Petrological and geochemical characteristics of felsic magma related to caldera-forming eruptions of Akan Caldera, East Hokkaido

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Akan Caldera (24*13 km in diameter) is one of Quaternary caldera clusters located at eastern Hokkaido, and has been formed by related pyroclastic flows and plinian eruptions during early and middle Pleistocene (Hasegawa et al., 2004). Akan pyroclastic deposits (APD) can be divided on the basis of intervening paleosols into at least seventeen stratigraphic units, which can be also grouped into six stages by significant time intervals such as 10 m thick gravel and sand beds (stage-I: Ak17-Ak14, stage-II: Ak13, stage-III: Ak12-Ak10, stage-IV: Ak9-Ak6, stage-V: Ak5-Ak3, stage-VI: Ak2-Ak1, in ascending order). There are several large-volume units (more than 10 km3: Ak13, Ak7, Ak4 and Ak2), whereas estimated volume of most of each unit is less than 10 km3. The component analysis of lithic fragments in pyroclastic fall deposits revealed that APD were derived from at least three distinct source regions in Akan caldera (Hasegawa and Nakagawa, 2005). In this study, we show petrological and geochemical characteristics of APD.

Juvenile eruptive materials of APD are composed of white pumice, gray pumice, banded pumice and scoria. There is no systematic difference in crystal contents (2-17 wt.%) among the seventeen units. Although phenocryst mineral in these materials are plagioclase, clinopyroxene, orthopyroxene and Fe-Ti oxides, olivine phenocrysts are often contained in Ak15, Ak14, Ak7, Ak6 and Ak3 (the latest unit of stage-I, -IV, and -V, respectively).The composition of juvenile materials in APD consists mainly of dacite and rhyolite (SiO2=63.4-76.2 wt.%), with minor amount of andesite (SiO2=60.5-62.6 wt.%). The APD shows a wide range in whole-rock compositions of K2O and trace elements with a small range in silica contents (e.g., K2O=0.8-2.8 wt.% Rb=18-73 ppm with SiO2=67-73 wt.%). In one stage, the magma compositions become less evolved toward the top of the sequence continuously. These characteristics are common to glass compositions.

Focused on stage-II and stage-IV, -V, -VI, in which large-volume ignimbrites (more than 10 km) were erupted, whole-rock composition of each stage shows nearly parallel and different trend on Haraker diagrams of K2O and Rb. It suggests that distinct magma systems were active from stage to stage. Thus, it could be concluded that Akan cladera would be formed by successive eruption not from one large and long-lived magma chamber but from several diverse short-lived magma chambers. This conclusion is consistent with the result of the component analysis of lithic fragments.

Nd-Sr isotopic compositions of silicic samples from APD sequence are determined. Although subtle, there is a distinct isotopic difference between the early stage (stage-I, -II, -III: 87/86Sr=0.70326-0.70334, 143/144Nd=0.51299-0.51303) and the late stage (stage-IV, -V, -VI: 87/86Sr=0.70330-0.70347, 143/144Nd=0.51294-0.51300, relatively enriched). We speculate that the magma source of APD is different between early and late stage of the caldera-forming eruptions of Akan Caldera.