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An analysis of the Greater Yellowstone Ecosystem archaeological assemblages of lithic raw materials

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Abstract Procurement of lithic raw materials has long been studied in the Greater Yellowstone Ecosystem, but it has lacked in its attention to non-volcanic sources. Sourcing tool stone has also long been problematic in the Intermountain West, where there is abundant lithic diversity with discontinuous source areas. This study illustrates the great diversity of strategies for procurement of tool stone by prehistoric foragers by analyzing the raw material types found within the archaeological sites of the Greater Yellowstone Ecosystem. Systematizing spatial distributions of assemblages by placing them on the geological landscape enables statistical cluster analyses to elucidate potential procurement areas and greater characterize the mobility of past peoples.

Introduction

An important aspect of prehistoric studies is the identification of the source of lithic raw materials (Andrefsky and Andrefsky Jr, 1998; Dowd and Vlcek, 2013; Kitchel, 2017; Luedtke, 1993; Miller, 2016, 1996). Addressed here is a problem plaguing many of these studies, namely, identifying quarry locations. Obsidian and some other volcanic stone types can be sourced using XRF (X-Ray fluorescence), but cherts, quartzites, and other materials are far more difficult. The method proposed here uses the relative frequencies of raw materials within archaeological collections across the Greater Yellowstone ecosystem (GYE), to identify possible quarry locations, and thus provide target regions for ground-truthing.

This work is based on the simple idea that by using natural lithic raw materials, prehistoric peoples effectively acted as field geologists, collecting and curating raw material on the landscape, providing us with the opportunity to use the fruits of their labors to help identify quarries. I have used qualitative macroscopic attributes of numerous samples from across Wyoming to allow for meaningful statistical analyses of the spatial distributions of lithic raw materials in archaeological and geologic contexts at large scales (Mahan, 2020). Using a single material type from the La Prele Mammoth site as a case study, I demonstrated the utility of using existing archaeological collections to source lithic artifacts of unknown provenience. This is an especially important endeavor for the Rocky Mountain West where there is abundant lithic diversity. I use this same methodology for the Yellowstone National Park repository to characterize and identify prehistoric tool stone quarries.

The techniques and methods explored in my previous study and now this one, are largely unknown or uncommon to the ways archaeologists typically go about investigating lithic sources (Andrefsky and Andrefsky Jr, 1998; Shackley, 2010, 2011). In that respect, this study is novel in its methodology as well as significant to future archaeologists. The systematic exploratory process of this method informs researchers where they might want to acquire natural raw material samples for comparison to archaeological samples, which can then lead to targeted instrumental geochemical analysis. Geochemical techniques are effective in sourcing volcanic stone (Eerkens et al., 2008; Glascock, 2011; Kitchel, 2017, 2018; McLaughlin et al., 2011; Shackley, 2011), but have been problematic when certain instruments or techniques are applied to nonvolcanic materials (Craig et al., 2007; Drake et al., 2009; Shackley, 2010). Although great strides have been made in rectifying sourcing in regions with wide chert diversity or non-homologous materials (Craig et al., 2007; Huckell et al., 2011; Kitchel, 2017, 2018; Pitblado et al., 2013), instrumental methods are still being developed and are largely untested in areas with unknown geologic diversity such as Wyoming.

In this study, I systematize the spatial distribution of lithic raw materials found within the Greater Yellowstone Ecosystem. I have in the past used curated assemblages from the University of Wyoming Archaeological Repository to predict tool stone source locations on the geologic landscape using Geographical Information Systems and spatial analyses.

I begin with the assumption that materials most common in a site's archaeological assemblage are derived from the geologic formations that contain knappable stone in the immediate area (Beck, 2008; Brantingham, 2003; Close, 1999). If true, by characterizing the lithic raw materials from a random sample of sites in a region (e.g., GYE), we can characterize the geologic lithic raw material landscape available to prehistoric foragers within that region. I have applied and tested this idea in Wyoming to characterize the spatial distribution of naturally occurring raw materials. Using these assumptions, we can use the frequency of raw materials across regions to identify local, and by proxy non-local, raw material sources. My primary working hypothesis is *the relative frequencies of raw materials within archaeological collections across a large space can be used to determine the provenience of lithic raw materials of uncertain source that occur in archaeological sites across the Greater Yellowstone Ecosystem.*

