Stratigraphy and Measurements of Magnetic Polarity for Volcanic Units in the Bruneau-Jarbidge Eruptive Center, Owyhee County, Idaho

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Technical Report 81-5
1981

Idaho Geological Survey
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Moscow, Idaho 83844

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Technical Report 81-5
Previously released as
Open-File Report 81-5
September 1981

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STRATIGRAPHY AND MEASUREMENTS OF MAGNETIC POLARITY FOR VOLCANIC UNITS IN THE BRUNEAU-JARBIDGE ERUPTIVE CENTER, OWYHEE COUNTY, IDAHO

by

Bill Bonnichsen[1]

ABSTRACT

The lateral extent and stratigraphic positions have been established for nine cooling units of the Cougar Point tuff and for several younger rhyolite lava flows that have had their source in the Bruneau-Jarbidge eruptive center of eastern Owyhee County, Idaho. Magnetic polarity measurements reveal that the rhyolitic volcanism which gave rise to these units of the Idavada Volcanics occurred over a span of time involving at least seven reversals of the earth's magnetic field during late Miocene and possibly early Pliocene time.

INTRODUCTION

The Bruneau-Jarbidge eruptive center is in eastern Owyhee County, Idaho, where it covers an area of a few thousand square kilometers (Figure 1). A voluminous succession of rhyolitic and basaltic magmas

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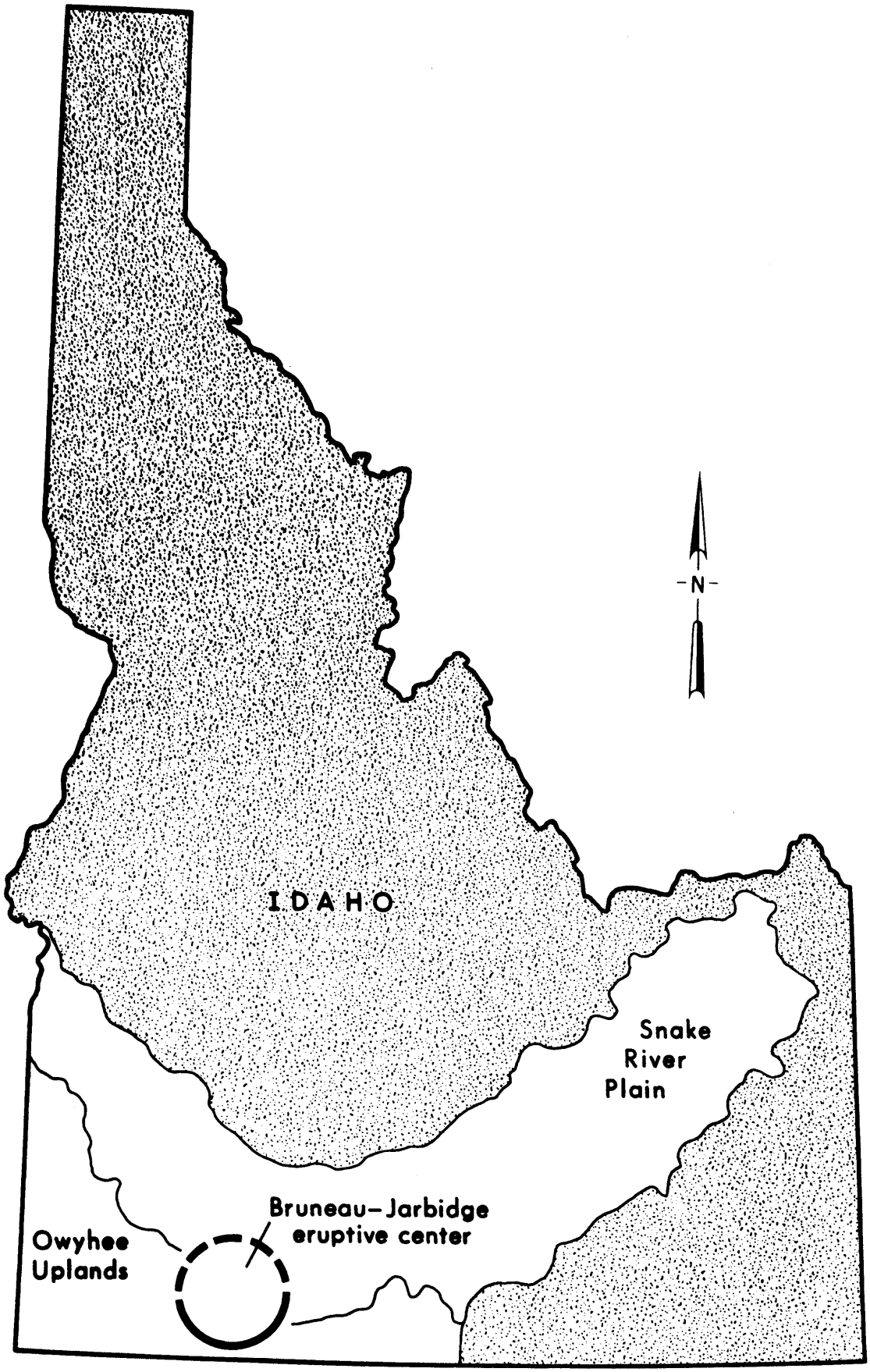

Figure 1. Index map showing the location of the Bruneau-Jarbidge eruptive center, Idaho.

was erupted from it during Miocene and Pliocene time. The southern boundary of the eruptive center has been mapped, but the northern margin is buried by rhyolite erupted from the center and by later sediments and basalt, so that its position is only approximated on Figure 1.

The principal purpose of this report is to document the stratigraphic relationships among the volcanic units in and adjacent to the Bruneau-Jarbidge eruptive center. Information is presented on the known areal distribution and stratigraphic succession of many of the major rhyolite units and some of the basalts that originated from the eruptive center, and on the results of 257 magnetic polarity measurements of rocks from these units. This paper is essentially a progress report, as the writer plans to continue geologic mapping, stratigraphic investigations, and measurements of the paleomagnetic polarity of units in Owyhee County.

The first rhyolites erupted from the Bruneau-Jarbidge eruptive center were emplaced as welded ash-flow tuffs and are known as the Cougar Point tuff (Coates, 1964). These units are exposed on both sides of the Idaho-Nevada border between 115° and 116° longitude (Figures 2 and 3). Situated to the north, and lying stratigraphically above the Cougar Point tuff, are several large rhyolite lava flows. Geologic mapping so far demonstrates that these flows are confined to the interior of the eruptive center; however, further work is needed to confirm this for parts of the eruptive center other than the southern portion. In the past, the Cougar Point tuff and overlying rhyolite lava flows have been considered part of the heretofore undivided Idavada Volcanics (Malde and Powers, 1962; Malde, Powers, and Marshall, 1963; Rember and Bennett, 1979).

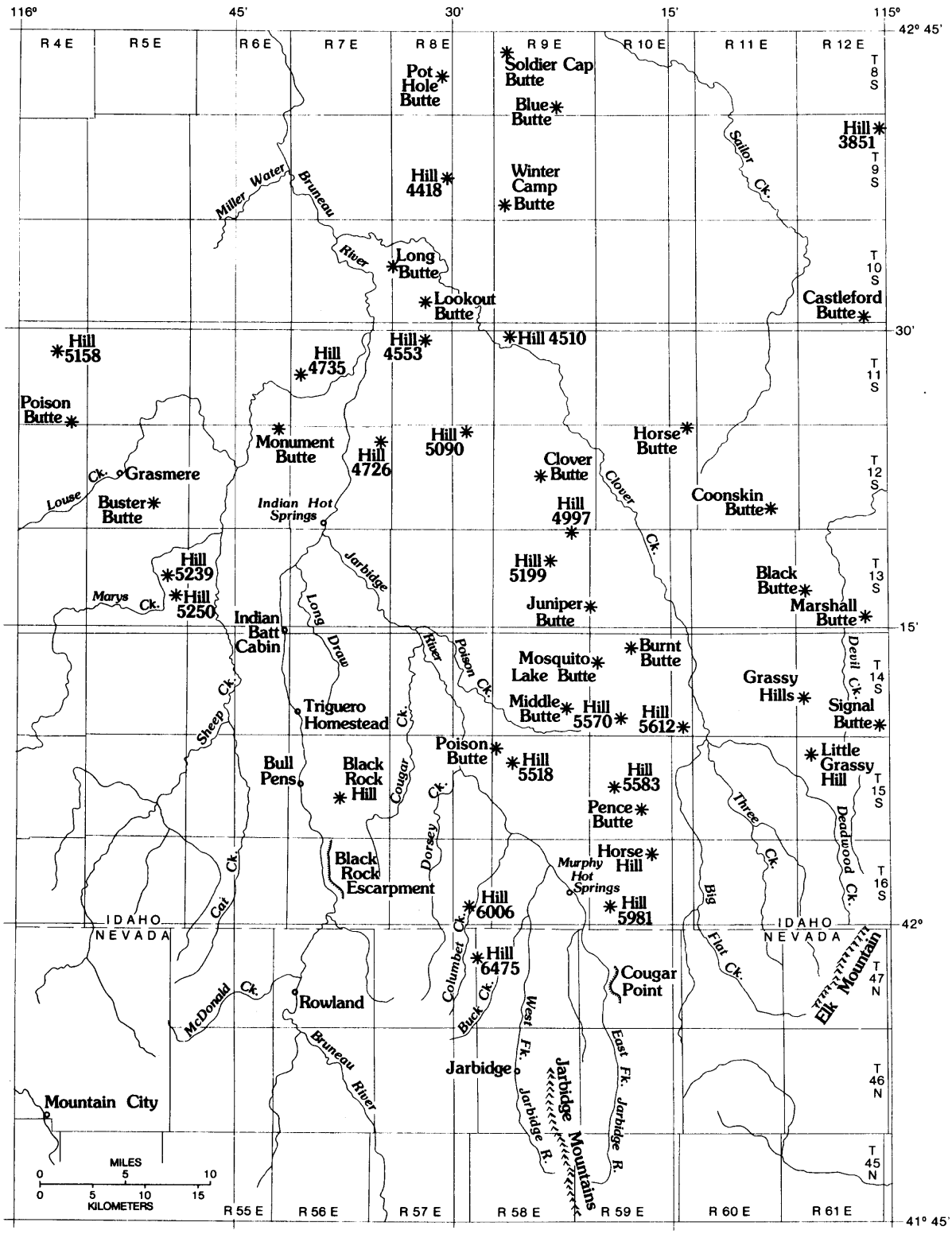

Figure 2. Geographic reference maps of eastern Owyhee County, Idaho, and vicinity.

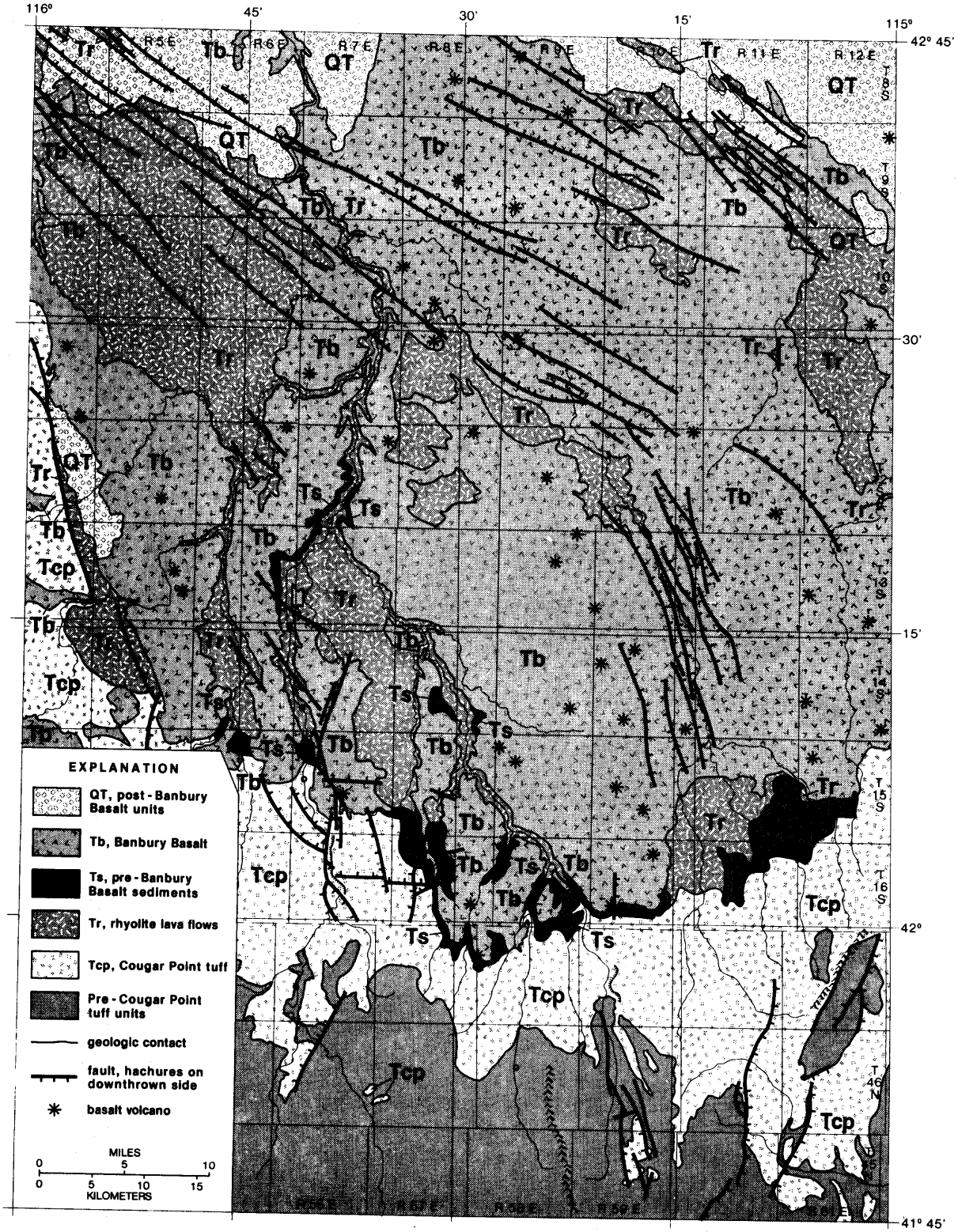

Figure 3. Generalized geologic map of eastern Owyhee County, Idaho, and vicinity.

A few basalt flows are intercalated within the upper part of the rhyolite lava flow succession, and numerous ones overlie the rhyolite units. These basalts form a major part of the Banbury Basalt (Malde and Powers, 1962; Malde, Powers, and Marshall, 1963; Rember and Bennett, 1979). Many vents, for the Banbury Basalt have been identified within the eruptive center. Most have the form of shield volcanoes; they are named and located on Figures 2 and 3.

The general stratigraphic relationships among the rhyolite units in the region are summarized in the schematic fence diagram shown in Figure 4. In the following sections of this report detailed information is presented on the lateral distribution of the rhyolite lava flows and individual cooling units of the Cougar Point tuff and for a few of the basalt units. The stratigraphic succession of volcanic units is documented by a series of photographs (Figures 5-17). The results of individual magnetic polarity measurements for various volcanic units are listed in Tables 1-24 and summarized in Tables 25 and 26 at the end of this report. These magnetic polarity measurements were made in 1978 and 1980 with a Model 70 fluxgate magnetometer manufactured by the California Electronic Manufacturing Company, Inc.

