The Biotic Influence on Speleothem Morphology

Studying life and life-mediated deposits in caves can provide information about habitability and mineral-life interactions in extreme environments and other planets. Asperge and Breezeway are examples of caves containing mineral deposits (helictites) whose formation is orchestrated by life. Such helictites grow in an area with little water, no light, and on a substrate that is rich in heavy-metals. Two specific helictites morphologies from Breezeway are of interest for our research: acicular and tubular. The former are made of aragonite, and their formation can be explained abiotically. Tubular morphologies are composed of calcite and present a central hole that challenges an abiotic genesis hypothesis. Similar to Asperge cave, we hypothesize that the tubular helictites from Breezeway formed biotically as well.

We used high-resolution imagery to seek biotic films, study textures, and chemical elements. SEM images reveal that small calcite “flakes” cover larger calcite crystals and small filaments create bridges between the calcite “flakes” and the calcite crystal. We suggest that such filaments are extracellular polymeric substances (EPS), which is a remnant of microbial life activity.

On acicular samples, we mostly observe pristine aragonite needles. However, on a few acicular samples, we observe what appears to be EPS. We suggest that such an EPS might represent the initial stages of the microbial colonization of an abiotic speleothem.

This research furthers the understanding that life exists in extreme environments and can create complex mineral deposits. Understanding how life can thrive in these conditions is a starting point for the study of life on other planets. Given that caves are present on Mars and other planetary bodies, we suggest a potential way to search for past or present evidence of life in the geological record.