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The Lava Butte Site Revisited

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THE prehistory of the upper Deschutes River Basin in central Oregon is becoming better known as a result of archaeological research projects completed during the 1980s (e.g., Pettigrew and Spear 1984; Minor and Toepel 1984; Scott 1985a; Scott et al. 1986; Davis and Scott 1986; Flenniken and Ozbun 1988; Minor et al. 1988; McFarland 1989). To date, however, few investigations have produced the abundance of archaeological material that was recovered during the excavations of the Lava Butte site (Ice 1962). Under the field direction of Donald E. Schwenk, a Washington State University (WSU) crew spent nearly three months excavating Lava Butte (35DS33) during the summer of 1961 as part of an archaeological salvage program for a Pacific Gas Transmission Company pipeline project (Mallory 1961; Ice 1962). Because of the regional importance of the site, combined with the fact that it was only briefly reported, the field data and the chipped stone artifact collection were analyzed by the authors to evaluate the original site interpretations. The results of this effort are described below.

SITE SETTING

The Lava Butte site is located within the High Lava Plains Physiographic Province (Baldwin 1981) and lies approximately 16 km. south of the city of Bend, Oregon (Fig. 1). The Deschutes River, located 6.4 km. west of Lava Butte, is the primary source of water in this region as it winds its way northward to its confluence with the Columbia River near The Dalles. The rain shadow effect of the Cascade

Mountain Range to the west blocks most precipitation, resulting in an arid climate. The High Lava Plains support a forest community of ponderosa (*Pinus ponderosa*) and lodgepole (*P. contorta*) pine, and an understory composed of manzanita (*Arctostaphylos* spp.), antelope bitterbrush (*Purshia* spp.), service berry (*Amelanchier* spp.) and other bushy vegetation. Modern animal life includes mule deer, small mammals, raptors, and songbirds (Bailey 1936).

The archaeological site is named after the Lava Butte cinder cone that lies about 1 km. to the west. The Lava Butte eruption, firmly dated by radiocarbon analysis at $6,169 \pm 65$ B.P. (Chitwood et al. 1977), was responsible for an extensive lava flow and a localized deposit of coarse cinders. The Lava Butte prehistoric site lies on a small, forested knoll adjacent to a deep (10 m.), narrow faultline.

PREVIOUS RESEARCH

When the Lava Butte site was first discovered in 1960, surface evidence was sparse. However, the site was subsequently tested and an abundance of subsurface artifacts was found in volcanically derived (Mount Mazama) sediments (Mallory 1961:9-11). Full-scale "salvage" excavations were undertaken at Lava Butte during the summer of 1961 (Figs. 2 and 3). Excavation of eight trenches provided a large artifact sample from the site deposits. A total of 1,742 chipped stone and ground stone artifacts was recovered by WSU (Ice 1962:19). Several poorly defined fire hearths, a biface cache, a flake cache, and 13 hopper-base mortars were exposed but only one

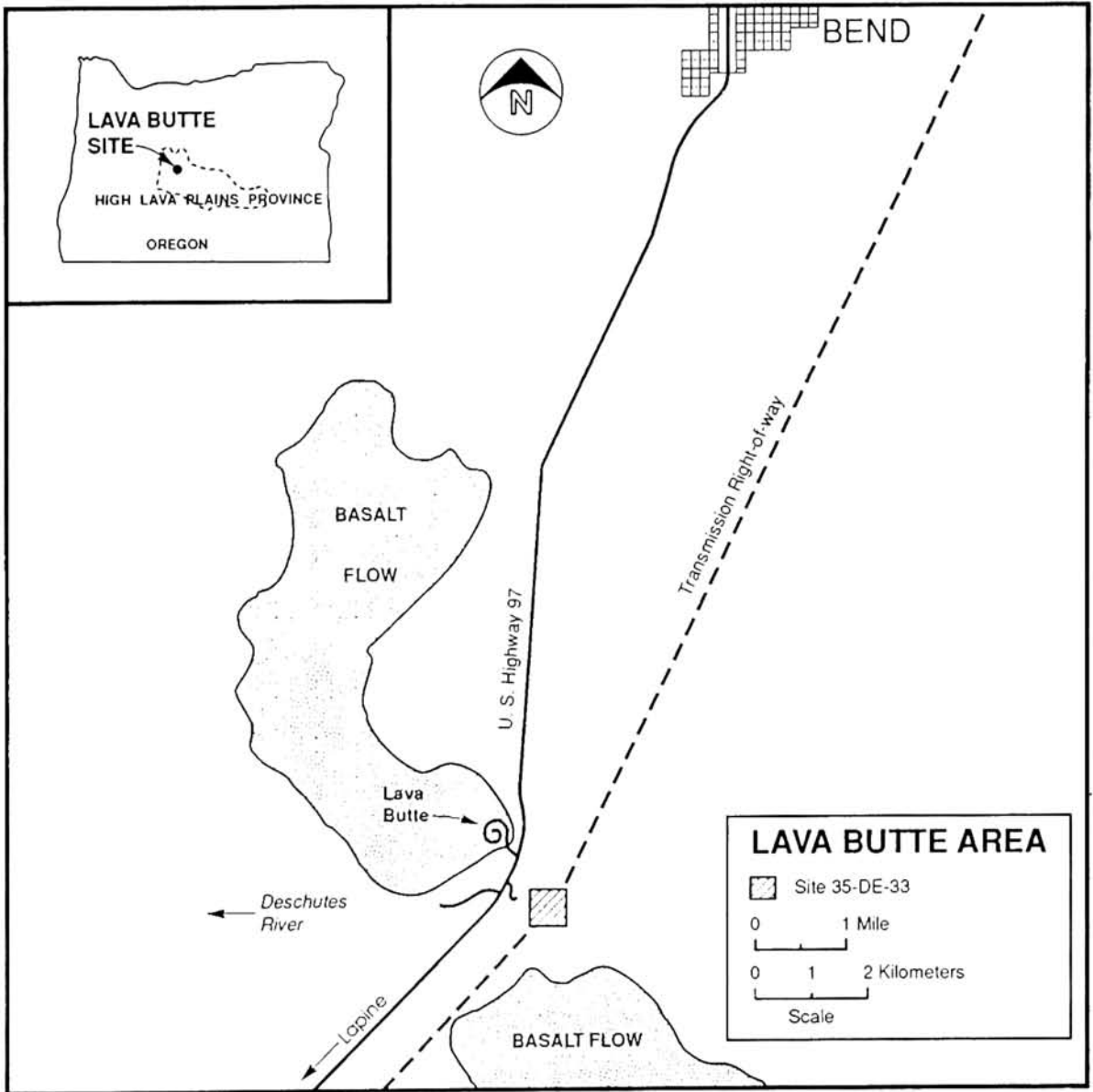


Fig. 1. Location of the Lava Butte site (35DS33) in central Oregon (from Ice 1962).

piece of bone (an awl) was found. No perishable items such as basketry fragments or cordage were recovered.