RHYOLITE LAVA FLOWS

Several large rhyolite lava flows occur within the Bruneau-Jarbidge eruptive center. These lie beneath a partial cover of Banbury Basalt and local accumulations of lacustrine, fluvatile, and fanglomeratic sediments and above the Cougar Point welded ash-flow tuff, which previously

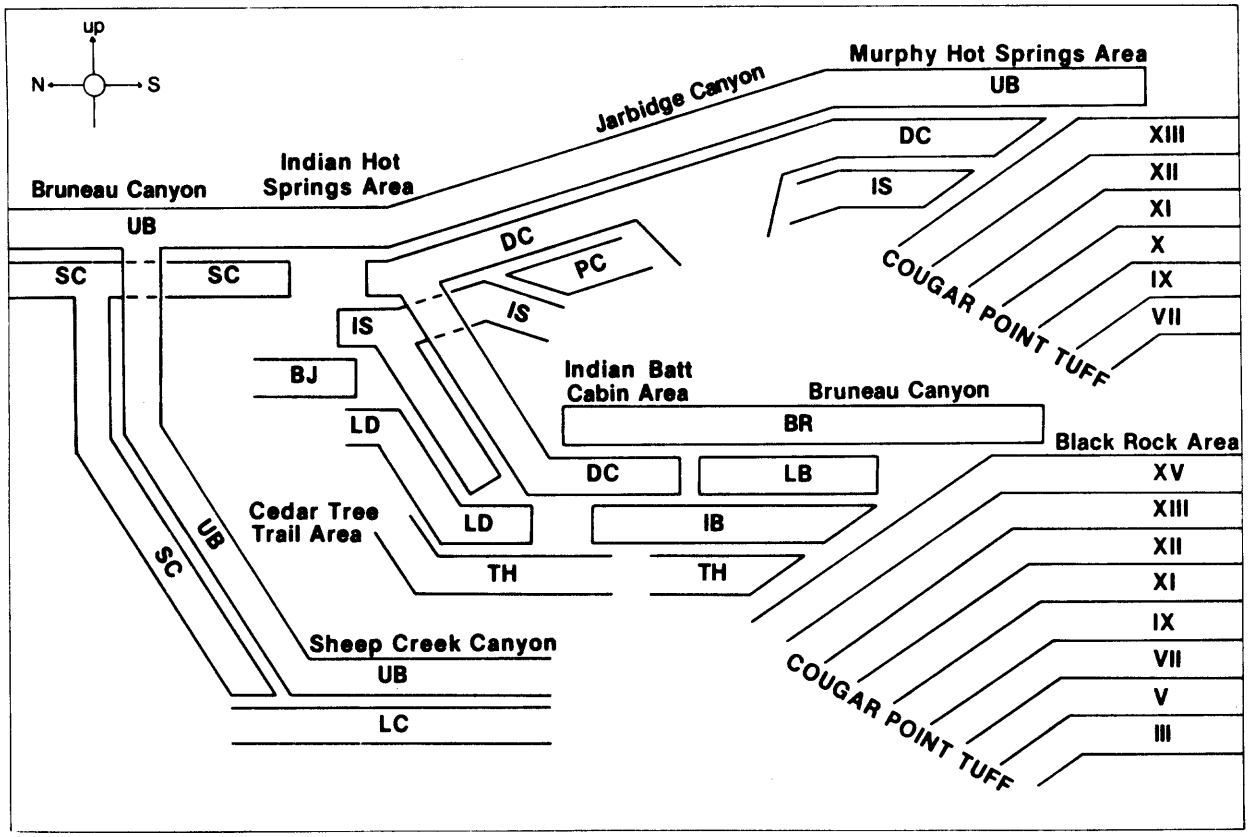

Figure 4. Schematic fence diagram showing the stratigraphic succession and lateral distribution of volcanic units exposed in canyon walls in the Bruneau-Jarbidge eruptive center (BJ--Bruneau Jasper rhyolite, BR--Black Rock basalt, DC--Dorsey Creek rhyolite, IB--Indian Batt rhyolite, IS--Indian Springs basalt, LB--lower basalt at Triguero Homestead, LC--lower rhyolite at Louse Creek, LD--Long Draw rhyolite, PC--lower rhyolite at Poison Creek, SC--Sheep Creek rhyolite, TH--Triguero Homestead rhyolite, UB--undivided flows of the Banbury Basalt, roman numerals--cooling units of the Cougar Point tuff).

had been erupted from the same volcanic center. At least one basalt unit (the Indian Springs basalt) and possibly additional ones--the lower flow at Triguero Homestead and the lower flow in the northeastern corner of the Buster Butte quadrangle (T. 12 S., R. 6 E.)--are intercalated with the rhyolite flows. Relative age relationships among many of the rhyolite flows have been determined from the excellent exposures in the canyon walls along the Bruneau and Jarbidge Rivers and Sheep Creek. The lateral distribution and stratigraphic relationships that have been determined are summarized in Figure 4, and individual units are discussed below.

DORSEY CREEK RHYOLITE

The Dorsey Creek rhyolite is well-exposed for about 40 kilometers in Jarbidge Canyon from its southeastern margin at Murphys Hot Springs to its northwestern margin near Indian Hot Springs where the Bruneau and Jarbidge Rivers run together. It is exposed for about 12 kilometers in Bruneau Canyon between Indian Hot Springs and the unnamed side canyon in SW¼ sec. 6, T. 14 S., R. 7 E., in the northern part of the Triguero Lake quadrangle. The unit is exposed in the Diamond A Desert northward from Cowan Reservoir between Jarbidge and Bruneau Canyons and is well-exposed in Arch Canyon along Cougar Creek and in Dorsey Creek Canyon.

The Dorsey Creek rhyolite flow attains its greatest observed thickness in the central part of its exposure in Jarbidge Canyon in T. 14 S., R. 8 E., where it exceeds 200 meters. Its maximum thickness cannot be determined because the base of the flow is below the canyon floor in that area. This thickest portion probably is near or over the zone from

which the rhyolite magma was erupted.

In the Indian Springs area the Dorsey Creek rhyolite lies above the Indian Springs basalt (Figure 5). Southeast of this, 11 to 15 kilometers upstream from the mouth of the Jarbidge, it lies above the lower rhyolite of Poison Creek (Figure 6). Between the Murphy Hot Springs area and the mouth of Dorsey Creek in Jarbidge Canyon, the Dorsey Creek rhyolite lies above the Indian Springs basalt. In Bruneau Canyon in the Indian Batt Cabin area, the Dorsey Creek rhyolite overlies the Indian Batt rhyolite (Figure 7).

These relationships reveal that the Dorsey Creek is the youngest rhyolite of all those exposed in Jarbidge Canyon and in Bruneau Canyon upstream from the Indian Springs area (Figure 4). Its age relationship to the Sheep Creek rhyolite has yet to be determined, as both are the uppermost rhyolite flow within the areas they underlie.

The results of eighteen magnetic polarity determinations at six stations within the Dorsey Creek rhyolite are given in Table 1. They clearly indicate normal polarity for the unit.

LOWER RHYOLITE AT POISON CREEK

An unnamed rhyolite unit is exposed in the lower part of Jarbidge Canyon and in adjacent parts of Poison Creek and Arch Canyons (lower part of Cougar Creek) in secs. 31 and 32, T. 13 S., R. 8 E., and sec. 5, T. 14 S., R. 8 E., 11 to 15 kilometers above the mouth of the Jarbidge. This unit is overlain by the Dorsey Creek rhyolite throughout its area of exposure (Figure 6). At its westernmost exposure, which is the original margin of the unit, the lower rhyolite at Poison Creek overlies

Figure 5. Looking south-southeast from hilltop in the NW¼SE¼ sec. 32, T. 12 S., R. 7 E., at the Dorsey Creek rhyolite (DC) overlying the Indian Springs basalt (IS) and the Long Draw rhyolite (LD) at the mouth of Jarbidge Canyon in Indian Hot Springs quadrangle.

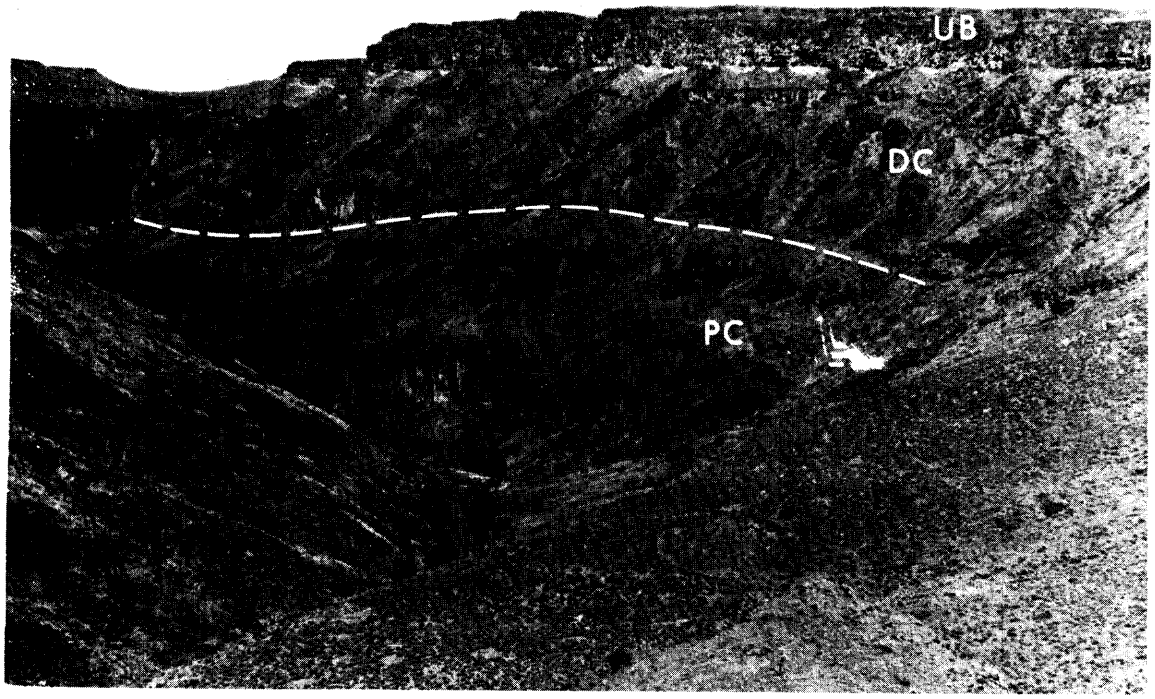

Figure 6. Looking west-northwest down Jarbidge Canyon from the SE¼SW¼ sec. 32, T. 13 S., R. 8 E., at the Dorsey Creek rhyolite (DC) overlying the lower rhyolite at Poison Creek (PC) in Inside Lakes quadrangle. Undivided Banbury Basalt flows (UB) form the canyon rim. The dashed line indicates the approximate position of the contact between the two rhyolite flows.

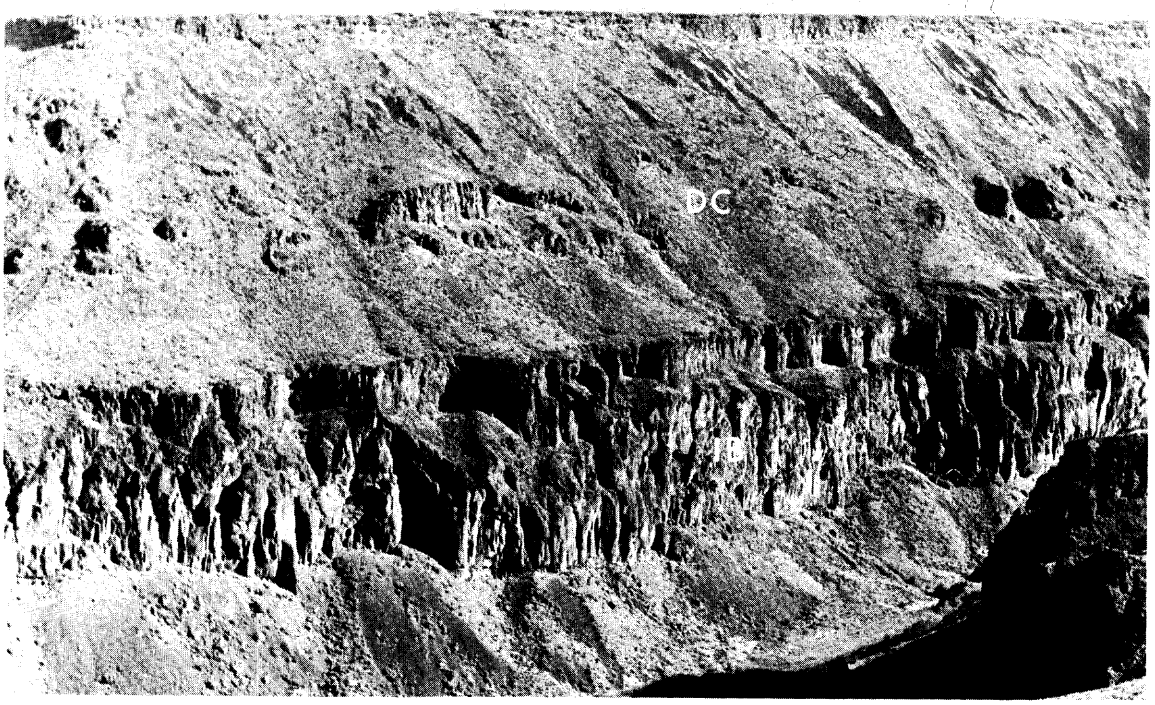

Figure 7. Looking east-southeast from the NW¼SW¼ sec. 36, T. 13 S., R. 6 E., at the Dorsey Creek rhyolite (DC) overlying the Indian Batt rhyolite (IB) on the east wall of Bruneau Canyon at the boundary between the Indian Hot Springs and Triguero Lakes quadrangles. The Black Rock basalt (BR) forms the canyon rim.

the Indian Springs basalt. At the southeastern limit of its exposure in Jarbidge Canyon, the lower rhyolite drops to an elevation lower than the bottom of the canyon, so that its southeastward extent is unknown.

The contact between the lower rhyolite and the overlying Dorsey Creek rhyolite is marked by only a few centimeters of ash and sediments and is characterized by irregular paleo-topographic variations; locally it dips as steeply as 30 degrees. These observations, along with the highly vesicular nature of the upper part of the lower rhyolite, suggest that the Dorsey Creek rhyolite was extruded only a geologically short time after the extrusion of the lower rhyolite at Poison Creek and thus preserved the initial topographic irregularities in the upper surface of the lower rhyolite from erosion.

The results of four magnetic polarity determinations at one station in the lower rhyolite at Poison Creek are given in Table 2. These suggest that the unit probably is characterized by a normal magnetic polarity, although additional determinations to confirm this would be desirable.

SHEEP CREEK RHYOLITE

The Sheep Creek rhyolite is exposed for about 30 kilometers in the walls of Bruneau Canyon between the southern part of sec. 15, T. 12 S., R. 7 E., about 6 kilometers below the mouth of the Jarbidge River, downstream to a tributary of the Bruneau known as Miller Water in sec. 13, T. 9 S., R. 6 E. The southern limit of exposure in section 15 is the margin of the flow. The northern limit of exposure at Miller Water, however, is the result of down faulting to the north so that the original

northern margin is hidden. The Sheep Creek rhyolite is excellently exposed in the walls of Sheep Creek Canyon from its mouth upstream for about 25 kilometers to where its orignial margin is exposed near the mouth of Louse Creek in sec. 21, T. 12 S., R. 6 E. This flow appears to be 200 meters or more thick throughout much of its exposed portions in Bruneau and Sheep Creek Canyons.

At its southern limit in Bruneau Canyon the Sheep Creek rhyolite overlies the Bruneau Jasper rhyolite (Figure 8), and at its southern margin in Sheep Creek Canyon it overlies the unnamed lower rhyolite at Louse Creek. Its stratigraphic relationship to the Dorsey Creek rhyolite has yet to be determined; most likely both are approximately the same age, based on their apparent end-to-end relationship north and south of the Indian Hot Springs area. The relationship of the Sheep Creek rhyolite to the rhyolite of the Big Hill area to the west and northwest has yet to be determined. Preliminary observations near the Big Bend of Sheep Creek suggests that part, if not all, of the rhyolite of the Big Hill area is the same flow as the Sheep Creek rhyolite flow. The relationship between the Sheep Creek rhyolite and the rhyolite flow or flows, which underlie much of the eastern half of the Stiff Tree Draw quadrangle and extensive areas farther east (principally in Tps. 11 and 12 S., Rs. 8 and 9 E.), has yet to be determined.

