Holocene Volcanism and its Effect on Human Occupation in the Susitna River Valley, Alaska

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Abstract

Archaeological and stratigraphic evidence from the Susitna River Valley, Alaska, has revealed a rich record of human occupation, as well as the presence of three distinct tephra deposits representing at least three distinct volcanic events: the Oshetna, Watana and Devil tephras. Archaeological excavations in the Susitna River Valley exhibit evidence of multiple instances of human occupation, occurring both before and after the significant volcanic events that the tephra units represent. Although stratigraphic evidence suggests that the three tephra units in the Susitna River Valley are distinct eruptive events that could have impacted ecosystems and subsistence resources, it is unclear how many eruptive events are represented and how human use of the area was affected by their deposition. Eruptive events likely affected ecosystems of subsistence resources and the lifeways of prehistoric occupants of the area and therefore consideration of the regional tephrochronology, in conjunction with the regional cultural chronology will provide a better understanding of how humans responded to ecological changes initiated by volcanism in the Susitna River Valley.

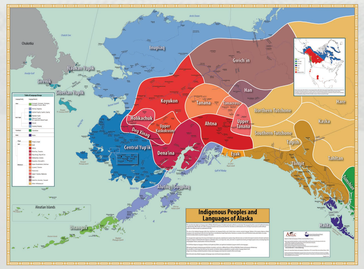
Previous work on archaeological sites in the Susitna River Valley suggests that humans occuped the area for the same reasons over many seasons over the past thousand years at least (Skeete 2008), and therefore a refined chronology of occupation in relation to volcanic events may reveal how ecosystem and subsistence resource disruptions affected human use of the area. Investigating changes in the soil stratigraphy and the characteristics and timing of the archaeological record can be valuable for understanding human response to changes in a marginal environment, such as the Susitna River Valley, after volcanic events. Interdisciplinary analyses incorporating the regional tephrochronology with the regional cultural chronology will offer a refined understanding of how volcanic events could have been affecting human lifeways in the Susitna River Valley. In addition, geochemical characterization of the tephras present will enable refined inter-site archaeological correlation within the Susitna River Valley and may contribute to volcanic hazard assessments.

Setting

The Susitna or "Sandy" River is lcoated in South-central Alaska, and flows 503 km from the Susitna Glacier, in the Alaska Range, to the Cook Inlet, near Anchoarge,

The Susitna River Valley

From State of Alaska

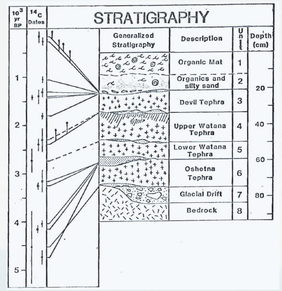


From Krauss et al. 2011

- Athabascan speaking groups, specifically the Western Ahtna and the Dena`ina, used the Susitna River Valley historically; little is known about the prehistoric occupation of the Susitna River Valley.
- Both groups were mobile hunter-gatherer groups that were place-oriented and relied upon seasonal changes in resource abundances to drive annual mobility patterns.
- The Susitna River Valley consists of upland and lowland areas that fostered a range of resources important to Western Ahtna and Dena`ina subsistence, including dietary contributions such as caribou and fish, but also economic needs, such as fur-bearing species.
- Reliance on these resources depended on seasonal movements and population densities, which could have been affected by ecological changes initiated by deposition of tephra, depending on the amount of tephra deposited, time of year, and environment of deposition.

Archaeological Work in the Susitna River Valley

- Archaeological work during the 1980s for the Susitna Hydroelectric Project aimed to locate and evaluate cultural material in the Susitna River Valley, and resulted in the identification of 258 archaeological sites (Dixon et al. 1985).
- Stratigraphy was documented throughout the project and 16 depositional units, consisting of lithologic units, contact units, and stratigraphic horizons, were identified. A chronological framework for the Middle Susitna River Valley was established using radiocarbon dates in association with stratigraphic units.
- Multiple tephra units were present at many of the sites excavated, which also exhibited evidence of multiple instances of human occupation. The tephra units were informally named, from oldest to youngest, the Oshetna, Watana, and Devil tephras.
- Analyses of the tephra present in the Susitna River Valley, focused on the mineralogy, petrography, and glass shard morphology of the tephra units to establish inter-site and intra-site correlations and variations (Dilley 1988; Dixon et al. 1985; Romick and Thorson 1983). The mineralogy of the three tephras present in the Susitna River Valley was found to be very similar, suggesting a similar source (Dixon et al. 1985)



Generalized stratigraphy of the Susitna River Valley, reproduced from Dixon et al. (1985) archaeological investigation reports .

The Oshetna Tephra

5130 ± 120 to 5900 ± 135 B.P.
Light grayish brown to gray, usually 3-5 cm thick and located directly on glacial drift. Two glass populations (Dilley 1988), possibly resulting from mixing of the overlying Lower Watana with the Oshetna.

