Lithofacies and eruptive styles of postcaldera volcano, the Akakura caldera in the South Kurikoma geothermal area, Northeast Japan

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The Pliocene to Pleistcene Akakura caldera with a topographic margin of 10 km in diameter, is located on the border of Yamagata and Miyagi Prefectures in the southern part of the South Kurikoma geothermal area. Caldera fill, over 1,400 m in thickness, consists of the Oha-yama Formation, the Kan-nodai Formation and the Mimizuku-yama Volcanics. The Mimizuku-yama Volcanics and the Kan-nodai Formation that are distributed in the southeastern part of the caldera record postcaldera volcanism and associated sedimentary processes. Based on grain size, composition and sedimentary structure, seven lithofacies are defined in the study area and are grouped into three categories: andesitic volcanic rocks, felsic pyroclastic deposits and epiclastic deposits.

Andesitic volcanic rocks comprise massive coherent andesite (dyke and lava flow) and associated non-stratified volcanic breccia (hyaloclastite and peperite). The coherent andesite is black to dark grey coloured, porphyritic and contains phenocrysts of plagioclase, augite, hypersthene and trace amounts of opaque minerals within the intersertal groundmass. The interior of the coherent andesite is characterized by columnar joint and polygonal joint with gradational contact. The hyaloclastite that is gradational with the coherent andesite contains ellipsoidal or circular shaped andesite blocks (lava lobe), up to 15 m in diameter, with irregular polygonal joints or radial columnar joints. The peperites with silt matrix develop along the margins and the bases of the andesite lavas. Six rock samples yield water-free SiO2 content of 59 to 63 wt. %. The andesitic volcanic rocks were produced by non-explosive, effusive eruption of andesitic magma in subaqueous setting. The magma was extruded as lava flows and was brecciated due to quench fragmentation on contact with water to produce the hyaloclastites and the peperites. The lava flows together with the hyaloclastites and the peperites probably formed small-scale andesitic volcano largely in a subaqueous setting.

Felsic pyroclastic deposites are poorly sorted, non-stratified to normally graded, crudely stratified and comprise lapilli- to block-sized pumice clasts with a small amount of lapilli-sized andesite clasts. Pumice clasts are dominated by white pumices with lesser grey pumices and banded pumices consisting of white and grey layers, with water-free SiO2 content of 67 to 75 wt. %. Bases of individual beds are commonly sharp and erosional with flame structures and ball-and-pillow structures in places. The crude stratifications are defined by alternations of pumice-dominated bed (5 to 70 cm thick) and lithick-dominated bed (1 to 5 cm thick). Bed thickness of this deposit and grain sizes of the clasts decrease toward the northwestern part from the southeastern part of the caldera. This deposit is interpreted as high-density turbidite. Voluminous pumice clats may reflect explosive eruption of felsic magma. Source area of the felsic pyroclastics is uncertain, but they are likely to have been derived from somewhere in the southeastern part of the caldera, based on the lateral facies change.

Epiclastic deposits include graded monomictic breccia, massive polymictic breccia and thinly interbedded mudstone and sandstone. The graded monomictic breccia is largely clast-supported and comprises angular to sub-angular andesite clasts that resemble the andesitic volcanic rocks. The massive polymictic breccia is non-stratified, poorly sorted and is composed of angular to sub-rounded basement rocks in addition to the andesitic volcanic rocks in a matrix of abundant pumice fragments and coarse sands to granules of the larger clasts with tuffaceous silt. These deposits are interpreted to have been deposited from sediment gravity flows, which presumably result from gravitational failures of postcaldera andesitic volcanic slopes and surrounding steep caldera walls.