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Crustal Assimilation versus Mantle Melts in Lavas from Banks Peninsula, NZ

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Intraplate volcanism was active continuously throughout the Cenozoic on the South Island of New Zealand producing two volcanic end members: 1) widely dispersed volcanic fields and 2) shield volcanoes. The Banks Peninsula represents the latter consisting of $\sim$ 2500 km^2 lavas erupted at two composite shield volcanoes – the older Lyttelton and the younger Akaroa volcano. Volcanic activity on Banks Peninsula persists $\sim$ 6 Ma and can be divided into four different phases. The first eruption of the Lyttelton volcano took place $\sim$ 12 Ma ago. Volcanic activity at the Lyttelton volcano proceeds until $\sim$ 10 Ma ago. Afterwards the center of volcanism shifts towards the SE by erupting the lavas of the Mount Herbert volcanic group, which gave two ^{40}Ar/^{39}Ar ages of 9.1 and 8.3 Ma. These ages overlap with volcanic activity at the Akaroa volcano $\sim$ 8.8 Ma ago, which was preceded by another shift of the main volcanic activity to the SE. The Diamond Harbour Volcanic Group occurring mainly at the outer flanks of the Lyttelton Volcano represents late stage volcanism (7.6 – 6.8 Ma). Mafic volcanic rocks sampled (MgO $>$ 4 wt%) range from basanites trough alkali basalts to tholeiites and can be divided by their silica content into a low silica group having SiO_2 $<$ 48.5 wt% and a high silica group with SiO_2 concentration $>$ 48.5 wt%. Trace element pattern of the volcanic rocks analyzed are akin to those of ocean islands basalts. Volcanic rocks of the low silica group show more pronounced peaks in Nb and Ta and troughs for Pb and K on a multi-element diagram, which becomes less pronounced in the high silica group. This is accompanied by increased ratios of fluid to less fluid mobile elements (e.g. Pb/Ce, U/Nb, Ba/La etc.) and lower concentrations of incompatible elements, like Rb, Ba, Nb, La etc. in the high silica group compared to the low silica

group. Isotope ratios measured on mafic volcanic rocks are enriched with the low silica group having higher ^{206}Pb/^{204}Pb, ^{143}Nd/^{144}Nd and ^{176}Hf/^{177}Hf ratios and lower ^{87}Sr/^{86}Sr, Δ 7/4 and ∂^{18}O values reflecting a HIMU-type source and a EMII-type source for the high silica group. Therefore, there are apparently two different types of sources beneath Banks Peninsula volcanoes 1) HIMU-type and 2) EMII-type source that could either imply mantle heterogeneity or the EM-type signature being created by crustal assimilation. Energy-constraint assimilation-fractional crystallization (EC-AFC) calculations require $\sim$ 8 % of crustal material to be assimilated into uncontaminated the HIMU-type samples to generate a similar EM-type signature as observed in our samples, which is plausible and underlined by trace element modelling. But how are the melts generated? In context of melt generation on the New Zealand micro continent, revealing no morphologic or geophysical indication of a thermal anomaly and/or extensional tectonism beneath Banks Peninsula an alternative process has to be introduced to trigger melting. A possible mechanism to produce melts stationary over $\sim$ 6 Ma is lithospheric detachment.