

Selected Volcanic Features of the South-Central Snake River Plain, Idaho

by

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ABSTRACT

Several volcanic constructs and craters localized on the south-central Snake River Plain including Wildhorse Corral, Horse Butte, Cottrells Blowout, Mosby Butte, Split Butte, and Kings Bowl were studied to learn more about the volcanic styles of that setting. All of these features are associated with Snake River Group Pleistocene and Holocene lava flows. In each study, field observations were coupled with petrographic and chemical data to aid in the reconstruction of a sequence of events in the evolution of the feature and, where possible, to establish the age or structural relationship of a specific feature to other nearby features. A synopsis of these studies is presented.

INTRODUCTION AND PURPOSE

Over the past decade, graduate students and staff of the Department of Geological Sciences at the State University of New York at Buffalo have undertaken studies of a variety of volcanic features located largely to the north and east of the Wapi lava flow (Figure 1), one of the youngest and most prominent lava flows of the south-central Snake River Plain in Idaho. Although one study was carried out on the Wapi flow itself (Champion, 1973), most of the other studies have involved features associated with older lava flows. The exact ages of these flows are unknown, but they are all assigned to the Snake River Group of Pleistocene and Holocene age and are all older than the Wapi flow dated at $2,270 \pm 50$ years (Ronald Greeley, personal communication, 1980). Despite their relative youth, outcrops of the lava features have been subdued somewhat by erosion, and windblown deposits of varying thicknesses now largely cover the flows. Interest in this region was

initially attracted by the rift systems that transect the Snake River Plain at this location (Prinz, 1970; Greeley and King, 1975a, 1975b) but was soon expanded to include the more prominent craters and volcanic constructs.

The purpose of these studies was to better understand volcanic features of the Snake River Plain and the characteristics of volcanism in that province. This has been accomplished by an analysis of the morphologies of selected features, noting their relative distribution and their relationship to surrounding features and flows. In each study, detailed field information has been reinforced with petrographic, mineralogical, and chemical data to gain insight into the volcanic processes responsible for these features.

The basalts of the central and eastern Snake River Plain are dominantly olivine tholeiites which have strong mineralogical and chemical similarities (Lee-man, 1974, 1982 this volume). Nevertheless, many of the flows detailed in these studies can be characterized and identified by subtle but nonetheless unique petrologic and fabric differences. Thus the size, shape, or grouping habit of plagioclase phenocrysts coupled with their abundance and/or the abundance or scarcity and habit of olivine phenocrysts commonly allows field identification of a particular flow. These observations together with other characteristics such as topography and degree of weathering aid in identifying the distribution of individual flows.

Each of these studies has been developed independently with the immediate objective of understanding the origin and development of the selected feature or features. Comparisons may subsequently be made to other features of similar morphology, physical proximity, or common structural control.

WILDHORSE CORRAL, COTTRELLS BLOWOUT, AND HORSE BUTTE

Wildhorse Corral, Cottrells Blowout, and Horse Butte are volcanic constructs located northeast of

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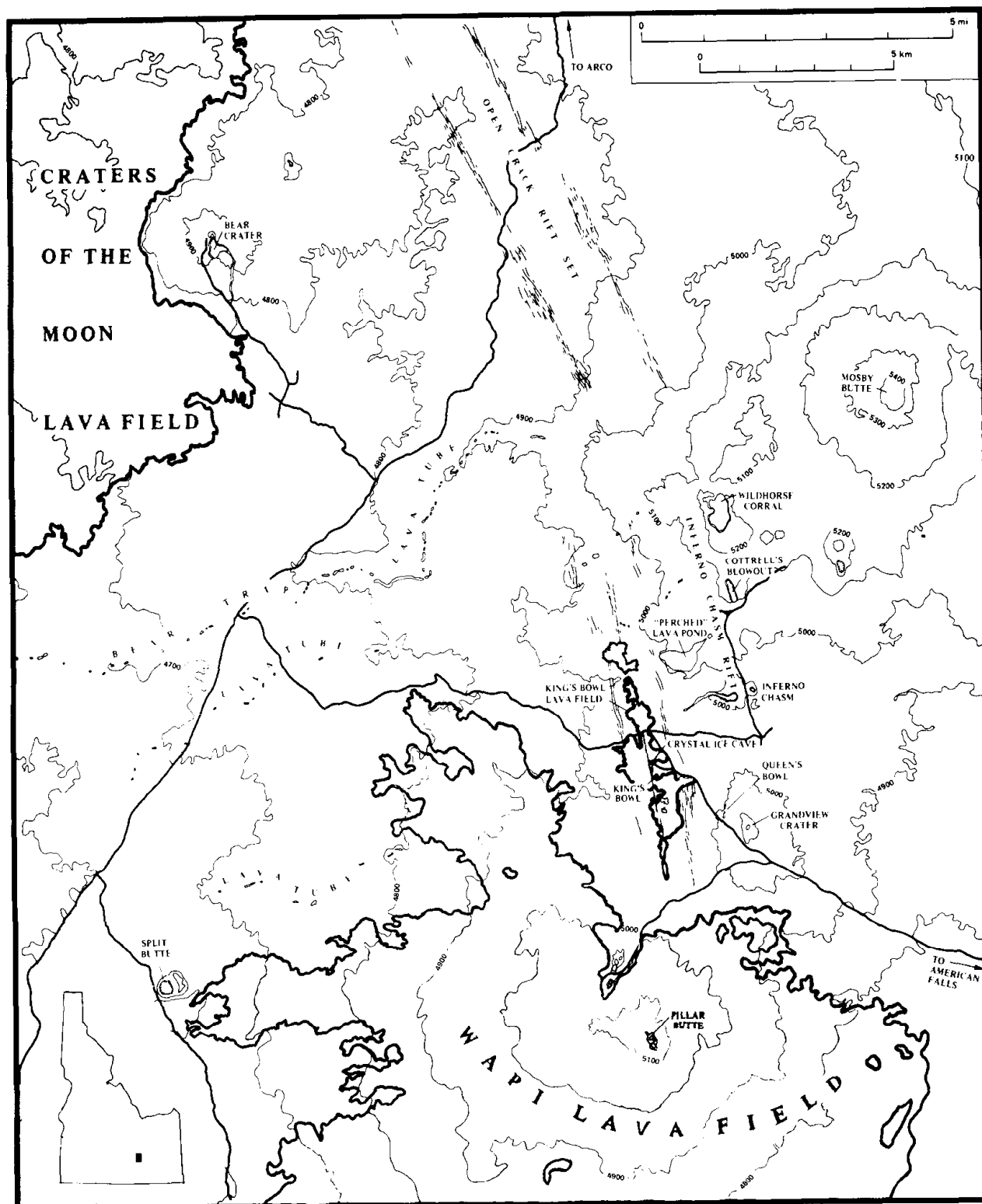


Figure 1. Topographic sketch map of the south-central Snake River Plain showing the location of features discussed in this paper (modified from Greeley and King, 1975b).

