Dynamic Land Use Patterns in the Prehistoric Absaroka Mountains, Wyoming

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ABSTRACT: Understanding dynamics of prehistoric landscapes is becoming increasingly important as our scientific community strives to make long term predictions about imminent global change affecting ecosystems and socio-systems. The Greybull River Sustainable Landscape Ecology (GRSLE) project investigates human ecological footprints in the Absaroka Mountains and Greater Yellowstone Ecosystem. Inferences about prehistoric hunter-gatherer behavior drawn from flaked-stone artifacts are crucial because the implements were used by prehistoric people to meet various subsistence needs, key components of their landscape impacts. This research uses obsidian source characterization to investigate the relationship of land use patterns between the Greybull River drainage and the surrounding region.

Source characterization of obsidian sampled from 25 archaeological sites of diverse temporal affiliations, use types, and ecosystems indicate dynamic spatial and temporal patterns. Obsidian is an exotic lithic material with the closest source at Obsidian Cliff in Yellowstone; however, samples were traced to distant outcrops as far as southwestern Utah. Obsidian distribution within the study drainage is indicative of prehistoric land use processes that were patchy and discontinuous. As a high quality and relatively rare lithic material, the incorporation of obsidian in a tool kit reflects broad social and ecological interactions distinct from extraction of local materials. The variability in the obsidian assemblage suggests that behavioral and environmental change was episodic, and coupled human-ecological prehistoric systems were multiple adaptive systems rather a single Pre-Columbian baseline.

PROJECT AREA

Archaeological surveys have been conducted through the Greybull River watershed for three years (Figure 1). The study area falls largely within the Greater Yellowstone Ecosystem and faces many similar management challenges. The GRSLE (Greybull River Sustainable Landscape Ecology) project is working within the Shoshone National Forest and Washakie Wilderness Area to identify the extent of archaeological resources. We emphasize the importance of adaptive responses for preservation and conservation of all natural resources, of which archaeology is only one component. The survey teams, primarily field school students and researchers from Colorado State University, document the surface record using non-destructive and non-collection techniques.

26,699 flaked stone artifacts have been observed and documented in the GRLSE project. Many of the sites were encountered during non-systematic surveying of the landscape. These encounters are often intensified by transects at 70cm spacing. The concentrated surveys and subsequent documentation record the archaeological landscapes.

Locally derived raw lithic materials include basalt, chalcedony, Irish Rock chert, Dollar Mountain chert and quartzite, silicified siltstone, and an unspecified volcanic rock. For this study, these materials are specified as Local Material. Silicified (often termed petrified) woods may be available in isolated pockets locally or may be non-local.

Obsidian is considered an exotic lithic material as it is not available locally. Further, quartzite and the fine-grained Morrison formation quartzites are exotic to the study area. The Bighorn Basin is the most likely source for most of the generic quartzites. The nearest known source of the Morrison formation is in the Bighorn Mountain range. The source for cherts undistinguishable as either Dollar Mountain or Irish Rock are not known. Some have been characterized as the distinct Madison formation cherts, but have been grouped with other cherts for the purpose of this study.

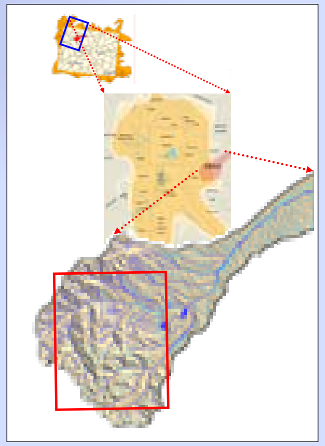

Figure 1. The GRSLE Study areas falls within the Greater Yellowstone Ecosystem.

Throughout northwestern Wyoming, sites contain artifacts of different flaked stone varieties, qualities and derivations. Several sources of high quality materials are known, from the Bighorn Mountains to the Hartville Uplift, to have a significant presence in the archaeological record. Among these material types is the presence of obsidian, formed as the result of volcanic lava flows. The flows cool so quickly that crystalline structures are prohibited from forming and the result is a glass material. The glassy nature of obsidian allows for relatively easy concoidal fracturing and tool production. Obsidian sources have been found throughout the northwestern portion of Wyoming including in Yellowstone National Park and Teton Mountains, and in Idaho such as Malad and Bear Gulch.

