Nitrogen isotopic evidence for Pliocene closure of the Central American Seaway

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Closure of the Central American Seaway (CAS) during the Pliocene may have contributed to the demise of Pliocene warmth and the eventual onset of Quaternary ice ages by potentially affecting the meridional overturning circulation that transports heat across latitudes and between hemispheres. Previous efforts to reconstruct CAS closure have focused on the origin of the modern day differences in surface water properties between the equatorial Pacific and Caribbean. However, the complexity of Caribbean Sea surface water hydography and concerns over the fidelity of paleo-hydrographic proxies leads to uncertainty in the CAS closure history. Here we revisit CAS closure using foraminifer-bound nitrogen isotopes (FB-δ^{15}N), a proxy for the nitrogen isotopic composition of nitrate supplied to the surface ocean. Today, δ^{15}N of this nitrate supply differs strongly between the eastern tropical Pacific (mostly >7‰) and the Caribbean (mostly 2-3‰), largely due to the regional signals of water column denitrification and N_2 fixation, respectively. FB-δ^{15}N measurements from Ocean Drilling Program Site 999 in the Caribbean Sea between 4.8 and 3.2 Ma show a sharp 1 ‰ FB-δ^{15}N decrease at 4.2 Ma, which we argue represents restricted eastward flow of thermocline nitrate from the Pacific into the Caribbean Sea due to CAS shoaling at this time. Implications of curtailed low-latitude thermocline water exchange between the Pacific and Atlantic Oceans for oceanic N-cycling and Pliocene climate evolution will be discussed.