U-series crystal ages in Mt St Helens lavas, 2000 ybp-2004 AD

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U-series ages of crystals in volcanic rocks can provide information on the duration of crystal residence in crustal reservoirs and can also be used as tracers to track crystal populations that may be recycled within the same volcanic system. We have previously reevaluated crystal ages in recent (<~2ka) Mt St Helens lavas [1, 2] based on differences in chemical behavior of Ra and Ba. Model ^{226}Ra-^{230}Th crystallization ages for plagioclase in 5 of 6 samples are 2-4 ka, indicating storage of crystals for hundreds to thousands of years prior to eruption. In two out of those five samples, ^{226}Ra-^{230}Th and ^{230}Th-^{238}U ages are discordant, a pattern consistent with protracted and/or episodic crystallization spanning tens of thousands of years. Finally, in the sixth sample (of the 1982 dacite dome), Ra in plagioclase is anomalously enriched relative to Ba. This pattern could be produced by rapid crystal growth, resulting in suppressed fractionation of Ra and Ba relative to that predicted for chemical equilibrium.

We are currently in the process of analyzing ^{226}Ra-^{230}Th and ^{230}Th-^{238}U disequilibria in mineral separates (plagioclase and amphibole) and groundmass from a sample of the Mt St Helens Nov. 2004 dome. We anticipate that the dataset will be complete by the time of the meeting, and we predict that 1) If the 2004 dome taps residual magma from the 1980's, 2004 plagioclase should show anomalouly high Ra/Ba, as observed in the 1982 dacite and consistent with ^{210}Pb-^{226}Ra data suggesting recent crystallization; 2) If petrographic differences between the 1980's and 2004 samples (e.g., fewer sieved cores in plag and the absence of reaction rims on amphibole in 2004) indicate that different crystal populations are being sampled, crystal ages could delimit the storage time; and 3) If the 2004 crystals contain a significant proportion of old (>10 ka) cores overprinted by young growth, ^{226}Ra-^{230}Th and ^{230}Th-^{238}U ages will be discordant.

References

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Plagioclase zoning in dacites of the current Mt. St. Helens eruption

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Mt. St. Helens' current activity started in late September 2004 with periodic phreatic steam blasts and minor ash eruptions followed by the appearance of a new lava dome in late October. Juvenile dacite samples collected in the crater on November 4, 2004, and January 3, 2005, are geochemically and petrographically distinct from 1980-86 dome rock. We have performed a textural and compositional analysis of plagioclase in new juvenile dacites to obtain additional constraints of magmatic processes leading up to and occurring during the current dome extrusion.

The dominant plagioclase population consists of euhedral, clear 0.5-1 mm phenocrysts making up >80% of all phenocrysts. Similarly sized phenocrysts and rare large crystals (1-3 mm) with a sieved core (rarely coarse) are subordinate. Plagioclase crystals of the dominant population reveal weak oscillatory zoning associated with only minor relief patterns on Nomarksi images. Furthermore, many plagioclase crystals indicate a characteristic rim that 1980-86 dome dacites lack. The rim is commonly emphasized by a zone of acicular opx inclusions typically aligned with their long axis parallel to the plagioclase rim. Nomarski images reveal that opx-enriched zones in plagioclase are typically inboard of a resorption surface that separates the rim from the rest of the crystal. Microprobe data indicate that plagioclase composition directly inside the resorption surface is An_{35-40} before experiencing abrupt increases by 5-20 mol% in adjacent overgrowth. Zoning within the rim is typically normal with return to An_{35-40} composition at the outermost rim.

Our data can be interpreted as evidence for a rise in temperature, perhaps due to influx of hotter magma, causing resorption of the plagioclases, which in turn could lead to a higher Ca/Na ratio in the adjacent melt. Renewed plagioclase crystallization of a Ca-enriched melt would lead to the initial higher An plag before equilibrium growth with reduced Ca/Na ensues. Our results may indicate introduction of hotter magma prior to ascent to the surface.