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Quantitative Palaeoenvironments from Speleothems (QUEST): magnetic properties of two New Zealand speleothems

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The QUEST project (QUantitative palaeoEnvironments from SpeleoThems) aims to develop novel geochemical proxies for speleothems which will allow quantitative reconstruction of past climate parameters, particularly precipitation. These proxies will then be employed to investigate Holocene variability in the Australasian region. In support of this goal, we investigate the magnetic properties of speleothems from two New Zealand caves which grew under widely varying climatic regimes. We intend to use the concentration of allogenic magnetic material in these speleothems as an independent proxy for hydroclimatic variability to help verify traditional tracers like stable isotopes and element dynamics.

Allogenic particles are often incorporated into speleothems as they grow. These particles may be sourced from overlying soils via infiltrating waters, or from flooding of subterranean passages. In both cases, the concentration of allogenic particles is indirectly linked to precipitation. The concentration of allogenic particles in speleothems is generally extremely low, making them difficult and time-consuming to quantify by traditional microscopic methods. However, if the allogenic fraction includes ferrimagnetic particles, these can be detected and characterised quantitatively using state-of-the-art non-destructive magnetic methods. Magnetic particles in speleothems thus represent a potentially high-quality proxy for hydroclimatic variability. Here we characterise the mineralogy, concentration and origin of the magnetic fraction found in flowstone cores and overlying soil samples from Nettlebed cave in the Kahurangi National Park (South Island) and Waipuna Cave in the Waitomo Region (North Island), and interpret these in terms of climatic and local geochemical processes.