PHYSICO-CHEMICAL CONDITIONS OF CRYSTALLIZATION OF LOW-TITANIUM LAMPROITES OF ALDAN (SIBERIA).

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The Aldan shield is abundant in Mesozoic low-alumina K- and Mg-rich rocks referred to the family of lamproites. They occur as sills, dikes and diatremes under structural-tectonic conditions typical of lamproites and in mineralogical-petrochemical features they are similar to the latter. At the same time these rocks are different from lamproites: they have low-titanium content, belong mainly to miaskitic type, typically do not contain Ba-Ti-Zr indicator minerals *(Bogatikov, et al.,1991)*.

Using methods of mineral thermobarogeochemistry - methods of studying solidified melt inclusions in minerals, we have elucidated physico-chemical conditions of formation of the Aldan mica lamproites: (leucite)-olivine-pyroxene and richterite-sanidine in the Murun Massif, olivine-pyroxene at the Yakokut Massif and in the Upper-Yakokut Trough and olivine-pyroxene-leucite on the Molbo River. Combination of these methods allowed data to be obtained on crystallization temperatures of minerals, chemical composition of mineral-forming medium and direction of its evolutional transformation as well as on fluid composition at the stage of crystallization of phenocrysts.

Crystallization temperatures of minerals were determined with the help of heating and homogenization of the fluid inclusion content in high temperature heating stage, under steady microscope observation of the course of phase transition. Fluid composition was elucidated when analyzing gaseous phase of melt inclusion on Raman-spectrometer *U-1000 "Jobin Yvon"*. The composition of silicate components of melt inclusions-crystalline phases and glasses - was determined on electron microprobe *"Camebax-micro"*. The composition of heated melt inclusions from cores of the earliest phenocrysts was taken as the composition of parent magma. The composition of unheated glassy inclusions in late phenocrysts and minerals of groundmass was compared with the compositions of derivative differentiated melts. The composition of interstitial glass in partly crystallized melts was identified with the composition of residual melts. Proper selection of samples allowed variations in the chemical composition of melts from nearly initial to residual to be observed and the trend of magma evolution during its crystallization to be plotted

The results obtained indicated both similar features and distinctions between the Aldan rocks and typical lamproites *(Mitchell and Bergman, 1991)*.

Crystallization temperatures of minerals in the Aldan rocks appeared to be similar to formation temperatures of minerals in standard lamproites: in the Murun and Yakokut massifs and in the Upper Yakokut Trough, pyroxene phenocrysts crystallized in the range of 1260-1200°C, small pyroxene grains - 1220-1170°C, while olivine phenocrysts - at temperatures essentially exceeding 1200°C. In the Molbo lamproites, pyroxene phenocrysts crystallized at 1240-1180°C, apatite - 1150-1030°C.

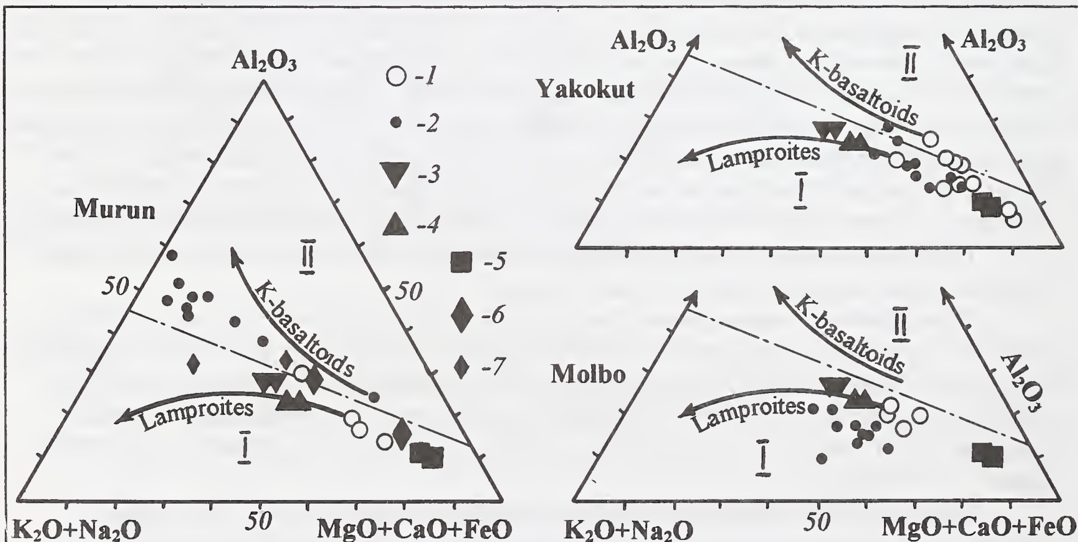
The chemical composition of melts, responsible for the formation of the Aldan lamproites, though being similar to a certain degree, was substantially different from the composition of common lamproite magmas. The latter over the whole period of crystallization *(Panina, 1993)* are characterized by low contents (2-8 wt.%) of Al_2O_3, remain agpaitic ($K_2O+Na_2O/Al_2O_3>1$), have low f ($100FeO/FeO+MgO+TiO_2<50$ mol.%), and appreciable predominance of SiO_2 over Al_2O_3 (5 mol.quantities).

