Sr-Nd-Pb isotope compositions of frontal arc stratovolcanoes in Northeast Japan arc

Masao Ban[1], Toshiro Takahashi[2], Yuka Hirahara[2], Tsukasa Ohba[3], Akihiko Fujinawa[4], Shintaro Hayashi[3], Takeyoshi Yoshida[5], Jun-Ichi Kimura[2], Takashi Miyazaki[2], Qing Chang[2], Ryoko Senda[2], Yoshiyuki Tatsumi[6]

[1]Yamagata University, Japan, [2]IFREE/JAMSTEC, Japan, [3]Akita University, Japan, [4]Ibaraki University, Japan, [5]Tohoku University, Japan, [6]Kobe University, Japan

E-mail: ban@sci.kj.yamagata-u.ac.jp

We present new Sr-Nd-Pb isotope compositions along with major and trace element compositions for representative NE Japan frontal arc startovolcanoes, at which calc-alkaline and tholeiite rock series coexist. We selected Hakkoda and Akitakomagatake volcanoes from the northern segment of the arc, Nasu and Takahara volcanoes from the southern segment. About twenty lava samples in each volcano were analyzed for this study. Coupled with the previously published data for Zao and Azuma volcanoes in the central segment, we examined the isotopic characteristics of the two rock series from the six volcanoes. It has been proposed that the tholeiitic basalt magmas from isotopically enriched source are produced by anatexis of the lower crustal amphibolite caused by the underplating of calcalkalic basalt magmas derived from isotopically depleted mantle source for central segment. In the northern segment, mantle-derived magmas are low-K tholeiitic basalts from depleted sources. The calc-alkaline andesites from the segment are isotopically similar to the basalts with contamination of slightly enriched source materials indicating derivation from the basalts. In the southern segment, medium-K and low-K tholeiite basalts coexist. The medium-K basalts are isotopically distinct from the low-K basalts. Therefore, compositionally distinct sources should be necessary for the basalts. The calc-alkaline andesite-dacite magmas of the same K suites have the same isotopic compositions with the basalts and can be derived from the coeval tholeiitic basalt of the same K suite by remelting and internal mixing processes. The source rocks of the NE Japan arc lavas are systematically enriched in terms of Sr-Nd-Pb isotopes from north to south as has been reported elsewhere. In addition to this, we newly found remarkable features that each the volcano has distinct quasi-linear isotopic trends on Pb-Pb and Nd-Pb isotope systematics showing positively and negatively inclined arrays, respectively. These features clarified that mixing of two source compositions basically form the isotopic trends in each volcano. The extrapolations of the isotopic trends towards the depleted endmember (unradiogenic Pb) source appear to converge at one point plot within the Indian MORB-type mantle compositional field. The extrapolations towards the radiogenic Pb diverge and point to the fields of the subducted sediment and of the lower crust. Although the isotopic trends differ between volcanoes, the trends in the same segment are similar. Moreover, the isotopic compositions of the rear arc volcanoes show similar spatial variation as observed in the frontal arc volcanoes although they plot close to the depleted ends of the mixing arrays found in the frontal arc volcanoes. These features suggest that (1) the isotopic composition of the depleted mantle source is uniform, whereas (2) systematic along arc variation exists in the subducted sediment or in the lower crust, or both.