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Trace elements and isotopic variations along Sunda arc, Java island, Indonesia: an evaluation of slab fluid contribution

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A geochemical dataset of lavas from Java island, Sunda arc is compiled for trace elements and isotopic variations, in order to understand along-arc variation of the contribution of slab-derived fluid to arc magmas. We divided the island into western, central and eastern sections in terms of volcanism and tectonics. Based on volcano distribution, the western section is subdivided into North-West Java (NWJ) and Central-West Java (CWJ) chains. The NWJ chain is considered to be tectonically affected by bending subduction structure that marks the transition from Sumatra arc to Sunda arc.

In general, lavas from this island are distinguished by enriched LILE and LREE, negative anomalies of Nb and Ti, and low Mg, Ni and Cr. We observed along-arc variation of subduction slab imprint including both sediment (SED) and altered oceanic crust (AOC) by examining fluid-mobile elements against HFSE ratios (e.g. B/Nb, B/Zr, Ba/La). We also evaluate depletion of Nb which characterizes arc magmas, by using Nb/HFSE (e.g. Nb/Ta, Nb/Zr) ratios, along this island. Radiogenic Sr-Nd isotopes were determined to examine contribution of SED and AOC to arc magma source. Then we combine these to find differences between western, central and eastern sections.

Nb/HFSE ratios are evenly low along western, central and eastern sections. However, these ratios increase from volcanic front toward back arc in central and eastern sections. In contrast, they are uniformly low across the western section, with little deviation in NWJ chain. The B/HFSE and Ba/HFSE ratios decrease from volcanic front toward back arc in the central and eastern sections. Whereas, they decrease but slightly across the western section. They are observed highest in lavas from central section compared to others. Isotopic ratios from all sections are shifted from Indian Ocean MORB field toward higher $^{87}Sr/^{86}Sr$ and lower $^{143}Nd/^{144}Nd$ ratios. Back-arc lavas from central section overlap with mantle array and exhibit the lowest $^{87}Sr/^{86}Sr$ in a wide range of $^{143}Nd/^{144}Nd$ ratios, whereas the volcanic-front samples overlap with compositions of Indian Ocean sediment. Back arc lavas from eastern section are displaced toward sediment composition, while the volcanic front is placed closer to MORB.

This increasing trend of Nb/HFSE from volcanic front toward back arc in central and eastern sections implies more enriched mantle source in the back arc. This back arc source enrichment is then confirmed by isotopic ratios. Despite the little deviation in NWJ chain, the general flat trend as observed in western section indicates similar mantle source across this section. Positive correlation between incompatible elements ratio and the depth of Wadati-Benioff zone denotes an identifiable influence of subducted slab along this island. The sharp decreasing trends of B/HFSE and Ba/HFSE in central and eastern sections suggest a definite reduced slab-fluid influence from volcanic front toward back arc. Compared to these sections, the western section is less pronounced in terms of subduction components enrichment. The greatest enrichment of subduction components in central section implies strongest slab fluid imprint in this section. The Sr-Nd isotopic pattern justifies the involvement of slab fluid in all sections. However, this pattern confirms the strongest subducted sediment-fluid contribution in volcanic front of central section. The more enriched mantle source in back arc compared to volcanic front is observed in eastern section. This evidence corroborates mantle source enrichment towards the back arc, in central and eastern sections.

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