Subduction zone input-output: Modeling of geochemical mass balance using the Arc Basalt Simulator version 5

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Mass balance of subduction input-output is one of the most important research subjects in elucidating seismicity, magmatism, and material recycling into deep Earth's interior. Arc magma genesis is a key to understand the mass balance because the magmatism plays key roles in differentiating and transporting the input-output materials. Arc Basalt Simulator version 5 (ABS5) is a forward geochemical/petrological model that can be used to examine the element mass balance in primary arc magmas including the source and nature of slab materials and flux melting of the mantle wedge peridotite. The inverse problem approach using ABS5 allows the estimation of intensive and extensive geophysical variables in arc magma genesis. The intensive variables are slab dehydration depth (*PSS*) and temperature (*T*SS) and mantle melting pressure (*Pperid*) and temperature (*Tperid*). The extensive variables are the amount of slab liquid added to the mantle (*Fslab liq*) and the degree of melting of the mantle (*Fperid*) along with the amounts of water in the slab liquid (*XH2Oslab liq*), mantle (*XH2Operid*), and magma (*XH2Omelt*). Subordinate geochemical variables that also can be estimated using ABS 5 include the degree of chemical reaction between slab liquids and the solid slab (*%R*); slab liquid fractions derived from igneous oceanic crust [*Fliq*(*AOC*)], sediment [*Fliq*(*SED*)], and metasomatized mantle peridotite layers [*Fliq*(*DMM*)]; and the degree of depletion of the mantle wedge (*%MORBext*). The mass balances for 26 incompatible elements, 6 major elements including H2O, and Sr–Nd–Hf–Pb isotopes are calculated based on the same scheme. Monte Carlo calculations are used to estimate the aforementioned variables by fitting the calculated magma composition to observed values. This paper describes the ABS5 calculation scheme and presents examples of its successful use. The geophysical variables determined for these example cases are compared with those estimated by other methods. The spatial variations of the magma productivity and implications for the location of the volcanic front are also discussed.

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