Past tropical climate change linked to ocean circulation

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A new record of past temperature change in the tropical Atlantic Ocean's subsurface provides clues as to why the Earth's climate is so sensitive to ocean circulation patterns, according to climate scientists at Texas A&M University.

Geological oceanographer Matthew Schmidt and two of his graduate students teamed up with Ping Chang, a physical oceanographer and climate modeler, to help uncover an important climate connection between the tropics and the high latitude North Atlantic. Their new findings are in the current issue of *PNAS*.

The researchers used geochemical clues in fossils called foraminifera, tiny sea creatures with a hard shell, collected from a sediment core located off the northern coast of Venezuela, to generate a 22,000-year record of past ocean temperature and salinity changes in the upper 1,500 feet of water in the western tropical Atlantic. They also conducted global climate model simulations under the past climate condition to interpret this new observational record in the context of changes in the strength of the global ocean conveyor-belt circulation.

"What we found was that subsurface temperatures in the western tropical Atlantic rapidly warmed during cold periods in Earth's past," Schmidt explains.

"Together with our new modeling experiments, we think this is evidence that when the global conveyor slowed down during cold periods in the

past, warm subsurface waters that are normally trapped in the subtropical North Atlantic flowed southward and rapidly warmed the deep tropics. When the tropics warmed, it altered climate patterns around the globe."

He notes that as an example, if ocean temperatures were to warm along the west coast of Africa, the monsoon rainfall in that region would be dramatically reduced, affecting millions of people living in sub-Saharan Africa. The researchers also point out that the southward flow of ocean heat during cold periods in the North Atlantic also causes the band of rainfall in the tropics known as the Intertropical Convergence Zone to migrate southward, resulting in much drier conditions in northern South American countries and a wetter South Atlantic.

"Evidence is mounting that the Earth's climate system has sensitive triggers that can cause abrupt and dramatic shifts in global climate," Schmidt said.

"What we found in our subsurface reconstruction was that the onset of warmer temperatures, thought to reflect the opening of this 'gateway' mechanism, occurred in less than a few centuries. It also tells us that it might be a good idea to monitor subsurface temperatures in the western tropical Atlantic to assess how the strength of the ocean conveyor might be changing over the next few decades as Earth's climate continues to warm."

"One way to prepare for future climate change is to increase our understanding of how it has operated in the recent past."

Provided by Texas A&M University