

FLAKED STONE ANALYSIS

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Flaked stone analysis of the materials recovered during the archaeological investigations at the Skyrocket site has been the result of efforts by several individuals over a period of eight years. During earlier phases of these investigations, Dr. James Bennyhoff, John Dougherty, Rusty Weisman, and Michael Rondeau examined the collections and made important contributions to the project. Bennyhoff's observations on at least 1091 items, mostly flaked stone, were recorded by assistants during several sessions March - May 1992 and provide a range of typological and chronometric information useful for understanding the collection. His efforts focused on linking diagnostic artifact forms to established cultural phases. As such, his contributions helped develop the chronologic framework applied to the Skyrocket collection.

Rondeau contributed several reports discussing various aspects of the collections, particularly with regards to the materials from the West and Northeast loci (Rondeau and Rondeau 1990, 1991). His contributions provided the groundwork for much of the subsequent research. The portions of the collections allocated to him for study, however, were often a mix of different time periods and technologies. Based on his extensive familiarity with flaked stone collections from the Sierra Nevada and adjoining regions, he identified temporally significant attributes characterizing assemblages within the Skyrocket materials. The results of these studies are not reported here verbatim but integrated when they contribute to the objectives of the project.

Dougherty and Weisman were present throughout the course of field investigations and, consequently, may have viewed more of the collection than any other individuals. Both recognized significant attributes of the flaked stone assemblages during and after excavation. Their experience helped guide further in-field investigation and provide direction for future research.

The study presented below is the result of several months of effort spanning a four-year period. During the various periods when analysis was conducted, not all materials were available for examination, nor was the entire debitage collection ever thoroughly sorted by an experienced lithic analyst to identify fragments potentially misclassified during initial sorts. Materials from the upper components—all artifacts from 160cm and above—were examined during a four-week period in winter, 1992/1993. These included 858 items (a small number previously examined by Rondeau) which were briefly described on 88 pages of notes. These notes are in the possession of the author and CSU Fresno's Anthropology Laboratory. Materials from the Deep Component were examined on several occasions comprising a longer period of time. A complete organized classification, however, was not possible due to time and space constraints; items were identified and in most instances, rough sorted.

Needless to say, the time allotted for analysis was insufficient to the task. The sample examined might comprise better than approximately 95% of the recovered artifacts and perhaps

less than 10% of the debitage. This includes virtually all the artifacts recovered from the upper soil strata within components 4-1 and about 90% of those from the deep component (8) and the TGC (Component 7-5). Samples of debitage selected for attribute analysis by CSUF students were examined on several occasions and most of the obsidian debitage from Component 8 was examined after the fact. All data used herein for calculations and tables was supplied by the principal investigators of the project.

The earliest flaked stone assemblage identified at Skyrocket is attributed to a Sierra foothill aspect of the Western Pluvial Lakes Tradition (WPLT). Dated approximately 9200-9000 b.p. at this site by radiocarbon analysis, the assemblage was recovered from the deep clay strata designated Component 8. These strata include the Gray Clay (GRC), Black Clay (BC), Green Clay (GC), and Feature 212 Fill (FEF). Although it was initially believed the materials from this assemblage were horizontally and vertically mixed with materials from another, presumably non-contemporaneous component, recent re-examination indicates some vertical differentiation might exist; this topic is discussed in another section of the final report.

Following the WPLT, the Stanislaus Phase represents an early Archaic assemblage characterized by attributes that differ dramatically in some respects from the WPLT but show similarities to other mid-Holocene collections throughout the Desert West. This assemblage was recovered primarily from the deep clay strata though like the previous assemblage, some materials also derived from the overlying TGC. Radiocarbon assays and obsidian hydration data placed this component approximately 8000-6900 b.p.

Materials morphologically similar to items within both the WPLT and Stanislaus Phase assemblages were identified within other soil strata albeit in much smaller numbers. Their presence in these upper strata can be explained primarily on the basis of the site's complex geomorphological history. It is also quite possible that the later of these assemblages was represented by occupations associated with strata within the TGC/DBGC series. Artifact scavenging by later occupants might also account for some of this.

Although two assemblages are defined for Component 8, additional flaked stone items recovered from the clay strata might indicate the presence of a third. Long-stemmed points of the Lake Mojave series could be affiliated with one or both of the defined assemblages or represent another less distinct component. This topic is discussed in greater detail below.

Calaveran Phase materials were recovered from the TGC strata and South Central strata 2 and 3. Moratto places this phase within the time period 5500-3000 b.p. (Moratto, in press). These dates are supported to some degree by radiocarbon and obsidian hydration data from the Skyrocket site. At the study site, Components 7-5 are dated 6,670 - 4,890 b.p., the lower end of the temporal spectrum could be attributed to the preceding Stanislaus Phase occupations or represent an earlier date for initiation of the Calaveras Phase.

An Upper Archaic Period assemblage attributed to the Sierra Phase (ca. 3000-1500 b.p.) was recovered primarily from the soil strata defining Components 4-1—Transitional, and Light, Medium, and Dark Brown Surface Loams (Trans, LBSL, MBSL, DBSL). Some materials associated with this assemblage also derived from the underlying TGC, possibly as a result of intrusive burials. Likewise, some materials from the preceding Calaveras Phase assemblage might have been recovered from these upper soil strata.

Materials attributable to the Redbud Phase (ca. 1500-700 b.p.) were identified in the

collection, however, the assemblage is not well-represented at this site and definition of its flaked stone characteristics is limited. Typologically diagnostic items and obsidian hydration data constitute most of the temporal evidence for materials attributable to this assemblage.

Horseshoe Bend Phase materials were also recovered from mixed deposits in the brown surface loams. This assemblage is dated to about 700-100 b.p. from other sites in the region. Typologically diagnostic items and obsidian hydration data are also the most reliable indicators of this assemblage.

The following sections describe the flaked stone collections by defined components, integrating these into temporally defined assemblages. The objective of these studies is twofold: 1) to characterize temporally discrete flaked stone assemblages in the Skyrocket locality represented by the recovered materials; and 2) to provide robust descriptions of these assemblages useful for constructing models of technological organization (Ericson and Purdy 1984; Kelly 1988; Nelson 1991). Together, these studies should provide the basis for developing a framework for examining aspects of cultural change and adaptation for the human groups occupying the region during the past 9,200 years.

Limitations affecting the success of these objectives include potentially significant mixing of materials within both Component 8—the lower soil strata, and components 4-1—the upper soil strata. Components 7-5 within the gravelly clay series—formed by colluvial/erosional events and brief periods of soil development—also failed to yield single component deposits. Reconstruction of flaked stone assemblages within the deep component relies on characteristics of technology and artifact morphology combined with toolstone material differences. Justification for this strategy is provided by information about contemporaneous assemblages throughout the western U.S.; comparison with these assemblages supports inferred differences and enables distinguishing between them. Characterization of flaked stone assemblages from the upper components is more restricted and relies even more so on inter-site comparison. As a consequence, less can be said about the later assemblages at Skyrocket without including information from the surrounding region, and refined reconstructions of past systems of technological organization are not possible; much of the conclusions are restricted to tool forms without the substantiation or clarification obtainable from debitage analysis.

ANALYSIS RESULTS

This section evaluates temporal differences in the flaked stone collection through comparison of component-specific data. Given the range of internal mixing of materials within the three dominant component groups—Components 8, 7-5, and 4-1—only gross comparisons can be accomplished. These comparisons, however, should enable us to address some important aspects of technological change. When possible, phase-based assemblages are used as the units of analysis to examine more relevant differences. Comparisons include changes in tool morphology, flaking technology, toolstone materials, and assemblage composition, and what these might mean in terms of technological organization for populations occupying the locality.

Given the circumstances and scope of the project, certain limitations apply. Obsidian

studies do not reflect the true diversity inherent in that assemblage. While Bodie Hills and Casa Diablo glass groups appear to predominate during all time periods, the varying importance or presence of other glasses are not accurately portrayed. Napa Valley, Annadel, Borax Lake, Queen/Truman, Mt. Hicks, and several lesser sources were identified but visual sourcing by macroscopic attributes did not distinguish them in many cases; XRF characterization was applied in selected samples. The absence of this detail is mostly important to the flake analysis as it has a bearing on deciphering differences in technological and economic strategies.

The following topics are addressed under general categories below.

1) Tool Morphology

It is proposed the proportions of various artifact categories and the relative diversity of forms represented has implications for understanding technological organization strategies. Differences in core technology have been used to address subsistence and settlement strategies throughout North American prehistory (Parry and Kelly 1987). In particular, a shift from standardized bifacial and unifacial cores to non-standardized multiple platform cores can signal a change from mobility to increased sedentism. Changes in proportions of core and tool forms are addressed to examine expected changes in assemblage functions through time.

2) Flaking Technology

In addition to general core use and tool production activities discussed below, two primary aspects of tool flaking technology are evident in the flaked stone collection and represent significant changes in the larger sphere of organization. First, changes in biface thinning technology are evident between earlier and later components. Second, bipolar reduction and increased recycling of obsidian items during later periods represents a shift in reduction strategies that signals changing perceptions of material value. Both technological shifts could relate to changes in organizational strategies related to functional objectives and/or resource abundance.

3) Toolstone Materials

The Skyrocket flaked stone collection contained an abundance of locally obtainable and exotic materials. Greater toolstone material diversity can reflect either greater population mobility or higher degrees of social interaction. Changes in the use of these materials for particular tool forms and the concomitant different proportions of technological byproducts are examined to develop the basis for models articulating the economic and technological spheres of past cultural systems.

Debitage

As noted, component specific differences indebitage classes within material types can address changes in technological systems. Comparisons are made between thedebitage material types within each component to examine variability within each temporal unit. Additionally, each material class is compared between components to address changes in the use of the lithic type through time. The conclusions presented below derive from attribute analysis of a sample of

the recovered debitage, comparisons between material classes of the total collection, and characterizations derived from calculations of mean weight.

Greenstone (GRS) was the dominant debitage material recovered (54%) and also represented the highest proportion of any material recovered—31% of all debitage was GRS from Component 4-1 and 20% of the total debitage was greenstone from Component 7-5. All other debitage material categories per component represented less than 10% of the total from the site in all cases. Fifteen percent of all debitage was FGS followed by basalt (11%). Obsidian comprised 8%, quartz comprised 7%, and chert represented six percent.

Stated another way, the highest recovery rates for any debitage material class per component was also GRS: 915.7/m³ for Component 4-1; and 407.0/m³ for Component 7-5 (Table 1). Fine-grained greenstone (FGS) was the dominant debitage material for Component 8, however, at 153.7/m³. Obsidian (OBS) and chert (CHR) marked the lowest recovery rates for each material per component. CHR ranged from a low of 1.7/m³ in Component 8 to 112.7/m³ in Component 4-1. OBS was lowest in Component 8 at 5.1/m³, increased to 40.6/m³ in Component 7-5 and reached a high in Component 4-1 at 171.6/m³ exceeding recovery rates for all other materials except basalt (BAS) and GRS.

Table 1. Comparison of Recovered Debitage by Material and Component.

