Geologists map prehistoric climate changes in Canada's Yukon Territory

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Researchers at the University of Pittsburgh have joined an international group of scientists to study past climate changes in the Arctic. Comprising geologists from Pitt's Department of Geology and Planetary Science, the team has analyzed sedimentary and geochemical records of water-level changes in Rantin Lake, located in the boreal forest of Canada's southeastern Yukon Territory. The results were published online in the April issue of *Journal of Paleolimnology* as one of 18 articles dedicated to reconstructing Arctic lake sediments climate and environmental changes during the Holocene (about 12,000 years before present day).

"During the last 10,000 years, there have been certain times in which rapid climate change events occurred," said David Pompeani, lead author and a Pitt PhD geology student. "By analyzing Rantin Lake, we've contributed a piece of the puzzle toward mapping the timing and magnitude of these prehistoric events throughout the Arctic."

Rantin Lake is part of a watershed containing a series of small lakes hydrologically connected through groundwater flow. The regional climate is subarctic and characterized by warm, wet summers and dry, cold winters. The lake is located at 60 degrees north in the Canadian Arctic, only 30 degrees away from the North Pole, where climate change is expected to be amplified.

In July 2006, the Pitt team—including Mark Abbott, associate professor of geology and planetary science, and Byron Steinman, a former PhD

geology student (now a postdoctoral researcher at Penn State University)—collected two sediment cores from the lake for analysis. The sediment cores were split and analyzed for paleoclimate proxy indicators, including geochemical composition, sedimentary structure, and macrofossil content (that which is visible without a microscope). The amount of water in a lake is directly related to its depth. Therefore, a loss in water during droughts is recorded by drop in lake levels, whereas wet periods are characterized by deep waters.

Using these proxy indicators, the researchers were able to make inferences about past variations in the balance between precipitation and evaporation in the southern Yukon. A comparison of the lake-level proxies with a previously developed fossil pollen record from the same lake found that rapid vegetation changes over the Holocene also occurred during shifts in the precipitation/evaporation balance, suggesting hydrologic conditions played an integral role in the evolution of the Yukon's ecosystem. The development of unique shallow-water sediment at the deep-water core site indicated that lake levels dropped significantly during a "megadrought" in the early Holocene.

"About 8,400 years ago, the lake almost dried out," said Pompeani. "We documented the timing of this drought and studied its transition to conditions more typical of what we observed in the late Holocene."

Pitt's study, says Pompeani, contributes to the long-term perspective on natural climate variability that is needed to understand historically unprecedented changes now occurring in the Arctic. Rapid changes in the Arctic climate system that occurred in the relatively recent past can be compared with climate models to improve the understanding of the processes responsible for such nonlinear changes.

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