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Caves in caves: Post depositional holes in stalagmites

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Previous studies of speleothems for the purposes of isotopic analysis and U-series dating have resulted in preparation of stalagmites by sectioning longitudinally along the growth axis. We frequently observe holes in such sections, both along the growth axis, and laterally to it, ranging in size up to several mm in diameter. Our initial supposition was that these holes are produced during the growth of the stalagmite under constant dripping conditions, but it was found that two kinds of holes exist within the stalagmites. "Axial holes" were formed syngenetically as is shown by the depression of growth layers into the holes and the persistence of the axial hole over many cm of the growth history. Some cut the active growth surface of the stalagmite. "Off-axis holes" are seen in many stalagmites (as well as stalactites); they cut discordantly through growth layers, and never terminate at a growth surface. They range in size from a few mm to several cm in maximum dimension, and may not be coaxially oriented. They are lined with micron-sized, randomly oriented calcite crystals and under which lies an organic-rich coating.

We used CT (Computed Tomography) and MRI (Magnetic Resonance Imaging) scanning in order to locate holes, and to search for water trapped in these macro-inclusions. These methods, allow us to visualize the holes without destruction of the stalagmite, the holes and the surrounding calcite. To our best knowledge, the present paper is the first to combine CT and MRI methods in the study of fluid inclusions in rocks, or in visualizing the distribution of holes in speleothems.

CT scans reveal abundant off-axis holes in some speleothems, while most display at least a few holes. MRI scans shows that, in uncut speleothems, these holes never contain water (although Genty et al. [2002] found water-filled holes in some stalagmites).

Off-axis holes may be a result of bioerosion, possibly bacterial, followed by partial refilling of the hole with calcite which is prevented from growing epitaxially on the host calcite.