Kings Bowl (Figures 1 and 2). Mercer (1979) mapped the flows related to each of the vents and identified two vent morphologies. One morphology shared by Wildhorse Corral and Cottrells Blowout is characterized by broad summit profiles with slopes of 4 to 5 degrees and large ovoid vent craters as much as 45 meters deep with nearly vertical walls. These craters are the result of extensive collapse following magma withdrawal in late stages of vent activity. The second morphology, shown by Horse Butte, has a steeper profile of about 15 degrees and two shallow, irregular summit depressions not believed to be the result of collapse.

All three of these features are on the Inferno Chasm rift set (Figure 1), a set proposed by Greeley and King (1975a) as one of two supplements to the four component sets of the Idaho rift originally identified by Prinz (1970). Although no fractures are visible, the Inferno Chasm rift set is indicated by a trend subparallel to the Kings Bowl rift set marked by the alignment of several prominent volcanic features

of about the same age: Grandview Crater, Inferno Chasm, Cottrells Blowout, and Wildhorse Corral. Greeley and King (1975b) suggested that the Inferno Chasm rift set might also include the vent which fed the Papadakis perched lava pond.

At the time the Inferno Chasm rift set was defined, Horse Butte was not recognized as a separate vent with its own flow but was believed to be a part of the Wildhorse Corral complex. This lack of identity was due at least in part to disruption of the symmetry of the Horse Butte shield by encroachment of its north flank by the Wildhorse Corral crater. Mercer's study (1979) demonstrated through overlap relations and differences in degree of weathering between these flows that Horse Butte was indeed a separate vent older than both Cottrells Blowout and Wildhorse Corral. The Horse Butte shield formed a barrier to lavas erupted from Cottrells Blowout, forcing channel-fed outflow from the Cottrells' vent to the south.

The time separation between these three features is unknown. Mercer (1979) has proposed a sequential tapping of the same magma chamber for both the Wildhorse Corral and the Cottrells Blowout flows. He believes that the initial eruption for these two vents was at Cottrells Blowout. Ultimately this vent closed and activity at Cottrells Blowout ceased. This was accompanied by withdrawal of magma followed by a relatively short period of quiescence during which the magma continued to differentiate. With renewed eruptive activity, new vents opened at the Wildhorse Corral site with the eruption of slightly cooler lava. This interpretation (Mercer, 1979) is based on a comparison of phenocryst size and the ratio of olivine to plagioclase in lavas from the vents of the two structures. The relative age of the three constructs is thus Horse Butte followed by Cottrells Blowout and finally Wildhorse Corral. The flows from all three of these vents are pahoehoe basalts with gently undulating, locally ropy surfaces. Many flows have lava tubes associated with them.

HORSE BUTTE

Horse Butte (Figure 3) is a small shield volcano with a slightly ovoid summit cone about 1,250 meters in diameter marked by two depressions at the vent each about 5 meters deep. The Horse Butte lava covers an area of about 18 square kilometers. Mercer (1979) hypothesized that activity at Horse Butte was fracture controlled and began as a fissure eruption. The eruption gradually concentrated along a short length of the fissure with transition to a more central-type eruption which, through successive outpourings of lava, ultimately resulted in the low shield cone.

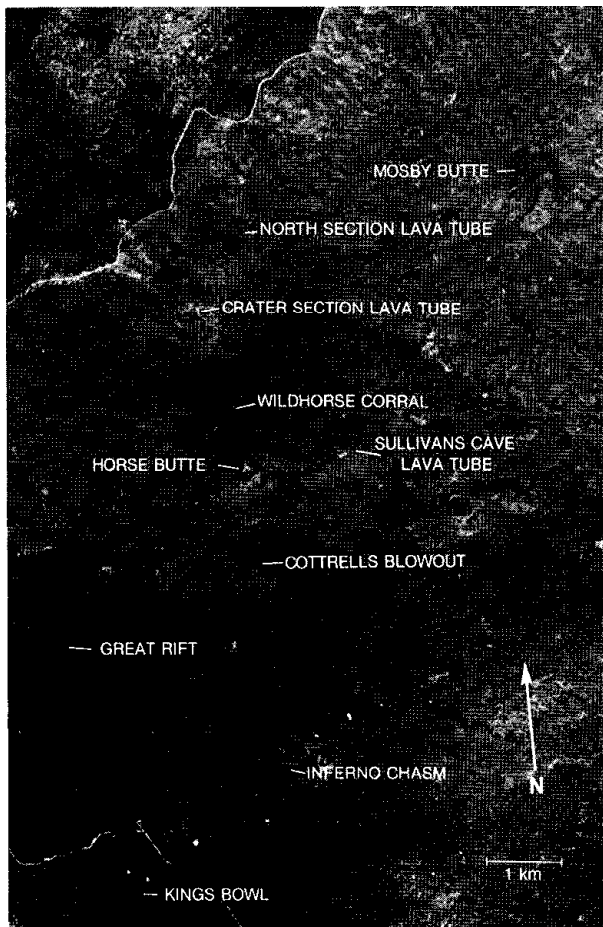


Figure 2. Index aerial photograph showing the location of features discussed in this paper.