	Component 8		Component 7-5		Component 4-1	
	Per Cube	Mean Wt	Per Cube	Mean Wt	Per Cube	Mean Wt
OBS	5.1	0.49	40.6	0.14	171.6	0.11
BAS	6.2	6.68	67.5	1.45	204.4	1.67
FGS	153.7	2.61	89.1	1.14	154.8	1.13
GRS	89.0	4.18	407.0	1.46	915.7	1.80
CHR	1.7	2.30	37.4	0.61	112.7	0.59
QUZ	11.0	2.99	51.2	1.04	108.7	0.92
Total	265.9		692.7		1667.8	
Mean	44.3	3.21	115.5	0.97	278.0	1.04

Recovery rates for OBS, BAS, GRS, CHR, and quartz (QUZ) increase dramatically through time as represented by components. Only FGS exhibits a variation to this pattern. The recovery rate for FGS shows a decrease within Component 7-5 then a complete rebound in Component 4-1. The Component 7-5 decrease in FGS debitage is nearly a 43% reduction from either of the other components.

Mean weight calculations for these materials shows that those in Component 8 contained

larger items than the other components. FGS and GRS debitage in Component 8 were twice as large as the same materials from other components. OBS and QUZ were three times the size of these materials in components 7-5 and 4-1, while BAS and CHR were about four times as large in Component 8 as they were in the other components.

The mean weight of virtually all materials denotes a decrease in average flake size through time. Only GRS and BAS exhibit higher values of materials in Component 4-1 than those of Component 7-5. These topics are discussed in relation to assemblage composition below.

Debitage Technological Sample

The technological sample was comprised of 2220 pieces (Table 2). The largest proportion of the items in the sample was FGS (59%). Twenty-six percent were GRS, 5% were CHR, 4% were BAS, 4% were OBS and 1% was QUZ. The following discussion draws on this sample and discusses each material by component.

Fine-Grained Greenstone (FGS)

Analysis of FGS debitage from Component 8 clearly displays a pattern supporting a full range of reduction strategies. A number of items can be attributed to core and early-stage tool production while another larger group indicates the middle and later stages of biface manufacture (Table 2). Simple/Simple accounted for 15% of the sample, Complex/Simple comprised 23%, Simple/Complex comprised 19%, and Complex/Complex accounted for twenty-nine percent (Table 3). Although flakes with complex platforms outnumbered those with simple platforms—490 vs. 387—the latter comprised a high proportion of those pieces with diagnostic platforms (44%). Less diagnostic flake fragments accounted for a small proportion (13%), but these were divided equally between complex and simple dorsal surfaces. Mean weight calculations for the FGS sample of flakes reveal many to be in the larger size ranges. Diagnostic flakes had mean weights between 4.9g and 9.5g, while fragments were within the higher range of those values (6.2g - 8.5g). Twenty-six percent of the pieces retained cortex (Table 2). Although mean weight calculations for cortical pieces showed they were larger on average than non-cortical, the latter were also characterized by large pieces (Tables 4 & 5). Mean weight values for non-cortical ranged from 4.0g to 8.1g.

The same pattern is supported to a lesser degree in Component 7-5. Simple/Simple flakes account for a larger proportion of the assemblage (25%) as do Simple/Complex (20%) but the proportion of Complex/Complex decrease (17%). Flakes in this component with simple and complex platforms were about equally represented. Mean weights for FGS flakes from this component reveal they were on average smaller than those from Component 8. The largest flakes from this sample were those classed as Complex/Simple with a mean weight of 6.4g. Flake fragments with complex dorsal surfaces were considerably smaller than those from Component 8 weighing an average of 1.8g; simple flake fragments, however, had identical mean weights as those in Component 8 (6.2g). In all, those with simple dorsal surfaces outnumbered complex flakes almost 2:1. Flakes with cortex (10%) were also marked by much greater mean

weights than non-cortical. One Complex/Simple flake was 21.0g and two simple flake fragments yielded a mean weight of 60.5g. In contrast, mean weight of non-cortical items ranged from 0.8g (n=20 Flake Simple) to 5.4g (n=18 Complex/Complex).

In Component 4-1 the proportions shift in favor of Complex/Complex (27%) and Simple/Complex (26%) while those more likely attributable to core reduction (Simple/Simple = 17%) indicate diminishing importance. Again, complex platforms outnumbered simple ones—89 vs.52. The mean weights for flakes in these categories were significantly less than those from lower components indicating that later stages of tool maintenance probably accounts for the majority of flakes in this sample. With the exceptions of Complex/Simple (1.6g) and Complex/Complex (1.3g), each flake category had mean weights less than 1.0g. Only 19% of the flakes retained cortex. These cortical items were larger than non-cortical: mean weight ranges for cortical were 0.5g to 3.1g, whereas non-cortical items were less than 1.2g.

Greenstone (GRS)

GRS debitage types from Component 8 depict a trajectory profile similar to the FGS although pieces tend to be larger. Core technology and biface production are both indicated. The highest proportion was represented by those with simple platforms and complex dorsal surfaces (29%), these were followed by Simple/Simple (22%). Flakes with complex platforms also accounted for about a third (33%). Less diagnostic fragments accounted for 16%, comprised mostly of those with complex surfaces (10%). Representing the lowest mean weight was the sample classed as Simple/Complex (9.5g) while the Flake Simple category was the largest (24.8g). Thirty-seven percent of the sample retained cortex but displayed mean weight ranges only slightly more than many of the non-cortical classes. For biface manufacture, an emphasis on early and middle stages of reduction is indicated by larger non-cortical flakes in the Complex/Complex group (8.3g) and the Simple/Complex group (10.2g); it is expected that a strongly represented later stage sample would be marked by smaller mean weights.

GRS debitage shows a continuation of core reduction activities in Components 7-5 and 4-1 with a possible increase in biface maintenance evident in the latter. In Component 7-5, those flakes with simple platforms comprise 41% of the sample. The mean weights of flakes in most categories differed little from those in Component 8 with the exception that values for Flake Simple and Flake Complex are reversed; whereas simple fragments had a higher mean weight in Component 8 (24.8g), complex fragments were heavier in Component 7-5 (22.8g). Among the other largest were Complex/Simple flakes (22.6g) and Simple/Simple (17.1g)

Flakes with simple platforms increased in Component 4-1 to 53% (n=87). Flakes with complex platforms in this component totaled 23% (simple dorsal) and 10% (complex dorsal). Mean weights for flakes in all categories from this component, however, were much less than those of lower levels. These ranged from a low of 0.5g for Flake Complex (n=4) to 9.1g for Simple/Simple (n=18). Those with complex platforms included 2.5g (S/C=11) and 4.0g (C/C=5). Both cortical and non-cortical items in this component have lower mean weight values than those in other components. Though cortical items tend to be heavier in most instances, mean weight values for the diagnostic flakes were less than 4.3g with the exception of 7 Simple/Simple (18.3g).

Table 2. Debitage Technological Sample.

Component	Basalt			FG Greenstone			Greenstone			Chert			Obsidian			Quartz			Total
	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	
F-Simp	4	7	2	19	22	61	3	43	20	4	6	8	0	5	7	0	1	4	216
F-Comp	1	5	4	8	12	73	4	19	32	3	2	13	0	2	11	2	0	1	192
Simp/Simp	4	3	11	29	33	150	18	55	70	4	7	10	0	0	3	0	3	5	405
Simp/Comp	4	2	9	43	26	194	11	41	42	9	4	1	1	10	10	0	1	1	409
Comp/Simp	5	3	14	23	17	237	7	32	92	1	6	14	0	0	8	1	0	3	463
Comp/Comp	7	0	7	46	22	296	5	25	64	5	6	12	0	0	30	2	0	0	527
Total	25	20	47	168	132	1011	48	215	320	26	31	58	1	17	69	5	5	14	2212
Cortical	5	9	12	30	12	263	16	53	123	4	6	3	1	0	2	2	3	4	548
Non-Cortical	18	10	35	138	113	752	32	141	205	22	25	55	0	17	67	3	2	7	1642
C/NC Total	23	19	47	168	125	1015	48	194	328	26	31	58	1	17	69	5	5	11	2190
% Cortical	0.22	0.47	0.26	0.18	0.10	0.26	0.33	0.27	0.38	0.15	0.19	0.05	1.00	0.00	0.03	0.40	0.60	0.36	0.25
% Non-Cort	0.78	0.53	0.74	0.82	0.90	0.74	0.67	0.73	0.63	0.85	0.81	0.95	0.00	1.00	0.97	0.60	0.40	0.64	0.75
Mean Weights	Basalt			FG Greenstone			Greenstone			Chert			Obsidian			Quartz			
	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	
F-Simp	4.8	17.0	1.0	0.3	6.2	6.2	2.7	6.4	24.8	0.5	1.0	4.4	0.0	0.4	0.6	0.0	1.0	0.5	4.32
F-Comp	0.0	6.8	8.8	0.8	1.8	8.5	0.5	22.8	12.7	1.0	1.5	10.0	0.0	1.0	0.8	0.5	0.0	5.0	4.58
Simp/Simp	1.0	6.0	13.7	0.5	4.8	6.4	9.1	17.1	11.4	1.5	0.2	4.8	0.0	1.0	0.0	0.0	1.3	0.8	4.42
Simp/Comp	1.0	15.0	7.9	0.6	3.3	4.9	2.5	9.5	9.5	0.3	0.5	4.0	0.2	0.2	0.2	0.0	2.0	1.0	3.48
Comp/Simp	1.8	26.0	9.1	1.6	6.4	9.5	4.3	22.6	14.2	8.0	3.5	13.2	0.0	0.0	2.6	2.0	0.0	20.7	8.08
Comp/Comp	5.4	0.0	9.6	1.3	3.4	7.7	4.0	13.2	8.8	0.6	1.0	3.2	0.0	0.0	0.9	0.5	0.0	0.0	3.31
Total (NA)	2.33	11.80	8.35	0.85	4.32	7.20	3.85	15.27	13.57	1.98	1.28	6.60	0.03	0.43	0.85	0.50	0.72	4.67	4.70

no weight available for 3 Simple/Simple flakes from Component 8

Table 3. Percentage Data for Material and Flake Types in Technological Sample.

Component	FG Greenstone N & %						Chert N & %					
	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8
F-Simp	19	22	61	0.11	0.17	0.06	4	6	8	0.15	0.19	0.14
F-Comp	8	12	73	0.05	0.09	0.07	3	2	13	0.12	0.06	0.22
Simp/Simp	29	33	150	0.17	0.25	0.15	4	6	10	0.15	0.19	0.17
Simp/Comp	43	26	194	0.26	0.20	0.19	9	4	1	0.35	0.13	0.02
Comp/Simp	23	17	237	0.14	0.13	0.23	1	6	14	0.04	0.19	0.24
Comp/Comp	46	22	296	0.27	0.17	0.29	5	7	12	0.19	0.23	0.21
Total	168	132	1011	1.00	1.00	1.00	26	31	58	1.00	1.00	1.00
Component	Basalt N & %						Greenstone N & %					
	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8
F-Simp	4	7	2	0.16	0.35	0.04	3	43	20	0.06	0.20	0.06
F-Comp	1	5	4	0.04	0.25	0.09	4	19	32	0.08	0.09	0.10
Simp/Simp	4	3	11	0.16	0.15	0.23	18	55	70	0.38	0.26	0.22
Simp/Comp	4	2	9	0.16	0.10	0.19	11	41	42	0.23	0.19	0.13
Comp/Simp	5	3	14	0.20	0.15	0.30	7	32	92	0.15	0.15	0.29
Comp/Comp	7	0	7	0.28	0.00	0.15	5	25	64	0.10	0.12	0.20
Total	25	20	47	1.00	1.00	1.00	48	215	320	1.00	1.00	1.00
Component	Obsidian N & %						Quartz N & %					
	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8
F-Simp	0	5	7	0.00	0.24	0.11	0	1	4	0.00	0.20	0.29
F-Comp	0	2	10	0.00	0.10	0.15	2	0	1	0.40	0.00	0.07
Simp/Simp	0	3	0	0.00	0.14	0.00	0	3	5	0.00	0.60	0.36
Simp/Comp	5	10	10	1.00	0.48	0.15	0	1	1	0.00	0.20	0.07
Comp/Simp	0	1	8	0.00	0.05	0.12	1	0	3	0.20	0.00	0.21
Comp/Comp	0	0	30	0.00	0.00	0.46	2	0	0	0.40	0.00	0.00
Total	5	21	65	1.00	1.00	1.00	5	5	14	1.00	1.00	1.00

Table 4. Cortical Materials in Technological Sample.

