



Press Release

Ice Age life high in the Andes

Tübingen archaeologists document highest-altitude human habitation in Peruvian Andes – 1,000 years earlier than thought

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In the southern Peruvian Andes, an archaeological team led by researchers from the University of Tübingen and the Senckenberg Center for Human Evolution and Paleoenvironment has documented the highest altitude ice age human occupation anywhere in the world — nearly 4,500 meters above sea level (masl).

Their discoveries date high-altitude human habitation nearly a millennium earlier than previously documented.

Despite cold temperatures, high solar radiation and low oxygen conditions at that altitude, hunter-gatherers colonized the remote, treeless landscapes about 12,000 years ago during the terminal Pleistocene — within 2,000 years after humans first arrived in South America.

“Study of human adaptation to extreme environments is important in understanding our cultural and genetic capacity for survival,” according to the research team, led by Kurt Rademaker, writing in the journal *Science*. Rademaker is currently a visiting fellow of the Institute of Prehistory and Medieval Archaeology funded through the Teach@Tübingen program. Rademaker was the 2014 recipient of the Tübingen Prize for Early Prehistory and Quaternary Ecology for his work on early human adaptations to high altitudes in the Andes.

Christopher Miller, Junior Professor for Geoarchaeology at the Institute for Archaeological Sciences at the University of Tübingen and member of the Senckenberg Center for Human Evolution and Paleoenvironment, also participated in the study. By analyzing thin sections of the rockshelter’s sediments, Miller could identify microscopic remains of ashes from the fires built by the earliest inhabitants. “The ashes were likely produced by burning locally available cushion plants, which are still used by indigenous inhabitants today,” said Miller. “This evidence further emphasizes the remarkable ability of the early inhabitants to exploit, and survive, in an extremely harsh environment.”

The researchers report the discovery of two new archaeological sites within the high-altitude Pucuncho Basin. The Pucuncho site, at 4,355 masl, yielded 260 stone tools, including projectile points as much as 12,800 years old. Cuncaicha rockshelter site, at 4,480 masl, contains a “robust, well-preserved and well-dated occupation sequence” up to 12,400 years old. The

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rockshelter, with views of wetland and grassland habitats, features sooted ceilings and rock art, and was likely used as a base camp.

Most of the stone tools at Cuncaicha were made from locally available obsidian, andesite and jasper, and are indicative of hunting and butchering consistent with limited subsistence options on the plateau, the researchers say. In addition to plant remains, bones at the site indicate hunting of vicuña and guanaco camelids and the taruca deer.

Pucuncho Basin was a high-altitude oasis for specialized hunting, particularly of vicuña, and later, herding of domesticated alpacas and llamas. While the Pucuncho Basin could have sustained year-round residence, the research team believes that wet-season storms and the dangers of hypothermia, as well as the need to maintain extended social networks and collect edible plants, may have encouraged regular descents.

In addition, the stone tools and chipped-stone debris included nonlocal, fine-grained rocks — some stream-polished. That indicates that the plateau's residents visited high-energy rivers in the lower elevations.

It is unclear whether the high-altitude human settlement required genetic or environmental adaptations. But with evidence of high-altitude human habitation almost 1,000 years earlier than previously documented, the implication is that there may have been more moderate late-glacial Andean environments and greater physiological capabilities for Pleistocene humans.

“The Pucuncho Basin sites suggest that Pleistocene humans lived successfully at extreme high altitude” write the researchers. “As new studies identify potential genetic signatures of high-altitude adaptation in modern Andean populations, comparative genomic, physiologic and archaeological research will be needed to understand when and how these adaptations evolved.” The high Andes play a significant role in the daily lives of modern-day Peruvians and the team's research shows that these spectacular mountains were as important for the first Peruvians as they are for their descendants today. These archaeological sites demonstrate that even during the Ice Age, humans were capable of exploring and adapting to new and difficult terrain.

In addition to Rademaker and Miller, the research team members are: Gregory Hodgins, University of Arizona; Katherine Moore, University of Pennsylvania; Sonia Zarrillo, University of Calgary; Peter Leach, University of Connecticut; David Reid, University of Illinois-Chicago; Willy Yépez Álvarez, Peru; and Gordon Bromley and Daniel Sandweiss, University of Maine.

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The University of Tübingen

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Our core research areas include: integrative neuroscience, clinical imaging, translational immunology and cancer research, microbiology and infection research, biochemistry and pharmaceuticals research, the molecular biology of plants, geo-environment research, astro- and elementary particle physics, quantum physics and nanotechnology, archeology and prehistory, history, religion and culture, language and cognition, media and education research.

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