

Supplemental figure 1: Graphs detailing the published vs analysed elemental data to determine the limit of detection.

Supplemental figure 2: BSE image from the tephra layer TM-24-3b displaying a selection of tephra shards. The data is found in Supplementary Table 2.

Supplemental figure 3: Panels (a-j) showing BSE images and EDX elemental maps of the microlite-rich Pomici di Base volcanic glass. Panel (a) shows a BSE image (50  $\mu\text{m}$  x 37.5  $\mu\text{m}$ ). Panel b displays the EDX layered image, where all element maps are combined to show different phases. Plagioclase crystals are highlighted with a pink colour. Panels c-j display the elemental maps for Si, Al, K, Ca, Na, Mg, Fe and Ti.

Supplementary Table 1:

- Chemical data for all glasses investigated in this study (Jarosewich et al., 1980, Jochum et al., 2011, Kuehn et al., 2011, Astimex MINM25-53 standard mount).
- Chemical information on the 11 samples used for standardisation in this study, from the Astimex MINM25-53 standard mount. Minerals used for each element are indicated with a **bold** font.
- Spot analyses on the basaltic glass VG-2 and the rhyolitic glass NMNH 72854 acquired for a different number of counts. Averages of each analysis for a specific count total are displayed in Table 1.
- Spot analyses and averages of spot analyses on the basaltic glass VG-2 and rhyolitic glass NMNH 72854 with varying scanning field of views - 0.1  $\mu\text{m}$ , 1  $\mu\text{m}$ , 5  $\mu\text{m}$ , 10  $\mu\text{m}$  and 50  $\mu\text{m}$  (width of FoV). Each analysis was run until one 1M counts was acquired.
- Analyses of ten glasses outlined in Supplementary Table 1. For each glass 25 analyses are investigated, ten new analyses of NMNH VG-2 and NMNH 72854, and 25 for each of the remaining eight glasses. The precision and accuracy of these analyses are outlined in Table 3.

Supplementary Table 2: All chemical data from this study on the tephra layer TM-24-3b from Lago Grande di Monticchio, Italy, the microlite-rich fall deposit SM21 from the Pomici di Base eruption of Somma-Vesuvius, and previously unpublished EPMA cryptotephra data on the Laki 1783-84 AD eruption originally presented in Rosca (2018).