The brief excavation report (Ice 1962) reflects the lack of comparative data from this region in the early 1960s. Based on the results of their fieldwork, the investigators concluded that: (1) the site was single component (it was

not stratified); (2) the site post-dated 6,000 or 7,000 B.P. and its use terminated between A.D. 1500 and 1800; (3) the inhabitants of Lava Butte were related culturally to people living on the Columbia Plateau; and (4) the site was primarily a hunting and gathering camp optimally situated to exploit deer following well-traveled game trails adjacent to the nearby lava flow.

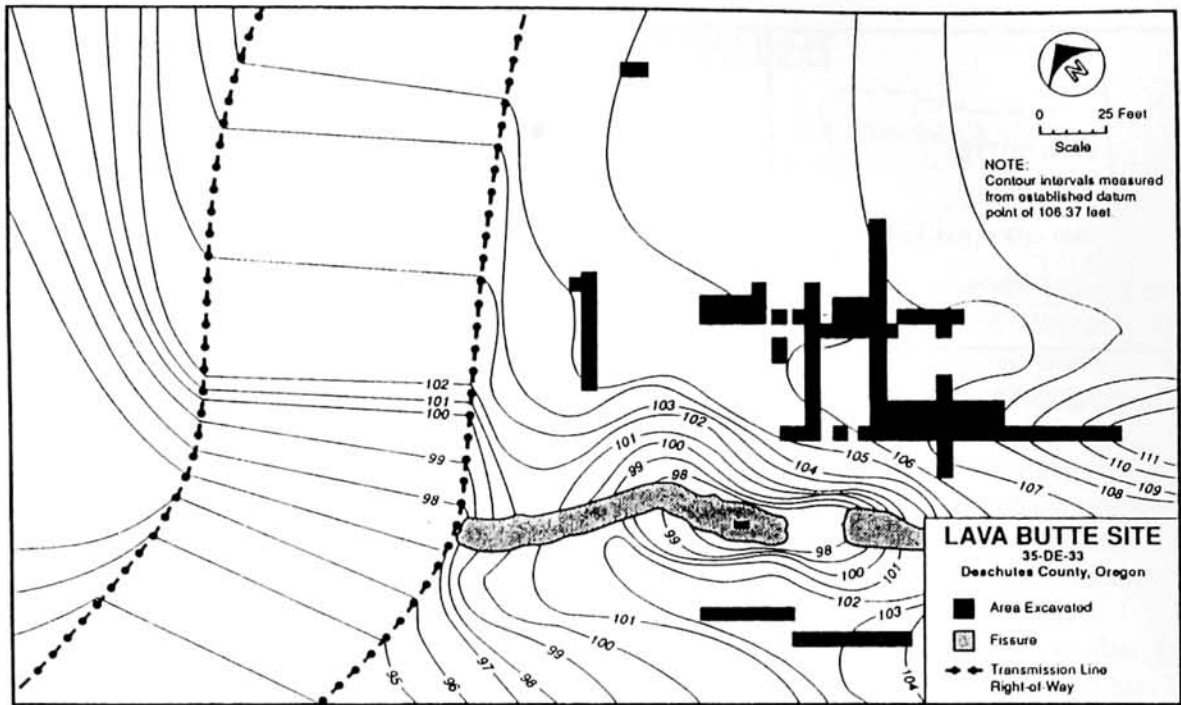


Fig. 2. Location of excavation units at Lava Butte (from Ice 1962).

SITE REANALYSIS

Our analysis focused on reclassification of the chipped stone artifact collection according to technology and function. With the exception of projectile points, we did not redescribe nor remeasure the collection because this information was already included in the original field report and artifact catalogue. Recent "pot-hunter" holes at Lava Butte allowed Forest Service soil scientists to reexamine site stratigraphy. A small sample of obsidian tools was submitted for x-ray fluorescence (XRF) source analysis and hydration measurements. These various data sets are presented below.

Reexamination of the Lava Butte chipped stone artifact assemblage was tempered by several factors. WSU excavated the site in 5-foot-square excavation blocks, kept vertical provenience in 6-inch (15.3 cm.) levels, and sifted all fill through 1/4-inch mesh screen (Ice 1962:17). During screening, apparently only

artifacts that could be identified as tools were collected, bagged, and labeled. With the exception of the flake cache, no mention is made of lithic debitage in the original field notes or site report. However, an abundance of debitage is visible in the refilled excavation holes at Lava Butte. Thus, the WSU excavation strategy produced information that is not fully compatible with data from more recently excavated sites in this region. Finally, some artifacts listed in the original Lava Butte field report and specimen catalogue (e.g., three bifaces from the cache, two stone beads, and the bone awl) were not present in the portion of the collection on loan to us from the Oregon State Museum of Anthropology.

The stratigraphy of the Lava Butte site (Fig. 4) was originally defined by Roald Fryxell, based on an analysis of bulk sediment samples collected during the site excavations (Ice 1962:11-16). The Forest Service soil analysis substantiates the original description.



Fig. 3. Open units during 1961 excavations of Lava Butte site (from Ice 1962).

Stratigraphically, Lava Butte is comparable to other open-air archaeological sites in central Oregon (e.g., Scott 1985b; Minor et al. 1988; McFarland 1989). A thin A1 soil horizon made of grey silt and pine-needle duff overlies a 70 cm.-thick AC horizon composed of a mixed deposit of Mount Mazama tephra and sandy loam (Ice 1962:11-16). The Mazama tephra was mixed or "reworked" through eolian processes and bioturbation (Ice 1962:15; Terry Brock, personal communication 1986). It, in turn, overlies a thin C horizon composed of fine windblown sand atop basalt bedrock.

The eruption of Lava Butte at 6,169 B.P. emitted a small plume of coarse cinders and pumice to the north and east of the cone

(Chitwood et al. 1977). However, because the site lies just outside the main cinder plume, only a few coarse cinders are mixed with the Mazama-derived soil at Lava Butte. The cinders do not occur as a distinct stratum useful for dating.

All cultural material from Lava Butte was found within the Mazama-derived sediments, indicating that the site post-dates 6,800 B.P. Most of the cultural debris was recovered from ground surface to 45 cm. in the site deposit. Ice's (1962) Level 2, extending from 6 to 12 inches (15.3 to 30.6 cm.) below ground surface, contained the most abundant artifacts.

