Biogeology and speleothems in Tjuv-Antes grotta, N. Sweden: a preliminary report

Magnus Ivarsson, Therese Sallstedt & Johannes Lundberg
- Wave abraded tunnel cave
- Formed along a dolerite dyke
- Entrance c. 90 masl
- The cave is about 7000 years old
Tjuv-Ante was a local thief (tjuv), Anders Andersson, who hid in the cave after escaping while being transported to the prison, or so the story goes. He was active in the mid-19 century.
TJUV-ANTES GROTTA
Storrisberget, Nordmaling
Mapped UIS-grade 5D
September 22 & 23, 1978
R. Sjöberg & R. Åhrin

From R. Sjöberg 1982. Tunnelgrottor i södra Västerbotten: Morfologiska och morfogenetiska studier. GERUM Rapport A31
From R. Sjöberg 1982. Tunnelgrottor i södra Västerbotten: Morfologiska och morfogenetiska studier. GERUM Rapport A 31
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Speleothems

Type 1:
Well developed "coral-like" morphologies

Dark, graded biofilms cover the tips of growing speleothem (Scale bar equals 1 cm)
Speleothems

ESEM/EDS of "Coralloid" microfabrics:

- C rich biofilm
- Euhedral calcite with trace amounts of Mg
- O, Ca, C
- O, Ca, S, C
- Gypsum?
- Spiky calcite
Speleothems

Type 2:

Spherical outgrowths resulting in a "popcorn-like" morphology

Less extensive coverage of dark biofilms on "type 2" speleothems compared with "type 1"
Speleothems

Type 3:

"Ghost coralloid knobs"; erosion surfaces

Dark graded biofilms cover flat, thin (>mm) crustal surfaces
Speleothems

ESEM/EDS data of fungal hyphae

<table>
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<th>Element</th>
<th>Weight%</th>
<th>Atomic%</th>
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<td>C K</td>
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<td>O K</td>
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<td>Ca K</td>
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<td>Totals</td>
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Filamentous (presumed fungal) biofilms: cover tips of actively accreting & eroded speleothems
Speleothems

ESEM and stereo-micrographs showing encrustation of fungal hyphae in "active" speleothems

Rapid CaCO₃ mineralization of filament surfaces on type 1 and 2 speleothems
"Constructive or destructive" - dual influence of fungal hyphae on speleothem fabrics?

Speleothems

Fungi filaments on "type 3" speleothems:

ESEM/EDS of erosion surface: O, Ca, O

"Etched channel"?

ESEM/EDS of fungal hyphae: O, C (trace amount Ca)

"Constructive or destructive" - dual influence of fungal hyphae on speleothem fabrics?
Modern biofilms
ESEM/EDS of modern biofilm

Element composition (EDS): C, Ca, O, Fe, P, Si, Al, S, Mg, K, (Mn, Ti)
Staining and fluorescence microscopy


Microorganisms interpreted as Actinomycetes.
ESEM of the Speleothem

Diameter: ~0.5-1 µm
Composition: C, Ca, O (Al)

Helically coiled hyphae loops corresponding to Acinomycetes morphology
Summary

- Formation of CaCO$_3$ speleothems in non-karstic caves
- Encrustation and etching; dual role of fungal hyphae in speleothem "life cycles"
- Possible connection between modern cave-wall biofilms (presumably dominated by actinomycetes) and the speleothem in Tjuv-Antes cave
Work in progress...

- Detailed study of speleothem microfabrics using petrographic techniques, ESEM, Synchrotron X-ray Tomography (SrXTM) etc.
- Fossil DNA extraction from "coralloid" speleothem
- Extraction of DNA from modern cave-wall biofilms
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