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A Phreatic Explosion after AD 1663 at the Hiyoriyama Cryptodome, Kuttara Volcano, Southwestern Hokkaido, Japan

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Hiyoriyama is a Quaternary dacite cryptodome located in Kuttara Volcano, southwestern Hokkaido, Japan. The cryptodome is 350–550 m across and 130 m high, with an explosion crater at the summit. Here we report on a small-volume, phreatic fall deposit (the Hy-a deposit) erupted from the crater. The deposit consists mainly of fresh to altered, dacitic lithic clasts (up to 30 cm across) in a fine-grained matrix. The petrological features of the dacite are identical to those of rocks within the wall of the crater. The deposit increases in thickness and maximum grain size toward the crater, suggesting it was erupted from the crater. The Hy-a deposit overlies the Us-b tephra, which was deposited in AD 1663. The lithology, distribution, and stratigraphy of the Hy-a deposit suggest that a phreatic eruption occurred after AD 1663 at the summit of the cryptodome, resulting in formation of the crater.

Key words: phreatic eruption, explosion crater, Hiyoriyama Cryptodome, Noboribetsu Geothermal Field, Kuttara Volcano

1. Introduction

Hiyoriyama is a Quaternary dacite cryptodome located in the northern part of the Noboribetsu Geothermal Field, Kuttara Volcano, Hokkaido, Japan (Fig. 1). The cryptodome has a small explosion crater at the summit, suggesting that a minor eruption occurred during or after emplacement of the dome (Fig. 2). No previous study has investigated the timing of the eruption, and the formation age of the crater is unknown. This paper describes the distribution, lithology, and stratigraphy of a small-volume, phreatic fall deposit associated with the crater, and discusses the timing of the crater-forming eruption.

2. Hiyoriyama Cryptodome

The Hiyoriyama Cryptodome is located in the western part of Kuttara Volcano (Fig. 1). The volcano consists mainly of an andesitic stratovolcano (elevation, 549 m above sea level) with a small caldera at the summit (Lake Kuttara). The volcano evolved over the period 80–45 ka, involving early silicic explosive activity and subsequent stratovolcano building associated with caldera collapse at 40 ka (Katsui *et al.,* 1988; Yamagata, 1994; Moriizumi, 1998; Moriya, 2003). The Noboribetsu Geothermal Field is inferred to have formed after the collapse of the caldera (Katsui *et al.,* 1988). The geothermal field is approximately 1 km wide (northeast-southwest) and 1.5 km long (northwest-southeast).

The Hiyoriyama Cryptodome is elliptical in plan view, ranging in diameter from 350 m (northeast-southwest) to 550 m (northwest-southeast). It rises 130 m above the surrounding area, with the highest point being 377 m above sea level (Fig. 2A). The surface of the cryptodome is covered with sediments up to 15 m thick (Katsui *et al.,* 1988). Fission-track dating yields ages for the dome of 15±4 ka and 14±4 ka (Goto and Danhara, 2011). An explosion crater at the summit (Hiyoriyama Summit Crater; Fig. 2B) is 40×95 m in size (elongate northwest-southeast) and 20 m deep, and contains active fumaroles. The crater retains its primary morphological features, including the crater rim and crater wall.

The Hiyoriyama Cryptodome consists of coherent dacite that is well exposed in the crater wall. The dacite is grey and porphyritic, containing phenocrysts of plagioclase (<4 mm long, 21–25 vol.%), quartz (<5 mm, 6–8 vol.%), hypersthene (<2 mm, 4–6 vol.%), trace amounts of augite (<1 mm) and opaque minerals (<0.5 mm), and rare hornblende (<0.2 mm) (Fig. 3 A). The groundmass (62–66 vol.%) is granophyric, containing silica minerals, feldspars, and opaque minerals of <0.1 mm in size. Table 1 lists the whole-rock

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