



## T52B-06 - Triple oxygen isotopes, aridity and uplift: a case study from the Atacama (Invited)



Friday, 13 December 2019



11:35 - 11:50



Moscone South - 156, Upper Mezz.

### Swirl Topics

Earth Processes - SWIRL

### Abstract

Oxygen isotope records are widely used to reconstruct histories of climate, topography and uplift, but their sensitivity to multiple variables often results in competing views of their interpretation. Carbonate clumped isotope paleothermometry aids interpretation of these data by providing constraints on both uplift and burial histories and the  $\delta^{18}\text{O}$  values of waters from which carbonate forms. However, even with these constraints, it can be difficult to draw definitive conclusions about climate and paleoelevation because the relationship between  $\delta^{18}\text{O}$  values of formation waters and local precipitation (e.g. influence of evaporation) is unknown. Recent work on triple oxygen isotopes ( $^{18}\text{O}$ - $^{17}\text{O}$ - $^{16}\text{O}$ ) in waters and carbonates demonstrate their sensitivity to evaporation and potential for evaluating the effects of evaporation on  $\delta^{18}\text{O}$  records. The Atacama Desert, one of the driest places in the world, is a perfect place to explore the utility of  $\Delta^{17}\text{O}$  because  $\delta^{18}\text{O}$  records are extensively used to infer its climate and uplift history but their interpretation is widely debated. Here we present triple oxygen ( $\Delta^{17}\text{O}$ ) and clumped ( $\Delta_{47}$ ) isotope data from nine palustrine, groundwater and soil carbonate samples from the Atacama (Barrancas Blancas region and Calama Basin) that span the last 24 Ma.  $\Delta_{47}$  temperatures range from 8 to 49 °C, with the warmest temperatures from the oldest samples. Reconstructed water  $\delta^{18}\text{O}$  values range from -4 to +1 ‰ and do not show significant trends with time but overlap with or are more positive than  $\delta^{18}\text{O}$  values of Atacama meteoric waters today. Carbonate  $\Delta^{17}\text{O}$  values (-167 to -141 per meg, reference  $\lambda = 0.528$ , VSMOW-SLAP) do not exhibit any temporal trends. Reconstructed water  $\Delta^{17}\text{O}$  values (-59 to -12 per meg) are lower than those for the majority of global meteoric waters today and indicate that highly evaporative conditions may have existed in the Atacama for the last 24 Ma, even amidst significant uplift. This result is in contrast to interpretations based on  $\delta^{18}\text{O}$  carbonate records alone. We will need additional  $\Delta^{17}\text{O}$  data from samples with greater temporal and spatial resolution to truly evaluate the history of aridity in the Atacama, but our initial results demonstrate the promise of combining  $\delta^{18}\text{O}$ ,  $\Delta_{47}$ , and  $\Delta^{17}\text{O}$  data for understanding the influence of temperature and evaporation on  $\delta^{18}\text{O}$  records.

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**Hagit P Affek**, Rolf Vieten, Shelly Bergel and Eugeni Barkan, Hebrew University of Jerusalem, The Fredy & Nadine Herrmann Institute of Earth Sciences, Jerusalem, Israel

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**Jordon Hemingway**<sup>1</sup>, Haley Olson<sup>1</sup>, Alexandra v Turchyn<sup>2</sup>, Edward Tipper<sup>2</sup> and David T Johnston<sup>3</sup>, (1)Harvard University, Earth and Planetary Sciences, Cambridge, MA, United States, (2)University of Cambridge, Cambridge, United Kingdom, (3)Harvard-Earth & Planet Science, Cambridge, MA, United States

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