A ^{210}Pb-^{226}Ra-^{230}Th-^{238}U study of Klyuchevskoy and Bezymianny volcanoes, Kamchatka

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Klyuchevskoy is one of the most active volcanoes on Earth, erupting lavas at a rate of ~ 1 m^3/s, equivalent to a 50 km length of mid-ocean ridge. Bezymianny is located 20 km south of the summit vent of Klyuchevskoy and has been erupting silicic andesites since its spectacular avalanche eruption in 1956. Major and trace element concentrations and long-lived radiogenic isotope data suggest that basalts and basaltic andesites from Klyuchevskoy and andesites from Bezymianny were derived by different degrees of partial melting of nearly identical mantle sources. Lavas with higher SiO_2 concentrations represent the differentiation products of lower degrees of melting after the mantle was fluxed with a fluid derived almost entirely from subducted altered basaltic crust with little or no sediment contribution. The higher SiO_2 concentrations for lavas derived from smaller degree melts suggest that they underwent more fractionation because of the loss of their higher water contents. High Th isotope compositions for all lavas from both volcanoes suggest that a significant time transpired between U addition by a slab-fluid and melting. If the excess ^{226}Ra in the lavas is from the slab-fluid, then long term multistage fluxing before melting is required to maintain these ^{226}Ra excesses. An alternative model attributes the excess Ra to melting caused by upwelling mantle in association with rifting of the central Kamchatka depression. The greater Ra excess for Klyuchevskoi's basaltic andesites compared to its basalts is consistent with generation of the Ra excesses during decompression melting, and a less than few thousand year time frame of differentiation after melting. The lower Ra excesses for Bezymianny's andesites compared to the more mafic lavas suggest a time frame of fractionation that is longer than this by several thousand years. When time since eruption is accounted for, all samples have (^{210}Pb/^{226}Ra) within 2σ analytical error of one, suggesting that significant long-term gas fluxing of ^{222}Rn into or out of both magma systems has not occurred.