Temperature change from greenhouse to icehouse climate

ALISON PIASECKI[1], VICTORIA TAYLOR[2], STEVEN BOHATY[3], PAUL WILSON[4], NELE MECKLER[5]

[1]UiB, Bjerknes Center, alison.piasecki@uib.no
[2]University of Southampton, vet1g12@soton.ac.uk
[3]University of Southampton, sbohaty@noc.soton.ac.uk
[4]University of Southampton, paul.wilson@noc.soton.ac.uk
[5] UiB, Bjerknes Center, nele.meckler@uib.no

Through the early Cenozoic, greenhouse gas concentrations declined as the global climate gradually cooled. But, at the the Eocene-Oligocene (E-O) transition around 34 Ma, there was an abrupt transformation as we switched from a greenhouse to icehouse climate. This transition involved a major shift in temperature, ice growth on Antarctica, a deepening of the calcite compensation depth, and other ocean chemistry changes. While these diverse signals make it an important transition to probe, they also influence many of the available paleoceanographic proxies. To combat this we use multiply substituted or 'clumped isotopes' on small benthic formanifera samples in order to record temperature changes across the E-O transition from a core off Newfoundland in the North Atlantic. This proxy is powerful because the temperature recorded is independent of the seawater chemistry in which the foraminifera form calcite, and we newly apply it to very small sample sizes. We find a sharp temperature drop across the E-O transition. In conjunction with this large temperature change, our $\delta^{18}O_{SW}$ record allows us to calculate the total ice volume growth across this transition with greater certainty due to our independent absolute deep sea temperature. In addition, our $\delta^{13}C$ record suggests an initiation of a modern North Atlantic Deep Water-like water mass coeval with ice growth and cooling, which is consistent with other records in the area (Coxall et al., 2018). With this new record we can better quantify global temperature, ice volume, and pCO_2 through the transition in order to understand the thresholds that separate our icehouse world from a greenhouse one.

Coxall H. K., Huck C. E., Huber M., Lear C. H., Legarda-Lisarri A., Regan M. O. X., Sliwinska K. K., Flierdt T., Boer A. M., Zachos J. C. and Backman J. (2018) Export of nutrient rich Northern Component Water preceded early Oligocene Antarctic glaciation. *Nature Publishing Group*, 1–9.