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Jordan Craters Volcanic Field

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First, A Note of Caution!

The Jordan Craters Volcanic Field contains a few potential hazards to visitors. In the middle of summer, the frequent high temperatures and lack of shade make dehydration and heat stroke a real concern. Make sure you take the proper precautions with sun protection, clothing, and an adequate water supply. Additionally, the surface of the lava flows can be quite unstable. Due to the nature of how they form, the surface of the lava may only be a thin crust above a large void space. Be careful with where you walk, beware of the possibility that the surface of the flows can collapse, and do not stand too close to the cliff edges. And finally, rattlesnakes are a common in the area. Make sure you pay attention to where you are walking and stay aware for rattlesnake warnings.

Introduction

Jordan Craters Volcanic Field contains a series of Holocene olivine basalt flows located in Malheur County in southeastern Oregon (Figure 1A). The lava flows fill a local depression of the Owyhee Plateau and cover an area of ~72 km^2 (extent of lava flows indicated by red outline in Figure 1B). The ~1 km^3 of lava filled an area once occupied by Cow Creek (Otto and Hutchinson, 1977), and today two lakes that bound the southeastern end of the lava flows are named Cow Lakes. Coffeepot Crater, the most prominent vent in the region, is found in the northwest corner of the field with the lavas prominently flowing out to the southeast. Jordan Craters Volcanic Field (JCVF) contains a wealth of basaltic lava flow features including cinder and spatter cones, ropey pahoehoe, and lava tubes, ponds, and channels.

Regional Setting

JCVF sits just off the western edge of the Snake River Plain and atop the Owyhee Plateau in a region with a complex structural history (Hart and Mertzman, 1983). The Owyhee plateau consists of a varied

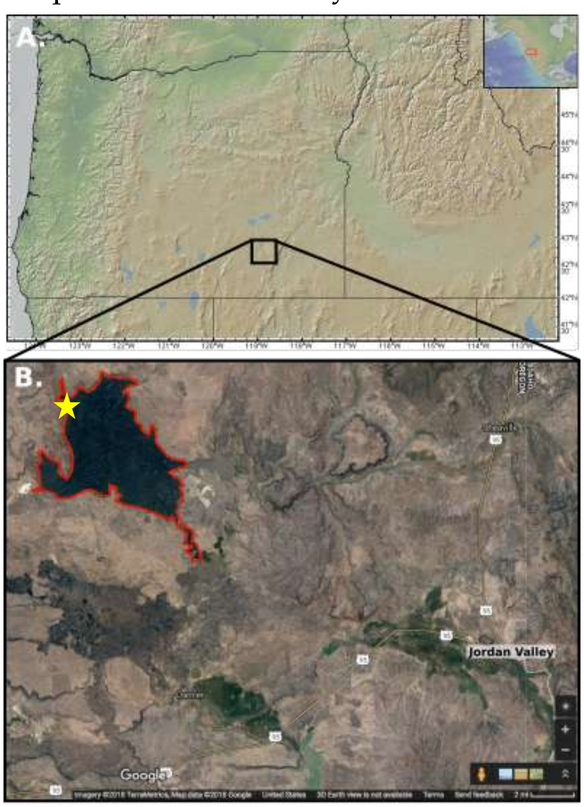


Figure 1. A. Map of Oregon-Idaho with box indicating location of Jordan Craters Volcanic Field. B. Google Earth image of Jordan Craters and the surrounding area. Red line delineates the extent of lava flows associated with Jordan Crater. Star indicates position of Coffeepot Crater.

assemblage of volcanic deposits that range from basaltic lava flows to large rhyolite ignimbrites. These deposits date from the late- to mid-Miocene (~17-18 Ma) essentially to the present. While there is still some debate as to the origin of these deposits, the onset of their eruption can be both spatially and temporally correlated to the arrival of the head of the Yellowstone hotspot (e.g. Geist and Richards, 1993). Also complicating the geologic history of the region is the thinning of the crust while under extensional forces which is related to, first, back-arc rifting of the Cascade Arc (e.g. Zoback et al., 1994), and later, Basin and Range extension. Much debate still exists regarding how the complex interaction of the Yellowstone hotspot and prolonged regional extension has affected the volcanic products erupted throughout the region.

Both the Yellowstone Hotspot and regional extension played a role in the eruptions at Jordan Craters. First, the Yellowstone Hotspot thermally eroded the base of the crust which results in a shorter travel path for magmas as they rise from the mantle, making eventual eruptions easier. Regional extension is associated with significant faulting that both thins the crust and provides pathways for the rising magma to exploit. The combination of the hotspot and extension results in a crust that is both thin and broken enough for magma to pass through. These ideal conditions allow for relatively primitive basalt (olivine-rich) to be erupted at the surface in JCVF.

