Pyroxenite is a possible cause of enriched magmas in island arc settings: Gorely volcano (Kamchatka)

Details

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Abstract

Kamchatka peninsula (Russia) is an island-arc with a complex geological history and structure. It has three distinct volcanic fronts, whose origins are still debated. Moreover, a junction with the Aleutian Arc (at ~56^{o}N) complicates the understanding of geodynamics at the region. The process of magma generation in Kamchatka involves several components: N-MORB mantle wedge (variably depleted), slab fluids and melts, and enriched mantle [Churikova et al. 2001, 2007; Yogodzinsky et al. 2001; Volynets et al. 2010]. Two of these end members (mantle wedge, slab fluids) are well studied [Portnyagin et al. 2007; Duggen et al. 2007]. However, the nature/genesis of the enriched magmas is unclear. In the standard model of arc volcanism depleted mantle peridotite in the mantle wedge partially melts to form parental basalts. However, evidence for pyroxenite melting in the arc environment was reported for the Mexican Volcanic Belt [Straub et al, 2008; Straub et al, 2013] and for Kamchatka [Portnyagin, 2009; Portnyagin, 2011; Bryant et al., 2011; Gavrilenko, 2012]. High precision Ni, Ca, and Mn contents of olivines from Gorely volcano confirm the existence of pyroxenite source in the mantle wedge [Gavrilenko, 2013]. Our forward modeling using Arc Basalt Simulator 4.0 (ABS) by [Kimura et al. 2011]) shows that we have primitive mantle as a source for Gorely volcano, a mantle more enriched than the DMM in the standard model for arc magmatism) REE inverse modeling [after Feigenson et al, 1983] agrees with the ABS forward model, returning the same REE pattern for the source. In contrast, ABS modeling for Mutnovsky volcano (next to Gorely, but closer to the trench) shows standard DMM as the source for the volcano. We

conclude that DMM is the composition for the mantle wedge rocks beneath Gorely volcano, but the enrichment of the parental melts at Gorely volcano is caused by reaction of DMM peridotite with slab melts/fluids to produce pyroxenite.

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