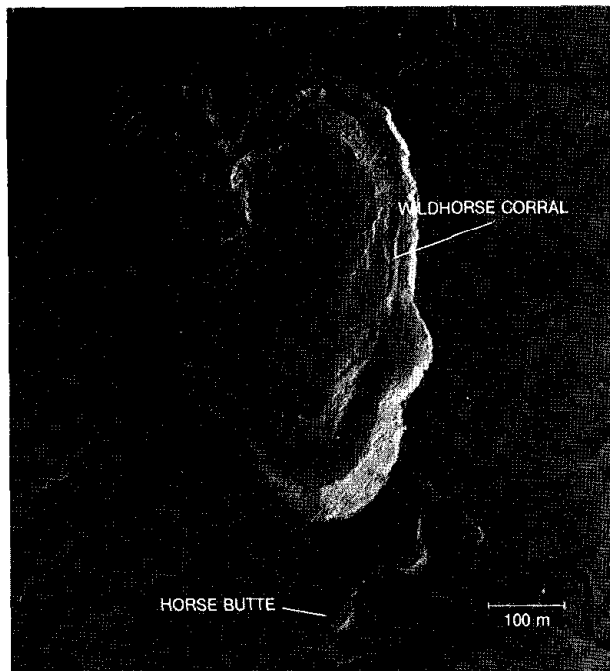


Figure 3. Low altitude aerial photograph of Wildhorse Corral and Horse Butte. The Wildhorse Corral terrace is about 23 meters below the rim. Horse Butte is marked by two shallow summit depressions. Note how the Wildhorse Corral crater is superimposed on the Horse Butte shield.

Horse Butte stands about 52 meters above the local surface of the surrounding plain.

Sullivan's Cave lava tube (Figure 2) is associated with the Horse Butte lava flow and is believed by Mercer (1979) to have been active at the time of the centralized eruptions. The Sullivan's Cave lava tube is about 500 meters long and extends east from the Horse Butte vent. Greeley and King (1979b) suggest that the Sullivan's Cave tube developed from a lava channel which became roofed over. Evidence supporting this includes the steep gradient, thick roof, and lack of layered lava exposed in the walls of the tunnel.

COTTRELLS BLOWOUT

Cottrells Blowout is believed to have begun its eruptive history from a fissure vent along a segment of the Inferno Chasm rift set somewhat shorter than the length of the present crater (Mercer, 1979). Cottrells Blowout (Figure 4) is about 595 meters long and 160 meters wide. Its maximum depth is about 43 meters. The rims at both ends of the crater are low and attain maximum height midway along the sides. As pointed out by Mercer (1979), the flows from this vent are limited in extent and cover only about 4.5

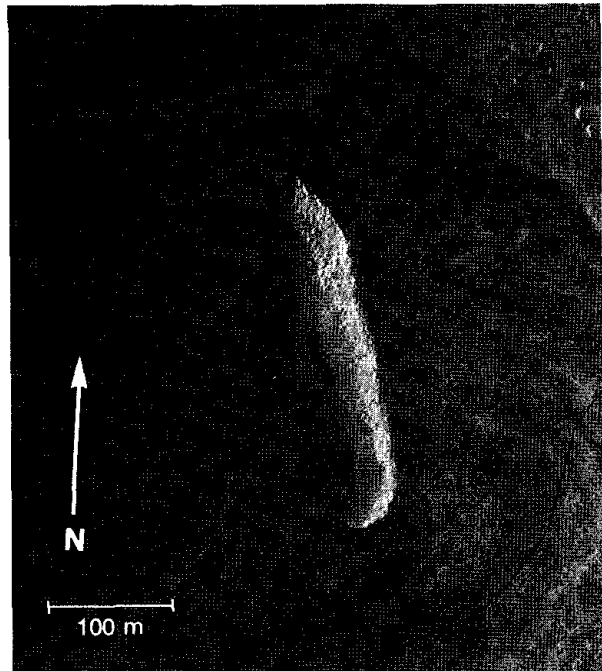


Figure 4. Low altitude aerial photograph of Cottrells Blowout. The elongation of this crater parallels the Inferno Chasm rift set. A small back flow is located at the north end.

square kilometers.

Early activity at the vent is marked in the stratigraphic sequence by thin (about 10 centimeters), areally restricted, gas-charged flows. The early thin flows are overlain by what Mercer (1979) has termed the main massive unit which represents a fissure eruption. This main massive unit flowed southward as a result of the Horse Butte shield already in place to the north.

A remnant of a raised lava channel in the main massive unit extends about 1.8 kilometers from the southwest edge of Cottrells Blowout. As described by Mercer (1979), the channel has a flat bottom and averages 13 meters in width. Lava levees about 1.5 meters high mark the edges of this channel. Both channel width and levee height decrease away from the source. This lava channel, when coupled with the small volume and simple characteristics of the massive flow, suggests that the effusion rate for this flow was high over a relatively short time.

Following eruption of the main massive flow, the Cottrells fissure vent is believed to have decreased to a point source from which numerous thin (10-25 centimeters), gas-charged, amoeboid-shaped flows were discharged. Their thin character allowed relatively rapid cooling which trapped gas in the lava and caused the present vesicular character of the flows. The concentration of these flows around the smaller vent accounts for the build up of the summit region of

Cottrells Blowout according to Mercer (1979).

Collapse marked the final stage of development at the Cottrells Blowout vent. Mercer (1979) believes that collapse directly followed a final minor eruptive stage which is marked by a small back-flow channel at the north end of the present crater. Collapse, resulting in the present elongate Cottrells Blowout crater, is believed to have been caused by withdrawal of magma down the vent.

WILDHORSE CORRAL

Wildhorse Corral is by far the largest and most prominent of these three Inferno Chasm rift set features. It is an irregular-shaped depression with its longest axis subparallel to the rift set (Figures 1 and 3). Wildhorse Corral is 935 meters long, 565 meters wide, and 41 meters deep. A terrace which averages 53 meters in width outlines most of the crater about 23 meters below the rim. At the northern end of Wildhorse Corral, the terrace is disrupted and broken into large outward-dipping slabs up to 30 meters long and 6 meters thick. The floor of Wildhorse Corral below the terrace level is nearly flat. Wildhorse Corral is a complex feature with a more complicated eruptive history than the other two vents already described.

