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Stalagmites as high-resolution archives of past fire severity

Our understanding of fire regimes is largely limited to the satellite era. Being able to reconstruct past fire frequency and severity in the pre-satellite era, as well as climate pre-cursors, would greatly extend our knowledge of past fire regimes, and increase our understanding of ecosystem resilience and human relationships to fire. This knowledge would better inform how fire regimes might evolve with climate change. Speleothems have recently been used to reconstruct past fire frequency in southwest Australia (McDonough et al., 2022). Strong seasonality in the region produces speleothems with annual growth layers, enabling the timing of fire events to be precisely dated. Fire-sensitive proxies were found to include soluble ash-derived elements (mostly transition metals) and proxies which reflect changes in soil productivity, hydrology, and evapotranspiration (e.g. calcite δ18O, growth rate, organic matter and fabric). However, the response of these proxies differed between fire events, implying that the proxy response might also be related to fire intensity. A calibration study is required to further our understanding of speleothem-based fire records and assess whether fire intensity reconstruction is possible. Here we present findings towards a calibration of speleothems as fire severity archives for a site in southwest Australia. First, we determine if wildfire ash chemical composition varies with fire intensity. Then, we use Synchrotron X-ray fluorescence microscopy elemental mapping to assess nine mini-cores from modern stalagmites known to have been actively growing during fires of differing intensities in 2019 and 2005 (with fire severity measured by satellite observations). Our results demonstrate clear differences in the composition of ash and the geochemical response of coeval stalagmites to known fires of differing intensities.

Level of Expertise

Early Career <5 years

Presenter Gender

Woman

Pronouns

She/Her

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