Upon formation of the Molbo lamproites, the composition of initial melts was also low-alumina (6-8% Al_2O_3), at all stages the transformations remained agpaitic, SiO_2/Al_2O_3 was not lower than 6 mol.quantities, while *f* was mainly within 65 mol.%. Differentiated melts preserved rather high content of femic components, and alkalis, and low content of aluminum: at 53 wt.% SiO_2 the melts contained 1.4 TiO_2, 7.8 Al_2O_3, 11 Feo, 1.5 MgO, 3.3 CaO, 2.2 Na_2O, 11 K_2O, and 2.5 wt.%BaO *(Panina, Konev, 1995).*

The melts taking part in formation of lamproites of the Yakokut Massif and Upper Yakokut Trough were characterized by a relatively low contents of Al_2O_3 (7-12 wt.%) and low *f* (only at late stages of transformation *f* slightly exceeded 50 mol.%). However, the ratio of alkalis and Al_2O_3 at different stages of crystallization of melts varied significantly, which resulted in either agpaitic or miaskitic character of melts. The SiO_2/Al_2O_3 ratio was within 4.4-6.6 mol.quantities. With 44.3 SiO_2 in initial melts, the content of MgO reached 16 wt.%, Al_2O_3-6.82, K_2O-5.85. During the evolution and crystallization, the alumo-alkaline component in melts grew, the contents of Si, Ti, Ba, and P increased, while the amounts of Ca and Mg decreased *(Panina, et al., 1995).*

In the Murun Massif the content of Al_2O_3 in initial melts during crystallization *(Panina, Vladykin, 1994)* increased more appreciably (to 15-19 at 60-63% SiO_2), *f* typically exceeded 50 mol.%, the ratio SiO_2/Al_2O_3 did not reach 5 mol. quantities, Na_2O+K_2O/Al_2O_3 was lesser than 1, i.e. differentiated derivative melts acquired a distinct miaskitic character in spite of the fact that the majority of lamproite rocks of Murun are agpaitic.

On the diagrams, reflecting the position of alumina-poor lamproites and high-alumina K-basaltoids in the system (K_2O+Na_2O) - Al_2O_3 - (MgO+FeO+CaO) *(Panina, 1993),* the rocks of the Molbo River and glasses in their minerals completely fall into the field of lamproites. They form a single evolution trend directed towards the increase of the content of alkalis and a decrease in the content of femic components and aluminum. The Yakokut rocks and the melts preserved in



1,2 - Aldan lamproites and glasses in their minerals (respectively); 3 - wyomingite of Leucite Hills; 4 - leucite lamproites of Noonkanbah; 5 - olivine lamproites of Ellendale; 6-7 - Spanish lamproites and glasses in their minerals (respectively).

their minerals are located mainly in the field of lamproites close to the separating line, only locally going beyond it to the field of K-basaltoids. The composition of inclusion glasses mainly fall into the field of occurrence of compositions of leucite lamproites of the Noonkanbah field (Australia) and Leucite Hills (USA). The Murun rocks are localized in the field of lamproites, while glasses in their minerals are localized completely in the field of Al-rich basaltoids, not far from the separating line. The lamproites of Spain and inclusion glasses in their minerals are arranged similar to them *(Bogatikov, 1991)*.

The composition of volatile components participating in formation of the Aldan rocks and typical lamproites is essentially different. As known *(Kadik, 1986)*, fluids in deep-seated melts are typically represented by water-carbon dioxide which are responsible for the metasomatic transformation of mantle substrate and promote melting of high pressure magmas. On crystallization of diamondiferrous lamproites of Western Australia, CO_2 was established to be of major and F - of considerable importance in the composition of fluids *(Sobolev, et.al., 1985)*.

The gas component of melt inclusion in olivine in the Yakokut lamproites was represented by 41 CO_2 and 58.9 N_2, in pyroxene - 100 mol.% N_2. The presence of other volatiles was also observed in inclusion glasses: from 0.37 F and 0.35 wt.% Cl in heated glasses from pyroxene of the Yakokut rocks and to 0.37 SO_3 and 0.47 wt.% Cl in unheated glasses from Molbo apatites. The composition of glassy incusions in the Murun Massif displayed lesser amount of Cl (0.1-0.2 wt.%) and greater concentrations of SO_3: 0.19 - in silicate and 16.9 wt.% in salt melts. It is assumed that during crystallization of initial melts the content of Cl, SO_3 and perhaps F and CO_2 increased and critical values at about 800°C. At these values the melt separated into silicate and salt (sulfate-carbonate?) components.

Conclusions. Appreciable distinctions of the substance composition and physico-chemical features of formation of the Aldan lamproitic rocks from common lamproites may be associated with the peculiar lamproitic magmatism of the region. The predominance of nitrogen fraction in fluid composition on crystallization of olivine and its nearly absolute value on formation of pyroxene may suggest low-depth conditions of generation and crystallization of the Aldan low-titanium lamproite magmas. The low-pressure conditions might have been the reason of the depletion of fused melts in Ti and Zr typical of common lamproites, which are transported mainly by high pressure alkaline fluids. We cannot also rule out that the specific character of the lamproite magmtism of the region was in some cases affected by mixing of typical lamproite melts with K-basaltoid magmas. This assumption is favored by some peculiar features of the chemistry of rock-forming minerals and numerous similar features between the Aldan lamproites and derivatives of K-basaltoid magmas, which are especially distinct in those objects where simultaneously both of these families are wide spread (for example, in the Murun Massif).

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