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Multi-proxy monitoring approaches at Kangaroo Island, South Australia

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Interpretations of geochemical signals preserved in young speleothems are greatly enhanced by comprehensive cave-site monitoring. In the light of this, a cave monitoring project is being conducted concurrently with the development of a new palaeoclimate record from Kelly Hill Cave (Kangaroo Island, South Australia). The site is strategically located because it is situated between longer-lived monitoring sites in southeastern and southwestern Australia, as well as being climatically 'upstream' from major population and agricultural centres. This study aims to understand possible controls on speleothem δ18O in Kelly Hill Cave through i. identification of local and regional δ18O drivers in precipitation; and ii. preservation and modification of climatic signals within the epikarst as indicated by dripwater δ18O.

These aims are achieved through analysis of a five-year daily rainfall (amount and δ18O) dataset in conjunction with in-cave drip monitoring. Drivers of precipitation δ18O were identified through linear regression between δ18O values and local meteorological variables, air-parcel back trajectories, and synoptic-typing. Synoptically driven moisture sources were identified through the use of NCEP/NCAR climate reanalysis sea-level pressure, precipitable moisture, and outgoing longwave radiation data in order to trace moisture sources and travel mechanisms from surrounding ocean basins.

Local controls on δ18O at Kelly Hill Cave are consistent with published interpretations of southern Australia sites, with oxygen isotopes primarily controlled by rainfall amount on both daily and monthly time scales. Back-trajectory analysis also supports previous observations that the Southern Ocean is the major source for moisture-bearing cold-front systems. However, synoptic typing of daily rainfall δ18O and amount extremes reveals a previously unreported tropical connection and moisture source. This tropical connection appears to be strongest in summer and autumn, but exists throughout the year. This indicates that a wider range of precipitation data sources can be combined to present a more comprehensive understanding of moisture dynamics and interaction of synoptic conditions to drive rainfall geochemistry.

Within the cave environment at Kelly Hill Cave there is high spatial variability in drip characteristics, both in terms of drip frequency and drip water δ18O. Ongoing analyses are aimed at determining if monthly and/or seasonal rainfall δ18O drivers are also reflected in dripwater values. Overall, Kangaroo Island presents a new location to investigate the interplay between tropical and temperate influences in southern Australia, as well as a location for east – west comparisons between monitoring sites across southern Australia.