Contrasting magmatic processes producing two coexisting rock series at Hakkoda, northern Honshu, Japan

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Two coexisting series of high Fe/Mg (referred to as TH) and low Fe/Mg (referred to as CA) lavas occur in Hakkoda volcano, northern Honshu, Japan. Two distinct trends intersect at an oblique angle on the SiO2 vs. FeO/MgO diagram (Miyashiro diagram): one, TH (tholeiitic) group, is characterized by a pronounced increase in FeO/MgO with increasing SiO2 and the other, CA (calcalkalic) group, by a modest increase in FeO/MgO. The bifurcating trends are also distinct on the MgO - K2O diagram. Many rocks of the CA group preserve records of open system magmatic processes as complex intracrystalline textures and as chemically disequilibrated mineral assemblages, involving coexistence of reversely-zoned pyroxenes with normally-zoned pyroxenes and of magnesian olivine with quartz phenocrysts, and various kinds of dissolution textures (e.g. dusty zones) in plagioclase, quartz, and pyroxenes. On the other hand, phenocrysts in the rocks from TH group exhibit simple normal zoning, implying crystallization during a simple magmatic process. The most plausible process that produced the CA group rocks is mixing between basaltic magma of TH group and a felsic CA endmember magma. The CA felsic endmember is not a simple derivative of TH magma by crystallization differentiation because the endmember composition is far from the liquid lines of descent. Referred to studies on some volcanoes in the region, it is most likely that the source of the CA felsic endmember is different from that of TH series rocks. Stratigraphy at northernmost cones suggests that erupted magma chronologically evolved in the order: differentiated TH basalt (lower North-Hakkoda basalt), felsic CA andesite (Tamoyachidake lavas), mixed magmas that chemically fluctuated from low-silica TH basalt to felsic CA andesite (Narusawa Lavas), and felsic CA andesite (Ohkuzure Lavas). This evolution implies that the TH series basalt magma and the CA felsic endmember magma contemporaneously existed beneath the cones. The chemical fluctuation during the eruptive period of Narusawa Lavas was caused by the temporal variation of mixing ratio between TH basalt and CA felsic endmember magmas. Regardless of rock series and degree of differentiation or mixing ratio, 87Sr/86Sr(0.7040), 143Nd/144Nd (0.51290), 206Pb/204Pb(18.4), 207Pb/204Pb(15.584), 208Pb/204Pb(38.54), 176Hf/177Hf (0.28316) isotopic ratios are nearly constant. This isotopic homogeneity of magma implies the isotopic similarity of source rocks of TH basalt and CA felsic endmember. It is considered that their sources are lithologically different (e.g. peridodite vs. gabbro) but isotopically similar. Solidified TH series magma is a possible source of the CA felsic endmember.