NEW DATA ON SOME GYPSUM SPELEOTHEMS IN THE VÎNTULUI (PĂDUREA CRAIULUI MOUNTAINS) AND RĂSTOCI (SOMEȘAN PLATEAU) CAVES

BOGDAN P. ONAC

Gypsum is by far the most common evaporite mineral in caves, being in the meantime the third in frequence after calcite and aragonite, among speleothems. Several caves in Romania have been mentioned because of gypsum speleothems. Two of these, Vîntului and Răstoci, respectively their gypsum speleothems make the subject of the present paper, providing several novelties for the national profile literature. Anthodites are not included since they have been subjected to a previous study.

VÎNTULUI CAVE (Wind's Cave)

The Ladinian limestones housing the cave are discordantly and transgressively covered by sandstones, microconglomerates and clay lenses, all of the covering formations with frequent pyrite occurrences. Gypsum speleothems in the cave are closely related to this mineral.

A previous paper (B. Onac, I. Viehmann, 1987) provided a general presentation of the gypsum speleothems in the cave, without a detailed crystallographical analysis. We shall further underline new aspects and reconsider several of the previous conclusions.

Gypsum crusts are the most common and widely spread sulphatic speleothems in the cave, being found along several kilometres of passages. Both granular and fibrous varieties have been found; the former (Fig. 1 a) are made of equigranular, tabulary and/or curved crystals. On the crusts' surface, gypsum rosettes up to 1.5 cm in diameter can be noticed, resulting from the arrangement of tabular crystals under various angles. Fibrous crusts (Fig. 1 b) are made of fine crystals perpendicular to the cave wall. Both types of crust vary in colour from dull-white to brown, with the thickness ranging from 0.5 to 3 cm. The sections of passages with a more abundant seepage display richer crusts (*1 Mai Passage*, *Metalul Hall*).

The gypsum crusts in the Vîntului Cave were produced by the SO_4^{2-}-rich solutions generated by oxidation of the pyrite in the overlaying sandstones and microconglomerates, during the ircontact with the limestone walls (Fig. 1). Both bedding planes and the rich fissural network facilitated the penetration of solutions in the cave environment.

At several locations, bundles of tabular gypsum crystals (Fig. 1 c) are to be noticed, varying from 0.5 to 6 cm of length and 0.1 to 0.5 cm thick. The crystals grow with the pinacoid face at an angle of 30 to 90° to the supporting surface, displaying numerous intergrowth twins, mainly after (100).

The paper in 1987 mentioned needle crystals randomly dispersed in a dusty clay matrix covering sections of the cave's first floor; they were considered to have been formed within the clay matrix. However, one must consider the fast development of the cave (there are 4 different levels of karstification, corresponding to the continuous deepening of the local base-level — the river Crişul Repede) as well as the chemical analysis of the underground water, which indicates low contents of SO_4^{2-}. Therefore, it is quite improbable that the clay deposited by the underground streams was and is a favourable environ for gypsum development. The microscopical investigation revealed crystals resulting from the destruction of fibrous crusts, hence no *in situ* development.

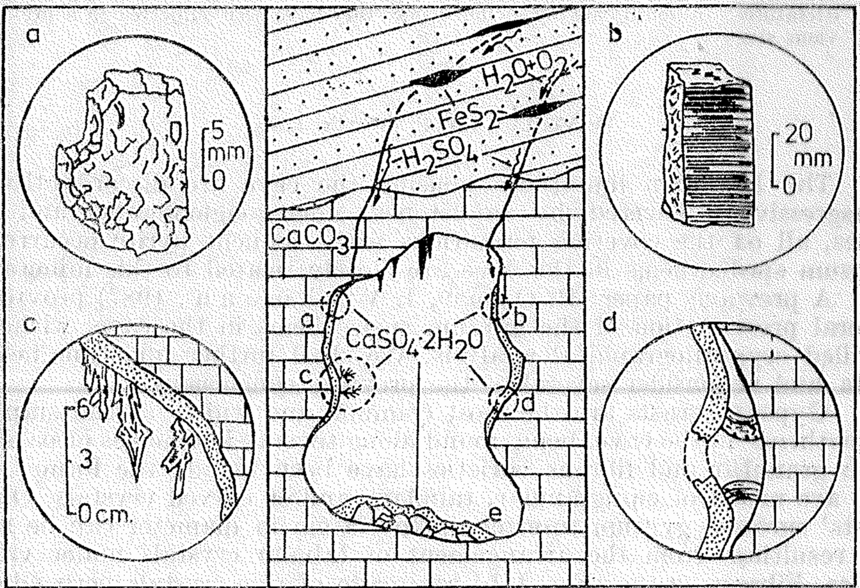

Fig. 1. — Gypsum speleothems in Wind's Cave (Pădurea Craiului). (after G. Calandri 1979, modif). a — granular crust; b — fibrous crust; c — bundle aggregates of tabular gypsum crystal; d — gradual peeling of gypsum crust; e — gypsum floor carpet.

