Many minerals incorporate water directly into their structure as molecular water (H$_2$O) or hydroxyl (OH). The oxygen ($^{16}\text{O}$,$^{17}\text{O}$,$^{18}\text{O}$) and hydrogen (H,D) isotopes of hydrated minerals are a potentially rich source of information about the environmental conditions under which hydrated minerals form and/or interact with fluids after deposition. As part of a 5-year European Research Council project, my group has been developing the use of triple oxygen and hydrogen isotopes of structural water contained in hydrated minerals as a paleoclimate proxy. We are pioneering new methods for measuring $d^{18}\text{O}$, $d^{17}\text{O}$ and dD in hydrated minerals by combining thermal gravimetric analysis and cavity ring-down laser spectroscopy. I will specifically discuss the merits and uncertainties in combining measurements of $d^{18}\text{O}$ of biogenic carbonates and triple oxygen and hydrogen isotopes of hydration water in gypsum (CaSO$_4$·H$_2$O) in lake sediments cores to estimate past changes in temperature, rainfall and relative humidity on the Yucatan Peninsula, Mexico.