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Organic proxy records from Lake Challa (Mt. Kilimanjaro area) reveal continental climate change in tropical Africa since the last Glacial

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The EuroCLIMATE project CHALLACEA aims to reconstruct -with excellent time resolution and age control- a continuous 25-kyr history of temperature and moisture-balance variation in equatorial East Africa from the sediment record of Lake Challa, a 4.2 km^2, 92 m deep crater lake on the lower East slope (altitude ca. 880 m) of Mt. Kilimanjaro. This freshwater lake has a permanently stratified water column and its water budget is controlled by subsurface in- and outflow. A 21.65 m long continuous composite profile was obtained from three parallel piston-cores and was dated using 34 AMS ^{14}C measurements.

We applied the TEX_{86} proxy for lake surface-water temperature based on fossilized crenarchaeotal membrane lipids. A centennial record for lake temperature was obtained: TEX_{86} values ranged from 0.48 during the Last Glacial Maximum (LGM) to 0.78 at the end of the Holocene, with a distinct warming phase between 19 and 8 kyr ago. With the TEX_{86} calibration for large lakes, this translates into a warming from ca. 14 ºC at the LGM to 31 ºC in the Holocene. Core-top sediments give TEX_{86} temperatures of 28-30 ºC, slightly above the peak (stratified-season) lake surface temperature of 27.5 ºC. The low temperatures at the LGM are somewhat surprising, but are possibly related to the greater regional influence of the Kilimanjaro ice cap. Terrestrial organic matter input had a distinct effect on the TEX_{86} values as archaeal lipids from soils interfered with lipids produced in the lake. This was especially the case during

the 14-8.5 kyr interval except for the Younger Dryas episode when terrestrial organic matter input falls back to levels of the last Glacial. This probably indicates a period of extensive input of soil-derived organic matter into the lake associated with greater subsurface inflow during wetter conditions. Compound-specific isotopes of the C_{31} n-alkane suggest a shift in vegetation from a dominance of C_4-grasses towards a greater component of C_3 plants as a response to more humid conditions around ca. 15 kyr. These organic proxy in combination with other records obtained in the CHALLACEA project allow for a detailed reconstruction of tropical climate change in the last 25 kyr.