

Exceptional fossilization in a hydrothermal environment

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Konservat-Lagerstätten – fossiliferous localities with preservation of soft parts – constitute the best available source of palaeobiological and palaeoecological information. The French Konservat-Lagerstätten of La Voulte-sur-Rhône (Callovia, Jurassic) present a very peculiar, high quality, preservation style, as well as a deep paleoenvironment, associated with hydrothermalism.

Here, we report geochemical and mineralogical investigations conducted on fossils preserved within carbonate-rich concretions from La Voulte. We identified mineral phases at different scales using a combination of microscopy and spectroscopy methods (SEM-EDS, TEM, synchrotron-based XRF, XRD and Ca-XANES).

Fluorapatite, Fe-sulfides (pyrite, pyrrhotite) and Mg-calcite are the major phases, while the surrounding matrix is composed of Mg-calcite, clays and detrital silicates. Fluorapatite and pyrite (and pyrrhotite) precipitated first, during biologically-induced decay under anoxic conditions, replacing delicate organic structures and thus preserving anatomical details. Mg-calcite then precipitated, forming the protective concretion.

Geochemical models also support that, paradoxically, biodegradation in anoxic conditions favored the preservation of delicate structures. Hydrothermal inputs probably played an important role in favoring the development of local anoxic conditions (and anoxic microbial metabolisms) and increasing cation availability. On a side note, it allowed the precipitation of Pb- and Zn- rich sulphides (galena and wurtzite) as part of the fossil paragenesis. As such, hydrothermal activity has probably favored exceptional preservation in this locality.