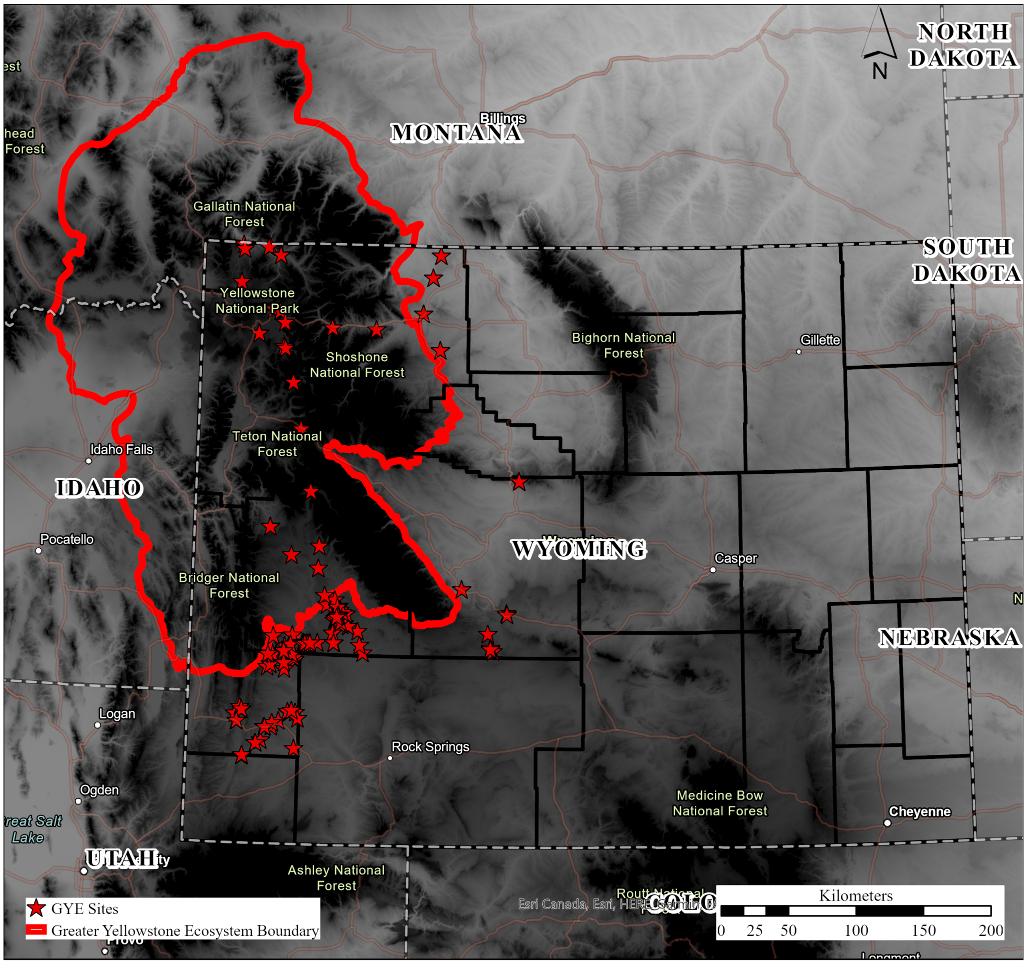
My reasoning goes like this. If a site is found to contain a nonlocal material of uncertain source, say a purple quartzite with green dots, to identify the most likely geologic source of that material, one could examine the database here to determine the areas of Wyoming where similar materials are most common in archaeological sites. Based on the locations of sites where purple quartzite with green dots are most common, we can identify the geologic formations that commonly occur in that area. Those geologic formations can be sampled, and the recovered materials compared to the archaeological specimens of interest using visual and chemical methods.

Here, I systematized the spatial distribution of lithic raw materials in the Greater Yellowstone ecosystem through a survey of archaeological collections from Yellowstone National Park. This study will help us fill in the gap in our knowledge of tool stone use in the Greater Yellowstone ecosystem, besides that of abundant obsidian use.

Methods

I added to my existing Wyoming lithic raw material database by sampling 28 archaeological sites contained within the GYE. These mostly included sites from Wyoming, but there were 11 from Montana. All of these sites though are presumed prehistoric. Most lithic artifacts do not have associated locational information and raw material types. Locational information, unless situated within certain sites by researchers, must be obtained from the Wyoming State Historic Preservation Office. As for raw material type descriptions, they do not exist.

