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Thirty-five million years of changing climate – carbon cycle dynamics

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Fifty-one years of scientific ocean drilling through the International Ocean Discovery Program (IODP) and its predecessors generated a treasure trove of Cenozoic climate and carbon cycle dynamics. Yet, it remains unclear how climate system and carbon cycle interacted under changing geologic boundary conditions. Here, we present the carbon isotope ($d^{13}C$) megasplice, documenting deep-ocean $d^{13}C$ evolution since 35 million years ago (Ma). We juxtapose the $d^{13}C$ megasplice with its $d^{18}O$ counterpart and determine their phase-difference on ~100-kyr eccentricity time-scales. This analysis uncovers that 2.4-Myr eccentricity modulates the in-phase relationship between $d^{13}C$ and $d^{18}O$ during the Oligo-Miocene (34-6 Ma), potentially related to changes in continental weathering. At 6 Ma, a striking switch from in-phase to anti-phase behaviour occurs, signalling a threshold in the climate system. We hypothesize that Arctic glaciation and the emergence of bipolar ice sheets enabled eccentricity to exert a major influence on the size of continental carbon reservoirs. Our results suggest that a reverse change in climate - carbon cycle interaction should be anticipated if CO_2 levels rise further and we return to a world of unipolar ice sheets.