A reduced continental temperature gradient in North America during the Early Eocene

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The Early Eocene (56 Ma) is the youngest period of Earth's history when atmospheric CO_2 concentrations reached levels close to those predicted for future emission scenarios (600-1500 ppm). Marine proxies record a significant reduction in the equator-to-pole meridional sea surface temperature gradient during the Early Eocene, while on land, a limited and relatively uncertain data-set prevents a thorough examination of the gradient. Here, we present clumped and stable oxygen isotope measurements of siderite samples collected along a north-south transect on the Americas. These siderites formed in kaolinitic soils that developed broadly under the extremely wet and warm conditions of the Early Eocene. They provide a record of both soil temperature and the $\delta^{18}O$ of meteoric water ($\delta^{18}O_{mw}$), which are independent proxies of climate. Both parameters were estimated using an in-house calibration constructed with synthetic siderite precipitated in the presence or absence of iron reducing bacteria at ambient temperatures. Preliminary clumped-based soil temperatures are indistinguishable from Texas (30 °N) to southern Alaska (56 °N). Preliminary estimates of $\delta^{18}O_{mw}$ are up to 8 ‰ more enriched relative to today. Moreover, the absolute depletion in $\delta^{18}O_{mw}$ from 30 to 56 °N is 3 ‰ less than today which implies a decrease in the atmospheric temperature gradient on the order of 6 °C. By expanding our data-set even further with two new sites in Colombia and northern Alaska, we provide strong evidence for a reduced continental temperature gradient from 0 to 70 °N.