The 120 ka Largest Caldera-forming eruption of Kutcharo volcano (Kp IV), east Hokkaido, Japan (Part 2): Generation and Preeruptive processes of Large Silicic magma system with Multiple Silicic magmas

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We present the detailed eruption sequence and general petrological features of eruptive materials of the Kp IV activity (Part 1: Hasegawa et al., in this meeting). In this study, we show petrological and geochemical data to discuss the formation and eruption processes of magma plumbing system of a large, silicic eruption. Kp IV eruption started with the ash and pumice fall (Unit 1 and -2), followed by a voluminous pyroclastic flow (Unit 3) and a small scale of mafic clasts-rich flow (Unit 4). The Kp IV juvenile materials are composed mainly of porphyritic pumice contained in all the units. In addition, a small amount of heterogeneous, nearly aphyric mafic clasts also appear in the northern flows of Unit 3 as well as Unit 4. On the basis of the mineral, whole-rock and matrix glass chemistries, we identified two silicic and three mafic end-member magmas: rhyolitic, dacitic, and three andesitic ones. Compositional variations of these andesitic magmas can be explained by fractional crystallization of a single primary magma. However, the rhyolite-MELTS program, mass balance calculation and Rayleigh fractionation models do not allow us to explain the generation of two silicic magmas by the fractional crystallization of these andesitic magmas. This suggests that these silicic magmas could be produced by partial melting of crustal materials, in which the andesitic magma could play as a heat source. On the other hand, the higher 87Sr/86Sr of dacitic pumice also suggests that the dacitic magma is not a parent of the rhyolitic one. Therefore, both rhyolitic and dacitic magmas would be produced independently at the same time. This would be possible that the partial melting of various crustal materials, which are heterogeneous in chemical compositions including Sr isotopes, to produce distinct silicic magmas. It has been believed that a large silicic magma system consists of a single silicic magma, which is evolved by the injection of mafic magma. However, we revealed that the silicic magma system in KP IV eruption was composed of two distinct magmas, dacitic and rhyolitic ones.

Whole-rock chemistry of the pumice suggests that dacitic magma had injected into rhyolitic one. Zoning profiles of orthopyroxene phenocrysts indicate that the dacitic magma had repeatedly injected into the rhyolitic one since several years before eruption, resulting in the formation of a zoned magma chamber. In contrast, on the basis of the durations of elemental diffusion in Fe-Ti oxides, three andesitic magmas sequentially injected into this zoned magma chamber less than a day before eruption. This injection could be considered as a trigger of caldera-forming eruption. Considering the temporal variations of whole-rock and matrix glass chemistries, upper part of the zoned magma was erupted in early phase (Unit 1 and -2), and lower dacitic magma was also withdrawn in climactic phase (Unit 3), resulting in the beginning of the Kp IV caldera-forming eruption.