Component	Basalt			FG Greenstone			Greenstone			Chert			Obsidian			Quartz			Total
	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	
F-Simp	0	2	0	2	2	24	1	14	14	1	1	0	0	0	0	0	0	1	62
F-Comp	0	3	1	0	0	34	0	6	12	0	0	2	0	0	2	2	0	1	63
Simp/Simp	0	2	4	6	4	39	7	1	35	2	1	1	0	0	0	0	2	1	105
Simp/Comp	2	2	3	8	1	48	4	16	15	0	1	0	1	0	0	0	1	0	102
Comp/Simp	1	0	3	6	1	61	3	8	31	1	0	0	0	0	0	0	0	1	116
Comp/Comp	2	0	1	8	4	57	1	8	16	0	3	0	0	0	0	0	0	0	100
Total	5	9	12	30	12	263	16	53	123	4	6	3	1	0	2	2	3	4	548
Mean Weights	Basalt			FG Greenstone			Greenstone			Chert			Obsidian			Quartz			
	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	
F-Simp	0.0	16.0	0.0	0.5	60.5	6.5	7.0	13.0	22.1	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	7.20
F-Comp	0.0	10.3	22.0	0.0	0.0	9.5	0.0	38.8	28.8	0.0	0.0	18.0	0.0	0.0	1.0	0.5	0.0	5.0	7.44
Simp/Simp	0.0	9.0	29.0	1.5	12.0	8.9	18.3	3.0	13.7	2.0	1.6	6.0	0.0	0.0	0.0	0.0	0.5	1.0	5.92
Simp/Comp	1.5	15.0	14.7	1.5	4.9	7.5	4.3	14.6	8.4	0.0	1.0	0.0	1.0	0.0	0.0	0.0	2.0	0.0	4.24
Comp/Simp	1.0	0.0	14.0	2.7	21.0	13.3	2.3	54.4	19.3	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.0	10.22
Comp/Comp	6.0	0.0	10.0	3.1	5.3	8.9	4.0	25.4	10.4	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.17
Total (NA)	1.42	8.38	14.95	1.55	17.28	9.10	5.98	24.87	17.12	1.83	0.93	4.00	0.17	0.00	0.17	0.08	0.42	9.33	6.53

Table 5. Non-Cortical Materials in Technological Sample.

Component	Basalt			FG Greenstone			Greenstone			Chert			Obsidian			Quartz			Total
	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	
F-Simp	4	5	2	17	20	37	2	29	6	3	5	8	0	5	7	0	1	0	151
F-Comp	0	2	3	8	12	43	4	13	28	3	2	11	0	2	9	0	0	0	140
Simp/Simp	3	0	7	23	29	111	11	33	35	2	6	9	0	0	3	0	1	4	277
Simp/Comp	2	0	6	35	18	146	7	25	27	9	3	1	0	10	10	0	0	1	300
Comp/Simp	4	3	11	17	16	176	4	24	63	0	6	14	0	0	8	1	0	2	349
Comp/Comp	5	0	6	38	18	239	4	17	48	5	3	12	0	0	30	2	0	0	427
Total	18	10	35	138	113	752	32	141	207	22	25	55	0	17	67	3	2	7	1644
Mean Weights	Basalt			FG Greenstone			Greenstone			Chert			Obsidian			Quartz			
	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	4-1	7-5	8	
F-Simp	4.8	17.4	1.0	0.2	0.8	6.0	0.5	3.2	31.2	0.3	1.0	4.4	0.0	0.4	0.6	0.0	1.0	0.0	4.04
F-Comp	0.0	1.5	4.3	0.8	1.8	7.8	0.5	15.4	9.4	1.0	1.5	8.6	0.0	1.0	0.8	0.0	0.0	0.0	3.02
Simp/Simp	1.3	0.0	5.0	0.2	3.8	5.5	3.2	7.0	9.1	1.0	0.2	4.7	0.0	0.0	0.0	0.0	3.0	0.8	2.49
Simp/Comp	0.5	0.0	4.5	0.4	2.7	4.0	1.6	6.3	10.2	0.3	0.3	4.0	0.0	0.2	0.2	0.0	0.0	1.0	2.01
Comp/Simp	2.0	26.0	7.8	1.2	5.4	8.1	5.8	12.0	11.7	0.0	3.5	13.2	0.0	0.0	2.6	2.0	0.0	7.0	6.02
Comp/Comp	5.2	0.0	9.5	0.9	2.9	7.5	4.0	7.4	8.3	0.6	1.0	3.2	0.0	0.0	0.9	0.5	0.0	0.0	2.88
Total (NA)	2.30	7.48	5.35	0.62	2.90	6.48	2.60	8.55	13.32	0.53	1.25	6.35	0.00	0.27	0.85	0.42	0.67	1.47	3.41

no weight available for 3 Simple/Simple flakes from Component 8

In an analysis of 3461 pieces of debitage from the West Locus, Rondeau found that GRS, which comprised almost 50%, was represented by the “complete reduction sequence beginning with flakes removed from cores by direct free-hand percussion through the entire sequence of percussion biface thinning stages as well as biface pressure flaking”; as much as 51.2% of the debitage could be attributed to primary reduction (Rondeau and Rondeau 1990). At that time of the investigations, however, it seems no distinction was made between GRS, FGS, and CHR; it is likely the first two categories were combined.

Basalt (BAS)

The BAS debitage sample yielded smaller amounts than FGS or GRS for each component but was similar in sample size to CHR. Component 8 was characterized by greater amounts of flakes with simple platforms (53%); complex platform flakes accounted for 34%. Flake fragments comprised only 13% of the sample; two-thirds were marked by complex dorsal surfaces (n=4). Twenty-six percent of the sample had cortex which were often twice to three times the mean weights of non-cortical items in the same classes. Mean weight values for cortical materials suggest core and early stage biface reduction, whereas non-cortical groups support a trend of middle and later stages.

Six flakes comprising the Component 7-5 sample shows a tendency for core reduction to predominate. About half the flakes in this sample retained cortex (n=9) and had mean weight values from 9.0 to 16.0g. Flakes and flake fragments with simple dorsal surfaces accounted for 60% of the total group. Simple platforms outnumbered complex ones three to one. Mean weights of non-cortical flakes were also very high for the Flake Simple and Complex/Simple categories, 17.4g and 26.0g, respectively.

The Component 4-1 flake assemblage showed similarities to Component 8. Nearly equivalent proportions of flakes reflected core reduction and biface reduction. Most were non-cortical (78%) and had low mean weight values (0.5g-5.2g). Those with complex platforms comprised 44% of the sample, while those with simple platforms represented 36% of the group. Mean weights for cortical items were less than 1.5g with the exception of two Complex/Complex flakes with a value of 6.0g.

Chert (CHR)

In contrast to the Component 8 reduction trajectories evinced by FGS and GRS flakes, CHR was characterized more strongly by the later stages of core reduction and biface manufacturing and maintenance. Early and late stage biface reduction activities appear to be indicated by a high number of Complex/Simple flakes (24%) having a mean weight of 13.2g and the next most prevalent types, Flake Complex (22%) with a mean weight of 10.0g and Complex/Complex (21%) having a mean weight of only 3.2g. Simple/Simple flakes comprised 17% of the sample but had a mean weight of only 4.8g; only one of those had cortex. The remaining 9 non-cortical items had a low mean weight value (4.7g). With the exception of cortical complex flake fragments (n=2; 18.0g) and non-cortical Complex/Simple flakes (n=14; 13.2g), mean weights tend to reflect a pattern of smaller flakes. The high value for

Complex/Simple flakes suggests earlier or middle stages of biface manufacture or reduction from more complex cores.

Thirty-one CHR pieces in the debitage sample from Component 7-5 also showed a high representation of biface modification or late stage core reduction. Complex/Simple accounted for 19% of the flakes; another 19% were Simple/Simple. Flakes with complex platforms comprised 54% of the sample. Mean weights for all flake categories were significantly less than those of Component 8. Means ranged from 0.3g (Simple/Complex) to 8.0g (Complex/Simple). The low mean weight value for Simple/Simple flakes suggests some derive from pressure retouch of tools, probably representing small flakes characterized by a central arris demarcating few dorsal scars.

Twenty-six flakes from the Component 4-1 sample suggest an even greater tendency for later stages of complex tool forms. Eighty-five percent were non-cortical. The largest cortical flake was classed as Complex/Simple weighing 8.0g—the largest mean weight recorded. Otherwise, all classes of cortical and non-cortical weighed less than 2.0g. The majority of the flakes were classed as Simple/Complex (n=9; 35%) with a mean weight of only 0.3g. Complex/Complex (19%) and Simple/Simple (15%) also had showed low mean weight values, 0.6g and 1.5g, respectively. On a 9.6% sample of flakes obtained from the West Locus (n=3461) Rondeau reported that the entire reduction sequence was represented but that percussion biface thinning predominated (1990).

Obsidian (OBS)

The quantity of flakes in the obsidian sample was also small. The reduction activities characterizing Component 8, however, were strongly represented by late stage biface maintenance. Complex/Complex flakes comprised 46% of the sample and an additional 15% were classed as Simple/Complex. An overwhelming 97% were non-cortical and with the exception of eight Complex/Simple flakes (2.6g) had mean weight values less than 1.0g. The two cortical items, both complex flake fragments, also revealed a mean weight of only 1.0g. Examination of the total obsidian debitage collection from this component confirmed the analysis results of the sample selected but revealed the presence of additional reduction events. Many of the flakes in the larger sample were identified as late-stage pressure and small to medium thinning flakes, some clearly from bifaces. Several large flakes derived from thinning larger bifaces were identified and at least three large flakes had cortex. One large cortical flake was a primary flake struck from a cobble of Bodie Hills glass (visual). Early reduction stages were also evident in some other primary flake forms including ventral face flakes.

Twelve flakes in the Component 7-5 sample showed a predominance of biface reduction activities; though all were non-cortical. Forty-eight percent of the sample was classed as Simple/Complex while 14% was Simple/Simple. An additional 24% were simple flake fragments. Although there was a predominance of flakes with simple dorsal surfaces, the mean weights of the items suggest smaller size ranges. Highest mean weights (1.0g) were recorded on two complex flake fragments and three Simple/Simple flakes.

Component 4-1 OBS was also marked by biface reduction activities. All five flakes in the sample were Simple/Complex with a mean weight of 0.2g. A standard deviation of 0.4g

suggests some were only slightly larger than the mean. One, weighing 1.0g, was classed as cortical; the remainder was not characterized for this attribute. A larger sample examined by Rondeau (1990) from the West Locus revealed a predominance of debitage “produced mainly by pressure flaking on bifaces with a limited amount from the final stage of percussion biface flaking”, including notching. OBS comprised almost 33% of the 3461 pieces of debitage from that locus. As many as 35.8% of the flakes had bifacial edges, there were 15 notching flakes, and the smallest size class accounted for 89.8% of the flakes.

