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Evidence of cultural responses to the impact of the Mazama ash fall from deeply stratified archaeological sites in southern Alberta, Canada

Gerald Anthony Oetelaar [a, *], Alwynne B. Beaudoin [b]

[a] University of Calgary, Calgary, Alberta, Canada
[b] Royal Alberta Museum, Edmonton, Alberta, Canada

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ABSTRACT

In a series of papers, we adopted a regional perspective to explore the short and long-term impacts of the Mount Mazama eruption on the plant and animal communities of the northwestern Plains and later developed a model to explain human responses to this natural disaster. The model assumed the convergence of natural disasters which forced the local bison hunters to abandon the impacted zone and to seek refuge among their distant relatives living beyond the eastern limits of their homeland. Together, the refugees and their hosts intensified their subsistence strategies and adapted or developed new methods of food preparation to accommodate the increased pressure on the local resource base. Throughout their stay, the groups continued to monitor the rebirth of their traditional homeland and eventually returned to the places occupied by their ancestors. Upon their return, the groups continued to hunt bison but adapted the stone boiling technology to produce bone grease and pemmican. This nutritious, storable and transportable food source alleviated the concerns about long-term shortages and became an important product in the regional exchange networks. The primary objective of this paper is to test this model using sedimentary, pedological and archaeological data recovered from two deeply stratified sites with evidence of human occupations before and after the eruption of Mount Mazama.

1. Introduction

In a series of papers, we have explored the short and long-term impacts of the Mount Mazama eruption on the plant, animal and human populations of the northwestern Plains (NWP), here defined as an area encompassing southern Alberta, southwestern Saskatchewan and Montana east of the Continental Divide (Oetelaar and Beaudoin, 2005; Beaudoin and Oetelaar, 2006; Oetelaar, 2014). Although located at some distance from the source in southwest Oregon, much of the study area was covered by a thick (ca 10 cm) layer of volcanic ash. Given the impact of this natural disaster on the plant and animal communities, the nomadic bison hunters occupying the area some 7627 years ago had little choice but to abandon the NWP and seek refuge among their relatives to the east. Together, these groups intensified their subsistence strategies and adapted or developed new methods of food preparation to accommodate the increased pressure on the local resource base. During their protracted stay, the bison hunters continued to monitor the regeneration of the environment in their traditional homeland through reconnaissance surveys. When the plant and animal communities had re-established themselves in the area, the people returned to their homeland and set up camp at the same place as their ancestors. However, these groups and their relatives adopted new survival strategies to better cope with such disasters in the future.

In our earlier discussions, we adopted a regional perspective and relied on analogues based on the results of research generated by the 1980 eruption of Mount St Helens (Oetelaar and Beaudoin, 2005; Beaudoin and Oetelaar, 2006; Oetelaar, 2014). This natural disaster was one of the first that allowed researchers to evaluate the impact of tephra accumulations on ecosystem functioning in temperate environments. Even though the research on the social impacts of the eruption was only marginally relevant to our understanding of the responses by mobile hunter-gatherers, these studies nonetheless provided detailed information on the impact of this natural disaster on the local and regional climate and on the plants and animals living in the impacted zone. We used the results of this research to model the potential impacts of the mid-Holocene explosive eruption of Mount Mazama on nomadic bison hunters and argued for the abandonment of the NWP (Oetelaar and

* Corresponding author.
E-mail addresses: gaoetela@ucalgary.ca, oetelaar@ucalgary.ca (G.A. Oetelaar).

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Beaudoin, 2005). In a later paper, we explored the human responses in more detail and outlined a change in subsistence strategies designed to cope with similar disasters in the future (Oetelaar, 2014). Our goal in this study is to test our model using data from two deeply stratified sites in southern Alberta with occupations below and above ash deposits approximately 1.5 m below surface.

We recognize that our sample size is small but the number of sites with cultural deposits dating to the interval immediately preceding and following this natural disaster is very limited. For decades, archaeologists have attributed the paucity of sites with occupations dating between 9000 and 5000 ^{14}C BP to the impact of the Hypsithermal, an episode of increased aridity on the NWP. The decreased precipitation and increased temperatures lowered water tables, increased salinity in ponds and lakes, expanded grasslands, decreased vegetation cover and increased fire frequency (Anderson et al., 1989; Vance et al., 1995). The sparse vegetation cover presumably influenced the nature and distribution of bison herds which supposedly sought refuge in the river valleys, localized uplands or the peripheries of the northwestern Plains (Reeves, 1973). The decrease in vegetation cover also accelerated the rate of erosion and sediment delivery to the drainage systems (Sauchyn, 1990; Oetelaar, 2004a) and activated a number of dune fields scattered across the Great Plains (Wolfe et al., 2002; Havholm and Running, 2005).