Mercer (1979) believes that the Wildhorse complex commenced with eruptions at two points along the Inferno Chasm rift set. These two sources expanded during the early eruptive phase and eventually coalesced into a single large fissure-type vent which predetermined the present elongate shape of the crater. Three massive flow units, each up to 3 meters thick and representing a period of high effusion, are identified as the basal units erupted from this vent. With a plentiful magma source, such flows can cover very large areas.

The Bear Trap lava tube and its associated flow is located west of Wildhorse Corral. The course of the Bear Trap lava tube is quite apparent on topographic maps, and it appears to head about 4.5 kilometers west-northwest of the Wildhorse vent. Mercer (1979) believes that the Bear Trap lava flow originated from the Wildhorse Corral vent. His conclusion is based in part on the massive Wildhorse Corral flows which suggest sufficiently large volumes of lava from this vent. He supports his hypothesis by noting a similarity in texture, phenocryst composition, and inferred crystallization sequence between the Wildhorse Corral and the Bear Trap flows. He further points out the probable presence of a lava tube between Wildhorse Corral and the apparent head of the Bear Trap lava tube based on both the topography of the intervening ground and the elevation difference between the two

points.

The early high effusive stage at the Wildhorse Corral vent was followed by a period of minor eruptions characterized by a thin zone (1 meter) made up of extremely thin vesicular layers of limited areal extent. The main Wildhorse Corral flow overlies the thin vesicular flows and was identified by Mercer (1979) as consisting of six relatively massive flow units. A prominent lava tube system occurs in the main massive unit and extends north-northwest from the Wildhorse Corral crater. Mercer (1979) divided this lava tube system into two sections (Figure 2). That section which extends about 1.6 kilometers north from Wildhorse Corral is designated the crater section, and an L-shaped branch which trends east and then north from the crater section is called the north section.

Greeley (1971) observed that most actively developing lava tubes form along the axis of highest velocity within a flow and will follow a course marked by stream beds, rifts, grabens, or fracture zones. It is apparent from the continuity of the crater section lava tube with the Inferno Chasm rift set features that the trend of the lava tube was predetermined by the rift. Mercer (1979) suggests that the crater section developed along the fracture zone as a fairly linear channel which roofed over in some sections and not in others. He believes that close to the vent the crater section channel did not roof over but existed as open lava ponds which themselves acted as sources for short-lived tributary channels.

A remarkably hemispherical basalt dome about 20 meters in diameter and 4.5 meters high protrudes from the crusted pond near the head of the crater section lava tube. Mercer (1979) favors the hypothesis that this dome formed due to hydrostatic pressure within the lava tube where flow velocity was greatest. An alternative explanation is that drainage through the tube was temporarily blocked and, with continued feeding from the source, a pressure build up caused the dome.

The north section of the Wildhorse Corral lava tube system consists of lower gradient segments with more regularly layered lava exposed in the walls and roofs. Based on Ollier and Brown (1965), Mercer (1979) believes that the formation of this section of the tube resulted from lower velocity laminar-type flow of the lava.

The Wildhorse Corral crater is believed to have enlarged somewhat during the eruption sequence, and Mercer (1979) proposes that a lava lake filled the vent crater to the rim for a time. A small overflow from this lava lake has been identified on the southwest edge of the present crater. Ultimately the lake probably drained to the northwest, possibly when a previously formed lava tube reopened to act

as a conduit. Following the draining of the lava lake, the summit region of the vent collapsed, causing the present irregular-shaped crater. The collapse occurred along fractures which both paralleled and intersected the Inferno Chasm rift set at high angles of up to 90 degrees. These fracture lines are evident in linear segments of the southern half of the Wildhorse Corral crater and are related by Mercer (1979) to an earlier period of dilation of the summit region of the volcano.

A second lava lake occupied the crater following the first collapse and is partially preserved in the 50-meter-wide terrace of Wildhorse Corral. On the basis of thickness of this lava lake "unit" and the cooling rates measured in Hawaiian lakes, Mercer (1979) estimates a minimum time of existence for this lake of 300 days.

MOSBY BUTTE

Mosby Butte is a prominent shield volcano about 4 kilometers northeast of Wildhorse Corral (Figures 1 and 2). The Mosby Butte flows cover about 36 square kilometers and show a profile of about 12 degrees near the vent which shallows to about 2 degrees away from the vent toward the more distal parts. One of the early objectives in the study of Mosby Butte was to determine whether chemical or petrographic differences occurred between rocks of the vent area and those of the distal parts of the flow which could be related to the slope differences. Another objective was simply to identify the Mosby Butte flow limits and determine the relationship to surrounding flows.

No significant chemical or petrographic difference was determined between the distal and vent portions of the Mosby Butte flow. The slope difference was explained by Foster (1978) to be the result of increased accumulation of cooler, more viscous lava late in the eruptive sequence. An alternative explanation is that the slope difference resulted from lower effusion rates late in the eruptive sequence which restricted outflow and lead to accumulation in the immediate vent area. Eight flows including the Wildhorse Corral flow were identified by Foster (1978) surrounding the Mosby Butte flow. Nine such flows are now recognized inasmuch as the Wildhorse flow was subsequently subdivided by Mercer (1979) who recognized and separated the Horse Butte vent and its associated flow.

Based on Walker's graph (1973) relating average rate of effusion with length of a flow, Foster (1978) calculated an average rate of effusion for the Mosby Butte vent at about 5.7 cubic meters per second. Coupling this value with assumptions covering both

areal size and thickness of the flow, he calculated a minimum duration of 2 years for the eruptive period of Mosby Butte. In spite of the many assumptions in this determination, the result nonetheless provides a realistic approximation for a minimum time span necessary for the Mosby Butte construct to develop. It also provides a useful value for approximating the development times of other major constructs in the area.

SPLIT BUTTE

Split Butte is about 10 kilometers southwest of the Kings Bowl (Figure 1). It has been identified as a maar crater (Womer, 1977; Womer and others, 1980; 1982 this volume) and is distinctly different from the other Snake River Group features discussed in this summary. Split Butte is a vent from which lava issued but with which no major flow is associated, although an outflow point from a contained lava lake has been suggested by Greeley and King (1975b). The limits of this suggested outflow have never been defined however; it remains an obscure entity indicated by a single low point in the Split Butte rim.