Quartz and Quartzite (QUZ)

The QUZ debitage sample was the smallest (n=24) and could be the most problematical regarding characterization of attributes and technologies. Each component appears to be dominated by core reduction activities, although Component 4-1 might contain some reduction of more complex tool forms, as well. On average, about half of the samples in each component retained cortex. Fifty-seven percent of the flakes in the Component 8 sample had simple platforms (n=8) and 71% had simple dorsal surfaces. Mean weights ranged as low as 0.5g for four simple flake fragments to 20.7g for three Complex/Simple flakes.

All flakes in the Component 7-5 sample had simple dorsal surfaces (n=5) and mean weight values of 2.0g or less. One non-cortical flake was the heaviest at 3.0g. The Component 4-1 sample had 40% with complex platforms and 80% with complex dorsal surfaces (50% of the latter group also had complex platforms). Non-cortical yielded the heaviest item, a Complex/Simple flake at 2.0g. Although not recognized in this small sample, bipolar reduction of this material was indicated for many pieces in a sample from the West Locus (Rondeau and Rondeau 1990). The QUZ debitage sample examined by Rondeau constituted 8% of 3461 pieces; some biface manufacturing was also indicated.

Cores

The number of cores of various materials changes between components. Given vagaries of the databases used, numbers are derived from those items obtained by standard and wet-screen recovery but mean weights derive from the total sample, a slightly higher number. GRS represented the most frequently used material: 49% of cores in Component 8; 66% in Component 7-5; and 60% in Component 4-1. Likewise, core tools were most frequently made from GRS: 60% of those in Component 8; 48% of Component 7-5; and 59% of Component 4-1. Added together, GRS items comprised 58% of the Core/Core Tool category. The frequency of GRS increased through time from 50% of the core items in Component 8 to 62% in Component 7-5 and 61% of those items in Component 4-1.

The use of FGS as cores was most prevalent in Component 8 (47%) constituting 38% of the cores from that component; only two FGS core tools were classified from that component. Nineteen percent of FGS cores were from Component 7-5 and 34% were from Component 4-1. FGS cores were, on average, lighter than BAS cores and half the mean weight of GRS cores.

As defined by mean weight of all recovered items, BAS, GRS and FGS core sizes decrease through time until they comprise about half the weights of those in Component 8. BAS

cores decline from 122.5g in Component 8, to 62.1g in Component 4-1. The mean weight of FGS cores in Component 8—119.2g—diminishes to 48.6g in Component 4-1. GRS cores in Component 8 have a mean weight of 200.7g which drops to 99.6g in Component 4-1. Mean weights of CHR cores did not vary significantly between components, ranging from 71.7g for Component 8 to 98.0g for Component 7-5 (Component 4-1 cores = 92.1g). QUZ cores from Component 8 had a mean weight of 242.7g, while those from Component 4-1 yielded a mean weight of 14.8g. Obsidian cores were too few in number to assess in this manner (n=2).

Bifaces

Items classed as bifaces includes projectile points and other biface forms. These are treated in greater detail below; consequently, this discussion will be brief. The dominant material used for bifaces in Component 8 was FGS (48%); GRS was second (31%). In Component 7-5, the dominant material was OBS (33%) followed by GRS (28%). Component 4-1 bifaces were also predominantly made on OBS (37%) and secondarily on GRS (26%).

The sizes of the items in these groups change through time. In Component 8, the mean weight of FGS bifaces is 21.3g, GRS is 35.8g. FGS decrease in mean weight to 12.2g in Component 7-5 and 11.3g in Component 4-1. The mean weight of GRS bifaces in components 7-5 and 4-1 also demonstrate smaller sizes; mean weights are 15.1g and 9.2g, respectively. OBS, which comprised less than 9% of the bifaces in Component 8 (mean weight = 3.3g), also exhibits an overall decrease in size in later components. In Component 7-5 they registered as 2.0g and in Component 4-1, 2.1g.

CHR bifaces comprised 6% of those in Component 8, 15% in Component 7-5, and 17% in Component 4-1. Although they became a greater proportion of the bifaces through time, their size also diminished. Their mean weight was 12.3g in Component 8, 6.8g in Component 7-5, and 3.9g in Component 4-1.

A similar pattern is evinced by BAS bifaces. In Component 8 they comprise only 4% of the bifaces. Although they increase in proportion in Component 7-5 (10%), they decrease in Component 4-1 (8%). Their mean weights exhibit a steady decrease through time: 29.7g, 14.4g, and 8.4g.

Items reminiscent of forms classified as Stepped Bifaces by Singleton (1986) were recovered throughout the deposits but seemed to predominate in components 7-5 and 4-1. These items were made on various grades of tabular greenstone and due to characteristics of the material, flake detachments frequently terminated with steps and hinges. It is asserted here that classification of these items as a type is not warranted. Whereas these forms of expedient tools tended to be somewhat larger and longer in Component 8, there was greater morphological diversity in the later components.

Bifacially Worked, Unifacially Worked, and Edge-Modified Flakes

These items are thought to represent essentially two functional categories. Worked flakes (i.e., retouched flakes) are believed to comprise manufacturing rejects—e.g., fragments of early and middle stage failures—or portions of broken non-diagnostic tools. Marked by contiguous

micro scars along portion or portions of an edge, EMFs are items thought to represent either flakes used as limited duration tools or edge-abraded early stage tool blanks lacking additional retouch. Assessment of these artifact classes can provide insight into temporal differences in tool production and use as it pertained to particular material groups within the technological system.

The majority of bifacially and unifacially worked flakes in Component 8 were made on GRS (45% and 43%). In contrast, most EMFs were made on FGS (60%). In Component 7-5, all categories were dominated by GRS: 53% of bifacially worked flakes; 48% of unifacially worked flakes; and 39% of EMFs. The pattern in Component 4-1 is more like that of Component 8; GRS dominates worked flakes (52% and 49%) and FGS again dominates the EMFs (48%).

Mean weights of these artifact groups reveals GRS was the material most often used for the largest items. GRS bifacially worked flakes from Component 8 were 63.5g, and for both components 7-5 and 4-1 were 30.5g. GRS comprised the heaviest unifacially worked flakes in component 8 and 4-1 (25.3g and 23.2g) but FGS was the heaviest of Component 7-5 (35.8g). The heaviest EMFs from components 8 and 4-1 were made on BAS (12.2g and 10.5g) but for Component 7-5 were GRS (11.3g).

OBS was the smallest of the tools in these categories for all components. OBS bifacially worked flakes ranged from 1.4g in Component 4-1 (n=20) to 2.9g in Component 8 (n=6). No unifacially worked flakes were recovered from Component 8 but those from components 7-5 and 4-1 were small—0.5g (n=2) and 0.8g (n=5), respectively. Thirty-one OBS EMFs from Component 8 had a mean weight of 0.7g. Those from components 7-5 (n=9) and 4-1 (n=30) were both 1.2g.

Worked flakes made on FGS were nearly twice the size of EMFs made on this material in almost all instances. From Component 8, bifacially worked, unifacially worked, and EMFs had mean weights of 23.8g, 14.5g, and 6.8g. For Component 7-5, these categories were 14.8g, 6.0g, and 7.8g. Component 4-1 items were 16.6g, 21.5g and 8.0g.

CHR bifacially worked flakes from Component 8 were large; mean weight was 44.0g. Unifacially worked flakes were smaller (11.9g). EMFs of this material for all components were small; mean weights ranged from 5.1g - 7.0g.

Overall, the smaller size ranges for flakes classed as EMFs for all materials in each component with the exception of obsidian, suggests a selection pattern by site occupants distinct from that characterizing bifacially and unifacially worked flakes. On the whole, this implies larger pieces tended to be selected for tool production through modification while smaller items frequently served as expedient tool forms.

ASSEMBLAGE COMPOSITION AND DIACHRONIC CHANGE

Significant changes are evident between several of the archaeological assemblages represented in the Skyrocket collection. These changes take the form of: 1) projectile point types; 2) use of lithic materials; 3) assemblage composition; 4) technological responses.

Projectile Points

The earliest projectile point forms tend to have wide necks with stem lengths nearly

equivalent with than neck width, and blades that range from triangular barbed forms to long slightly shouldered types; most bases are rounded—i.e., tongue-shaped—rather than truly contracting. Moderate edge-abrasion is evident on basal elements, basal thinning is often apparent, and particularly on triangular blade forms, pressure flaking serves to regularize margins. These are made on flakes, bifaces, and possibly large tabular pieces (although this isn't well demonstrated) that are percussion shaped and sometimes thinned. Most are made on FGS though others are classed as GRS or CHR. Most of the larger forms can be assumed to represent spear points while some of the smaller lighter variants could conceivably have served as darts for throwing sticks. A single fluted point could be associated with this assemblage (see below).

Points with long tapering stems are not easily assigned to a specific time period. Some could be associated with either the preceding or succeeding assemblages. Some are well made forms characterized by technological attributes similar to specimens classed with the large stemmed forms, while others that might be long-stemmed forms show affinities to the variability evident in the small dart classes.

A variety of small dart forms are assigned to the period following the large stemmed group. These tend to have wide necks with expanding bases and a low neck:base ratio. Made on a diverse range of materials and having an equally diverse range of haft forms, these points are often basally thinned and exhibit scar patterns presumed to represent frequent maintenance episodes. About a third are made on obsidian derived from Bodie Hills and Casa Diablo localities. Most can be shown to derive from small to medium size flakes, some which retained cortex. Small variable dart forms could span a few thousand years at this locality and characterize much of the mid-Holocene.

Concave base forms first occur in Component 7-5; two are OBS and one is CHR. This component also contains a number of points classed as contracting stem, side-notched, and Elko types. Component 4-1 contained the greatest number of small arrow-tip form. DSNs, Cootonwoods, and small contracting stem forms co-occur with small side-notched forms, Elko Series points, Rosegate Series points, and a variety of other forms.

Materials Summary

FGS

The use of FGS for formal tools is most prevalent in Component 8 (45%); it comprised 51% of all tool forms (Table 6). Its use in this component is overwhelmingly attributed to the earliest assemblage. Forty-eight percent of the bifaces in this component were made on this material. The proportion decreases in the following two components to 9% in each. Mean weight for non-projectile point bifaces of FGS is significantly greater in Component 8 as well (18.0g; sd=14.8g) but less than that of the projectile point class (22.2g; sd=19.9g). The lighter mean weight for non-projectile point bifaces is attributed to the predominance of thin knife forms in this category.

FGS along with GRS was also the material used most frequently for cores and core tools. Core forms made of FGS were also among the heaviest for Component 8; sizes of FGS core forms also decreased through time. The majority of unifaces and various scraper forms were also

made on FGS (43%). The mean weight of these items—25.5g—was within a similar range defined for BAS (25.2g) and CHR (21.5g).

Worked flakes and debitage support conclusions about reduction trajectories recognized in the tool forms. Worked flakes, mostly fragments, were characterized by mean weight values similar to those defining the scraper forms and small bifaces. This range would be expected on the presumption these items are frequently represented by fragments of larger intended forms. Debitage mean weights were among the highest for this component and diminish in size in the following components. Proportions of debitage types also confirm tool production activities such as biface manufacture and general core reduction from cobbles and tabular forms. Twenty-six percent of the flakes in the analytic sample retained cortex; their mean weight was 9.10g.

