

Inner Workings: Climate change frees ancient artifacts

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One summer 10,300 years ago, a Native American hunter prowled the Rocky Mountains, near what's now Yellowstone National Park. The hunter's weapon was an atlatl, or spear thrower, used to launch stone-tipped darts at prey—bighorn sheep, perhaps—that rested in a spot where winter snow persisted, cool and free of biting insects. Although the hunter's success is unknown, in 2007, Craig Lee picked up one of his darts—bent, missing its tip, trampled by a sheep, but still recognizable, and the oldest human artifact ever found in ice (1).

Lee, who works at the University of Colorado Boulder, is one of a small but growing group of archaeologists who investigate permanent ice patches and glaciers. As the climate warms, the ice melts, and artifacts trickle out. If archaeologists manage to be in the right place at the right time, all they have to do is pick them up. This approach has

allowed archaeologists to better understand how ancient people who lived near frigid locales, ranging from Neolithic travelers to Roman armies to Native Americans hunters, used the cold sites for hunting or travel. "This is one tiny little instance where climate change is affording us the opportunity to learn something about the past," Lee says. "It is the tiniest of silver linings."

The situation has also pitted archaeologists in a race against time. Although they doubt Earth's ice will melt completely, archeologists must catch as much as they can before the items sit exposed. Ancient tools and clothing are astonishingly well preserved in ice, but they start to degrade as soon as they emerge. Archaeologists stabilize and dry them for long-term storage. "The sad fact of the matter is, the few things we find are clearly the tip of the iceberg," Lee says. "It's inconceivable to think about what's been lost."

Glacial archaeology differs from traditional archaeology in a couple of key ways: practitioners don't have to dig, and they find different kinds of things. Typically, archaeologists unearth the most durable remnants of a civilization—its arrowheads, its potsherds. Thanks to the ice, alpine archaeologists find much more—leather, textiles, wooden darts, and arrows with feathers still attached. "We're getting a glimpse into the archaeological record like we've never had before," says James Dixon, director of the Maxwell Museum of Anthropology and professor of anthropology at the University of New Mexico in Albuquerque.

Icy Reception

A few decades ago, there was no such thing as glacial or ice patch archaeology. Although people picked up isolated artifacts as early as the 1930s (2), they assumed the findings were one-offs, not indicators of widespread use of icy territories by ancient peoples. Dixon recalls that his first ice patch grant proposal in the 1990s was rejected, in part, for that reason. He colorfully paraphrases one reviewer's comments: "We know people never lived on ice. This is the most ridiculous idea we've ever heard."

However, as ice melt increased, and researchers, working at locations from the Rockies to the Alps, shared discoveries over the Internet, they realized people did use ice regularly, for hunting or travel. Some died there, notably Ötzi the "Iceman," who traveled the Alps more than 5,000 years ago, and Kwäday Dän Ts'inchí, who died in modern-day British Columbia more than 550 years ago (3). Ice archaeologists held their first international symposium in 2008 in Bern, Switzerland, and published the first issue of *Journal of Glacial Archaeology* in 2014 (2). Perhaps a few dozen archaeologists worldwide are collecting frozen artifacts, estimates Greg Hare, the senior projects archaeologist with the Yukon government in Whitehorse, Yukon, Canada.

Ice preserves artifacts in two different kinds of sites: glaciers and ice patches. Valley glaciers were sometimes used as mountain passes, and travelers like Ötzi left behind gear and shoes. For example, Albert Hafner and colleagues, studying the Schnidejoch pass in



This photo of the Friday ice patch, one of 28 known archaeological ice patches in southern Yukon, was taken in 1999 during a dramatic melting period. The black material in the lower right is ancient caribou dung that had recently melted out of the ice. Image courtesy of the Government of Yukon.



This moccasin, made from three pieces of hide sewn together with sinew thread, was found in 2003 at the Gladstone ice patch in the Yukon. At about 1,400 years old, this is the earliest example of Yukon footwear and one of the oldest such artifacts found in Canada. Image courtesy of the Government of Yukon.



These three dart foreshafts would have been attached to long throwing darts or main shafts. Found near Yukon ice patches, radiocarbon dating suggests they're 2,050–4,450 years old. Image courtesy of the Government of Yukon.

the Swiss Alps, have discovered Neolithic leather clothing, Roman shoe nails, and a shoe repair kit from the 14th or 15th century. The dates of their artifacts correspond to times when the climate was warm, making the area passable (4).

Small ice patches, in contrast, are alpine sites where the snow never fully melts down to the ground. During cold years, the snowpack

builds up; during warm summers, ice that froze long ago may melt, releasing artifacts. Animals went to ice patches to avoid insect pests, and human hunters followed. These permanent snow sites are not easy to find, but there is one clue from what the ancient prey animals left behind, Dixon says: “We look for the brown ice.” The color indicates a melting

patch; downslope, they look for artifacts that flowed away as the ice liquefied.

Trailblazers

Access to such sites varies. Dixon gets to most of his Alaskan ice patches via helicopter, whereas, elsewhere, some researchers enjoy a hike. James Dickson, a retired professor of archaeobotany of the University of Glasgow in the United Kingdom, who worked on Ötzi, trekked to the site on well-traveled trails and stayed in a hostel nearby. His identification of bog moss in the Iceman’s body led him to hypothesize that Ötzi knew about the plant’s antiseptic properties and used it to bind a wound on his hand (5). If true, this would be the earliest evidence for medicinal use of bog moss, Dickson says.

Because many glacial and ice patch artifacts contain carbon, researchers can use radiocarbon dating. For example, Hare and colleagues in the Yukon have collected about 240 objects so far, including many darts and arrows. Based on the dating, he estimates that people switched from throwing spears to bows and arrows around 1,200 years ago (6). Archaeologists knew the bow and arrow showed up in North America around that date, but the more precise radiocarbon analysis allowed Hare to determine that the new weapons were adopted quite rapidly, over a few decades.

The dart Lee found was made of birch, and decorated with two sets of three lines. Lee speculates these could be “ownership marks,” identifiers that help the hunter claim his kill (1). In the field, Lee finds it easy to imagine himself in that hunter’s moccasins, because the ice patch environment hasn’t changed much. “You can just sit down and watch the animals come in,” he says. “These materials go a long way towards humanizing that distant past.”

- 1 Lee CM (2010) Global warming reveals wooden artefact frozen over 10,000 years ago in the Rocky Mountains. *Antiquity* 84:325.
- 2 Dixon EJ, Callanan ME, Hafner A, Hare PG (2014) The emergence of glacial archaeology. *J Glacial Archaeol* 1(1):1–9.
- 3 Beattie O, et al. (2000) The Kwāday Dān Ts’ínchi discovery from a glacier in British Columbia. *Can J Archaeol* 24(1-2):129–147.
- 4 Hafner A (2012) Archaeological discoveries on Schnidejoch and at other ice sites in the European Alps. *Arctic* 65(Suppl 1):189–202.
- 5 Dickson JH, et al. (2008) Six mosses from the Tyrolean Iceman’s alimentary track and their significance for his ethnobotany and the events of his last days. *Veg Hist Archaeobot* 18(1):13–22.
- 6 Hare PG, Thomas CD, Topper TN, Gotthardt RM (2012) The archaeology of Yukon ice patches: New artifacts, observations, and insights. *Arctic* 65(Suppl 1):118–135.