With the exception of projectile points, we did not analyze the horizontal patterning of all chipped stone artifacts from Lava Butte. In

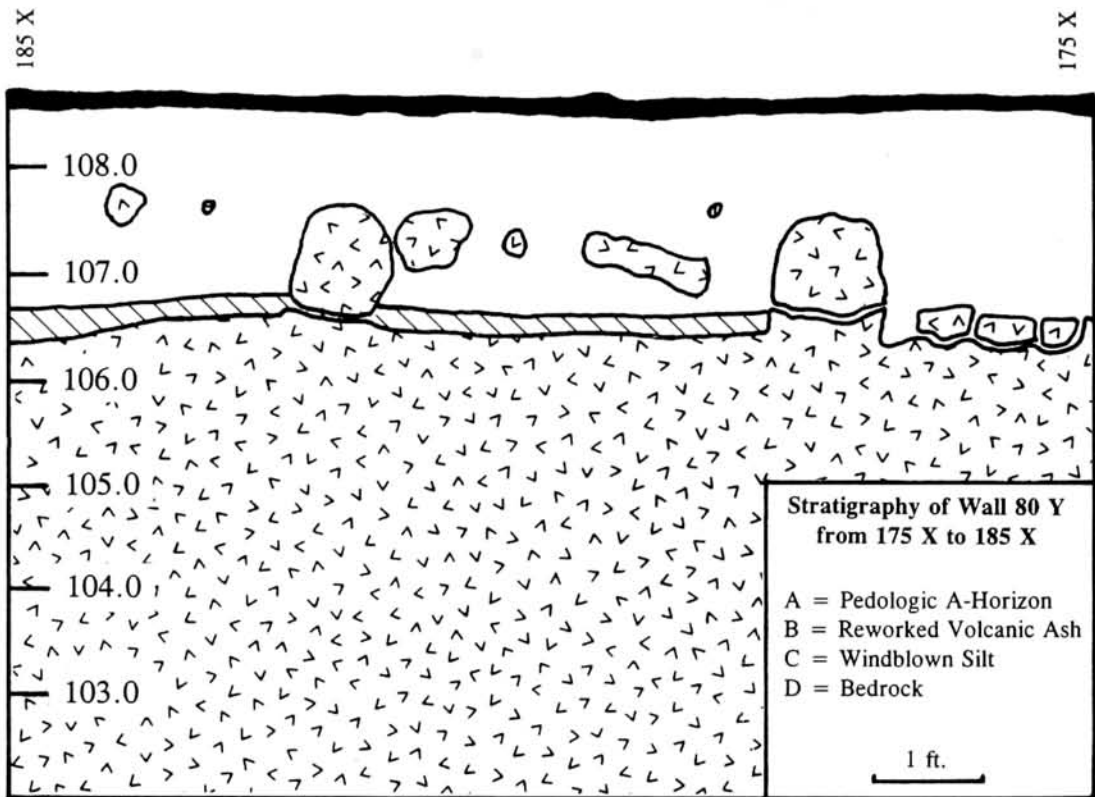


Fig. 4. Lava Butte site stratigraphy (from Ice 1962).

general, lithics were evenly distributed throughout the entire area excavated by WSU, with concentrations of projectile points located in the central and southeastern-most excavation trenches (see Fig. 2). Both Middle Archaic Elko and Late Archaic Rosegate and Desert Side-notched points were found in these areas, suggesting that the site occupations overlap.

Artifacts

We reexamined and categorized the entire chipped stone artifact collection according to artifact types (e.g., bifaces, unifaces) currently used in the archaeological literature of the upper Deschutes River Basin (e.g., Minor and Toepel 1984; Scott 1985a). Our classification is by techno-morphological type rather than the out-

dated functional typology used in the original site report. For example, WSU identified 1,042 "scrapers" (Ice 1962:19), whereas we were only able to identify 143 unifaces that may have functioned in some type of scraping task. Most of the "scrapers" are edge preparation, margin removal, and outrepassé flakes (cf. Flenniken and Ozbun 1988:101, Fig. 31, c and d) and are the byproducts of biface reduction. Ice (1962:19) also identified 64 "drills" and four stone "awls" but we were only able to identify one bifacially flaked drill (see Ice 1962:59, Plate VI, c). The results of our reclassification are summarized in Table 1. A list of all artifacts typed according to our classification scheme was included with the collection returned to the Oregon State Museum of Anthropology.

Table 1
DISTRIBUTION OF ARTIFACTS BY WSU LEVEL FROM LAVA BUTTE

Artifact/Level	1 ^a	2	3	4	5	6	7	8	9	10	11	12 ^b	Totals
Projectile Points	35	61	32	22	12	8	3	1	0	1	0	1	176
Bifaces	59	79	41	30	19	12	5	0	3	0	1	2	251
Unifaces	20	44	29	20	11	5	8	2	1	2	0	1	143
Ground Stone ^c	7	13	6	5	3	2	1	0	0	0	0	0	37
TOTALS	121	197	108	77	45	27	17	3	4	3	1	4	607

^a excludes surface artifacts.

^b levels below Level 12 produced a total of three formed tools.

^c includes hopper-base mortars, milling and hammerstone fragments, pestle fragments, and unidentifiable functional ground stone objects.

With the exception of projectile points, most artifacts could not be positively associated with either the Middle Archaic (7,000-2,000 B.P.) nor Late Archaic (after 2,000 B.P.) occupations due to the comparatively shallow, homogeneous, and somewhat smeared nature of the site deposits. In several cases, however, we have made tentative temporal assignments based on obsidian hydration data. For the purposes of this analysis, the chipped stone tool assemblage is divided into projectile points, bifaces, and unifaces.

Projectile Points. The original site report classified 426 artifacts from Lava Butte as projectile points (Ice 1962:19). We identified 176 as complete or fragmentary projectile points. Of this total, 130 were sufficiently complete to be placed within recognized northern Great Basin projectile point series (e.g., Hanes 1988). The analyses of projectile point assemblages from other sites in this region have identified a bimodal distribution in neck width dimension, one between 4.5 and 8 mm. and the other between 8.1 and 13 mm. (Pettigrew 1982, 1985; Minor and Toepel 1984). Artifacts that fall into the lower mode are interpreted to be arrow points whereas those that fall into the upper mode are considered to be dart points.

Using this distinction, the Lava Butte projectile points are separated into narrow-necked arrow points and broad-necked dart points.

The 20 narrow-necked arrow points from Lava Butte were found from ground surface, where they were the most numerous, to approximately 120 cm. deep in the site deposit where one specimen was recovered. Most of the small arrow points are made from thin flakes of obsidian but others are made of chert. A total of 17 specimens fit within the Rosegate projectile series and three others belong to the Desert Side-notched point type (Fig. 5, row 4). As a group, they range from 17 to 29 mm. in maximum length, 12 to 16 mm. in maximum width, 1 to 3 mm. in maximum thickness, and 3 to 7.5 mm. in maximum neck width. The Rosegate series appears in the northern Great Basin of Oregon after 1,600 B.P. and persists to approximately 500 B.P., whereas the Desert Side-notched type is common after 600 B.P. (Hanes 1988; Pettigrew and Lebow 1989).