The results of fourteen magnetic polarity determinations at four locations in Bruneau and Sheep Creek Canyons in the southern part of the unit are given in Table 3. They signify that the Sheep Creek rhyolite probably is characterized by normal magnetic polarity, although additional determinations in the central and northern parts of the unit should be made for confirmation.

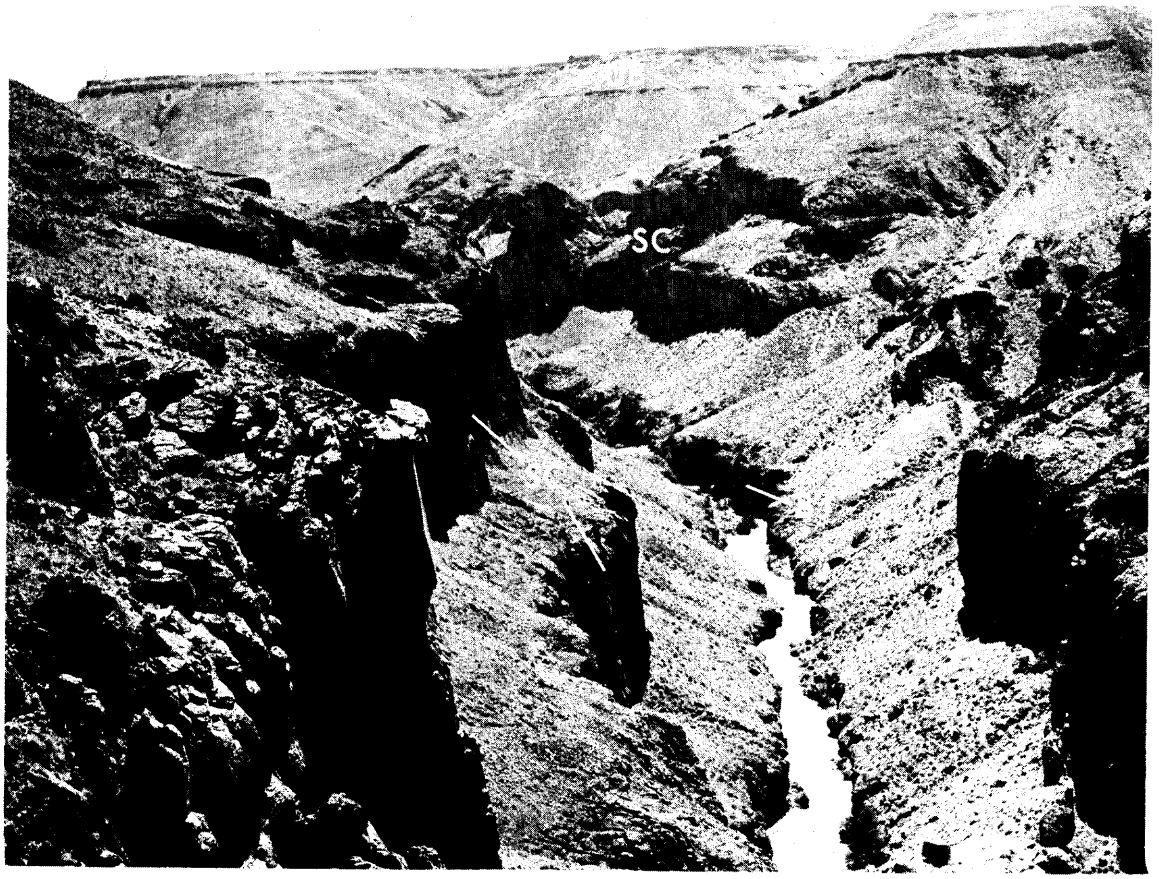

Figure 8. Looking south-southwest up Bruneau Canyon from SW¼SE¼ sec. 3, T. 12 S., R. 7 E., at the Sheep Creek rhyolite (SC) overlying the Bruneau Jasper rhyolite (BJ) in Stiff Tree Draw quadrangle. Undivided Banbury Basalt flows (UB) occur at and below the canyon rim.

RHYOLITE OF THE BIG HILL AREA

Rhyolite is exposed throughout an area of 500 to 600 square kilometers in the central to southeastern part of the Big Hill and southwestern part of the Winter Camp 15-minute quadrangles and in the northeastern part of the Blackstone Reservoir and western part of the Cave Draw 7½-minute quadrangles as well as parts of adjoining 7½-minute quadrangles (principally in Tps. 9, 10, and 11 S., Rs. 4, 5, and 6 E.). It has yet to be determined if this large area of rhyolite consists of one or more flows. Preliminary observations north and west of the Big Bend of Sheep Creek in the Cave Draw and Blackstone Reservoir quadrangles suggest that at least part of the Big Hill area rhyolite is the same as the Sheep Creek rhyolite.

The results of five magnetic polarity determinations at two roadcuts along Idaho Highway 51 (Table 4) suggest that the Big Hill area rhyolite might be characterized by a normal magnetic polarity. However, considerable geologic field work and additional magnetic polarity determinations are needed before a definite conclusion can be reached.

LOWER RHYOLITE AT LOUSE CREEK

An unnamed rhyolite flow occurs beneath the Sheep Creek rhyolite near the mouth of Louse Creek in secs. 15, 16, and 21, T. 12 S., R. 6 E. This unit is exposed for at least a few kilometers to the south in the bottom of Sheep Creek Canyon (Figure 9), but its full extent has yet to be traced. Consequently its stratigraphic position relative to any unit but the Sheep Creek rhyolite is unknown.

The results of four magnetic polarity determinations at two stations for the lower rhyolite at Louse Creek are given in Table 5. These

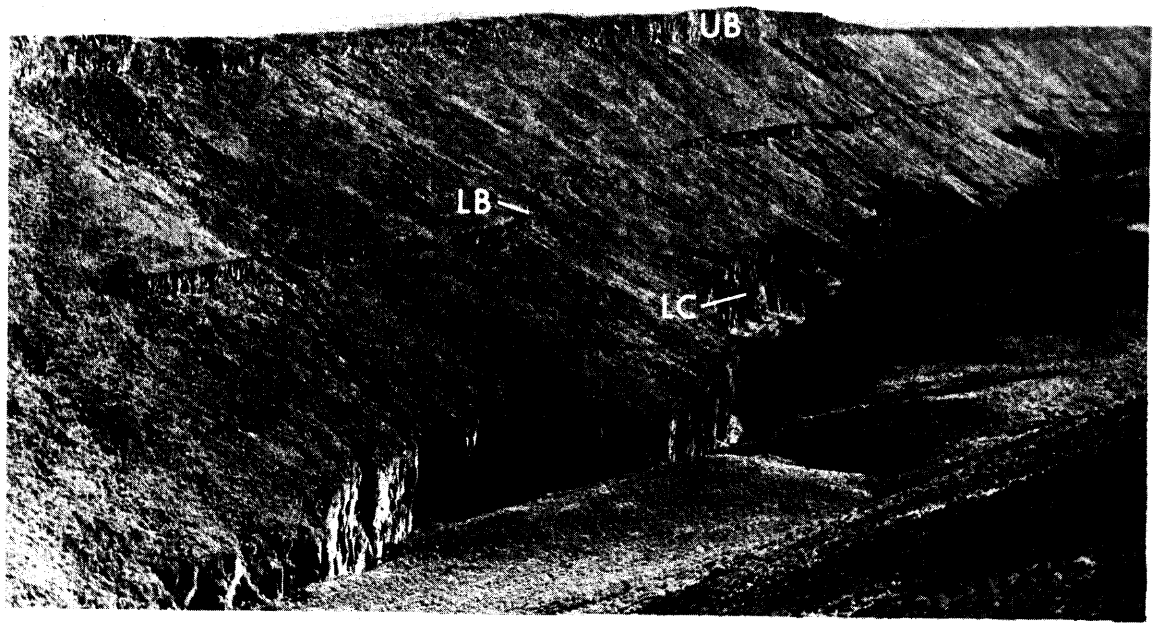

Figure 9. Looking southeast up Sheep Creek Canyon from the SW¼NW¼ sec. 21, T. 12 S., R. 6 E., at the lower rhyolite of Louse Creek (LC) overlain by the unnamed lower basalt (LB) and undivided Banbury Basalt (UB) flows at the canyon rim in Buster Butte quadrangle.

suggest normal polarity for the unit, but additional determinations at other localities are needed for confirmation.

BRUNEAU JASPER RHYOLITE

The Bruneau Jasper rhyolite is exposed for nearly 8 kilometers in the bottom of Bruneau Canyon from the Indian Hot Springs area north to about a kilometer south of the mouth of Stiff Tree Draw. The southern limit of exposure of this unit in the northern part of sec. 33, T. 12 S., R. 7 E., is the original margin of the flow. Here it lies below the Indian Springs basalt and above the Long Draw rhyolite. At the northern limit of its exposure in the north part of sec. 10, T. 12 S., R. 7 E., the unit is overlain by the Sheep Creek rhyolite, and it drops to an elevation lower than the bottom of Bruneau Canyon (Figure 8), so that its extent to the north is unknown. The Bruneau Jasper rhyolite is named for the well-known deposit of Bruneau jasper it contains in sections 28 and 33 near its southern margin. This flow is nearly 150 meters thick where both its base and top are exposed in section 28.

The results of five magnetic polarity determinations from samples from two stations in the southern part of the Bruneau Jasper rhyolite are given in Table 6. These indicate probable reversed polarity for the unit. Additional measurements should be taken at localities farther north to confirm these results.

LONG DRAW RHYOLITE

The Long Draw rhyolite is exposed for more than 6 kilometers in Bruneau Canyon in the Indian Hot Springs area and upstream, and in the

bottom of Jarbidge Canyon for about 4 kilometers upstream from the mouth of the river. At its northernmost exposure in the northwestern part of sec. 33, T. 12 S., R. 7 E., about a kilometer downstream from Indian Hot Springs, it disappears beneath the Bruneau Jasper rhyolite. In the Indian Hot Springs area and for about 3 kilometers up Bruneau Canyon, as well as for the extent of its exposure in Jarbidge Canyon, the Long Draw rhyolite is overlain by the Indian Springs basalt (Figure 5). The original margin of the flow is exposed in Bruneau Canyon in the northeastern part of sec. 13, T. 13 S., R. 6 E. Here, it is overlain by the Dorsey Creek rhyolite and, in turn it overlies the Triguero Homestead rhyolite (Figure 10).

The Long Draw rhyolite is named for Long Draw, a local tributary which enters the Bruneau River from the southeast at the north edge of sec. 18, T. 13 S., R. 7 E., in the thickest portion of the Long Draw rhyolite flow. This Long Draw should not be confused with another tributary with the same name that enters the Bruneau River from the west at the north edge of sec. 13, T. 14 S., R. 6 E. The Long Draw rhyolite is at the same stratigraphic position as the Indian Batt rhyolite, the north margin of which is exposed 3 to 4 kilometers farther south in Bruneau Canyon; both are sandwiched between the Dorsey Creek and Triguero Homestead flows. It is doubtful if these two are equivalent, however, since their magnetic polarity signatures appear to differ.

The results of six magnetic polarity determinations at two stations in the Long Draw rhyolite are given in Table 7. They indicate normal magnetic polarity for the unit.

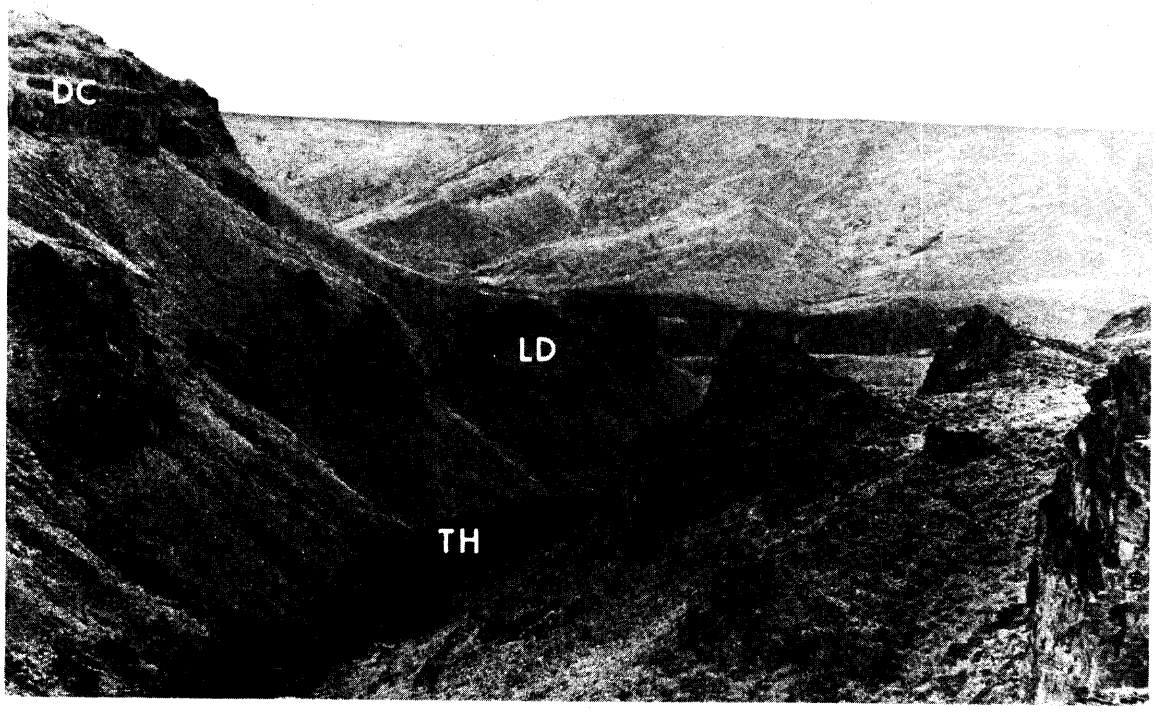

Figure 10. Looking southwest up Bruneau Canyon from the NW¼NW¼ sec. 18, T. 13 S., R. 7 E., at the Dorsey Creek rhyolite (DC), overlying the Long Draw rhyolite (LD), which overlies the Triguero Homestead rhyolite (TH) in Indian Hot Springs quadrangle.

INDIAN BATT RHYOLITE

The Indian Batt rhyolite is exposed for about 16 kilometers in the walls of Bruneau Canyon from the center of sec. 25, T. 13 S., R. 6 E., about 2 kilometers north of Indian Batt Cabin, to at least as far south as the north part of sec. 18, T. 15 S., R. 7 E., in the north part of the Bull Pens locality. At its northernmost extent, the original margin of the flow is exposed and is overlain by the Dorsey Creek rhyolite (Figure 7). The Indian Batt rhyolite overlies the Triguero Homestead rhyolite (Figure 11) for many kilometers in Bruneau Canyon. At its southern extent in the canyon the relationship of the Indian Batt rhyolite to other units has been obscured by several large debris flows (Figure 12). Most likely, however, the unit overlies the upper unit of the Cougar Point tuff there, and terminates against it in a depositional onlap angular unconformity as indicated schematically in Figure 4.

The Indian Batt rhyolite is also well-exposed for several kilometers along Sheep Creek, west of Bruneau Canyon. The southern limit of its exposure is near the mouth of Cat Creek in sec. 33, T. 14 S., R. 6 E., where the flow overlies the Triguero Homestead rhyolite. The northern extent of the Indian Batt rhyolite in Sheep Creek Canyon has yet to be determined. However, it does extend farther north than where the Grasmere-Rowland road crosses the canyon in sec. 15, T. 14 S., R. 6 E.

