

Archeological Fieldwork At Yellowstone's Obsidian Cliff

By Leslie Davis, Stephen Aaberg, and Ann Johnson

Obsidian Cliff is only one of a number of potentially glassy rhyolite flows in and around Yellowstone NP, however prehistoric people selected that high quality obsidian source for tool making more often than any other Rocky Mountain source. Based on the chemical "fingerprinting" of archeological obsidian (primarily from sites outside the park), it is now known that early Native Americans were selecting and using Obsidian Cliff obsidian for making tools by at least 11,000 years ago. Intermittent use of obsidian quarried from Obsidian Cliff continued into the early historic period.

Obsidian Cliff is the name given one of four rhyolite lava flows north of the Yellowstone caldera. This topographic feature within the Rhyolite Plateau was formed 180,000 years ago by eruption through a vent 1 km to the east of where the highway between Norris and Mammoth passes Obsidian Cliff. That flow filled a pre-existing valley and rapidly chilled against the old valley wall. Obsidian Creek downcut through the old valley wall and exposed the obsidian cliff. The top of the flow is covered by a loose rubble mantle resulting mostly from frost weathering of local bedrock. The presence of Paleozoic quartzite, Quaternary basalt, and igneous erratics suggests deposition by glacial transport and ice decay.

The NPS contracted with Montana State University in 1988 for technical data needed to develop a National Historic Landmark nomination for Obsidian Cliff. An archeological study was initiated because little was known regarding the spatial extent of quarry features, prehistoric obsidian procurement practices, and the within-source trace-element composition and geochemical variability of Obsidian Cliff obsidian.

Work was designed to provide evidence essential for understanding prehistoric quarrying activity and to analyze obsidian samples in order to fingerprint geochemically the Obsidian Cliff flow. Before fieldwork could begin, however, the Obsidian Cliff flow area was burned by the Wolf Creek fire of 1988. The survey was postponed and conducted during the 1989 field season. The burnoff of heavy vegetation cover created an additional research opportunity: to assess fire effects on prehistoric cultural features, artifacts, and geological obsidian.

As with most of the 1988 fires in Yellowstone NP, the Wolf Creek fire burned with varying intensity, differentially affecting specific geological and cultural landscapes. This mosaic burn pattern was evident over much of the Obsidian Cliff flow, approximately two-thirds of which was intensely burned.

The 1989 archeological study recorded 59 prehistoric obsidian procurement loci (discrete small-scale activity areas) within the exploited Obsidian Cliff flow. The plateau is considered to be a single, extensive lithic procurement site (48YE433). Surface and subsurface obsidian procurement loci (quarry features) are the most prominent archeological manifestations on the plateau. The quarry features vary in form and scale, ranging from single oval pits to multiple overlapping/interlocking pits that occupy large surface areas (up to 250 m long). Additionally, winding linear trenches and shallow quarries occur in surface obsidian outcrops. The general absence of occupation debris indicates that the prehistoric people who acquired obsidian moved to adjacent areas at lower



Intensely burned landscape shown here reveals partially infilled, single oval pit – an obsidian quarry feature.

elevations near water and shelter to establish camps and work the obsidian.

Fire damage at Obsidian Cliff affected the physical environment and modified the archeological landscape (artifacts and context) at each of the 59 loci. Alteration was greatest at those loci that were burned intensely. The loci without vegetative cover were subject to erosion. Indeed, erosion already was evident (9 months post-fire) at some intensely burned areas where runoff had resulted in incipient gullying and mass wasting. Elk and deer had put deep tracks in the softened cultural surfaces at several sites, mixing cultural materials. While the adverse effects of such bioturbation (mixing) were minimal, they did impact cultural deposits deprived of protective duff and understory ground cover. Fortunately, potentially destructive on-the-ground fire suppression activity was not undertaken on the flow itself.

The major factor widely affecting both the physical and archeological environments was the windthrowing of burned trees. (These are not called deadfalls, since many are still living; they toppled because organics in the soil, which supported the roots and held trees upright, were eliminated by burning.) Windthrown trees often pulled up large quantities (up to several cubic meters) of sediment, rocks, and cultural materials trapped within the root masses. The disturbance and disruption of site stratigraphy and associated artifactual context were evident in many such instances.

Modification to surface obsidian artifacts at intensely burned loci was variable, but in certain cases, substantial. Archeological bone and organics on or close to the surface at intensely burned cultural loci would have been severely damaged or destroyed by fire, much as ungulate skeletal remains were burned. Exposed archeological and geological obsidian often was head-fractured or exfoliated. Oxidized surfaces on a great

number of obsidian artifacts at many burned loci were attributed to intense heating; oxidation appeared as a bright silver rind and a subtle dulling of rock surface.

Where obsidian was subjected to such heat, the internal structure commonly was modified. Such heating and oxidation of obsidian may prohibit, or complicate, the successful application of such technical studies as hydration dating and compositional analysis. The percentage of fire-fractured obsidian artifacts at most loci was low, but a large proportion of surface-exposed artifacts was oxidized.

Given the purposes of the 1989 archeological inventory and documentation project at Obsidian Cliff, the 1988 fire significantly enhanced both the long-range and short-range visibility of often subtle cultural features, loci, and artifacts. Pre-fire archeological reconnaissances of this heavily forested, dissected, high relief plateau had been severely hampered by accumulations of deadfall on steep slopes. Visibility through the forest itself was restricted to only a few meters by close-standing lodgepoles and a thick carpet of duff that masked the ground surface. The fire thus rendered visible a large number of archeological manifestations, exposing them to the possibility of vandalism.

In the last analysis, however, the 1988 fire and burn-off were opportune. The 1989 archeological reconnaissance, under post-fire conditions, provided basic primary data regarding quarry formation, lithic procurement strategies, and initial lithic reduction technology without the necessity of exposing artifacts, features, and activity areas by excavation.

The 1989 fieldwork yielded two major products: (1) the archeological inventory: (a) map of the Obsidian Cliff obsidian procurement site; (b) basic information regarding lithic extraction techniques employed by Native Americans; (c) a draft Obsidian Cliff National

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Historic Landmark nomination; and (2) an extensive compilation or sourcebook of Obsidian Cliff flow geochemistries and comparable data for archeological obsidian specimens from interior western North America sources.

Obsidian Cliff flow geochemistry was characterized from 80 specimens analyzed by non-destructive x-ray fluorescence for zinc (Zn), gallium (Ga), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), and niobium (Nb). The resulting elemental homogeneity of specimens within that sample, collected from within the 14.5 k2 flow, was both remarkable and informative. These quantitative data are in excellent agreement with previously published geochemical standards for Obsidian Cliff obsidian. The variability of most source-diagnostic trace elements is limited; bivariate scatter diagrams cluster paired trace elements tightly.

This sample is the best source-specific, geochemical profile available for Obsidian Cliff. These data and others obtained from montane and plains archeological sites in Montana, and from other even more distant sites that contain Obsidian Cliff obsidian, are summarized in a technical report available from the Rocky Mountain Region: *The Obsidian Cliff National Historic Landmark Lithic Source Area, Yellowstone NP: Geoarchaeological Baselines and Perspectives*, by Leslie B. Davis, Stephen A. Aaberg, and James G. Schmitt (1991).

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