Few Late Archaic sites have been excavated in central Oregon. In these sites, Rosegate predominates numerically over the Desert Side-notched type in each projectile point collection. Site 35CR21 in the Crooked River drainage east



Fig. 5. Representative projectile point types from Lava Butte: artifacts in rows 1-3 are broad-necked dart points; artifacts in Row 4 are arrow points.

of the upper Deschutes River Basin yielded a radiocarbon date on composite charcoal of $1,660 \pm 140$ B.P. in association with a Rosegate point (Pettigrew 1982:42). Within the upper Deschutes River Basin, Lava Island Rockshelter yielded two radiocarbon dates that appear to be contemporaneous with a Late Archaic assemblage of Rosegate and Desert Side-notched points. A date of $1,420 \pm 80$ B.P. was obtained from a composite charcoal sample while the other date of 140 ± 60 B.P. was obtained on bark from a storage pit (Minor and Toepel 1984:17). Rosegate and Desert Side-notched points similar to those from Lava Butte have been recovered from sites with no associated radiocarbon dates

(Scott 1985a, 1985b; McFarland 1989, 1990) and as surface finds throughout the upper Deschutes River Basin.

A total of 110 broad-necked projectile points was found from ground surface to approximately 76 cm. deep in the site deposit. Forty percent of these dart points were recovered from levels 2 and 3, extending from 15.3 to 45.9 cm. below ground surface. The remainder are clustered immediately above and below these levels and decrease dramatically in number by Level 6, at approximately 91.8 cm. below ground surface. The broad-necked points range from thin, well-flaked, corner-notched projectiles with concave ($N=63$) and straight

(N=34) bases to thick points with rounded bases (N=13) (Fig. 5, rows 1-3). They vary from 11.8 to 42 mm. in maximum length; 12.5 to 22 mm. in maximum width, 3 to 6 mm. in maximum thickness; and 8.5 to 17 mm. in maximum neck width dimension. This range in morphology and size is apparently the result of different corner-notched point rejuvenation trajectories prior to artifact discard at Lava Butte (cf. Flenniken and Raymond 1986). Some of the larger specimens (see Ice 1962:57, Plate IV, m-o) may have served as hafted knives. Lithic material types include equal numbers of obsidian and variously colored cryptocrystalline silicate artifacts.

The majority of the dart points from Lava Butte fit easily within the Elko Corner-notched type, as described by O'Connell (1967), Heizer and Hester (1978) and others, and refined by Thomas (1981). The Elko series has greater antiquity and longevity in the northern Great Basin than in other Basin regions (see Thomas 1981). For example, in the northeastern Great Basin, the Elko horizons at Hogup Cave (Aikens 1970), Dirty Shame Rockshelter (Hanes 1988), and Skull Creek Dunes (Wilde 1985) occur as early as 8,000 B.P. and persist until 600 B.P. The evidence from the northwestern Great Basin in Oregon is less conclusive but few deeply stratified sites have been excavated. The original provenience information of the Elko points recovered from Fort Rock and Connley caves (Bedwell 1973) and the Odell Lake site (Cressman 1948) is questionable enough to make the Early Archaic (pre-7,000 B.P.) age assignments for Elko suspect (see Pettigrew and Lebow 1989:75). However, Elko is clearly present at these sites after 7,000 B.P., i.e., during the Middle Archaic Period.

The few radiocarbon dates obtained from Middle Archaic (Elko assemblage) sites in central Oregon are not of great antiquity. A date of $2,150 \pm 300$ B.P. from a charcoal sample in Lava Island Rockshelter was assigned

to the extensive Elko assemblage recovered from the shelter (Minor and Toepel 1984:17). Site 35CR20L, located in the Crooked River drainage east of the Deschutes River Basin, yielded a radiocarbon date of $2,850 \pm 110$ (Pettigrew 1982:17). An uncorrected radiocarbon date of $2,750 \pm 120$ B.P. was obtained from charcoal associated with Elko points and lithic workshop debris at the Sand Spring site, located immediately east of the Deschutes River Basin (Scott 1985a:2). Elko-style projectile points are also documented from test excavated sites lacking radiocarbon dates (e.g., Scott 1985b:22-28; McFarland 1990) and are commonly reported as surface finds in Forest Service CRM documents.

Bifaces. The 251 bifaces identified during our analysis range widely in shape and size (see Ice 1962:60, Plate VII). The majority are made of obsidian but some cryptocrystalline silicate specimens are represented. Only two percent of the bifaces are complete. Of the 251 bifacial artifacts, 217 could be classified according to their stage in the biface manufacturing process developed by Sharrock (1966), Muto (1971), and others. Most bifaces are stage 3 and 4 "blanks." They are refined in outline shape, are comparatively thick in cross-section, have relatively sinuous edges, and exhibit only minimal edge preparation. Eleven percent of the assemblage includes stage 1 and 2 biface cores common in quarry and workshop assemblages such as those in the nearby Newberry Caldera (Flenniken and Ozbun 1988). Thirty-nine percent of the bifaces are stage 4 and 5 preforms and finished tools similar to artifacts found in campsites and rockshelters (e.g., Minor and Toepel 1984; McFarland 1989).

The focus of the biface reduction technology at Lava Butte was apparently on the intermediate and late stages of manufacture. The numerous edge-preparation and biface thinning flakes in the site collection and back-dirt piles are byproducts of this technology (e.g., Flenn-

niken and Ozburn 1988). Production-related breakage patterns that could be identified on the bifaces include bending (75 percent), perverse (18 percent), and incipient (seven percent) fractures. The roughed-out blanks and small preforms suggest that useable flakes and projectile points were the intentional end products of this reduction process. The large number of fragmentary and heavily resharpened projectile points discarded at the site, and the relative scarcity of preforms in the chipped stone assemblage, indicates an emphasis on replacing broken dart, and possibly arrow, points.

Many of the Lava Butte bifaces may have been used as tools for expedient chopping, cutting, and scraping tasks. Other bifaces appear to have served as sources of raw material for making flake tools. However, it was difficult to distinguish use wear from edge preparation during flintknapping and post-depositional scarring, especially on obsidian tools.

A cache of seven, laurel-leaf shaped obsidian bifaces was found *in situ* in levels 2-4 at Lava Butte (Fig. 6) (also see Ice 1962:56, Plate IIIA). However, only four of the seven artifacts were included in the site collection returned by WSU for permanent deposit at the Oregon State Museum of Anthropology. The four bifaces were percussion flaked; two show evidence of the original detachment scar, indicating that the bifaces were produced from very large flakes. The bifaces were also pressure flaked and exhibit slight "shoulders." Artifacts similar to those from Lava Butte have been found in the Ray (Shotwell 1986), Sugar Cast (Stuemke 1986) and Swamp Wells (Scott 1985b) caches. A biface nearly identical to those from Lava Butte in lithic type (Newberry Volcano obsidian) and production technology was found at the Bear Saddle site in the western Oregon Cascades (Nilsson 1989:63, Fig. 4-11, A), indicating possible intermontane trade or transport of obsidian tools from central Oregon. The obsidian hydration measurements from each

specimen are similar to rind measurements for the corner-notched projectile point sample made of Newberry Volcano obsidian and thus, are tentative evidence that the cache dates to the Middle Archaic occupation of Lava Butte (Table 2).

