Homogeneous mantle and diverse arc crust: Significant role of mafic lower crust for chemical diversity of arc magmas

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We examined the origins of the diverse arc magmas erupted along the Quaternary frontal arc of the NE Japan arc using Sr–Nd–Hf–Pb isotopic and trace and major element compositions. The frontal arc is characterized by the coexistence of medium- to low-K calc-alkaline to tholeiitic magmas. The remarkable finding of this study is quasi-linear isotopic trends in Pb–Pb and Nd–Pb isotope space, which are distinctive of the magmas from individual volcanoes, irrespective of their magma suites. The isotopic trends form mixing lines between depleted mantle-derived basalts and enriched mafic lower crustal materials. The trends converge in the depleted side, and the locus falls in the field of Indian MORB-type source mantle affected by subducted slab components. The enriched ends are significantly diverse and fall into the compositional fields of the local basement granitoids isotopically heterogeneous along the arc. We also conclude that assimilation fractional crystallization (AFC) or melting-assimilation-storage-hybridization (MASH) in the amphibolite lower crust is responsible to the magma differentiation. The role of the amphibolite lower crust is cryptic in many cases; however, the detailed study of the magmas from NE Japan revealed a significant role.