Although some archaeologists argued for the abandonment of the NWP, others have attributed the poor representation of early Archaic sites to sampling biases caused by the differential preservation and poor visibility of cultural deposits dating to this interval (Reeves, 1973; Artz, 1996). These discovery biases have been described and discussed in a number of geoarchaeological publications (e.g., Wilson, 1983; Mandel, 1992; Bettis, 1995; Waters and Kuehn, 1996; Albanese, 2000; Artz, 2000) and have been substantiated by the presence of appropriately aged cultural deposits in deeply stratified sites (e.g., Reeves and Dormaar, 1972; Wilson, 1974; Gryba, 1975; Doll, 1982; Van Dyke and Stewart, 1985; Zurburg, 1991; Walker, 1992; Oetelaar, 2004a, 2011; Cyr, 2006). Others attribute the lack of mid-Holocene sites to the misidentification and incorrect assignment of early Archaic projectile points as more recent side- or corner-notched types (Reeves, 1973), a conclusion substantiated by the sample of points recently recovered from securely dated assemblages preserved in deeply stratified sites (Walker, 1992; Kaastan, 2004; Nicholson and Playford, 2009; Oetelaar, 2011).

Regardless of these potential biases, many researchers still believe that the number of sites dating to the Hypsithermal interval is consistently lower than that of preceding or succeeding episodes (e.g., Greiser, 1985; Forbis, 1992; Walker, 1992; Albanese and Frison, 1995; Dyck and Morlan, 2001; Frison, 2001; Husted, 2002). Furthermore, they attribute the poor representation of sites to changes in adaptive strategies even though they cannot agree on the nature of those cultural adaptations. To some, the inhospitable environment during the Hypsithermal prompted the abandonment of the Plains generally (Mulloy, 1958, p. 208–209) or of the short grass plains only (Wedel, 1978; Husted, 2002, p. 199) whereas others have argued for a decreased reliance on grassland resources (Forbis, 1992; Albanese and Frison, 1995). Perhaps the most widely accepted human response is a change in subsistence and settlement strategies with a greater emphasis on refugia. Prompted by the scarce, unpredictable, and non-potable surface water as well as the dramatic reduction in discharges from rivers and springs, people and animals converged on these localized concentrations of resources near sources of permanent water (Hurt, 1966; Buchner, 1980; Sheehan, 1994, 2002; Bamforth, 1997, p. 36). Variously identified as oases or refugia, these concentrations of resources occurred along major river valleys, near perennial springs, near localized uplands and along the peripheries of the Plains proper (e.g., Buchner, 1980; Walker, 1992; Sheehan, 1994, 1995, 1996, 2002; Meltzer, 1999).

While accepting the hypothesized changes in subsistence and settlement strategies as responses to the prolonged effects of the Hypsithermal, we nonetheless identified a brief interval with limited, if any, evidence of human occupation coincident with the eruption of Mount Mazama (Oetelaar, 2014). On the basis of this evidence, we proposed a brief episode of abandonment as the only way to cope with the impact of the volcanic eruption during this episode of resource stress. Therefore, we expected to find such evidence of abandonment in the limited number of deeply stratified archaeological sites with pre- and post-eruption occupations. In recent years, archaeologists have, with a reasonable degree of success, implemented new procedures to discover deeply buried cultural deposits dating to this interval and, as a result, our sample of sites with early Archaic occupations is increasing. As expected, these sites typically occur on lakeshores (Doll, 1982), on river terraces (Wilson, 1974), along spring-fed creeks in the immediate vicinity of localized uplands (Gryba, 1975; Oetelaar, 2011), and in the foothills region along the western margin of the NWP (Van Dyke and Stewart, 1985; Oetelaar, 2004a). Unfortunately, not all of these sites have comparable cultural deposits immediately below and above the tephra layer nor have they been subjected to comparable levels of investigation. Therefore, even today the sample of deeply stratified sites with components pre- and post-dating the eruption remains very small. For these reasons, we have decided to test our model with data from two recently excavated sites; one site in the foothills region and another in the vicinity of a localized but prominent upland. We recognize the preliminary nature of this study and thus fully expect revisions to the model as the sample of sites with pre- and post-Mazama deposits increases in the future.

2. The model

Based on available evidence, the explosive eruption of Mount Mazama occurred in the autumn 7627 ± 150 cal BP (Zdanowicz et al., 1999) or 6730 ± 45 ^{14}C BP (7640–7620 cal BP) (Hallett et al., 1997), as human groups on the northwestern Plains were already coping with the cumulative effects of the Hypsithermal. The inferred impacts of this volcanic eruption on the local ecology and human populations have been described in Oetelaar and Beaudoin (2005) and Beaudoin and Oetelaar (2006), and are only briefly summarized in the ensuing paragraphs. Some thirteen to sixteen hours after hearing the initial blasts from the eruption, the people witnessed the approach of a massive black cloud accompanied by thunderous blasts and spectacular lightning displays, unexpected phenomena at this time of year on the NWP. Bracing for the impending storm, the people were even more startled as a dry snow settled on the landscape. Although initially alarmed by these sights and sounds, the occupants of the NWP became somewhat more apprehensive as the darkness and rather severe cold weather persisted during succeeding days. Relying on their accumulated winter stores, the people spent the next several months in their lodges, involved in ceremonies and rituals designed to provide explanations for these unnatural events (Ray, 1933, p. 108).

The true impact of the volcanic eruption did not become evident until the following spring and summer as unusual sunrises and sunsets greeted the people and unseasonable temperatures persisted throughout the year. To make matters worse, the air and water were filled with particulate matter as the ash continued to accumulate and as the wind continually mobilized and redistributed the unstable sediments on the surface. Having used up most of their winter food stores, the people started to worry about their welfare because very few plants managed to emerge through