An Analysis of Organic Ice Patch Materials

Colin M. King[1,2,3], Scott Dersam[1,2,3], Craig M. Lee[1], Kathryn Puesman[4]

[1]Montana State University, Department of Sociology and Anthropology
[2]Alpine Ecosystems Research Institute
[3]Beartooth Ecosystems Alpine Archaeological Research (BEAAR) Project
[4]Paleoscapes Archaeobotanical Services Team (PAST), LLC

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Introduction

Ice patches are a unique source of information that can be used to infer past cultural and natural environments. For example, materials exposed by melting ice in the Rocky Mountains include a c. 10,400, cal BP dart foreshaft in the Greater Yellowstone Ecosystem (GYE), and in Colorado's Rocky Mountain National Park, c. 3,860 cal BP large timber trees *Picea Engelmannii* (spruce) and the remains of c. 3,270 cal BP *Bison bison* (bison). Collectively, the exposure of these materials inform us about ancient environments and modern changes occurring in the alpine.

Project Description

Alpine Ecosystems Research Institute (AERI) began preliminary investigation of ice patches in 2021, and during the 2023 field season, two kinetically stable ice patches in the GYE were systematically surveyed for cultural use or identifiable paleo-environmental remains. The survey was conducted by AERI under research director Scott Dersam in the eastern GYE. The late lying snow fields yielded likely non-cultural organic botanical remains which were collected for analysis. Examination of the area using Google Earth imagery suggests the presence of two small areas or "cores" of relict and possibly ancient ice in these locations. Following VanderHoek et al. (2012) and Lewis (1939) both are consistent with "transverse" ice patches in that they lie horizontally on a slope below the crest of a ridge. One is c. 15 m in length and the other is c. 10 m in length. This area of ice patches was identified by Lee (2019) for the Greater Yellowstone Coordinating Committee (GYCC) as "SB1_A."

Results

Three of the botanical samples were analyzed for genus/species identification and composition, e.g., branch, trunk, or root. Two of the samples (1A and 2A) are consistent with *Picea* sp. (spruce) and of similar composition–likely fragments of branches. The third sample (3A) is *Abies* sp. (fir). Based on the generally smaller size of the tracheids, it is likely also from a branch. Two of these samples were submitted for AMS ^{14}C analysis to Beta Analytic. Sample 1A SB1_A dated to c. 1331 cal BP and Sample 3A SB1_A dated to 1,629 cal BP.

Discussion

The 2023 season was an above average year for snow accumulation in this area of the GYE. The presence of the ancient wood suggests that while on average SB1_A has remained stable, the exposure of c. 1,700 wood in 2023 could indicate increasing melt. Although the survey did not yield archaeological material, the paleobotanical samples provide an indicator concerning the rate at which these ice patches may be receding. This type of data exemplifies one of the most tangible indicators of climate change in the intermountain west. Interestingly, the wood emerging from SB1_A is relatively young compared to other dated perineal ice patches in the Rocky Mountains. As such, it provides an important data point reflecting the spectrum of materials emerging from this portion of the cryosphere.

Dr. Scott Dersam and Katrina Rorhus collect wood samples

SB1_A

Sample: 1A-SB1_A
Species: *Picea* (spruce)
AMS ^{14}C age: 1440 ± 30 BP
Calendar Age at 2 sigma,
100% probability:
1297 - 1373 BP
Median Prob.: 1331 cal BP

Sample 3A-SB1_A
Species: *Abies* (Fir)
AMS ^{14}C age: 1740 ± 30 BP
Calendar Age at 2 sigma,
95.2% probability:
1567 - 1705 BP
Median Prob.: 1629 cal BP

Sample ID	Identification		Identification
	Scientific Name	Common Name	Notes
1A Sample 1	*Picea* sp.	Spruce	Tracheids; resin canals with thick-walled epithelial cells, resin canals solitary or contiguous; piceoid cross field pitting; no helical (spiral) thickenings; bordered pits on the tracheid radial walls were most often single
2A Sample 1			
3A Sample 2	*Abies* sp.	Fir	Tracheids with no resin canals; Taxodioid cross-field pitting; Ray height 1-30+ cells; Rays uniseriate or occasionally biseriate

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