# 新潟大学災害・復興科学研究所 共同研究報告書

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# Integrated reconstruction of the late Pleistocene eruptive and glacial histories of Tateyama Volcano(立山火山での噴火史と氷河史の 統合的復元)

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# **研究要旨**(Abstract) (400 字以内)

A field survey at Tateyama Volcano was undertaken to evaluate the evidence for lava-ice interaction during the last glacial period (ca. 71-12 ka) in Japan. Preliminary geomorphological, textural, and petrographic results indicate a syn-glacial age (ca. 45 ka) lava was emplaced against the margin of a glacier. Further geochronological data are required to examine the relationship between volcanic activity and glacier fluctuations at Tateyama.

#### A. Objectives

The aim of this project was to identify and describe eruption products that were formed by the interaction between lava flows and glaciers at Tateyama Volcano, for the scientific objectives of: (i) constraining the glacial history of Japan's Northern Alps; and (ii) advancing our understanding of the relationships between volcanic activity and glacier fluctuations. Previous studies of this area have reported landforms and deposits that were formed by the expansion of glaciers at Mount Tateyama during the last glacial period between ca. 71,000 and 12,000 years ago (Kawasumi, 2007). Volcanic activity at Tateyama also occurred during this period, and previous studies have suggested that the eruptive products may contain valuable information about the paleoenvironmental conditions at that time (Ito, 1995). The characteristic textural and

morphological features of lava flows and pyroclastic units that were emplaced against glacial ice at stratovolcanoes can be recognized (Conway et al. 2015). Mapping the distributions and measuring the eruption ages of these glaciovolcanic features permits reconstruction of the previous extents of glaciers in volcanic regions (Conway et al. 2016). Application of this novel approach to paleoclimate research in Japan will offer traditional advantages over glacier reconstructions using moraine distributions that have been problematic due to poor preservation and imprecise age constraints (Sawagaki et al. 2004). By undertaking this case study at Tateyama Volcano, we aim to provide new perspectives on the links between volcanism and the cryosphere in Japan and globally, which is especially pertinent as volcanic regions many are currently undergoing deglaciation due to climate change.

#### B. Methods

A geomorphological and lithological investigation of late Pleistocene to Holocene glacial and eruptive landforms and deposits was undertaken during a field survey in September 2024.

The nature and distributions of glacial cirques, moraines, and till were inspected at Mount Tateyama between elevations of 2,300 and 3,000 metres above sea-level (m asl).

The lithofacies of the Tamadono lava flow unit (ca. 45 ka) were examined from its ventproximal exposures (near Mount Jodo) to its prominent outcrop site (Tamadono Iwaya). Fracture characteristics and petrographic textures of this lava unit were investigated in the field. Specifically, we measured the spacings and orientations of platy joints, and assessed the groundmass crystallinity of the lava.

# C. Results

Brief descriptions for the main targets visited during the field survey are provided herein.

Cirques on the western side of Mount Tateyama summit peak extend from 3000 to 2700 m asl. Much of the landscape downslope from this limit is covered by fluvioglacial gravels and till.

At several locations, 0.4-1.2 m-thick sections of alternating soils and tephra layers was observed above the gravels. The volcanic ash towards the base of such sections was tentatively interpreted to be the widespread ca. 7.3 ka Akahoya ash from Kikai caldera. Towards the top of the sections, several layers of hydrothermally altered ash and lapilli were observed. These uppermost deposits were interpreted to be derived from middle to late Holocene phreatic eruptions at Tateyama Volcano (Jigokudani or Mikurigaike vents).

The Tamadono unit (ca. 45 ka; Nakano et al.,

2010) is a moderately porphyritic andesitic lava that extends from the saddle to the west of Mount Jodo down to the Murodo Plateau. At its vent-proximal outcrops, the lava was observed to be a glassy, slope-mantling flow with prominent autobrecciated zones and a maximum thickness of approximately 5 m. In contrast, at the Tamadono Iwaya site, the lava unit is approximately 20 m-thick and exhibits pervasive platy jointing. The joints are spaced at distances of 2-8 cm and predominantly have horizontal orientations. The groundmass of the lava here is slightly more crystalline than the lava observed upslope.

#### D. Discussion

The field survey has confirmed the widespread evidence for past glaciation of the upper portions of Tateyama Volcano and its surrounding basement rocks. Moreover, the morphological and textural features of the Tamadono lava flow indicate that it was buttressed against the margins of a glacier during its emplacement. We interpret that the lava was deflected from travelling further north and forced to pond into a 20 m-thick unit at the Tamadono Iwaya location. We did not observe columnar joints indicative of rapid cooling of the lava against glacial ice or meltwater, and interpret that the outer margins of the lava were eroded subsequent to its emplacement. The erosion has exposed the interior of the flow. which had experienced endogenous flow and shearing as it cooled slowly. This prolonged cooling process occurred in the thick flow interior that was isolated from the atmosphere, and produced the prominent platy joints and microcrystalline groundmass texture. Such features make the lava suitable for future <sup>40</sup>Ar/<sup>39</sup>Ar geochronological analyses, which are required to improve the precision of current age estimates.

Both the absence of columnar joints and the prominence of platy joints were noted as typical features for ca. 40 ka ice-bounded andesitic lava flows of similar thicknesses at Ruapehu Volcano in New Zealand (Conway et al., 2015).

# E. Conclusions

This study has produced a new account of eruptive deposits produced by volcano-ice interaction during the late Pleistocene in Japan. Field survey observations and comparisons to well-documented examples from New Zealand have provided valuable evidence for the process of glaciovolcanism at Mount Tateyama. We infer that glacial impoundment of the Tamadono lava occurred during the last glacial period, and has produced a rare and novel record of lava-ice interaction in the Northern Alps. Further geochronological studies should be undertaken for the field area, to improve our understanding of the timing of glacial and eruptive events and their relevance to defining volcano-climate connections.

# F. Outcomes (presentation/papers, if any) 1. 論文発表 (掲載誌名・巻号・頁・発行年を記入し, 掲載論文あるいはPDFファイルを別紙で1部提出)

## 2. 学会発表(学会名・発表年月・開催地なども記入)

Volcanological Society of Japan Annual Conference, 18/10/2024, Sapporo ("更新世火 山における<sup>40</sup>Ar/<sup>39</sup>Ar 年代測定に最適な溶岩流組 織の特徴づけ")

## G. Patents

- 1. 特許取得
  - n/a
- 2. 実用新案登録

n/a

- 3. その他
  - n/a