Clocking the speed of ocean circulation holds the key to past African climates

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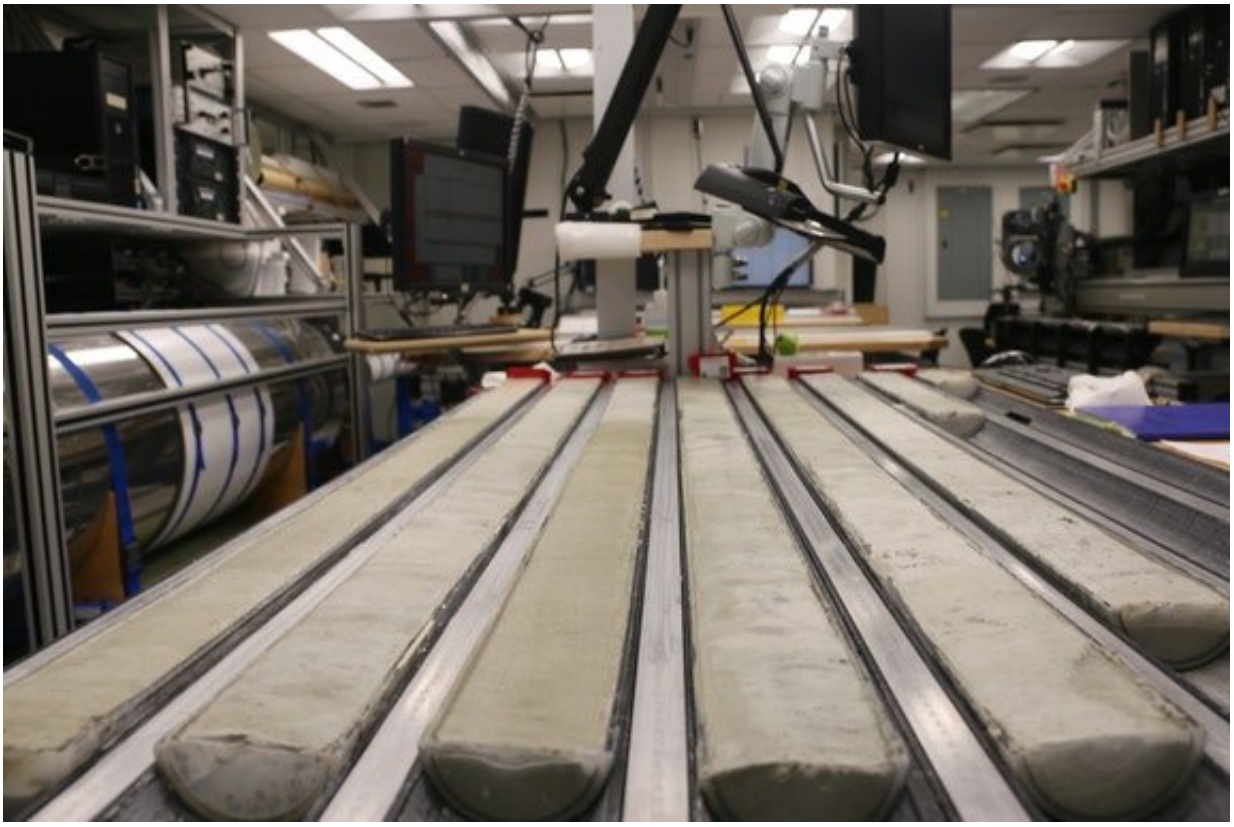

Sediment core was taken from the Mozambique Channel. Credit: Cardiff University

Scientists have identified a new mechanism to account for the drastic aridification in eastern Africa over the past two million years, with likely

implications for understanding the evolution and dispersal of our early human ancestors.

In a study published today in *Nature*, a team led by scientists at Cardiff University propose that roughly 2.1 million years ago, changes in the speed of Indian Ocean waters through the Mozambique Channel were synchronized with the onset of the east-to-west atmospheric circulation pattern along the Pacific Ocean.

This so-called Walker circulation resulted in subsequent changes in the Indian Ocean region causing dry spells in eastern Africa during glacial periods.

The study also found that the increasingly dry and cold spells were punctuated by wetter and warmer periods. The team say that ultimately, their results could contribute to understanding and explaining why humans first dispersed beyond Africa around this time.

As part of the study, a sediment core was taken from the Mozambique Channel—a 1,600 km-long arm of the western Indian Ocean located between Madagascar and Mozambique. Using tiny fossils of single-celled organisms known as foraminifera, as well sediments taken from the core, the team reconstructed the flow speed of the ocean's circulation extending 7 million years into the past.

The team identified two significant points when the speed of the ocean through the channel changed.

The first occurred roughly 2.1 million years ago and coincided with the onset of the Pacific Walker Circulation—a phenomenon where easterly trade winds move surface water towards the west. The second change occurred roughly 900,000 years ago and coincided with the onset of intensive ice ages, which would go on to appear in major cycles of

roughly 100,000 years.

"The establishment and long-term enhancement of the coupled Pacific and Indian Ocean Walker circulation would have suppressed rainfall in eastern Africa, particularly during ice ages after 2.1 million years ago," said co-author of the study Professor Ian Hall, from Cardiff University's School of Earth and Environmental Sciences.

Lead author of the study Dr. Jeroen van der Lubbe, also from Cardiff University's School of Earth and Environmental Sciences, said: "At first we were astonished to find that our detailed reconstruction of ocean flow speed in the Mozambique Channel remained relatively unchanged throughout several major shifts in the Earth's climate system, such as the development of Northern Hemisphere icesheets, but so clearly reflected the synchronous establishment of the Pacific and Indian Ocean Walker circulation some 2.1 million years ago.

"Now, we have identified a mechanism why this is the case."

The team say that their results will inform future studies to understand how climate fluctuations may have been a critical factor of hominin evolution and dispersal over the last 2.1 million years.

Professor José Joordens, co-author of the study from Naturalis Biodiversity Center in the Netherlands, added: "Around 2 million years ago, hominin diversity in Africa was high implying a considerable widening of niches and dietary differentiation among several species of our genus Homo. Also, this is when early Homo populations for the first time expanded far beyond Africa.

"It is still an enigma what caused these events, but we believe that our detailed climate record may hold the key to solve many of the outstanding puzzles in palaeoanthropology."

The sediments were retrieved from the Mozambique Channel by the International Ocean Discovery Program (IODP) Expedition 361, on which Professor Ian Hall was co-chief scientist.

More information: H. J. L. van der Lubbe et al, Indo-Pacific Walker circulation drove Pleistocene African aridification, *Nature* (2021). DOI: 10.1038/s41586-021-03896-3