Ice sheet melt identified as trigger of Big Freeze

March 31 2010

The main cause of a rapid global cooling period, known as the Big Freeze or Younger Dryas - which occurred nearly 13,000 years ago - has been identified thanks to the help of an academic at the University of Sheffield.

A new paper, which is published in *Nature* today, has identified a mega-flood path across North America which channelled melt-water from a giant ice sheet into the oceans and triggering the Younger Dryas cold snap.

The research team, which included Dr Mark Bateman from the University of Sheffield's Department of Geography, discovered that a mega-flood, caused by the melting of the Laurentide ice sheet, which covered much of North America, was routed up into Canada and into the Arctic Ocean.

This resulted in huge amounts of fresh water mixing with the salt water of the Arctic Ocean. As a result, more sea-ice was created which flowed into the North Atlantic, causing the northward continuation of the Gulf Stream to shut down.

Without the heat being brought across the Atlantic by the Gulf Stream, temperatures in Europe plunged from similar to what they are today, back to glacial temperatures with average winter temperatures of -25^{o}C. This cooling event has become known as the Younger Dryas period with cold conditions lasting about 1400 years. The cold of the Younger Dryas affected many places across the continent, including Yorkshire in the Vale of York and North Lincolnshire which became arctic deserts with sand dunes and no vegetation.

Before now, scientists have speculated that the mega-flood was the main cause of the abrupt cooling period, but the path of the flood waters has long been debated and no convincing evidence had been found establishing a route from the ice-sheet to the North Atlantic.

The research team studied a large number of cliff sections along the Mackenzie Delta and examined the sediments within them. They found that many of the cliff sections showed evidence of sediment erosion. This evidence spanned over a large region at many altitudes, which could only be explained by a mega-flood from the over-spilling of Lake Agassiz, which was at times bigger than the UK, at the front of the Laurentide Ice-sheet rather than a normal flood of the river.

Dr Bateman, who has been researching past environmental changes both in the UK and elsewhere in the world for almost 20 years, runs the luminescence dating lab at Sheffield. The lab was able to take the MacKenzie Delta sediment samples from above and below the mega-flood deposits, and find out when the mega-flood occurred, enabling its occurrence to be attributed to the start of the Younger Dryas.

The study will help shed light on the implications of fresh water input into the North Atlantic today. There are current concerns that changes in the salinity of the ocean today, could cause another shut down of the Gulf Stream. Current climate changes, including global warming, may be altering the planetary system which regulates evaporation and precipitation, and moves fresh water around the globe.

The findings, which show the cause, location, timing and magnitude of the mega-flood, will enable scientists to better understand how sensitive both oceans and climates are to fresh-water inputs and the potential climate changes which may ensue if the North Atlantic continues to alter.

Dr Mark Bateman, from the University of Sheffield's Centre for International Drylands Research at the Department of Geography, said: "The findings of this paper through the combination of luminescence dating, landscape elevation models and sedimentary evidence allows an insight into what must have been one of the most catastrophic geological events in recent earth's history. They also show how events within the Earth-climate system in North America had huge impacts in Europe."

More information: The paper, entitled 'Identification of Younger Dryas outburst flood path from Lake Agassiz to the Arctic Ocean' was published in Volume 464 (7289) of *Nature*: Julian B. Murton, Mark D. Bateman, Scott R. Dallimore, James T. Teller and Zhirong Yang.

Provided by University of Sheffield