

Differentiation process for magma in the arc crust of the Sengan volcanic region, Northeastern Japan, constrained from principal component analysis

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In order to investigate the geochemical process that took place during the evolution of the island arc magma, we employed principal component analysis (PCA) to evaluate the compositional variations of volcanic rocks from the Sengan volcanic cluster of the Northeastern Japan Arc. We analyzed the trace element compositions of various volcanic rocks, sampled from 17 different volcanoes in the volcanic cluster. The PCA results demonstrated that the first three principal components accounted for 86% of the geochemical variation in the magma of the Sengan region. It indicates that chemical variations of magmas from Sengan cluster were accounted for only three geochemical processes. The first, the second, and the third principal components appear to represent magma mixing, crystallizations of olivine/pyroxene, and crystallizations of plagioclase, respectively. These represented 59%, 20%, and 6%, respectively, of the variance in the entire compositional range, indicating that magma mixing accounted for the largest variance in the geochemical variation of the arc magma. The PCA results demonstrated that intermediate-felsic magma ($\text{SiO}_2 > 57$ wt.%) was derived from magma mixing. Spatial distribution of the score of the 1st principal component systematically correlates with geodesic analysis, high geothermal gradient, seismic low velocity and lower electrical resistivity zone in the crust, indicating large-scale partially molten zone developed in the lower to the middle crust of the Sengan region.

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