

# Science and Technology Group Annual Report FY2017

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## 1 Introduction

In FY2017, I continued to work on the paleoclimate evolution of Donnehue's cave region in the Midwestern USA, with a focus on the Marine Isotope Stage 7 (MIS7) interglacial period. Specifically, my research focused on the following questions: 1- Do the two stalagmites (DC1 and DC34), for which I have previously (i.e. in FY 2016) obtained preliminary U-Th ages, contain coeval sections for MIS 7?; 2- What was the active growth duration for the stalagmites DC1 and DC34 during the MIS7?; 3 - What was the growth interval for a third MIS 7 stalagmite (DC48, for which I previously obtained only the growth initiation age), and how does it compare with DC1 and DC34, which are located in a different part of the cave?

This line of inquiry was driven by the fact that these stalagmites offer a unique opportunity to better understand both the cave system (by first examining the growth dynamics of stalagmites largely precipitating during the same time period, but supplied by three different dripwater pathways) and the overall climate conditions, starting with water availability during the transition from glacial conditions (i.e. MIS 6 interval) to the MIS 7 interglacial.

To help answer these questions, I obtained high-resolution uranium-series dates for these three MIS 7 stalagmites and constructed their age models.

Additionally, in order to identify paleoclimate changes such as moisture source variations, regional precipitation variability, and changes in the vegetation cover I obtained high-resolution stable isotope data ( $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$ ) for DC1 and DC34.

## 2 Activities and Findings

I obtained high resolution U-Th dates for three stalagmites from different parts of Donnehue's Cave, and their detailed chronology reveals the following:

- 1- DC 1 and DC34 contain one confirmed coeval section during one of the warmest intervals of MIS 7 (i.e. MIS7 a-c; PAGES, 2016); there may be a second coeval section during a later interglacial episode (MIS5e), but additional U-Th dates are needed to determine if an exact growth overlap occurs.
- 2- All three stalagmites (DC1, DC34, and DC48) grew predominantly during the two warmest intervals of MIS 7: MIS 7a-c and MIS 7e (Figure 1). Surprisingly, DC1 presents a growth interval (ca. 170,000 to 154,000 years BP) during the MIS 6 glacial episode, suggesting that, for at least this time period, the temperature rose above 0 degrees Celsius and there was water availability within the karst system.
- 3- DC48 growth period spans most of the MIS 7 and, interestingly, continues growing during periods of time when DC1 and DC34 were in hiatus. I attribute the different growth dynamics of these stalagmites to variable hydrological conditions at their respective drip sites.

The high resolution isotope data for DC34 and DC1 shows a higher variability for  $\delta^{13}\text{C}$  than for the  $\delta^{18}\text{O}$ , which appears to be typical for stalagmites from this cave. The comprehensive interpretation of these data is work in progress, pending additional analyses.

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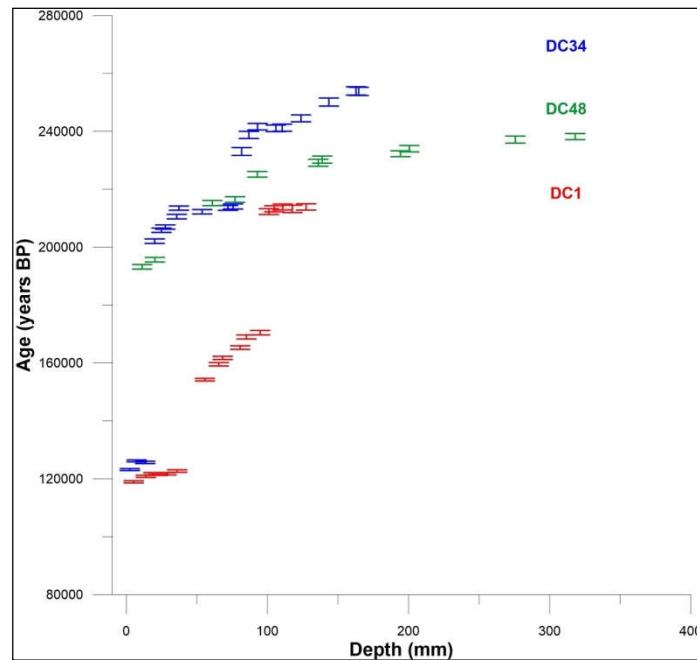


Figure 1 Depth vs Age model for stalagmites DC1, DC34 and DC48

## 3 Collaborations

Prof. Hai Cheng, Xi'an Jiaotong University, China.  
Dr. Klaus Peter Jochum, Max Planck Institute for Chemistry, Germany  
Prof. Christoph Spötl, University of Innsbruck, Austria  
Mr. Samuel Panno, Illinois State Geological Survey, USA.

## 4 Publications and other output

Chirienco, M.I, Cheng, H., Spötl, C., Li, X., Panno, S.V., Lundstrom, C.C.L:  
*Climate variability during MIS3 recorded by two stalagmites from  
Donnehue's Cave, Midwestern USA.* Waikato University, New Zealand (2017)

## References

PAGES (Past Interglacials Working Group of PAGES) (2016), Interglacials of the last 800,000 years, *Rev. Geophys.*, 54, 162–219, doi:10.1002/2015RG000482