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Slab Melt Generation above fossil subducted Slabs: Evidence from Simbo Volcano, Solomon Island Arc

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Here we present new major and trace element data and Sr-Nd-Hf-Pb isotope compositions for high-magnesian andesites from Simbo volcano, Solomon islands, to constrain the role of slab melting processes in presently active subduction systems, The presence of slab melts in the Solomon arc can be attributed to the unique tectonic setting of the arc that consists of two chains. The formation of the northeastern volcanic chain was initiated by southward subduction of the Pacific plate beneath the Indian-Australian plate until a revearsal of subduction polarity occurred ca. 10 Myr ago. Geophysical evidence indicates that a fossil Pacific slab is still present beneath the Solomon islands. Currently, the Indian-Australian plate is being subducted northeastwards along the San Cristobál trench, forming the younger and still active south-western arc chain. The presently active Simbo volcano has a unique position as it is located directly above the southern flank of the presently active San Cristobál trench and on top of a subducting strike-slip fault of the Woodlark spreading center (Indian-Australian plate) that is presently subducted beneath the Solomon islands.

Geochemical and petrological data of volcanic rocks from Simbo are in stark contrast to those of volcanic rocks from islands northeast of the trench. Simbo-type rocks are high-Mg andesites, displaying 60 to 62 wt% SiO_2but rather primitive Mg–Ni-Cr characteristics with 4 to 6 wt % MgO, up to 65 ppm Ni, up to 264 ppm Cr and Mg# of 67 to 75, which altogether is unique among all Solomon island arc rocks. The compositions are explained by a binary mixture of silicic and basaltic melts with a basaltic endmember similar to back-arc-type basalts from the Woodlark Ridge. The SiO_2-rich mixing endmember displays Gd_N/Yb_N of up to 2.2 which is relatively high compared to MORB, thus suggesting a slab melt origin. Olivine phenocrysts with Fo# 90 were

acquired during interaction with the basaltic endmember and rims of opx around the olivines indicate disequilibrium-reactions with the felsic host melt.

^{87}Sr/^{86}Sr (0.7035–0.704), εNd (+6.4 to +7.9) and εHf (+12.0 to +14.4) reveal the presence of an Indian-type mantle beneath both Simbo and all other volcanic islands of the New Georgia Group which are located north of the San Cristobál trench. ^{206}Pb/^{204}Pb (18.43 to 18.52), ^{207}Pb/^{204}Pb (15.49 to 15.55) and ^{208}Pb/^{204}Pb (18.13 to 18.34) in the Simbo rocks, however, suggest an influence of slab-melts derived from the subducted Pacific plate for southern Simbo, where also the highest Gd_N/Yb_N values are reported. A regional shift of Hf-Nd-Pb isotope compositions towards an Indian-Australian slab signature can be identified towards northern Simbo which is located closer to the center of the San Cristobál trench, suggesting a decreasing influence of slab-melts from the old subducted Pacific slab. Altogether, melting of fossil slabs appears to be an important mechanism that triggers slab melting in present day arc systems. In the case of Simbo, the slab melts are mixed to various degrees with back-arc basalts from the Woodlark spreading center. Melt ascent preferentially occurs through the transform-fault beneath Simbo, leading to increased volumes of erupted magma.