Study confirms mechanism for current shutdowns, European cooling

by Peter Clark

CORVALLIS, Ore. â€“ A new study by paleoclimatologists at Oregon State University adds credence to the theory that the ocean current patterns, which keep Europe warm, may be forced to slow or stop â€“ victims of a surge of fresh water and reduced salinity in the North Atlantic Ocean.

Research just published in Proceedings of the National Academy of Sciences, a professional journal, provides new data that indicate why these current patterns changed in the distant past, sometimes in the remarkably short period of time of a decade or less. The issue is of significant concern in Europe, where this phenomenon could cause substantial cooling.

The latest findings contradict some studies done a couple years ago, which were not supportive of these theories about the trigger of sudden climate change and breakdowns of this â€œthermohaline circulationâ€• current pattern.

â€œSome recent papers strongly questioned this hypothesis about rapid changes in the overturning circulation patterns in the North Atlantic Ocean,â€• said Peter Clark, a professor of geosciences at OSU. â€œBased on some sediment dating and computer models, these reports caused quite a bit of confusion in this field, which hopefully the new findings will help clarify.â€•

Clark said some of the sediment dating strategies in the previous work may have been flawed. The newest study, he said, suggests the basic theory about the trigger that caused rapid shutdown of these current patterns remains quite plausible. The issue takes on importance, researchers say, because of concerns that Greenlandâ€™s ice sheet may melt as a result of global warming â€“ providing the type of fresh water pulse that in the past has shut down one of the Earthâ€™s great current patterns, and one which might cause a much colder climate in Europe.

The debate, which is still ongoing in scientific circles, is an argument over what caused the â€œYounger Dryasâ€• cold event in a 1,400-year period that began as the Earth was coming out of its last Ice Age, about 12,900 years ago. In this event, parts of the Northern Hemisphere rapidly cooled down as much as 20 degrees Fahrenheit in 10-100 years â€“ an extraordinary plunge into icy conditions in a very short period of time. And about 1,400 years later, it warmed up a similar amount, even faster â€“ in about 10 years.

Major temperature changes of this magnitude â€“ and so rapidly â€“ over large parts of the Earth seem almost impossible by current, comparatively stable climate standards. But they appear to have happened, and scientists want to know why.

In their search, a theory has been developed that much of the time, a huge conveyor belt of warm, less-salty surface water moves from the tropical Atlantic Ocean to the far North Atlantic, where it finally becomes so cold and salty that it sinks, moves south and continues the circulation pattern.

This process, called thermohaline circulation, only happens in two regions of the Earthâ€™s polar areas. But in the case of the North Atlantic, it is responsible for giving Europe a temperate climate that bears little relationship to its far-north latitude â€“ most of Great Britain is at the same latitude as central Canada.

The newest study has found data that completely support climate models and geological descriptions of how this enormous change took place during the Younger Dryas period. At that time, researchers believe an ice dam broke in Lake Superior. Huge amounts of fresh water that had been flowing down the Mississippi River instead went into the North Atlantic, all the way from central Canada. The flow of warm ocean waters slowed and then stopped, causing dramatically colder temperatures in much of the Northern Hemisphere.

The specific data supporting this theory, Clark said, were sediment cores from the St. Lawrence Seaway that had a chemical signature identical to what would have been suspected from their land of origin â€“ certain levels of magnesium, strontium and carbon isotopes, and especially a level of highly-enriched uranium peculiar to central Canada.

â€œThis is the first direct documentation of the route that fresh water influxes took into the North Atlantic during the Younger Dryas,â€• Clark said. â€œItâ€™s very strong evidence that is difficult to explain any other way. We know what happened to the ocean circulation patterns back then, and now weâ€™re getting the evidence to show why it happened.â€•

Assuming this theory is true, it means that large influxes of fresh water into the North Atlantic do have the capability of slowing or stopping this major ocean current, and in time frames shorter than many might imagine. Depending on the rate and extent of melting, Clark said, itâ€™s possible that loss of the Greenland ice sheet could provide an input of fresh water similar in magnitude to that of the broken ice dam during the Younger Dryas.

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Collaborators included researchers from the College of Science and College of Oceanic and Atmospheric Sciences at OSU; the University of Kiel in Germany; the U.S. Geological Survey; and the University of Victoria in Canada.

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