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# Preparation processes and evolution of the 2011 eruption of Shinmoe-dake -insights from volcanic ash

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Analyses of ash are important in predicting future activities. We discuss temporal change of ash from Shinmoe-dake, for the periods a) from August 2008 to 26 January 2011 (sub-Plinian activity) and b) after the start of lava accumulation in crater on 28 January 2011. Increase of juvenile material was detected for ash from January 19, 2011 activity (reported to JMA in the noon of January 26). Ash particles were categorized into pumice, scoria, fresh lava, altered material, and crystal. Pumice and scoria include both of juvenile and slightly altered particles. Ratios of these ash components are based on particle number (250-500 micrometer).

**August 2008 to June 2010 (2008/8/22, 2010/3/30, 2010/5/27, 2010/6/27):** Eruptive activities are basically phreatic. Ratios of scoria and pumice particles are always less than 10%, and those pumice particles are less than 1% in most samples. Each of fresh lava and altered material accounts for 20-50%. All pumice particles are slightly altered, with change in color, adherence of finer altered material in vesicle and ablation of particle surface. A part of scoria particles after 27 May, 2010 have glaze, indicating a possibility of juvenile material. Particles of non-altered lava (gray, black, brownish-red and greenish gray) have variable crystallinity in groundmass. Even the lava particles with glassy groundmass are free from glaze, being different from those after February of 2011. Particles of altered material are either those with orange color or those with silicification accompanying sulfide minerals. Crystal particles are plagioclase, clinopyroxene, orthopyroxene and Fe-Ti oxides.

**January 19, 2011:** Eruptive activity shifted to phreatomagmatic. Pumice particles reach 8% and 95% of all are very fresh without alteration and adherence of finer altered material, which is remarkably different from previous period. The pumice particles have blocky surface with low vesicularity, implying the interaction of magma with aquifer. 20% of scoria particles (4% in total) have graze, implying a possibility of juvenile material.

**After February 2011(2/2, 2/7-8, 2/18, 2/24, 3/13) :** Changes from the previous two periods are 1) Increase of non-altered lava to 65-80%, 2) decrease of altered material to the range of 10 to ca. 2%, addition of olivine as crystal particle. Addition of particle from lava accumulated in Shinmoe crater led to the change 1). The non-altered lava particle in this period includes two types, A) glaze-free particles which had been always found in ash since August 2008, B) very fresh, glassy lava with remarkable glaze. The latter corresponds to lava newly accumulated in crater in 2011. The type B lava accounts for half of non-altered lava (ca. 65% in total) in February 2 ash. With time passage, type B lava changes in color from olive (2/2, 2/7-8) to greenish gray and becomes weak in glaze, which makes it difficult to distinguish it from type A lava. At least, Type B lava particle in February 2 and February 7-8 ash resembles in appearance to particles obtained artificially crushing February 1 volcanic bomb from the accumulated lava. Furthermore, phenocryst assemblages are the same between the type B lava and the bomb (plagioclase, clinopyroxene, orthopyroxene, olivine and Fe-Ti oxides). Ash of February 2 and February 7-8 include vesiculated glass particles with the same color (olive) as the type B lava. Ratio of the vesiculated glass in ash decreases from ca. 7% (2/2) to 1% (2/7-8). Most particles of scoria and pumice can be interpreted as juvenile. Pumice particle are always less than 2%. Ratio of scoria particle mostly increases with time, 0.2%(2/2), 3%(2/7-8), 6%(2/18), 15%(2/24), 8%(3/13). The scoria particles may be derived either from unsolidified part of the accumulated lava or deeper part of the magma plumbing system.

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