The Indian Batt rhyolite is named for the Indian Batt Cabin located in Bruneau Canyon in the southern part of sec. 36, T. 13 S., R. 6 E., where it is the lowest flow exposed in the canyon walls (Figure 7). North and south of this locality, the flow can be observed to lie above the Triguero Homestead flow. The Indian Batt rhyolite is at the same stratigraphic

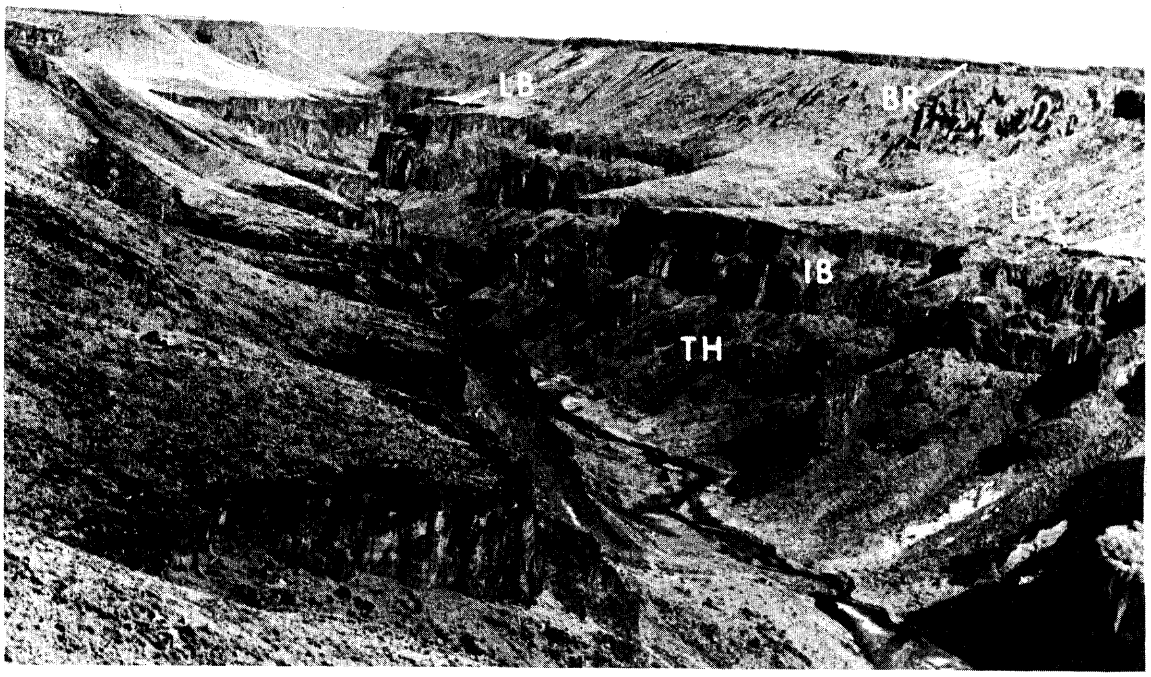

Figure 11. Looking north down Bruneau Canyon from NW¼NE¼ sec. 25, T. 14 S., R. 6 E., at the Indian Batt rhyolite (IB) overlying the Triguero Homestead rhyolite (TH) in Triguero Lake quadrangle. Note the unnamed lower basalt of Triguero Homestead (LB) just above the Indian Batt rhyolite and the Black Rock basalt (BR) at the canyon rim.

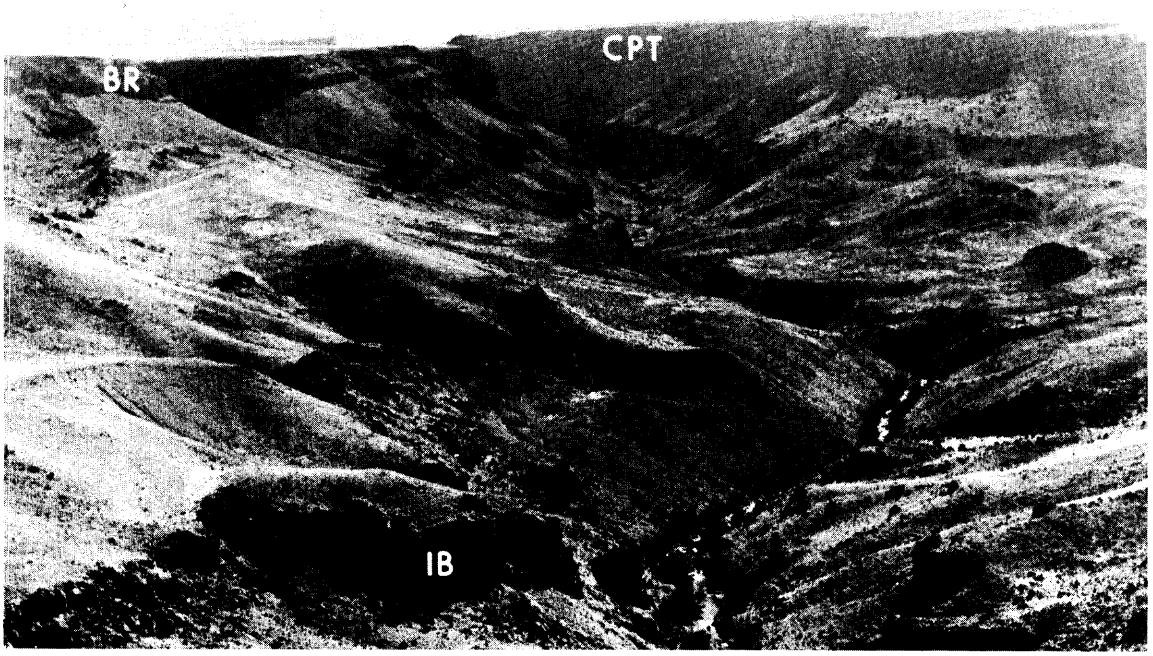

Figure 12. Looking south-southeast up Bruneau Canyon from SW¼SE¼ sec. 7, T. 15 S., R. 7 E., at the Cougar Point tuff (CPT) where it plunges beneath the edge of Triguero Homestead and Indian Batt (IB) rhyolite flows and large debris flows in Triguero Lake and Triplet Butte quadrangles. The Black Rock basalt (BR) forms the eastern canyon rim.

level as the Long Draw rhyolite and overlying Indian Springs basalt, which are exposed a few kilometers farther north in Bruneau Canyon. It is not known if the Indian Batt rhyolite is older, intermediate between, or younger than these units. Since the appropriate observations have yet to be made in Sheep Creek Canyon, the relationship between the Indian Batt rhyolite and the unnamed lower rhyolite at Louse Creek is also unknown.

The results of eleven magnetic polarity determinations taken at five stations are given in Table 8 for the Indian Batt rhyolite. The results, which are interesting and seem to characterize the unit, show that all six of the vitrophyre samples have a reversed, sometimes strong, magnetic polarity, whereas the five lithic samples have a weak normal polarity. The reason for this difference between the vitric and lithic samples is unknown. It is also unclear if the unit was extruded when the earth's magnetic field was reversed, normal, or undergoing a transition. Additional magnetic polarity measurements from the Indian Batt rhyolite clearly would be worthwhile, to see if the pattern indicated above remains the same and to evaluate its meaning.

TRIGUERO HOMESTEAD RHYOLITE

The Triguero Homestead rhyolite is well-exposed for 19 to 20 kilometers in Bruneau Canyon between the mouth of Long Draw (Figure 10) at the north edge of sec. 18, T. 13 S., R. 7 E., to just north of the corner of secs. 5, 6, 7, and 8, T. 15 S., R. 7 E., about 1.4 kilometers south of the Homer Bedal Homestead. At its northern extent the unit disappears beneath the Long Draw rhyolite, and at its southern limit it lies beneath

the Indian Batt rhyolite. The unit may actually extend as far south as an isolated exposure of rhyolite in the southeast corner of sec. 7, T. 15 S., R. 7 E., on the east side of the Bruneau River, but this has yet to be investigated. The Triguero Homestead rhyolite is also exposed intermittently beneath the Indian Batt rhyolite in secs. 28 and 33, T. 14 S., R. 6 E., and secs. 3 and 4, T. 15 S., R. 6 E., in the canyons of Sheep Creek and its tributary, Cat Creek.

The Triguero Homestead rhyolite is named for the Frank Triguero Homestead in the NW¼ sec. 30, T. 14 S., R. 7 E., where the unit is the lowest of two thick rhyolite flows in the canyon (Figure 11). In sec. 1, T. 13 S., R. 6 E., and sec. 36, T. 14 S., R. 6 E., near the Indian Batt Cabin locality, a 2-kilometer gap exists in the exposure of the Triguero Homestead rhyolite. The lower rhyolite exposures in the canyon north and south of this gap are probably parts of the same flow because of their stratigraphic position beneath the Indian Batt rhyolite and because of the prominantly developed columnar jointing that characterizes the vitrophyric portion of both the northern and southern segments of the unit. The Triguero Homestead rhyolite is the oldest rhyolite flow that has been found in the Bruneau-Jarbidge eruptive center. It lies above the youngest unit of the Cougar Point tuff but appears to be separated from the older welded tuff units by extensive, but poorly exposed, deposits of bedded tuff. Preliminary geologic observations in secs. 32 and 33, T. 14 S., R. 6 E., and secs. 3 and 4, T. 15 S., R. 6 E., in Sheep Creek and Cat Creek Canyons and in secs. 7, 17, 18, 19, and 20, T. 15 S., R. 6 E., in Bruneau Canyon (Figure 12) suggest that the Cougar Point tuff was downfaulted to the north, probably prior to the extrusion

of the Triguero Homestead rhyolite, so that the Triguero Homestead rhyolite terminates against this structural boundary (caldera margin?) with a depositional onlap angular unconformity over the Cougar Point tuff (Figure 4).

The results of fourteen magnetic polarity determinations taken at seven different stations (Table 9) in the Triguero Homestead rhyolite indicate normal magnetic polarity for the unit.

RHYOLITE FLOW OR FLOWS IN THE THREE CREEK AND CEDAR CREEK RESERVOIR AREAS

A large area in the western, central, and northern part of the Three Creek quadrangle and local parts of adjacent quadrangles (principally in Tps. 15 and 16 S., Rs. 10 and 11 E.) are occupied by a rhyolite lava flow (Figure 3). The geologic map prepared by Citron (1976) shows this flow to be more than 17 kilometers long from southwest to northeast and more than 7 kilometers from southeast to northwest. This flow lies above Unit XIII of the Cougar Point tuff, with a depositional onlap angular unconformity occurring between the two units. The stratigraphic relationship of this flow to the other rhyolite flows within the Bruneau-Jarbidge eruptive center is unknown, and magnetic polarity measurements from samples of the unit have yet to be made.

Rhyolite from one or several lava flows is exposed along Cedar Creek and its tributaries near the Cedar Creek Reservoir in T. 14 S., R. 13 E., and vicinity (Rember and Bennett, 1979). This locality is 5 to 10 kilometers east of the eastern margin of the area, shown in Figures 2 and 3, in southwestern Twin Falls County. The rhyolite flow or flows in the Cedar Creek Reservoir area overlie rhyolite welded

tuffs that are similar to, and perhaps part of, the Cougar Point tuff. Their stratigraphic position relative to the rhyolite lava flows within the Bruneau-Jarbidge eruptive center is not yet known. The results of nine magnetic polarity measurements taken at one station along Cedar Creek (Table 10) probably indicate normal magnetic polarity for the rhyolite flow in the area.

RHYOLITE LAVA FLOWS IN AND ADJACENT TO THE NORTHEASTERN PART OF THE BRUNEAU-JARBIDGE ERUPTIVE CENTER

In the northeastern portion of the Bruneau-Jarbidge eruptive center, between Bruneau Canyon and Clover Creek, an extensive area is underlain by one or more rhyolite lava flows. This area includes significant portions of the Inside Lakes, Stiff Tree Draw, Clover Butte North, Juniper Ranch, and Juniper Butte quadrangles (principally in Tps. 11 and 12 S., Rs. 8 and 9 E.). The rhyolite in this region has yet to be systematically investigated. At present, no magnetic polarity measurements are available.

Northeast of the Bruneau-Jarbidge eruptive center extensive areas in the Crows Nest and Blue Butte 15-minute quadrangles and the Coonskin Butte 7½-minute quadrangle are underlain by rhyolite lava flows. The outlines of these general areas were mapped by Malde, Powers, and Marshall (1963) and are shown in the northeastern part of Figure 3. Their relationship to any of the other rhyolite flows within the Bruneau-Jarbidge eruptive center is unknown. Geologic reconnaissance investigations in this region reveals more than one flow (Figure 13). Magnetic polarity measurements at two locations in the northern part of the Blue Butte and

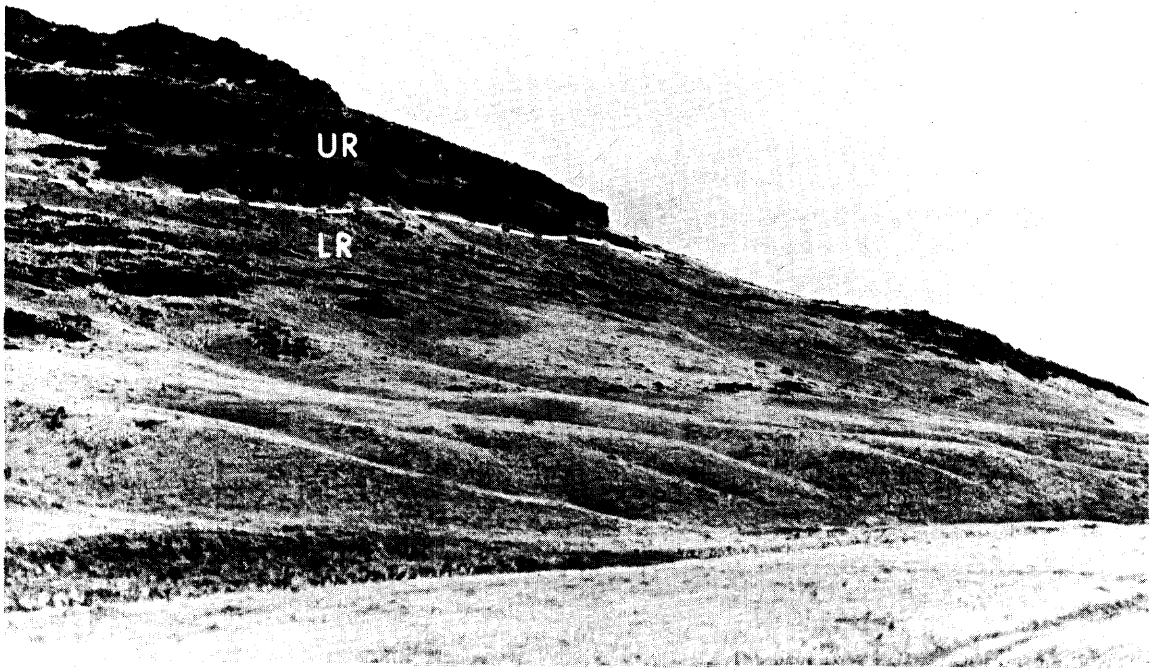

Figure 13. Looking northeast from the NW¼ sec. 23, T. 8 S., R. 10 E., at the east end of the hill on the north side of Sailor Creek in Blue Butte quadrangle. The dashed line is the approximate contact between the unnamed upper rhyolite (UR) and lower rhyolite (LR) flows.

Crows Nest quadrangles are given in Table 11.

