New study determines more accurate method to date tropical glacier moraines

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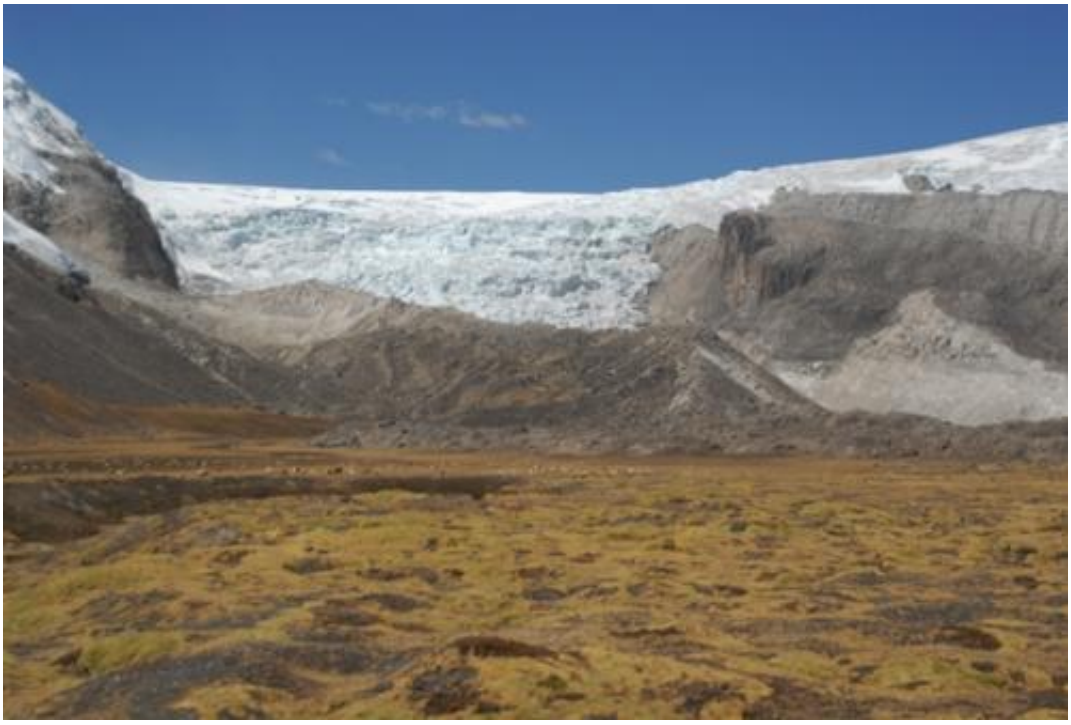

The Quelccaya Ice Cap, the world's largest tropical ice sheet, is rapidly melting. Credit: Meredith Kelly

A Dartmouth-led team has found a more accurate method to determine the ages of boulders deposited by tropical glaciers, findings that will likely influence previous research of how climate change has impacted ice masses around the equator.

The study appears in the journal *Quaternary Geochronology*.

Scientists use a variety of dating methods to determine the ages of glacial moraines around the world, from the poles where glaciers are at sea level to the tropics where glaciers are high in the mountains. Moraines are sedimentary deposits that mark the past extents of glaciers. Since glaciers respond sensitively to climate, especially at high latitudes and high altitudes, the timing of glacial fluctuations marked by moraines can help scientists to better understand past climatic variations and how glaciers may respond to future changes.

In the tropics, glacial scientists commonly use beryllium-10 surface exposure dating. Beryllium-10 is an isotope of beryllium produced when cosmic rays strike bedrock that is exposed to air. Predictable rates of decay tell scientists how long ago the isotope was generated and suggest that the rock was covered in ice before then. Elevation, latitude and other factors affect the rate at which beryllium-10 is produced, but researchers typically use rates taken from calibration sites scattered around the globe rather than rates locally calibrated at the sites being studied.

Dartmouth College-led researchers analyzed beryllium-10 concentrations in moraine boulders deposited by the Quelccaya Ice Cap. Credit: Meredith Kelly

The Dartmouth-led team looked at beryllium-10 concentrations in moraine boulders deposited by the Quelccaya Ice Cap, the largest ice mass in the tropics. Quelccaya, which sits 18,000 feet above sea level in the Peruvian Andes, has retreated significantly in recent decades. The researchers determined a new locally calibrated production rate that is at least 11 percent to 15 percent lower than the traditional global production rate.

"The use of our locally calibrated beryllium-10 production rate will change the surface exposure ages reported in previously published studies at low latitude, high altitude sites and may alter prior paleoclimate interpretations," said Assistant Professor Meredith Kelly, the study's lead author and a glacial geomorphologist at Dartmouth.

The new production rate yields beryllium-10 ages that are older than previously reported, which means the boulders were exposed for longer than previously estimated. Prior studies suggested glaciers in the Peruvian Andes advanced during early Holocene time 8,000 -10,000 years ago, a period thought to have been warm but perhaps wet in the Andes. But the new production rate pushes back the beryllium-10 ages to 11,000 -12,000 years ago when the tropics were cooler and drier. Also during this time, glaciers expanded in the northern hemisphere, which indicates a relationship between the climate mechanisms that caused cooling in the northern hemisphere and southern tropics.

The findings suggest the new production rate should be used to deliver more precise ages of moraines in low-latitude, high-altitude locations, particularly in the tropical Andes. Such precision can help scientists to more accurately reconstruct past glacial and climatic variations, Kelly said.

Provided by Dartmouth College

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