PETROGENESIS OF TASMANIAN TERTIARY BASALTS

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Tertiary basaltic rocks (64 to 8.5 Ma) outcrop over 4060 km_2, or about 6%, of the Tasmanian landmass. These mantle-derived rocks range from quartz tholeiite through olivine alkaline basalt and basanite to nephelinite and melilitite. About 110 samples of the Tasmanian Tertiary basalts have been analysed for major and more than 40 trace elements; more than 50 of these basalts have been analysed for Sr-Nd-Pb isotopic ratios. This dataset covers all the basalt types, with most samples having relatively high MgO content (7-16 wt%, with Mg#=0.58-0.72) and thus providing a rich resource to define geochemical signatures of the basalts and their mantle sources (Zhang et al. in press *The Geological Evolution of Tasmania*). There are systematic variations between SiO_2 (i.e., rock type) and many major and trace elements. In general, SiO_2 contents correlate negatively with MgO, TiO_2, Na_2O, K_2O and P_2O_5 and many incompatible elements (such as Ba, Sr, Nb, Ta, Zr, Hf, Th, U, Be and LREE to MREE). The incompatible-element contents decrease by factors of 6-8 from olivine melilitite and nephelinite to quartz tholeiite (e.g., from 69-171 ppm to 12-20 ppm Nb). Three distinct incompatible-element patterns can be recognised for the Tasmanian basalts. (1) Olivine melilitites, nephelinites and many basanites show significant enrichment in U, Th, Nb, Ta and LREE and strong depletion in K. (2) Alkali olivine basalts and some hawaiites and olivine tholeiites exhibit a smooth incompatible-element pattern with a moderate peak at Nb and Ta, but without strong K-depletion. (3) Quartz tholeiites and some olivine tholeiites and hawaiites have overall low contents of strongly incompatible elements (from Rb to Sr) and are enriched in K, Rb and Pb

$^{87}Sr/86Sr$ ratios of the Tasmanian basalts range from 0.70260 to 0.70670 and εNd from +7.6 to +0.7. $^{87}Sr/^{86}Sr$ increases and εNd decreases with increasing SiO_2. They have $^{206}Pb/^{204}Pb$ of 18.929-20.770, $^{207}Pb/^{204}Pb$ of 15.547-15.691 and $^{208}Pb/^{204}Pb$ of 38.476-39.854 and mostly plot on or below the Northern hemisphere Reference Line. At least three source components are required to explain the geochemical variation of the Tasmanian basalts; a Pacific-MORB type asthenosphere, a HIMU-type mantle source and an enriched source with crustal or subduction-related signatures. Both the HIMU and enriched sources could reside within the lithosphere as metasomatised domains. Mantle source heterogeneity as shown from systematic differences in radiogenic isotope signatures in the Cainozoic basalts in eastern Australia can be explained with an isotopic framework reflecting mantle source end-members for the Australian intraplate volcanism. The delineated mantle components include the Pacific and Indian MORB-type asthenosphere, the Australian Plume, and SCLM domains with EM2, EM1 and HIMU (via the Balleny Plume?) signatures. Secular distribution of these mantle sources will constrain the Phanerozoic tectonic evolution in the eastern Australia.