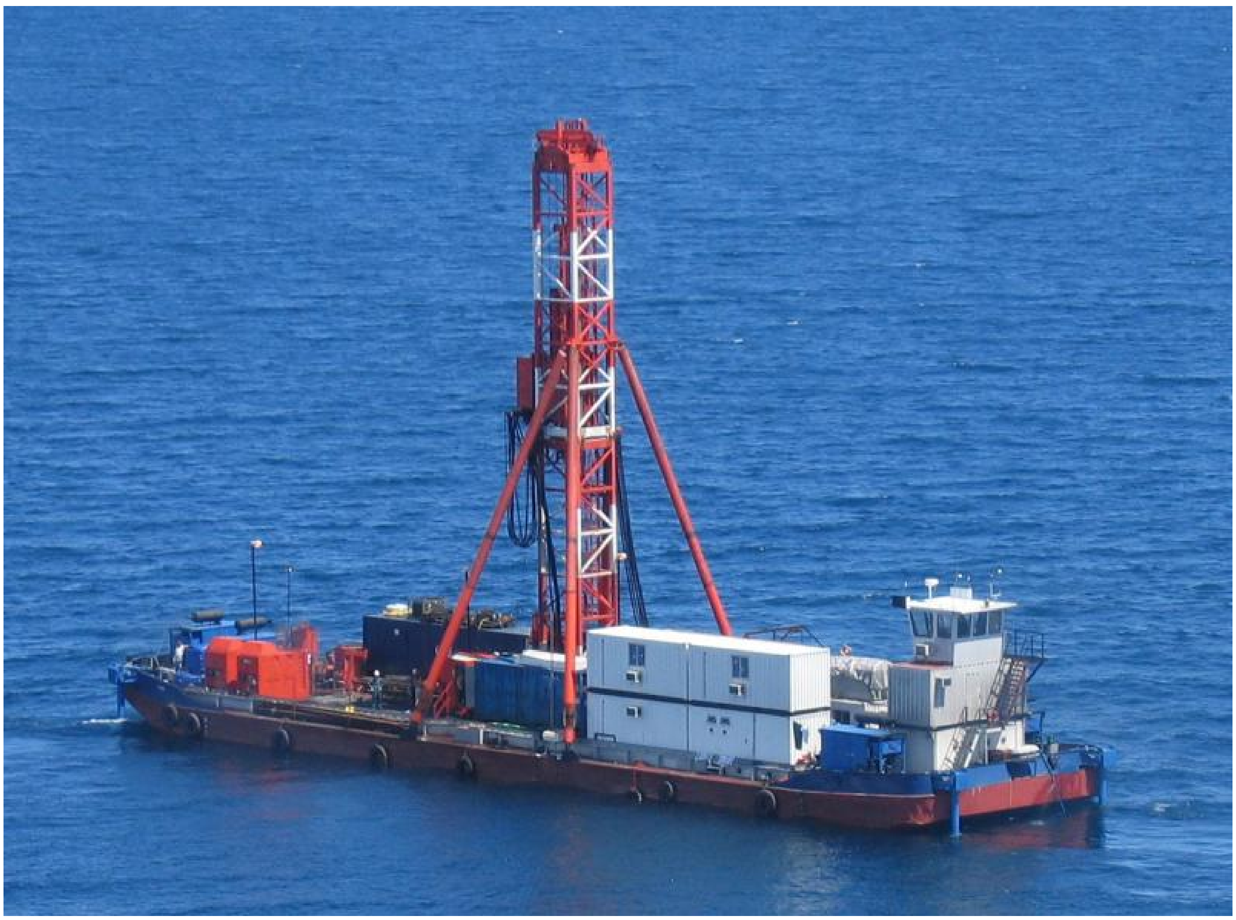
Sediment study of African lake may help explain huge number of related fish species

December 8 2015, by Bob Yirka



Drilling site in nearly 2000' of water on Lake Malawi. Drill cores at this location penetrated more than 1250' below the bottom of the lake. Credit: Jason Agnich, University of Minnesota Duluth.

(Phys.org)—A team of researchers affiliated with several universities in the U.S. has conducted a drilling study of Lake Malawi in South-East Africa and suggest their findings may help explain the large number of cichlid species that call the lake their home. In their paper published in *Proceedings of the National Academy of Sciences,* the team describes their drilling expedition, what the sediment samples showed and why they believe their findings may help explain the unusual number of related fish species.

Scientists have debated amongst themselves the possible reasons for such a large number of cichlid species in one lake—over a 1000, which is more than any other lake. Possible ideas have included unknown environmental factors or biological tendencies of the cichlid in general. In this new effort, the researchers suggest it might have been because lake levels changed so dramatically over the years.

To learn more, the researchers traveled to the lake and conducted drilling operations, collecting sediment samples that revealed lake level changes over the past 1.3 million years. In looking at the data, the team found that that there were approximately 24 dry periods where the lake level dropped at least 650 feet and multiple periods where excessive moisture caused the lake to overflow into the surrounding area. There was also a big change that occurred approximately 800,000 years ago where the climate shifted from one that was mostly dry, to one that was much wetter. They noted that during some of the low level periods the lake likely broke into several pieces.

The researchers suggest that such dramatic fluctuations in lake levels could account for the huge number of cichlid species, a dominant fish that would have had to be able to change quickly to adapt to new conditions—lower lake levels, for example, would have meant the water would have been a lot saltier with dramatically different pH levels, and if the lake broke up for long periods of time it would have led to isolation of some species.

If the theory by the team is correct, it still does not explain, as they acknowledge, how it was that so many of the species that developed managed to survive till today. That answer will likely take a genetic study.

More information: Continuous 1.3-million-year record of East African hydroclimate, and implications for patterns of evolution and biodiversity, Robert P. Lyons, DOI: 10.1073/pnas.1512864112

Abstract
The transport of moisture in the tropics is a critical process for the global energy budget and on geologic timescales, has markedly influenced continental landscapes, migratory pathways, and biological evolution. Here we present a continuous, first-of-its-kind 1.3-My record of continental hydroclimate and lake-level variability derived from drill core data from Lake Malawi, East Africa (9–15° S). Over the Quaternary, we observe dramatic shifts in effective moisture, resulting in large-scale changes in one of the world's largest lakes and most diverse freshwater ecosystems. Results show evidence for 24 lake level drops of more than 200 m during the Late Quaternary, including 15 lowstands when water levels were more than 400 m lower than modern. A dramatic shift is observed at the Mid-Pleistocene Transition (MPT), consistent with far-field climate forcing, which separates vastly different hydroclimate regimes before and after ~800,000 years ago. Before 800 ka, lake levels were lower, indicating a climate drier than today, and water levels changed frequently. Following the MPT high-amplitude lake level variations dominate the record. From 800 to 100 ka, a deep, often overfilled lake occupied the basin, indicating a wetter climate, but these highstands were interrupted by prolonged intervals of extreme drought. Periods of high lake level are observed during times of high eccentricity. The extreme hydroclimate variability exerted a profound influence on

the Lake Malawi endemic cichlid fish species flock; the geographically extensive habitat reconfiguration provided novel ecological opportunities, enabling new populations to differentiate rapidly to distinct species.

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