A Geochronologically-Constrained Test of the Monterey Hypothesis for Miocene Climate Change

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Abstract

The Miocene Climate Optimum warming (MCO, 16.9 – 14.7 Ma) and Middle Miocene Climate Transition cooling (MMCT, 14.7 – 13.8 Ma) provide opportunities to study carbon cycle dynamics in the geologically recent past. The Monterey Hypothesis interprets MMCT cooling as part of a positive feedback in which enhanced organic carbon burial drew down atmospheric CO_2. The hypothesis has been supported by correlation of phosphorites and organic-rich deposits in the Monterey Formation in coastal California with positive carbon isotope excursions in the global record and the Miocene cooling trend. Here, we test the Monterey hypothesis by quantifying and temporally constraining organic carbon mass accumulation rates (OCMAR) using 31 new U/Pb zircon LA-ICPMS and 14 new CA-ID-TIMS ages on volcanic ash beds in the Monterey Formation along the Santa Barbara coast. Contrary to predictions of the Monterey Hypothesis, we find that OCMAR and phosphogenesis in these localities were strongly dependent on sea level and sedimentation rate. Instead, organic carbon burial rates in the Monterey Formation responded to local tectonic forcing and global climate change, implicating other changes in carbon sources or sinks as drivers of Miocene cooling.