Unifaces. A total of 143 artifacts was classified as unifaces that apparently functioned either as scraping or cutting implements. They include plano-convex endscrapers (Ice 1962:59, Plate VI, j - p), sidescrapers (Ice 1962:61, Plate VII, f, i and l), and notched pieces (Ice 1962:59, Plate VI, q and s), as well as a wide assortment of retouched and utilized flakes. Many are made on large and small obsidian flakes that show deliberate edge retouching. The flake scars observed on others may simply be laboratory "bag wear" or resulted from edge preparation during flintknapping. A total of nine plano-convex endscrapers made of crypto-crystalline silicate exhibit careful flaking on one edge but the remaining specimens made of obsidian appear as though they were flaked and used at the spur of the moment for a task and then were discarded.

Lithic Debitage. Some 710 pieces of obsidian chipped stone debitage are included in the Lava Butte artifact collection. These pieces were collected during the original excavations because they were considered to be "knives," "scrapers," "awls," and "burins" (see Ice 1962:61, Plate VIII, b-d, k, l, n, and o). However, most are the products of biface reduction. They range in size from 3 to 10 cm. in maximum dimension. Many show either early or late stage percussion flake scars on their dorsal surfaces. Some flakes exhibit few dorsal surface percussion flake scars and are relatively thick in cross-section, indicating that they were removed from large pieces of raw material or roughed-out cores brought to the Lava Butte site. No small pressure or notching flakes were collected during the excavations so the full range of lithic reduction activities at the site is



Fig. 6. Representative artifacts from the biface cache.

undocumented. However, the number of preforms and rejuvenated projectile points indicate that the final stages of lithic reduction were undertaken at Lava Butte.

A flake "cache" composed of 33 large percussion flakes of Newberry Volcano obsidian was found *in situ* in Level 2 (see Ice 1962:56, Plate IIIB). Flake morphology varies but the specimens range from five to eight cm. in maximum dimension and appear to have been produced from one or more large biface cores. In fact, the "cache" may more accurately be a lithic reduction area where flakes were removed from a large biface core. All are ready-made tool blanks. Obsidian hydration rind measurements from eight of the flakes (Table 2) fell

within the same hydration range as the corner-notched projectile point assemblage and biface cache, suggesting it was associated with the Middle Archaic occupation of Lava Butte.

Ground Stone. Because the focus of our analysis was on the chipped stone assemblage, only a small part of the ground stone collection was examined by the authors. Ground stone was distributed through all excavation levels at Lava Butte which precluded making a strong identification with either the Middle or Late Archaic occupations. The abundance of hopper-base mortars and ground stone at Lava Butte is currently unique among identified prehistoric sites in the upper Deschutes River Basin.

Thirteen hopper-base mortars, which exhibit

Table 2
OBSIDIAN SOURCING AND HYDRATION DATA FROM LAVA BUTTE ARTIFACT SAMPLE

Specimen No.	Artifact Type	Mean Hydration Width (μ)	Source	WSU Level ^a
A29-736	biface	2.6	Newberry Volcano	2
A29-738	biface	3.1	Newberry Volcano	3
A29-740	biface	2.8	Newberry Volcano	3
A29-741	biface	3.0	Newberry Volcano	3
A29-786	debitage	1.9/3.3 ^b	Newberry Volcano	2
A29-787	debitage	2.6	Newberry Volcano	2
A29-796	debitage	2.0	Newberry Volcano	2
A29-803	debitage	2.5	Newberry Volcano	2
A29-805	debitage	2.3	Newberry Volcano	2
A29-809	debitage	2.6/3.3	Newberry Volcano	2
A29-812	debitage	2.2	Newberry Volcano	2
A29-817	debitage	2.1	Newberry Volcano	2
A29-11	dart point	2.3	Newberry Volcano	2
A29-35	dart point	1.1/3.2	Obsidian Cliffs	2
A29-42	dart point	2.2	Quartz Mountain	2
A29-51	dart point	NVB ^c	McKay Butte	4
A29-53	dart point	2.2	Newberry Volcano	4
A29-93	dart point	3.0	Silver Lake/Sycan Marsh	5
A29-94	dart point	3.1	Newberry Volcano	6
A29-170	dart point	1.7	Newberry Volcano	1
A29-194	dart point	NVB	Newberry Volcano	1
A29-208	dart point	3.7	Silver Lake/Sycan Marsh	4
A29-240	dart point	2.1	Newberry Volcano	6
A29-329	dart point	2.8	Newberry Volcano	1
A29-414	dart point	2.6	Newberry Volcano	2
A29-595	dart point	2.1	Quartz Mountain	3
A29-597	dart point	2.7	Unknown	3
A29-628	dart point	2.2	Newberry Volcano	4
A29-652	dart point	2.4	Newberry Volcano	7
A29-702	dart point	2.5	Quartz Mountain	5
A29-703	dart point	2.5	Cougar Mountain	5
A29-840	dart point	3.3	Newberry Volcano	1
A29-852	dart point	2.0	Newberry Volcano	2
A29-1074	dart point	NVB	Unknown	2
A29-1124	dart point	3.2/4.1	Newberry Volcano	5
A29-1204	dart point	diffuse rim	Newberry Volcano	6
A29-S-12	arrow point	1.0	Newberry Volcano	surface
A29-S-37	arrow point	1.2/1.9	Newberry Volcano	surface
A29-205	arrow point	1.4	Newberry Volcano	2
A29-263	arrow point	NVB	Newberry Volcano	1
A29-725	arrow point	NVB	Newberry Volcano	1
A29-753	arrow point	diffuse rim	Newberry Volcano	8

^a WSU levels: 6 inches = 15.3 cm. (i.e., Level 1 = 0 to 15.3 cm.).

^b multiple bands and/or variable widths.

^c no visible band.

very shallow circular depressions ranging from 6 to 11 cm. in maximum dimension, were identified in the original report (Ice 1962) (Fig. 7). Ice identified 11 "milling stones," of which five are clearly pestle fragments made of basalt. The remaining specimens may have functioned as metates or grinding stones (Ice 1962:62-63, Plates IX and X). However, four fist-sized basalt cobbles, ranging in maximum size from 3.5 to 6.5 cm., may have possibly functioned as flintknapping hammerstones based on spalling and wear observed on the cobbles. Ten of the 12 "abrading stones" made of scoria and vesicular basalt were examined by the authors. These specimens ranged in size from 2.1 to 13.8 cm. in maximum dimension and exhibited small striations and grooves suggesting they functioned as flintknapping abraders (see Flenniken and Ozbun 1988:47-50).

