Magma feeding system of Shirataka volcano, Moriyoshi volcanic zone, northeastern Japan arc

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Following five geological units from the Shirataka volcano are related to magmatic eruption; these are the Kokuzo lava(KL), Numata pumice flow deposit(NPFD), Hagino block-and-ash flow deposit(HBFD), Shiratakayama-Kitsunegoe-Nishikuromoriyama lava domes(SLDG), and Higashikuromoriyama lava dome(HLD) in the ascending order. Many petrologic features suggest that all rock from this volcano was formed by magma mixing. The phenocrysts are divided into 3 groups, according to their chemical compositions; phenocrysts come from the mafic, felsic end-member, and intermediate magmas. The linear trends on variation diagrams suggest that the intermediate magma was formed during the mixing process between the mafic and felsic end-member magmas. In this study, we clarified the petrologic characteristics of these two end-member magmas for each unit and examined the magma feeding system of the Shirataka volcano.

Taking account of the petrological features, those products are devided into 6 petrologic groups. Considering the mineralogical and geochemical data, we estimated the compositions of two end-member magmas for each group. (1) low-K series rocks from the KL; the felsic end-member: SiO_2=65-66wt.%, pl(An33-53)-hyp(Mg-v=52-56)-aug(Mg-v=65-72)-hbl-qtz, 850-900 degrees C, the mafic end-member: SiO_2=46-48wt.%, ol-pl(An70-77). In addition, K and Rb contents of this group are obviously lower than those of the medium-K series rocks. (2) medium-K series rocks from the KL; the felsic end-member: SiO_2=65-66wt.%, pl(An35-55)-hyp(Mg-v=52-63)-aug(Mg-v=66-72)-hbl-qtz, 850-900 degrees C, the mafic end-member: SiO_2=52-54wt.%, pl(An77-87). (3) pumices from the NPFD; the felsic end-member: SiO_2=65-66wt.%, pl(An37-53)-hyp(Mg-v=52-55)-aug(Mg-v=65-72)-hbl, 750-800 degrees C. The another phenocryst is pl(An56-73). No phenocrysts from the mafic end-member magma are obseved. In addition, Nb and Zr contents of this group show peculiar compositions compared with those of the other medium-K series rocks. (4) scoriae from the NPFD; the felsic end-member: SiO_2=65-66wt.%, pl(An42-60)-hyp(Mg-v=61-63)-aug(Mg-v=68-71), 800-900 degrees C, the mafic end-member: SiO_2=53-54wt.%, pl(An80-87). (5) the HBFD; the felsic end-member: SiO_2=65-67wt.%, pl(An40-55)-hyp(Mg-v=48-59)-aug(Mg-v=65-72)-hbl-qtz, 800-900 degrees C, the mafic end-member: SiO_2=52-54wt.%, ol-pl(An77-87)-aug(Mg-v=78-81), 1150 degrees C. (6) the SLDG and HLD; the felsic end-member: SiO_2=66-67wt%, pl(An40-60)-hyp(Mg-v=52-63)-aug(Mg-v=62-72), 800 degrees C, the mafic end-member: SiO_2=53-54wt.%, pl(An72-87).

It is estimated that the primary magma of (1) differs from those of (2)-(6), because K and Rb contents in the mafic end-member magma of (1) are obviously lower than that of (2)-(6). In the mafic end-member magmas of (1)-(6), the following phenocrystic assemblages can be observed; pl, ol+pl, and ol+pl+aug. Chemical compositions of these phenocrysts of each group are different. The felsic end-member magma of (1) has lower K and Rb contents than those of (2)-(6) as well. The following phenocrystic assemblages of (1)-(6) can be observed; pl+hyp+aug+hbl+qtz, pl+hyp+aug+hbl, and pl+hyp+aug, moreover An contents, Mg-value, and magmatic temperature of these phenocrysts of each group have various compositions. The trace element model calculations show that the felsic end-members cannot be derived through fractional crystallization of phenocrystic minerals from the corresponding mafic end-members (particularly Zr, Y), but the felsic end-members could be produced through partial re-melting of solidified mafic end-member magmas, if gabbroic residual was assumed.