The database was already built from a previous thesis, so I was able to add my sampled sites and artifacts from the Yellowstone Heritage and Research Center. Originally, I wanted to randomly sample the sites that I analyzed, but due to the lack of assemblages with more than 50 lithic artifacts, I chose to include all of them (n = 28) and incorporated them into sites within or near the GYE recorded from the University of Wyoming Archaeological Repository (UWAR; n = 96; Figure 1; UWAR, accessed 2020; Mahan, 2020). The database sample does not dis-



Greater Yellowstone Ecosystem Archaeological Sites

Figure 1. Overall sample of sites from or near the GYE within the database

criminate against how the site was deposited or discovered (e.g., buried or surface sites). These are not relevant, because I argue the same geological formations that were ideal for making stone tools when humans first started exploiting lithic resources in a region are still present. Time-period is also not necessarily important for this study, although placing assemblages into a chronology can provide further insight to the exploitation of tool stone through time. For each site, I gathered data including county and/or state, site name, archaeological time period, geological zone, and datum year.

From each site, I analyzed the first 50 lithic artifacts that I encountered (or as much as 100 if present), and I described each using standardized raw material parameters. These variables include raw material type (i.e. chert, quartzite, obsidian, etc.), dominant color, opacity, inclusion type (if any or not), artifact type, and count.

There were some geographic limitations to my analysis, listed below, as there have been for previous lithic studies (Pitblado et al., 2013; Roebroeks and Hennekens, 1990; Wilson, 2007). None of these invalidate the methods introduced here. That said, there is no doubt they play a role in any sample that is derived from the types of data that are gathered here (i.e., other state surveys).

This method of site selection limits the spatial extent of my database to Wyoming. Materials with primary outcrops that occur outside of the border of Wyoming will not be well represented in the database, although they may be present, particularly if they outcrop in close proximity to the state. In that case, one would still be able to identify minimally the general region or at least the cardinal direction from which they were derived. For example, if I find that a certain raw material most commonly occurs along the Western border of the state, an Idaho source could reasonably be inferred.

One of the early restrictions of this database, which this project attempts to reconcile, was the lack of GYE assemblages contained within UWAR. With the addition of 29 sites spanning much of the GYE, this should no longer be considered a limitation. My sample is predominantly comprised of artifacts collected during CRM (Cultural Resource Management) or compliance archaeology projects and regions where archaeological research has been conducted; it fails to account for regions of the state that have not been surveyed for material culture due to private land. Though Wyoming ranks fifth in the nation for states with the most acres of public land (33,964,230 acres or 55.9%), it also means that almost half of the state is not represented (TIGER Database and 2010 Census). The role this plays here is that much of the work is done within the National Park and in areas where compliance archaeology must be conducted (i.e., roadways).

For each site assemblage, I analyzed and recorded numerous characteristics of chipped stone artifacts, regardless of artifact type. The database includes primary, secondary, tertiary flakes, shatter, flake tool, retouched flake, biface, core, projectile point, drill, spokeshave, scraper, graver, and chopper. Although not directly imperative for the research questions asked here, artifact types collected can provide insight on the distances of sources to sites (Kelly and Todd, 1988; Surovell, 2009). For example, sites that contain a majority of primary or secondary flakes are indicative of a reduction event that a researcher could assume a prehistoric flintknapper received their tool stone from a closer distance rather than a further one (Kuhn, 1994; Surovell, 2009). It is possible to sort this type of data when using my database if a researcher desired to use these assumptions when sourcing tool stone.

Debitage is described in terms of its raw material type, dominant color(s), inclusions, and opacity. There was no size cut-off for flakes. Through the eye of Minimum Analytical Nodule Analysis, these small flakes or shatter would be viewed as a good thing, revealing the diversity of raw material (Larson and Komfeld, 1997).

Preliminary results

It is clear from this study that there is a great diversity of tool stone in GYE archaeological assemblages. A total of 850 artifacts were analyzed from the Yellowstone Heritage and Research Center in addition to the 1,958 artifacts from neighboring counties within or near the GYE. Raw materials from these samples of archaeological assemblages include obsidian, chert, quartzite, silicified wood, basalt, and dacite. A great majority of the assemblages contained volcanic rock, but a great amount appears to also be made from varieties of silicified wood, chert, and quartzite. Further statistical analyses and comparison will make these characterizations more clear.

Conclusions

The GYE is a diverse geological area with a storied past and present. Undoubtedly, Yellowstone National Park is known for its thermal features and volcanic activity. This has certainly influenced the GYE's reputation for having a large abundance of obsidian raw material and thus, a great amount of obsidian or volcanic chipped stone artifacts. With that said, the research here demonstrates that indigenous peoples were using non-volcanic tool stone as well, and to a great degree.

Future work

My analysis of the Greater Yellowstone Ecosystems' lithic raw material does not end here. This database will be used to compare other archaeological assemblages. Frequency trends of raw materials found in sites will provide an opportunity for ground truthing.

Cluster analyses can narrow down the expanse of space we can expect to find a lithic source and compare to the artifacts found within assemblages.

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