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LIQUATION DIFFERENTIATION AND INTERACTION OF LIQUID PHASES IN SYNTHETICMINERAL ALLOYS MELTS

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Natural stone - is a unique material, which is the standard combination of durability, reliability and beauty. Therefore, natural stone is still popular, along with modern synthetic materials, especially at a time when important aesthetic qualities.

A variety of patterns and textures of natural stone provides petrochemical processes that occur in the magma at the stage of formation of rocks. To form the texture of the stone the most important process is the separation of the melt to separate liquid phases. These phases differ in density, composition, color, shape, mineral aggregates, etc.

The role of magmas in the formation of bundles of macro-and micro-structure of the rockshas been evaluated recently. In chemistry, the existence of two immiscible liquids of different densities has long been known, the simplest example of such a system of "oil-water." At the end of the XIX century. The view emerged that immiscibility may be present in the molten silicate magma, this phenomenon is called "phase separation" or "liquation differentiation" [1]. Study of this phenomenon and its influence on the formation of the rocks studied by well-known foreign and domestic scholars like Levinson-Lessing, Bowen and Greig [2,3]. The main directions of the discussion around the phenomenon of phase separation, there were two: whether it exists and if there is any rock may result from this process. Much less attention is paid to the crystallization of silicate melt stratified rocks. It was believed that each of the liquid phases crystallize separately, suggesting that these processes occur in parallel [4].

With the development of research techniques, it was shown that phase separation is present in some granites, basalts, as well as in lunar rocks [5]. It was found that the effect of stratification is present in virtually all glass and many other synthetic silicate melts. The phenomenon of phase separation is most effective in the study of synthetic materials. Of all the materials that separate into two liquid phases, synthetic mineral alloys are most similar to the rocks [6].

Synthetic mineral alloys (siminals) - a type of petrurgical materials obtained by crystallization of molten rock, or various waste products of basic and ultra basic character. Siminals - it is also a material obtained by the relaxation of physical and chemical processes associated with the cooling of the melt produced by oxide mixture with a high concentration of silica.

Siminals structure is a combination of crystalline aggregates, ranging in size from 100 nm to 800 microns, and an amorphous glassy phase with nanoscale nucleation.

Earlier phase separation siminals not investigated because it was believed that the phenomenon of immiscibility exists only at high temperatures, and hence, by the time of crystallization, even if there was segregation, the melt becomes homogeneous state. We believe that the liquid phase in the melt siminals certainly interact, as well moistened with each other. The study of the crystallization of silicate melts from the separated state, taking into account the interaction between the phases is an urgent task. The solution to this problem will manage the processes of phase separation in order to achieve certain properties siminals, including aesthetic.

The purpose of this study is to examine the interaction of fiber in the melt phase during crystallization siminals.

The phenomenon of phase separation in the melts siminals was first discovered in the industrial manufacture of products from them for stone casting technology. Watching the process, the engineers found that by pouring superheated melt products are highly fragile. On the cleaved products such visible banded structure. The shape and distribution of contrasting bands of repeating the direction of flow of melt in the mold. This texture is called "tree". Since the phenomenon of phase separation led to the marriage of products, the only focus of his study was to identify the conditions under which it can not arise. Once these conditions are found in practice, research on this matter have ceased.

In the works of Fenner [7] notes that melt into fibers when the system loses its balance. The melt can lose your balance when lowering the temperature or the temperature drops and the simultaneous crystallization.

Therefore, segregation can be stable and metastable [8]. Recognized as a stable one that occurs before the liquidus and the metastable one which occurs in the interval between the liquidus and solidus. In practice, most siminals production is a metastable phase separation.

In the works of American Scientists Rutherford and Hoffman [9,10], noted that the allocation of droplets of one liquid in another, a further change in composition of these fluids depends on the diffusion of elements in both melts and the surface phase sections. This process is similar to the processes of nucleation and crystallization of solid solutions from the melt, but the rate is much higher, as occurs in fluid.

Visually segregation in siminals has banded texture on the macro - and micro - level (Fig. 1), since the melt siminals dynamically positioned (poured into a mold).

Liquation siminals texture can be described as a mass matrix are areas with very different composition and structure.

In 1987 E. Roeder [11], a famous scholar of lunar rocks, explained a clear selectivity, because of the growing crystal is a two-phase melt inclusions in the form captures that fluid, which strongly differs from it in composition, since the components of the second liquid consumed with growth.

Therefore, the phase separation in siminals is not a process parallel to the crystallization of two liquid phases, and the process of combating a specific mineral phases for the "Leadership", a kind of "expansion".

Since the beginning of deposition of droplets of one phase relative to the other, immediately begins a rapid exchange of elements. One phase is the one whose free energy at the surface above begins to actively grow at the expense of pumping from the other siblings, capturing some parts of "donor" phase.