FGS continues to serve as an important raw material through the following two components but its overall use diminishes. Regarding formal tools, the proportion of FGS drops to 13% in Component 7-5 and 11% in Component 4-1. Debitage proportions closely mirror those characterizing formal tools. In Component 8, FGS debitage represents 58% of all in that category, but the proportions in the following two components decrease to 13% and 9%, respectively. A dramatic shift in flake-to-tool ratios also characterizes the changing role of this material. Whereas its ratio in Component 8 is low, much like those of other materials, later components are marked by much higher proportions of flakes relative to tools. Although primary reduction of locally obtained material continues, the proportion of cortical to non-cortical drops to 10% in Component 7-5 and 18% in Component 4-1. Whereas the mean weight of the cortical flakes in Component 7-5 (17.28g; n=12) support the continuation of primary reduction of large pieces, the value for those from Component 4-1 (1.55g; n=30) suggests far smaller items were responsible for these materials.

Table 6. Selected Data for FGS.

	Percent of Total Tools				
	Biface	Core/Tool	Uniface	Worked Flake	Other
Comp. 8	0.21	0.03	0.14	0.04	0.58
Comp. 7-5	0.16	0.14	0.07	0.31	0.32
Comp. 4-1	0.30	0.10	0.02	0.30	0.29
	Mean Weight				
Comp. 8	21.33	107.40	25.47	19.25	
Comp. 7-5	12.15	80.70	8.98	11.31	
Comp. 4-1	11.26	40.66	5.73	18.27	

GRS

GRS was the second most important material for manufacture of biface forms in Component 8 (31%) and the dominant material in core and core tool forms (50%; Table 7). Regarding uniface tools (34%), worked flakes (44%), and debitage (33%), it reflected similar patterns evinced by FGS. As such, tool production and use trajectories appear to be similar to those characterizing FGS. Only 43% of the GRS bifaces were projectile points, however, compared to 68% of the FGS items.

Mean weights for most tool categories in Component 8 were highest on this material. Debitage was second only to BAS, and like FGS was characterized by types reflecting a broad range of reduction trajectories supporting those defined by tool types. Thirty-seven percent of the flakes in the analytic sample retained cortex; these had a mean weight of 17.12g.

Later assemblages in components 7-5 and 4-1 are marked by GRS use and discard distinct from those of Component 8. Flake-to-tool ratios increase significantly as they do in other materials, but use of GRS for tools increases from 32% in Component 8 to 43% in Component 7-5 and 45% in Component 4-1. The proportions characterizing debitage increase from 33% of Component 8 to 59% of Component 7-5 and 55% of Component 4-1, and recovery rate per cubic meter increases ten-fold. Clearly greater amounts of debitage were being produced relative to the numbers of tool forms discarded in later times. The proportion of cortical material also remains high—27% for Component 7-5 and 33% for Component 4-1. While the mean weight of the material from Component 7-5 (24.87g) was slightly greater than that of Component 8, the value for the material from Component 4-1 indicates a reduced flake size (5.98g).

Table 7. Selected Data for GRS.

	Percent of Total Tools				
	Biface	Core/Tool	Uniface	Worked Flake	Other
Comp. 8	0.22	0.06	0.18	0.10	0.44
Comp. 7-5	0.21	0.21	0.06	0.34	0.18
Comp. 4-1	0.25	0.15	0.02	0.28	0.30
	Mean Weight				
Comp. 8	35.76	201.35	66.58	44.86	
Comp. 7-5	15.06	91.66	83.58	28.09	
Comp. 4-1	9.20	77.87	28.60	28.20	

Mean weight of tool forms decreases dramatically in later components as well. Cores decline in size by 50% in Component 7-5 and an additional 20% in Component 4-1. Uniface

forms increase slightly in size in Component 7-5, however, this might be due to the vagaries of a smaller sample size. They decrease nearly 30% in size in Component 4-1. Debitage mean weight decreases overall as recovery rate again increases along with flake-to-tool ratio.

BAS

The use of BAS through time shifts from an emphasis on biface forms and scrapers to bifaces and worked flakes (Table 8). Bifaces increase in proportion to other tool forms through time, from 26% in Component 8, to 42% in Component 7-5 and 46% in Component 4-1. Although they increase in proportion, they decrease significantly in size as gauged by mean weight. Scrapers of BAS are overwhelmingly represented in Component 8 (26%) and virtually insignificant in components 7-5 (6%) and 4-1 (2%). Core and core tool forms—which comprise only 10% of Component 8—reach a high in Component 7-5 (16%) and decrease again to 11% in Component 4-1. The mean weight of these items in Component 8 (125.61g) is much greater than the other components, 55.19g and 70.98g, respectively.

The flake-to-tool ratio characterizing BAS through time is less than but not unlike that of other local materials. The proportions in Component 8 are significantly lower than the values exhibited by components 7-5 and 4-1. Like the other local materials, debitage size decreases in the later components but to a greater degree. Mean weight values of EMFs are similar to those characterizing GRS in components 8 and 4-1 and more like FGS in Component 7-5.

Table 8. Selected Data for BAS.

	Percent of Total Tools				
	Biface	Core/Tool	Uniface	Worked Flake	Other
Comp. 8	0.26	0.10	0.26	0.07	0.32
Comp. 7-5	0.42	0.16	0.06	0.26	0.10
Comp. 4-1	0.46	0.11	0.02	0.23	0.17
	Mean Weight				
Comp. 8	29.71	125.61	25.17	12.98	
Comp. 7-5	14.41	55.19	2.58	24.48	
Comp. 4-1	8.38	70.98	46.63	19.14	

CHR

The earliest uses of CHR focused on unifaces (27%), bifaces (15%), and worked flakes (13%); cores/core tools comprised only 1% of the collection (Table 9). Mean weights of unifaces and worked flakes are not significantly different than those characterizing the same categories in

FGS and BAS, but are much lower than those for GRS. Mean weight of debitage (2.30g) is close to that of FGS but the flake-to-tool ratio is the lowest of any material (1.2:1). The sample of debitage selected for technological analysis also showed a predominance of smaller flake types and a very high proportion of non-cortical items (95%).

This pattern differs somewhat from those exhibited by locally obtained materials. The proportion of bifaces is much lower than FGS, GRS, or BAS and reflects primarily the assemblage of small dart points. Low flake-to-tool ratios are presumed to reflect reduction trajectories characterized predominantly by maintenance and repair of curated tools. It is possible, but still not significant, that misclassification of some FGS as CHR could account for higher mean weight values exhibited in the technological sample. Overall, however, mean weight for this material reflects the smaller sizes recovered (2.30g).

Table 9. Selected Data for CHR.

	Percent of Total Tools				
	Biface	Core/Tool	Uniface	Worked Flake	Other
Comp. 8	0.15	0.01	0.27	0.13	0.44
Comp. 7-5	0.32	0.10	0.05	0.29	0.23
Comp. 4-1	0.54	0.03	0.01	0.24	0.19
	Mean Weight				
Comp. 8	12.32	80.50	21.50	22.26	
Comp. 7-5	6.79	76.95	7.69	14.21	
Comp. 4-1	3.95	47.94	7.50	11.98	

Projectile point forms (11.8g) are smaller than those of FGS, GRS, and BAS as are non-point forms (17.0g). Standard deviation values also reflect less diversity of size than these other materials. Biface forms are larger in this component than those representing later time periods, as well. In components 7-5 and 4-1, however, CHR point and non-point forms are often heavier than some local materials. In Component 7-5, they weigh more (10.2) than BAS biface forms (7.1g), FGS non-points forms (12.6g) and GRS points (9.5g). In Component 4-1 they weigh far less than projectile points of local materials (1.8g; sd=1.1g) and about the same as other non-point forms (10.8g; sd=8.3g).

The predominance of non-cortical debitage also characterizes later components. Eighty-one percent of the analytic sample in Component 7-5 and 85% of the sample in Component 4-1 were non-cortical. The mean weight values for these data sets also indicate the flakes were much smaller than those of Component 8 (Tables 4 & 5).

Bifaces and worked flakes become the dominant tool categories in components 7-5 and 4-1 and unifaces decline to 5% and 1% of those assemblages, respectively. The mean weights for

these two categories also reflect a significant diminishment in size; reductions of 50%-60% are indicated.

Flake-to-tool ratios increase greatly over those of Component 8 but are only slightly greater than those of OBS. This also corresponds to increases in recovery rates and decreases in size as indicated by mean weight.

OBS

Changes in proportions and uses of obsidians are most distinct between the earliest and most recent time periods. Component 8 obsidian is dominated by Bodie Hills, secondarily by Casa Diablo; diverse other sources are represented in small numbers. Napa Valley glass is present in a few projectile points and several pieces of debitage. Some Mt. Hicks and a Borax Lake item might also be attributed to this time. XRF analysis of one projectile point did not result in identification of a known source.

Table 10. Selected Data for OBS.

	Percent of Total Tools				
	Biface	Core/Tool	Uniface	Worked Flake	Other
Comp. 8	0.54	0.01	0.04	0.07	0.34
Comp. 7-5	0.82	0.01	0.01	0.08	0.08
Comp. 4-1	0.84	0.00	0.00	0.07	0.09
	Mean Weight				
Comp. 8	3.28	16.00	18.00	2.92	
Comp. 7-5	1.95	1.00	1.00	2.17	
Comp. 4-1	2.05	NA	NA	1.30	

Obsidian during the earliest time periods arrived at the Skyrocket locality primarily as formed bifaces and the tool assemblage is dominated by this category (54%; Table 10). Some bifaces appeared to have been larger forms based on recovered remnants and certain debitage classes, while other forms were predominantly small reworked dart points. At least one obsidian biface resembles the basal portion of a form similar to the large rounded base FGS points characterizing the earliest assemblage. Although not demonstrable, other fragments could derive from similar forms or large biface knives; the presence of large biface forms is also supported by some of the debitage types identified. Other fragments are byproducts and remnants of large and small early, middle, and late stage forms comprised of mid-sections, ends, and margins. Mean weight of OBS bifaces in this component was 3.28g indicating many of the more intact items were in the size range of the small darts. Half of a single narrow keeled uniface was also

identified in the debitage sample and is not included in the data below.

Later time periods are dominated by Bodie Hills as well, though Casa Diablo might still retain secondary dominance but to a lesser degree. These time periods might mark the first appearance of some other eastern Sierra sources such as Queen Truman Meadows, and some smaller sources from other localities north and northeast in western Nevada. Mt. Hicks is still present in small numbers while Annadel occurs only in the later time periods at this locality.

Recovery rates for obsidian debitage increase dramatically through the components while mean weight decreases. Items retaining cortex in the analytic sample are always proportionately low; the entire sample for Component 4-1 was clearly too small to consider meaningful in this analysis (n=5). Tool classifications show an increasing proportion in the number of bifaces, worked flakes, and edge-modified flakes through time as well. Bifaces remain the dominant tool class but increase dramatically in the later components (82% and 84%, respectively). Biface forms get smaller on average and probably more fragmentary in these components. While a single obsidian core was recorded in each of the earlier components, none were identified in the most recent.

