GeoNote 16

Geology of Scenic Jarbidge Canyon Near Murphy Hot Springs, Idaho

The walls of Jarbidge Canyon have helped geologists learn how the Snake River Plain evolved over the last few million years. The rocks exposed in this nearly thousand-foot-deep canyon reveal the awesome volcanic eruptions that occurred here in the geologic past.

Jarbidge Canyon and Murphy Hot Springs in southeastern Owyhee County can be reached by traveling on Three Creek Road about 50 miles west from U.S. Highway 93 at Rogerson. The community of Murphy Hot Springs sits astride the East Fork of the Jarbidge River in the bottom of the canyon (Figure 1). From the rim on the east side, the road winds down to Murphy Hot Springs and follows the East Fork downstream about 2 miles to its confluence with the West Fork and then along the West Fork southward (upstream) another 13 miles to the historic gold-mining town of Jarbidge.

Several rock layers are exposed in the walls of Jarbidge Canyon. From the oldest unit in the bottom of the canyon to the youngest at the top, geologists have named them the Jarbidge Rhyolite, the Cougar Point Tuff, the Dorsey Creek Rhyolite, lake and stream sediments, and the Diamond A Desert and Big Flat basalt flows (Figure 2). These volcanic and sedimentary rocks were deposited before the Jarbidge River cut its spectacular canyon through them.

Basalt and rhyolite are different types of lava rock. Rhyolite, like granite, has large amounts of silicon, sodium, and potassium. Basalt, by contrast, has considerably more iron, magnesium, calcium, and aluminum and less silicon, sodium, and potassium. Lava is molten rock that flows like hot molasses, tar, or even as slowly as glacial ice, depending on how viscous and how hot it is. Basaltic lava comes from much deeper in the earth than rhyolitic lava and consequently is hotter.

Volcanism can range from the nonviolent eruption of lava flows to the extremely explosive eruption of blocks of rock, pumice, and finely divided fragments of the magma body. Basaltic volcanism is usually nonviolent unless shallow surface water or ground water is involved. Rhyolitic volcanism ranges from nonviolent to extremely explosive, and typically is quite explosive. During an explosive event, tuffs form when particles the size of dust, sand, and pebbles, and which can be cool, hot, or even molten, are deposited together. Rhyolitic tuffs and both rhyolitic and basaltic lava flows are present in the Murphy Hot Springs area.

The Jarbidge Rhyolite and the Jarbidge Mountains

The oldest rock unit exposed in Jarbidge Canyon is the Jarbidge Rhyolite. It formed about 17 million years ago and makes up the lower canyon walls at the town of Jarbidge. A mile to the north in the West Fork canyon, the unit disappears beneath the younger Cougar Point Tuff. Farther to the south, however, the Jarbidge Rhyolite reaches to the crest of the Jarbidge Mountains. The Jarbidge Mountains are one of the Basin-and-Range mountain ranges. They were uplifted along major faults several million years ago, after the Jarbidge Rhyolite had erupted and after the Snake River Plain had started to form. The Jarbidge Rhyolite is made up mainly of rhyolite lava flows and is the host rock for the gold-bearing veins that have been mined at Jarbidge.

The Cougar Point Tuff and the Bruneau-Jarbidge Eruptive Center

The Cougar Point Tuff is the series of hard, weather resistant rock layers that dip gently northward. They can best be seen in the East Fork canyon from the rim and from the grade into Murphy Hot Springs. In the West Fork canyon these layers first appear at the mouth of Buck Creek as you drive south toward Jarbidge. A few miles farther south, striking rock pillars, eroded from these layers, congregate in rows on the canyon walls. When viewed from Jarbidge, the Cougar Point Tuff has a purplish color high on the cliffs north of the town, where it lies above the lighter colored Jarbidge Rhyolite.

The Cougar Point Tuff is rhyolitic in composition and was deposited about 11 million years ago. These tuff layers were erupted explosively in stages from a region north of the Murphy Hot Springs. The region is some 50 miles across and has been named the Bruneau-Jarbidge eruptive center. A large depression formed in the million or so years during which these eruptions were occurring, but it has since been filled by lava flows and sediments. The depression had developed as a gigantic collapsed crater because of the thousands of cubic miles of volcanic rock that erupted from beneath the region.

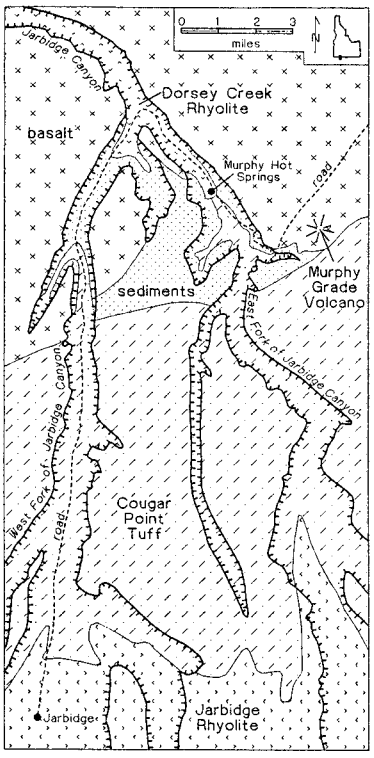

Figure 1. Map of the Murphy Hot Springs-Jarbidge area.