Overview of Jordan Craters Volcanic Field

The precise age of the eruptions at Jordan Craters is not known, although growth rates of lichen found on the basalt and weather rates allow for estimates of between 4000 and 9000 years (Otto and Hutchinson, 1977). Additionally, a single piece of charred wood was found while coring Cow Lake sediments at the southeastern edge of the lava flows. This piece of wood dates to 3,200 years using radiocarbon dating, but it is unclear how this piece of wood relates to the sequence of lava flows erupted in JCVF. Finally, a sign at the Jordan Craters parking area states that one flow in the middle of the field may be as young as 100 years, although this date is uncited and the origin of this information is unknown. In summary, the ages of these eruptions are poorly constrained and the use of modern techniques for dating basalt flows would certainly be welcome. What we do know is

Figure 2. View of Coffeepot Crater looking to the southwest.

that the lava flows are very young, geologically speaking, and certainly have been erupted sometime over the past few thousand years.

The most prominent feature within the JCVF is Coffeepot Crater, found at the northwestern edge of the field (Figure 2 and shown in light blue, Figure 3). This crater appears to be the source for much of the basalt found to the southeast. The walls of the crater show evidence for eruptions that transitioned between cinder, spatter, and lava flow eruptions. Spatter appears to make up most the crater walls; During spatter eruptions, molten lava is thrown from the vent and accumulates near the edges of the vent, eventually building the edifice of the crater itself. It is also clear that the crater would occasionally fill with ponded lava until that lava would breach the crater walls. The lava would then flow out to the southeast through a complex system of tubes and channels, many of which can still be seen at the surface today. Finally, cinder has accumulated at the surface of the modern cone as pieces of lava that were thrown from the vent but solidified prior to hitting the ground.

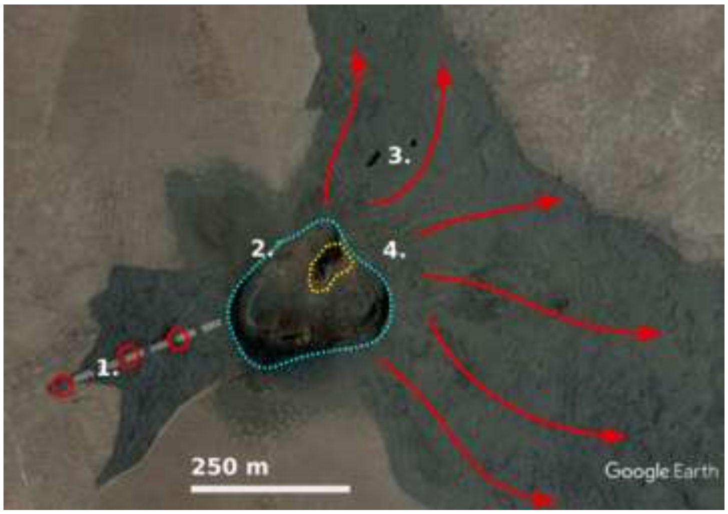
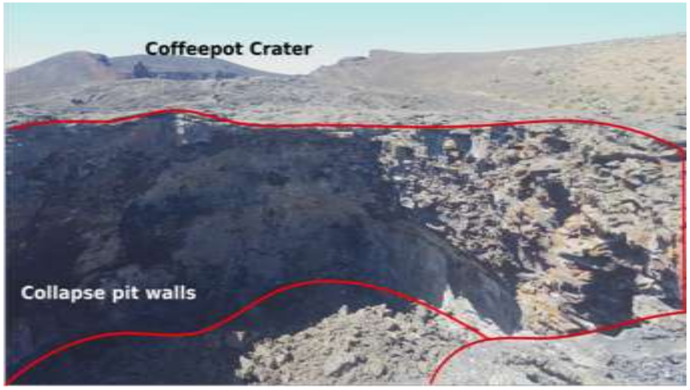


Figure 3. Close up view of Coffeepot Crater (blue outline). Red lines show dominant flow directions for lava flows. Numbers 1-4 indicate prominent features found near the crater: 1. Small spatter cones (red circles) erupted along a linear fissure 2. Cracks in the crater rim and view into the crater 3. Collapsed lava ponds 4. System of lava channels and tubes that fed lava flows. Yellow dashed line indicates section of the crater wall that has collapsed back towards center of crater.

In addition to the main Coffeepot Crater, there is chain of small spatter cones formed along a linear fissure extending WSW from the main crater rim (#1 in Figure 3). These spatter cones likely fed the small accumulation of lava flows (~2% of the total lava) to the west of Coffeepot Crater. The linear nature of these features suggests the presence of a weakness in the crust that is due to regional stresses.



