Ethiopian lake sediments reveal history of African droughts

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Lake Tana, Ethiopia.

A new survey of Lake Tana in Ethiopia – the source of the Blue Nile – suggests that drought may have contributed to the demise of the Egyptian Old Kingdom, around 4200 years ago.

A team led by the University of Aberystwyth used seismic surveys and sediment cores to work out how the lake's water levels has varied over the past 17,000 years and linked this to evidence for global climate change.

Understanding how and why rainfall patterns change is particularly important for sub-Saharan Africa, where prolonged droughts have such serious social and economic consequences.

The climate here is dominated by the African-Asian monsoon and the

movements of the Intertropical Convergence Zone (ITCZ). This is an area of erratic weather patterns, where winds from the northern and southern hemispheres meet close to the equator: sailors know it as the Doldrums.

Seasonal movements of the ITCZ can affect the strength of the monsoon. A strong monsoon leads to higher lake levels, and this can be traced in ancient lake sediments. Lake Tana is particularly good for this kind of research because it's close to the northern limit of the ITCZ so even slight a southward movement of the ITCZ is reflected in the lake's geological history.

Fleshing out the detail of the region's rainfall history and linking it to past climate change can improve predictions of future rainfall. The detail enables scientists to check the ability of their climate models to accurately 'predict' past climate change; this fine tuning means they can be more confident of the models' accuracy when predicting future events.

There was already strong evidence for an abrupt drought in Africa around 16,500 years ago, linked to changes in the Earth's climate. The researchers wanted to understand the region's subsequent climate history, including finding any evidence for a dry period around 4200 years ago, when the Egyptian Old Kingdom declined.

"We were looking for evidence for long-term drought events to provide a historical context to data modellers," says Dr. Michael Marshall from Aberystwyth University, a lead author of the research paper published in Global and Planetary Change. "We wanted to find out when and how quickly drought has come about in the past."

The researchers used seismic (sound) survey and cores taken through the bottom of the lake, to get a picture of the stratigraphy or layers of

sediment that have been carried into the lake by 17,000 years of rainfall.

They then used chemical and magnetic analysis to determine the conditions under which the sediments were deposited, giving them a picture of periods of relatively dry or wet weather. By carbon dating the layers the researchers then tied these wet/dry phases to existing evidence for climate change events – like movements in the ITCZ.

This let them align periods of sub-Saharan drought to periods of global climate change.

The Blue Nile is the main tributary of Egypt's Nile river and it delivers most of the sediment to the Nile's floodplain. These fertile soils were the bedrock of ancient Egyptian civilisation, so long-term changes in the flow of the Nile would have had a profound effect on Egyptian society.

"Finding a distinct dry period around the time of decline of the Old Kingdom is complicated by the fact that the climate was becoming drier overall during that time anyway," explains Marshall.

Nevertheless, the researchers' analysis of the sediments did reveal a distinct dry episode around 4200 years ago. This would have lowered water levels in Lake Tana and reduced the flow of the Nile, interrupting the regular supply of fertile sediment to the Nile delta. Archaeological evidence shows that the Old Kingdom was already beginning to wane; reduced Nile flow could have contributed to its demise.

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More information: Late Pleistocene and Holocene drought events at

Lake Tana, the source of the Blue Nile. Michael H Marshall, et al. doi: 10.1016/j.gloplacha.2011.06.004

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