



Recent carbonate sinter-formation in Karlovy Vary (Karlsbad), Czech Republic: an approach with “petrifying” experiments

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Water of the hot springs in Karlovy Vary in the Czech Republic form carbonate sinters since at least 200.000 years, which were traditionally called “Sprudelstein” (“Vřídlovec”) after the main “Sprudel” (Vřídlo) spring. The natural sinters were firstly used as raw material for quick lime production and for decorative purposes. The rock body formed by the carbonate precipitation is known as “Sprudelschale” which covers the granitic bedrock and controls the pressure conditions in the hot spring system. It is also responsible for the spectacular spring activity comparable to geyser springs. Carbonate precipitation can be observed today at the outlets of the thermal water in the river bed near the spa facilities in the centre of Karlovy Vary.

The mineralized water reaches the surface at a temperature of approx. 80 °C. It is piped to local spa hotels and drainages. Permanent precipitation of carbonate sinters with a maximum precipitation rate of up to 0.3 mm/d occurs in pipes and causes severe technical problems. All attempts to avoid or at least reduce the in-pipe precipitation by commercial technical means stayed unsuccessful.

The fine grained, laminated to homogeneous carbonate precipitates consist of rhomboedric calcite and/or needle-shaped aragonite and are enriched with iron oxides and hydroxides.

The rapidly growing carbonate crystals differ in composition and fabric as a result of variations in temperature, pressure, chemistry of the source water and the position

within the degassing process. Furthermore examples are quoted to demonstrate how the diameter, the water flow parameters and the material of the water-bearing pipes affect the formation of the carbonate sinter.

The process of encrusting surfaces and objects through contact with the water has been commercially used for producing souvenirs by incrustation of natural and artificial objects since the 19th century. Since then some experiments were performed with “petrification” of various objects to find new aspects of precipitation and crystallization.

As a new experimental approach to the precipitation process ceramic tablets (3 x 3 x 0,5 cm) were petrified in two test series at an unequal distance from the water source for 10 and 20 days respectively. Daily records of the mass difference of the carbonate sinter with respect to the air-pressure were taken. These experiments revealed the formation of both minerals aragonite and/or Mg-calcite at 68 °C. Stable isotope analyses show $\delta^{18}\text{O}$ -values of the sinter from 11.47 to 12.72 ‰, SMOW and $\delta^{13}\text{C}$ -values from +1.43 to +2.65 ‰, PDB. Some of the isotope variations can be explained by phase transitions between Mg-Calcite and Aragonite. Samples of the daily state of incrustation allowed to visualize the growth processes in SEM photomicrographs.