Distribution and eruptive volume estimation of Ito, Hachinohe and Aso4 pyroclastic flow deposits

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Estimation of distribution and eruptive volume of large to middle-scale pyroclastic flows are important for evaluation of affected area and emplacement processes of pyroclastic flows. Distributions and eruptive volumes just after the eruption were estimated at Ito pyroclastic flow deposit derived from Aira caldera (30ka), Hachinohe pyroclastic flow deposit derived from Towada caldera (15ka) and Aso4 pyroclastic flow deposit derived from Aso caldera (90ka). The eruptive volumes of tephra falls derived from pyroclastic flows (co-ignimbrite ash) are not included for the estimation.
The distributions of pyroclastic flow deposits just after the eruption were made by the following method. (1) made current distributions of pyroclastic flow deposits using geological maps, and published research papers, (2) made upper and lower elevations and thickness point datasets using boring (drilling) data (eg. Kunijian and Geo-Station), published papers and geological maps, (3) convert deposit thickness into non-welded from welded part (eg. 1000kg/m^3 of non-welded, 1700kg/m^3 of weakly welded, 2000kg/m^3 of highly welded at Ito pyroclastic flow deposit), and (4) estimate distribution of submarine area with the consideration of sea-level at the time of eruption (Ito: -100m, Aso4: -50m). For example, the energy cone simulations were used to estimate the maximum travel distances in the sea area for Ito pyroclastic flow. The energy cone parameters of Ito pyroclastic flows were H/L=0.005-0.014 and column collapse height=1050-1200m. The eruptive volume were estimated by the following method. (1) made 5km or 1km mesh data, (2) calculate the distribution area of pyroclastic flow deposit in each mesh, (3) calculate maximum, average and minimum point thickness datasets in each mesh, (4) If no point data were available in the mesh, the Kriging method were used to estimate the thickness value in the mesh, and (5) the total volume were estimated from the sum of multiply the area by the thickness data of each mesh (maximum, average and minimum cases).
The estimated eruptive volumes of Ito pyroclastic flow with 1km mesh were 325km^3(max), 200km^3(ave) and 130km^3(min) in DRE. The estimated volumes of outflow deposit (except the within the caldera deposit) were 250km^3(max), 125km^3(ave) and 50km^3(min) in DRE. The estimated volumes of Hachinohe pyroclastic flow (outflow deposit) with 5km mesh were 27km^3(max), 20km^3(ave) and 13km^3(min) in DRE. The estimated volumes of Aso4 pyroclastic flow with 5km mesh were 530km^3(max), 370km^3(ave) and 200km^3(min) in DRE. The estimated volumes of outflow deposit were 400km^3(max), 270km^3(ave) and 140km^3(min) in DRE. The thickness of the point data sets was reduced due to erosions; therefore, the reliable eruptive volumes of pyroclastic flows were considered between maximum and average estimations. The more precise estimation of original surface and basal topography of the pyroclastic flow deposits and evaluation of distribution in the sea area are the important key factors for the estimation of eruptive volume of large-scale pyroclastic flow deposits (The above estimated volumes are provisional; the values may change due to further studies).

Keywords: Pyroclastic flow, Distribution, Eruptive Volume, Ito, Hatchnohe, Aso4

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