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Eruption history and temporal change of magma systems of Chikurachki and Fuss volcanoes, Paramushir Island, Kuril arc

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Tephrostratigraphic and petrological study for Chikurachki (1,816m)-Tatarinov-Lomonosov volcanic chain (CTL volcanic chain) and Fuss volcano (1,772m), at southern Paramushir island, northern Kuril islands, was carried out in order to reveal the Holocene explosive eruption history and temporal change of magma systems of these active volcanoes. In addition to geological survey, we determined petrological features of juvenile materials from these volcanoes. In the studied area, we described tephra successions at 54 localities and identified more than 20 major eruptions consist of pumice fall, scoria fall and ash fall deposits, each of which is separated by paleosol or peat layers. The source volcano of each recognized tephra layer is confirmed by correlation with proximal deposits of each eruption center with respect to petrography, whole-rock and glass chemistry. The eruption age of each layer was decided by radiocarbon dating, presence of dated widespread tephra from Kamchatka, and soil thickness sandwiched by tephra layers. Eruption volumes of each eruption were roughly estimated by using isopach maps and geological information from Belousov et al. (2003) that performed volcanological survey at the eastern side of Chikurachki volcano.

The Holocene activity in this region was initiated by eruptions from Tatarinov and Lomonosov volcanoes. After the eruptions, Fuss and Chikurachki volcanoes started their explosive activities at ca. 7.5 ka, soon after the deposition of widespread tephara from Kurile Lake-Iliinisky caldera at southern Kamchatka. Compared with Fuss volcano located on back-arc side, Chikurachki has been more active with higher magma discharge rate. The two active volcanoes have shown harmonic changes of style and frequency of eruption from 7.5 ka to the present as follows. Plinian eruptions of Fuss volcano had repeated from 7 ka to 4 ka, whereas frequency of Chikurachki volcano had decreased during this interval. Since then, Chikurachi has restarted its explosive eruptions frequently to continue the eruptive activity until now.

Whole-rock compositions of the rocks of CTL volcanic chain and Fuss are clearly divided into medium-K (SiO_2=49-63%: K_2O=0.5-1.8%) and high-K groups (SiO_2=52-63%: K_2O=1.5-3.2%), respectively. These suggests that magma systems of the CTL volcanic chain and Fuss volcano are different each other and has been independently constructed. Among the CTL volcanic chain, Chikurachki scoria shows one linear trends within lower silica compositions (SiO_2=49-55%) on Harker diagrams. These compositions are gradually evolved between basaltic to basaltic-andesite with time suggesting that the magma system might be not largely changed but be slightly evolved by fractional crystallization. In contrast, compositional fields of glass chemistries for Fuss pumices are distinct between each eruption on K_2O Harker diagram, that shows different K_2O level within a narrow range of SiO_2 compositions (=70-76%). This implies that Fuss volcano is characterized by a short-lived magma system, which has been frequently replaced by distinct and relatively small magmas. In summary, the volcano with higher magma discharge rate, such as Chikurachki volcano, would continue eruptive activity under a stable magma system, whereas the volcano which is characterized by lower magma discharge rate, such as Fuss volcano, could be constructed with intermittently supply of small magma batch.

Keywords: Kuril arc, tephrostratigraphy, tephrochronology, Paramushir island, Chikurachki volcano, magma system