Hydrogen isotope study of the eruptive materials of Tenmei eruption of Asama volcano

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We measured the water contents and hydrogen isotope compositions of the eruptive materials of the 1783 ('Tenmei') eruption from Asama volcano, central Japan, of which the eruption sequence has been well established based on the geological and archaeological studies. The water contents and deltaD values were measured for the Tenmei fallout pumice, Agatsuma pyroclastic flow, and Kambara pyroclastic flow. To minimize the effect of weathering and alteration, the step-heating method was employed and the magmatic water was clearly distinguished from the meteoric water by comparing the data with the theoretical mixing line with meteoric water. It was concluded that the appropriate the starting temperature of gas collection, T_0, below which the secondary-hydrated meteoritic water was mainly degassed, is 100-120 deg C for Tenmei fallout pumice, ca. 200 deg C for Agatsuma and Kambara pyroclastic flows.

The following three possibilities are discussed for the origin of the variation in X_{H2O}-deltaD values among the ejecta, assuming that the variation results only from the difference in the degassing process. 1) The three erupted materials were the quenched products of a single course of degassing, in which hydrogen isotope fractionation proceeded from the equilibrium- via Reyleigh- to the kinetic controlled-fractionation. The X_{H2O}-deltaD values of the Agatsuma and the Kambara pyroclastic flows were derived from that of the Tenmei fallout pumice with kinetically-controlled fractionation. 2) The degassing proceeded firstly with equilibrium fractionation, and then switched to the Reyleigh at different water contents for the different ejecta, decreasing in the order of Tenmei fallout, Agatsuma and Kambara. 3) The switching in the case 2) occurred at the same water content, and then equilibrium fractionation of the pyroclastic flows occurred.