However, the images obtained by optical microscopy revealed the presence of not two components, and three. As already mentioned, the phase separation in the metastable siminals has character, that is, at the time of separation in the melt is already present, and even crystal nucleation in the initial stages of growth. Nucleation and crystal nuclei are formed by the phases, the melting point of which the most high. Previous studies of phase composition siminals with phase separation [12] showed that, in their present diopside, augite, aegirine, and quartz (Fig. 2). Moreover, the composition of diopside (Na5Ca5)(Cr5 Mg5)Si (Al) 2O6 , the concentration of chromium in siminals low, about 5-6%, so it is obvious that the first nucleation will be the nucleation of diopside. However, their growth will be limited due to the low concentration of chromium in the melt. The refore, nucleation of diopside can develop into a small chip located at a large distance from each other.

Nucleation of diopside are "mechanical modifiers", they acquire a phase close to the augite $(Ca,Na)(Mg,Fe^{2+},Fe^{3+},Al^{3+})[(Si,Al)_2O_6]$. As the crystallization of augite captures a small drop of "donor" phase, which is a mixture of quartz and aegirine, aegirine part of a mixture of quartz and solidifies in amorphous glassy state.

In support of the above-described sequence of crystallization processes are images(Fig. 3) and the results of spectral microprobe analysis (Table 1) obtained by electron microscopy. Scanning electron microscopy and microprobe analysis performed at the facility JSM-6390LV.

When taking the sample surface in the modes of chemical and topographical contrasts revealed that the theoretical assumption made above is confirmed.

Consider the images of the same plot. In Fig. 4, and the image that takes into account the chemical contrast, and Fig. 4b - topography. Lots of diopside, which are in stark contrast to the chemical composition, almost not detectable visually on the topography. From this we can conclude that they are in the surrounding augite formations. Augite is strongly distinguished from the height of the relief of that part which is a

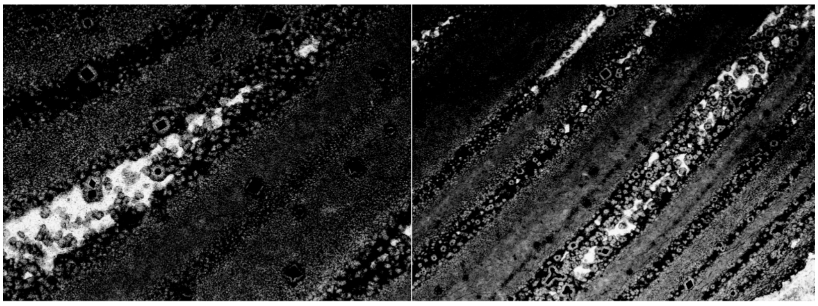

Fig. 1. Siminals structure with the addition of chromite in the charge, an optical microscope, x100 (nicols crossed)

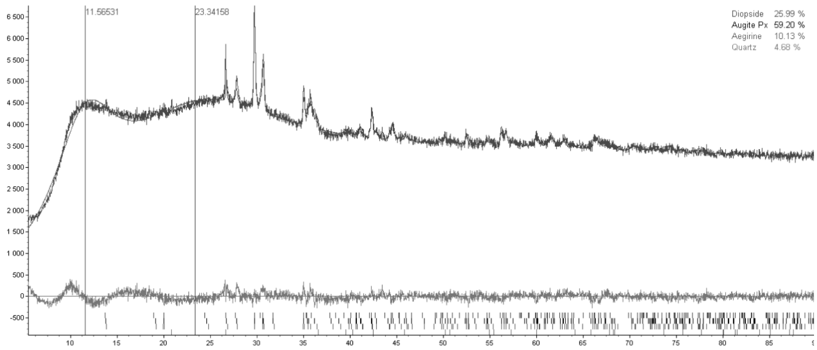

Fig. 2. Diffractogram of the sample siminals a fixed state of phase separation

Table 1

The composition of the elements at the points of the spectral analysis

The point of the analysis	The content of the element, %										
	O	Mg	Al	Si	Ti	V	Cr	Fe	Na	K	Ca
spectrum 1	40,63	5,33	6,12	27,08	0,89	-	0,24	10,32	0,86	0,28	8,36
spectrum 4	13,82	4,28	3,43	0,34	0,45	0,4	54,16	23,14	-	-	-
spectrum 5	46,57	5,55	5,79	25,52	0,78	-	-	7,75	1,01	0,19	6,84

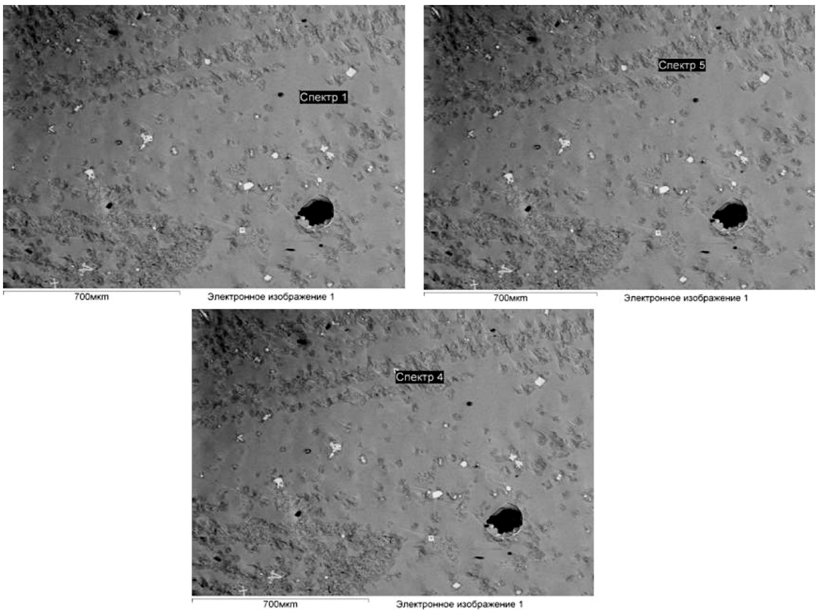

Fig. 3. Image of the surface of the samples obtained by scanning electron microscopy, indicating the points of spectral analysis

