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Reconstraction of eruptive sequence of Chuseri tephra formation (eruptive episode C) in Towada volcano

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Towada volcano is a caldera volcano, and the interior of crater is filled with much water. In recent eruptive episode from Nakanoumi crater, their activities are characterized by the transition from magmatic eruption to phreatomagmatic one (Hayakawa, 1985). In the latest episode, the change of eruptive styles progressed continuously without intermittent time (Hiroi and Miyamoto, 2011). Although the recent activities are a good instance to clarify a mechanism of the transition between eruptive styles, the continuity is not almost discussed in other episodes.

Chuseri tephra formation (To-Cu), which is the largest eruption from Nakanoumi crater, was formed at 6,2ka (Kudo and Sasaki, 2007). This formation consists of 3 units, Chuseri pumice (CP), Kanegasawa pumice (KP) and Utarube ash (UA) in ascending order, and has progressed from magmatic (CP) to phreatomagmatic (UA) (Hayakawa, 1983). Hayakawa (1985) reconstructed the eruptive sequence, however, the temporal relations among 3 units were not discussed. The interpretation about eruptive style and the stratigraphy of KP did not agree within previous studies. In this study, based on a detailed field survey, we clarify the reconstruction of eruptive sequence in To-Cu focusing especially on the continuity among all units.

CP is the plinian pumice deposits, and total thickness is 327cm at SE8.1km from source. We divide into 4 sub-units from CP1 to CP4 by a grain size variation. From CP1 to CP2, the grain size once becomes finer. In CP3, it changes coarser and finally turn very finer in CP4. CP was formed by an eruption column because these grain size variations are drastic and continuous. CP3 is homogeneous pumice fall deposits without changes of the grain size, and the thickness variation decreases systematically with distance from vent. On the other hand, the thickness of CP4 overlain directly by KP does not decreases systematically. This difference indicates that a part of CP4 is eroded before KP deposition, the transition from CP to KP is discontinuous.

KP is divided into 5 sub-units (KP1˜KP5) from facieses; KP2, KP4, KP5 are lapilli layers and KP1, KP3 are fine ash layers. KP2 and KP4 consist of contrastive two parts. The lower part is a lithic rich containing about 70wt% lithic fragments with a little pumice. The upper part is a pumice fall deposit with about 30wt% lithic fragments. The transition of these parts is gradual and these two parts is observed far places. Thus these deposits are derived from one eruptive column formation. In previous studies, KP has been considered two normal grading pumice fall layers (Hayakawa, 1985) and alternation of pumice and lapilli (Matsuyama and Oike, 1986). However, KP is interpretated the fall deposits changing from lithic rich part to pumice rich part. KP5 is observed only lithic rich part and the thickness variation does not show a systematic decline alike CP4.

Hayakawa (1985) concluded that pyroclastic surge deposits in UA were distributed only inside caldera, however, we observed UA erodes the lower layer at the outside of caldera. It suggests UA consists of ash fall and pyroclastic surge deposits out of caldera.

Based on the result of our field survey, the eruption sequence are reconstructed as below; CP initiated from CP1, and the column once diminished (CP2). The column rapidly grew and became the largest keeping steadiness for a long period (CP3). Finally the column suddenly diminished (CP4). On the transition from CP to KP the short dormancy are indicated by the eroded surface of CP4 . KP progressed from explosive activity to steady column formation. KP repeated intermittent eruption and finally transited phreatomagmatic eruption (UA). Though erosion of KP5 by the surge deposits in UA makes unclear about the time relation from KP to UA, the lack of pumice part in KP5 implies a short dormancy. The above eruptive sequence suggests that 3 units of To-Cu are formed from 3 independent events divided by the short dormancy among each unit.

Keywords: Towada volcano, Chuseri tephra formation, magmatic eruption, phreatomagmatic eruption