Geochemical variations in Japan Sea back-arc basin basalts formed by high-temperature adiabatic melting of mantle metasomatized by sediment subduction components

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The Yamato Basin in the Japan Sea is a back-arc basin characterized by basaltic oceanic crust that is twice as thick as typical oceanic crust. Two types of ocean floor basalts, formed during the opening of the Sea of Japan in the Middle Miocene, were recovered from the Yamato Basin during Ocean Drilling Program Legs 127/128. These can be considered as depleted (D-type) and enriched (E-type) basalts based on their incompatible trace element and Sr-Nd-Pb-Hf isotopic compositions. Both types of basalts plot along a common mixing array drawn between depleted mantle and slab sediment represented by a sand-rich turbidite on the Pacific Plate in the NE Japan fore arc. The depleted nature of the D-type basalts suggests that the slab sediment component is nil to minor relative to the dominant mantle component, whereas the enrichment of all incompatible elements in the E-type basalts was likely caused by a large contribution of bulk slab sediment in the source. The results of forward model calculations using adiabatic melting of a hydrous mantle with sediment flux indicate that the melting conditions of the source mantle for the D-type basalts are deeper and hotter than those for the E-type basalts, which appear to have formed under conditions hotter than those of normal mid-oceanic ridge basalts (MORB). These results suggest that the thicker oceanic crust was formed by greater degrees of melting of a hydrous metasomatized mantle source at unusually high mantle potential temperature during the opening of the Japan Sea.