Geophysical Research Abstracts
Vol. 20, EGU2018-12744, 2018
EGU General Assembly 2018

Local and distant Pacific climate signals in cave hydrochemistry: Waipuna cave, New Zealand.

Cinthya Nava (1), Adam Hartland (2), Bethany Fox (2), Ola Kwiecien (1), Fernando Gazquez (3), and Sebastian Breitenbach (1)

(1) Ruhr-Universität Bochum, Institute of Geology, Mineralogy & Geophysics, Sediment & Isotope Geology, Bochum, Germany , (2) School of Science, University of Waikato, NZ., (3) School of Earth & Environmental Science, University of St. Andrews, UK.

In this study, the preliminary results of monitoring at Waipuna cave, New Zealand, are introduced to support the development of speleothem paleoclimate archives of long-term variability in the El Niño-Southern Oscillation (ENSO) and teleconnections to high southern latitudes. Waipuna cave is located in Waitomo region, North Island, NZ, which in turn is situated at the southwestern fringe of the Pacific Ocean, an area highly sensitive to ENSO and the southern Westerlies (Shulmeister et al 2004). Monitoring of current surface and in-cave microclimate parameters help us to understand and interpret the conditions under which geochemical proxies were incorporated into the speleothem and quantify climate-speleothem transfer functions.

Aspects of water chemistry such as electrical conductivity, pH, temperature, major ions and total alkalinity have been monitored at monthly intervals at six strategic drip sites inside Waipuna Cave over the last two years. Drip rates have been automatically logged and dripwater samples analysed for trace elements as well as stable isotopes (δD and δ^{x8}O). Information on cave meteorology (temperature, pCO_2) and hydrology (drip rated) that are key to understanding the controls on speleothem grow were also monitored along with external meteorological conditions, including temperature and rainfall, the latter using an automated station. HYSPLIT backward trajectory modeling is used to trace the history of moisture delivered to Waipuna Cave and its influence on drip hydrochemistry.

Significant correlations between Mg/Ca (R^2=0.58) and Sr/Ca (R^2=0.68) with drip rates were evident, consistent with prior calcite precipitation along the dripwater flow path. Dripwater stable isotopes show no secondary evaporation making them suitable for tracking of moisture history. Dripwater Na shows a strongly positive correlation (R^2=0.65) with K, indicating the transport of sea salt aerosols. Comparison of changes in Na and K with our backward trajectory model results show an intriguing relationship with wind direction and intensities, indicating the potential of these elements as proxies of windiness. High wind intensities from the west lead to increased Na and K concentrations, whereas southerly wind vectors result in reduced input of sea-salt-derived Na and K in Waipuna Cave dripwater.

Comparisons of stable isotope and elemental composition in speleothems can be used to reconstruct the intensity of the southern Westerlies and local rainfall amount. Fast growing speleothems from Waipuna Cave are likely to record wind speed and wind direction, and can be used to help test spatio-temporal variability of the connection between ENSO and the southern Westerlies, the latter being typically weaker under La Niña conditions (negative ENSO anomalies).

Shulmeister, J., Goodwin, I., Renwick, J., Harle, K., Armand, L., McGlone, M.S., Cook, E., Dodson, J., Hesse, P.P., Mayesky, P., Curran, M., (2004) The Southern Hemisphere Westerlies in the Australasian sector over the last glacial cycle: a synthesis. Quaternary International 118-119, 23-53.