COUGAR POINT TUFF

The Cougar Point tuff is the sequence of welded ash-flow tuff cooling units that erupted from the Bruneau-Jarbidge eruptive center prior to the formation of the rhyolite lava flows discussed in the preceding section. Its known distribution in Idaho and northern Nevada, around the southern margin of the Bruneau-Jarbidge eruptive center, is noted in Figure 3. Its eastern and western limits in Idaho have yet to be determined. The detailed distribution of the Cougar Point tuff is known for some portions of northern Nevada (Rowland quadrangle--Bushnell, 1967; Jarbidge quadrangle--Coats, 1964), but for much of that region the unit has been lumped with late Miocene welded tuff units from other source areas (Hope and Coats, 1976; Stewart and Carlson, 1976, 1978).

WELL-EXPOSED CANYON LOCALITIES

The most informative localities at which to examine the Cougar Point tuff are in the canyons of the Bruneau and Jarbidge Rivers and Sheep Creek. In the bottom of the canyon of the East Fork of the Jarbidge River, the tuff is exposed southward from Murphy Hot Springs (NW¼ sec. 24, T. 16 S., R. 9 E.) past Cougar Point (Figure 14) to the Robinson Hole area (sec. 29, T. 47 N., R. 59 E.) where it rises southward, lying unconformably on the Jarbidge Rhyolite (Coats, 1964). In the bottom of the canyon of the West Fork of the Jarbidge River, it is exposed southward

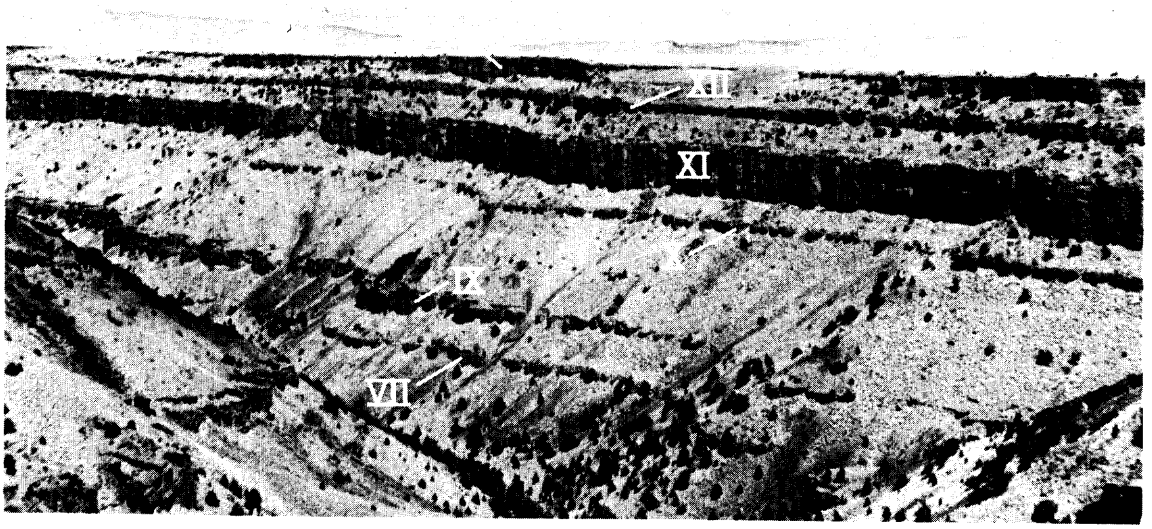

Figure 14. Looking north-northwest, down Jarbidge Canyon, from Cougar Point (NE¼ sec. 20, T. 47 N., R. 59 E.) at the Cougar Point tuff in Jarbidge quadrangle. The various cooling units are designated by roman numerals.

from about 0.6 kilometer north of the mouth of Buck Creek (south edge of sec. 21, T. 16 S., R. 9 E.) to about 2 kilometers south of the mouth of Jack Creek in sec. 9, T. 46 N., R. 58 E., where it overlies the Jarbidge Rhyolite. In the bottom of Bruneau Canyon, the Cougar Point tuff is exposed southward from the Bull Pens area (south part of sec. 18, T. 15 S., R. 6 E.) to about 2 kilometers north of the mouth of McDonald Creek in section 8, T. 47 N., R. 56 E., where it unconformably overlaps the older Bieroth Andesite (Figure 15) of Bushnell (1967). In the canyon of Sheep Creek, units of the Cougar Point tuff are exposed southwestward from 1.6 kilometers upstream from the mouth of Cat Creek (near the site of Bieroth Place, southeast corner, sec. 32, T. 14 S., R. 6 E.) to an as yet undetermined position a few kilometers north of the Idaho-Nevada border, where it overlies an older volcanic unit resembling the Jarbidge Rhyolite. The extent and nature of the Cougar Point tuff in the Sheep Creek drainage have yet to be investigated.

Of the well-exposed sections of Cougar Point tuff noted in the previous paragraph, the best-exposed and most complete one is in Bruneau Canyon. The best-exposed portion extends from the Black Rock Crossing road on the east side of the canyon in sec. 4, T. 16 S., R. 7 E., southward to Deep Creek in sec. 28, T. 16 S., R. 7 E. The exposure of the Cougar Point tuff at this place on the Black Rock escarpment (Figure 16) and southward in the canyon wall east of Triplet Butte (Figure 17) should be considered as the reference locality, as it is the best-exposed of any of the occurrences and the most complete. Eight of the principal cooling units that comprise the Cougar Point tuff are exposed at this locality.

The Cougar Point tuff was named by Coats (1964) for its well-exposed

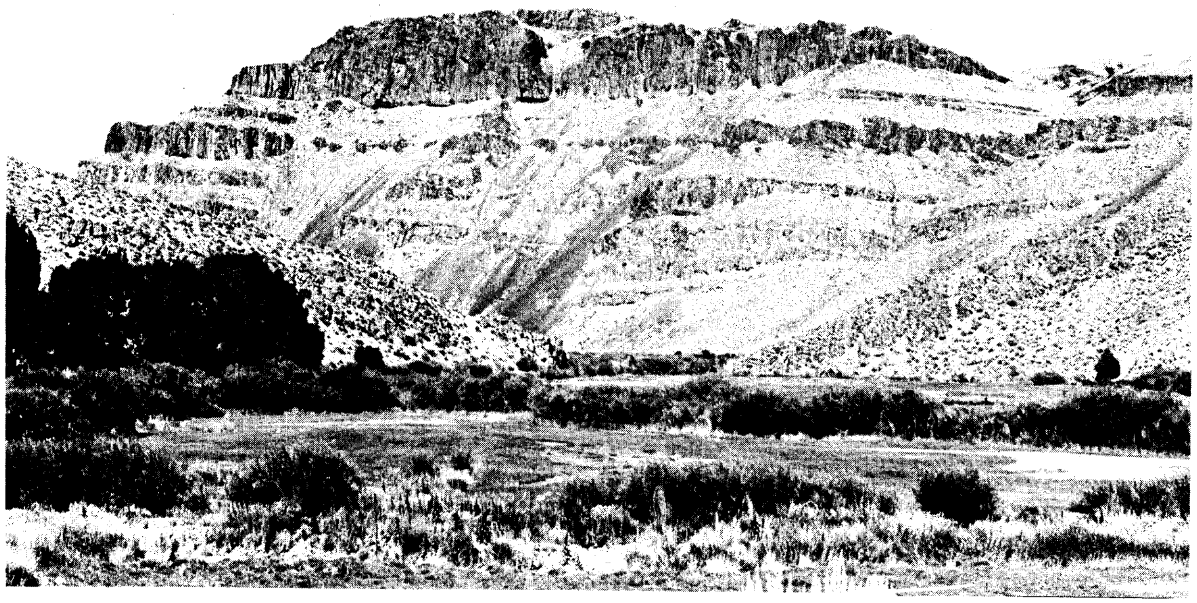

Figure 15. Looking northeast down Bruneau Canyon from SE¼ sec. 17, T. 47 N., R. 56 E., at the lower cooling units of the Cougar Point tuff (roman numerals) unconformably lying above the Bieroth Andesite (BA) in Rowland quadrangle. Note how the lowest Cougar Point tuff units pinch out southward against the older volcanics.

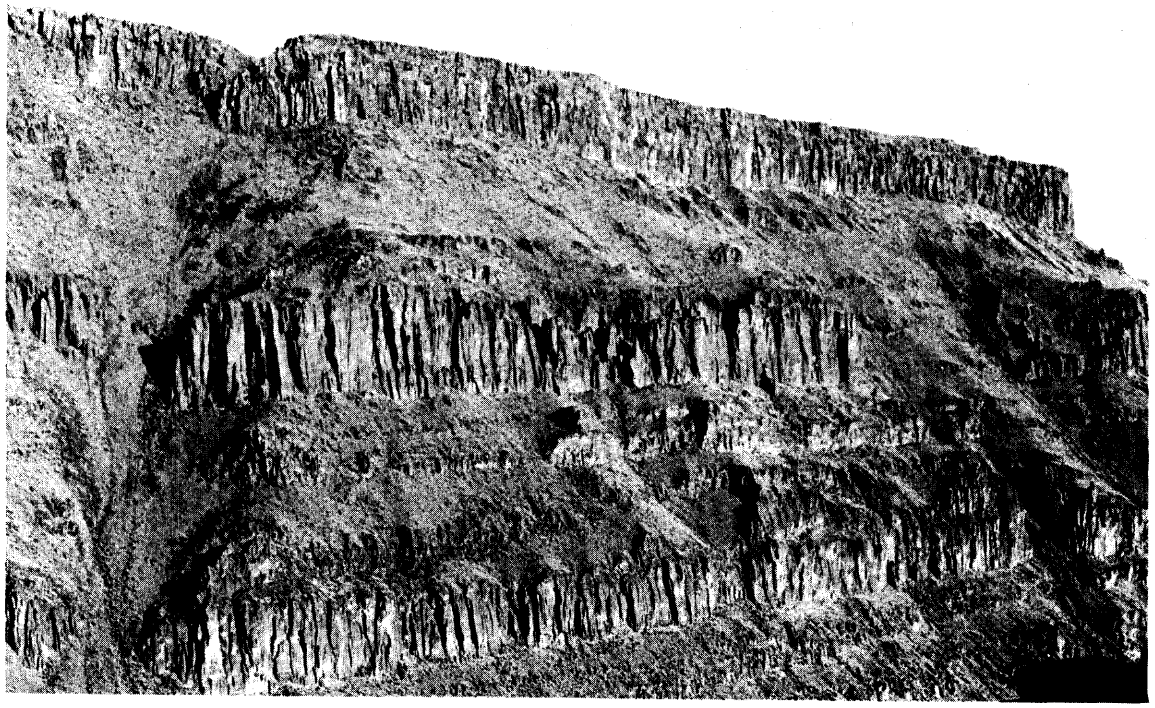

Figure 16. View of the Cougar Point tuff cooling units on the Black Rock escarpment, east side of Bruneau Canyon, looking southeast from SW¼NE¼ sec. 8, T. 16 S., R. 7 E., in Triplet Butte quadrangle. Individual cooling units are designated by roman numerals. The fault gully on the left side of the view affords the easiest access to the units on the escarpment.

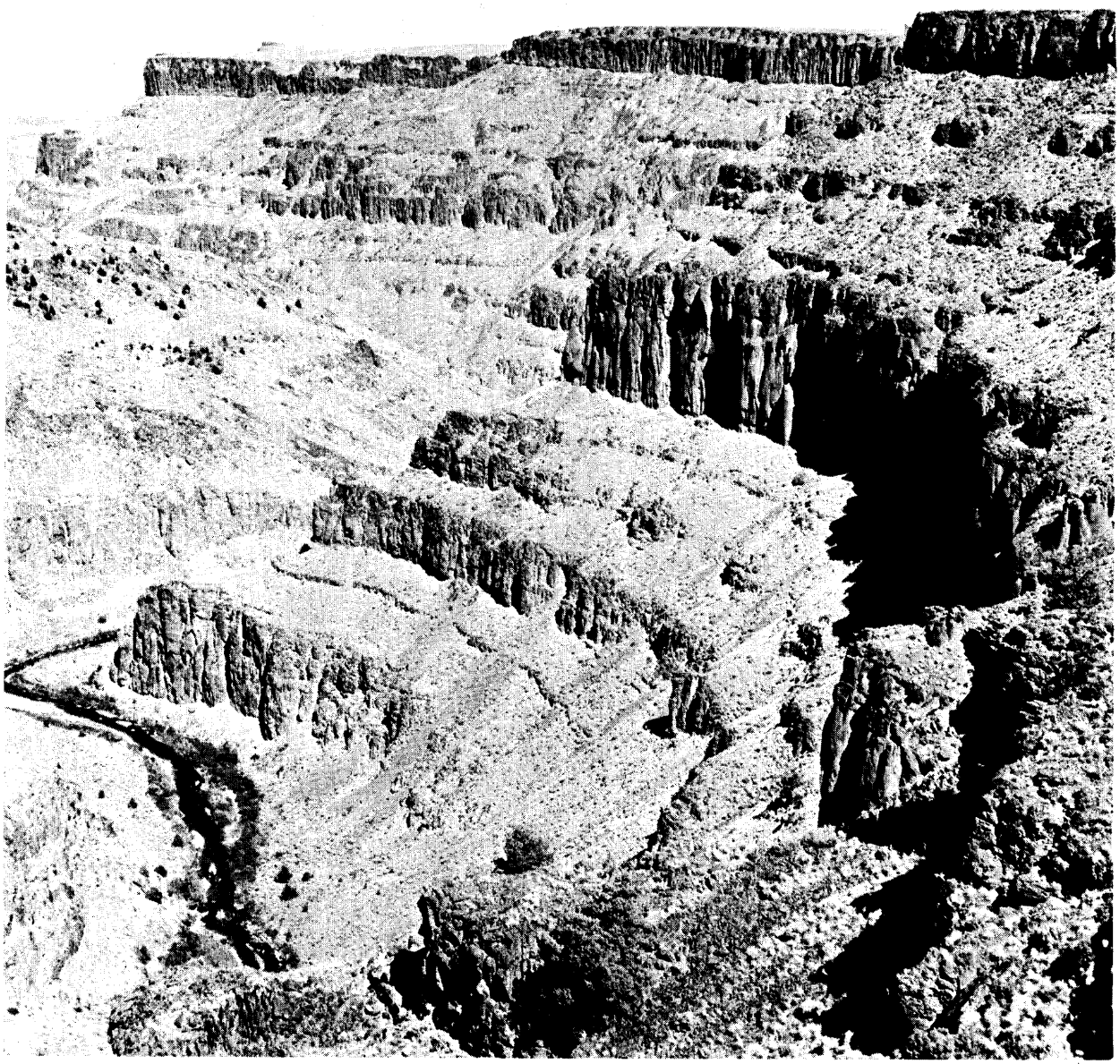

Figure 17. View looking north from SE¼NE¼ sec. 28, T. 16 S., R. 7 E., of the east side of Bruneau Canyon in Triplet Butte quadrangle. Various cooling units of the Cougar Point tuff are indicated by roman numerals.

occurrence in the canyon of the East Fork of the Jarbidge River in secs. 17 and 20, T. 47 N., R. 59 E., that can be observed from Cougar Point on the east side of the canyon. Six cooling units of the Cougar Point tuff are exposed there (Figure 14); however, neither the lowest nor highest part of the sequence is exposed at this locality.

BASIS OF INTERNAL STRATIGRAPHIC NOMENCLATURE

Based on the stratigraphic succession in Bruneau and Jarbidge Canyons, areal mapping, thin-section observations, chemistry, and magnetic polarity measurements, it is clear that the Cougar Point tuff consists of at least nine cooling units. Most appear to be compound cooling units formed from a sequence of eruptions. An interim nomenclature system using roman numerals to designate the various units has been adopted by the writer; the units that have been recognized on various canyon walls are indicated in Figures 14, 15, 16, and 17. The current system using roman numerals has proven satisfactory and supercedes two previous designation systems, as noted in the next paragraph. Once the preliminary mapping and initial stratigraphic observations and correlations are complete for the Cougar Point tuff, it may be appropriate to adopt a nomenclature system utilizing place names for the various units. This will depend on the results of future geologic mapping and stratigraphic studies and on the eventual definition of the Cougar Point tuff regarding which welded tuff cooling units are included in and excluded from the unit. These uncertainties apply particularly to the unmapped area west of Bruneau Canyon where previously unrecognized cooling units may be found, and to the area southeast of the eruptive center where additional ash-flow

tuff cooling units exist.

