UNUSUAL CALCITE SPECIMENS FROM DALNEGORSK

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The Dalnegorsk Ore Field is a genuine Mineralogical Paradise. A lot of mineral species found here occurred in various associations and in numerous forms. Tens of thousands of unique mineralogical specimens come from the Dalnegorsk mines including exceptional calcite pieces whose examples can be seen in Figures 1 and 2.

Many of them attract attention not only by their exquisite beauty but also their uncommonness and even mysteriousness challenging the inquisitiveness of a mineral amateur.

Figure 3 illustrates tubular calcite formations from the Nikolaevsky Mine, Dalnegorsk, which known as helictites. They are somewhat exotic for Dalnegorsk. In fact, the world of helictites lies principally in karst caves where they attain wide diversity and large sizes (Fig. 4). On the other hand, such a find says of a karst manifestation as helictites only appear and grow at "cave" conditions i.e. in the air environment and being controlled by the carbon dioxide balance between the mineralizing solutions and the surrounding air. The occurrence of calcite helictites at such a deposit suggests that an air cavity exists connected with the outside world where calcium carbonate solutions can penetrate enriched with carbon dioxide. Karst occurrences are really known at the Dalnegorsk deposits (Moroshkin & Frishman, 2001). The source of the mentioned solutions was atmospheric precipitations enriched with carbon dioxide from the air. Water infiltrated limestone cracks and pores and washed calcium carbonate from it.

The specificity of outlook and generation processes of helictites as well as of stalactites, stalagmites and other "speleothems" – decorations of caves, is defined

1. **Calcite** crystal. 7cm high. Nikolaevsky Mine, Dalnegorsk, Russia.

2. **Calcite** crystal. 7.5 x 4.5 cm. Vtoroi Sovetsky Mine, Dalnegorsk, Russia. Specimen: Victor V. Ponomarenko.

3. **Calcite** helictites. 13.5 cm. Nikolaevsky Mine, Dalnegorsk, Russia.

4. **Calcite** helictites, up to 24 cm long. Cave Kap-Kutan, Turkmenistan. Photo *in situ*: Vladimir A. Maltsev.

by the behavior particularity of calcium carbonate in water. Calcite and aragonite are nearly insoluble in pure water; but their solubility increases as the carbon dioxide superfluity due to changing from calcium carbonate into easily soluble calcium bicarbonate:

$$CaCO_3 + CO_2 + H_2O = Ca(HCO_3)_2.$$

The process is reversible: once the carbon dioxide concentration drops in ambient air the calcium carbonate solution emits part of its own carbon dioxide into the air, the calcium carbonate's solubility drops, and the excess carbonate precipitates as calcite or aragonite crystals. Therefore the crystallization of calcite proceeds under the control of not only temperature and solvent evaporation, but mostly with the carbon dioxide balance in solution and ambient air.

The structure of cave helictites as well as the mechanisms of their birth and growth were studied by Moscow mineralogists Vladimir A. Maltsev (1957–2014) and Viktor A. Slyotov (Maltsev, 1997; Slyotov, 1985). The same topics were elucidated by V.A. Maltsev in his short but informative manuscript *"How stone flowers grow?"* published only in Russian by the Ural speleologists in a small circulation and posted on the Internet (Maltsev, 2014). V.A. Slyotov also showed (Slyotov, 2019) some tubular aggregates of pyrite to be generated in a similar way (Fig. 5).

5. **Pyrite**, helictite-like aggregate. 4.5 cm. Mikhailovskoe deposit, Kursk Region, Russia.

A helictite may appear around a pore or a small fissure in the cavity or stalactite wall through which the carbonate solution may percolate. Due to the contact with air the calcium carbonate solubility drops and calcite precipitates around the hole usually as spherulites or spherocrystals. In the process of growth, the spherulites intergrow one with another: at first, just two of them then one more join them, etc. Once any three of them have intergrown, a closed contour arises on the way of the percolating solution to become the embryo of a future capillary channel. The contour is growing due to the solution entering through the hole and gradually merges into a pipe, a helictite. Its growth rate depends on the feeding solution concentration and input as well as its evaporation and carbon dioxide emitting. Both are controlled by the cavity ventilation which depends on the conditions inside the cavity and beyond it. Ventilation is the necessary condition for the helictite to come into existence and to develop. Correspondingly, the occurrence of helictites witnesses the existence of a hole or holes providing the possibility of intercommunication between the cavity and the outer atmosphere.