THE RELATIONSHIP BETWEEN HIGH-MAGNESIUM AND HIGH-ALUMINA BASALTS OF THE KLYUCHEVSKOY VOLCANO - INSIGHT FROM MELT INCLUSIONS STUDY

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Calc-alkaline basalts of Klyuchevskoy volcano form continuous compositional trend from high-magnesium (HMB - MgO – 11.6, Al_2O_3 – 13.9 мас.%) to high-alumina basalts (HAB – MgO – 5.2, Al_2O_3 – 18.2 мас. %). To clear up the relationship between HMB and HAB and to compare their rock forming melts we studied melt inclusions (MI) in olivines, clinopyroxenes from HMB (flow Bulochka) and olivines, clinopyroxenes, plagioclases from HAB (flow Apakhonchich).

Partially recrystallized inclusions in minerals of HMB consisting of glass, clinopyroxene, spinel and fluid bubble were rehomogenized. Olivines and clinopyroxenes were heated up to 1220 and 1120 °C, exposured during 10 and 15 min respectively and then were rapidly quenched (~200°/sec). Quenched inclusions contained glass and fluid bubble. MI in HAB phenocrysts were represented by glassy inclusions (glass+fluid phase) and required no experiments.

Estimates of crystallization temperatures (T_{cryst}) were based on calculated "dry" pseudoliquidouse temperatures of mineral-melt equilibria. T_{cryst} of HAB phenocrysts were corrected according to water content in melt. T_{cryst} vary from 1320-1300 °C for Ol (Fo_{91-90}), 1240-1190°C for Ol (Fo_{88-86}) and Cpx $\#Mg_{88-87}$ and 1145-1030 °C for phenocrysts of HAB. Pressure was estimated using composition of Cpx ($\#Mg_{70-81}$) by means of Cpx geobarometer [1]. Its values are no more than 3-3.5 kbars. For estimating water content in melts, those are in equilibrium with Ol and Pl it was used calculation method similar to that in [2]. Water content in HAB melts varied from 0 to 5 wt.%; high-alumina melts contained the most high amount of water. Minimum calculation estimate of water content in HMB melts is 1.1 wt.% on average. This is in a good agreement with analytical data [3,4] of water content in olivine ($Fo_{87-90.5}$)-hosted MI from HMB - values within 1.5- 2.5 wt.%.

Composition of studied MI is shown on fig.1. Magnesium melts (MgO > 8 wt.%) (a part of melts from group 2) were obtained from studied MI in HMB olivines ($Fo_{86-88.5}$) taking into account post entrapment effect of "Fe-loss" [5]. Parental melts of HMB contain 12 wt.% MgO and are in equilibrium with olivine $Fo_{90.8}$. They were received by modeling reverse fractionation of olivine from magnesium MI. Melts of group 1 (data of [3,4]) are in equilibrium with olivine $Fo_{87-90.5}$. It's important to say that obtained magnesium melts differ from bulk rock composition of Klyuchevskoy volcano by elevated CaO, Al_2O_3 and low SiO_2 (see Fig.1). Melts with MgO < 6 wt.%, received from MI in HAB minerals form wide composition field (group 3) and characterize final stage of magma evolution at Klyuchevskoy volc. [6]. It's interesting to note that melts from MI in Cpx ($\#Mg_{78-87}$) of HMB are similar in composition to a part of melts of group 3 (Al_2O_3 < 16, MgO < 6 wt.%). This can confirm the fact of genetic relationship between melts from which HMB and HAB minerals crystallized.

Study of crystal inclusions in minerals also confirms such a relationship [7]. However our data of composition of MI in HAB and HMB minerals at this moment can't allow saying evidently about one continuous evolution trend of melts from HMB to HAB. This is because we have no melts with MgO –6-8 wt.% and HAB melts, corresponding in composition to those of HMB.

Modeling of decompression fractional crystallization with initial melt identical to HMB allows us to receive observed composition spectrum with MgO< 6 wt.% [6] (fig. 1). But when taking average composition of MI in HMB olivine as initial melt no model crystallization trends can explain observed variation of HAB melts (fig. 1).

The discrepancy between composition of high-magnesium melts (MgO>8 wt.%) from inclusions in HMB olivines and bulk magnesium and high-magnesium basalt chemistry can be caused by two reasons: 1) variation of initial melts composition and 2) partial decripitation of MI. The first reason is not suitable, because among the rocks of Klyuchevskoy volc. there are no rocks, corresponding in composition to melts obtained.

Alternative explanation of observed discrepancy could be natural partial decripitation of MI [9]. The fact is that arround recrystallized MI in magnesium olivines aureoles of secondary melt and fluid inclusions often occur. This is a characteristic feature not only for Klyuchevskoy volc. basalts but for some other volcano basalts too, for ex. basalts of volc. Avacha. Such peculiarity can be explained by the process of partial decripitation of MI after they were trapped. Decripitation leads to descrepancy between bulk inclusion and initially trapped melt compositions. As a result after heating experiments bulk inclusion composition will be shifted to that of "daughter" mineral (Cpx in our case).