Split Butte is named after a prominent gap or discontinuity which exists in the upper layers of the tephra sequence found on the east side of the structure (Figure 5). The tephra ring is asymmetric and higher on the east side than on the west. This asymmetry is attributed to prevailing west winds at the time of eruption which caused a greater accumulation of ejecta on the downwind side of the vent. Inasmuch as the "split" is also on the east side, it too has most likely been caused by prevailing west winds during and subsequent to eruption. Although other hypotheses could be advanced to explain this split, no field evidence has ever been found to support any cause other than wind erosion.

Split Butte crater is unique among the constructs of this discussion owing to its tephra ring which indicates a pyroclastic phase of the eruption. The eruptive sequence has been described by Greeley and King (1975) and detailed by Womer (1977) and Womer and others (1980; 1982 this volume). Briefly summarizing, when the vent at Split Butte first erupted, lava came into direct contact with ground water. The interaction of the hot lava with cool ground water caused the formation of a glassy ash which was erupted early in the sequence as base surge but later was dominantly air fall (Womer, 1977). A rampart of tephra layers developed around the vent with opposing dips to the layers on the outside and inside of the ring. Intermittent explosive intervals occurred and carried larger blocks of material out of

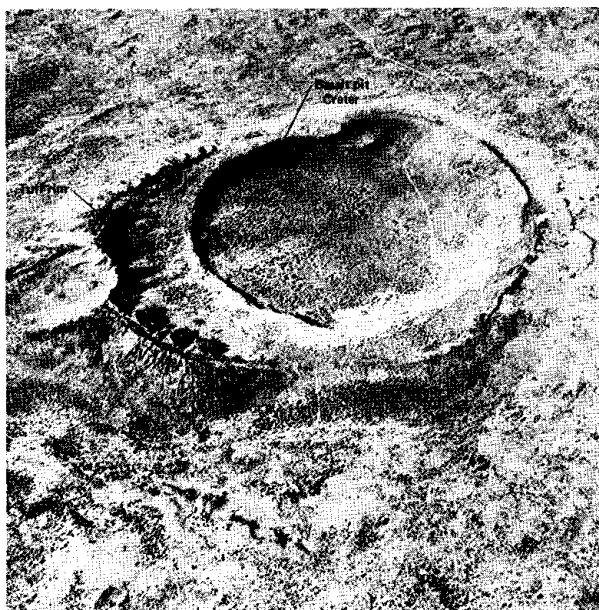


Figure 5. Oblique aerial view of Split Butte viewed to the southwest (east is toward the left hand side of the picture). The "split" is a gap or discontinuity in the tephra rampart and is visible on the left. The split is oriented with its long axis nearly due east. The low point in the tephra ring is visible in the upper right portion of the construct and is marked by the trail. The tephra ring of Split Butte contained a lava lake which crusted and collapsed leaving the present inner terrace. Photograph by Ronald Greeley.

the vent and into the ash-dominated tephra rampart.

In time the water-lava contact within the Split Butte conduit was sealed causing a change in eruptive style. Material was no longer forcibly ejected from the vent but rose to the surface where it was confined by the earlier-formed tephra ring as a lava lake. The rise of lava in the conduit was insufficient to overtop the tephra rampart with the possible exception of the limited overflow mentioned above. Thus the contained lava cooled and the lake crusted over. The solidified upper portion of the conduit remained stable only as long as lava was being forced toward the surface. Ultimately, withdrawal of liquid material in the subsurface allowed the central portion of the lava lake to subside. The result is the present structure of Split Butte which appears in aerial photographs as a group of nested craters made up of the outer tephra ring, a relatively flat inner terrace, and the down-dropped central portion. The inner terrace marks the level of the lava lake when it crusted.

Split Butte exemplifies a type of eruption that is unusual but not unique on the Snake River Plain. Among other examples of pyroclastic eruptions on the eastern plain are Sand Butte and Menan Buttes. Each of these features has a distinct history reflecting the sequence of lava-water interaction during the

eruption. The vent at Split Butte predates the nearby Wapi flow inasmuch as a tongue of Wapi lava reaches to and covers the lower part of the Split Butte structure on the east side (Womer, 1977; Womer and others, 1982 this volume).

KINGS BOWL AND RELATED FEATURES

Kings Bowl is a prominent, ovoid crater about 85 meters long, 30 meters across at the widest point, and 30 meters deep situated on the main fracture of the Great Rift. This crater marks the vent for the Kings Bowl lava flow (Figures 1 and 2), which has been dated at $2,130 \pm 130$ years (Prinz, 1970).

On an aerial view (Figure 6), the Kings Bowl flow can be readily distinguished by its low albedo and by flow pattern directed away from the Kings Bowl crater. Other features visible by aerial photograph inspection are a light-colored ash field east of the rift near Kings Bowl and a discontinuous ring of basalt mounds (Figure 6). When connected, these basalt

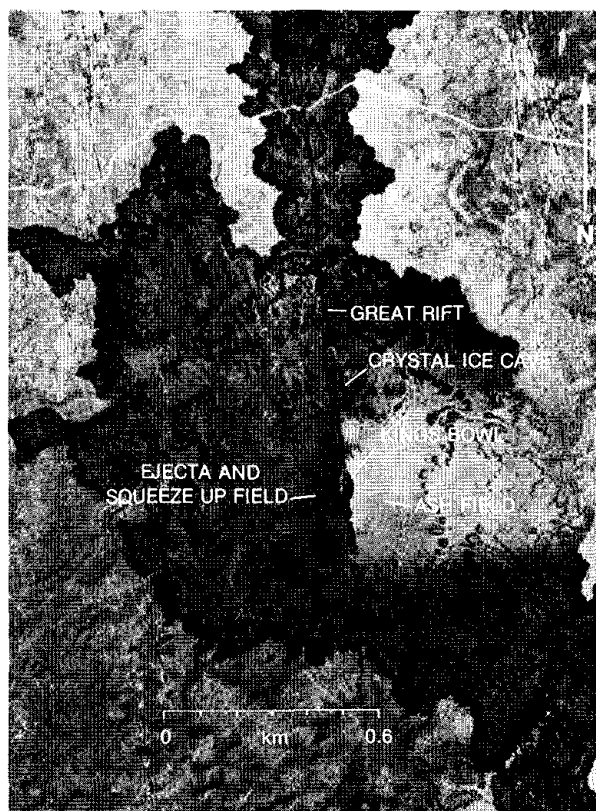


Figure 6. Vertical aerial view of the Kings Bowl flow showing the location of the various features discussed in the text. Note the irregular outline of basalt mounds distributed around the Kings Bowl vent. USGS photograph CYN-7B-103.

mounds appear to mark temporary but nonetheless definite locations where movement of lava outward from the vent was arrested for a time.

