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インドネシアのカルデラ火山の特徴とカルデラ噴火への準備過程
Characteristics of a caldera volcano, and process to a caldera-forming eruption in Indonesia

高田 亮 [1*], 古川 竜太 [1], 土志田 潔 [2], アンドリュウスチュチ [3], カルタディナタ [3]
TAKADA, Akira[1*], FURUKAWA, Ryuta[1], TOSHIDA, Kiyoshi[2], S. Andreastuti[3], N. Kartadinata[3]

[1] 産総研, [2] 電力中央研究所, [3] インドネシア火山地質災研究減センター
[1]Geological Survey of Japan, AIST, [2]CRIEPI, [3]DVGHM

There are various volcanoes in the world. Almost volcanoes erupted frequently. However, some volcanoes seem to be quite for preparing a large-volume eruption with caldera formation. What is a caldera-forming eruption? Compared with usual eruptions, a caldera-forming eruption, erupted volume˜ 10-1000 km3, causes huge direct damages, wide-spread pyroclastic flow, air fall, lahar, tsunami, and global impacts such as climate change; The recovering time is more than 10 years for climate, ocean, food, human health, traffic, buildings, and 100-1000 years for land use. Japanese have forgotten a caldera-forming eruption, because the last one occurred 7,000 years ago. Indonesia was suffered twice for the last 200 years, and three times within 1000 years. The total victims amount to 130,000, which is 55 % of the total ones from eruptions in the world during the last 200 years.

We have questions on the caldera-forming eruption. (Q1) Can we get a precursor sign for the eruption (where, when, what volume)? (Q2) Is not the eruption infrequent (< once / 100 years)? (3) Can we evaluate the next candidate for hazard mitigation? We carried out the JST-JICA project as follows. The first is to study the process to the caldera forming eruption, that is, the quantitative eruptive history of target volcano to caldera-forming eruption, especially, multi-caldera volcanoes in Bali (Furukawa et al., 2012). (2) The second is to clear the frequency of the caldera-forming eruption, that is, the temporal and spatial distribution of the eruption in East Java and Bali (Toshida et al., 2012). The third (this paper) is to evaluate volcanoes base on the obtained geological data, in order to answer (Q1) and (Q2). The results will contribute to the answer of (Q3).

The short-term evolution: During the last a few months, we may catch the short-term process as the progressive activity to the climax eruption. We compiled the example of Pinatubo 1991 eruption, Philippine (Harlow et al., 1996; Hoblitt ea al., 1996; White et al., 1996; Wolfe and Hoblitt, 1996), that of Krakatau 1883 (Rampino and Self, 1982), that of Tambora 1815 (Junghuhn, 1854; Self et al., 1984, Stothers, 1984; Yamamoto et al., 2000; Takada and Yamamoto, 2008). There occurred a lot of small eruptions and hydrothermal explosions during the last a few months just before the climax. Moreover, there occurred unusual wide-range hydrothermal activity, 2-5 km-wide, before the climax, suggesting the existence of an active large volume magma beneath the summit.

The long-term evolution: There was a large shield or stratovolcano constructed with a large eruption rate before the caldera forming eruption, for example, Tambora, and Tenggar. In contrast with those volcanoes, Kelute has never cause the caldera-forming eruption. The long-term eruption rate is far smaller than those of volcanoes with caldera. The Kelute is composed of several volcanoes with repose periods. Next, we compiled the eruptive histories of caldera volcanoes which were studied as corporation projects between GSJ and VSI: Tambora (Takada et al., 2000; Matsumoto et al., 2000), and Rinjani (Takada et al., 2003; Nasution et al., 2003; Furukawa et al., 2004; Furukawa et al., 2005). We got the scenario that, during the last 10,000 years before the caldera formation, the eruption rate decreased, eruption style changed to more explosive, and chemical composition changed.

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