Long-term monitoring of drip water trace elements and Cl variability of Río Secreto Cave in the Yucatan Peninsula, Mexico.

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Stalagmite calcite $\delta^{18}O$ and trace element ratios (e.g. Mg/Ca and Sr/Ca) provide paleoclimate records with near global distribution. Paleoclimatic interpretation of trace element ratios depends on the specific processes of the cave, including ventilation and the prior calcite precipitation (PCP) driven by hydroclimate. In the Yucatan Peninsula, stalagmite $\delta^{18}O$ is a demonstrated proxy for paleorainfall, in caves with >95% relative humidity and constant temperature. We now provide an integrated study in the Rio Secreto cave system of rainfall, groundwater and drip water samples over 2014-2018, at weekly intervals over 36 months, and then monthly intervals over 16 months. In addition to in-situ physical-chemical monitoring, analysis of >800 samples of groundwater, rain, and 7 speleothem forming drips includes Mg, Ca, Sr, Ba, U, Cl, Fe, Mn, Al and Ti. Elemental concentrations vary between drips, even where adjacent within 1-100 m within the cave. There is broad time varying coherence over seasons and years amongst most drips. One drip has an order of magnitude higher concentrations for Al, Mn, Fe and Ti and is classified as an overflow hydrology. The elemental ratios relative to Ca indicate PCP is occurring in most drips, even though the vadose zone is maximum 10 m thick. This study supports the use of Mg/Ca, Sr/Ca and Ba/Ca ratios as robust paleoclimatic proxies from stalagmites of this region. The long-term nature of this study allows for valuable assessment of inter-annual variance in response to climate forcing.