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Diverse magmatic effects of subducting a hot slab in SW Japan: results from forward modeling

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In response to the subduction of the young Shikoku Basin of the Philippine Sea Plate, arc magmas erupted in SW Japan throughout the late Cenozoic. Many magma types are present including ocean island basalt (OIB), shoshonite (SHO), arc-type alkali basalt (AB), typical sub-alkalic arc basalt (SAB), high-Mg andesite (HMA), and adakite (ADK). OIB erupted since the Japan Sea back-arc basin opened, whereas subsequent arc magmas accompanied subduction of the Shikoku Basin. However, there the origin of the magmas in relation to hot subduction is debated. Using new major and trace element and Sr-Nd-Pb-Hf isotope analyses of 324 lava samples from seven Quaternary volcanoes, we investigated the genetic conditions of the magma suites using a geochemical mass balance model, Arc Basalt Simulator version 4 (ABS4), that uses these data to solve for the parameters such as pressure/temperature of slab dehydration/melting and slab flux fraction, pressure, and temperature of mantle melting. The calculations suggest that those magmas originated from slab melts that induced flux-melting of mantle peridotite. The suites differ mostly in the mass fraction of slab melt flux, increasing from SHO through AB, SAB, HMA, to ADK. The pressure and temperature of mantle melting decreases in the same order. The suites differ secondarily in the ratio of altered oceanic crust to sediment in the source of the slab melt. The atypical suites associated with hot subduction result from unusually large mass fractions of slab melt and unusually cool mantle temperatures.

Keywords: SW Japan, Volcanic rocks, Geochemistry, Forward model