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A new approach for the interpretation of stable isotope signals in speleothems using noble gas temperatures

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The development of a measurement and extraction system for noble gases contained in speleothem fluid inclusions enables the determination of equilibration temperatures. This so-called noble gas temperature (NGT) can be used in addition to other proxies, such as stable oxygen and carbon isotopes or trace elements, to constrain paleoclimate changes. Typical sample sizes are about 1 g calcite. With this quantity, and a low contribution of air-filled inclusions to the total signal, an uncertainty of about 1°C is achievable. Using stalagmites from the Bunker Cave in northern Germany a NGT record was established. This record covers different periods of the last 130 ka and offers the possibility to compare temperature changes reconstructed from NGTs with variations in the stable isotope and trace element data of the same stalagmite. Most noticeable is the evolution of the δ^{18}O signal, which shows a strong depletion during periods of increased NGTs. The comparison of the NGTs with other climate records shows the detected temperature changes to be consistent with variations reconstructed e.g. from pollen, ice cores and corals.