Synchronic bipolar reworking of obsidian tools is first identified in Component 4-1 during a period ascribable to the Sierra phase (Rondeau 1990) but temporally disjunct recycling of this material occurred during many time periods. Among twenty-five multiple band specimens the smallest bands ranged from 1.5 μ - 5.2 μ with the majority measured at 3.6 μ (n=3) and 3.9 μ (n=4); the mean value of these items was 3.8 μ (most were BH, 3 were CD; Table 11). Likewise, rejuvenation of snapped discarded bifaces into corner-notched or corner-removed points occurred in Sierran times. Of six items exhibiting truncated bend breaks on stem elements, five yielded hydration bands ranging from 4.4 μ - 5.1 μ (mean = 4.6 μ); four of these were BH, one was MH.

Table 11. Hydration Data for XRF Assigned Specimens.

	AN	BL?	BM	DF	MH	NV	QT	Unk
Count	1	1	1	1	6	17	1	1
μ Range					2.7-6.3	2.2-7.8		
μ Mean	2.6	6.2	4.6	5.1	4.6	4.1	4.2	5.3
μ S.D.					1.20	1.43		

* Five others were classed as Unknown on visual attributes not included. One NV had a double band, 4.4/5.4 μ , both included. Other NV specimens classified by visual attributes not included.

Flake-to-Tool Ratios

Component 8 exhibits the lowest ratio of flakes to tools of all components (7.4:1; Table 12). Likewise, CHR in Component 8 shows the lowest ratio of all material data sets within all components (0.5:1).

Excluding QUZ, the ratios calculated for BAS, FGS, and GRS denote the greatest increases in debitage relative to tools. While the ratios for BAS show an increase through each component, those for FGS and GRS exhibit a subtle reversal in Component 4-1. Regarding non-local materials, OBS and CHR ratios during components 4-1 and 7-5 are very similar.

Table 12. Flake-to-Tool Ratios (total flakes divided by total tools).

FLAKES	OBS	BAS	FGS	GRS	CHR	QUZ	Total
Comp. 8	368	452	11127	6468	122	797	19334
Comp. 7-5	4415	7341	9692	44283	4064	5571	75366
Comp. 4-1	12786	15230	11529	68217	8394	8097	124253
Total	17569	23023	32348	118968	12580	14465	218953
Percent	0.080	0.105	0.148	0.543	0.057	0.066	1.00
TOOLS	OBS	BAS	FGS	GRS	CHR	QUZ	Total
Comp. 8	92	92	1334	819	231	34	2602
Comp. 7-5	118	69	164	386	134	28	899
Comp. 4-1	344	132	242	813	242	52	1825
Total	554	293	1740	2018	607	114	5326
F:T Ratio	OBS	BAS	FGS	GRS	CHR	QUZ	Total
Comp. 8	4.0	4.9	8.3	7.9	0.5	23.4	7.4
Comp. 7-5	37.4	106.4	59.1	114.7	30.3	199.0	83.8
Comp. 4-1	37.2	115.4	47.6	83.9	34.7	155.7	68.1
Total	31.7	78.6	18.6	59.0	20.7	126.9	41.1

Considering only formal tool categories—bifaces, cores/core tools, unifaces—similar patterns are revealed (Table 13). The similarities between OBS and CHR in components 4-1 and 7-5, however, become less apparent, but again, both are within ranges distinct from local materials. The difference can be attributed to the omission of larger numbers of CHR worked and used flakes relative to formal tools. Likewise, the ratios for FGS and GRS for all components become more pronounced suggesting perhaps the relative importance of these local materials for manufacturing activities during all time periods, but as noted above, mean weight for debitage decreases indicating a preponderance of smaller pieces.

If these figures are assumed to reflect real changes in site specific activities pertaining to flaked stone materials, it can be reasoned that site function during the earliest periods of occupation was markedly different than that of later periods as regards this sphere of the

economy. Although vast quantities of FGS and GRS debitage were produced during manufacturing activities during the earliest phases of occupation, a high proportion of modified pieces were also generated and discarded. A different interpretation, however, can be applied to the CHR and OBS figures. In these instances, the data sets probably reflect the curation of tool forms brought to the site. Infrequent maintenance episodes could account for the low proportion of debitage produced from these materials.

Table 13. Flake-to-Tool Ratios (total flakes divided by formal tools).

FLAKES	OBS	BAS	FGS	GRS	CHR	QUZ	Total
Comp. 8	368	452	11127	6468	122	797	19334
Comp. 7-5	4415	7341	9692	44283	4064	5571	75366
Comp. 4-1	12786	15230	11529	68217	8394	8097	124253
Total	17569	23023	32348	118968	12580	14465	218953
Percent	0.080	0.105	0.148	0.543	0.057	0.066	1.00
TOOLS	OBS	BAS	FGS	GRS	CHR	QUZ	Total
Comp. 8	55	57	501	378	99	24	1114
Comp. 7-5	99	44	61	187	64	14	469
Comp. 4-1	289	79	111	345	139	40	1003
Total	443	180	673	910	302	78	2586
F:T Ratio	OBS	BAS	FGS	GRS	CHR	QUZ	Total
Comp. 8	6.7	7.9	22.2	17.1	1.2	33.2	17.4
Comp. 7-5	44.6	166.8	158.9	236.8	63.5	397.9	160.7
Comp. 4-1	44.2	192.8	103.9	197.7	60.4	202.4	123.9
Total	39.7	127.9	48.1	130.7	41.7	185.4	84.7

COMPONENT 8: DISCUSSION

The Sierra Foothill Aspect of the Western Pluvial Lakes Tradition referred to as the Early Clarks Flat Sub-Phase (Moratto in press) is characterized by large stemmed and slightly shouldered lanceolate projectile points; diverse forms of unifaces (including standardized cores and a range of formal and informal flake tools); and large thin bifaces. Biface thinning, marked by a predominance of large broad, often well-spaced thinning scars, percussion overshots, and percussion end-thinning, is well-reflected in the debitage assemblage as well. The latter contains

many large flakes, some with ground platforms.

Predominant use of fine-grained greenstone (FGS) further defines this assemblage; a small proportion of materials within the proposed assemblage are classed as basalt, greenstone, and chert. Only a few obsidian items show morphological similarities to the shouldered or other large biface forms, and only a few obsidian items might have yielded true hydration band values consistent with the radiocarbon ages.

It is unclear whether the single Western Clovis projectile point recovered from the deep clay strata can be confidently assigned to the predominant aspect of the WPLT assemblage. This item could represent: 1) the sole diagnostic remnant of an earlier, poorly represented or recognizable occupation; 2) a curated “heirloom”; or 3) a technological holdover replaced in time by stemmed forms.

Although stem morphology varies, projectile points in this assemblage are defined principally by their haft elements. A sample of six points defined as Large Stemmed Lanceolates shows many have wide necks (mean=25.94mm) and rounded or, less often, squared-off stems. Hafting lengths on this sample average 20.03mm. Stem lengths are frequently a little shorter than neck widths as defined by a ratio calculated from stem length divided by neck width (0.77). Broad-neck forms can be grouped into two categories: triangular blade forms frequently with barbs; and long bladed lanceolate forms without barbs but having minimal shouldering at the juncture between haft and blade. The latter forms are often much thicker (mean=10.58mm; n=3) than the former (mean=8.42mm). It is likely the latter represent spear tips while some of the narrow-necked, long-stemmed variants of the barbed forms could be dart tips. Moderate edge abrasion is apparent on stem elements of many of the large shouldered points.

Non-projectile bifaces include items recognizable as early, middle, and late stage forms characterized by percussion and pressure flaking. Bend fractures, end-thinning plunges, overshots, and perverse breaks are failure types represented. Platform preparation techniques evident on some biface margins and on some flake platforms within the debitage assemblage include grinding and isolation. Many of these were classed as various forms of knives, a rationale based on high width:thickness ratios (or low thickness:width ratios), pressure retouched edges, low edge angles, regularized margins, and an absence of impact fractures.

As noted above, high numbers and proportionally high amounts of FGS flakes within the Simple/Simple and Flake Simple categories point to early-stage and core reduction activities for this material. Additionally, FGS flakes with cortex accounted for 26% of the technological sample, and 24% of the aforementioned categories. Middle and later stages of biface shaping are also indicated by proportions of FGS flakes within the Simple/Complex and Complex/Complex categories (48%) as well as a number of biface forms with varying amounts of retouch marked by bending breaks, overshots, and end-thinning plunging flakes. As anticipated, the proportion of Complex/Complex flakes retaining cortex is low relative to other categories, representing only 19% of this category, but still high compared to other material classes.

Trajectories for FGS include several emphasizing biface shaping. These included projectile point manufacture, repair and possibly, replacement, and biface knife production. Additionally, it is likely given the assemblage and patterns recognized elsewhere, that many bifaces were scheduled for non-articulated reduction trajectories, e.g., those characterized by limited stage reductions at the manufacture locale and subsequent modification elsewhere as

requirements dictated. Projectile points evince aspects of trajectories ranging from manufacture to repair episodes and terminate in discard of broken forms. Some also show apparent evidence of re-use as another tool form where fracture planes have been retouched. Most bifaces appear to be too thin to function as cores for a sustained period of time, but some items of sufficient size might have been transported off site.

Biface forms were frequently initiated from flake blanks of varying size. Smaller blanks were used to produce smaller lanceolate bifaces, knives, and some flake tools. Medium flake blanks were evident in trajectories leading to shouldered stemmed points, lanceolate bifaces, and various flake tools. Larger blanks, presumably generated at the toolstone source area, were made into large lanceolate points, knives, and general biface forms. Trajectories for these larger items particularly, were dependent on the initial thickness of the blank. Items scheduled for use as knives and stemmed point preforms were especially sensitive to size constraints.

Although no diagnostic blade cores were identified, a number of uniface core forms were classed as plano-convex (n=41) and plano-triangular (n=30). Together these represent 58% of the unifacial cores. It might be the case these items represent subsequently modified unifacial rotational cores previously shaped to facilitate detachment of blade forms.

Uniface forms include a diversity of morphological types, some suggesting patterns of use and rejuvenation. Reduction and use trajectories indicative of tool curation are evident in steeply retouched scrapers. Many of these forms are consistent with use trajectories reflecting repetitive cycles of use and resharpening of the working edge often resulting in archaeologically classified “backed” forms (Dibble 1995).

Regional Positioning of Component 8 Bifaces

Items subsumed into this assemblage exhibit characteristics reminiscent of certain Paleoindian technologies. Specifically, larger FGS bifaces from Component 8 are frequently marked by broad, regularly spaced, expanding thinning scars; overshots and plunging flakes from end-thinning are common; and edge-trimming and platform preparation are evident. The apparent objective to flatten the cross-sectional profile of the form while retaining maximum width is a trait recognized in large bifaces from some Paleoindian collections but rarely in later assemblages (Gramly 1993; Wilke, et al. 1991; Woods and Titmus 1985).

Likewise, large stemmed points, often characterized by basal thinning and moderate abrasion along hafting element margins, are regularly attributed to Paleo-Archaic interface assemblages throughout the Western U.S. (Willig and Aikens 1988). Morphologically similar forms have been termed Western Stemmed Series (Willig and Aikens 1988) and Borax Lake Widestem (Fredrickson 1973). Among these groups, the Western Stemmed Series often contains items with edge-ground hafting elements.