The first systematic stratigraphic work on the Cougar Point tuff was conducted by the writer in July, 1972, in the West Fork of the Jarbidge Canyon in secs. 21, 22, 27, and 28, T. 47 N., R. 58 E., near and on Deer Creek grade. Five Cougar Point tuff cooling units occur in the area. They were designated, from top to bottom, A, B, C, D, and E. Later that summer additional stratigraphic work in the East Fork of the Jarbidge Canyon showed that the Cougar Point tuff consisted of six cooling units. Once these were correlated with those in the West Fork, it was found that an additional unit occurred between C and D. It was designated as D'. In 1975, when Citron mapped the Cougar Point tuff and other units in the Three Creek area east of Jarbidge Canyon, he designated A as Tcp_1, B as Tcp_2, C as Tcp_3, D' as Tcp_4, D as Tcp_5, and E as Tcp_6 (Citron, 1976).

In 1977, when the writer started to determine the detailed stratigraphic relations in the south-central and southwestern parts of the Cougar Point tuff volcanic field, the logical starting place appeared to be the excellently exposed section on the Black Rock escarpment in Bruneau Canyon. At that time, none of the unit-by-unit correlations within the Cougar Point tuff from Bruneau Canyon to its exposures in the East and West Forks of Jarbidge Canyon had been made. It was then that the more flexible interim stratigraphic nomenclature system, using alternate roman numerals, was devised. The first work done on the Black Rock escarpment was in the southwestern part of sec. 9, T. 16 S., R. 7 E., where erosion along a fault has formed a gully which provides the only reasonably easy access on foot to units which otherwise crop out as

cliffs (Figure 16). An examination of the Cougar Point tuff at this locality revealed that seven cooling units were present. These were designated, from bottom to top, as III, V, VII, IX, XI, XIII, and XV. This alternate-numbering system left room for additional but yet to be discovered units that might need to be added to the sequence, without resorting to confusing designations such as the previously used D'. Later observations north and south of the access gully in section 9 revealed that an additional unit did occur between units XI and XIII. Accordingly, it was designated as XII.

In 1978 and 1980 additional investigations, including magnetic polarity measurements, chemical analyses, and thin-section studies for nearly all of the Cougar Point tuff units, and unit-by-unit mapping in the northeastern part of the Rowland 15-minute quadrangle was conducted to establish, as well as possible, the unit-by-unit correlations between the Bruneau and Jarbidge Canyons. This combination of techniques proved to be definitive, so that a unit designated by any particular roman numeral in Figures 14, 15, 16, and 17 is known to be the same unit from canyon to canyon. The chemical analyses and the petrographic observations upon which these correlations are partly based will be detailed by the writer in other reports released by the Idaho Bureau of Mines and Geology. The magnetic polarity determinations are given in Tables 12-18 and are discussed below.

Up to the present time, nine cooling units have been found in the Cougar Point tuff. (All but unit X, which is the D'-Tcp_4 unit and exposed only in the East Fork of the Jarbidge Canyon, occur in the Bruneau Canyon reference section, as shown in Figures 16 and 17.) In

ascending order these are III, V, VII (E, Tcp_6), IX (D, Tcp_5), X (D', Tcp_4), XI (C, Tcp_3), XII (B, Tcp_2), XIII (A, Tcp_1), and XV. The older but now discarded designations are indicated above in parentheses for the various units. The roman numerals I, II, IV, VI, VIII, XIV, XVI, and up have not yet been utilized.

COOLING UNIT XV

The uppermost Cougar Point tuff cooling unit, XV, is somewhat limited in its distribution. Its most prominent occurrence is along the rim of Bruneau Canyon (Figures 12, 16, and 17). It occurs as the surface bedrock unit throughout much of the Cowan Reservoir and Triplet Butte 7½-minute quadrangles. It has been found at only one place as far east as the Jarbidge River drainage. This occurrence is about 0.6 kilometer north of the mouth of Buck Creek in the bottom of the West Fork of the Jarbidge Canyon (Station 193, Table 12). Although it cannot be conclusively proven that this isolated occurrence in Jarbidge Canyon is part of Unit XV, the similarity of it in petrographic, chemical, magnetic polarity, and stratigraphic position with the main part of the unit farther west makes the assignment to Unit XV seem very reasonable. Unit XV is known to occur west and northwest of Black Rock escarpment, but its distribution in that area has yet to be mapped. Magnetic polarity measurements of thirteen samples from three stations for Unit XV are given in Table 12. They indicate probable normal polarity for the unit. The "no response" readings and the anomolous negative readings suggest, however, that additional measurements are needed to confirm this.

COOLING UNIT XIII

Unit XIII is the most widespread of the Cougar Point tuff cooling units. It is present, but not prominent, in Bruneau Canyon (Figures 16 and 17). It is known to occur west of Bruneau Canyon, but its distribution there has yet to be mapped. It is the uppermost unit in the Jarbidge River drainage area, occurring at the canyon rim (Figure 14). East of the Jarbidge River system, Unit XIII is the bedrock unit that underlies a large part of the Three Creek and Curtis Draw quadrangles. In Idaho, it extends east of the Curtis Draw quadrangle (east of lat. 115°) an undetermined distance. In Nevada, the unit is widely distributed in the northern parts of the Contact, Elk Mountain, Jarbidge, and Rowland quadrangles; however, its eastward, southern, and westward distribution limits have yet to be determined. So far, this unit has been shown to extend for at least 65 kilometers along the Idaho-Nevada border. Magnetic polarity measurements for twelve Unit XIII samples, collected at two stations, indicate normal magnetic polarity (Table 13).

COOLING UNIT XII

Unit XII is widely distributed but does not appear to be as extensive as the overlying unit. Its most prominent occurrences are in the walls of the East and West Forks of Jarbidge Canyon (Figure 14). In the Jarbidge and Elk Mountain 15-minute quadrangles, it occurs beneath Unit XIII east of the Jarbidge drainage and presumably beneath that unit throughout much of the Three Creek and Curtis Draw 7½-minute quadrangles. It is present in Bruneau Canyon, but its distribution there seems sporadic (Figures 16 and 17). This probably shows that Bruneau Canyon is near

its western limit. The unit has been traced in the field across the northern parts of the Rowland and Jarbidge quadrangles between the canyons of the Bruneau River and East and West Forks of the Jarbidge. Magnetic polarity measurements for thirteen samples of Unit XII, collected at two stations, are given in Table 14. These measurements indicate a normal magnetic polarity for the unit.

COOLING UNIT XI

Unit XI forms a very prominent part of the Cougar Point tuff in the canyons of the Bruneau River and the East and West Forks of the Jarbidge. In Bruneau Canyon (Figures 15, 16, and 17) it forms a prominent cliff in about the middle of the exposed section and displays many picturesque erosional pillars. It clearly is a compound cooling unit and one of the thickest of the Cougar Point tuff units. In Jarbidge Canyon, it is also a very prominent unit, although not generally as thick there as in Bruneau Canyon. The unit has been traced across the northern part of the Rowland and Jarbidge quadrangles between the Bruneau and Jarbidge Canyons. Its distribution east of Jarbidge Canyon in northern Nevada has yet to be explored. It probably occurs in Sheep Creek Canyon west of the Bruneau River, but its extent to the west has yet to be examined. Magnetic polarity measurements for eleven samples collected at three stations are given in Table 15. These indicate a reversed magnetic polarity for the unit.

COOLING UNIT X

Unit X is prominently exposed only in the canyon of the East Fork

of the Jarbidge River (Figure 14). Scattered outcrops of probably the same unit were also found in the east canyon wall of the West Fork of the Jarbidge near the mouth of Deer Creek (sec. 27, T. 47 N., R. 58 E.); but there the unit is only a few meters thick and does not form a traceable scarp. Farther north in the West Fork Canyon, near the Idaho-Nevada border, the overlying Unit XI develops an interesting lower subunit. It may be that Unit X merges into the base of the overlying unit, as both thicken toward their source, forming a composite sheet. This possibility has yet to be evaluated by walking out the distribution of Unit X, however. Unit X has not been detected in Bruneau Canyon yet. At present, no magnetic polarity measurements are available for this unit.

COOLING UNIT IX

Unit IX is only known to be exposed in the canyons of the Bruneau and Jarbidge Rivers (Figures 14, 15, 16, and 17). In Jarbidge Canyon it generally occurs as a rather massive unit, whereas in Bruneau Canyon it forms a multiple scarp unit conspicuously thinner than the units above (XI) and below (VII). Based on chemical composition, petrographic features, magnetic polarity measurements, and position in the stratigraphic succession, Unit IX is probably the same in both canyons. Magnetic polarity measurements for nineteen Unit IX samples, collected from four stations, are given in Table 16. These results indicate probable normal magnetic polarity for the unit. More data should be collected to confirm this. For the two Bruneau Canyon stations in Table 16 at which the samples showed no magnetic response, strong oxidation of the rhyolite as it cooled probably destroyed the original magnetite. At both of these

localities the unit contains abundant jasper in its upper portion, suggesting that it was submerged in water shortly after it was erupted.

COOLING UNIT VII

Unit VII occurs as a massive cliff near the bottom of both the Jarbidge and Bruneau Canyons (Figures 14, 16, and 17). It is thicker in Bruneau Canyon. In both it pinches out southward against older topography (Figure 15). Magnetic polarity determinations for thirteen samples from three stations are given in Table 17. These indicate a reversed magnetic polarity for the unit.

COOLING UNIT V

Unit V occurs as a relatively thin scarp in Bruneau Canyon (Figures 15, 16, and 17) that locally nearly pinches out. At some localities where it is thin, the unit contains vitrophyre layers in its central part, demonstrating a compound cooling unit nature. Unit V is not extensively developed in the Jarbidge River drainage. However, a possible occurrence of this unit is exposed along the West Fork of the Jarbidge, about 1.3 kilometers north of the mouth of Deer Creek in sec. 21, T. 47 N., R. 58 E. Magnetic polarity measurements for nine samples collected from three stations in Unit V are given in Table 18. These indicate a normal polarity for the unit.

COOLING UNIT III

Unit III of the Cougar Point tuff is exposed only in the bottom of Bruneau Canyon (Figures 15, 16, and 17) between the fault-controlled

gully in the southwestern part of sec. 9, T. 16 S., R. 7 E., and the Rowland, Nevada, area, where it pinches out against the older Bieroth Andesite of Bushnell (1967). Unit III is the oldest welded ash-flow tuff found so far in the Cougar Point tuff. What may be below it in the bottom of Bruneau Canyon has yet to be determined. At present, no magnetic polarity measurements are available for this unit.

UNIDENTIFIED COOLING UNITS WEST OF BRUNEAU CANYON

Preliminary observations of the Cougar Point tuff west of Bruneau Canyon, especially in Sheep Creek Canyon, indicate the presence of several cooling units. These units have yet to be correlated with the succession of units exposed on the Black Rock escarpment. The magnetic polarity measurements collected to date for these units are given in Table 19. For the data in this table the relationship between the upper and lower units at stations 520, 521, and 549, which are in the same sector of the Canyon between Black Canyon and Cat Creek, has yet to be established relative to the upper, middle, and lower units exposed farther southwest at station 518 in the Three Forks area.

UNASSIGNED WELDED ASH-FLOW TUFF COOLING UNITS IN THE CURTIS DRAW QUADRANGLE

Three thin welded ash-flow tuff cooling units lying above Unit XIII of the Cougar Point tuff occur in the northeastern part of the Curtis Draw quadrangle (T. 15 S., R. 12 E.). These units pinch out westward, but they thicken and extend for an undetermined distance east of the Curtis Draw quadrangle. They have not been named, and it is not yet

clear if they should be assigned to the Cougar Point tuff or to some other group of silicic volcanic units. Magnetic polarity measurements have been made on these three units and are given in Table 20. The results indicate normal magnetic polarity for all three. In Table 20, these units are called the lower, middle, and upper units, referring to their mutual stratigraphic positions.

BASALT FLOWS

Many basalt flows occur in the Bruneau-Jarbidge eruptive center. All but one, the Indian Springs basalt, are part of the Banbury Basalt, so far an undivided geologic unit in southwestern Idaho into which numerous basalt lava flows and intercalated sediments have been lumped (Malde and Powers, 1962; Malde, Powers, and Marshall, 1963; Rember and Bennett, 1979). The Indian Springs basalt is older than the Dorsey Creek rhyolite and thus is part of the Idavada Volcanics. In the Bruneau-Jarbidge eruptive center most of the flows can be related to the specific vents that are shown on Figures 2 and 3. Only those flows for which magnetic polarity data are available are discussed below.

INDIAN SPRINGS BASALT

The Indian Springs basalt is a group of basalt flows with no intervening sedimentary interbeds. It is most conspicuously exposed in the southern part of the Indian Hot Springs quadrangle, sandwiched between the Long Draw and Dorsey Creek rhyolite flows above the confluence of the Bruneau

and Jarbidge Rivers (Figure 5), and for a few kilometers up Jarbidge Canyon. This basalt unit is the only one so far that definitely is intercalated between any of the rhyolite flows within the Bruneau-Jarbidge eruptive center. The thickest part of the Indian Springs basalt, about 50 meters thick, is in Jarbidge Canyon in secs. 10, 14, and 15, T. 13 S., R. 7 E. The localized occurrence of fragmental basaltic pyroclastic deposits in those sections suggests that the vent area is nearby. In portions of the Indian Springs area the Indian Springs basalt displays prominent oxidation and the development of calcite, opal, and zeolites in vesicles and veins. Evidently this part of the unit was submerged in water shortly following its eruption.

The Indian Springs basalt has been traced as far north in Bruneau Canyon as the southern edge of sec. 28, T. 12 S., R. 7 E., about a kilometer north of Indian Hot Springs. At this locality the basalt unit lies above the southern margin of the Bruneau Jasper rhyolite. It extends a bit more than 3 kilometers upstream from Indian Hot Springs in Bruneau Canyon between the Long Draw and Dorsey Creek rhyolites (Figure 4), where it terminates in the western part of sec. 8, T. 13 S., R. 7 E. The Indian Springs basalt can be traced continuously for about 12 kilometers up Jarbidge Canyon to sec. 31, T. 13 S., R. 8 E., where it disappears beneath the lower rhyolite of Poison Creek (Figure 4). This basalt reappears farther to the southeast in the bottom of Jarbidge Canyon, beneath the Dorsey Creek rhyolite. It is intermittently exposed for more than 12 kilometers in the bottom of the canyon between the southwestern portion of sec. 11, T. 15 S., R. 8 E., just downstream from the mouth of Dorsey Creek to the confluence of the East and West Forks of the Jarbidge

River in sec. 10, T. 16 S., R. 9 E.

The results of thirteen magnetic polarity measurements on Indian Springs basalt samples from three stations are given in Table 21. They indicate a reversed magnetic polarity for the unit.

UNNAMED LOWER BASALT AT TRIGUERO HOMESTEAD

For about 6 kilometers in Bruneau Canyon, between sec. 12, T. 14 S., R. 6 E., on the north and sec. 32, T. 14 S., R. 7 E., on the south, a basalt unit lies immediately above the Indian Batt rhyolite flow (Figure 11), under a cover of sediments that exceeds 100 meters thick in the north part. This basalt unit is thickest on the east side of the canyon, near the Frank Triguero Homestead in sec. 30, T. 14 S., R. 7 E., where it consists of several individual flows but contains no sedimentary interbeds. At its northern margin, it is within about 1.4 kilometers of the south margin of the Dorsey Creek rhyolite flow. Its age, relative to that of the Dorsey Creek rhyolite, has yet to be established. It seems likely, however, that this basalt unit is older than the Dorsey Creek rhyolite, since it occurs immediately on top of the Indian Batt rhyolite, whereas the southern edge of the Dorsey Creek rhyolite in Bruneau Canyon is separated from the Indian Batt rhyolite by about 30 meters of sediments.

