Coexistence of mantle- and crust-derived island-arc tholeiites with associated calc-alkaline magma at Akita-Komagatake volcano, Northeast Japan arc

Akihiko Fujinawa[1], Masao Ban[2], Tsukasa Ohba[3], Jun-Ichi Kimura[4], Toshiro Takahashi[4], Yuka Hirahara[4], Takashi Miyazaki[4], Qhan Chin[4], Ryoko Senda[4]

[1]Ibaraki University, Japan, [2]Yamagata University, Japan, [3]Akita University, Japan, [4]JAMSTEC IFREE, Japan

E-mail: fujinawa@mx.ibaraki.ac.jp

Akita-Komagatake volcano is located in the Sengan geothermal field of the Northeast Japan arc. The volcanoes in this field are characterized by predominant low-K tholeiitic magmas with co-existing minor medium-K calc-alkaline magma. This is contrastive to the general tendency of the coexisting two magma types in the frontal arc volcanoes of the Northeast Japan arc, at which calc-alkaline magma erupted predominantly. Akita-Komagatake volcano consists of the main stratocone with a caldera in the south and several parasitic cones at the summit. The main stratocone collapsed and the caldela formed at about 13 ka, associated with a pyroclastic flow. Magmatic eruption history in the post-caldera stage is divided into two sub-stages by a dormancy of activity between 7 and 4ka. Summit parasitic cones in the northern area were built in the earlier sub-stage (13-7 ka), whereas parasitic cones in the southern area developed during the later sub-stage (post 4 ka). This study examines the spatial-temporal variations of the magma types and the compositional variations in each magma type. Genetic relationships among the magma types were examined by analyzing elemental and isotopic compositions. Low-K tholeiitic magmas have been the dominant rock type throughout the post-caldera stage. The early sub-stage (13 ka) began with eruptions of the low-K tholeiitic andesites, and was followed by low-K tholeiitic basalts to andesites. calc-alkaline andesites erupted only episodically in the later sub-stage after 4 ka. During this later sub-stage low-K tholeiitic magma was still dominant with the first eruption of an andesite followed shortly afterwards by low-K tholeiitic basalts to basaltic andesites. Low-K tholeiitic andesite was erupted during the most recent eruption.

The calc-alkaline andesite indicates incorporation of large amount of crustal materials (crustal assimilation), whereas low-K tholeiitic basalts are more likely derived from the sub-arc mantle. This model is consistent with the previous works on the genesis of low-K tholeiitic and calc-alkaline magmas. Even so, two types of isotopically distinct low-K tholeiitic andesites are present. One low-K tholeiitic andesite type shows involvement of isotopically enriched crustal source material which is more enriched than the contemporaneous calc-alkaline andesite. The other low-K tholeiitic andesite type is derived from depleted mantle source by fractional crystallization unaffected by crustal assimilation.

Plausible genetic relationships among the magmas at Akita-Komagatake are summarized as follows: (1) basaltic low-K tholeiitic magmas was generated immediately by the mantle and simply crystallized to form LTH basaltic andesites, (2) calc-alkaline magma was the mixture between basaltic low-K tholeiitic magmas and a felsic magma of crustal melt in origin, and (3) the low-K tholeiitic andesite with enriched (crustal) source might have been generated by a high degree of melting of an amphibolitic crust.