Chemical heterogeneity of the rhyolitic Toya caldera magma body, Southwest Hokkaido, Japan

Ryo Fukuda[1]; Satoshi Okamura[1]

[1] Sapporo, Hokkaido Univ. Educ

Toya caldera, southwest Hokkaido is one of the largest calderas of the late Pleistocene (0.13Ma; Okumura and Sangawa, 1984) in north Japan. The volume of the Toya pyroclastic deposit is estimated to be more than 150 km3. The pyroclastic deposits are divided into several sheets of pyroclastic flow and fall, Tpfl-I (Toya pyroclastic flow I), Tpfl-II, Tpfa (Toya pyroclastic fall), Tpfl-III and Tpfl-IV in ascending order (Ikeda and Katsui, 1986). The earlier pyroclastic flow and fall deposits consist predominantly of ash associated with accretionary lapilli, suggesting they are the products of phreatomagmatic explosions. After a short hiatus, the later stage pyroclastic flow, Tpfl-IV, composed of large pumice lumps and ash, was discharged during the climax event, and forms an extensive pyroclastic plateau around the Toya caldera. Highly evolved and crystal-poor rhyolitic magma, representing the upper to middle levels of the reservoir, was erupted during the first stages producing pyroclastic flow and fall deposits (Tpfl-I, -II, Tpfa, and Tpfl-III). Crystal-rich, more mafic dacitic magma was tapped from the lowermost parts of the reservoir during the last stage of pyroclastic flow eruption (uppermost Tpfl-IV). The most common mineral, plagioclase, ranges from 10-15 vol.% in pre-Tpfl-IV deposits to up to 50 vol.% in the uppermost Tpfl-IV. Glass shards are both spherical (bubble-walled) and elongate (pumiceous) in pre-Tpfl-IV but become more pumiceous in the uppermost Tpfl-IV.

SiO2 content in whole rocks (pumices) ranges from 76.9 wt% in pre-Tpfl-IV deposits to 67.6 wt% in the uppermost Tpfl-IV. Al2O3 indicates a reverse trend from 13.0 wt% in pre-Tpfl-IV deposits to 19.3 wt % in the uppermost Tpfl-IV. There is a steep gradient in trace element content within the Tpfl-IV deposit. The upper part of plagioclase-rich Tpfl-IV deposit is strongly enriched in Sr, Zr and depleted in Rb, Ba and Y. Incompatible element ratios show mixing trend between two end-members, rhyolitic and dacitic magmas, which suggests that the two different magma sources existed beneath the Toya caldera. The plagioclase phenocrysts in several pumices are divided into three types by chemical compositions, that is An10-15, An20-40, and An40-85. Main type of plagioclase is most sodic plagioclase, An10-15 in rhyolitic pumice. Dacitic pumice has higher Ca plagioclase, An40-85 with normal and reverse zonings, often characterized by resorption texture. An20-40 plagioclase occurs in rhyolitic to rhyodacitic pumices, suggesting a crystallization from the mixed magma between rhyolitic and dacitic magmas. The formation of the Toya caldera may have been triggered by the dacitic magma injection into the rhyolitic magma body.