

## Insights into Early Cenozoic climate from coupled sulfur and carbon isotopes in foraminiferal calcite.

VICTORIA C. F. RENNIE<sup>1\*</sup>, GUILLAUME PARIS<sup>2</sup>,  
SIGAL ABRAMOVICH<sup>3</sup>, ALEX SESSIONS<sup>2</sup>, JESS F. ADKINS<sup>2</sup>  
AND ALEXANDRA V. TURCHYN<sup>1</sup>

<sup>1</sup>Department of Earth Sciences, University of Cambridge,  
Cambridge CB2 3EQ, UK,  
vcr22@cam.ac.uk (\*presenting author)

<sup>2</sup>Dept. of Geology and Planetary Sciences, Caltech, Pasadena,  
CA, USA

<sup>3</sup>Dept. of Geological and Environmental Sciences, Ben-Gurion  
University of the Negev, Beer-Sheva, Israel

The marine biogeochemical carbon cycle is intrinsically linked to the marine biogeochemical sulfur cycle, via the oxidation of organic carbon during bacterial sulfate reduction. Over geological time, this coupling of the carbon and sulfur cycles is often explored using the carbon and sulfur isotopic composition of aqueous carbonate and sulfate. Over the course of the early Cenozoic, the carbon isotope composition of foraminiferal calcite suggests a major reorganization of the carbon cycle, with enhanced organic carbon burial in the Paleocene, and subsequent oxidation of this organic carbon or increased volcanism through the Eocene. Over this same time period, however, the sulfur isotope composition of marine barite exhibits only one shift of 5‰ in the early-to-mid Eocene. One complication of interpreting the coevolution of the carbon and sulfur cycles over the Cenozoic, however, is the fact that the mineral proxies used to reconstruct each cycle may not be temporally coincident, and may be extracted from different sediment cores in different ocean basins, leading to age-model uncertainty when the records are merged. To properly ascertain the phasing between early Cenozoic changes in the carbon and sulfur cycles, we would ideally measure carbon and sulfur isotopes on the same mineral.

A new sulfur isotope analytical technique [1] has been optimised for foraminiferal calcite as a proxy for seawater  $\delta^{34}\text{S}_{\text{SO}_4}$ . The  $\delta^{34}\text{S}_{\text{SO}_4}$  in foraminiferal calcite can then be tied to records of carbon isotopes from stratigraphically identical samples, resolving previous age model uncertainties. We present coupled carbon and sulfur isotope records from the same core over the early-to-mid Eocene, to better resolve the relative timing of changes in the carbon and sulfur cycles. We use a numerical model to explore the relative changes in the carbon and sulfur cycles in the early-to-mid Eocene.

[1] Paris *et al* 2013 *Chemical Geology*, **345**, 50-61