Highly interesting are the so-called "wasp nests" which we consider to have formed by uneven growth and gradual "peeling" of gypsum crusts off the limestone walls. The phenomenon is caused by the pressure of the newly-grown perpendicular crystals under the previously formed crust (Fig. 1 d). Consequently, fairly large sections of the crusts break and fall to the cave's floor. They are subsequently bound together by the solutions reaching the floor, resulting in a "carpet" of gypsum sometimes more than 10 cm thick (1 Mai Passage, Fig. 1 e).

RĂSTOCI CAVE

The cavity developed along the Eocene/Oligocene boundary (V. Todoran, B. Onac, 1989) in a bioaccumulated and bioconstructed pile of limestones (with nummuliths, algae and corals) part of the comprehensive series of *Culmea Cozlei*.

Gypsum genesis is closely related to the gypsum efflorescences developed on the bedding-planes of the clayish-bituminous shales known as the *Ileanda Layers*, shales outcropping NE and NW of the Răstoci Cave.

The first mention of gypsum speleothems in the cave is due to B. Onac and V. Todoran, (1987) who described the following forms: crusts, crystals and anthodites. Several novelties concerning the first two are to be further presented.

The crusts are, like in Vîntului Cave, the most frequently encountered sulphate speleothems; half of the length of the cave's passages are covered with such crusts which are rarely more than 2 mm thick. A detailed analysis revealed a radiar pattern of the efflorescences that make the crust, pattern that was assigned to a starburst-type crust. Such a crust has not been previously mentioned in Romanian endokarst. This subtype of sulphate crust is made of selenite crystals developed in a radiar pattern from a common centre (Fig. 2 a), being parallel to the wall unlike the majority of the crusts in which the crystals grow perpendicular to the wall. The diameter of such an efflorescence may reach 11.5 cm.

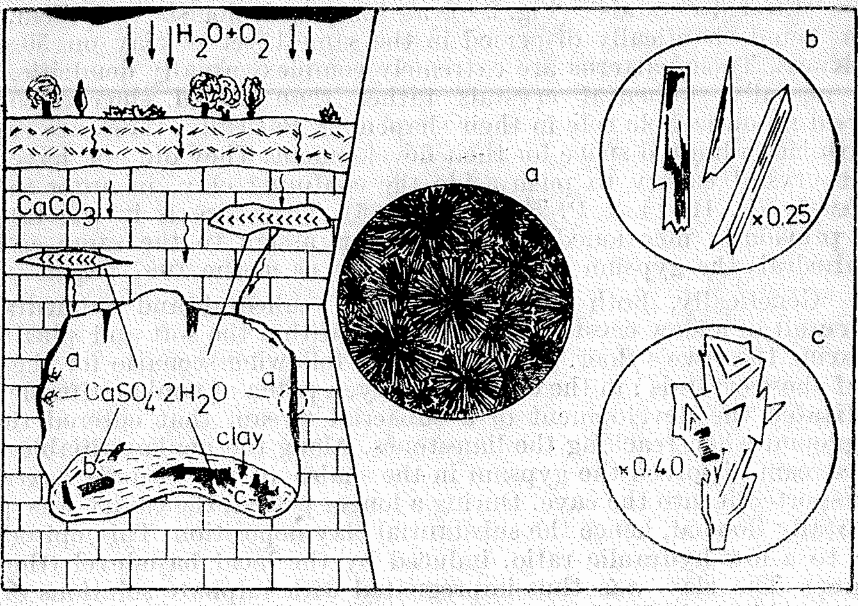

Fig. 2. — Origins and crystallization patterns of the gypsum in Răstoci Cave (Podişul Someşan).
a — starburst gypsum; b — needle-like selenite, lense-shaped, sword (euhedral crystals); c — croded crystals (subhedral gypsum); d — anthodites (gypsum flowers).

In the sections where the starburst crust develops, the walls are covered with a fine layer of clay. This association led us to the assumption that the genesis of these speleothems is closely related to the adsorption phenomenon. The solution supply is rather punctual so that the solutions would accumulate and get fixed along the clay/limestone interface, on the clay, strictly around the pores, controlled by the adsorption forces. The fine layer of clay acts like a screen, forcing the parallel-to-the-wall pattern of crystallization of gypsum.

