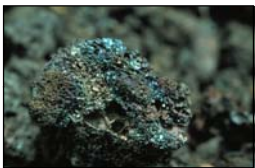


Description of Map Units

Lava flows of the Broken Top area, Craters of the Moon lava field
Units arranged by age; youngest unit located at top of lefthand column and become progressively older as move down toward right

MAP SYMBOLS

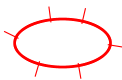
- **Cave**
Buffalo Caves: lava tube formed by the withdrawal of molten lava after the formation of a surface crust
- **Hiking trail**
- **Road (Surfaced)**
- **Contour line**
- **Contact**
Dashed where approximately located; relative ages of flows along contact indicated by Y, younger, O, older
- **Fault**
Approximate fault line; cube on downthrown side
- **Scarp**
Gravity fault: vertical lines point to area of lower elevation
- **Fissure**
Eruptive and noneruptive fissures: eruptive fissures are fractures through which lava erupted, while noneruptive fissures represent fractures in the lava through which lava did not erupt



- **Flow front**
Related to Sawtooth flow; two prominent flow fronts ranging in height and length, surrounded by smaller fronts. Area is also characterized by rafted blocks ranging in size from < 1 m to ~ 20 x 30 m



- Crater**
Crater rim on volcanic vent: hachures point toward central depression



- Lava pond**
Lava pond surrounded by levees; hachures point away from ponded area



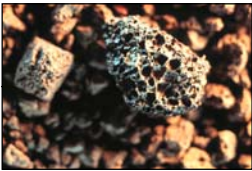
- Trench Mortar Flat flow (2,205±25) and related deposits**
Pahoehoe basalt-hawaiiite flows
Thin, shelly flows erupted (and surface fed) from the northern part of the Trench Mortar Flat eruptive fissures lying southeast of Big Cinder Butte cinder cone (cc3)



- Spatter**
Accumulations of agglutinated spatter and cinders related to the Trench Mortar Flat events



- Volcanic ash deposits**
Ash and fine lapilli associated with the Trench Mortar Flat eruptive events. The material is mainly < 1 m thick and is located along the north end of Trench Mortar Flat on the downwind (NE) side of the source vents



- Sawtooth flow (6,020±160) and related deposits**
A'a trachyandesite flow
Flow is generally characterized by large ash units and steep-fronted lobes and was issued from vent at south end of Big Cinder Butte cinder cone (cc3)



- Slabby lava flow**
Rafted slabs and surfaces of pahoehoe lava believed to occur as late-stage streams between Sawtooth A'a lobes. Some of the slabby flows appear to be remobilized regions of the Sawtooth A'a flow.



- Big Cinder Butte cinder cone**
Contains large crater with walls mantled by agglutinated spatter and minor flows. Reported by Stearns (1928) to be one of the largest purely basaltic cinder cones in the world, having a height of 240 m and a volume of approximately 0.2 cubic km. The aligned craters on the east and south flanks of the cone are likely to be part of the Trench Mortar Flat eruptive fissure system



- Volcanic ash deposits**
Ash and fine lapilli associated with Big Cinder Butte (cc3). Deposits occur as thick as 1 m on inner crater walls, and as thick as ~ 5 m, though discontinuously, on west and south flanks of cone



- Crescent Butte flow (nd, ~15,000) and related deposits**
Pahoehoe basalt flow
Surface-fed, pahoehoe flow issued from Crescent Butte cinder cone (ch1). Majority of flow vegetated and covered in thin deposit of colluvium



- Crescent Butte cinder cone**
Western side of cone is covered in ash from Trench Mortar Flat eruptive fissures. Cinder cone is the source vent for the Crescent Butte lava flow (fh1)



- Cinder cones (Holocene and latest Pleistocene)**
A series of Holocene and latest Pleistocene cinder cones having no known associated lava flows; exact ages have not been assigned to these cinder cones



GEOLOGIC UNITS

- **Broken Top flow (nd) and related deposits**
Pahoehoe basalt flow
Surface-fed flow from vents, fissures, cracks, and a few small spatter vents on east and southeast flanks of Broken Top cinder cone (ca1). Vents may have formed during partial collapse of the cone. Flow is characterized by hummocky, rough lava with polygonal joints, numerous inflation pits, pressuse plateaus, and ridges



