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Early Evolution of Potassic Melts in Convergent Margin Settings: Evidence from the South Tabar Ridges, NE Papua New Guinea

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Potassic magmatism hosting economic Au deposits occurs within the Tabar-Lihir-Tanga-Feni (TLTF) island chain, NE Papua New Guinea. The islands are situated within a former forearc basin and magmatism is triggered by extension post-dating active subduction [1]. Subduction related metasomatism of the mantle wedge and melting of clinopyroxene-rich sources have been suggested to account for K-rich magmatism in the TLTF island chain [2]. However, primitive lavas are scarce and magma evolution at crustal depths – leading to diverse melt compositions and volcanic edifices – is poorly constrained.

This study focuses on primitive K-rick ankaramites, previously unknown from the area, and more Na-rich absarokites sampled along two volcanic ridges south of Tabar Island during research expedition SO299 DYNAMET (2023). Fresh lava samples were petrographically studied, and mineral and glass compositions were measured by EPMA. Representative whole-rock samples were analysed for their major and trace element compositions and radiogenic Sr-Nd-Hf-Pb isotope ratios.

Primary olivine-hosted melt inclusions preserve primitive ankaramitic composition with $K_2O/Na_2O \approx 1$. Olivine and clinopyroxene xenocrysts, identified based on mineral textures and composition, were scavenged from lower-crustal cumulates. They record an earlier phase of igneous activity, reflecting the complex evolution of the basin's crust. Primitive K-rich ankaramites thus represent mantle-derived potassic melts that underwent minimal differentiation at crustal levels.

Zoning of phenocrysts in absarokite lavas records a prolonged history of fractional crystallization interrupted by recurring replenishment events. Gabbroic accumulation and volatile saturation possibly occurred at lower crustal conditions, as indicated by clinopyroxene-liquid thermobarometry. Biotite crystals formed exclusively within clinopyroxene-hosted melt inclusions record a closed-system reaction (Fig. 1).

Absarokite lava samples from the Tabar group islands are characterized by lower LILE enrichment over HFSE, higher $^{143}Nd/^{144}Nd$ and $^{206}Pb/^{204}Pb$ and lower $^{87}Sr/^{86}Sr$ (Fig. 2) relative to primitive ankaramite. Crustal assimilation and fractional crystallization may explain these variations and may be a major mechanism controlling the composition of erupted melts in similar igneous systems.

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