Eruptive sequence of AD1895 activity of Zao volcano, NE Japan

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The Zao volcano is one of active volcanoes in NE Japan. The latest major activity is a series of phreatic eruptions in AD1895. Based on the geologic features of the eruptive products and the documentations of this activity, we revealed the sequence of the mode of eruptions in detail.

The eruptive products distribute within an area of 300 m around the crater lake Okama. These consist of hydrothermally altered matrix of fine ash with various amounts of altered lithic fragments, andesites and scoria, and are divided into six layers (layers 1 to 6). The lower layers 1 to 4 are usually much thinner than the layers 5 and 6. Comparing the documentations with geologic features of the deposits, we inferred that the layers 1-2, 3-4 and 5-6 were formed by the eruptions on 15^{th} -19^{th} February, 22^{nd} August, and 27^{th} -28^{th} September, respectively.

Several reports showed that a white smoke burst up from the crater lake in 15^{th}, and the pisolitic ash fell in 19^{th} of February. The scale of the first phreatic eruption episode would have been very small, which deposited mainly ash fall. The layers 1 and 2 are well-sorted ash consisting of whitish and pale-gray ash, respectively. Lapilli size volcanic bombs and accretionary lapilli which suggest fall origin are observed in places. The total volume of the layers 1 and 2 are estimated to be less than 3.8×10^6 kg.

In August, the activity of phreatic eruptions would become more intense than in February. Some newspapers reported ash fall in Yamagata City in 22^{nd} August. The layers 3 and 4 of the second episode are normally-sorted ash. Whitish-gray colored layer 3 shows repeated inverse grading and bedding sags are observed in the lower boundary. Pale-gray colored layer 4, which is distributed restrictedly in the topographic low, shows weak laminations, discontinuous lapilli trains, and local concentration of lapilli. These features suggest that the layer 3 has pyroclastic fall origin, whereas the layer 4 results from the pyroclastic surge. The estimated volume of layers 3 and 4 are 3.8×10^6 and 5.7×10^6 kg, respectively.

On 27^{th} September, the activity reached climax and pyroclastic fall deposits were formed by repeated phreatic eruptions. Some newspapers reported that the black and white smokes had been witnessed with rumbling in the morning. A sketch of 27^{th} September is showing that many large clasts fell down from the eruption column of 350 m height and an umbrella part. The eruption continued until 28^{th} September. The layers 5 and 6 are poorly to very poorly-sorted pale-gray and gray colored matrix-supported tuff breccia, respectively. The lower part of the layer 5 shows massive facies, whereas lithic fragments formed weak stratifications in the upper part of the layer 5 and the layer 6. The long axis of large clasts in the layer 6 aligns horizontally. The layers 5 and 6 thin rapidly away from the crater lake. In addition, layer 5 shows normal-sorting in some distance from the crater, and bedding sags are observed in the layer 6 of the topographic high. From these data, the layers 5 and 6 would mainly result from the pyroclastic fall. The weak stratifications of these layers suggest that these deposits were formed by repeated eruptions. The granulometric analysis supports this interpretation. The estimated volume of layers 5 and 6 are 5.0×10^7 and more than 3.9×10^8 kg, respectively. The estimated crater size is 30 m in diameter and the energy is more than 10^{11} J.