Field examination of the Kings Bowl flow reveals two phenomena west of the Kings Bowl which are not visible on aerial photos. One is an ejecta field, and the other is an area of squeeze-up locations where very viscous lava oozed up through fractures in the solid crust.

The ejecta field (Figures 7 and 8) extends about 245 meters west from the Kings Bowl crater. The largest blocks in the field are found adjacent to the crater, and the ejecta fragments become progressively smaller away from the crater. The squeeze-ups (Figures 9, 10, and 13) are located within the ejecta field. Many of the squeeze-ups have been struck by solid ejecta from Kings Bowl suggesting a brief and violent event at or near the end of the eruptive sequence. Many of the impacted squeeze-ups have irregular open holes in their surfaces from which fractures radiate (Figure 11). In some, the block which caused the hole and the fractures still remains wedged in the hole, while in others these blocks may be found on a floor inside the convex shell of the squeeze-up. These relationships show that some of the squeeze-ups had developed a sufficiently thick crust at the time of

impact of the blocks to behave as brittle material. The relationships also show that the central part of some of the squeeze-ups had drained after they crusted leaving them as hollow structures. In other of the squeeze-ups, however, the oozing lava of the squeeze-up is found wrapped around fragments which are obviously blocks ejected from the Kings Bowl vent. This suggests that solid blocks from the vent may have been responsible for some of the fractures where squeeze-ups developed.

Collectively, all of the features found on the flow (basalt mounds, ash field, ejecta field, and the squeeze-ups) support reconstruction of a sequence of events in the Kings Bowl eruption. The original vent in the Kings Bowl eruption is believed to have been a short fissure, perhaps even a point source located somewhere in the area of the present Kings Bowl crater. At the time of the initial eruption it is believed that the rift was not present as such but defined as a zone of weakness which controlled the positioning of the vent. Lava extruded at the surface and cooled as it flowed away from the vent. A confining levee was built and a shallow lava lake developed (Figure 12). Subsequently outflow may have become restricted or reduced by changes in the vent, and a build up of pressure caused tumescence around the vent which in



Figure 7. A view to the southeast of the ejecta field close to the vent and on the west side of Kings Bowl.

turn weakened or even fractured the lake-confining levee. When outflow at the vent resumed, these weak zones in the levee developed into channelways for molten lava and are believed to have enlarged as the lava continued to flow through. Portions of the levee were thus removed resulting in the present discontinuous ring of basalt mounds (Figures 12 and 13). Depending on how the present mounds are connected, this hypothesized sequence could have occurred once or twice during the early eruption. It appears that there are two concentric rings of basalt mounds, but particularly on the west side, large gaps exist in this pattern and the distribution of the mounds could be interpreted as a single more complex ring. Outflow patterns between these mounds can be seen both on the aerial photographs and at locations in the field (Figure 14).

It is believed that a once continuous levee or levees thus confined a lava lake (or lakes) and that near the end of the Kings Bowl eruptive sequence the lake crusted over with a layer of cooled lava several centimeters thick. Because lava was still coming into the lake, the system remained dynamic; the lake crust fractured, and individual plates or slabs of crust were the result.

The eruptive climax apparently occurred when upwelling lava in the conduit came in contact with

ground water. This stage is indicated by both the ash and the ejecta field. Solid ejecta is found dominantly on the west side of Kings Bowl suggesting that the water-lava contact was asymmetric in relation to the conduit. Thus the trajectory of solid fragments was directed toward the west at a relatively low angle. The eruption was analogous to pressure relief from a boiler. Enough force was generated to carry large fragments (up to 1.5 meters in diameter) out of the conduit to locations close to the vent while smaller blocks were carried farther from the vent with the smallest being deposited about 245 meters west of the crater. Simultaneously, ash-sized lithic ejecta was carried up by the same force but was winnowed out of the erupting cloud by strong prevailing winds from the west. This was the prevailing wind direction at the time Split Butte was active as well.

It should not be forgotten that a lava lake existed at the time of the eruptive climax. Perhaps some lava had already developed squeeze-ups at plate intersections, most probably at points where several crustal plates came together. Some of these early-formed squeeze-ups were sufficiently cooled so that their crust was able to behave as brittle material when struck by solid ejecta. This accounts for the squeeze-ups with impact holes or fracture patterns on them. At the same time but elsewhere, ejected solid blocks

