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Water content of glass inclusions in the 1813 ejecta at Suwanosejima volcano by micro FT-IR reflectance method

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Volcanic eruption has wide variety from effusive to explosive eruptions. Volatile content, or mostly water content, at magma chamber has been attributed as one of the driving forces of explosive eruptions. Although degree of degassing, or loss of gas, during ascent in conduit is thought to be a major factor that control eruption styles so far, initial volatile content is still one of the strong factors as a driving force for explosive eruptions because this value would give the upper limit for explosive eruptions. In terms of the initial water content, glass inclusions in phenocrysts have been targeted for years, but it is still difficult to prepare many doubly polished thin sections of small glass inclusions for micro-transmission FT-IR method. Recently Yasuda (2013) developed micro-reflectance FT-IR method for the first time that enables us to analyze many small inclusions without any special treatment of small samples.

Suwanosejima volcano is one of the most active volcanoes in Japan with successive Strombolian eruptions recently. On the other hand, the volcano had experienced much voluminous explosive eruptions, such as Plinian eruptions, every some hundred years in its geologic history (Shimano et al., 2013). It is surely important to know how much water contents of magma was just before such eruptions with different intensity. The 1813 eruption of Suwanosejima volcano is the best example for such objectives. Shimano and Koyaguchi (2001) reconstructed eruption sequence of this eruption and showed that various types of eruptions took place in contrast to homogeneous composition of magma throughout the sequence. By using petrological hygrometer of Housh and Luhr (1991), they have reported that the initial water content was constantly about 3.0 wt.% for all variety of eruption styles assuming equilibrium between melt and the rim of plagioclase phenocryst. Then they showed that difference in the degree of degassing during ascent had controlled eruption styles on the basis of bulk rock water content of the products. However, there are no initial water content reported to be analyzed directly for natural samples. There are also rooms for discussion in terms of heterogeneity of magma because phenocrysts show reverse zoning that may indicate magma mixing just before its ascent. To uncover such aspects, we carried out water content measurement of glass inclusions by micro-reflectance FT-IR method for the 1813 products as well as for those of 10 ka eruption for comparison.

The results of the 1813 products were 1.0-2.0 wt.% and 0.6-1.2wt.% for plagioclase and pyroxene phenocryst, respectively. Those of the 10ka products were 1.4-3.0 wt.% and 2.0-2.4 wt.% for plagioclase and pyroxene phenocryst, respectively.

For the 1813 products, the results show that glass inclusions show systematically lower water content than those estimated by Shimano and Koyaguchi (2001). There may be two possible interpretations; 1) the estimated water content by Housh and Luhr (1991) was incorrect, and 2) the values reflect those at different stage of phenocryst growth. The latter is most likely as most glass inclusions are trapped in the central part of the phenocrysts whereas most phenocrysts show reverse zoning. Thus we interpret that melt has been trapped by phenocrysts when magma had up to 2.0 wt.% of water, and then the rim of phenocryst has crystallized when new magma (or water) came and mixed to be one with water content around 3.0 wt.%. The systematically higher water content of the 10 ka glass inclusions are consistent with that this eruption was more voluminous than the 1813 eruption.

This is the preliminary report and the number of glass inclusion analyzed is not yet enough to cover all the variety of inclusions and host phenocrysts, and we will continue analysis to better constrain water content and its heterogeneity at the onset of eruptions.

Keywords: glass inclusion, water content, micro-reflectance FT-IR, Suwanosejima