178-1 - KARST HYDROLOGICAL CONTROL ON OXYGEN ISOTOPE VARIABILITY OF CAVE DRIP WATER: A REGIONAL CAVE MONITORING STUDY FROM THE PERUVIAN ANDES

Tuesday, 17 October 2023

8:00 AM - 5:30 PM

Hall B (2, David L Lawrence Convention Center)

Booth No. 192

Abstract

Recent studies have improved our understanding of how karst hydrology impacts variability in modern cave drip water $\delta^{18}O$ values and the resultant calcite $\delta^{18}O$ values of speleothem paleoclimate records. Monitoring of cave drip water isotope values reveals that flow path controls the differences in drip site values in many caves worldwide. We present a case study of three caves from the central Peruvian Andes where isotopic differences between sites are informed by monitoring data. Relative humidity at Huagapo and Pacupahuain caves is 100% year-round with no fluctuations, so any isotopic fractionation of waters must occur in the vadose zone or epikarst. Precipitation isotope data from the 2022-2023 year show differences with elevation, where annual mean precipitation at 3600 masl (meters above sea level) is, on average, 2‰ greater than precipitation at 4100 masl. Cave drip water was sampled four times (April, June, and November 2022, and June 2023). Average drip water $\delta^{18}O$ values were lowest at the high elevation (4004 masl) cave of Antipayargunan -14.7 ± 2.5‰; similar values were found at the lowest elevation (3600 masl) cave of Huagapo -14.5 ± 1.2‰. Pacupahuain cave had the highest values with an average of -13.9 ± 1.7‰. The higher values at Pacupahuain Cave (3800 masl) may be attributed to higher evaporation due to vadose zone residence time, a lower average recharge elevation for this catchment and/or potential contribution from a sinkhole lake (Lago Gallerina) above the cave. Huagapo Cave is large, and sampling sites over 1 km in distance show that the $\delta^{18}O$ value of drip water increases by 0.5‰ with increasing distance from the cave entrance. Drip counting sensor data and a continuous SYP autosampler at Pacupahuain Cave provide a time series showing that drip rate peaks during the monsoon season. More specifically, the data show a maximum of 2 ‰ difference in drip water at the autosampler site between the end of the wet season in May and the middle of the dry season in August – at which point drips cease for six months. Seasonal recharge dominates most drip water sites, while drip counters show evidence for fracture and diffuse flow-dominated drip sites. These data suggest that, similar to other cave sites, flow path is important for intra-cave differences in drip water isotope values. However, we find that karst hydrology plays a more dominant role between caves.

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