The few long-stemmed forms recovered from Skyrocket resemble other tapering and parallel-sided stem types classified as Lake Mojave (Campbell et al. 1937), Lind Coulee (Daugherty 1956), Haskett (Butler 1965, 1967), Cougar Mountain (Layton 1979), and Parman (Layton 1970). Willig and Aikens place the Western Stemmed tradition within 10,500 - 7,500 years b.p. (1988:19). Among these sites, Lind Coulee has yielded dates of 8,600±65, 8,700±400 and 8,720±200 years and Cougar Mountain yielded dates of 8,510±250 and 8,650±250 (cited in

Willig and Aikens 1988; Butler 1965). At the Sunshine Locality in the eastern half of Nevada, long-stemmed points are also assigned an age of 10,500 - 8,500 years b.p. (Price and Johnston 1988). For the Tonopah, Nevada area, Tuohy (1988:222) places the stemmed series within the provisional Transitional Period at 9,500 - 8,500 b.p. intermediate between the fluted and concave series of the Paleoindian Period (12,000 - 11,000 b.p.) and the Silver Lake, Pinto, Elko, and Northern Side-notched of the Archaic Period (after 8,000 b.p.). Likewise, Price and Johnston (1988) recognize three temporal phases during the Late Paleoindian/Early Archaic Transition marked by different projectile point associations.

At some sites and localities in the western U.S., large and long-stemmed points co-occur with fluted points, while at other places, they co-occur with small dart forms in the absence of fluted types (e.g., Price and Johnston 1988; Zancanella 1988; Beck and Jones 1988; Hutchinson 1988; Carlson 1988; Warren and Crabtree 1986). Many sites have been identified that contain only fluted points (Fagan 1988; Gramly 1993; Stanford and Jodry 1988; Wilke et al. 1991; Woods and Titmus 1985), while at some locations, the large stemmed series might occur without either of the other forms. Given these circumstances, it is probably best to assume the large stemmed series represents a separate temporal phase intermediate between the other assemblages. Co-occurrence of these forms with fluted or dart points, therefore, could be considered a matter of coincidence related more to environmental context and resulting settlement patterning.

Inasmuch as tool form diversity and trajectories representative of virtually the full range of stone reduction can be used to evaluate aspects of population mobility and settlement patterning, the flaked stone assemblage argues for sustained use of this locality during the Paleo-Archaic Transition. Whether this sustained use was the result of year-round occupation or frequent seasonally proscribed re-visitation, can not be determined from the flaked stone data alone.

CONCLUSIONS

It is clear from the Component 8 data that a full range of activities pertaining to flaked stone acquisition and use occurred. Tools were produced, used at the locality as well as presumably elsewhere, maintained, and replaced. While seasonality of site use can not be determined directly from flaked stone items, tool functions can be ascribed to hunting, butchering, and processing of hard and soft materials. A range of flake tools and drill forms could attest to both vegetal and faunal processing. A high degree of production of flakes from cores could also be assumed to represent the need for frequent replacement of expedient cutting and scraping tools.

Flaked stone evidence from the earliest time period of site use suggests either frequent seasonal visits to the locality for material replacement while subsistence activities also occurred or potentially year-round sustained use of the locality for a comparatively short duration. Given the low proportion of non-local materials ascribed to the formal tool classes of this assemblage, the latter interpretation is favored. This conclusion can be qualified, however, by presuming the

inhabitants of the region at this time depth pursued subsistence activities within a geographically proscribed region where FGS was readily accessible and therefore had little need of supplementing their toolkits with non-local materials.

Three Lake Mojave Series projectile points recovered from the deep clay strata were made from diverse toolstone materials. While these forms are typically ascribed to WPLT assemblages throughout the Desert West, they exhibit some technological and morphological similarity to some of the large stemmed and lanceolate forms made on FGS in this assemblage. Given their material types, however, it is tempting to assign them to the Stanislaus Phase assemblage; the technological characteristics of manufacture and maintenance could be attributed to either group.

Technological organization of the following small dart assemblage population was characterized by attributes indicating a greater degree of mobility. This conclusion is derived from the greater degree of tool maintenance, low numbers of primary forms, morphological diversity, and material variability evident in the flaked stone assemblage. Assuming the majority of non-local materials can be ascribed to this population, settlement relocation in the pursuit of subsistence apparently either brought the group into contact with peoples from the east side of the Sierra Nevada range or marked a high level of transhumance across the crest. Material diversity within the flake tool categories could be assumed to indicate this population also pursued a subsistence strategy entailing a broad variety of regionally dispersed processing activities as well.

Much of Component 7-5 is represented by materials from upper and lower strata of the other components; certain proveniences might be defined by temporally delimited assemblages but data from these were not available for this study. The use of exotic materials increases in this component; CHR and OBS now represent 11% of the debitage sample and 28% of the tools. A significant increase in worked flakes and core/core tools and a decline in the size of these and other tools is coupled with increased flake-to-tool ratios and decreased flake size.

Technological organization of site inhabitants during the last 4,000 years as represented by Component 4-1 is more difficult to define given the amount of mixing of occupational deposits. Again, potential single component areas of this deposit might be identified in the future but more specific data was unavailable for this report. While this time period represents at least four archaeologically defined cultural components, certain generalizations regarding the flaked stone assemblages must be applied.

Overall, debitage materials other than GRS (55%) each account for 7-12% of the recovered sample. This differs from Component 8 where FGS (58%) and GRS (33%) accounted for all but 9% of the sample; individual materials other than these ranged from 1% (CHR) to 4% (QUZ) in that component. Thus, the relative importance of these other materials increases with time. This is reflected in the general decrease in local materials: BAS, GRS, FGS debitage combined dropped to 79% and for tools the proportion declined to 65%.

In fact, this can be seen more dramatically in the proportions of tool types. Obsidian was used for bifaces in this component in 37% of that group. It comprised 33% of Component 7-5's group but only nine percent in Component 8. Obsidian EMFs comprised only 2% of that category in Component 8 but 8% in this component.

CHR comprised 6% of the bifaces and 15% of the unifaces in Component 8 but 17% of

the bifaces and only 7% of the unifaces in this component. This reflects both a shift in the use of CHR for bifaces but also a change in the importance of uniface forms, the latter representing a significant attribute of the earliest assemblage. Use of CHR for EMFs drops from 8% in Component 8 to 1% in this component. The number of cores/core tools of CHR increases from three in Component 8 to seven in Component 4-1.

The mean weight for all debitage materials is less in Component 4-1 than it is in Component 8. This also correlates with tool size which evinces a decrease in this component and general increases in flake-to-tool ratios for most materials which is greater than Component 8 but somewhat lower than the previous component.

Among the few well-defined Sierra Phase assemblages in the region which might be useful for comparison is TUO-2192, the Sturgis Site. Situated several miles east of Sonora, this site appeared to be dominated by a Middle Period deposit focused at the North Locus (Vaugh and Rondeau 1990). Middle Period diagnostic materials included a few corner-notched forms, a bipoint, a concave base form, a triangular form, nine handstones, two complete millingslabs, a sandstone pipe, and a steatite bead. A pestle, two complete unifaces and one fragment, and a dozen bifaces and fragments were also recovered. Most OBS bifaces were fragments. A milling station indicating a possible Late Period occupation was identified at the South Locus, however, recovery rates there were very low and lacked temporally diagnostic materials. Excluding a few outliers, obsidian hydration for 42 specimens from the North Locus—mostly BH—exhibited a range of 3.7μ - 5.5μ (mean = 4.5μ). This data was marked by a limited bimodal distribution characterized by means of 4.3μ and 4.8μ .

Flaked stone debitage at this site was marked by a recovery rate of 300 items per cubic meter, most of it from the North Locus (93%). Although this figure was closest in value to that defined for Component 4-1 at Skyrocket, OBS rates were higher ($265/m^3$) and CCR was much lower ($22/m^3$); the latter at this site, however, comprises local cherts and thus might include a variety of FGS and CHR. Flake-to-tool ratios were 289:1 for OBS, 30:1 for CCR, and 29:1 for other. With the exception of OBS, these figures were much lower than those characterizing Component 4-1. The high ratio exhibited by OBS could be interpreted as the product of a high degree of tool curation.

Situated a few miles east of Sonora, TUO-2642, the Kelley Site contained a pronounced Horseshoe Bend Phase assemblage and a sparsely represented Sierra Phase component (Rondeau 1992). Use during the Redbud Phase and earlier times was minimally indicated. The flaked stone assemblage was defined by 37 DSNs, 34 large points and fragments, 5 drills, 13 cores, 26 formed flake tools, and 75 EMFs (Rondeau 1992). Nearly 38% of the DSNs and 69% of EMFs were made of OBS; this material comprised 29% of debitage.

Debitage recovery rates on 8.83 cubic meters excavated were $621/m^3$: OBS was $182/m^3$; CCR was $355/m^3$; and miscellaneous igneous materials were $7/m^3$. Using only formal tools, flake-to-tool ratios for OBS was 20:1; if EMFs are included this value is 12:1. The higher of these ratios is lower than the value defining the assemblage from Component 4-1 at Skyrocket. For CCR the figure is 62:1, higher than the figure for either FGS or CHR from Component 4-1.

Seventy-seven percent of the OBS submitted for source analysis was BH; the remaining 23% was comprised of Napa Valley (n=4), Casa Diablo (n=4), Queen/Truman (n=3), "Queen Impostor"/Mt. Hicks (n=4), Mono Glass Mtn. (n=1), and non-OBS (n=1). As much as 84% of

the entire hydration sample could be BH (Rondeau 1992:50).

CAL-991, Ft. Mountain Rockshelter, was situated about 18 miles north of New Melones Reservoir. Although hydration results and some artifact forms suggest the site contained materials dated to the last 3000 years, most of the deposit was dominated by occupational residues attributed to Phase II Late Period assemblages (White 1988). A total of 6.3m³ of earth were excavated during the data recovery phase. Based on this figure, debitage recovery rates were determined as 79/m³ for OBS, 1214/m³ for CCR, or about 1301/m³ total. All the OBS flakes were less than half inch in size, 69% were trapped in 3-mm screen; 97% of the CCR was under half inch size (White 1988:47-48). The high recovery rate figure for CCR might be partly accounted for by inclusion of a variety of cherts in the sample, however, another explanation presented below could also be considered the primary factor.

Flake-to-tool ratios for this site can not take into account component divisions, but most flaked stone materials used in the calculations can be attributed to the Horseshoe Bend Phase. The OBS flake-to-tool ratio (9:1) was in a range compatible with figures for Component 8 at Skyrocket indicating very little debris production relative to tool use. CCR was calculated at 47:1, also relatively low but compatible with the value representing CHR in Component 4-1 at Skyrocket. The exceedingly low value for OBS is best explained as significant differences in site function between this site and Skyrocket and consequent technological organization. Ft. Mountain Rockshelter was characterized by minimal square footage used by about 8-10 people (White 1988). Occupation represented "the colonization of a poor habitat as a consequence of population pressures elsewhere in the region. Small group size, residential mobility, and localized opportunistic subsistence strategy based on marginal foods are taken to be the colonizing population's typical response to the degree of uncertainty and abbreviated carrying capacity of a poor habitat and were contributing factors to occupation of a small, but habitable regress" (White 1988:i). Tool maintenance was spatially concentrated creating a high recovery rate and a similar high discard/loss rate for functionally maintainable items.

Additional Comparison

The variability of uses exhibited by locally obtained materials versus exotic ones characterizes significant differences within and between components. Specifically, local materials (BAS, FGS, GRS) retaining cortex comprised 29% of the debitage sample for these materials in Component 8. The mean weight of these combined items was 13.72g indicating the predominance of large flakes. In contrast, cortical exotic materials (CHR, OBS) comprised only 4% of that sample and were represented by smaller flakes (2.09g) including many pressure flakes but a number of larger flakes compatible with biface thinning and some primary reduction.

