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Siliceous ferrihydrite speleothems with microbial imprints in a volcanic tube (Buracos cave, Terceira, Azores)

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Located in the Malha Grande lava field (with probable eruptive centers at Galiarte cone area), Gruta dos Balcões is the longest cave on Terceira island. Isolated parts of the main lava tube of Gruta dos Balcões includes the Gruta dos Buracos (Pereira et al. 2004). We present here results of morphological, mineralogical and petrological investigations realized in the iron speleothems of the Buracos cave ("Gruta dos Buracos") and offer an assessment of biological and non-biological mechanism that could have formed these speleothems.

The iron speleothems are stalactites, stalagmites, columns and flowstones that cover the walls and the floor of the cave as a "river". They show brown, yellow, orange and reddish colours.They are porous and friable, but sometimes lamina or zones more compact are interlayered. The stalactites can be from a several centimetres to 3 meters long and often are aligned along cracks.

Powder X-ray diffraction patterns of the studied samples show a broad scattering band between 15 and 45° 2θ, which two broad main peaks are around 35 -36° 2θ (about 2.50 Å) and around 62-63 2θ° (about 1.49 Å). They are defined as incipient "2-lines" ferrihydrite (Jambor & Dutrizac 1998).

Under SEM, the samples show many rounded crystal/particles with different sizes (always less than 1 μm) and normally ranging from 0.3 to 0.5 μm. They form grumelar aggregates or cover fine rods/filaments. The thickness of the filaments ranges from 0.5 μm to 2 μm and sometimes have a hollow center. The length can range from 3 μm (perhaps fragments) to 50 μm or more. The features of shape and size are consistent with a bacterial origin. Later cementation of the primary filamentous microtexture produce compact zones. In many spelothems can appear laminated structures like stromatolites. EDS analysis of the filaments and agglomerates of particles/crystals showed that they were mainly composed of variable amounts of Fe, O, Si and C. The Fe:Si ratio varies between 2.45 and 5.4. Locally some minor elements (Al, Ca and Mn) can be found. The presence of C, in important amounts (16-23 atomic %), show that organic microorganism are incorporated into the mineral precipitates. In Buracos cave the Si adsorbed on the ferrihydrite surface inhibit their transformation to more stable oxides (Jambor & Dutrizac 1998). Lava tubes, in warm climate, are extensively colonized by microorganisms. Not only the microbiota serve as templates for iron deposition, but their organic remains are also incorporated into the mineral precipitates. The latter stages of iron precipitation are inorganically driven. In Buracos Cave it have not been found sulphur or other indicator of acid environments and the common neutrophilic iron-oxiders will be evolved (Kasama & Murakami 2001, Baskar et al. 2007).

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