

*Arkady Glikin*<sup>1</sup>

### **FEATURES OF RAPAKIVI ORIGIN IN TERMS OF POLYMINERAL-METASOMATIC CRYSTALLOGENESIS**

Experimental investigation of crystal formation processes in multi-phase and isomorphic-mixed systems, conducted since the beginning of 1980s (Glikin and Sinai 1983, 1991; Glikin et al. 2001; etc.), established a series of peculiar phenomena. They arise due to a presence of a characteristic stage of metasomatic replacement combined in a various ratio with either a growth stage (in supersaturated solutions) or a dissolution stage (in undersaturated solutions). A pure metasomatic replacement, represented itself by a set of interrelated synchronous sub-processes of dissolution and growth, is developed when a saturated solution interacts with a foreign crystal phase. The generalised polymineral-metasomatic approach of crystallogenesis is a principal basis for mineral origin reconstructions. As a result an attention is attracted to some mineral features unmarked formerly, and well-known problems can be delighted from inordinary positions. Rapakivi structure examed mainly for the rocks of the Vyborg massif is an example. It is characterised by numerous units which have a close structural-morphological similarity with different model products synthesized at metasomatic replacement of single crystals.

Model metasomatic products, investigated in situ in about 200 ternary systems, are specified by the inheritance degree of structural and morphological features of an initial crystal (Glikin and Sinai 1991; Glikin 1991, 1995a). The product structure either remains monocrystalline (isomorphic replacement) or becomes polycrystalline (mainly non-isomorphic replacement); negative products being of a minimal degree of the structural inheritance, appear at special conditions. The product morphology either inherits the shape from protocystal (pseudomorphs) or differs from that (“automorphs”). They give a continuous series divided conventionally to vicinal, face and habit pseudomorphs (respective features of protocystals are remained), then localized, dissipated and translocated automorphs (protocrystal places are marked or lost). Extent of preservation of the protocystal shape is defined by the kinetic diffusion properties of the system, while the reaction rate, product structure, and volume effect depend upon the type of phase equilibrium the system possesses, which is described by the Schreinemakers phase diagrams. Bag-like automorphs including Liesegang rings are caused by some combination of the compound diffusion rates in the solution and the product precipitation rate. Porous and box-like pseudomorphs are formed at volume-deficite reactions.

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<sup>1</sup> *Crystallography Department of St.Petersburg University, University Emb. 7/9, 199034, St.Petersburg, Russia, e-mail: [glikin@ag2460.spb.edu](mailto:glikin@ag2460.spb.edu)*

Mixed crystal origin is of a high importance for rapakivi due to feldspars present a principal part of the rock. Such a process is a combination of phenomena, considerable part of which does not fall under the classical theory restrictions (Glikin and Sinai 1983; Glikin et al. 1994; Glikin 1995b, 1996; Kryuchkova et al. 2002). The replacement preserving monocrystallinity is divided into two types: 1) volume-deficit replacement limited by fast diffusion within the solution and accompanied by inserting inclusions into the crystal body (final pseudomorphs are peculiar spongy crystals); and 2) volume-excess replacement limited by extremely slow solid phase diffusion and accompanied by a spread of a continuous rim into the crystal body with autoepitaxial excrescences around it. A change of the type during a process course is possible. The process consists in random alternations of growth and dissolving of microspots on a crystal surface. When temperature drops sharply the replacement becomes negligible and normal crystal growth is observed. On certain cooling metastable heterogeneous equilibrium of the solution is established; there exist two isomorphic crystalline phases enriched with ultimate components of the thermodynamic equilibrium composition. Composition trajectories and equilibrium states are displayed by modified concentration phase diagrams.

Processes in quaternary and more complex systems result in combined products. Among them there are spongy pseudomorphs which pores are filled by a solid compound, filled box-like pseudomorphs and bag-like automorphs.

Some characteristic structure details of rapakivi, compared with experimental products of crystal replacement, determine the rock as a secondary one after a gigantic-grained anorthosite (Glikin 1991). It appears to be constituted of innumerable interpenetrated polymineral products after feldspar protocystals. Local heterogeneities of the rock structure are considered as replacement forms specified similarly to the listed monocrystal and polycrystal pseudomorphs and automorphs. They are represented by continuous or chain-like orbiculars (spherical or polyhedral) and by associated grown (faceted) and dissolved (rounded) porphyroblasts.

**Orbiculars** are known as continuous feldspar spheres filled by a granite aggregates and found rarely. Meanwhile chain-like feldspar spheres of a various degree of the chain density, are widespread but masked by a surrounding granit structure. Both the orbicular forms are considered as analogues of the experimental spherical bag-like automorphs. A metasomatic replacement is the only known way for their origin. Their wide occurrence in rapakivi appears to be the key for the determination of a metasomatic stage in the origin of such a rock. **Porphyroblasts** are considered as analogues of the experimental monocrystalline pseudomorphs. *Spherical porphyroblasts* were formed through volume deficit replacement accompanied by a dissolution. Their zonality is a secondary one connected with inserted solid inclusions and compositional varieties. The low-temperature quartz included into porphyroblasts (Koval and Valasis 1989) confirms a secondary hydrothermal origin of solid inclusions. A regular concentric distribution of inclusion zones is the consequence of a diffusion limitation of the implantation process. *Polyhedral porphyroblasts* were formed through replacement processes characterized by a volume excess and limited by a diffusion within a solid substance. Accordingly, their zoning is asymmetric and should be defined as a primary one.

Differences in replacement effects of feldspar crystals are connected with variations of their initial chemical compositions. The reaction type (with a volume deficit or excess) and a replacement degree depends on ratios of isomorphic components in a crystal and in a solution. Crystals enriched by different isomorphic components relatively to the solution equilibrium, are replaced by different mechanisms (volume deficit and excess). Combined spherical-polyhedral zoning is formed owing to a chemical and temperature evolution of a metasomatic solution.

Metasomatic signs in rapakivi (separate positions of porphyroblasts, characteristic boundaries of massifs, etc.) were investigated by Velikoslavinsky (1953), Sudovikov (1967), Koval and Valasis (1989). Polymineral-metasomatic approach results in an extension of this direction on the novel experimental grounds.

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