Inclusions in phenocrysts from pyroclastics of the Aira pyroclastic eruption, SW-Japan

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The Aira pyroclastic eruptions are typical examples of the catastrophic Late Pleistocene eruptions that occurred in the Japanese Island. Samples from the Osumi air fall and Ito pyroclastic deposits were systematically collected at the Tarumizu and Shibushi areas. Inclusions within phenocrysts from the pyroclastics were investigated using microscopy, EPMA, Micro laser Raman spectrometry, CNS analysis, pyrolysis gas chromatography mass spectrometry (Py-GC/MS) and stable carbon analysis. The results are summarized as follows:

1. Varieties of inclusions The phenocrysts (plagioclse, quartz, orthopyroxene magnetite and ilmenite) contains inclusions of glass, F-apatite (F=2-4wt%), Fe-S material, carbonaceous material and corundum. Boron is concentrated in some carbonaceous inclusions. Inclusions associated with glass are divided into four types; type 1: one phase (glass); type 2: glass + fluid; type 3: glass + crystal; and type 4: glass + fluid + crystal.

2. Concentrations of fluorine, chlorine and sulfur in glass inclusions At Tarumizu, the Osumi pyroclastic deposits are geologically divided into four units. Variations of maximum fluorine and sulfur concentrations in each units are: unit-1 (F:0.7wt%; SO3:0.1wt%); unit-2 (F:0.4wt%; SO3:0.04wt%); unit-3 (F:0.9wt%; SO3:0.2 wt%); unit-4 (F:0.9wt%; SO3:0.012wt%); and Ito pyroclastic deposits (F:0.75wt%; SO3:0.20wt%). These patterns of variation are recognized in glass inclusions from air fall deposits at Shibushi, indicating that correlation of pyroclastic deposits between the different areas is possible using fluorine. Each unit may correspond to one magma batch (unit).

Maximum concentrations of fluorine, chlorine and sulfur in glass inclusions are: Osumi pyroclastic deposits F=1.32 wt%, Cl=0.78wt%, SO3=0.19wt%. For the Ito pyroclastic flow deposits the values are 0.85wt%, 0.17wt%, and 0.21wt% respectively. Maximum concentrations of matrix glass in the Osumi pyroclastic deposits are 0.28 wt%, 0.24wt%, and 0.10wt%, respectively, whereas those in the Ito pyroclastic deposits are 0.16wt%, 0.18wt, and 0.05wt%, respectively. The differences of the volatile concentrations between the glass inclusion and matrix glass corresponded to emission of volatile components. A huge volume of volatiles, especially fluorine and sulfur were released to the atmosphere during the catastrophic Aira pyroclastic eruption.

3. Stable carbon isotope ratios Delta13 C values of carbonate carbon in phenocrysts from the pyroclastic deposits at the Tarumizu site are: Unit-1, -26per mill; Unit-2, -31per mill; Unit-3, -28per mill; Unit-4 and Ito pyroclastic flow deposits, -30per mill.

4. Origin of volatile components The phenocrysts contain F-apatite, Fe-S mineral, carbonaceous material and corundum as inclusion. Some glass inclusion contain high concentration of boron. Stable carbon isotope ratios range from -26 to -31per mill. These features are characteristics of marine sediments, suggesting that the felsic magma supplying the Aira pyroclastic deposits interacted strongly with surrounding Simanto belt sedimentary rocks during ascent and stopping of magma and subsequent storage in the magma reservoir.

However, Aira pumices show 87Sr/86Sr(0.706) and ENd(-5.6 to -4.1)(Arakawa et al., 1998), suggesting that an assimilation of a large amount of melt from surrounding sedimentary rocks is not consist. Therefore, an assimilation of volatile components with a small amount of melt from sedimentary rocks is required.