Component 7-5 was marked by a lower proportion of cortical material in the local debitage sample (20%) but a higher proportion in the exotic sample (12%); although the latter might indicate an emerging trend, it is probably best explained by the low number of specimens in that sample (n=52). Mean weights indicate a slight increase in size of local cortical materials (16.84g) over Component 8, and a decrease in size of exotic material (0.47g).

Although the proportion of cortical local material remains high in Component 4-1 (21%) the mean weight values indicate a significant reduction in flake size (2.98g) much closer to that

represented by OBS in Component 8. Sixteen percent of the exotic materials retained cortex; these yielded a mean weight value of 1.00g. Again, the sample size of the exotic materials (n=31) could be skewing the results.

Thus, cortical local material decreases slightly in proportion relative to the data set but significantly in size. Exotic materials with cortex also exhibit declines in proportion and a decrease in size, but the contrasts are not as extreme. It is concluded the use of local materials is marked by significant differences in technological strategy over time but the role of exotic materials undergoes less demonstrable change, at least as viewed from this perspective with the data at hand. The latter frequently arrive at the site in highly reduced forms retaining little cortex and continue to be treated as conserved resources throughout time.

The greatest overall differences in the use of flaked stone materials through time can be attributed to the emphasis on tool manufacture from local FGS in Component 8. The high proportion of bifaces and unifaces, coupled with the intensive production of these and other tools and the contribution of greater amounts of debitage, much of it of a larger size, has generated greater distinctions between the assemblages. As stated in another portion of the report, changing environmental conditions might have reduced or eliminated access to this material sometime after 7000-8000 years ago. This might in part be a factor in the increasing importance of GRS throughout time, a material characterized by poorer isotropic structure but perhaps greater availability.

Summation

Changing proportions of tool forms and toolstone materials throughout time at the Skyrocket site denotes significant changes in technological organization of the inhabitants. These changes can be linked to adaptations within the paleo-toolkits, changes in site and assemblage functions, and related changes in subsistence strategies. One aspect of these changes, the decrease in the relative importance of FGS, can probably be readily attributed to changes in the local environment brought on by pronounced shifts in regional climatic patterns. Had this local material been available in greater quantities to later inhabitants, it can be assumed it would have played a more important role in the manufacturing activities at the site, probably to the detriment of GRS. Certain functional differences between the uses of these materials briefly touched on above might have emerged in greater detail.

Changes in biface thinning objectives through time might be linked to the abundance of FGS during the period represented by the earliest Component 8 assemblage but is more directly attributable to a significant shift in toolkit functions. Technological and morphological changes in bifaces between the earliest assemblage and later periods is a pattern recognized throughout the western U.S. These differences are attributed to changes in weaponry technology, undoubtedly in part a response to subsistence readaptations.

Additionally, standardized bifacial and unifacial core forms in the early period (56%) give way to smaller non-standardized forms later in time. These shifts presumably reflect changing strategies in technological organization as well. Earlier standardized forms allowed for greater predictability in flake detachment and establish forms suited to intended reduction trajectories for defining essential toolkit elements, e.g., biface knives and large unifacial scrapers.

Later core forms are presumed to reflect an increase in the use of smaller more expedient tools as well as production of smaller formal tools corresponding with increased population sedentism. The latter, of course, corresponded with a new technological development, the bow and arrow. For the past 1500 years, production of projectile points for hunting and weaponry required much smaller pieces of raw material and resulted in much smaller pieces of manufacture debris. Accordingly, the masses of raw material required for the tools used in the pursuit of daily sustenance diminished significantly.

Although the information potential of this site has not been fully realized, it is expected continuing regional investigations in the Sierra Nevada foothills will eventually recognize single component deposits providing the conditions necessary for better defining the flaked stone assemblages of mid-Holocene and later occupations. It is only through the study of these temporally delimited assemblages that any major advances in understanding the technological organization of individual cultural units will be achieved. Although the present study has been hindered by an inadequate degree of temporal resolution, the general patterns of change demonstrated will hopefully contribute to research objectives of others working in the region.

REFERENCES CITED

Beck, Charlotte and George T. Jones

1988 Western Pluvial Lakes Tradition Occupation in Butte Valley, Eastern Nevada. In, Early Human Occupation in Far Western North America: The Clovis-Archaic Interface. Willig, J.A., C.M. Aikens, and J.L. Fagan, eds. Nevada State Museum, Anthropological Papers, No. 21. Carson City.

Butler, B. Robert

1965 Contributions to the Archaeology of Southeastern Idaho. *Tebiwa* 8:41. Pocatello.

1967 More Haskett Point Finds from the Type Locality. *Tebiwa* 10:41. Pocatello.

Campbell, E. W. C., W. H. Campbell, E. Antevs, C. A. Amsden, J. A. Barbieri, and F. D. Bode

1937 The Archaeology of Pleistocene Lake Mojave: A Symposium. *Southwest Museum Papers* 11. Los Angeles.

Carlson, Roy L.

1988 The View from the North. In, Early Human Occupation in Far Western North America: The Clovis-Archaic Interface. Willig, J.A., C.M. Aikens, and J.L. Fagan, eds. Nevada State Museum, Anthropological Papers, No. 21. Carson City.

Daugherty, Richard D.

1956 The Archaeology of the Lind Coulee Site, Washington. *Proceedings of the American*

Philosophical Society 100(3):223-278.

Dibble, Harold

1995 Middle Paleolithic Scraper Reduction: Background, Clarification, and Review of the Evidence to Date. *Journal of Archaeological Method and Theory* 2(4):299-368.

Ericson, J.E. and B.A. Purdy

1984 *Prehistoric Quarries and Lithic Procurement*. Cambridge University Press, Cambridge.

Fagan, John L.

1988 Clovis and Western Pluvial Lakes Tradition Lithic Technologies at the Dietz Site in South-central Oregon. In, Early Human Occupation in Far Western North America: The Clovis-Archaic Interface. Willig, J.A., C.M. Aikens, and J.L. Fagan, eds. Nevada State Museum, Anthropological Papers, No. 21. Carson City.

Fredrickson, David A.

1973 *Early Cultures of the North Coast Ranges, California*. Unpublished Doctoral dissertation. U.C. Davis: Department of Anthropology, University of California.

Gramly, Richard M.

1993 *The Richey Clovis Cache: Earliest Americans Along the Columbia River*. Persimmon Press Monographs in Archaeology.

Hutchinson, Phillip W.

1988 The Prehistoric Dwellers at Lake Hubbs. In, Early Human Occupation in Far Western North America: The Clovis-Archaic Interface. Willig, J.A., C.M. Aikens, and J.L. Fagan, eds. Nevada State Museum, Anthropological Papers, No. 21. Carson City.

Kelly, Robert L.

1988 The Three Sides of a Biface. *American Antiquity*, 53(4):717-734.

Layton, Thomas N.

1970 *High Rock Archaeology. An Interpretation of the Prehistory of the Northwestern Great Basin*. Unpublished Ph.D. Dissertation, Department of Anthropology, Harvard University, Cambridge, Mass.

1979 *Archaeology and Paleo-Ecology of Pluvial Lake Parman, Northwestern Great Basin*. *Journal of New World Archaeology* 3(3):41-56.

Moratto, Michael J.

in press *Culture History of the New Melones Reservoir Area, Calaveras and Tuolumne Counties, California*. Ms. for proposed Fenenga Memorial Volume.

Nelson, Margaret C.

- 1991 *The Study of Technological Organization*. *Archaeological Method and Theory*, Vol. 3. M.B. Schiffer, editor. University of Arizona Press, Tucson.

Parry, William J. and Robert L. Kelly

- 1987 *Expedient Core Technology and Sedentism*. In, *The Organization of Core Technology*. J.K. Johnson and C.A. Morrow, eds. Westview Press, Inc., Boulder, Colorado.

Price, Barry A. and Sarah E. Johnston

- 1988 *A Model of Late Pleistocene and Early Holocene Adaptation in Eastern Nevada*. In, *Early Human Occupation in Far Western North America: The Clovis-Archaic Interface*. Willig, J.A., C.M. Aikens, and J.L. Fagan, eds. Nevada State Museum, Anthropological Papers, No. 21. Carson City.

Rondeau, Michael F.

- 1992 *The Archaeology of the Kelley Site: A Phase II Report for the Archaeological Excavation of CA-TUO-2642, for the East Sonora Bypass Project, Tuolumne County, California*. California Department of Transportation, Sacramento.

Rondeau, Michael F. and Vicki L. Rondeau

- 1990 *Preliminary Findings: Report on the Analysis of Flaked Stone from the West Locus of CA-CAL-629/630, Calaveras County, California*.

- 1991 *Preliminary Findings: Report on the Analysis of Flaked Stone from the Northeast Locus of CA-CAL-629/630, Calaveras County, California*.

Singleton, William L.

- 1986 *Flaked Stone Tools*. In, *Archaeological Investigations, 1968-1980, at 65 Indian Activity Sites near the Stanislaus River, Calaveras and Tuolumne Counties, California*. Michael J. Moratto and William L. Singleton, eds. INFOTEC Development, Inc., Sonora, CA.

Stanford, Dennis J. and Michael A. Jodry

- 1988 *The Drake Clovis Cache*. *Current Research in the Pleistocene* 5:21-22.

Tuohy, Donald R.

- 1988 *Paleoindian and Early Archaic Cultural Complexes from Three Nevada Localities*. In, *Early Human Occupation in Far Western North America: The Clovis-Archaic Interface*. Willig, J.A., C.M. Aikens, and J.L. Fagan, eds. Nevada State Museum, Anthropological Papers, No. 21. Carson City.

Warren, Claude and Robert H. Crabtree

- 1986 *Prehistory of the Southwestern Area*. In, *Handbook of North American Indians. Vol 11*. Warren L. d'Azevedo, editor. Smithsonian Institution, Washington, D.C.

Waugh, Georgie and Michael F. Rondeau

1990 Phase II Test Evaluation Report for Archaeological Sites CA-TUO-2192, CA-TUO-2194, CA-TUO-2349 on State Route 108, for the East Sonora Bypass Project, Tuolumne County, California. California Department of Transportation, Sacramento.

White, Greg

1988 Archaeological Investigations at Fort Mountain Rockshelter (CA-CAL-991), A Late Prehistoric Habitation Site in Central Calaveras County, California. Submitted to USDI Bureau of Land Management, Sacramento, California.

Wilke, Philip J., J. Jeffrey Flenniken, and Terry L. Ozbun

1991 Clovis Technology at the Anzick Site, Montana. *Journal of California and Great Basin Anthropology* 13(2):242-272.

Willig, Judith A., C.Melvin Aikens

1988 The Clovis-Archaic Interface in Far Western North America. In, Early Human Occupation in Far Western North America: The Clovis-Archaic Interface. Willig, J.A., C.M. Aikens, and J.L. Fagan, eds. Nevada State Museum, Anthropological Papers, No. 21. Carson City.

Woods, John C. and Gene L. Titmus

1985 A Review of the Simon Clovis Collection. *Idaho Archaeologist* 8(1):3-8.

Zancanella, John K.

1988 Early Lowland Prehistory in Southcentral Nevada. In, Early Human Occupation in Far Western North America: The Clovis-Archaic Interface. Willig, J.A., C.M. Aikens, and J.L. Fagan, eds. Nevada State Museum, Anthropological Papers, No. 21. Carson City.

CA-CAL-629/630
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FLAKED STONE ANALYSIS

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