

High precision Pb and Sr-Nd-Hf isotope constraints on mantle source variations along the Solomon arc

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Along the Solomon island arc, SW Pacific, the Indian plate is presently subducted beneath the Pacific plate and the Ontong-Java Plateau (OJP). Geophysical evidence indicates the presence of a fossil slab of Pacific oceanic crust that was subducted until ca. 12 Ma b.p. [e.g., 1]. To assess along arc variations in the composition of the mantle wedge and subduction components we determined Sr-Nd-Hf-Pb isotope and major/trace element compositions of representative arc magmas covering the complete southern island arc chain (ca. 1000 km).

Rock compositions vary from picritic to dacitic, but also include adakites (Sr/Y up to ca. 200), high-Mg andesites and rocks with affinities to boninites. $^{87}\text{Sr}/^{86}\text{Sr}$ and ϵNd values along the arc range from 0.7029 to 0.7052 and +5.6 to +8.8, respectively. ϵHf values range from +10.5 to +14.9. These values partially overlap with compositions of the Indian MORB field and values of the neighbouring Vanuatu arc [2]. Combined ϵHf - ϵNd systematics show that most examined Solomon arc lavas were most likely generated within Australian-Indian type mantle indicating that the active trench does not mark the boundary between the Australian-Indian and Pacific mantle domains. Pacific-type ϵHf - ϵNd compositions are restricted to older basaltic Pacific oceanic crust, adakitic magmas originating from the fossil Pacific slab or subducted OJP rocks. Their existence confirms the geophysical model suggesting subduction of the lower portions of the OJP [e.g., 3].

In contrast to Hf-Nd compositions, Pb isotope compositions in the lavas are dominated by subduction components. High-precision Pb isotope data obtained by Tl normalisation using MC-ICP-MS ($^{206}\text{Pb}/^{204}\text{Pb}$ 18.351 to 18.853, $^{207}\text{Pb}/^{204}\text{Pb}$ 15.479 to 15.564 and $^{208}\text{Pb}/^{204}\text{Pb}$ 38.105 to 38.462) indicate the absence of significant amounts of subducted pelagic sediments. Along arc variations rather indicate a bimodal (Indian – Pacific) distribution of Pb isotope compositions, reflecting contributions from both subducted Pacific and Australian-Indian type oceanic crust.

References

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