



## Mineralogical indicators of intrachamber magma degassing and oxidation in Shiveluch (Kamchatka)

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Processes of the intrachamber magma degassing precede degassing in the conduit on the final stages of eruption and may be of no less importance. Appearance of the free fluid phase at the depth can be responsible for intrachamber elements transport, pressure buildup and local magma oxidation. We interpret phenocrysts zonality in Shiveluch andesites in terms of such degassing based on our experimental data. High magnesium andesite of Shiveluch volcano (Kamchatka) was studied at  $\text{PH}_2\text{O}=2$  kbar. Bulk hydrous glass was prepared in the series of operations including hydrothermal reducing of the initially melted oxidized rock powder under hydrothermal conditions and remelting. The  $\text{Fe}^{2+}/\text{Fe}^{3+}$  ratio in the final hydrous glass was estimated with Mossbauer spectroscopy. It corresponds to  $\text{fO}_2 = \text{NNO} - \text{NNO}_2$  in the andesite melt at the experimental PT parameters. Short experiments yield crystals grown from the melt with  $\text{Fe}^{2+}/\text{Fe}^{3+}$  ratio close to the initial value. Liquidus temperature of amphibole was found to be 970°C. The analysis of composition of amphiboles grown at  $T=950\text{°C}$  demonstrates that the sum  $\text{Fe}^{3+} + \text{Ti}$  (in  $\text{M}_1 + \text{M}_2$ ) is inversely correlated with alumina content in the octahedral coordination:  $\text{Al}_\text{VI} = 0.601 - 0.330(\text{Fe}^{3+} + \text{Ti})$ . The  $\text{Al}_\text{VI}$  content rises with melt reduction (Simakin et al., 2009). Liquidus temperatures of plagioclase have been found at  $\text{PH}_2\text{O}=1$  kbar (1000) and 2 kbar (960). They are in excellent correspondence with values predicted with model by Putirka (2005): 1006 and 956 correspondingly. While using this model we analyse composition of plagioclase at the variation of the water content in the wide range (1-6 wt.%) while changing melt temperature to keep plagioclase on the liquidus. It appears that dependence of the anorthite content in plagioclase on the water content has minimum. It means that degassing coupled with magma heating may result in both direct and inverse zonality in plagioclase. The examples of zonality pattern of magmatic minerals that can be unambiguously attributed to degassing coupled with heating are met at the study of Shiveluch volcanic rocks. In Karan extrusion there are amphibole phenocrysts demonstrating relatively reduced  $\text{fO}_2 = \text{NNO}$  cores overgrown with higher temperature zones formed at  $\text{fO}_2 = \text{NNO}+1$ . Due to amphibole stability anticipated degassing would occur at the relatively high water content. Variations of the plagioclase composition from Karan extrusion often follow positive correlation between albite and iron content. In the view of high water content (above 2.5 wt.%) water loss coupled with heating will result in the more sodic plagioclase. Iron content rise in this case may be prescribed to the local oxidation of the magma. In spite of the failure to find experimental evidences (Burkhard, 2005) these data suggest that degassing can cause oxidation of magma.

### References.

Burkhard D.J.M. (2005) Mineralogical Magazine, 69(2), 103-117.  
Putirka K.D. (2005) American Mineralogist, 90, 336-346.  
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