

Towards a new proxy of continental atmospheric humidity: the triple oxygen isotopic composition of plant biosilica.

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There is a serious lack of proxy suitable for reconstructing, in a quantitative way, past changes of continental atmospheric humidity. This reduces the possibility to make model-data comparisons necessary for the implementation of climate models. Over the past 10 years, analytical developments have enabled a few laboratories to reach sufficient precision for measuring the triple oxygen isotopes, expressed by the ^{17}O -excess, in water, water vapor, atmospheric oxygen, and minerals. The ^{17}O -excess represents an alternative to d-excess for investigating relative humidity conditions that prevail during water evaporation. The ^{17}O -excess of water results from the increase of kinetic isotopic fractionation at evaporative sites as a function of decreasing relative humidity. This mechanism occurs at large scales, i.e. during seawater evaporation or during plant canopies transpiration. Unlike d-excess, ^{17}O -excess is supposed to be insensitive to temperature and less sensitive than δD and $\delta^{18}\text{O}$ to equilibrium fractionation during transport and precipitation. Additionally, the ^{17}O -excess is recorded in biogenic minerals less prone to weathering than organic compounds. Here, we calibrate the ^{17}O -excess of plant biosilica as a new air humidity proxy. First, we examined the behavior of the ^{17}O -excess in soil water, leaf water and phytoliths in growth chambers in response to changes in relative humidity. Second, we measured the ^{17}O -excess of soil phytolith assemblages from inter-tropical savannas and forests distributed along humidity transects. Both approaches show similar dependency of phytolith ^{17}O -excess to relative humidity. The results allow to discuss future calibration directions aimed at estimating the precision of the obtained relationship and at quantifying the successive isotopic fractionations in play at the soil-plant-atmosphere interface, to provide a strong proxy of past atmospheric relative humidity.