S4 Summer School on Speleothem Science

28 July - 2 August 2013
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Lecture Abstract:

Frontiers of Speleothem Research

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The past two decades have seen a remarkable increase in interest in the use of speleothems to derive qualitative and quantitative palaeoenvironmental information. During this time, much frontier research has focused on developing technological solutions to the long-standing and difficult analytical challenges associated with extracting reliable quantitative palaeoclimatic information from speleothems (e.g. precise chronologies, temperature and precipitation proxies). Recent examples of proxy development include ingenious methods for the measurement of fluid inclusion stable isotope ratios, clumped isotopes, fluid inclusion liquid-vapour homogenization and noble gas temperatures, stalagmite water and trace element contents (Zhang et al., 2008; Dublyansky and Spötl, 2009; Affek et al., 2008; Krüger et al., 2011; Kluge et al., 2008; Vogel et al., 2012, 2013; Fairchild et al., 2001; Fairchild and Baker, 2012; Baldini et al., 2012; Stoll et al., 2012). Cave monitoring studies have also contributed immensely to interpretations by providing crucial site-specific insights, calibration datasets and a much better understanding of possible seasonal biases in proxies (e.g. Mattey et al., 2010). These field- and laboratory-based technological developments remain hugely important, and are likely to underpin much speleothem research over the next decade. As a research community however, we must also seek to develop broader perspectives and a better understanding of Earth's climate system in order to inform our interpretations. Specific issues include the geographic length scales on the continents over which climate variables can plausibly vary, the spatial and temporal stationarity of climatic and isotopic gradients (McDermott et al., 2011), as well as the stationarity of teleconnection-climate relationships (Comas-Bru and McDermott, 2013). In this regard, we must seek to develop new frontiers, integrating our results with those of colleagues who derive records from the adjacent oceans, and with results from the climate modeling community. Such integration is essential in order to avoid over simplified site-centered perspectives, to ensure that our interpretations are regionally coherent and to consolidate speleothem research as a frontier science in palaeoclimatology.

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