Temperature Change across the Eocene-Oligocene Transition using the Carbonate Clumped Isotope Paleothermometer on Foraminifera

SIERRA V. PETERSEN[1]* AND DANIEL P. SCHRAG[1]

[1]Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA, 02138 USA (*correspondence: speters@fas.harvard.edu)

The Eocene-Oligocene transition (EOT) marks the onset of glaciation on the Antarctic continent and is arguably one of the most dramatic climate shifts in the Cenozoic period. This period of climate change is marked by a large (>1‰) increase in the $\delta^{18}O$ of benthic foraminifera [1], which represents the combined influence of cooling and increased continental ice volume that cannot be separated using stable isotope analysis alone. Previous studies have tried to determine the contribution of each of these effects by independently measuring temperature using proxies such as Mg/Ca [2, 3]. However, across the EOT there was a ~1 km shift in the carbonate compensation depth that affected [CO_3^{2-}] and complicates use of the Mg/Ca proxy at this time [4].

Here we present independent estimates of temperature across the EOT using the carbonate clumped isotope paleothermometer – a temperature proxy based on the ordering of the heavy isotopes ^{13}C and ^{18}O within the carbonate lattice [5]. There is no evidence to date that suggests this proxy is affected by changes in [CO_3^{2-}], making it a good candidate for studying the EOT. We developed a new inlet apparatus that allows measurement of <2 mg samples (compared with previous studies using 8-15 mg per replicate), which made it possible to study foraminifera using this proxy. Thermocline-dwelling planktonic foraminifera (*Subbotina angiporoides, S. utilisindex)* were picked from the Southern Ocean core ODP689B [64°31'S, 03°06'E, Maud Rise] across an interval spanning the EOT. Previous work on this core using stable isotopes and Mg/Ca make it a good candidate for inter-proxy comparison [3, 6]. New clumped isotope data presented here refine the estimated temperature change across this interval as well as the contribution of increased ice accumulation on Antarctica.

[1] Zachos, *et al* (2001) *Science* **292**, 686-693. [2] Lear, Elderfield, & Wilson (2000) *Science* **287**, 269-272. [3] Billups & Schrag (2003) *EPSL* **209**, 181-195. [4] Peck, *et al* (2010) *Paleoceanography* **25**, PA4219. [5] Eiler (2011), *Quat. Sci. Rev*. **30**, 3575-3588. [6] Bohaty, Zachos, & Delaney (2012) *EPSL* **317-318**, 251-261.