

## The September 14, 2015 phreatomagmatic eruption of Nakadake crater, Aso Volcano, Japan and its deposits

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Following the November 2014-May 2015 magmatic activity including ash and strombolian eruptions, an explosive eruption occurred at Nakadake first crater, Aso Volcano in central Kyushu, southwestern Japan, on September 14, 2015. We performed fieldwork for observing and sampling of the related deposits in the proximal and distal areas immediately after the eruption. Based on these field observations, the eruption deposits were divided into ballistics, pyroclastic density current and ash-fall deposits.

A large number of ballistic clasts was scattered within about 500 m from the center of Nakadake first crater. Although the largest clast with a diameter of 1.6 m existed at the southwestern crater rim, most of ballistic clasts were less than 10 cm in diameter. We sampled all ballistic clasts from an area of 3.5 m<sup>2</sup> at the southwestern rim of Nakadake first crater. The total number of ballistic clasts deposited on the area was 158. Almost half of the ballistics appeared as fresh and unaltered basaltic andesite rocks interpreted to be derived from a fresh batch of magma, while the rest was weakly to highly altered clasts. An area of 2.3 km<sup>2</sup> was covered by a relatively thin ash interpreted to be derived from pyroclastic density currents (PDCs). The deposits were distributed with the SE-trending main axis and two minor axes of the NE and NW. The maximum thickness was less than 10 cm at the crater rim and the PDC deposits were wholly fine grained beds containing no block-sized clasts. Based on the isopach map, the mass of the PDC deposits was estimated at ca. 52,000 tons. The ash-fall deposit was finer grained and was clearly distributed about 8 km to the west of the source crater. The mass of the ash-fall deposit was calculated at about 27,000 tons. Adding the mass of the PDC deposits, the total eruptive mass of the September 14, 2015 event was 79,000 tons.

The polarizing microscope observations revealed that all samples of the September 14 deposits consisted of glass shards (20-30 %), crystal and lithic (40-50 %) grains. Most glass shards were unaltered poorly crystallized pale brown glasses which probably represented juvenile magma. Results of EPMA analysis indicate that chemical composition of glass shards included in the September 14 deposits were similar to those of glasses in the 1979, 1989-1990 and November 2014-May 2015 ash. These evidences including video footages suggest that the September 14, 2015 eruption of Nakadake first crater was phreatomagmatic origin. Similar phreatomagmatic eruptions occurred at Nakadake on September 6, 1979 and April 20, 1990 whose eruptive masses were one order larger than that of September 14, 2015 eruption. These eruptions impose a great hazard for areas within 1-2 km of the active Nakadake crater, yet efficiently impossible to predict due to the lack of any precursors.

Keywords: phreatomagmatic eruption, ballistic clasts, pyroclastic density current, Aso Volcano, Nakadake