Contiribution of slab melting and slab dehydration to magmatism in the Japanese arc

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The nature of metasomatic agents, aqueous fluids or partial melts from the subducted slab, has been discussed for arc magmatism, as these processes strongly control the compositions of slab-derived and slab-residual components. In order to identify these metasomatic agents and their relationships to tectonic settings, Hf-Pb-Sr-Nd isotopic ratios, in conjunction with major/trace elements and radiometric ages are presented for the NE Japan arc volcanism. Clear temporal variation in Hf isotope ratios is demonstrated, from the low value in the early Miocene to the high value in the late Miocene and Quaternary, whereas there are little changes in Sr-Nd isotopic compositions. In particular, Choshi high-Mg andesites (HMA), dated at 23 Ma by Ar-Ar dating, show the lowest Hf isotope ratios, associated with low La/Nb and high Th/Yb. These geochemical characteristics are similar to those of Setouchi HMA in SW Japan (around 14 Ma), which is best explained by slab melting and subsequent reaction with the mantle wedge peridotite. Slab melting requires anomalously high temperature conditions either in the mantle wedge or subducted slab. Since young slab subduction had not been recognized beneath NE Japan, it is most likely that the high temperature conditions had been achieved around 23 Ma by hot asthenospheric injection into the mantle wedge associated with back-arc opening of the Japan Sea basin. This suggests that movement of NE Japan arc took place prior to that of SW Japan arc to form the back arc basin, which is in accordance with the previous tectonics and choronology studies for the Japan Sea opneing. Hf isotope ratios are relatively high at a given Nd isotope ratio, coupled with high La/Nb and Ba/La, for the SW Japan arc lavas in the late Miocene and Quaternary. This is best explained by addition of fluids from subducted sediments and oceanic crust to the mantle wedge after cooling of the mantle wedge. The present study provides an implication for relative mobility of elements during subduction. As Hf is less mobile than Pb, Sr and Nd, Hf may be useful to resolve ancient dehydration and subduction processes producing some recycled mantle components that might be responsible for causing mantle heterogeneity