The timing of compositionally-zoned magma reservoirs and mafic 'priming' weeks before the 1912 Novarupta-Katmai rhyolite eruption

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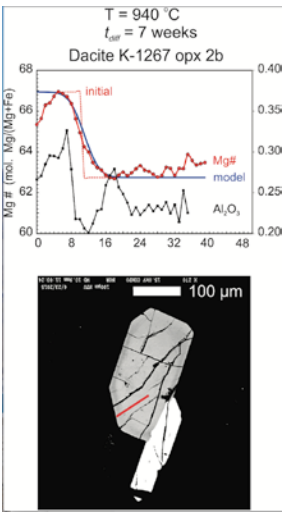

The June, 6, 1912 eruption at Novarupta vent, Alaska was the largest of the 20th century (>13 km^3 of magma). It ejected >7 km^3 of rhyolite, followed by andesite and dacite. Early ideas about the origin of pyroclastic flows and magmatic differentiation (e.g., compositional zonation of reservoirs) were shaped by this eruption. Despite being well studied, the timing of events that led to the chemically and mineralogically zoned magma reservoir remain poorly known. Here we provide new insights using the textures and chemical compositions of plagioclase and orthopyroxene crystals and by reevaluating previous U-Th isotope data. Compositional zoning of the magma reservoir likely developed a few thousand years before the eruption by progressive additions of mafic magma below an extant silicic reservoir. Hot, Mg-, Ca-, and Al-rich mafic magma intruded into, and mixed with, deeper parts of the reservoir (andesite and dacite) multiple times. Modeling the relaxation of the Fe-Mg concentrations in orthopyroxene and Mg in plagioclase rims suggests that the last recharge event occurred only weeks prior to the eruption. Rapid transfer of volatiles and heat from the recharge magma, coupled with volatile exsolution within the andesite and dacite, pressurized the reservoir and likely propelled a ~10 km lateral sill that allowed the overlying rhyolite to reach the surface.