

Correlations of the Takeyama-Ks10 and Hegawa-Ks5 tephras, two Middle Pleistocene widespread tephras derived from southern Kyushu, SW Japan

*Fumikatsu NISHIZAWA¹, Takehiko Suzuki¹

1. Tokyo Metropolitan University

This study shows the correlations of the Middle Pleistocene widespread tephras derived from southern Kyushu, southwest Japan. Two Middle Pleistocene widespread tephras referred to here as Takeyama-Ks10 (Tkym-Ks10) and Hegawa-Ks5 (Hgw-Ks5) have been newly recognized.

The southern Kyushu caldera region composed of the several large calderas, located in southwest of the Japanese islands, is one of the most active volcanic regions providing voluminous widespread tephras. Eight widespread tephras have been reported from the southern Kyushu caldera region since 1 Ma. Five of them occurred in a cluster after the eruption of the Kakuto tephra (330–340 ka). Compared with the tephras of the Late Pleistocene to Holocene, widespread tephras of the Early to Middle Pleistocene ages have not been well studied. On the other hand, four widespread tephras (Ks18, Ks11, Ks10 and Ks5, in ascending order), which are thought to derive from southern Kyushu, are intercalated in the Kasamori Formation of the Kazusa Group, in Boso Peninsula, central Japan. Among them, Ks10 and Ks5 have uncertainties of identification and their correlations as a widespread tephra. Although Ks10 and Ks5 are broadly recognised in southwest to northeast Japan as distal ash fall deposits, the proximal pyroclastic flow deposits (PFDs) of Ks10 and Ks5 has not yet been determined in Kyushu Island. Moreover, there are petrographically similar tephras to these two tephras, which leads to difficulties and mistakes in the widespread correlation.

In southern Kyushu, we newly defined two PFDs: Takeyama (Tkym) and Hegawa (Hgw) PFDs, in ascending order. Tkym and Hgw are stratigraphically above the Kb-Ks tephra (Kb-Ks). Based on the petrographic properties including the glass chemistry, we examined their correlations with Ks10 and Ks5. Tkym-Ks10 was identified using a combination of refractive indices and major element chemical composition of glass shards ($n=1.498-1.501$, SiO_2 : 78.3-78.6 wt.%, TiO_2 : 0.2-0.3 wt.%, Al_2O_3 : 12.2-12.4 wt.%, FeO : 1.0-1.1 wt.%, CaO : 1.1 wt.%, K_2O : 2.9-3.0 wt.%, Na_2O : 3.4-3.6 wt.%) and mineral assemblage composed of abundant hornblende and few biotite and quartz. On the other hand, Hgw-Ks5 was identified using a combination of refractive indices and major element chemical compositions of glass shards ($n=1.504-1.506$, SiO_2 : 77.2-77.5 wt.%, TiO_2 : 0.3-0.4 wt.%, Al_2O_3 : 12.6-12.7 wt.%, FeO : 1.4-1.5 wt.%, CaO : 1.3-1.4 wt.%, K_2O : 2.9-3.1 wt.%, Na_2O : 3.4-3.7 wt.%) and mineral assemblage composed of orthopyroxene and relatively few hornblende.

Based on previous isotope stratigraphy studies, the eruptive ages of Tkym-Ks10 and Hgw-Ks5 are 480–530 ka (MIS 13) and 430–450 ka (MIS 12), respectively. The apparent volume of each tephra estimated from the distribution area and thickness of the co-ignimbrite ash fall deposits (CAFD) is approximately $> 100 \text{ km}^3$, assuming that each CAFD originating from the Aira Caldera is distributed concentrically. Therefore, a Volcanic Explosivity Index (VEI) of 7 was assigned to the eruptions. Eight widespread tephras derived from the southern Kyushu caldera region during the last 600 ka, Smkd-Ks18 (part of former Hwk), Kb-Ks, Kkt, Ata-Th, Ata, K-Tz, AT and K-Ah tephras, in ascending order, had been reported. This indicates that eruptions accompanying huge pyroclastic flow deposits (VEI 7) occurred at an average interval of about 75 kyr as the whole Kagoshima Graben. However, considering two newly defined widespread tephras Tkym-Ks10 and Hgw-Ks5 positioned between Kb-Ks (530 ka) and Kkt (340 ka) from Kb-Ks to Kkt eruptions, the frequency of large caldera eruption (VEI 7) through the past 600 ka was

revised to once in 60 kyr on average. In addition, focusing on the eruption interval in detail, the interval has changed at Hgw-Ks5 eruption. During the period of 500 kyr from Smkd-Ks18 eruption to Ata eruption (105 ka), the average interval of large-scale eruption in the Kagoshima Graben had become longer from 40 to about 100 kyr after the Hgw-Ks5 eruption.

Keywords: widespread tephra, Middle Pleistocene, correlation, southern Kyushu, Kasamori Formation