Proxy evidence and model explanation for rapid hydroclimate change in East Africa at the end of the Younger Dryas

IAN J. ORLAND[1], FENG HE[2], STEPHEN J. BURNS[3], CAMERON J. BATCHELOR[1], HAI CHENG[4,5], R. LAWRENCE EDWARDS[5]

[1] Dept. of Geoscience, Univ. of Wisconsin-Madison, USA. orland@wisc.edu, batchelor2@wisc.edu

[2] Center for Climatic Research, Nelson Inst. for Env. Studies, Univ. of Wisconsin-Madison, USA. fenghe@wisc.edu

[3] Dept. of Geosciences, Univ. of Massachusetts-Amherst, USA. sburns@geo.umass.edu

[4] Inst. of Global Change, Xi'an Jiaotong Univ., China. cheng021@xjtu.edu.cn

[5] Dept. of Earth Sciences, Univ. of Minnesota-Twin Cities, USA. edwar001@umn.edu

Stepwise changes in East African rainfall at the end of the Younger Dryas cold period have been previously inferred from isotopic proxy records in lake and marine sediment cores from the region, and have been tentatively attributed to dynamics of the Indian summer monsoon [1]. Although the measured durations of these shifts are 500-1400 yr – longer than coeval shifts at other tropical locations [2] – theoretical extrapolation suggests that the sampling resolution and age control of the sedimentary records obscure more rapid changes [1].

Here, we analyzed the rainfall proxy $\delta^{18}O$ by ion microprobe in 865 spots along a 5 cm traverse of a stalagmite from Moomi Cave (Socotra, Yemen) [3]. Twelve new U-Th dates span the traverse from 11.9 to 10.9 ky BP. A Bayesian age model includes two growth hiatuses observed by confocal fluorescent microscopy. Our reconstruction constrains the timing and duration of an abrupt rainfall increase at the end of the Younger Dryas (11.6±0.1 ky BP, duration ≤300 yr), and ≤100 yr shifts at the start/end of the Preboreal Oscillation (PBO; 11.2-11.0 ky BP).

Combined with TraCE-21ka transient climate simulation and isotope-enabled model output, our results indicate that these rapid changes in rainfall reflect the response of the Indian monsoon margin to Atlantic meridional overturning circulation (AMOC). Late in deglaciation, the northern margin of the monsoon deflected south of Moomi during periods of weak AMOC. Notably, the occurrence of the PBO in the model is not prescribed by North Atlantic freshwater forcing.

References cited:

[1] Tierney and deMenocal (2013) *Science* **342**, 843-846.

[2] Partin et al. (2015) *Nature Comm.* **6**, 8061.

[3] Shakun et al. (2007) *E. P. Sci. Lett.* **259**, 442-456.