A two-stage evolution of the Buckland central volcano, Australia

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$^{40}Ar/^{39}Ar$ geochronology of a sequence of volcanic rocks collected along two vertical transects (T1 and T2) at the continental Buckland shield volcano, Qld, Australia, reveals two distinct periods of eruption [29.9 ± 0.3 and 27.5 ± 0.2 Ma] separated by a ~2 Ma hiatus. The early eruptive sequence (29.9 ± 0.3 Ma), only identified in the lowermost units at T2, is comprised of reasonably primitive (MgO = 8.3 ± 0.45 wt%) transitional to sub-alkaline basalts. The low $^{207}Pb/^{204}Pb$, $^{87}Sr/^{86}Sr$, Ba/Th and Ba/Nb and the high $^{143}Nd/^{144}Nd$ ratios for these lavas are consistent with three component mixing involving primitive mantle, depleted mantle, and HIMU-like sub-continental lithospheric mantle (SCLM) components. The second eruptive episode at 27.5 ± 0.2 Ma started with an alkaline sequence at T2 and progressed to sub-alkaline to transitional compositions towards the top of both transect locations. These younger alkaline and sub-alkaline to transitional sequences display a wider range in MgO (7.97 – 4.35 wt%) and extend toward higher $^{207}Pb/^{204}Pb$, $^{87}Sr/^{86}Sr$, Ba/Th and Ba/Nb and lower $^{143}Nd/^{144}Nd$ than the more primitive lavas from the first eruptive event. The younger lavas are thus more similar to the plume component of Sun et al. (1989). However, some of the younger sub-alkaline to transitional lavas also show trace-element evidence for crustal contamination (low N/U and Ce/Pb, high Th/Ta). Our results are consistent with the following temporal sequence for the Buckland volcano: at 29.9 ± 0.3 Ma, plume-derived melts interact with the SCLM and erupt quickly, with minimal crustal interaction; after a ~2 Ma hiatus, volcanism recommenses at 27.5 ± 0.2 Ma with eruption of an alkaline sequence, chemically distinct from the earlier lavas and showing a plume component largely free of lithospheric contributions; this brief period of alkaline volcamism is followed by eruption of subalkaline to transitional lavas, still showing a strong plume signature, but also displaying evidence of crustal contamination. This petrogenetic sequence, with the incorporation of a SCLM component early, an eruptive hiatus and a crustal component late in the history of magmatism, may be a feature common to Eastern Australia central volcanoes.

[1]. Sun *et al*. (1989) *Cambridge University Press,* 333-347.