The 120 ka Largest Caldera-forming eruption of Kutcharo volcano (Kp IV), eastern Hokkaido, Japan (Part 1): Implications for successive pyroclastic flows from multiple vent system

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Kutcharo volcano, eastern Hokkaido, has repeated caldera-forming eruptions since 400 ka to form the largest Quaternary caldera (20 x 26 km) in Japan. The most voluminous (175 km3) eruption "Kp IV" occurred 120 ka. The eruption deposits can be divided into 4 units, in ascending order. Unit 1 consists of silt-sized, cohesive ash with widely dispersal. Unit 2 is composed of a thin, poor-sorted pumice fall deposit, characterized by narrow distribution and small volume (<0.2 km3). Unit 3 is the most voluminous and widely distributed pyroclastic flow deposits. Although Unit 4 is also composed of pyroclastic flow deposits, it is distributed in a limited area in north of the caldera. The boundary between Unit 3 and -4 is sharp and sometimes cuts lapilli pipe structures of Unit 3. These suggest that the final phase (Unit 4) was much smaller than climactic phase (Unit 3) and that there existed possible time gap between both units. Juvenile materials of Kp IV mainly consist of pumice (74-78 wt% in SiO2) associated with minor amount of mafic clasts (52-73 wt% in SiO2). The mafic clasts are only found from Unit 3 of the northern area and Unit 4. According to SiO2-P2O5 diagram, the mafic clasts can be classified into three types which vary in chemistry with stratigraphic levels: Low-P in the lower part of Unit 3, High-P in the upper part of Unit 3 and Medium-P types in Unit 4. These three types of the clasts make three distinct mixing trends in the diagram. Distinct lithofacies of Unit 3 between north and south and temporal change of contained mafic clasts, from Low-P to High-P, in the northern flows suggest that northern and southern flows of Unit 3 could be considered to be heterotopic, contemporaneous products derived from multiple vent systems. This would be consistent with types of lithic-rich layers in Unit 3. The northern flows of Unit 3 include ground layers which are rich in oxidized andesite. However, lithic concentration zones of the southern flows of Unit 3 are rich in porphyritic andesite. In the final eruption phase, northern vents system had been active to erupt medium-P mafic clasts with pumice. These types of magma and their sequence suggest that the three mafic magmas independently and intermittently injected into main silicic magma. Considering distribution of deposits containing mafic clasts, it seems that feeder vents for mafic clasts possibly located at northern area of the caldera to erupt with voluminous pumice magma, whereas other vents at the southern area only fed pumice magma. The volume ratio of pumice abruptly decreases in Unit 4, indicating that the silicic magma would be nearly exhausted.

Compared with typical caldera-forming eruptions, Kp IV eruption is characterized by the lack of a typical plinian column. Thus, it can be concluded that eruptive activity had suddenly reached its climax without making a stable column. This is possibly caused by the developments of multiple vent system in the early phase of the eruption.