Science and Technology Group Annual Report FY2018

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1 Introduction

In FY2018, I continued to work on the paleoclimate evolution of Donnehue's cave region in the Midwestern USA, with a focus on identifying the cave system's response to various signals from the soil and the atmosphere occurring during both the interglacial periods and the transitions to glacial periods.

Paleoclimate studies of caves that are easily accessible benefit from a comprehensive monitoring of the cave system's environment and chemistry. The data from monitoring, for example, the time evolution of the drip water isotope and trace element composition, can be compared against other signals, such as, isotope composition of precipitation, soil trace element analysis, etc. This allows for a better understanding of how the speleothem chemistry responds to the chemistry of the environment, thus helping to better differentiate between the sources of the recorded signals. An important caveat is that such data is difficult to extrapolate too far into the geologic past, such as is the case of my study.

Fortunately, the presence of stalagmites that grew during two different interglacials and two different glacials (i.e. MIS 5e and MIS7 interglacial periods and MIS3 and MIS 6 glacial periods) allows for a direct comparison of their signal, thus allowing for differentiating between a regional signal and a more complex past climate change signal.
In order to obtain a very accurate comparison, I chose to image the micro structure of all the samples through confocal microscopy. Additionally, I completed the trace element and stable isotope analyses on all coeval portions of these stalagmites.

2 Activities and Findings

Firstly, I obtained high resolution trace element data for the coeval section of three stalagmites (DC1, DC34, and DC48) from different parts of Donnehue's Cave. This allowed for a direct comparison of their growth dynamics and their relation to the three respective drip sites. My preliminary results have yielded valuable information regarding the variations in different trace elements compositions. One example is the Mg/Ca ratio variation, which may correlate with the amount of rainfall over time. By examining the Mg/Ca ratio in multiple stalagmites that grew during both glacial and interglacial episodes, I seek to identify how the rainfall responded to past climate change in my region.

Secondly, I used a confocal microscope to obtain micro-X-Ray fluorescence scans of all stalagmites in the study. This method allows for a complete visualization of: annual growth laminae presence and morphology (Figure 1), variations in organic/fluorescent material with time, and hiatuses which may not be identifiable through dating methods due to their uncertainty.

Thirdly, I obtained high resolution isotope data for the both the coeval parts of Dc48, as well as for parts of it which fill in the gaps of the other two MIS7 stalagmites (DC1 and DC34).

The comprehensive interpretation of these data is currently in progress.

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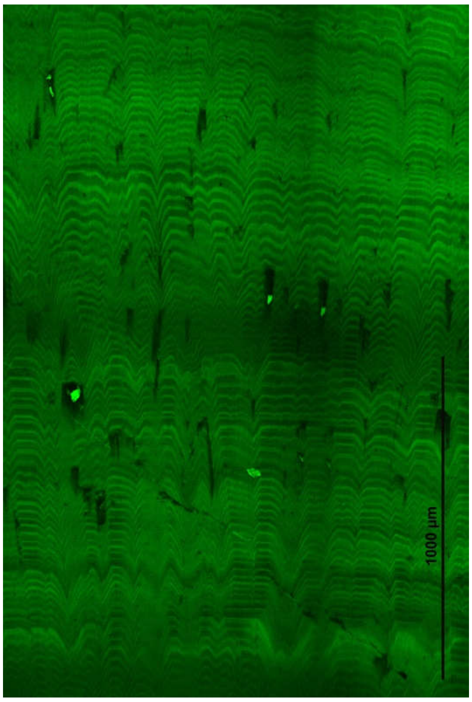

Figure 1. Confocal microscope image showing annual lamination (dark and light band couplets) along elongated columnar crystals

3 Collaborations

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References

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