The Watana Tephras

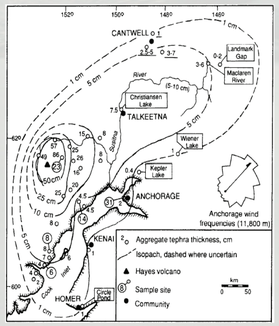
1880 ± 50 to 2690 ± 70 B.P.
Lower (unoxidized) Watana: light brownish yellow and 1-10 cm thick, separated from the Oshetna tephra by a thin lens of charcoal and organic material.
Upper (oxidized) Watana: dark reddish brown and highly weathered compared to the lower Watana, 5-10 m thick.
Differentiation between the Lower and Upper Watana difficult, likely respresents multiple closely spaced events.

The Devil Tephra

1435 ± 31 to 1514 ± 37 B.P.
Light gray to pinkish gray, 3-8cm thick, directly overlies the Upper Watana tephra, with an obvious contrast in color and texture, or separated from the Upper Watana by charcoal and eolian horizons.

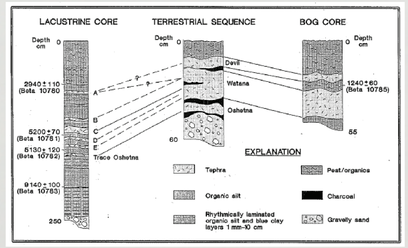
Radiocarbon dates and field descriptions from Romick and Thorson (1983)

Hayes Tephrochronology



Hayes tephra set isopach map reproduced from Riehle et al. (1990).

- Riehle et al. (1990) established the geochemistry of tephra deposits in the Cook Inlet region derived from the Hayes volcano, a vent in the Tordrillo Mountains. The "Hayes tephra set" was designated, consisting of deposits from seven or eight eruptions, constrained by 18 radiocarbon dates to between 3500 and 3800 years B.P.
- Biotite and a high ratio of amphibole to pyroxene phenocrysts are unique mineralogic characteristics of the Hayes tephras, which are calc-alkaline dacites (Riehle 1985).
- Dilley (1988) and Riehle (1990) suggest that the Watana and Devil tephras originated from the Hayes vent, and that the discrepency in radiocarbon dates originated due to contamination from Tertiary coal, making the ages appear too old, or downward leaching of hummus, making the ages appear too young.



Correlation of the terrestrial Oshetna, Watana, and Devil tephras with lacustrine and bog cores, reproduced from Dilley (1988).

- Geochemical characterization and radiocarbon dating will allow for more precise age determinations and correlation to the Hayes tephra set.

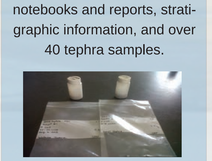
Research Purpose and Questions

The purpose of this project is refine the definition of tephra stratigraphy in the Susitna River Valley, and to consider it in the context of human presence in the Susitna River Valley.

- How many volcanic events are represented in the stratigraphic record of the Susitna River Valley, i.e. do the Devil, Watana and Oshetna tephra units each represent one volcanic event or are they composites of more than one tephra deposit?
- The archaeological record does not offer a resolution high enough to demonstrate the impact of volcanic eruptions on prehistoric populations. However, using radiocarbon dates, in conjunction with stratigraphic information and previous analyses in the Susitna River Valley (Dixon 1985, Skeete 2008), what can be learned about the timeframe of volcanic events relative to archaeological dates in the Susitna River Valley?

Museum Specimens

Material collected during archaeological work in the 1980s is housed at the University of Alaska Museum of the North, and includes field notebooks and reports, stratigraphic information, and over 40 tephra samples.



Core Samples

Terrestrial archaeological tephra samples may be correlated to tephra recovered from recently collected lacustrine core samples, which will offer more fine-grained tephra data.

Radiocarbon Samples

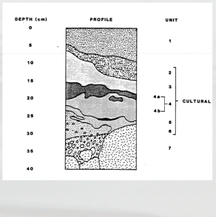
Approximately 60 radiocarbon samples, both from archaeological contexts and associated with tephra units, were collected during the archaeological work in the 1980s. Some of these dates are not accurate, whereas others may be incorporated into the analysis. Additional dates may also be obtained from samples within the museum collections that have not been analyzed yet.

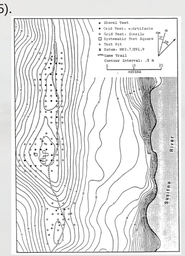
Methods

- Wet sieve tephra samples from archaeological sites and cores, separating into size fractions of +0.250mm, -0.250 to +0.125mm, and -0.125 to +0.063mm.

- Select optimal samples to ensure juvenile material will be mounted for electron microprobe analysis.

TLM-040 composite stratigraphy and map, reproduced from Dixon et al. (1985).





- Use geochemistry data, radiocarbon dates, and stratigraphy to create refined Susitna River Valley chronology.

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