Magnetic polarity measurements of three samples collected at a station above Triguero Homestead on the west wall of Bruneau Canyon are given in Table 22. These measurements suggest a normal magnetic polarity for the unit, but more measurements are needed for confirmation. If it has a normal polarity, this basalt could not be the time equivalent of the Indian Springs basalt, even though it may be older than the Dorsey Creek rhyolite.

UNNAMED BASALT UNITS IN THE BUSTER BUTTE QUADRANGLE

On the west side of Sheep Creek Canyon in sec. 21, T. 12 S., R. 6 E., at a location about 2 kilometers southwest of the mouth of Louse Creek, magnetic polarity measurements have been made on the two unnamed basalt units shown in Figure 9. The results (Table 23) suggest that both have a reversed magnetic polarity; however, additional measurements are needed to confirm this. These basalt units have yet to be correlated with basalt flows that are exposed at other localities. The lower basalt unit does not extend to the north of this location. It occurs beneath about 60 meters of sediments between it and the upper basalt at the canyon rim. If its magnetic polarity is confirmed to be reversed, it could be approximately the same age as the Indian Springs basalt, which occurs less than 10 kilometers to the east.

BLACK ROCK BASALT

The Black Rock basalt consists of a succession of basalt flows erupted from a vent at the site of Black Rock Hill in sec. 21, T. 15 S., R. 7 E., and in parts of adjacent sections in the northeastern corner of the Triplet Butte quadrangle. This volcano has had its western side downfaulted relative to the eastern side, exposing numerous thin vesicular flows and a small diabase plug. The lava from this vent flowed mainly northward to cover much of the area extending about 5 kilometers on either side of Bruneau Canyon. The flows from the Black Rock vent have been traced more than 23 kilometers north of the vent on the west side of Bruneau Canyon to sec. 11, T. 13 S., R. 6 E., in the Cedar Tree Trail area in the southwestern part of the Indian Hot Springs quadrangle. It

has not yet been determined how much farther north the unit extends away from the canyon rim. The original area covered by basalt flows from the Black Rock vent must have exceeded 200 square kilometers. This basalt unit is stratigraphically above all of the rhyolite units in the area, as demonstrated by its overlying the Dorsey Creek rhyolite (Figure 7) for several kilometers along Bruneau Canyon between the Indian Batt Cabin and Cedar Tree Trail areas. The Black Rock basalt is the uppermost basalt in the area through which it has been mapped (Figure 11); however, its stratigraphic relationship to other basalt units in adjacent areas has yet to be examined. It generally lies at the surface, although along its southern margin, between the Sheep Creek and Bruneau Canyons, it is overlain by gravel deposits that locally exceed 40 meters in thickness.

Magnetic polarity measurements of twenty-three samples of basalt from flows in the Black Rock unit, collected at seven stations, are given in Table 24. These indicate a normal magnetic polarity for the unit, although about a quarter of the measurements indicate local reversed polarity. However, at least part of these spurious measurements are from rim rock samples, which very likely have had their polarity reset because of lightning strikes.

DISCUSSION

A summary of the magnetometer deflection measurements and corresponding magnetic polarities for each of the units is given in Table 25. For many units, including the Dorsey Creek, Sheep Creek, and Triguero Homestead

rhyolites, the Indian Springs basalt and most of the Cougar Point tuff cooling units, where eight or more measurements at three or more stations has given consistent results, the magnetic polarity seems unequivocal. However, for other units, such as the lower rhyolites at Poison Creek and at Louse Creek, where only a few measurements are available, the magnetic polarity assigned should be considered tentative, and additional measurements are needed to confirm the results. For those units where two or fewer deflection readings of the same sign are available, no assignment of polarity has been made.

From many of the locations illustrated in Figures 5 to 17, as well as from observations made elsewhere, the relative stratigraphic sequence for most of the volcanic units from the Bruneau-Jarbidge eruptive center has been established. This succession is summarized on the left-hand side of Table 26. A few rhyolite lava flows have yet to be fitted into the definite sequence shown; these and their possible limits are shown on the right-hand side of Table 26. The only limits in stratigraphic position established so far for the Sheep Creek rhyolite are that it overlies the Bruneau Jasper rhyolite and lies beneath flows of the Banbury Basalt. The only limit so far for the lower rhyolite at Louse Creek is that it lies beneath the Sheep Creek rhyolite. The stratigraphic limits for the Indian Batt rhyolite are that it lies above the Triguero Homestead rhyolite and that it is beneath the lower basalt at Triguero Homestead which, in turn, lies beneath one of the Banbury Basalt units, the Black Rock basalt. Continued geologic mapping, additional magnetic polarity determinations, and follow-up mineralogical and chemical studies, should answer many of the questions regarding the stratigraphic succession

of volcanic units in the eruptive center.

The summary of magnetic polarities for the various units that constitute the established stratigraphic sequence on the left-hand side of Table 26 indicates at least seven different magnetic intervals are represented in the evolution of the Bruneau Jasper eruptive center. Most likely, additional magnetic intervals will be found, since no work has yet been done on the forty or more basalt units that constitute the overlying Banbury Basalt. Additional mapping of the Cougar Point tuff and rhyolite lava flows, especially in the western part of the eruptive center, may also turn up new units.

ACKNOWLEDGMENTS

The writer takes pleasure in thanking Gary Citron, Dale Conover, Falma Moye, Kurt Othburg, Maura Weathers, Carol Bonnichsen, James Bonnichsen, and Everett Bonnichsen for their assistance during various portions of the field work leading to this report.

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TABLES

Table 1. Fluxgate magnetometer deflection measurements for Dorsey Creek rhyolite samples.

Station	Location	Quadrangle	Magnetometer Readings	Comments
199	NE¼SW¼ sec. 3, T. 16 S., R. 9 E. (Jarbidge Canyon)	Dishpan	1 +	from near base
			2 +	from near base
			3 +	from near base
			4 +	from near base
			5 +	from near base
			6 +	from near base
			7 +	from near base
466	SE¼SW¼ sec. 5, T. 13 S., R. 7 E. (Bruneau Canyon)	Indian Hot Springs	1 +	lithic, from near base
			2 + weak	lithic, from near base
			3 +	lithic, from near base
469	NW¼SE¼ sec. 4, T. 13 S., R. 7 E. (Jarbidge Canyon)	Indian Hot Springs	1 +	basal vitrophyre
			2 +	lithic, from base
			3 +	lithic, from base
474	NW¼NE¼ sec. 15, T. 15 S., R. 8 E. (Dorsey Creek Canyon)	Poison Butte	1 +	lithic, from near base
475	SW¼SW¼ sec. 11, T. 15 S., R. 8 E. (Jarbidge Canyon)	Poison Butte	1 +	basal vitrophyre
495	NE¼SW¼ sec. 32, T. 13 S., R. 8 E. (Poison Creek Canyon)	The Arch	1 + strong	lithic, from base
			2 +	lithic, from base
			3 + strong	basal vitrophyre

Table 2. Fluxgate magnetometer deflection measurements for samples of the unnamed lower rhyolite at Poison Creek.

Station	Location	Quadrangle	Magnetometer Readings	Comments
494	NW¼SW¼ sec. 32, T. 13 S., R. 8 E. (Jarbidge Canyon)	The Arch	1 + weak	lithic, from middle
			2 + weak	lithic, from middle
			3 +	lithic, from middle
			4 +	lithic, from middle

Table 3. Fluxgate magnetometer deflection measurements for Sheep Creek rhyolite samples.

Station	Location	Quadrangle	Magnetometer Readings	Comments
497	NW¼SE¼ sec. 3, T. 12 S., R. 7 E. (Stiff Tree Draw)	Stiff Tree Draw	1 + very weak	lithic, 30 m above base
			2 + very weak	lithic, 60 m above base
			3 + weak	lithic, 60 m above base
			4 +	lithic, 90 m above base
			5 +	lithic, 120 m above base
			6 + weak	lithic, 170 m above base
529	SW¼NW¼ sec. 23, T. 11 S., R. 6 E. (side canyon at Big Bend of Sheep Creek)	Cave Draw	1 +	upper vitrophyre
			2 +	lithic, upper part
			3 +	lithic, upper part
			4 +	lithic, upper part
530	NW¼NW¼ sec. 15, T. 12 S., R. 6 E. (Sheep Creek Canyon)	Cave Draw	1 +	lithic, upper part
			2 +	lithic, upper part
			3 +	lithic, upper part
533	SE¼SE¼ sec. 16, T. 12 S., R. 6 E. (Sheep Creek Canyon)	Blackstone Reservoir	1 +	basal vitrophyre

Table 4. Fluxgate magnetometer deflection measurements for rhyolite samples from the Big Hill area.

Station	Location	Quadrangle	Magnetometer Readings	Comments
526	SE¼SE¼ sec. 19, T. 9 S., R. 5 E. (U. S. Highway 51 roadcut)	Big Hill	1 -	vitrophyre
			2 +	lithic
			3 +	lithic
527	SE¼NW¼ sec. 17, T. 10 S., R. 5 E. (U. S. Highway 51 roadcut)	Big Hill	1 +	lithic
			2 +	lithic

Table 5. Fluxgate magnetometer deflection measurements for samples of the unnamed lower rhyolite at Louse Creek.

Station	Location	Quadrangle	Magnetometer Readings	Comments
532	SE¼SE¼ sec. 16, T. 12 S., R. 6 E. (Sheep Creek Canyon)	Blackstone Reservoir	1 +	upper vitrophyre
534	SE¼NW¼ sec. 21, T. 12 S., R. 6 E. (Sheep Creek Canyon)	Buster Butte	1 +	upper vitrophyre
			2 +	lithic, upper part
			3 +	lithic, upper part

Table 6. Fluxgate magnetometer deflection measurements for Bruneau Jasper rhyolite samples.

Station	Location	Quadrangle	Magnetometer Readings	Comments
471	NW¼NW¼ sec. 33, T. 12 S., R. 7 E. (Bruneau Canyon)	Indian Hot Springs	1 -	lithic, from middle
491	NW¼SE¼ sec. 28, T. 12 S., R. 7 E. (Bruneau Canyon)	Indian Hot Springs	1 -	upper vitrophyre
			2 - strong	upper vitrophyre
			3 -	lithic, upper part
			4 -	lithic, upper part

Table 7. Fluxgate magnetometer deflection measurements for Long Draw rhyolite samples.

Station	Location	Quadrangle	Magnetometer Readings	Comments
467	NW¼SE¼ sec. 5, T. 13 S., R. 7 E. (Bruneau Canyon)	Indian Hot Springs	1 + strong	upper vitrophyre
			2 + strong	upper vitrophyre
			3 + strong	upper vitrophyre
470	NW¼NW¼ sec. 4, T. 13 S., R. 7 E. (confluence of Bruneau and Jarbidge Rivers)	Indian Hot Springs	1 + weak	lithic, upper part
			2 + strong	lithic, upper part
			3 + weak	lithic, upper part

Table 8. Fluxgate magnetometer deflection measurements for Indian Batt rhyolite samples.

Station	Location	Quadrangle	Magnetometer Readings	Comments
509	NW¼SE¼ sec. 36, T. 13 S., R. 6 E. (Bruneau Canyon)	Indian Hot Springs	1 - 2 -	basal vitrophyre basal vitrophyre
513	NE¼NE¼ sec. 25, T. 14 S., R. 6 E. (Bruneau Canyon)	Triguero Lake	1 - strong 2 + very weak 3 + very weak	basal vitrophyre lithic, from middle lithic, from middle
538	NW¼NW¼ sec. 28, T. 14 S., R. 6 E. (Sheep Creek Canyon)	Antelope Creek	1 - 2 -	basal vitrophyre basal vitrophyre
541	SE¼NE¼ sec. 21, T. 14 S., R. 6 E. (Sheep Creek Canyon)	Antelope Creek	1 + weak 2 - strong	lithic, upper part upper vitrophyre
543	NW¼SW¼ sec. 15, T. 14 S., R. 6 E. (Sheep Creek Canyon)	Triguero Lake	1 + weak 2 + weak	lithic, from middle lithic, from middle

Table 9. Fluxgate magnetometer deflection measurements for Triguero Homestead rhyolite samples.

Station	Location	Quadrangle	Magnetometer Readings	Comments
500	NE¼NW¼ sec. 18, T. 13 S., R. 7 E. (mouth of Long Draw)	Indian Hot Springs	1 + 2 + 3 +	lithic, upper part lithic, upper part lithic, upper part
506	SW¼SE¼ sec. 1, T. 14 S., R. 6 E. (Bruneau Canyon)	Triguero Lake	1 + 2 +	lithic, from middle lithic, from middle
508	SW¼NE¼ sec. 36, T. 13 S., R. 6 E.	Indian Hot Springs	1 + 3 +	upper vitrophyre lithic, upper part
511	SE¼NE¼ sec. 24, T. 14 S., R. 6 E. (Bruneau Canyon)	Triguero Lake	1 + strong 2 + strong	basal vitrophyre basal vitrophyre
512	SE¼SE¼ sec. 24, T. 14 S., R. 6 E. (Bruneau Canyon)	Triguero Lake	1 + strong	basal vitrophyre
550	NW¼NW¼ sec. 33, T. 14 S., R. 6 E. (Sheep Creek Canyon)	Antelope Creek	1 + 2 +	lithic, upper part lithic, upper part
551	NE¼SW¼ sec. 28, T. 14 S., R. 6 E. (Sheep Creek Canyon)	Antelope Creek	1 +	lithic, from middle

Table 10. Fluxgate magnetometer deflection measurements for samples of the unnamed rhyolite flow near Cedar Creek Reservoir.

Station	Location	Quadrangle	Magnetometer Readings	Comments
461	NW¼NE¼ sec. 27, T. 14 S., R. 13 E. (Cedar Creek Canyon)	Cedar Creek Reservoir	1 +	lithic
			2 +	lithic
			3 +	lithic
			4 +	lithic
			5 +	lithic
			6 +	lithic
			7 +	lithic
			8 erratic	lithic
			9 +	lithic

Table 11. Fluxgate magnetometer deflection measurements for samples of unnamed rhyolite flows in the northern part of the Blue Butte and Crows Nest 15-minute quadrangles.

Station	Location	Quadrangle and Unit	Magnetometer Readings	Comments
556	NW¼ sec. 23, T. 8 S., R. 10 E. (south side of hill)	Blue Butte (upper flow)	1 +	lithic, from middle
			2 +	lithic, from middle
			3 -	basal vitrophyre
556	NW¼ sec. 23, T. 8 S., R. 10 E. (south side of hill)	Blue Butte (lower flow)	1 +	lithic, from middle
			2 +	lithic, from middle
			3 +	lithic, from middle
558	NW¼NE¼ sec. 33, T. 8 S., R. 11 E. (southeast end of hill)	Crows Nest	1 - very weak	lithic
			2 - very weak	lithic

Table 12. Fluxgate magnetometer deflection measurements for samples of Cougar Point tuff unit XV.

Station	Location	Quadrangle	Magnetometer Readings	Comments
193	SE¼SW¼ sec. 21, T. 16 S., R. 9 E. (Jarbidge Canyon)	Dishpan	1 +	vitrophyre
			2 +	vitrophyre
			3 +	lithic, upper part
			4 +	partly fused ash at base
375	SE¼NE¼ sec. 28, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 - erratic	lithic, lower part
			2 +	lithic, lower part
			3 +	lithic, lower part
			4 -	fused ash at base
			5 + very weak	fused ash at base
			6 +	fused ash at base
376	SW¼NE¼ sec. 27, T. 16 S., R. 7 E. (head of "Hole in the Ground" Canyon)	Cowan Reservoir	1 no response	lithic, from middle
			2 no response	lithic, from middle
			3 erratic	lithic, from middle

Table 13. Fluxgate magnetometer deflection measurements for samples of Cougar Point tuff unit XIII.

