Constraints on the timing of explosive volcanism at Aso and Aira calderas (Japan) between 50 and 30 ka: New insights from the Lake Suigetsu sedimentary record (SG14 core)

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Supporting Information (Files uploaded separately)

Captions for Tables S1 to S6
Introduction

The supporting information includes the major, minor and trace element compositions of individual glass shards from the Lake Suigetsu tephra layers and near-source reference material.

The major and minor element compositions of individual glass shards from the SG14 tephra layers and near-source reference material (see Table S1) were measured using a JEOL-8600 wavelength-dispersive electron microprobe (WDS-EMP) at the Research Laboratory for Archaeology and History of Art (RLAHA), University of Oxford. Analyses used an accelerating voltage of 15 kV, beam current of 6 nA and 10 µm-diameter beam. Peak counting times were 12 s for Na, 50 s for Cl, 60 s for P, and for 30 s for all other elements. The electron microprobe was calibrated using a suite of mineral standards and the PAP absorption correction method was applied for quantification. The accuracy and precision of these data were assessed using analyses of the MPI-DING reference glasses (ATHO-G-1, StHs6/80-G and GOR132-G) from the Max Plank Institute [Jochum et al., 2006], which were run as secondary standards (see Table S2). Data were filtered to remove non-glass analyses, and those with analytical totals < 93%.

Trace element compositions for the glass shards obtained from the SG14 sediments (see Table S3) were measured by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) at the Department of Solid Earth Geochemistry, Japan Agency for Marine-Earth Science and Technology (JAMSTEC). The analytical equipment used include the deep-ultraviolet (200 nm) femtosecond laser ablation system (DUV-FsLA) of OK-Fs2000K (OK Laboratory, Tokyo, Japan) connected to the modified high-sensitivity sector field ICP-MS of Element XR (Thermo Scientific, Bremen, Germany). All analyses used a 25 µm crater diameter and depth, and conditions followed those reported by Kimura and Chang [2012]. Ten major elements including P$_2$O$_5$ and 33 trace elements were analysed for each sample, and were also run alongside several MPI-DING references glasses [Jochum et al., 2006] and the BHVO-2G standard provided by the Geological Survey of Japan.

Trace element compositions for proximal units Aso-Kpfä, A-Fm and A-Kn (see Table S5) were performed using an Agilent 8900 triple quadrupole ICP-MS (ICP-QQQ) coupled to a Resonetics 193nm ArF excimer laser-ablation system in the Department of Earth Sciences, Royal Holloway, University of London, using analytical procedures and data reduction (Microsoft Excel) methods outlined by Tomlinson et al. [2010]. MPI-DING glasses (StHs6/80-G and ATHO-G-1; Jochum et al. [2006]) were analysed alongside the tephra deposits to monitor the accuracy (see Table S6).

References

Jochum, K. P., Stoll, B., Herwig, K., Willbold, M., Hofmann, A. W., Amini, M. et al., (2006). MPI-DING reference glasses for in situ microanalysis: New reference values for element concentrations and isotope ratios. *Geochemistry, Geophysics, Geosystems*, 7(2). [https://doi.org/10.1029/2005GC001060](https://doi.org/10.1029/2005GC001060)

Tomlinson, E. L., Thordarson, T., Müller, W., Thirlwall, M. & Menzies, M. A. (2010). Microanalysis of tephra by LA-ICP-MS—strategies, advantages and limitations assessed using the Thorsmörk Ignimbrite (Southern Iceland). *Chemical Geology*, 279(3-4): 73-89. [https://doi.org/10.1016/j.chemgeo.2010.09.013](https://doi.org/10.1016/j.chemgeo.2010.09.013)
Table S1. Major and minor element compositions of individual glass shards from the Lake Suigetsu (SG14 core) cryptotephra layers. These were measured using a JEOL-8600 wavelength-dispersive electron microprobe (WDS-EMP) at the Research Laboratory for Archaeology and the History of Art (RLAHA), University of Oxford.

Table S2. Analyses of the MPI-DING reference glasses (ATHO-G-1, StHs6/80-G and GOR132-G) from the Max Plank Institute [Jochum et al., 2006]. These were run as secondary standards alongside the glass shards from the Lake Suigetsu cryptotephra layers (Table S1).

Table S3. Trace element compositions for the glass shards obtained from the Lake Suigetsu (SG14 core) cryptotephra layers. These were measured by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) at the Department of Solid Earth Geochemistry, Japan Agency for Marine-Earth Science and Technology (JAMSTEC).

Table S4. Analyses of the MPI-DING reference glasses from the Max Plank Institute [Jochum et al., 2006] and the BHVO-2G standard provided by the Geological Survey of Japan. These were run as secondary standards alongside the glass shards from the Lake Suigetsu cryptotephra layers (Table S3).

Table S5. Trace element compositions for proximal units Aso-Kpfa, A-Fm and A-Kn. These were measured by laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) in the Department of Earth Sciences, Royal Holloway University of London.

Table S6. Analyses of the MPI-DING reference glasses (StHs6/80-G and ATHO-G-1) from the Max Plank Institute [Jochum et al., 2006]. These were run as secondary standards alongside analyses of the glass shards from the Lake Suigetsu cryptotephra layers (Table S5).