilted sides of swelled-up lobes of lava, liftup caves at concave edges, and walk down soil-filled tension cracks. Consider the surprising variety of small-and large-scale landforms that this process of inflation creates. As windblown soil slowly fills cracks, pits, and caves, this remarkable landscape becomes home to an increasing variety of plants and animals.

REFERENCES

Chitwood, L. A., 1987, Origin and morphology of inflated lava (abstract): Amer. Geophysical Union, EOS, vol. 68, no. 44, p. 1545.

Holcomb, R.T., 1981, Kilauea Volcano, Hawaii: chronology and morphology of the surficial lava flows: U.S. Geol. Survey, Open-File Report 81-354,p.94.

ONDA ACTIVITIES

ONDA has joined with other conservation groups in retaining Don Tryon as a consultant to assist with the Desert protection campaign.

Don will put together a list of activists who will receive action alerts on proposed management activities within Wilderness Study Areas. He will personally work with BLM to try and protect Study Areas until Congress passes legislation.

The conservation community and the Congress need a status report on how well the Wilderness Study Areas have been protected. Don will write such a report.

Finally, there is no collection of data about all of the BLM wildlands. The BLM wilderness study only addresses about half of BLM wild areas. Don Tryon will put together an atlas of these areas in the Sage Proposal.

These projects will be in progress over a two year period. They dovetail nicely with ONDA's objective of collecting data about the wild areas by a volunteer membership group.

SQUAW RIDGE FIELD TRIP

There are several options for this trip:

1. Drive down Sat., hike and return the same day.(This is a very long drive)
2. Drive down Fri. evening, stay at Crawford's cabin, hike Sat., and return.
3. Drive down Sat. morning, hike and stay over Sat. night.

The Crawfords can accommodate up to 8 people each night on a first-call/sign-up basis. Bring sleeping bags and food to fix, or eat at the restaurant. Lunches must be packed. There is also a motel available. What we see and do will be weather and road dependable. Bring binocs and throw in the X-C skis.

Call Fran at 382-2658 for questions, signup and directions.

NOTICE TO FIELD TRIP PARTICIPANTS

Weather is often severe and terrain rough so proper dress and footwear is essential. Bring water and lunch. Please contact trip leaders for difficulty, mileage, etc. You participate at your own risk.

Times 18

OREGON NATURAL DESERT ASSOCIATION
MEMBERSHIP APPLICATION

Times 12

I'd like to join the Oregon Natural Desert Association and recieve the monthly news letter.

- ✓ Individual--$12.00
- ___ Couple-------$15.00
- ___ Family------$20.00

___ I'd like to contribute more. Enclosed is my contribution of $_____

Times 10

My interests are: ✓ Natural History ✓ Geology
___ Botany ✓ Wildlife ___ Cultural Resources
✓ Wilderness Protection ___ Recreational Hiking

Times 10

I'd like to participate in the folowing: ✓ News letter ✓ Field trips ___ Membership/fundraising ___ Programs

Times 12

Name Mike Sequeira
Address 20941 Desert Woods Dr.
Bend 97702

Phone 382-1227
Best time to call is?
PM

OREGON NATURAL DESERT ASSOCIATION
P.O. Box 1005
Bend, Oregon
97709

Times 12

To_____

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