Finally, there are a number of interesting lava flow features found within the vicinity of Coffeepot Crater. Two large collapsed lava pits or lava ponds are found to the northeast of the main crater (#3 in Figure 3 and Figure 4). These pits represent places where lava occasionally ponded and overtopped the confines of the pit to spill out as the thin flows that can be observed at the surface today. Looking at the walls of these lava ponds, you can see the way in which the surface of the lava ponds rose through time as successive flows overtopped the banks and solidified at the surface.

Figure 5. View looking SW into one of the collapsed lava pits with layers of individual basalt flows visible on right side of image. Red lines indicate upper and lower surfaces of pits.

Along the entire eastern and southeastern sides of Coffeepot Crater, numerous complex lava tubes and channels are visible (#4 in Figure 3 and Figure 5). These structures are the main pathways by which lava was transported away from the main crater and out to the southeastern most extents of the flow field. Flowing through lava tubes, where the surface quickly crusts over, allows the lava to flow longer distance because it remains insulated from atmospheric temperatures. The lava channels (Figure 5) have levee structures that controlled the direction the lava travelled. Occasionally, however, the lava flowed at too high a volume and overtopped the levees, creating thin veneers of lava on the upper surfaces of the levees, effectively growing the height of the levees.

Figure 4. Lava channel and levee structures on the margins of the channel.

Conclusions

Jordan Craters Volcanic Field is a spectacular example of recent basaltic volcanism in southeastern Oregon. The location of this field area, along the margin of the Snake River Plain and Basin and Range extensional provinces, make JCVF a great place to investigate how regional processes can affect the volcanic products erupted on the surface. Because of the relative youth of these lava flows, many features are extremely well preserved. The volcanic features described in this field guide are only a brief introduction to the wealth of structures that can be observed at JCVF.

References

-Geist, Dennis, and Mark Richards, 1993, Origin of the Columbia Plateau and Snake River Plain: Deflection of the Yellowstone plume: Geology, v. 21, p. 789-792.
-Hart, W.K., and Mertzman, S.A., 1983, Late Cenozoic volcanic stratigraphy of the Jordan Valley area, southeastern Oregon: *Oregon Geology*, v. 45, p. 15-19.
-Otto B R, Hutchison D A, 1977. The geology of the Jordan Craters, Malhuer County, Oregon. *Ore Bin*, 39: 125-140.
-Zoback, M.L., E.H. McKee, R.J. Blakely, and G.A. Thompson, 1994, The northern Nevada rift: Regional tectono-magmatic relations and middle Miocene stress direction: Geological Society of America Bulletin, v. 106, p. 371-382.

Directions to start of Field Trip Log

-From Boise travel west along I-84 until exit 33A toward ID-55 Nampa/Marsing.
-Merge onto ID-55/W Karcher Rd and continue 13.5 miles.
-Continue straight onto ID-55 S as you cross over the Snake River. Travel 3.2 miles.
-Turn left onto US-95 S and continue 36 miles through Sheaville, Oregon.
-Follow sign just passed mile marker 12 on US-95 S for Jordan Craters. Right onto Curly Lodge Rd (unmarked)

Field Trip Log

Interval	**Total**	**Description**
23.5 mi worn	23.5 mi	Drive along Curly Lodge Rd towards Jordan Craters. Follow signs where posted, and generally follow the most well roads. Arrive at fork in the road marked with sign for Jordan Craters (left) and Owyhee River (right).
1.5 mi	25 mi	Take right at sign for Owyhee River and continue 1.5 miles down road to overlook. Here we will see overview of stratigraphy of the Owyhee Canyon related to Yellowstone Hotspot. Complex assemblage of basaltic lava flows and rhyolite ignimbrites.
OPTIONAL		Continue 5.5 miles down road to Owyhee River to Historic Birch Creek Ranch.
1.5 mi	26.5 mi	Return up road to previous intersection.
1.4 mi	27.9 mi	Follow signs for Jordan Craters, go left at intersection. Continue 1.4 miles down to the southwest.
1.4 mi	28.3 mi	Turn left at sign for Jordan Craters. Arrive at Coffeepot Crater. From the parking area follow the loop to the east, clockwise around Coffeepot Crater. Along the route you will

observe (1) spatter cones erupted along fissure extending west from main crater, (2) interior view of stratigraphy of Coffeepot Crater and crater floor, (3) multiple lava pond/collapse features, (4) lava channels. Continue as far out along the loop as desired.

Return to parking area and return along same route to Boise.