

Testing the role of large igneous province volcanism in the Miocene Climate Optimum with a new boron isotope record from the Western Pacific Warm Pool

JENNIFER KASBOHM^{1,2}, DR. HANA JURIKOVA³, ANN HOLBOURN⁴, NOAH J. PLANAVSKY², JAMES W. B. RAE³
AND PINCELLI M. HULL²

¹Carnegie Science

²Yale University

³University of St Andrews

⁴Christian-Albrechts-University

Understanding Miocene climatic changes requires the development of proxy records within a well-calibrated temporal framework. Large igneous province emplacement in the Columbia River Basalt Group (CRBG) has been suggested to cause elevated global temperatures and CO₂ during the Miocene Climate Optimum (MCO), but assessing the connection between volcanism and warming requires robust timelines for proxy records of these events. While we have developed a new age model for CRBG volcanism based on high-precision U-Pb geochronology (Kasbohm et al., 2023) and a U-Pb age model for the MCO that reinforces the validity of astronomically tuned age models for this event (Kasbohm et al., 2024), only a small number of MCO proxy records have been age-calibrated through astronomical tuning. Existing boron isotope CO₂ proxy records from the MCO were age-calibrated through biostratigraphy alone, hindering correlation to known intervals of CRBG volcanism. These records showed high-amplitude CO₂ variability, calling into question the stability of the Miocene climate system.

Here, we present a new boron isotope record from International Ocean Discovery Program Site U1490 (Western Pacific Warm Pool), which has an astronomically tuned age model concordant with our radiometric ages for the MCO (Holbourn et al., 2024). This new record targets the onset of the MCO through the end of the main-phase CRBG volcanism (17.1-16 Ma) at ~15 kyr resolution, with lower resolution across the entire MCO (17.8-13 Ma). We find well-resolved and relatively stable pH values across the MCO. Our reconstructed CO₂ estimates show less variability than prior records, though we note somewhat variable correlation with changes in MCO benthic $\delta^{18}\text{O}$ values. We observe little change in CO₂ resulting from CRBG surface volcanism, and no strong correlation between CO₂ changes and the tempo of CRBG eruptions. A transient uptick in CO₂ prior to surface eruptions, as well as sustained somewhat higher values afterwards, may be explained by cryptic degassing of large amounts of CRBG magma trapped in the crust, but the magnitude of this CO₂ change was small.