

High resolution tropical isotope dendroclimatology: Prospects and challenges

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We describe an approach to the development of proxy hydrometeorological estimates from tropical trees. The approach relies on the observation of the annual wet-dry seasonality typical to tropical environments as mirrored in the oxygen isotopic composition of wood-derived alpha cellulose. A modified protocol allows for rapid, simple and non-toxic micro-extraction of pure alpha cellulose, which is isotopically indistinguishable from that produced by more classical means. A new high temperature reactor for use in an induction heater permits isotopic analysis of alpha cellulose samples as small as 30ug and O(100) automated sample analyses per day at low cost. A forward model adapted for tropical environments can be used to test the interpretation of the isotopic data and to plan sampling networks. Development of long hydrometeorological records from the terrestrial tropics by a growing number of colleagues is underway. Together we should be able to build a network of paleoprecipitation records which should greatly improve our ability to model past climates and to understand linkages between surface ocean temperature patterns and large-scale drought.

The Zn isotopic composition of diatom frustules: An archive of past trace metal depletion in HNLC zones?

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Zinc is among the essential trace-metal micronutrients for phytoplankton. In common with some other bio-active trace metals, Zn concentrations are highly depleted in those parts of the surface ocean that are replete in the major nutrients (so-called High Nitrate-Low chlorophyll, or HNLC, zones), such as the Southern Ocean. The proposed release of these HNLC zones from trace metal limitation is one of the key hypotheses to explain lower atmospheric CO₂ during glacial periods [1]. The preferential incorporation of light Zn isotopes into phytoplankton organic material [2] leaves residual seawater Zn isotopically heavy. The isotopic heaviness of the residual seawater Zn could track the degree of trace metal depletion in the past if a suitable archive of surface seawater Zn isotopes could be identified.

Here we investigate diatom opal as a record of the Zn isotopic composition of surface seawater. We have measured Zn isotopic compositions in cleaned diatom frustules from a sequence of core-top samples across the Southern Ocean. Diatom opal exhibits heavy Zn isotopic compositions, centred at $\delta^{66}\text{Zn}_{\text{Lyons-JMC}}$ compositions around +1‰, which is significantly heavier than the continental input of +0.3‰ but similar to surface waters from the NE Pacific HNLC zone. These results suggest that Zn isotopes in diatom frustules have potential as a record of past trace metal depletion in HNLC zones.

[1] Brovkin *et al.* (2007) *Paleoceanography* **22**, PA4202.

[2] John *et al.* (2007) *Limnol. Oceanogr.* **52**(6), 2710-2714.