Modeling Nd oceanic cycle in present and past climate, with a focus on the closure of the Panama isthmus during the Miocene.

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The international GEOTRACES program has been organized to study the oceanic processes that control the oceanic distribution of trace elements in the ocean. Nd isotopes measurements represent a promising tracer to study past and present ocean circulation. However the processes that control the distribution of this tracer in the ocean are still not perfectly understood. Modeling represents a unique tool to improve our understanding on this trace element in the ocean. We will present some modeling studies where we have explicitly implemented this tracer in the General circulation model NEMO. The modeling studies has allowed us to progress in our understanding of Nd cycle in the ocean and to investigate the fluxes that dominate the Nd Input in the ocean, and to apprehend the relevant processes that control the internal oceanic cycle. We then show some results from past climate, focusing on the closure of the Panama Isthmus and its impact on the climate and the oceanic circulation during the Miocene.

Using Bulk Paleosol Organic Matter to Reconstruct Atmospheric $\delta^{13}C_{CO2}$

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The carbon isotopic composition of dispersed organic matter in paleosols has the potential to provide two of the input parameters into Cerling's [1] atmospheric pCO_2 paleobarometer equation. These variables are the $\delta^{13}C_{CO2}$ of the atmosphere and the $\delta^{13}C$ of soil respired CO_2. The isotopic composition of marine carbonates has often been used as a proxy for the composition of the atmosphere however, tenuous correlations between marine and terrestrial rocks limits the resolution of resulting atmospheric pCO_2 reconstructions. Additionally, bulk paleosols provide a terrestrial continuum of values for the paleosol barometer as opposed to the sporadic occurrence of coals or charcoal. Therefore, this study investigates the use of dispersed organic matter in paleosols as a record of atmospheric $\delta^{13}CO_2$.

Modern soils have not provided much insight into the likelihood that an atmospheric signal will be preserved in paleosol organic matter. Soil organic matter (SOM) in modern soils typically displays an increase in $\delta^{13}C$ with depth casting doubt on its isotopic reliabily in the rock record. The multitude of conflicting theories that have been proposed to explain modern depth trends in $\delta^{13}C$ of SOM [2] may indicate that the modern is not an appropriate analogue for ancient soils. We therefore turn to the rock record for evidence of a preserved atmospheric signal in bulk paleosol organic matter. Only pre-Miocene paleosols are considered in this study to avoid the confounding presence of C_4 plant material which would add an additonal pool of organic matter with its own distinct atmospheric signal. Additionally, none of the studied paleosols exhibit macroscopic evidence of extreme drought conditions, an environmental stress that significantly alters the atmospheric carbon isotope signal preserved in fossil plants.

The successions of stacked paleosols that we have studied (Late Cretaceous/EarlyTertiary in west Texas and Late Triassic in eastern Arizona) have the following characteristics: 1.) Low organic carbon contents (<0.05 wt. %), 2.) No correlation between organic matter abundance and carbon isotopic composition 3.) Carbon isotopic compositions that are similar to modern C_3 plants, 4.) No consistent relationship beween soil depth and $\delta^{13}C$ of SOM, 5.) Presence of temporal trends in the $\delta^{13}C$ of SOM that can be correlated to $\delta^{13}C$ trends in coeval marine carbonates, and 6.) Carbon isotopic compositions that are similar to terrestrial organic matter of the same age from different geographic locations.

Based on these observations, it appears that dispersed organic matter in bulk paleosol samples has the potential to preserve a carbon isotope ratio that reflects the composition of the ancient atmosphere and may be used for quantitative atmospheric reconstructions.

[1] Cerling T.E. (1991) *Science* **291**, 377-400. [2] Ehlringer J.R., Buchmann R.N., Flannagan L.B. (2000) *Ecological Applications* **10**, 412-422.