On the other hand, the lack of clear discontinuities within the limestone pile to intersect the cavity, seems to be responsible for the absence of seepage crusts. The peeling mentioned in Vîntului Cave was also noticed in Răstoci Cave, although at a much less important scale, being restricted to the central area of the crust.

The microscopic study of the crystals in the clay matrix (Fig. 2 b, c) undertaken by M. Nedopaca et al. (1989) provided evidences of selenite crystals with highly variable size, shape and degree of perfection. Euhedral crystals (Fig. 2 b) take a columnar shape (001) sparsely prismatic, usually perfectly transparent. Sometimes they are slightly coloured yellow-ochre by fine grains of clay. These crystals do not exceed 15 cm in length and 1.5–2 cm in thickness. Quite often needle-like, lense-shaped and sword crystals puncture the clay layer's surface. Their position is almost perpendicular to the cave's floor, the crystals lifting pieces of clay.

"Eroded crystals" (Fig. 2 c), as some speleologists call them, have been found chaotically dispersed in the same layer of clay on 50 cm of thickness. Their patterns are extremely complex, usually dendritic. They are actually subhedral crystals rather than eroded, since dissolution played no noticeable role in their shapening. Basically, these are crystals which had a limited space for their development. They did not have sufficient crystal energy to push aside the confining clay, in order to grow perfectly (C. Hill & P. Forti, 1986). Their size is in the range of the previously mentioned ones. We may assign to the same category (subhedral) the gypsum balls described by us in the 1987 paper.

Genetically, both types of crystals (euhedral and subhedral are the result of a slow crystallization process within the soft and plastic clay covering the cave's floor. We propose the following scenario for the genesis of these crystals : in the cave's vicinity, a patch of nonkarstifiable rocks facilitated the development of a subaerial stream that entered the underground when reaching the limestones. Along the nonkarstifiable track, the stream dissolved the gypsum in the shales of the *Ileanda Layers* and transported it into the cave. During a longer period, the cavity was partly or totally flooded, hence the substantial clay deposition. This episode was due to a low hydraulic ratio, induced by the local base-level (the river Someş). The clay was thus impregnated with sulphate solutions of high concentration which, once a certain physico-chemical status reached, triggered the crystallization by two consecutive steps : the "nucleation" and the crystal-growth-proper (G. Diaconu, 1989). The first step corresponded to the issuing of the crystallization germs, the second to the completion of the crystalline edifice. The resulting crystals' morphology is, as we already mentioned, very complex. Aside from the developmental environ (the clay matrix) the morphological variability was controlled by the ion concentration in the solutions, their quantitative ratios as well as the presence or absence of catalytic or inhibiting ions.

CONCLUSIONS

The highly particular patterns of the gypsum speleothems in both caves and their different origin are caused by the following factors: tectonics, different geological context (the rocks housing and the ones covering the cavities), primary gypsum's origins, the specific way of its transportation into the caves and the paleoevolution of the karstic networks.

REFERENCES

1979 CALANDRI, G., *I cristalli di gesso in grotte calcaree.* Speleologia, Riv. Soc. Spel. Ital., 2, 45–47.

1989 DIACONU G., *Studiul mineralogic și genetic al argilelor și carbonaților din peștera Cloșani.* Rez. tezei de doctorat, București.

1986 HILL, A. CAROL., FORTI, P., *Caves minerals of the world.* Natl. Spel. Soc., Huntsville, Alabama, 115–126.

1989 NEDOPACA, M., ONAC, B., TODORAN, V., *Aspecte ale micromorfologiei cristalelor de gips din peșteri.* Bul. Speol. FRTA–CCSS, București, 12, 9–14.

1987 ONAC, B., TODORAN, V., *Contributions à la connaissance des formations de gypses de la grotte de Răstoci (NO de la Roumanie). The Eocene from the Transylvanian Basin*, Cluj-Napoca, 301–306.

1987 ONAC, B., VIEHMANN, I., *Origines et formes d'apparition du gypse dans Peștera Vîntului (Monts Pădurea Craiului).* Theoretical and Applied Karstology., București, 3, 243–245.

1989 TODORAN, V., ONAC, P.B., *Eocene/Oligocene boundary in the Purcăreț-Mesteacăn area (The Someș Plateau). The Oligocene from the Transylvanian Basin*, Cluj-Napoca, 129–132.

Mining Entreprise Suncuiuș

Received February 10, 1990