Figure 2. Overview of study area landscape. Looking south from the approximate middle of the study area.

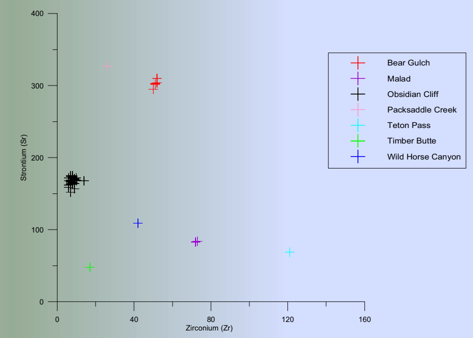

Figure 6. Bivariate plot of Sr and Zr relative proportions for artifacts. Note clustering of source groups.

Figure 7. Example of GRSLE obsidian artifacts.

Source Characterization using edXRF

Non-destructive energy dispersive x-ray fluorescence spectrometry (edxrf) was used to analyze 53 artifacts from the surface of various archaeological sites collected during the 2004 GRSLE field season, northern Wyoming. Analyses were performed at the Geochemical Research Laboratory on a QuanX-ECTM (Thermo Electron Corporation) edxrf spectrometer equipped with a silver x-ray tube, a 50 kV x-ray generator, digital pulse processor with automated energy calibration, and a Peltier cooled solid state detector. The instrument was operated to optimize excitation of the diagnostic elements rubidium (Rb Kα), strontium (Sr Kα), yttrium (Y Kα), zirconium (Zr Kα), and niobium (Nb Kα),

X-ray spectra were acquired and elemental intensities extracted for each peak region of interest, then matrix correction algorithms were applied to specific regions of the x-ray energy spectrum to compensate for inter-element absorption and enhancement effects. After these corrections are made, intensities are converted to concentration estimates by employing a least-squares calibration line established for each element from analysis of up to 30 international rock standards.

Trace element measurements are expressed in ppm by weight, and matches between samples and known obsidian chemical groups are made on the basis of correspondences (at the 2-sigma level) in diagnostic trace element concentration values. Artifact-to-obsidian source (geochemical type) correspondences were considered reliable if diagnostic mean measurements for artifacts fell within 2 standard deviations of mean values for source standards.

SAMPLING

Sampling obsidian for source characterization began in the 2004 field season. In order to complete the edxrf analysis, artifacts must be a minimum of 10mm in length and a minimum of 1.5mm thick. Formal and expedient tools (Figure 5) were preferentially sampled in order to assess chronology. Additionally, debitage of larger (intra-site comparison) sizes were selected at sites containing several obsidian artifacts.

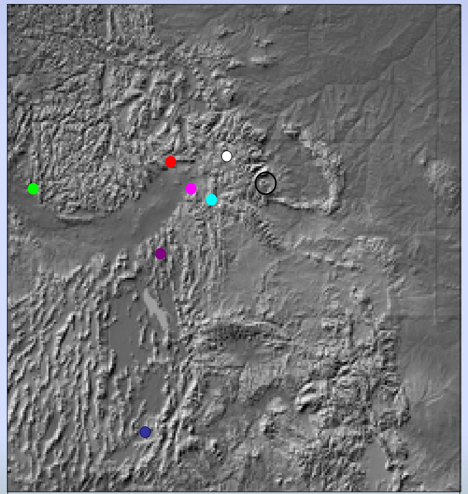

Figure 8. Satellite Image with obsidian source distribution. Study area indicated by black circle. Colors correspond to sources in figure 6. Western edge of map is western edge of Idaho state.

Defining the Greybull Pattern

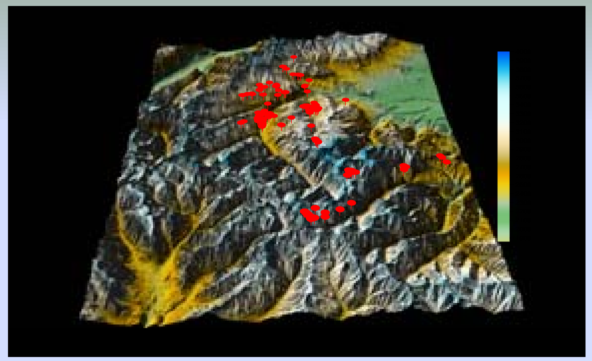

Figure 3. Map of project areas elevation and prehistoric sites. Oriented North-South.