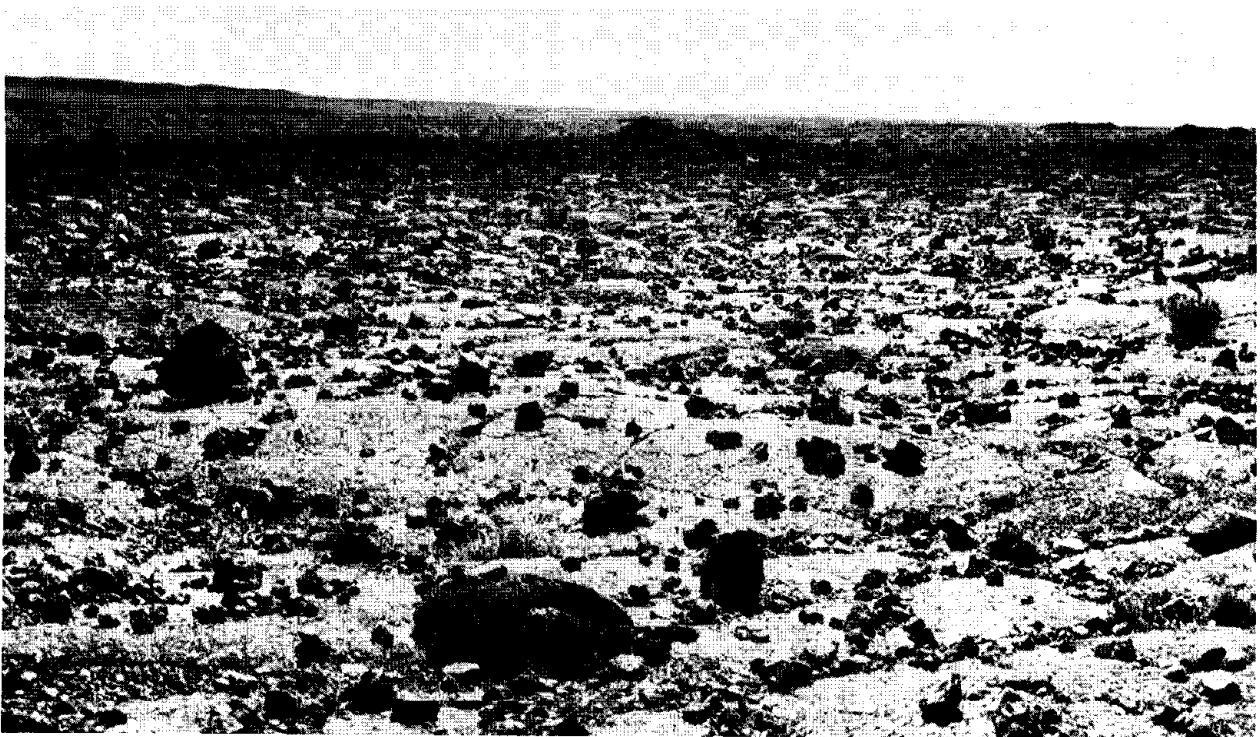


Figure 8. A view to the southeast of the Kings Bowl ejecta field farther from the vent than view in Figure 7. The trace of the Great Rift is obvious in the upper portion of the photograph. The hemispherical mound in the center foreground is a squeeze-up.



Figure 9. A view to the east of an area of the ejecta field densely covered with squeeze-ups. The Great Rift trends left-right through the picture at the edge of the vegetated region.



Figure 10. A close up view of several squeeze-ups. Note the Kings Bowl ejecta in close association.

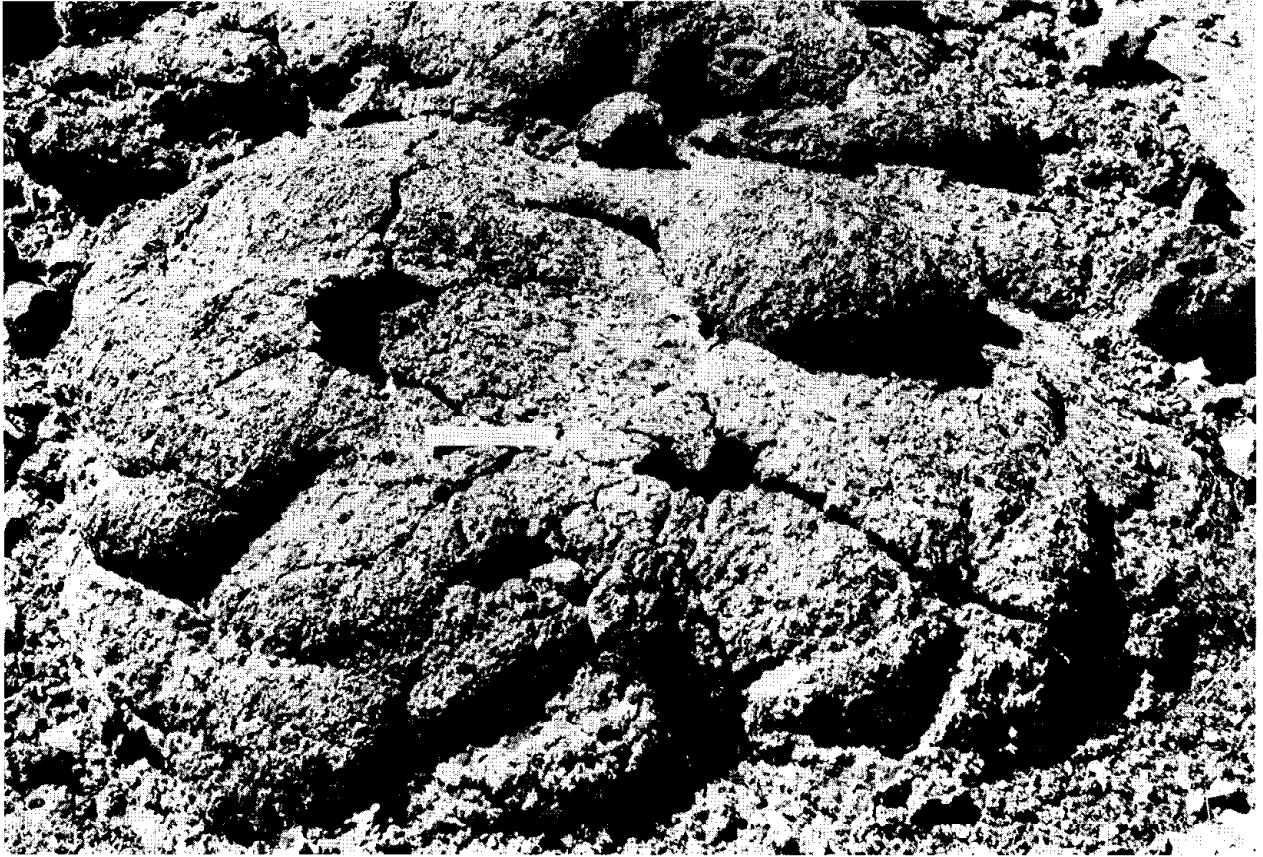


Figure 11. Impact holes in the squeeze-ups caused by blocks thrown from the Kings Bowl vent. The scale is 6 inches long.

