Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37216

Constraining Middle Miocene ocean circulation under relatively low atmospheric CO_2

KARLOS G. D. KOCHHANN[1], PAM VERVOORT[2] AND SANDRA KIRTLAND TURNER[3]

[1]GEOMAR Helmholtz Centre for Ocean Research Kiel
[2]University of Birmingham
[3]University of California, Riverside

Reconstructions of atmospheric CO_2 predict concentrations of 350-600 ppm in the Middle Miocene. However, under these relatively low CO_2 concentrations, climate models struggle to simulate Miocene surface and deep ocean warmth, and ocean circulation patterns that are consistent with proxy data. This suggests a potential model-data mismatch in climate sensitivity and/or global moisture and heat distribution. Here, we use the intermediate complexity Earth system model cGENIE to assess how varying climate sensitivity and North Atlantic salinity fluxes influence the fit between model results and proxy data in the interval leading up to the Miocene Climate Optimum (MCO; ~17.0 Ma). We show that at ~400 ppm, simulated sea surface temperatures are generally colder than proxy estimates but the fit can be improved by increasing radiative forcing. In addition, increased salinity (decreased fresh water) fluxes in the North Atlantic lead to enhanced formation of warm high-salinity intermediate Northern Component Water. This increases bottom water temperatures, improving the match with deep ocean temperature reconstructions from proxy data and benthic foraminiferal carbon isotope records (a proxy for ocean overturning circulation); as well as increases the carbonate content (preservation) of deep ocean sediments at a global scale, which improves the match with proxy wt% $CaCO_3$records. Our results suggests that the Middle Miocene was characterized by higher-than-modern equilibrium climate sensitivity and that models may need to impose a freshwater flux correction (similar to that needed for the present-day to simulate Atlantic Meridional Overturning Circulation - AMOC) to accurately simulate Middle Miocene ocean circulation patterns and deep ocean carbonate chemistry.