Station	Location	Quadrangle	Magnetometer Readings	Comments
60	SE¼NW¼ sec. 28, T. 16 S., R. 9 E. (mouth of Buck Creek)	Dishpan	1 +	lower part
			2 +	lower part
			3 +	lower part
375	SE¼NE¼ sec. 28, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 +	lithic, lower part
			2 + weak	lithic, lower part
			3 +	lithic, lower part
			4 +	lithic, lower part
			5 +	lithic, lower part
			6 +	lithic, lower part
			7 + weak	lithic, from middle
			8 + weak	lithic, from middle
			9 +	lithic, from middle

Table 14. Fluxgate magnetometer deflection measurements for samples of Cougar Point tuff unit XII.

Station	Location	Quadrangle	Magnetometer Readings	Comments
375	SE¼NE¼ sec. 28, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 +	lithic, lower part
			2 very erratic	lithic, lower part
			3 + erratic	lithic, lower part
			4 +	lithic, from middle
			5 +	lithic, from middle
			6 +	lithic, from middle
			7 +	lithic, upper part
			8 erratic	lithic, upper part
			9 + weak	lithic, upper part
382	NW¼SE¼ sec. 28, T. 16 S., R. 9 E. (Jarbidge Canyon)	Dishpan	1 +	lower part
			2 +	lower part
			3 +	lower part
			4 + weak	lower part

Table 15. Fluxgate magnetometer deflection measurements for samples of Cougar Point tuff unit XI.

Station	Location	Quadrangle	Magnetometer Readings	Comments
383	NW¼NE¼ sec. 33, T. 16 S., R. 9 E. (Jarbidge Canyon)	Dishpan	1 -	lithic, from middle
			2 -	lithic, from middle
			3 -	lithic, from middle
385	SW¼NW¼ sec. 3, T. 47 N., R. 58 E. (Jarbidge Canyon)	Jarbidge	1 -	lithic, lower part
			2 -	lithic, lower part
463	NW¼NW¼ sec. 4, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 -	lithic, lower part
			2 -	lithic, lower part
			3 -	lithic, lower part
			4 - very weak	lower part
			5 no response	lithic, lower part
			6 no repsonse	lower part

Table 16. Fluxgate magnetometer deflection measurements for samples of Cougar Point tuff unit IX.

Station	Location	Quadrangle	Magnetometer Readings	Comments
177	NW¼SW¼ sec. 9, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 no response	
			2 no response	lithic, lower part
			3 no response	lithic, lower part
384	SW¼NE¼ sec. 28, T. 47 N., R. 58 E. (near Deer Creek grade)	Jarbidge	1 +	lower part
			2 +	lower part
			3 +	lower part
			4 +	lower part
			5 +	lower part
			6 +	lower part
463	NW¼NW¼ sec. 4, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 no response	lithic
			2 no response	
			3 no response	lithic
			4 no response	lithic
			5 no response	
			6 no response	lithic
499	SE¼SE¼ sec. 21, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 +	lithic, upper part
			2 +	lithic, from middle
			3 + erratic	lithic, from near ba:
			4 +	lithic, from near ba:

Table 17. Fluxgate magnetometer deflection measurements for samples of Cougar Point tuff unit VII.

Station	Location	Quadrangle	Magnetometer Readings	Comments
177	NW¼SW¼ sec. 9, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 - very strong	lithic
			2 - very strong	
			3 -	lithic
			4 -	
384	SW¼NE¼ sec. 28, T. 47 N., R. 58 E. (near Deer Creek grade)	Jarbidge	1 -	basal vitrophyre
			2 -	basal vitrophyre
			3 -	lithic, lower part
			4 -	lithic, lower part
			5 -	lithic, upper part
			6 -	lithic, upper part
499	SE¼SE¼ sec. 21, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 -	lithic, upper part
			2 -	lithic, from middle
			3 -	lithic, from base

Table 18. Fluxgate magnetometer deflection measurements for samples of Cougar Point tuff unit V.

Station	Location	Quadrangle	Magnetometer Readings	Comments
177	NW¼SW¼ sec. 9, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 no response	lithic
			2 + very weak	
			3 +	lithic
209	NE¼SE¼ sec. 21, T. 47 N., R. 58 E. (Jarbidge Canyon)	Jarbidge	1 + very weak	lithic, oxidized
			2 +	vitrophyre
			3 +	vitrophyre
499	SE¼SE¼ sec. 21, T. 16 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 +	lithic, lower part
			2 + weak	lithic, lower part
			3 +	lithic, lower part

Table 19. Fluxgate magnetometer deflection measurements for samples of unidentified Cougar Point tuff units in the Antelope Creek, Black Leg Creek, and Triguero Lake quadrangles.

Station	Location	Quadrangle and Unit	Magnetometer Readings	Comments
498	SE¼SE¼ sec. 4, T. 15 S., R. 6 E. (Cat Creek)	Triguero Lake	1 +	lithic, from middle
			2 +	lithic, from middle
			3 + strong	lithic, from middle
518	NW¼NE¼ sec. 23, T. 15 S., R. 5 E. (Sheep Creek Canyon)	Black Leg Creek (upper*)	1 - weak	lithic, from middle
			2 + weak	lithic, from middle
			3 + strong	lithic, from near base
518	SW¼NE¼ sec. 23, T. 15 S., R. 5 E. (Sheep Creek Canyon)	Black Leg Creek (middle*)	1 + strong	lithic, lower part
			2 +	lithic, lower part
			3 +	lithic, lower part
518	SW¼NE¼ sec. 23, T. 15 S., R. 5 E. (Sheep Creek Canyon)	Black Leg Creek (lower*)	1 -	lithic, upper part
			2 -	lithic, upper part
520	SW¼SW¼ sec. 6, T. 15 S., R. 6 E. (Sheep Creek Canyon)	Antelope Creek (upper*)	1 + strong	lithic, lower part
			2 +	lithic, lower part
520	SW¼SW¼ sec. 6, T. 15 S., R. 6 E. (Sheep Creek Canyon)	Antelope Creek (lower*)	1 +	upper vitrophyre
521	NW¼NW¼ sec. 7, T. 15 S., R. 6 E. (Sheep Creek Canyon)	Antelope Creek (lower*)	1 + strong	lithic, from middle
			2 +	lithic, from middle
549	NW¼NE¼ sec. 5, T. 15 S., R. 6 E. (Sheep Creek Canyon)	Antelope Creek (upper*)	1 +	lithic
			2 +	lithic

* The correlations between the upper, middle, and lower units at station 518 and the upper and lower units at stations 520, 521, and 549 have yet to be established. However, the upper unit at station 520 is the same as the upper unit at station 549, and the lower unit at station 520 is the same as the lower unit at station 521.

Table 20. Fluxgate magnetometer deflection measurements for samples from unnamed welded tuff units in the Curtis Draw quadrangle.

Station	Location	Unit	Magnetometer Readings	Comments
126	SE¼NW¼ sec. 26, T. 15 S., R. 12 E. (hill 6079)	middle	1 +	
			2 + erratic	
			3 - erratic	
128	SW¼NE¼ sec. 26, T. 15 S., R. 12 E. (Little House Creek)	lower	1 +	lithic
			2 +	lithic
			3 +	lithic
			4 +	lithic
			5 +	lithic
			6 - very strong	lithic
206	NW¼SE¼ sec. 2, T. 16 S., R. 12 E. (ridge west of Little House Creek)	lower	1 +	lithic
			2 +	lithic
			3 very erratic	lithic
462	SW¼SE¼ sec. 14, T. 15 S., R. 12 E. (hill 5955)	upper	1 +	lithic
			2 - erratic	
			3 +	
			4 +	
			5 +	lithic
			6 +	
462	SW¼SE¼ sec. 14, T. 15 S., R. 12 E. (hill 5955)	middle	1 - strong	
			2 + erratic	
			3 +	
			4 +	vitrophyre
			5 +	
			6 +	fused ash

Table 21. Fluxgate magnetometer deflection measurements for Indian Springs basalt samples.

Station	Location	Quadrangle	Magnetometer Readings	Comments
199	NE¼SW¼ sec. 3, T. 16 S., R. 9 E. (Jarbidge Canyon)	Dishpan	1 -	west of river
			2 - very weak	west of river
			3 no response	west of river
			4 -	east of river
			5 - weak	east of river
			6 - weak	east of river
469	NW¼SE¼ sec. 4, T. 13 S., R. 7 E. (Jarbidge Canyon)	Indian Hot Springs	1 -	upper part
			2 -	upper part
			3 -	from middle
			4 -	base
501	SE¼NE¼ sec. 5, T. 13 S., R. 7 E. (confluence of Bruneau and Jarbidge Canyons)	Indian Hot Springs	1 -	upper part
			2 -	from middle
			3 -	base

Table 22. Fluxgate magnetometer deflection measurements for samples of the unnamed lower basalt unit at Triguero Homestead.

Station	Location	Quadrangle	Magnetometer Readings	Comments
173	NW¼NE¼ sec. 25, T. 14 S., R. 6 E. (Bruneau Canyon)	Triguero Lake	1 + strong 2 + strong 3 +	(all 3 samples are from the same flow)

Table 23. Fluxgate magnetometer deflection measurements for samples from unnamed basalt units in the Buster Butte quadrangle.

Station	Location	Unit	Magnetometer Readings	Comments
535	SE¼NW¼ sec. 21, T. 12 S., R. 6 E. (Sheep Creek Canyon)	lower	1 + very weak 2 - 3 - very weak	lower part lower part lower part
536	SW¼NW¼ sec. 21, T. 12 S., R. 6 E. (Sheep Creek Canyon)	upper	1 - 2 - 3 - strong	(all 3 samples are from lower to middle part of the unit)

Table 24. Fluxgate magnetometer deflection measurements for Black Rock basalt samples.

Station	Location	Quadrangle	Magnetometer Readings	Comments
173	NW¼NE¼ sec. 25, T. 14 S., R. 6 E. (Bruneau Canyon)	Triguero Lake	1 + very strong 2 + 3 + strong	bottom flow from middle of unit top flow
364	NW¼SW¼ sec. 18, T. 15 S., R. 7 E. (Bruneau Canyon)	Triplet Butte	1 + 2 + 3 + 4 - erratic 5 - erratic 6 - erratic	top flow top flow top flow top flow top flow top flow
505	NE¼NE¼ sec. 11, T. 14 S., R. 6 E. (Long Draw)	Triguero Lake	1 + weak 2 + 3 + 4 + weak 5 + weak	bottom flow bottom flow next to bottom flow next to bottom flow top flow
517	SE¼NW¼ sec. 7, T. 15 S., R. 7 E. (Bruneau Canyon)	Triguero Lake	1 + strong 2 + 3 + strong 4 -	bottom flow next to bottom flow from middle of unit top flow
539	NW¼SE¼ sec. 28, T. 14 S., R. 6 E. (Sheep Creek Canyon)	Antelope Creek	1 +	one flow
542	NE¼NW¼ sec. 15, T. 14 S., R. 6 E. (1 kilometer NNE of White Homestead)	Triguero Lake	1 - 2 + strong 3 + strong	(all 3 samples are from the single flow here)
544	NW¼NE¼ sec. 34, T. 14 S., R. 6 E. (near Grasmere-Rowland road)	Triguero Lake	1 - strong	one flow

Table 25. Summary of magnetic deflection measurements and magnetic polarities.

Unit	Number of Stations	Number of Deflection Measurements +	-	other	Apparent Magnetic Polarity
Dorsey Creek rhyolite	6	18	0	0	Normal
Lower rhyolite at Poison Creek	1	4	0	0	Normal
Sheep Creek rhyolite	4	14	0	0	Normal
Rhyolite from Big Hill area	2	4	1	0	
Lower rhyolite at Louse Creek	2	4	0	0	Normal
Bruneau Jasper rhyolite	2	0	5	0	Reversed
Long Draw rhyolite	2	6	0	0	Normal
Indian Batt rhyolite	5	5	6	0	*
Triguero Homestead rhyolite	7	14	0	0	Normal
Rhyolite near Cedar Creek Reservoir	1	8	0	1	Normal
Blue Butte and Crows Nest quadrangles } upper-Sta 556	1	2	1	0	
Blue Butte and Crows Nest quadrangles } lower-Sta 556	1	3	0	0	Normal
Blue Butte and Crows Nest quadrangles } Sta 558	1	0	2	0	
Cougar Point tuff, Unit XV	3	8	2	3	Normal
Cougar Point tuff, Unit XIII	2	12	0	0	Normal
Cougar Point tuff, Unit XII	2	11	0	2	Normal
Cougar Point tuff, Unit XI	3	0	9	2	Reversed
Cougar Point tuff, Unit IX	4	10	0	9	Normal
Cougar Point tuff, Unit VII	3	0	13	0	Reversed
Cougar Point tuff, Unit V	3	8	0	1	Normal
Cougar Point tuff unit at Cat Creek, Triguero Lake quadrangle	1	3	0	0	Normal
Cougar Point tuff units near Three Forks of Sheep Creek, Black Leg Creek quadrangle } upper	1	2	1	0	
Cougar Point tuff units near Three Forks of Sheep Creek, Black Leg Creek quadrangle } middle		3	0	0	Normal
Cougar Point tuff units near Three Forks of Sheep Creek, Black Leg Creek quadrangle } lower	1	0	2	0	
Cougar Point tuff units in SE Antelope Creek quadrangle } upper	2	4	0	0	Normal
Cougar Point tuff units in SE Antelope Creek quadrangle } lower	2	3	0	0	Normal
Unnamed welded tuff units in NE part of Curtis Draw quadrangle } upper	1	5	1	0	Normal
Unnamed welded tuff units in NE part of Curtis Draw quadrangle } middle	2	7	2	0	Normal
Unnamed welded tuff units in NE part of Curtis Draw quadrangle } lower	2	7	1	1	Normal
Indian Springs basalt	3	0	12	1	Reversed
Lower basalt at Triguero Homestead	1	3	0	0	Normal
Basalt units, sec. 21, T. 12 S., R. 6 E., Buster Butte quadrangle } upper	1	0	3	0	Reversed
Basalt units, sec. 21, T. 12 S., R. 6 E., Buster Butte quadrangle } lower	1	1	2	0	
Black Rock basalt	7	17	6	0	Normal

* The Indian Batt rhyolite flow seems to be characterized by a reversed polarity for vitrophyre samples and a normal polarity for lithic samples; thus it may be transitional.

Table 26. Stratigraphic succession and magnetic polarity of volcanic units erupted from the Bruneau-Jarbidge eruptive center.

	Units whose relative stratigraphic positions are known	Magnetic Polarity	Units whose relative stratigraphic positions are only approximately known and their magnetic polarity; arrows indicate possible age range of units
Flows of the Banbury Basalt	Black Rock basalt	Normal	
Rhyolite lava flows and intercalated basalt flows	Dorsey Creek rhyolite	Normal	Sheep Creek rhyolite (Normal)
	Lower rhyolite, Poison Creek	Normal	
	Indian Springs basalt	Reversed	
	Bruneau Jasper rhyolite	Reversed	Lower rhyolite at Louse Creek (Normal)
	Long Draw rhyolite	Normal	
	Triguero Homestead rhyolite	Normal	
Cougar Point tuff	cooling unit XV	Normal	
	cooling unit XIII	Normal	
	cooling unit XII	Normal	
	cooling unit XI	Reversed	
	cooling unit X	?	
	cooling unit IX	Normal	
	cooling unit VII	Reversed	
	cooling unit V	Normal	
	cooling unit III	?	
Jarbidge Rhyolite		?	

Lower basalt at Triguero Homestead (Normal)

Indian Batt rhyolite (Transitional?)