

The Speleothem Phosphate Palaeothermometer

Our latest scientific project in the Matienzo caves addresses the difficult issue of building a climate record of past temperature. Of the techniques currently available to do this, these suffer from ambiguity around calibration, require large sample sizes, and are very spatially limited to specific parts of the World. This has prevented scientists from obtaining a high resolution, high density network of terrestrial temperature records, leaving a significant gap in our knowledge and understanding of palaeoclimate.

In this project, we aim to develop a new technique, allowing us to extract absolute temperature values from speleothems based on the phosphate content of the speleothem calcite. This idea is based on existing knowledge that oxygen isotopes within a phosphate molecule change according to temperature when contained within soil and hydrological systems. When phosphate entering into a cave becomes incorporated into speleothem calcite, the temperature signal should thus be locked into the palaeorecord. As the internal temperature of shallow caves reflect the average external temperature, we think this should provide an opportunity to build a truly independent terrestrial temperature record, that can be used in cave sites globally.

This specific research project represents the first step of the scientific journey towards building the speleothem thermometer. We will develop a modern-day calibration between phosphate contained within Riaño cave drip waters, incubated at different temperatures. We will then test the suitability of this calibration by extracting phosphate from modern speleothems which have grown in cave sites around the World, at known temperatures ranging between 2 to 25 °C.

If this relationship between phosphate and temperature is found to be robust, future work will focus on extracting the palaeotemperature record from speleothems which have grown over a range of different timescales and in different locations.

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Peter Wynn, February 2023