^{210}Pb-^{226}Ra-^{230}Th implications for the timescales of island arc magma degassing

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Island arc rocks have (^{210}Pb/^{226}Ra) ratios from 0.24 to 2.88. The ^{210}Pb deficits are most readily explained by protracted magma degassing. Using published numerical models, the data suggest that degassing occurred continuously for up to 47 years prior to eruption. Such time scales are similar to eruption periodicity but not clear link is observed. Longer periods are required if degassing was discontinuous, less than 100% efficient or if there was magma recharge or storage post degassing but prior to eruption. The formation, migration and extraction of gas bubbles must be extremely efficient in mafic magma whereas the higher viscosity of more siliceous magmas retards the process and leads to ^{210}Pb excesses in some instances. There is a broad negative correlation between (^{210}Pb/^{226}Ra) and SO_2 emission rate and the results have implications for hazards and hydrothermal and copper-porphyry systems. A suite of lavas erupted in 1985-6 from Sangenang Api volcano, at the rear of the Sunda arc, are characterised by deficits of ^{210}Pb relative to ^{226}Ra from which 6-8 years of continuous ^{222}Rn degassing is inferred. These data form a linear ^{210}Pb/Pb-^{226}Ra/Pb array which might be interpreted as an 71 year isochron. However, the array passes through the origin suggesting displacement downwards from the equiline in response to degassing and so the array is inferred not to have any age significance. Modelling shows that the range of ^{226}Ra/Pb ratios requires 1000's years to develop consistent with differentiation occurring in response to cooling at the base of the crust. Thus, degassing post-dated, and was not responsible for magma differentiation. At Mount St. Helens, the manner of degassing, as deduced from ^{210}Pb compositions appears characteristic of the eruptive style. The data show that ascending magma can stall within the magma conduit, leading to the accumulation of volatiles and the formation of ^{210}Pb excesses which signals the presence of degassing magma at depth.