OBSIDIAN SOURCING AND HYDRATION ANALYSES

A small sample (3%) of 42 obsidian artifacts from the Lava Butte chipped stone assemblage was submitted for XRF sourcing and hydration analyses (Table 2). Our analyses focused on the projectile points, bifaces, and flake cache in an effort to identify obsidian procurement patterns, refine site chronology, and evaluate stratigraphic integrity. One half of the projectile point sample was chosen nonrandomly from all levels of the site deposit; the remainder were chosen by a simple random sampling procedure. Obsidian XRF (Hughes 1989) and hydration measurement (Origer 1989) analytical procedures are described in the respective laboratory reports.

Thirty-two tools were manufactured from "Newberry Volcano" obsidian (Hughes 1989) (Table 2). Two other local obsidians, Quartz Mountain and McKay Butte, are represented. Three nonlocal glass sources in the sample include Silver Lake/Sycan Marsh, Cougar Mountain, and Obsidian Cliffs in the Three

Sisters Wilderness Area. Given the relatively short 24 km. distance of Lava Butte from the Newberry Caldera, the prevalence of Newberry Volcano glass in the site assemblage is not surprising.

Many obsidian sources within the Newberry Caldera are of Holocene age (McLeod et al. 1981) and thus, are potentially important aids in dating archeological sites where Newberry Volcano glass is present. However, the chemical source profiles of Newberry Caldera flows overlap and only the 1,300 B.P. "Big Obsidian Flow" currently is distinguishable from other sources using XRF analysis (cf. Jack and Carmichael 1969; Hughes 1989). Interestingly, none of the Lava Butte specimens correlate to the Big Obsidian source indicating either sampling error, limited use of the Big Obsidian source or diminished use of Lava Butte after 1,300 B.P.

Obsidian hydration analysis produced a relatively small range of micron readings between "no visible band" (NVB) to 4.1 microns (Origer 1989) (Table 2). The random and nonrandom hydration band samples produced the same range of micron readings, indicating that the hydration data are generally representative of the site as a whole.

Hydration measurements on the 30 projectile points ranged from NVB to a maximum 4.1 microns (Table 2). Hydration rind thickness on the four bifaces made of Newberry Volcano obsidian ranged from 2.6 to 3.1 microns (mean = 2.8). Hydration measurements on eight flakes of Newberry Volcano obsidian in the flake cache ranged from 1.9 to 3.3 microns (mean = 2.53). The authors are unaware of hydration data for a comparably sized sample of Elko points from the upper Deschutes River Basin. However, the same range of low (<2 microns) hydration values in the Lava Butte arrow point population is mirrored at two other Late Archaic sites in the upper Deschutes River Basin where Rosegate and Desert Side-notched arrow points

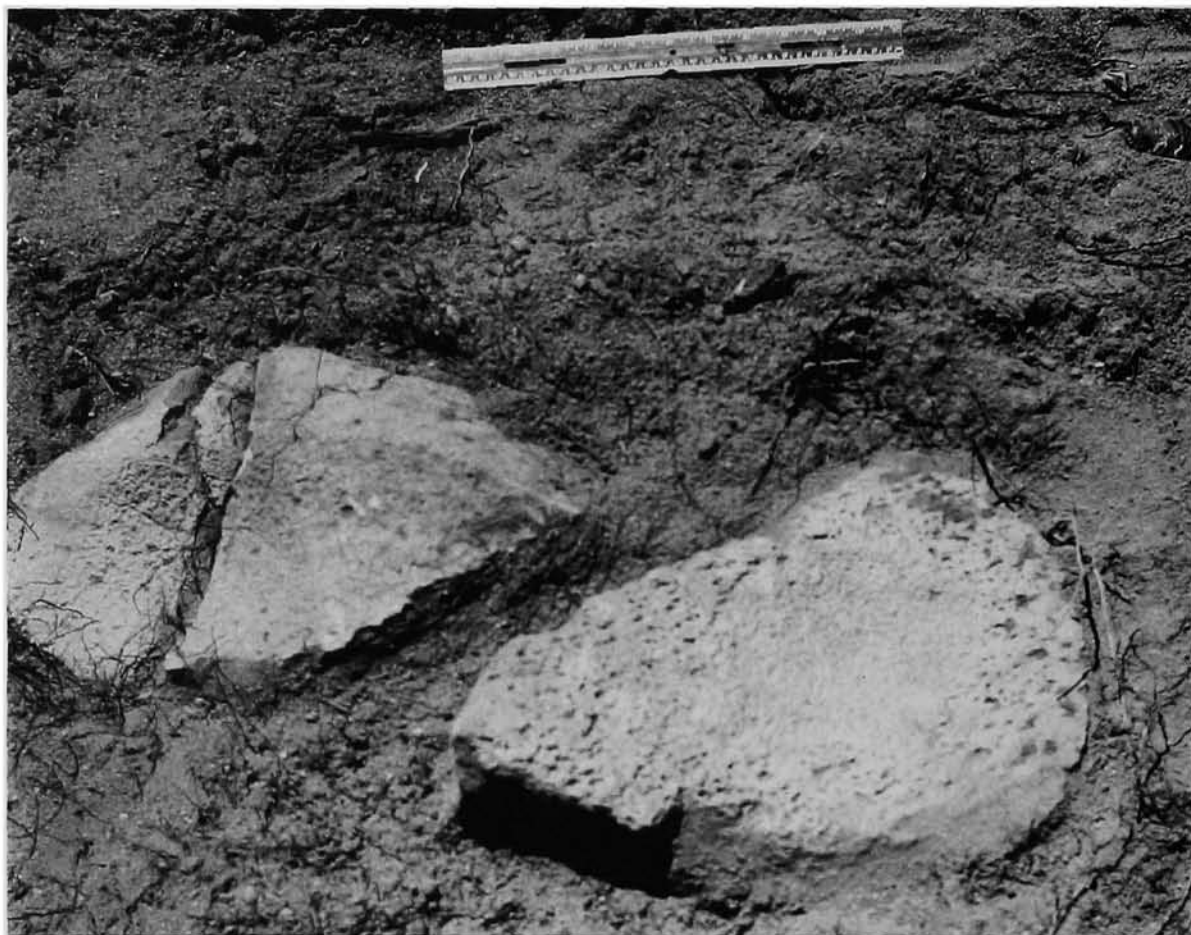


Fig. 7. Example of hopper-base mortars found at Lava Butte (from Ice 1962).

made of Newberry Volcano glass predominate (McFarland 1989:120-123).

