Geochemical relationships of basalts and andesites from the Kuan-Yin Mt. at NW Taiwan

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The Ryukyu arc and the North Luzon arc intersect at northern Taiwan. Although the petrogenesis of these two oceanic arcs have been investigated in broad views, detailed geochemical relationships of the constituent lavas forming each volcano have yet been established. In this contribution, 45 samples form the Kuan-Yin Mt. on the western end of the Ryukyu arc were analyzed for major and trace element compositions as well as Sr, Nd, and Hf isotope ratios for insightful petrogenesis constraints.

Based on the constituent minerals, lavas forming the Kuan-Yin Mt. have been classified into pyroxene andesites (PA), two pyroxene andesites (TPA) and hyperthene-hornblende andesites (HHA) with an order of decreasing eruption ages (0.53, 0.43, and 0.34 Ma, respectively). The youngest olivine basalts (OB; 0.2 Ma) occur at the southeast of the Kuan-Yin Mt. forming a small cinder cone. All the samples are characterized by Nb, Ta, and Ti depletions, typical of arc lavas. As a whole, the Kuan-Yin Mt. lavas have CaO contents decreasing and Al_2O_3 contents increasing with decreasing MgO contents in the sequence of OB–PA–TPA–HHA samples, consistent with clinopyroxene fractionation without plagioclase fractionation. However, the PA samples have slightly higher total iron, TiO_2 and P_2O_5 and lower SiO_2 abundances than the TPA samples at a given MgO content. In addition, the La versus Nd plot clearly shows that the four sample groups define sub-parallel positive trends with La abundance increasing from OB to PA to TPA to HHA samples at a common Nd content. Similar distribution patterns are observed in the La–MREE and La–HREE plots. Therefore, these four lava groups were not related by fractional crystallization but derived from distinct parent magmas. Although the $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$ ratios of the four group samples largely overlapped, the $^{87}Sr/^{86}Sr$ ratios of the PA samples are lower than those of the other samples. Therefore, the trace element and isotopic variations conclude that the four lava groups forming the Kuan-Yin Mt. were evolved from different parental magmas from distinct mantle sources and cannot be related by fractional crystallization and magma mixing.