Each Cougar Point Tuff layer was produced from a separate eruption that probably came out of long, now-buried fissures. Each of these violent events consisted of an enormous, prolonged explosion similar to that in the 1980 Mount St. Helens eruption, but on a scale immensely larger. In view of the Cougar Point Tuff's much greater volume, each eruption was hundreds to thousands of times more destructive than the Mount St. Helens event. By contrast, each Cougar Point Tuff eruption blew tens to hundreds of cubic miles of red-hot ash high into the atmosphere, perhaps as high as 20 miles. And the ensuing hell-fired torrent was no less astounding.

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When the column of fiery material collapsed and fell back to earth much like an avalanche, it picked up incredible speed. The incandescent, hot-ash cloud flowed at tens or even hundreds of miles per hour across the earth's surface for tens of miles in all directions. The ash was still so hot when it came to rest that the individual particles welded themselves together to form the solid rock we now see. It is probable that each of these eruptions lasted for days, or even weeks. The thin sedimentary layers that occur between these volcanic rock layers indicate that thousands of years passed between eruptions.

The Dorsey Creek Rhyolite

The Dorsey Creek Rhyolite is a large lava flow. It is about 8 million years old and extends 25 miles from Murphy Hot Springs down Jarbidge Canyon to the confluence with Bruneau Canyon. It also is present for the first mile up the West Fork from the confluence with the East Fork. The original southern edge of the flow, consisting of hundred-foot high bulbous masses of jointed rhyolite, forms the cliffs on both sides of the canyon at Murphy Hot Springs. Good examples of such bulbous masses can also be seen near the confluence of the East and West Forks of the Jarbidge.

The Dorsey Creek Rhyolite is huge. It contains at least 18 cubic miles of lava rock and is more than 650 feet thick in Jarbidge Canyon, 10 to 15 miles downstream from Murphy Hot Springs. It probably erupted from fissures within the Bruneau-Jarbidge eruptive center and, along with other large rhyolite lava flows, filled most of the depression. When it erupted, the Dorsey Creek lava was extremely viscous and flowed quite slowly. The lava probably took several years to erupt and flow to its final resting place, and then took many more years to cool and solidify.

Sediments in the Moat Zone

After the rhyolite lava flows had nearly filled the Bruneau-Jarbidge eruptive center, a moatlike depression was left around its margin (Figure 2). This moat zone was then filled by gravel and finer grained detritus eroded from nearby highlands such as Elk Mountain and the Jarbidge Mountains. At times the moat may have held a shallow lake. The moat-zone sediments are exposed along the upper part of the Murphy Hot Springs grade. Hundreds of feet of similar sediments occur in the West Fork canyon but are obscured from view by slope debris.

Basalt Flows

The most recent volcanism in the Murphy Hot Springs area was the eruptions of basalt lava flows that cover the sediments and form the dark-colored canyon rims. These flows erupted from a number of small shield volcanoes. The rim on the east side of the canyon is the Big Flat basalt. It discharged from two volcanoes near Murphy Hot Springs: one is Horse Hill, 4 miles to the northeast; the other is the Murphy Grade volcano, 2 miles to the southeast (Figure 1). The rim on the west side of the canyon is the Diamond A Desert flow. It erupted from two shield volcanos several miles to the west and just across the Nevada border.

The Origin of Jarbidge Canyon

After the volcanism, streams established their drainages on, or skirted the edges of, the basalt flows. This set the stage for the carving of Jarbidge Canyon. Most of the canyon was eroded in the Pleistocene Epoch during the last 1.6 million years. When this downcutting started, a large ancient lake, Lake Idaho, occupied much of the western Snake River basin between Twin Falls, Idaho, and Baker, Oregon. The canyon cutting began when Lake Idaho was tapped and drained by the Snake River, as it cut the lake's new outlet, Hells Canyon, deeper and deeper. While the lake waters were being lowered, and afterwards, the tributary streams to Lake Idaho, including the Bruneau-Jarbidge system, carved their deep gorges. The climate during that time was wetter than now, and the greater amount of runoff helped to quickly cut the canyons. In fact, a small glacier occupied the area known today as "the Crater" at the northern end of Jarbidge Mountain. The meltwater from this glacier also contributed at times to increased stream flowage.

Murphy Hot Springs

The Murphy Hot Springs area lies in the moat zone above the margin of the Bruneau-Jarbidge eruptive center (Figure 2). The hot water that feeds the spring rises along faults beneath the moat zone. These faults were buried by the southern edge of the Dorsey Creek Rhyolite when it flowed into place from the north. When Jarbidge Canyon was cut to its present level, the top of the fault zone was exposed and allowed waters heated at depth to form the hot spring.

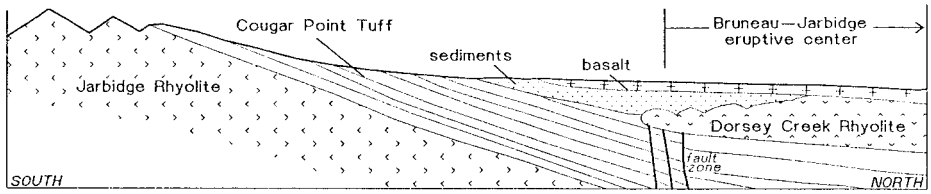

Figure 2. Schematic north-south cross-section of the area.

Jarbidge Canyon is another of Idaho's many scenic places. Its beauty can be viewed today with wonder and amazement, but the geologic story behind its creation makes the view that much more remarkable.

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