New conceptual modeling of the 1888 eruption of Bandai Volcano - Focusing on the effects of distributed hydrothermal system

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1. Introduction: Various kinds of studies have been conducted on the eruption of Bandai Volcano occurred on July 15, 1888, which caused one of the worst volcanic hazards in Japan, but the processes and mechanisms of the eruption are not fully understood yet. One of the problems is that the lined fissures, which had discharged steam columns higher than 500 m even three weeks after the eruption (Sekiya and Kikuchi, 1889), have not been interpreted appropriately. Conceptual modeling of the 1888 eruption has been conducted in relation to the studies for hydrothermal systems in active volcano areas (Shigeno, 2004).

2. Conceptual model: Fig. 1 summarizes the new conceptual model, showing the central part of Bandai Volcano as plans. The 1888 eruption, as a whole, was estimated to have occurred along the following stages.

(0) Pre-eruption stage: A hydrothermal system (probably of the mixed hot-water and steam type; ca. 300 C?) of the fractured reservoir type, ca. 1.5 km long extending SSE-NNW direction (steeply dipping to ENE), had developed under the Kobandai-san. It had supplied geothermal fluids (mostly steam including some acidic gases) to the three hot springs distributed at the northwestern part of the Kobandai-san. The origins of most heat and fluids of the hydrothermal system were probably volcanic gases from the depth of the Numano-taira area, which corresponds to the central crater of Bandai Volcano.

(1) First stage (for a very short time): The eruption began, as a steam explosion, at the southeast slope of the Kobandai-san (the uppermost part of the Numano-taira). Volcanic gases stored at the upper part of the deep magma chamber and/or in the central vent of Bandai Volcano had possibly contributed the eruption. The location of the eruption and its surrounding topography caused the high-temperature blasts to the southeast areas along the canyon of the Numano-taira and Biwa-sawa.

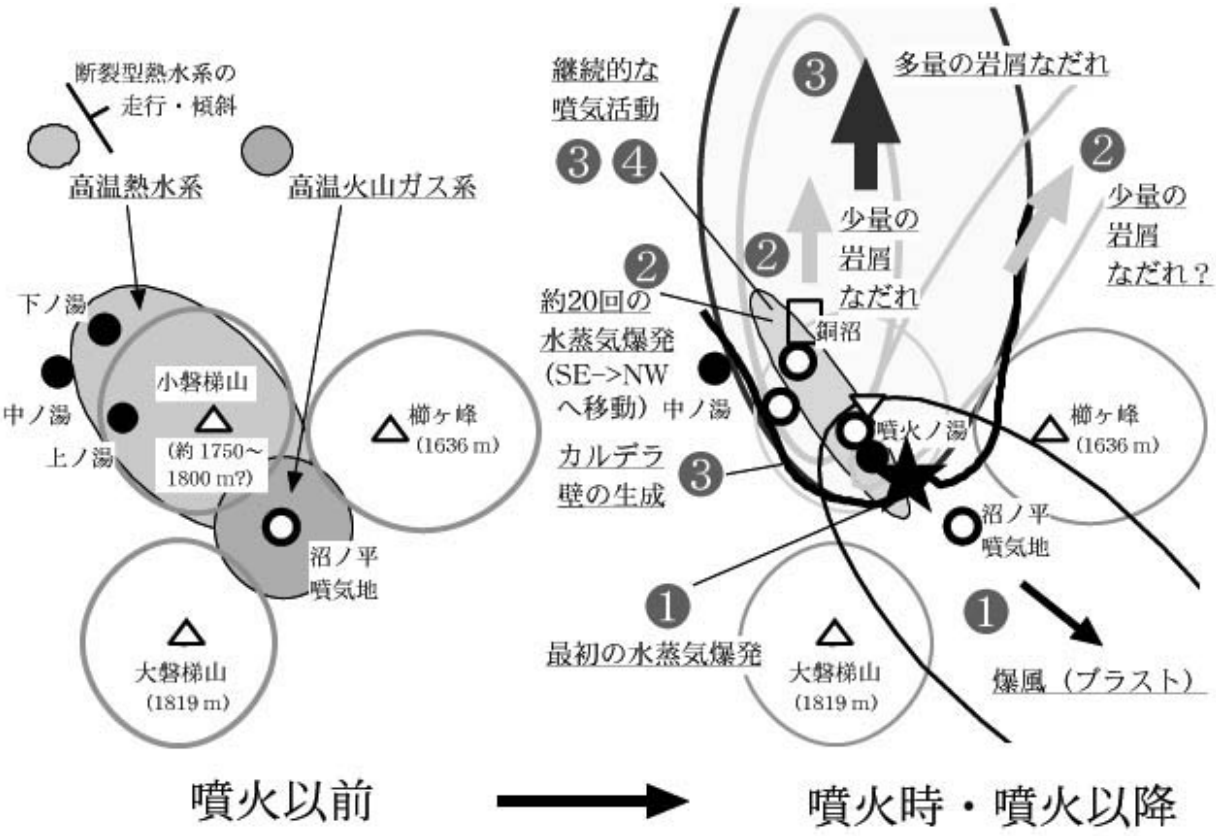
(2) Second stage (for a couple of minutes): Sudden pressure drop underground due to the first explosion caused a series of steam explosions of the hydrothermal system. They had migrated to NNW direction (ca. 20 time) across the Kobandai-san (avoiding its summit area due to the topographic pressure effect), and ended at the Aka-numa area on its north slope.

(3) Third stage (for a couple of hours): The deep part of the hydrothermal system had remained, and continuously produced the lined steam discharges. The Kobandai-san, cut by the chain of hydrothermal explosion craters aslant through its shoulder, and a part of the Kushiga-mine had collapsed with a series of debris avalanches to north causing high dust clouds and loud noises. As the result, a large caldera was formed. Steam explosions of the high-temperature fluids in the rocks from the hydrothermal system and slippery characteristics of alteration zones had probably contributed to the collapse.

(4) Post-eruption stage: The lined steam discharges from the remained hydrothermal system had continued, gradually decreasing the intensity.

3. Summary: Distributions of hydrothermal systems and alteration zones have related to various volcanic hazards, but studies on them have been very limited. Optimizing the hazard mitigation, environment protection, and various resources development of active volcano areas in Japan, where the land resources are very limited, is necessary. For that purpose, understanding the natures of the distributed hydrothermal systems and alteration zones through well drilling and monitoring survey will be very important.

Reference: Shigeno, H. (2004) Cooperation of volcano hazard mitigation and geothermal energy exploitation - Consideration from the 1888 eruption (steam explosion) hazard of Bandai Volcano. Geothermal Energy, vol.29, no. 1 (in press). (published by New Energy Foundation in Japanese)



第１図 磐梯山1888年7月15日噴火（水蒸気爆発）の新しい概念モデル（平面図）

噴火後も活発だった噴気活動（❹）に注目し，左図・右図で噴火前の高温熱水系の発達，それに起因した３時階（❶・❷・❸）の噴火活動などをモデル化した．噴火前および噴火後の温泉・噴気地の概略の位置を黒丸・白丸で示した．詳しくは本文参照．