КОМПЛЕКСУВАННЯ МІНЕРАЛОГО-ГЕОХІМІЧНИХ, ЛІТОЛОГО-ПЕТРОГРАФІЧНИХ ТА ГЕОФІЗИЧНИХ МЕТОДІВ У МОДЕЛЮВАННІ ПРОЦЕСІВ УТВОРЕННЯ КОРИСНИХ КОПАЛИН

DISTORTION OF THE FORM OF TOPAZ POLYHEDRA FROM CHAMBER PEGMATITES OF THE KOROSTEN PLUTON (UKRAINIAN SHIELD) AND ITS GENETIC SIGNIFICANCE

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Встановлено асиметричність реальних кристалів волинських топазів. Це дає змогу за зміною співвідношення розмірів граней конкретної простої форми відтворювати параметри мінералоутворювального середовища. Зокрема, в камерних пегматитах Коростенського плутона часто фіксуються багатогранники топазу із видимою симетрією, близькою до P або L_2. Перші росли в потоці речовини так, що площина симетрії топазу співпадала з площиною симетрії потоку, другі росли в потоці, який рухався паралельно граням призм {110},* рідше – {120*}. Така форма кристалів, паралельно з дослідженням анатомії топазу, може надавати цінну генетичну інформацію.

СПОТВОРЕННЯ ФОРМИ БАГАТОГРАННИКІВ ТОПАЗУ З КАМЕРНИХ ПЕГМАТИТІВ КОРОСТЕНСЬКОГО ПЛУТОНА (УКРАЇНСЬКИЙ ЩИТ) ТА ЙОГО ГЕНЕТИЧНЕ ЗНАЧЕННЯ

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Introduction. Studies of topaz crystals from chamber pegmatites of the Korosten pluton (Ukrainian shield) began immediately after the first finds at the end of the 19th century and their numerous results are summarized in *(Lazarenko et al., 1973)*. However, such an important indicator of crystal morphology as a distortion of habit has not been studied, despite the large amount of data on the features of crystal morphology of topaz *(Naumko, Vovk, 2000; Vovk, Naumko, 2005, 2013, 2014; Naumko, 2006; Vovk, 2016; Pavlyshyn et al., 2017, etc.).*

Object. We studied topaz crystals from various mineral-structural zones of chamber pegmatites, both collected personally and from the collections of the Museum of precious and decorative stones (Zhytomyr region), the mineralogical museum of the Ivan Franko Lviv National University, private collections.

Methodology. Methods *(Vovk, 2016)* included goniometry, construction of gnomostereographic, orthogonal and axonometric crystal projections, statistical analysis (descriptive statistics, cross tabulation, cluster analysis), drawing in Shape, Inkscape, GIMP programs in MX Linux operating system.

Briefly about topaz in chamber pegmatites of Volyn. Unique topaz - morion chamber *(Yermakov, 1957)* granitic pegmatites are spatially and genetically related to granitic intrusions of shallow depths, in particular, rapakivi granite of the Korosten pluton located in the northwestern part of the Ukrainian shield *(Lazarenko et al., 1973).* They contain large and transparent well-cut topaz crystals, which are mainly associated with chambers, as well as leaching zones and metasomatically altered rocks of fully differentiated pegmatites. It has been shown that crystallographically topaz is a clearly individualized mineral *(Lazarenko et al., 1973; Vovk, 2016).* Due to the wealth and significant prevalence of simple forms, as well as the uneven development or absence of individual faces, it is possible to study the degree of distortion on topaz crystals as an important indicator of the symmetry of the crystals and the environment.

Results and its discussion. As a prerequisite, let us point out that the symmetry of real crystals obeys to the Curie principle, which means in this case that only the symmetry elements common to the crystal and the medium in which it is formed will be preserved on real polyhedrons.

The types of symmetry with axes of infinite order are reduced to the following groups *(Shafranovskiy, Plotnikov, 1975):*

1) $\infty L_\infty \infty PC$ is a ball;
2) ∞L_∞ is a ball filled with an optically active liquid;
3) $L_\infty \infty\ L_2 \infty P\Pi C$ is a cylinder;
4) $L_\infty \Pi C$ is a rotating cylinder;
5) $L_\infty \infty P$ is a cone;
6) $L_\infty \infty\ L_2$ is a twisted cylinder;
7) L_∞ is a rotating cone.

In a real fluid-dynamic situation of a mineral-forming medium, its symmetry often evolves as follows: $\infty L_\infty \infty PC \rightarrow L_\infty \infty P \rightarrow P$.

Symmetry P corresponds to the flow of the mineral-forming fluid. The resulting topaz crystals can have P symmetry if their symmetry plane coincides with the flow symmetry plane, or have no elements at all. The first ones, by which it is easy to determine the direction of fluid flow, are described by I.V. Johansen (1949). In particular, he showed that, since the faces in the lower part of the crystal are much larger than those in the upper part, the upper faces grew faster and their sizes are smaller. This was limited by the possibility of supplying the necessary portions of fluid to the growing faces. Hence, it follows that the movement of the fluid flow was carried out in the direction from top to bottom. Such crystals of topaz were found in the pegmatites of the Korosten pluton.

If the planes of symmetry of the fluid flow and the polyhedron do not coincide, then we get triclinic crystals, of which there are much more in the overburden chambers of chamber pegmatites. Apart from these two types, we have found polyhedra with external symmetry L_2. It is difficult to imagine a medium with such symmetry, because it is unlikely that an attached crystal grows between two fluid flows of matter moving in opposite directions. Nevertheless, polyhedra flattened along the M {110} faces are frequent, less often along l {120}, i.e., they grew in a medium in which the flow of matter moved in a direction parallel to the {110} faces (less often {120}). The stream moved in the direction from smaller simple-shaped faces to large ones. The direction of the fluid flow is more difficult to establish with more or less the same development of the topaz crystal faces.

Since the rate of growth of topaz faces is affected not only by the mineral-forming fluid, but also by numerous small mineral phases that settle out of an aqueous solution diluted by boiling on the faces of crystals *(Vozniak, Belskyi, 2021),* a more accurate picture of the parameters of the mineral-forming environment can be obtained by studying the anatomy of topaz crystals, which is closely related to connected with its morphology. Real topaz crystals are more or less asymmetric. Anomalous properties of Volyn topazes are caused by the loss of their homogeneity and anisotropy *(Pavlyshyn, Voznyak, 2020).*

Conclusions.

1. Topaz crystals in chamber pegmatites of the Korosten pluton were found in chambers, leaching zones, less often in graphic, pegmatoid, feldspar zones and in metasomatically altered rocks. All the polyhedra are more or less distorted. The crystals from the leaching zones are almost ideal.

2. The bulk of the topaz polyhedra are confined to the chambers. They are the most distorted ones.

3. Many crystals have been identified that are flattened along the M {110} faces, less often along the l {120} faces with an external symmetry close to L_2, or without visible symmetry elements.

4. Polyhedra with external symmetry P were also found.

5. Crystals with L_2 or P symmetry grew in the flow of a mineral-forming fluid, the direction of movement of which can be determined by the distortion of the crystal habit.

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