With the exception of Friedman's experimental work (Friedman and Long 1976; Friedman and Trembour 1978), relatively little effort has been given to developing hydration curves for the abundant obsidian sources in central Oregon. Thus, extant obsidian hydration data must largely be used in a relative rather than absolute sense. Because the bulk of Lava Butte projectile points correlate with Newberry Volcano glass, comparisons were made between the hydration readings from the dart and arrow point populations from Lava Butte. The hydration data show a slight overlap in the range of values in the arrow and dart point populations.

For example, the thickest hydration rind (1.9 microns, if the larger value is used) on a Rosegate point (Specimen A29-S-37) falls within the same range as the thinnest rind (1.7 microns) on an Elko series dart point (Specimen A29-170). More significantly, the data do not show a large (e.g., greater than one micron) gap in hydration values among the two point populations, suggesting that a minimal (or no) occupational hiatus occurred during the transition from dart to arrow point technologies.

Experimental hydration studies in the Newberry Caldera (Friedman and Trembour 1978), provide additional, albeit tentative, insight into the age of the Lava Butte artifacts. When plotted against the hydration rate of 3.0

$\mu\text{m}^2/1,000$ years developed for Newberry Volcano obsidian by Friedman and Trembour (1978:48), the artifacts made of Newberry Volcano glass range from 1,000 (1.7 microns) to 4,000 (3.4 microns) years in age. However, these data must be used with caution, given the experimental nature of Friedman and Trembour's (1978) work and the lack of site specific air and soil temperature data from Lava Butte.

An attempt was made to assess stratigraphic integrity by plotting hydration rind measurements of all "Newberry Volcano" artifacts ($N=32$) with their vertical provenience. The hydration values of the dart points, bifaces and flake cache showed no pattern of increasing hydration values with increasing artifact depth. For example, specimens with relatively large hydration values (e.g., Specimen 840: 3.3/Level 1) were found in the upper levels while artifacts with smaller hydration rinds (e.g., Specimen 652: 2.4 microns/Level 7) were recovered from lower levels in the site deposits. However, with the exception of one specimen found in Level 8, the small sample of arrow points were clustered from ground surface to Level 2 (Table 2). These data suggest that while the site deposits have been "smeared" by bioturbation, site integrity is better at Lava Butte than at adjacent open-air sites (e.g., Minor et al. 1988) that have been badly affected by historic railroad logging (see Davis and Scott 1986:108-112).

SITE INTERPRETATIONS

Chronology

The reanalysis of the Lava Butte chipped stone artifact assemblage clarifies the occupational history of the Lava Butte site. However, lacking organic debris, the site can only be dated by relative rather than absolute methods. Despite suggestions to the contrary (Lyman et al. 1983:58), we found no evidence in the original field notes nor in the extant chipped stone artifact collection to indicate the site is

7,000 years in age or older. None of the lanceolate-shaped bifaces nor corner-notched projectile points in the collection were recovered from the paleosol beneath the Mazama-derived soil horizon.

Although a post-6,800 B.P. baseline date for Lava Butte is certain, how soon after the Mazama eruption human habitation occurred is unknown. The Lava Butte eruption of 6,169 B.P. may have inhibited human use of the immediate site area until vegetation (and animal life) was reestablished in the coarse cinders. Because cultural material does not occur especially deep in the Mazama-derived sediments, the environmental and stratigraphic evidence suggests that the initial occupation of the site took place after Lava Butte erupted.

This inference is supported by the projectile point types found at Lava Butte. Corner-notched Elko points comprise most of the projectile point assemblage. As discussed previously, the Elko series may have great antiquity in this area of the Northern Great Basin, perhaps extending into the Early Archaic Period (pre-7,000 B.P.), but the few radiocarbon dated Elko assemblages from central Oregon (Pettigrew 1982; Minor and Toepel 1984; Scott 1985a) post-date 3,000 B.P., suggesting that Lava Butte may also fit within this late Middle Archaic time frame. Middle Archaic (Elko) expansion and settlement of the upper Deschutes River Basin may have been inhibited by intense local volcanic activity.

Continuity in prehistoric occupation from the Middle to Late Archaic periods at Lava Butte is documented by the presence of Elko dart points and Rosegate and Desert Side-notched arrow points. Overlapping artifact provenience and hydration values of the dart and arrow point populations indicate there was little or no occupational hiatus at Lava Butte. The presence of Desert Side-notched points suggests habitation continued after 500 B.P., as concluded by Ice (1962) in his field report.

However, the lack of Big Obsidian Flow glass in the sourced samples tentatively suggests the site was minimally used after 1,300 B.P.

The vertical distribution of the projectile points, coupled with the hydration data, indicate that Lava Butte is the product of multiple prehistoric occupations over many centuries that were partially mixed or "smeared" by a variety of natural processes. Pettigrew (1982:42) has argued that narrow-necked and broad-necked projectile points were used concurrently in this region of the Northern Great Basin for as long as 1,000 years, with each point type reflecting different weapon systems. Thus, Lava Butte may have been occupied by prehistoric groups during the gradual Middle to Late Archaic transition from the atlatl to the bow and arrow as the primary weapon system in the upper Deschutes River Basin.

Site Utilization and Seasonality

To date, few archaeological sites in the upper Deschutes River Basin of central Oregon have been classified according to existing hunter-gatherer site typologies (e.g., Thomas 1983). Site typologies have been difficult to construct in this region due to the lack of excavation data, poor perishable artifact preservation, little chronological control, and a current tendency to view most sites as "transitory occupations" or "hunting camps" (e.g., Lyman et al. 1983:72-75; Minor et al. 1988). Therefore, our attempt to infer site type and activities at Lava Butte must be regarded as tentative.

The various attributes of the Lava Butte site indicate that it functioned as a "residential base" (Binford 1980:9) rather than a transitory, task-specific field camp. This assignment is based on the attributes of: (1) large size; (2) strategic location to multiple resources; (3) high artifact density and tool kit diversity; (4) lithic industry emphasizing secondary reduction stages; and (5) relatively large number of

features (e.g., tool caches and fire hearths) that differentiate Lava Butte from a "typical" Great Basin aboriginal field camp (cf. Thomas 1983: 79-81). The site likely has an accretional formation history representing reuse of the location over many centuries. However, the abundance, diversity, and distribution of artifacts and features are indicative of a base camp rather than a repeatedly used field camp. Whether both the Middle Archaic (Elko) and Late Archaic (Rosegate/Desert Side-notched) occupations represent residential bases is not clear but the substantially fewer Late Archaic projectile points in the Lava Butte assemblage suggest the latter habitation served as a field rather than base camp.