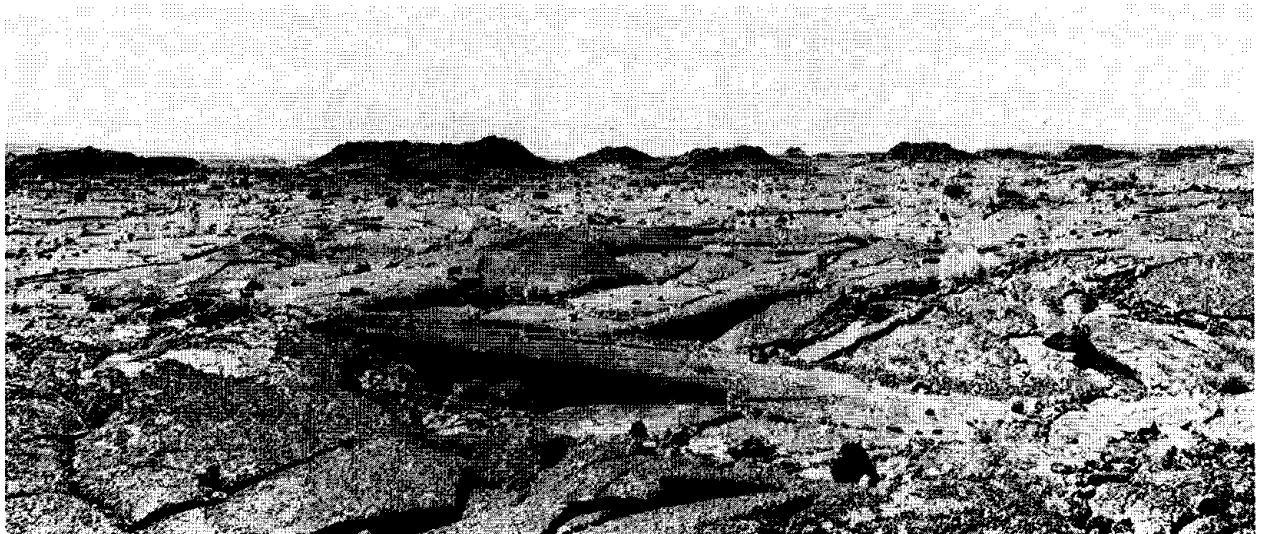


Figure 12. The surface of the Kings Bowl lava lake viewed to the southeast. Ejected blocks from Kings Bowl are visible and part of the ring of basalt mounds are evident in the background.



Figure 13. View of the squeeze-up field with some of the basalt mounds visible in the background. Photograph by J. Papadakis.

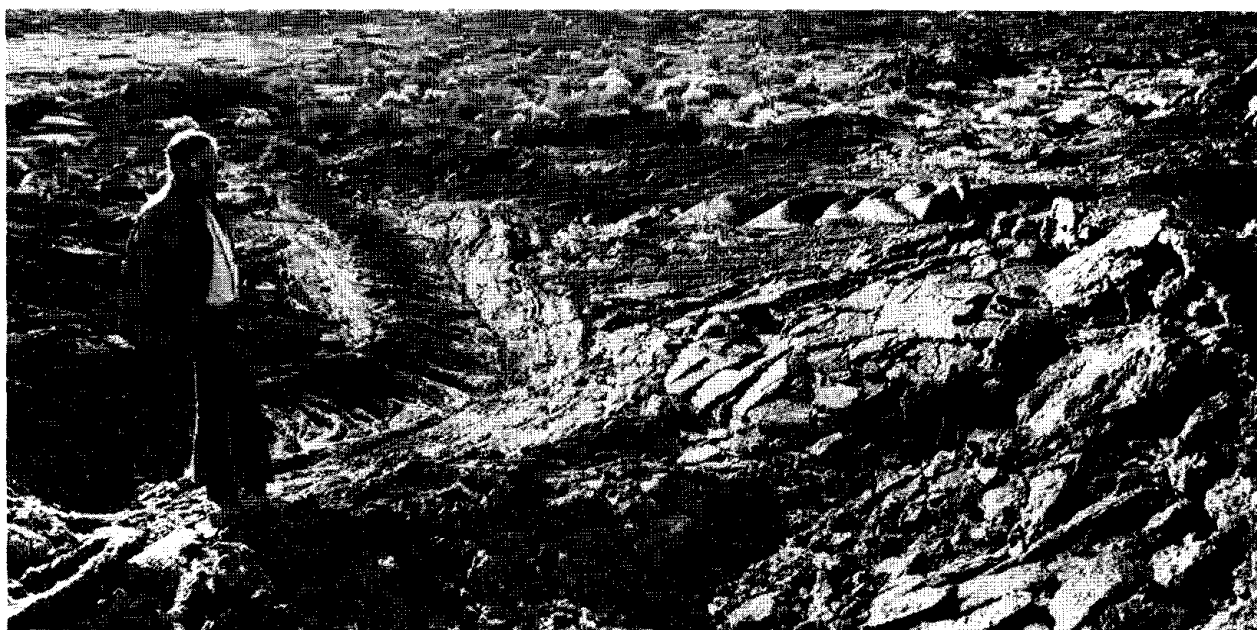


Figure 14. Part of an outflow channel between two of the basalt mounds. This is located at the northwest end of the Kings Bowl lava lake.

from the vent broke through parts of the lava lake crust allowing still-molten lava beneath the crust to ooze up and flow around the impacting blocks.

If the entire area of the present ejecta field of the Kings Bowl vent were imagined to be covered by a layer of the largest-size ejected fragments, the resulting volume would be insufficient to refill the present Kings Bowl crater. Thus the final phase at the Kings Bowl site was collapse, probably related to the withdrawal of magma back down the conduit.

CONCLUSION

Each eruptive complex studied is unique in one sense but in another shares some characteristics with surrounding flows and features. The result of lava-water interaction is quite marked, reflecting the continuing presence of abundant ground water in the basalt flows of the Snake River Plain. An easily overlooked stage associated with many if not most of the vents is a collapse stage, usually late in the evolution of the feature. This is particularly significant in the development of the elongate vents associated with the rift sets. However, it is also important in understanding the evolution of features such as the nested craters at Split Butte.

Even in settings of such apparent similarity as the Recent basalt flows of the Snake River Plain, it is often possible to reconstruct an eruptive sequence. Studies such as the ones summarized here provide insight into the volcanic styles of the eastern Snake River Plain. In many instances the knowledge gained in such studies is applicable as well to similar-appearing volcanic features on other planets and to a better understanding of the volcanic regimes associated with them.

ACKNOWLEDGMENTS

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