Uranium series - size correlations in intraplate basaltic volcanic fields: source control on physical parameters

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Small volume basaltic eruptions within volcanic fields have the potential to reveal subtle features of magmatic processes which are overwhelmed in larger systems such as central continental volcanoes, ocean island basalts and large igneous provinces. One of the major findings of recent research has been that such volcanic fields can reveal the fine detail of source heterogeneity both on whole field and single volcano scales. Because small volume centres often display almost complete volcanic sequences within a range of eruptive styles and sizes, opportunities are presented whereby correlations between physical features and chemical compositions can be investigated in detail. The Auckland Volcanic Field (AVF) in northern New Zealand is one of the best-sampled cases of a basaltic volcanic field; the volcanoes comprising the field show a spectrum of sizes and compositions from small volume nephelinitic maars and tuff dominated centres, through medium sized alkalic basanitic and basaltic scoria cones, to larger volume subalkalic basalt scoria and lava dominated centres. We focus on four eruptions which display a size and compositional spectrum: Purchas Hill (11ka, the smallest sampled volcanic centre in the AVF, nephelinitic in composition), Mt Wellington (10ka, medium sized, alkalic basalt) and the two eruptions of Rangitoto (Rangitoto 1: 552yrs BP, medium sized, alkalic basalt, and Rangitoto 2: 502yrs BP, the largest volcanic centre in the AVF, subalkalic basalt). U series and other isotopic data for the largest, smallest and two medium sized volcanic centres in the field show strong correlations between eruptive volume and isotopic composition. Preliminary data show that the volcanic centres display a spectrum of compositions in U-Th isotopic, Pb isotopic and SiO2 vs. Total Alkali space, with the smallest centre (Purchas Hill) displaying the highest (230Th/232Th) (1.38), the most radiogenic 206Pb/204Pb (19.416) and 208Pb/204Pb (39.009), the lowest SiO2 (39 wt%) and highest total alkalis (6 wt%). The largest centre displays the lowest (230Th/232Th) (1.14), the least radiogenic 206Pb/204Pb (19.039) and 208Pb/204Pb (38.781), the highest SiO2 (49.5 wt%) and lowest total alkalis (3 wt%). Other isotopic and trace element parameters tentatively show similar correlations. The observed differences in the chemical parameters can be attributed to melting of a heterogeneous source, where the heterogeneity results in varying magmatic processes. These results suggest that physical parameters of individual centres in intraplate volcanic fields may dominantly be dictated by processes in the deep asthenosphere.