Season of use of the Lava Butte area must currently be inferred from circumstantial evidence. The absence of faunal and floral remains preclude identifying the resources used. However, a heavy emphasis on hunting activities, as exemplified by abundant discarded projectiles, lack of preforms, and some diagnostic flintknapping debitage, is clearly indicated, especially during the Middle Archaic (Elko) occupation. The Lava Butte site is located between several extensive lava flows that restrict access to the east bank of the Deschutes River. The gap between the flows is a natural travel route, especially for deer migrating between their summer range in the Paulina Mountains (Newberry Caldera) and the Deschutes River Basin, and their winter range in the adjacent Fort Rock Valley. As Ice (1962) originally inferred, if a similar migratory pattern existed in prehistory, then Lava Butte was optimally situated as a hunting camp from which large numbers of deer could be taken. These migrations occur during late spring through early fall (Bailey 1936), suggesting Lava Butte may have been occupied during these seasons. During butchering and processing, the deep bedrock fault adjacent to the main site deposit may have provided effective "cold storage" for

freshly butchered animals and other perishable plant food products (cf. Henrickson 1990).

The hopper-base mortars and ground stone tool fragments are circumstantial evidence of spring through fall plant food gathering and processing. At a radius of five km. from the site, the modern plant species diversity is low and vegetation consists of ponderosa and lodgepole pine, manzanita, and bitterbrush forest. However, the Deschutes River lies within a typical foraging radius of 10 km. (as defined in Binford 1982) from Lava Butte. An easy morning walk would have placed the inhabitants of Lava Butte within a river environment with access to aboriginally used plants such as western yarrow (*Achillea lanulosa*), wax currant (*Ribes cereum*), western chokecherry (*Prunus demissa*), and wild rose (*Rosa* spp.) (Franklin and Dyrness 1973). Rainbow (*Oncorhynchus mykiss*) and cutthroat (*O. clarki*) trout, whitefish (*Prosopium williamsoni*), several varieties of suckers (e.g., *Catostomus* spp.), and river mussel (*Margaritifera falcata*) would have been available in the Deschutes River (see Minor and Toepel 1984); anadromous fish are not present in the upper reaches of the Deschutes River Basin.

The large amount of debitage (either collected as tools by WSU or observed in back dirt piles), tools, bifaces, and large flake cache, all derived from Newberry Volcano obsidian, indicate that tool manufacturing was an important site activity. If actual quarrying was done in conjunction with habitation of the Lava Butte site, then this activity was likely accomplished during June through October when the Newberry Caldera obsidian sources were comparatively snow-free.

Adaptive Strategies and Settlement Networks

Though we classify Lava Butte as a base camp, this designation does not imply a high degree of residential permanence. Both ethnographic and archaeological survey data from central Oregon document high residential

(forager) mobility over an extended geographic range (e.g., Blyth 1938; Stewart 1939; Lyman et al. 1983). Thus, the archaeological traces of this settlement system include a relatively small number of seasonally used foraging base camps, such as Lava Butte, and many satellite procurement locations (field camps) in nearly every environment of the upper Deschutes River Basin.

Strategic foraging base camps not only include rockshelters along major water courses (e.g., Minor and Toepel 1984; Scott 1986:5-9), but also sites associated with volcanically formed lava tubes, ice caves, and overhangs throughout the arid High Lava Plains. Currently, the premier example of this site type is Lava Butte, but small-scale testing at Mahogany Cave, an open-air site focused around the mouth of an ice cave, also produced an abundance of Middle and Late Archaic artifacts that would likely rival Lava Butte upon more extensive excavation (Scott 1985b:22-29). Unfortunately, many of these sites situated around or in lava beds and ice caves in central Oregon have been extensively looted by artifacts thieves (Clark 1990:4-6) and today, sites such as Lava River, Skeleton, Pictograph, and Arnold ice caves are popular spelunker and visitor attractions. Opportunities for understanding this important site type are therefore diminishing.

The prehistoric attraction for volcanically formed features on the High Lava Plains is intuitively easy to infer. Lava flows formed natural travel corridors for both people and animals. Water and ice were seasonally and perennially available in some lava tubes and caves. Lava formations provided hiding locations for tool caches (Scott et al. 1986) and possibly areas where food resources could be cached in "cold storage" (cf. Henrickson 1990). Many lava features formed protected overhangs and caves suitable as residential bases.

Satellite field camps located away from the residential bases are documented by abundant

small and large flaked stone scatters recorded throughout the upper Deschutes River Basin of central Oregon. Excavated prehistoric field camps have consistently yielded small assemblages of discarded corner-notched and stemmed dart points, smaller arrow points, a few biface fragments, and abundant intermediate and late stage reduction debitage (Cole 1977; Pettigrew and Spear 1984; Scott 1985a, 1985b; Minor et al. 1988; McFarland 1989). These sites appear to have functioned primarily as locations for hunting and butchering, gathering plant foods, collecting and quarrying tool stone, and other task-focused activities.

The temporal, seasonal, and functional linkages of base and satellite encampments and activity areas in the upper Deschutes River Basin are not well documented and will require further data collection, technical analyses, and model testing to delineate (Davis and Scott 1986:118-119). At present, existing settlement models for the Archaic Period in central Oregon (see Lyman et al. 1983; Pettigrew 1982; Minor et al. 1988) are highly intuitive but recognize an important aspect of upper Deschutes River Basin archaeology: despite at least two decades of field searches, sites such as Lava Butte are rare whereas literally hundreds of small lithic scatters have been recorded (e.g., Cole 1977; Pettigrew and Spear 1984; Minor et al. 1988; Scott 1986; McFarland 1989). Future field surveys and testing programs in the upper Deschutes River Basin hopefully can be designed with enough sophistication to someday identify other sites with the same research potential as Lava Butte.

SUMMARY

The Lava Butte archaeological site is of pivotal importance to the current understanding of upper Deschutes River Basin prehistory. Though the original Lava Butte excavation report provided only brief description and minimal interpretation, field notes and the chipped stone artifact collection allowed us to reassess the site

interpretations offered in the original WSU field report (Ice 1962). These efforts have modified the interpretations of Ice (1962) concerning site age, seasonality, and function. Although Ice (1962) interpreted Lava Butte to have Columbia Plateau cultural affiliations, our analysis indicates that the site is best understood within the context of northern Great Basin prehistory.

Based on our study, we interpret Lava Butte to be an extensively used foraging base camp that was first inhabited during the Middle Archaic Period, but after the eruption of Lava Butte at 6,169 B.P., by human populations using Elko series dart points. Circumstantial evidence suggests multiple, spring through fall habitations occurring over a period of many centuries. Situated around a deep bedrock fault, the site was optimally located to take advantage of both forest and riverine resources. Lava Butte was subsequently occupied during the Late Archaic Period (after 2,000 B.P.) by populations first using Rosegate, then Desert Side-notched, projectile points. The relative scarcity of Late Archaic Period projectile points indicates that this habitation was more ephemeral and task-specific than the Elko occupation. The site was apparently inhabited during the transition from atlatl to bow and arrow technologies in central Oregon. Abundant volcanic activity in the upper Deschutes River Basin may have initially inhibited extensive human settlement, but by the Middle Archaic Period, the volcanic terrain of the region provided attractive natural features and habitational settings that were important to survival on the High Lava Plains.

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