

A 2000-year rainfall record from the Eastern Tropical Pacific and ENSO variability during the Common Era

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The ENSO is the dominant mode of interannual tropical climate variability with widespread global teleconnections. Understanding its natural variability is a key factor to evaluate its effect on the internal variability in the global climate system. We present a 2000-year rainfall reconstruction from the Eastern Tropical Pacific based on a calibrated lipid biomarker ratio, the DiTe index [1], using the annually laminated sedimentary sequence of a crater-lake located in Isabel Island (Mexico). In the region, the highly seasonal rainfall pattern is dominated by ENSO dynamics, resulting in drier/wetter conditions during positive (El Niño)/negative (La Niña) anomalies. Our inferred past rainfall variability shows negative anomalies at millennial and centennial scale coinciding with periods of high frequent and strong El Niño events being coherent with other hydroclimatic records, based on independent proxies within the target region. Our record of subdecadal resolution allows for detailed evaluation of regional rainfall variability during key periods, such as, the Medieval Climate Anomaly and Solar minima and therefore, contributes to the understanding of climatic variability in the Tropical Pacific. [1] Romero-Viana, Kienel & Sachse (2012), *Palaeogeogr. Palaeoclimatol. Palaeoecol.* 350, 49-61.

Are the anhydrite and gypsum carbonation pathways the same?

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Coupled dissolution-recrystallization reactions during interactions between carbonate-bearing fluids and calcium sulphate minerals lead to de novo formation of CaCO₃ polymorphs. The carbonation of anhydrite (ANH, CaSO₄) and gypsum (GYP, CaSO₄·2H₂O) produces dramatic changes in both textural and chemical properties of the starting calcium sulphate phase (e.g., porosity, composition etc.). However, our understanding of such processes is still fragmented.

Here we present an experimental study comparing the carbonation of ANH and GYP at 25 °C. In both cases, the formation of various CaCO₃ polymorphs occurred immediately upon contact between the solid phase and a Na₂CO₃ solution. However, differences in textural features and reaction pathways were observed between both systems. GYP carbonation produces a large volume of porosity with a prominent gap between parent and product phases. Conversely during ANH carbonation such a gap does not form and porosity generation is minimal. Furthermore, the produced CaCO₃ polymorphs are spatially differently distributed on ANH vs. GYP surfaces and within the replaced layer indicating that the nature and reactivity of the parent phases control the CaCO₃ polymorph and the evolution of textural features during carbonation. These results have implications for biomineralization, CO₂ sequestration and industrial applications.

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