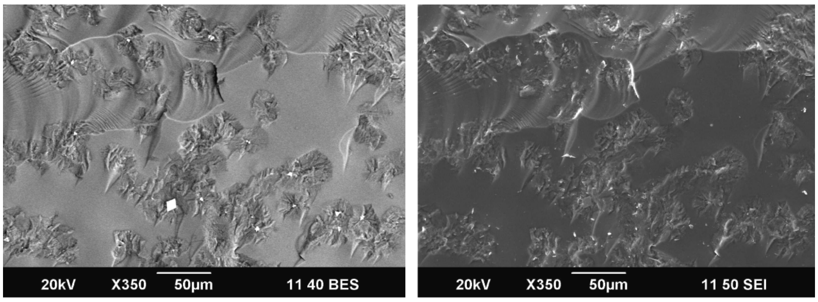

Fig. 4. Image of the surface area of a sample surface at different shooting modes for electron microscopy: a - a chemical contrast, b - topographical contrast

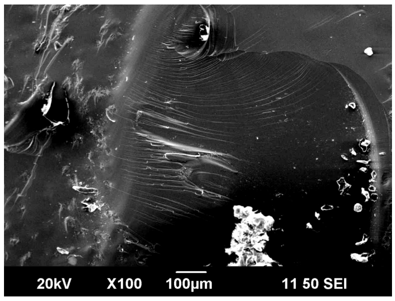

Fig. 5. The site of fracture on the surface of the hardened area in the amorphous-glassy state

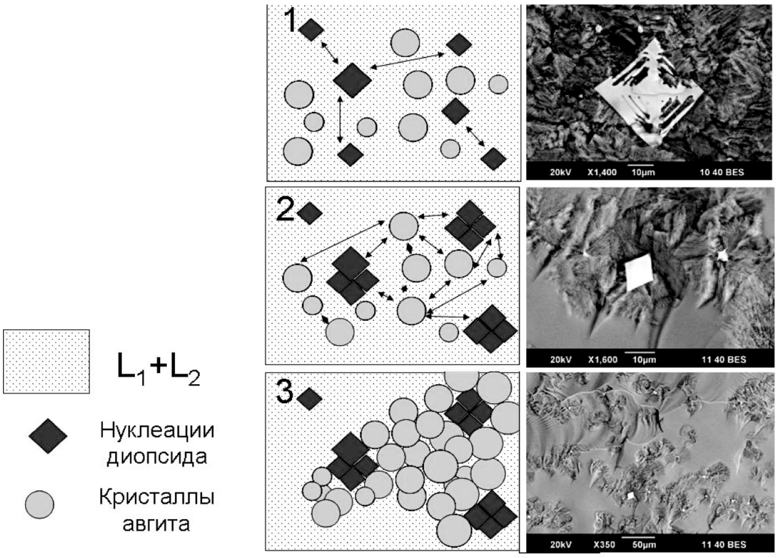

Fig. 6. The order of crystallization siminals of the two-phase fluid: a - scheme, b - electron microscopy images illustrating the pattern

mixture of quartz and aegirine (it hardens partially amorphous state, according to the fracture, Fig. 5).

It turns out that, in a metastable state, without regard to hetero-and homogeneous nucleation, is a selective capture of one liquid phase, the other liquid phase. An exciting phase has the form of drop-shaped inclusions, and exciting distributed among them in the form of worm-like structures. We can say that the relaxation processes in the crystallization of the melt phase separation take place successfully in some phases, but in general the complete relaxation occurs.

The successive stages of crystallization of the two-phase liquid melt siminals we presented graphically in Fig. 6, and the most indicative and reinforced our view of electron microscopy images (Fig. 6b).

Thus, thanks to the research found that in general the whole process of structure formation of the two-phase melt siminals can be characterized as a process catalyzed exchange of items between the two phases on the basis of the basicity in the crystallization conditions. As a result, one of the other fluids trapped as inclusions, there are areas with a chaotic distribution of components and atypical morphology, which follows the shape of one of the two-phase melt of liquid phases. This allows further, using the installed feature, to manage the process of phase separation of silicate melts, predicting the composition of the liquid phases, the nature of their interaction at different stages, and hence to achieve a certain color contrast of these phases, the amount of layers to separate them in the solid state and thus does not mimic the natural beauty and harmony of stone and reach her, driving petrochemical reactions in the melt.

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