47.6% of the 147 prehistoric sites contain obsidian artifacts (Figure 2). The average site is comprised of 10.0% flaked obsidian. Elevation does not appear to be a factor in the artifact size variability of the entire obsidian assemblage.

During 2004, we began to collect samples of obsidian for future geochemical sourcing. 70 samples were collected from 28 sites representing a wide range of site type and location. Artifacts will be returned to their collected provenience when complete.

Sites in the study area range in elevation from 3400m to 2200m, with the average site around 2800m. While this may represent some survey bias, the archaeological sites reflect broad adaptations to variable resource patches.

Assemblage Dynamics

Curated artifacts represent greater material use over time and should appear smaller in the record than those derived of locally available materials.

- -Average maximum length of all flaked stone artifacts is 14.7mm in length. Average obsidian artifact is 10.6 mm.
- -Obsidian exhibits the smallest range in length of all the material types in the study area.
- -Local materials and quartzites have the largest ranges of artifact length.
- -Evidence suggests that the distinct Obsidian outlier, at 86.2mm in maximum length, is the product of recorder error.
- -The variety in length distribution between obsidian and local materials suggests differing reduction or use strategies.

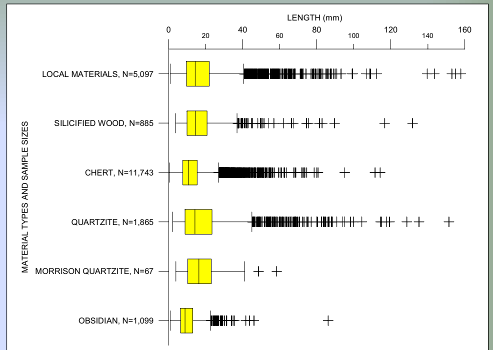

Figure 4. Box-and-whisker plot of artifact length by material type.

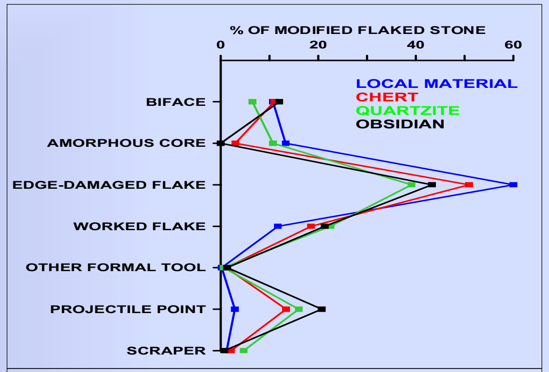

Figure 5. Tool type differences between materials.

-Local materials have the lowest percentage of projectile points, suggesting that local materials were used for more expedient purposes.

-21% of the non-debitage obsidian assemblage has been identified as projectile points.

-Only one amorphous Obsidian core was recorded in the study area. The complete core was 17.1mm at its maximum length and exhibited no cortex. This suggests a high degree of reduction before discard.

Regional Patterns - Scaling Up

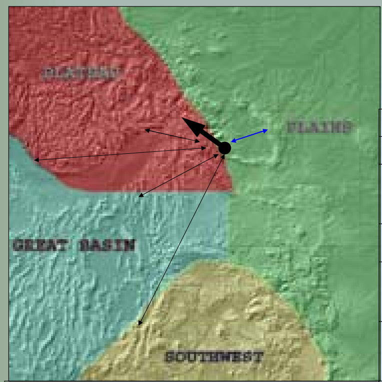

Figure 9. Black arrows indicate transport of obsidian artifacts. Blue arrow indicates movement of chert and quartzite materials.

The obsidian sample from the GRSLE project reflects prehistoric land use that intersects four culture areas. Culture areas (Kroeber 1939) are largely defined by adaptation to broad environmental zones.

