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A millennial-scale record of mean annual air temperatures spanning 70 ka over the Cretaceous-Paleogene boundary

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The Cretaceous-Paleogene (K-Pg) boundary experienced major environmental perturbations due to volcanism and bolide impact, as well as the most famous mass extinction in geologic history. However, the response of the climate system to these drivers at different timescales, and thus their relationship to the mass extinction is highly debated. In particular, the role of climate change in biodiversity patterns immediately preceding the boundary is poorly understood.

Lipids from fossil peats (coals) provide an opportunity to reconstruct terrestrial temperatures across the Cretaceous–Paleogene boundary at a millennial-scale resolution. Here we present mean annual air temperature records spanning ~70 ka over the K-Pg boundary, from sites across North America (palaeolatitudes 45–55 degrees N). Our data show that temperatures ranged from 16–29 degrees C, more than 10 degrees C higher modern temperatures at equivalent latitudes in North America.

Using 5-ka temporal bins, our data show that MAATs peaked at ~26 degrees C in the last millennia of the Cretaceous, following 35 ka of warming from ~23 degrees C. Peak warmth was followed by ~5 degrees C cooling over the following 30 ka. We observe no “impact winter” nor a spike in temperature immediately following the boundary. If such phenomena occurred, their duration was below the resolution of our record: ~1 ka. Our record also shows a previously unrecognised brief interval of cooling from 10 to 5 ka pre-boundary.

Our study places new bounds on millennial-scale trends in MAAT change in the terrestrial realm and demonstrates large and rapid temperature swings across the K-Pg interval. These data allow for improved understanding of the role of climate in the decline of Cretaceous flora and fauna and may help elucidate the relative influence of volcanism and bolide impact on terrestrial temperatures.