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Microbial control on the triple oxygen isotope composition of Cenozoic marine sulfate

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The triple oxygen isotope composition ($\delta'^{17}O$) of sulfate minerals is widely used to constrain ancient atmospheric pO_2/pCO_2 and rates of gross primary production. The utility of this tool is based on a model that sulfate oxygen carries an isotope fingerprint of tropospheric O_2 incorporated through oxidative weathering. Work to date has targeted Proterozoic environments (2.5 to 0.542 billion years ago) where large isotope anomalies persist; younger timescale records, which would ground ancient environmental interpretation in what we know from the modern Earth, are lacking. Here we present a high-resolution record of the $\delta^{18}O$ and $\delta'^{17}O$ in marine sulfate for the Cenozoic. This new record carries a $\delta'^{17}O$ close to 0, suggesting that the marine sulfate reservoir is under strict control by biogeochemical cycling (namely microbial sulfate reduction) with no discernible contribution from atmospheric oxygen on this timescale. We interpret a relatively steady flux of microbial sulfur cycling (terrestrial and marine), even as (1) the early Cenozoic saw a massive burial of reduced sulfur and (2) global sulfide weathering rates are thought to increase over the last 50 million years.