TABLE 1. Culture Area Significance

CULTURE AREA GROUPS	SUBSISTENCE (KEY RESOURCES)	HOUSING AND TECHNOLOGY	SETTLEMENT PATTERN	POLITICAL ORGANIZATION
GREAT BASIN	Gathering, some hunting fishing (seeds, roots, nuts, rabbits, grasshoppers)	Wickiup (brush hut), nets (for hunting), digging sticks, seed beaters, basketry	Dispersed extended family units, winter villages	Fluid bands, temporary leaders
PLATEAU	Gathering, riverine fishing, hunting (roots, salmon, deer)	Pit houses, pole-and-mat lodges, basketry, weirs	Permanent villages, (seasonal dispersal) fishing camps	Egalitarian village council
SOUTHWEST	Horticulture (rainfall or irrigated), hunting gathering, herding (corn/beans/squash, deer, sheep)	Adobe apartments, hogans, thatched huts, pottery, grinding stones, basketry,	Permanent villages (Pueblo), semi-nomadic (Athapaskans), seasonal weaving villages (others)	Clan leaders, village chiefs, sodalities (highly variable)
PLAINS (western)	Bison hunting	Hide tipis, earth lodges, travois, hoe, horse complex, buffalo robes	Nomadic bands with seasonal tribal encampment	Politically unified tribe, tribal council, military and ceremonial sodalities

79% of the GRSLE obsidian sample comes from the Obsidian Cliff source in the current Yellowstone National Park. This source is the closest to the study area at a distance of 200km. Five artifacts were fashioned from Bear Gulch, Idaho, volcanic glass and two specimens match the Malad, Idaho, chemical signature. Single artifacts share the trace element profile of Wild Horse Canyon (Mineral Mountains), Utah, volcanic glass, Teton Pass, Wyoming, Packsaddle Creek, Idaho, and Timber Butte, Idaho. Preliminary investigations on the Greybull cultural chronology indicate the most intense use of obsidian occurred in the Late Archaic time period approximately 5,000 to 3,000 b.p. (Burnett 2005).

Mummy Cave, a stratified archaeological site 100km to the northwest, exhibits distinct temporal variability in obsidian curation with most of the assemblage dating to 8,500 b.p. coming from Bear Gulch and none from Obsidian Cliff (Hughes 2001).

The Helen Lookingbill site, approximately 100km to the southwest, has a predominance of Obsidian from Bear Gulch between 6,000 and 3,000 b.p (Kunselman 1994).

Other curated artifacts in the Greybull include steatite from Wind River Mountains to the southwest. Chert and Quartzites from Bighorn Basin and Mountains to the east and northeast.

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Modeling Prehistoric Land Use

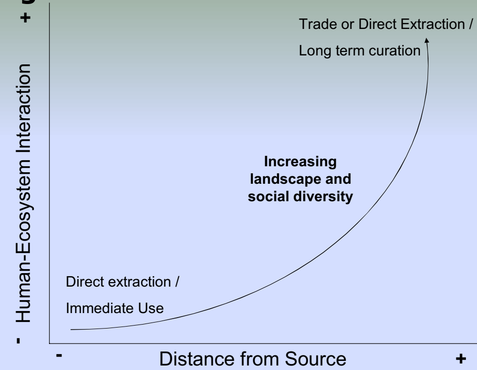

Figure 10. Conceptual model of change observed as distance from obsidian or lithic raw material source increases.

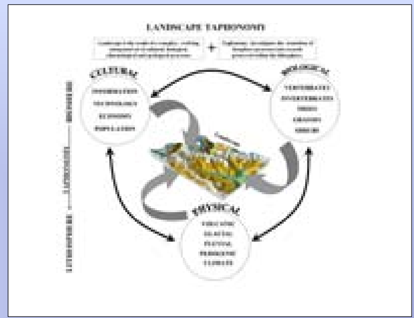

Figure 11. Landscape Taphonomy model of Biocomplexity in Archaeology Record (after Todd 2004)

Using the classic definition of taphonomy as investigation *of biosphere processes transitioning into records preserved within the lithosphere,* archaeology also is in an appropriate disciplinary space to provide methodological and analytical tools for bridging studies of contemporary landscape processes to long-term perspectives.

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