

Science and Technology Group Annual Report FY2020

Chirienco Mirona
Science and Technology
Associate

1 Introduction

A comparative study of Midwestern USA paleoclimate and paleoenvironment from cave deposits

In my previous research I have focused on stalagmites from Donnehue's Cave (southern Indiana, Midwestern USA). In my new project, seeking a comprehensive view of regional responses to paleoclimate events, I plan to obtain high-precision and high-resolution U/Th and stable isotope ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) analyses of stalagmites from additional caves across the Midwestern USA, with a focus on samples precipitated during the Holocene Epoch (11,700 yr to present).

Stalagmite fabrics

The morphology of the stalagmite laminae, and the type of layer-bounding surfaces between different growth intervals within the same stalagmite are known to yield important paleoclimate and paleoenvironmental information (e.g. Dreybrodt, 1999; Railsback et al., 2013; Railsback et al., 2016). Layer bounding surfaces, as defined by Railsback et al., 2013 “delimit series of layers and represent periods of non-deposition, either because of exceptionally wet, or exceptionally dry conditions”. By examining these features in a large population of stalagmites within the same cave I plan to achieve the following: 1) Select the growth intervals within individual stalagmites that are most suited for a petrographic study, and identify and characterize their layer-bounding type, 2) Establish detailed microstratigraphic logs for stalagmite characterization, and 3) Complement this study with geochemical analyses where necessary.

2 Activities and Findings

A comparative study of Midwestern USA paleoclimate and paleoenvironment from cave deposits

We selected three stalagmites collected from different caves across Midwestern USA for processing and stable isotope analyses ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$). The stalagmites were previously sectioned along their vertical growth axis at the Illinois State Geological Survey. Each of the stalagmites was first polished and then milled at 0.2 mm intervals (Figure 1). The sample processing and the stable isotope analyses were completed at the University of Innsbruck (Austria). The data interpretation is in progress.

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Figure 1. The three stalagmites after polishing and sampling (the ridge across the middle axis represents the high-resolution isotope track)

Stalagmite fabrics

I examined several slabs and thin sections of different stalagmites and identified the first few candidates for an in depth study. Preliminary examinations in both hand specimens and in thin sections reveal layer-bounding types consistent with very arid/glacial conditions for one stalagmite that precipitated, with interruptions, during the Marine Isotope Stage 2 (MIS 3), the Last Glacial Maximum, and Allerod interstadial. Other stalagmites, precipitated during key glacial and interglacial conditions, show similarly promising morphologies and are currently being processed.

3 Collaborations

Prof. Christoph Spötl, University of Innsbruck, Austria

Samuel Panno, Senior Geochemist, Illinois State Geological Survey, USA

Prof. Hai Cheng, Institute of Global Environmental Change Xi'an, Jiaotong University, China

Jingyao Zhao, Institute of Global Environmental Change Xi'an, Jiaotong University, China

Dr. Klaus Peter Jochum, Max Planck Institute for Chemistry, Germany

Brigitte Stoll, Max Planck Institute for Chemistry, Germany

Ulrike Weis, Max Planck Institute for Chemistry, Germany

Dr. Jasper Wassenburg, Max Planck Institute for Chemistry, Germany

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