Geophysical Research Abstracts, Vol. 7, 01026, 2005
SRef-ID: 1607-7962/gra/EGU05-A-01026

U-series disequilibrium constraints on adakite formation at the Guagua Pichincha, Ecuador.

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The U-series disequilibria are often used to evaluate transfer time of magma from its source to the surface at subduction zones. Due to the physical and chemical properties of the elements composing the radioactive decay chains of uranium, U-series disequilibria can also be used as a tracer of sources and processes generating magmas. For instance, in the case of fluid flux induced partial melting of the mantle wedge, the U-series signature is different from that of slab melting leading to adakitic lavas. Calc-alkaline basalts and andesites show excesses of U and Ra over Th (due to the higher mobility of these elements than that of Th in the presence of fluids) whereas in slab melting produces lavas with (^{238}U/^{230}Th) < 1 due to the fact that eclogitic (garnet and rutile) residue will retain U more than Th during partial melting of a metabasaltic crust.

It is, therefore, appropriate to test the proposed model that historical adakitic lavas (between 500 and 2000 AD) from the Guagua Pichincha volcano (Ecuador) originate from melting of the young Nazca plate by measuring U-series disequilibria in these lavas. The major and trace elements composition of these lavas could, in principal, be explained by the hypothesis of slab melting but the U-Ra-Th results show U and Ra excesses over Th that are typical signatures of fluid addition during the generation of arc magmas. The adakitic lavas from Guagua Pichincha are, therefore, likely to result from flux melting of the mantle. The particular adakitic characteristics of these lavas would in that case request significant cristallisation and fractionation of garnet. The fluid component in the lavas appears to have increased with time based on the increasing U and Ra excesses towards the present. Significant variation in (^{230}Th/^{232}Th)

demonstrates that the adakites did not homogenize before eruptions in a long-lived magma chamber, but could reflect the mantle source heterogeneity. Large excess of Ra over Th which increases with time also suggests a rapid magma transfer from the source to the surface.