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Paleoclimate reconstructions beyond the limits of preservation of clumped isotope signatures: An example from Early Eocene soil carbonates in Argentina.

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Even though clumped isotopes are a relatively new proxy, most of the background work needed to apply it has already been established. One area where additional work is needed is in understanding to what extent the clumped isotope signal is preserved. To date, this question has been explored through controlled laboratory experiments, and two different conceptual models have been developed to explain these experiments (Passey and Henkes, 2012; Stolper and Eiler, 2015). It is not clear yet which of the two models better describes this process, an important gap in understanding because both have different predictions for the limits of clumped isotope preservation. More importantly, one model envisions reordering kinetics as an intrinsic property shared by all samples of the same minerology while the other allows for some heterogeneities in reordering kinetics. Here, we present the clumped isotope compositions of soil calcites from northern Argentina in a stratigraphic section that includes the Paleocene/Eocene Thermal Maximum. These samples have partially reordered clumped isotope signatures and experienced a common burial history. Consequently, our observations can be used to test the predictions of the reordering models. We show that although the clumped isotope signal is only partially preserved, meaningful paleoclimate information is still preserved in these samples. Finally, we discuss the implications of our results for the use of clumped isotopes deep in the geologic past, where most sections have experienced significant amounts of burial and diagenesis.

Passey B. H. and Henkes G. a. (2012) Carbonate clumped isotope bond reordering and geospeedometry. Earth Planet. Sci. Lett. 351–352, 223–236.
Stolper D. a. and Eiler J. M. (2015) The kinetics of solid-state isotope-exchange reactions for clumped isotopes: A study of inorganic calcites and apatites from natural and experimental samples. Am. J. Sci. 315, 363–411.