Magma System Model for Sakurajima volcano, Japan

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Sakurajima is the most active volcano in Japan threatening the population of four large cities within 15 km. The volcanic centre formed 26 ka ago in the southern part of Aira caldera and has a varied record of eruptions consisting of effusive lava flows and seventeen Plinian events (including four recorded in historical time). The most recent Plinian eruption, in 1914, was the largest event of the 20th century in Japan. An increased activity and a change to more mafic Vulcanian eruptive style have been observed since 1955. Recent ground deformation modelling indicates that the surface around the volcano has inflated to a similar level inferred prior to the 1914 eruption.

The aim of this study is to determine whether the geophysical observations can be linked to changes in magma geochemical composition for the different styles of eruption within the framework of the trans-crustal magma/mush model. Interpretation of geochemical data, allowed us to build a magma system model for Sakurajima vocano in which mantle-derived mafic magmas assimilate pyroxene-bearing crust. Subsequent evolution of the magma, initially assessed using AFC modelling, generates mushy felsic zones within the magma chamber at around 11-18 km (estimated from geobarometry and partial melting modeling) below Aira caldera. Magma mixing (as indicated from (1) systematic decrease of K, Mg, Ca, Fe, Rb, Sc and V linear to silica content; and (2) reverse complex zoning, corroded cores and skeletal and sieve textures of phenocrysts) is likely to have resulted from the injection of new hotter mafic liquids into the main magma reservoir. This may trigger the magma ascent to shallower depths and potential eruptions. The ongoing research has been testing this model by (1) estimating depths and temperatures of magma sources for individual samples using geothermobarometry, (2) assessing magma residence times and ascent rates through diffusion studies, and (3) partial melting and mush modelling.