



## **Cathodoluminescence of carbonate speleothems: An overview**

Th. Götte and D. K. Richter

Institute for Geology, Mineralogy, Geophysics; Ruhr-University Bochum, Germany

Thomas.Goette@ruhr-uni-bochum.de

Extensive cathodoluminescence (CL) investigation of carbonate speleothems have shown that in general the intrinsic luminescence is predominant. This dark blue luminescence, which occurs in very pure carbonates, is not a result of the incorporation of activating trace elements but only of lattice defects within the carbonate crystal. Orange, green or pale violet luminescence colours which are induced by the activation of  $Mn^{2+}$  (orange in calcite and Mg-calcite, green in aragonite) or  $REE^{3+}$  (especially  $Dy^{3+}$  and  $Sm^{3+}$ , pale blue to pale violet in (Mg-)calcite and pale bluish green in aragonite) can only be observed in speleothems which have grown in special environments. The reason for the variable CL-properties can be investigated by spectroscopy of the different luminescence emission.

Several primary and secondary phenomena in speleothems can be made visible by means of CL:

- Intrinsic luminescence – even in Mn-containing host rocks
- Lamination caused by different contents of impurities
- Free vs. inhibited crystal growth (variation of the thickness of the water film)
- Growth discordances – especially at the side of wall sinter and stalagmites
- Phases of corrosion
- Episodical enrichment of Mn in cryocalcites
- Incorporation of Sinter- and host rock fragments

- Incorporation of materials originating from the surrounding area of the cave
- Sealing of primary and secondary porespace
- Sealing of fractures within the sinter
- Calcitisation of aragonitic sinter

Additionally to the visualization of these single phenomena, CL-investigation plays an important role in the paleoclimatic interpretation of the sinter formation:

- The recognition of detrital materials (sinter and extraclasts) and of later mineralization (cementation and replacement) is important in order to select samples, which are suitable for geochemical investigations (C/O-isotopes, TIMS U/Th, etc.)
- Systematic studies of the distribution of Mn and REEs in postglacial stalagmites in central Europe have shown a significant enrichment during the Atlantic stage (9000-6000 yrs BP) and for subrecent/recent times.

The occurrence of Mn-containing layer in sinter which have grown on the walls and on the ground, in stalagmites and cave pearls and the absence of any Mn-enrichment in carbonates which have freely crystallized in standing water may indicate the participation of biofilms – further research is required to elucidate these phenomena.