Contributions of Slab Fluid, Wedge Mantle, and Crust to the Origin of Quaternary Lavas in the NE Japan Arc

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Quaternary lavas from the Northeast (NE) Japan arc show geochemical evidence of mixing between mantle-derived basalts and crustal melts from the magmatic front, whereas significant crustal signals are not detected from the rear arc lavas. The along arc chemical variations in lavas from the magmatic front are attributable almost entirely to geochemical variations in the crustal melts that were mixed with a common mantle-derived basalt. The mantle-derived basalt is slightly enriched than in the rear arc in Nd-Sr-Pb isotopic compositions but the variation is less pronounced if crustal contributions were eliminated. Therefore, the source mantle compositions and slab-derived fluxes are relatively uniform across and along the arc. Despite this, incompatible element concentrations are significantly higher in the rear arc basalts. We examine an open system, fluid fluxed melting model, assuming that depleted MORB source mantle melted by the addition of fluids derived from subducted oceanic crust (MORB) and sediment (SED) hybrids at mixing rate 7% and 3% SED in frontal and rear arc sources. The results reproduce the chemical variations found across the NE Japan arc with the conditions: 0.2 % fluid flux with degree of melting F = 3 % at 2GPa in the garnet peridotite field for the rear arc, and 0.7% fluid flux rate with F = 20 % at 1GPa in the spinel peridotite field beneath the magmatic front. The chemical process operating in the mantle wedge requires: (a) various SED-MORB slab hybrid fluids; (b) various fluid flux rate; (c) a common depleted mantle source; with (d) different melting parameters for the origin of across-arc chemical variations.