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U-series constraints on the genesis of high-Mg andesites at White Island, new Zealand

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White Island, which lies off shore of New Zealand in the southern part of the Tonga-Kermadec island arc, has been erupting unusually primitive, high Mg andesites since 1977 which afford a unique opportunity to assess slab melting models. They are Fo80-93 olivine-saturated rocks which have MgO contents up to 10 percent (Mg\# = 65-71) with SiO_2 of 56-58 and contained 1.4-4.4 H_2O. They have incompatible trace element characteristics that are typical of arc rocks and flat rare earth element patterns. $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$ ratios of 0.51282- 0.51266 and 0.28301-0.28298, respectively, are consistent with subducted sediment addition and there is no clear correlation of either isotope ratio with MgO. The rocks have modest (3-10 percent) ^{238}U excesses at low ($^{230}Th/^{232}Th$) ratios (0.697 to 0.722). ^{226}Ra-^{230}Th disequilibria is also restricted but, unusually, includes both ^{226}Ra excesses and deficits with ($^{226}Ra/^{230}Th$) = 0.93-1.07 and samples analysed for ^{210}Pb have age corrected ($^{210}Pb/^{226}Ra$)o = 1.12-1.55. Sr/Y and Tb/Yb ratios are both low and relatively invariant at 8 and 0.3 respectively and along with the ^{238}U-^{230}Th disequilibria preclude an origin in which residual garnet was involved. The occurrence of ^{226}Ra deficits and the preservation of a negative correlation between ($^{226}Ra/^{230}Th$) and ($^{230}Th/^{238}U$) require the presence of residual amphibole during partial melting followed by rapid magma ascent. This limits the amount of possible melt ï¿½ wall rock interaction which might reduce source-derived Tb/Yb ratios. The White Island high Mg andesites did not form by partial melting of eclogite in the subducting Pacific plate but do require a source containing residual amphibole which may be responsible for the elevated SiO2 of the rocks. Their primitive, olivine-saturated compositions suggest that the source was peridotitic rather than an amphibolitic underplate. The stability of amphibole may reflect the transition from oceanic to continental lithosphere and a cooler mantle wedge.