- **Pressure plateau**
Pressure induced uplift of lava flow, usually followed by a breakout flow and displaying numerous tension cracks



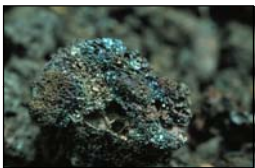
- **Shelly pahoehoe**
Areas of pahoehoe where the surface of which contains open tubes and blisters



- **Broken Top cinder cone**
Much of the cone may have formed by eruptions from main fissure on west side of cone. The west flank is mantled by agglutinated spatter (aa1) from the fissure, and is cut by northwest-trending faults and fissures which are thought to be related to Trench Mortar Flat (fa3) events and fissures associated with the Broken Top flow (fa1)



- **Volcanic ash deposits**
Ash and spatter from vent on west side of Broken Top cinder cone, generally deposited less than 1 m thick



- **Slump zone**
Area on west-northwest side of Broken Top cinder cone characterized by numerous fault lines highlighting slump blocks



- **Blue Dragon flow (2,076±45) and related deposits**
Pahoehoe basalt-hawaiiite flow
Characterized by spiny pahoehoe flows having fresh, iridescent dark and light blue, glassy, vesicular surfaces. The flow consists of two lobes that moved east and west from fissure-controlled vents at the Spatter Cones (ca2) and the southern part of Big Craters cinder cone (ca5). The fissure system features spatter cones and pit craters.



- **Slabby pahoehoe**
Formed near rootless vents from degassed, highly viscous lava that was erupted late in the eruptive sequence, generally over relatively steep slopes



- **Onlap**
Lava onlap related to inflation from lava ponds (Big Sink and Unnamed Sink)



The Broken Top Area was first mapped by Mel Kuntz et al. (1989) as part of the U.S Geological Survey's 1:24,000 Geologic Map of the Inferno Cone Quadrangle, Butte County, Idaho. More detailed mapping of the Broken Top Area was undertaken during the summer of 2004 by GIP (Geologist in the Parks) interns and other volunteers (Clennon, Truitt, and Hansen). This mapping was then completed during the summer of 2005 by a GIP intern (Wetherell). The purpose of the project was fourfold: first, the field mapping provided young geologists with experience in the field and allowed them to hone their previously acquired field mapping skills; second, the completed map provides Craters of the Moon National Monument and Preserve with an educational and interpretive tool for the public; third, the map offers a more detailed look at the youngest lava flow and associated cinder cone in the park; and finally, the Broken Top Area is important geologically because it exhibits nearly every feature associated with basaltic volcanism.

Data for the 1:12,000 Broken Top Area map was drawn from U.S. Geological Survey publication GQ-1632 (Kuntz et al, 1989) and additional field mapping conducted during the summer of 2004 and 2005. GPS coordinates were recorded using a Trimble GeoXM GPS (Global Positioning System) unit and were transferred into ArcGIS 8.3 and 9.0. Radiocarbon ages were drawn from U.S. Geological Survey publication GQ-1632 (Kuntz et al, 1989); for further description see Kuntz, Champion, and others (1986), Kuntz and others (1982), and Kuntz, Spiker, and others (1986). * Ages in years before present, nd, not dated

REFERENCES
Kuntz, M. A., Lefebvre, R. H., Champion, D. E., Skipp, B. A., 1989, Geologic Map of the Inferno Cone Quadrangle, Butte County, Idaho: U.S. Geological Survey Quadrangle Map GQ-1632, scale 1:24,000.
Margaret, G., McAfee Jr., R., Wolf, C. L., eds., 1972, Glossary of Geology: American Geological Institute.
Stearns, H. T., 1928, Craters of the Moon National Monument, Idaho: Idaho Bureau of Mines and Geology Bulletin 13, 57 p.
Field photos courtesy of: Douglas Owen, Kimberly Truitt, Nichole Hansen, Bob Lillie, and Prudence Wetherell