Thus the problem of genetic relationship between melts from which minerals of HMB and HAB crystallized is still under discussion. Direct data of composition of melts in HMB minerals show that there are no melts among them corresponding to HAB and the most primitive melt from melt inclusions can't be linked with high-alumina magmas by fractional crystallization of Ol and Cpx. Investigations will be continued in that direction and we hope it will allow us to solve the paradox in near future.

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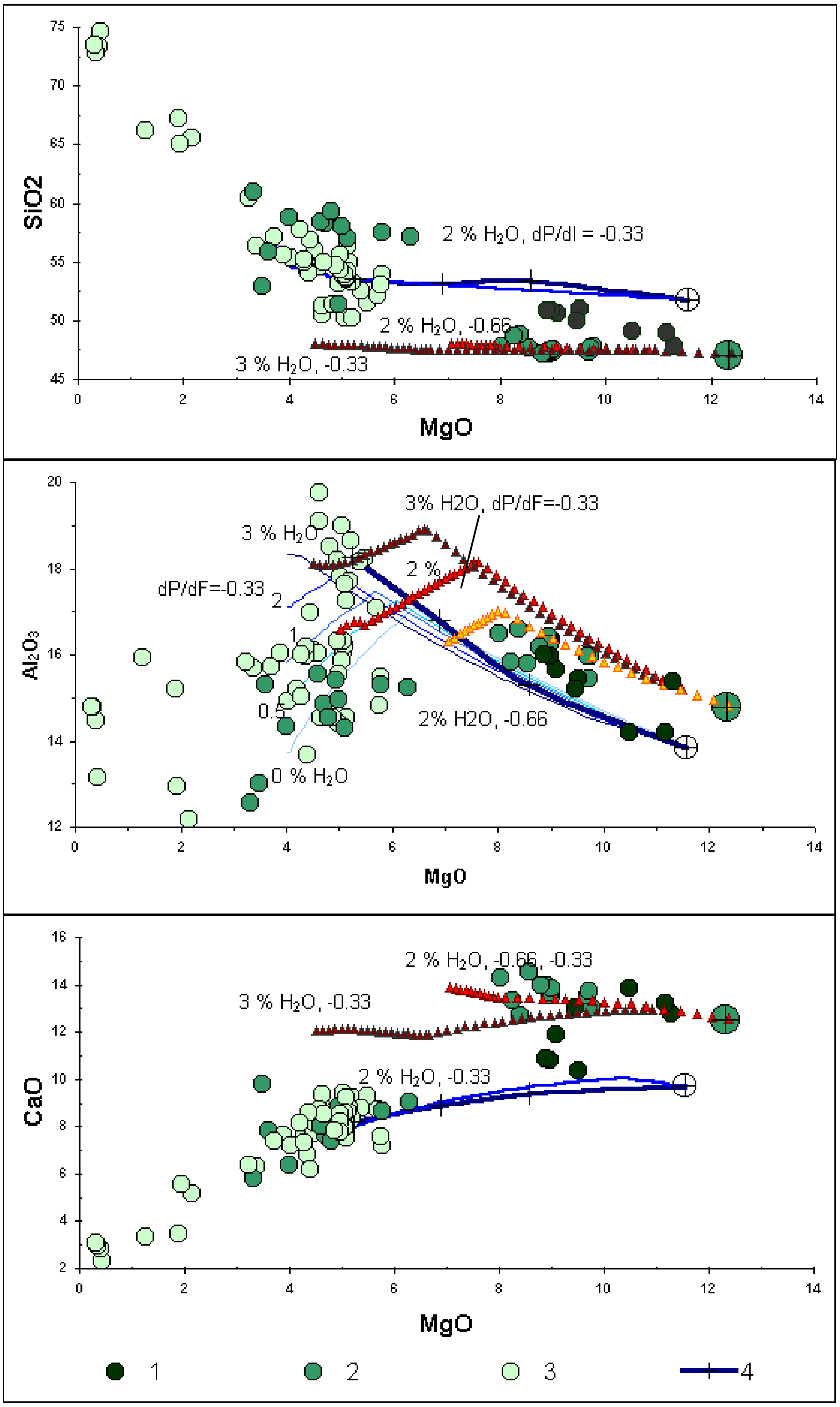

Fig. 1. Melt compositions obtained on the base of melt inclusions study. MI in the minerals of HAB and HMB of Klyuchevskoy volc.: 1) olivines ($Fo_{87-90.5}$) - data of [3,4]; 2) olivines ($Fo_{86-88.5}$), Ol ($Fo_{90.8}$) – average composition, Cpx ($\#Mg_{78-87}$) from HMB flow Bulochka; 3) Ol (Fo_{71-79}), Cpx ($\#Mg_{70-81}$), Pl (An_{47-84}) from HAB flow Apakhonchich [6]; 4 – trend of Klyuchevskoy volc. bulk rock chemistry. Model crystallization trends with two different initial high-magnesium melts are shown by thin lines and triangles (Pinit.=18 kbar). Initial water content and decompression rate are also shown on diagrams (% H_2O, dP/dI).