IMMISCIBILITY IN FLUID-MAGMATIC SYSTEMS AND ITS ROLE IN THE PROCESSES OF MINERAL - AND ORE-GENESIS

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The main factor affected on the ore-bearing of the fluid-magmatic system is phase condition and chemical composition of fluid. As fluid we realize isolated as one, two or (rare) more phases part of total system, containing volatile (water, carbonic acid) and salt unions. In nature fluid phases exist in wide diapason of TP-parameters – from thousands degrees and Mbars up to first degrees and $n*10^{-3}$ bars. Their existence diapason is extended from outer core to the earth's atmosphere. Neither melts, no crystal phases can exist in such wide parameters interval. This is connected with the fact that the melts and crystal phases are partially or completely ordered and so their ability to the transformation in accordance to outer conditions is much less. Fluid-magmatic systems can be considered at different aspects: (1) as homogeneous – then their properties (but not properties of fluids) will determine the evolution of system; (2) as inhomogeneous (consisting from two or more phases) – then description of fluid-magmatic system will be adequate only with consideration of the properties of immiscible fluid-magmatic system. In the beginning of XX century many petrologists show possible immiscibility of magmatic systems (Greig, Cirkel, Rosenbush and others). But they cannot receive accurate evidences of existence of liquid immiscibility in fluid-magmatic systems. In the middle of XX century scientists began to consider volatile and salt components as factors of liquation (Levinson-Lessing, Marakushev and others). Successful attempts of such systems modeling have been produced. But in the alumina-silicate melts the immiscibility took place rarely. In the end of XX century it has been considered that immiscibility of fluid-magmatic system in most choices has been determined by presence of two phases: (1) alumina-silicate melt and (2) fluid, salt ingredient of which can approach 100 wt %.

The main aspects of ore-genesis are: mechanism of ore matter concentration and method of its separation from alumina-silicate melt. Earlier it has been shown that water-salt phase of high concentration is an effective ore elements concentrator. Under certain conditions in the process of liquid immiscibility origin this phase can separate from alumina-silicate melt. Now existence of liquid immiscibility in silicate-salt systems is proved. It has been estimated that different salts have different ability to extraction of ore components. Distribution coefficients of ore elements (Zn, Pb, Cu, La, Ce, W, Mo) at 800-1200°C vary from 2 up to 100 (in favour of salt melt). At the PT conditions of post-magmatic stage salt phases have different behaviour. Solutions of I-type salts (NaCl, KCl, KF and others) are not such effective in accumulation and deposition of ore matter as II-type salts (NaF, LiF, $Na_2Si_2O_5$, Na_2CO_3, Na_2SO_4 and others) are. Peculiarities of phase relations allow to consider these salts as optimize environment (phase) for the concentration, transport and deposition of ore components at TPX- parameters of mineral genesis change.

These processes could play the main role in genesis of Lovozerskii massif, which is characterized by high concentration of II-type salts (NaF, $Na_2Si_2O_5$, Na_2CO_3, Na_2SO_4 and others) in mineral-forming fluid. We study the rocks of massif to estimate PTX-parameters of its formation and evolution. Complex of mineral geothermometers based on the phase equilibriums of solid solutions of Fe-Mg and leucocratic minerals has been used to estimate the temperatures. It has been established that different rocks were formed at different parameters. The data of temperatures of mineral paragenesis formation allow to conclude that: (1) luyavrites (and sodalite-bearing luyavrites) have a mineral-genesis temperatures 850-460°C; (2) urtites, containing ore minerals (loparites) have 450-380°C; (3) foiyaites, containing the paragenesis of feldspar – nepheline have <430°C. These facts does not agree with obtained conceptions of formation of differentiated complex rocks: (1) formation of differentiated complex by total cooling with processes of crystallization differentiation (which mean smooth change of temperature in section of massif); (2) stage introduction (which mean high temperatures of crystallization for urtites and foiyaites ~700-850°C). According to our point of view the formation of differentiated complex rocks can be explain by wide development of liquid immiscibility processes such as alkaline alumina-silicate melt + salt melt (containing NaCl, NaF, $Na_2Si_2O_5$, Na_3AlF_6, Na_2SiF_6, $NaAlO_2$, Na_2CO_3, Na_2SO_4, Na_3PO_4 and others). During introduction of drop-liquid layering fluid-magmatic system and formation of stratiform intrusion the processes of alumina-silicate melt crystallization forming the layers of luyavrites took place simultaneously. Later at temperature decrease up to 550-600^{o}C the processes of crystallization of II-type salt systems containing a lot of alumina-silicate matter have began. The paragenesis of foiyaites with salt minerals inclusions (villiomite), pegmatites and ore paragenesis containing loparites have been formed. So, the differentiated complex rocks have been formed during complicated evolution of heterogeneous fluid-magmatic system, at the beginning presented by agpaitic alumina-silicate melt and high salt fluid. The most part of ore paragenesis was connected with crystallization of II-type salt systems and took place at 380-450^{o}C.

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