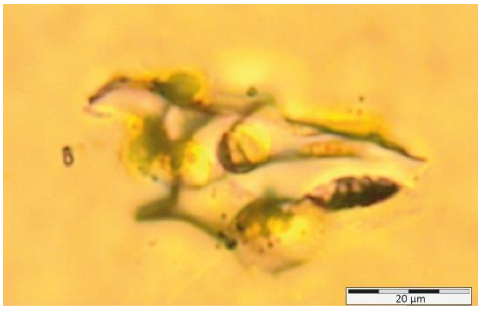
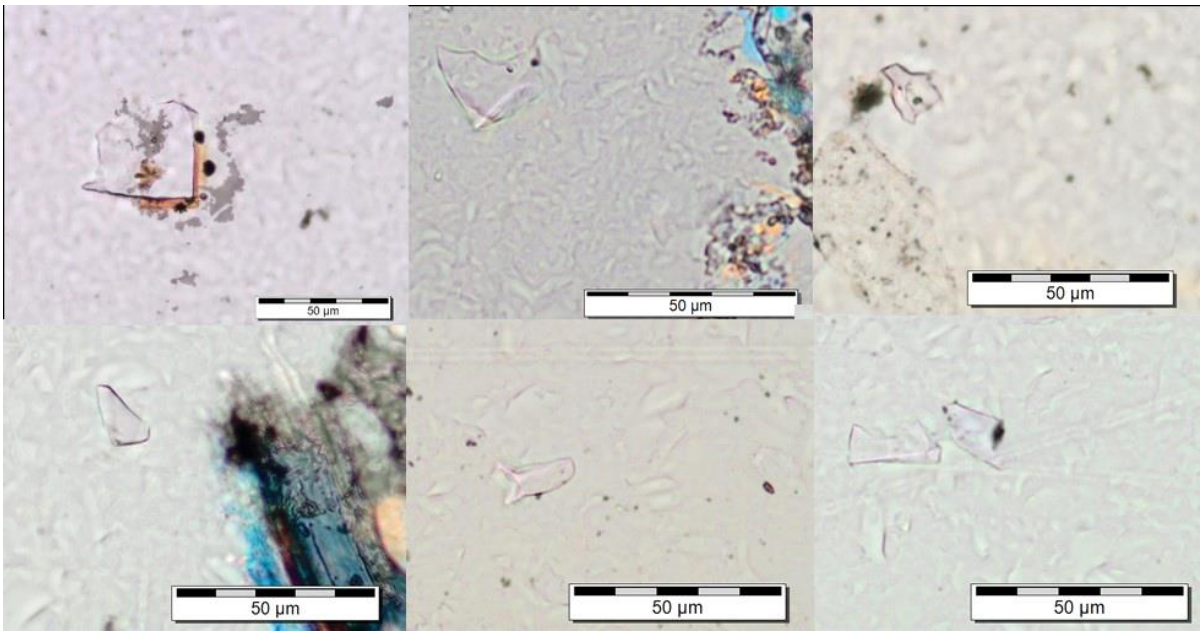
Supplemental material for: Plunkett G, Sigl M., Pilcher J.R., McConnell J.R., Chellman N., Steffensen J.P. & Büntgen U. 2020. Smoking guns and volcanic ash: the importance of sparse tephras in Greenland ice cores. *Polar Research 39*. Correspondence: Gill Plunkett, Archaeology and Palaeoecology, School of Natural and Built Environment, Queen's University Belfast, Belfast BT7 1NN, Northern Ireland, UK. E-mail: g.plunkett@qub.ac.uk.

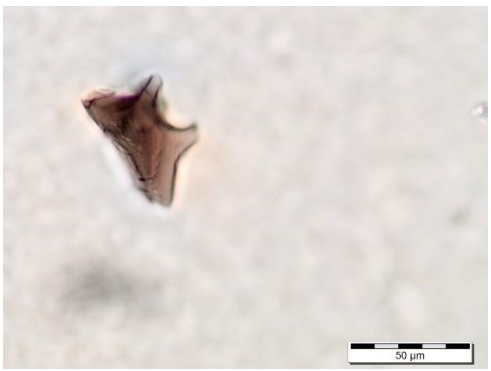


Supplementary Fig. S1. QUB-1835 tephra shard (post-analysis).

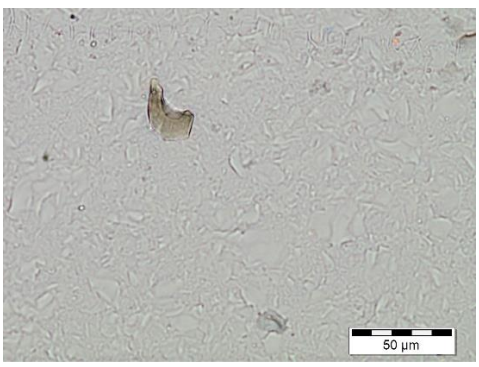
Supplementary Fig. S2. QUB-1841 probable tephra shard (not analysed).



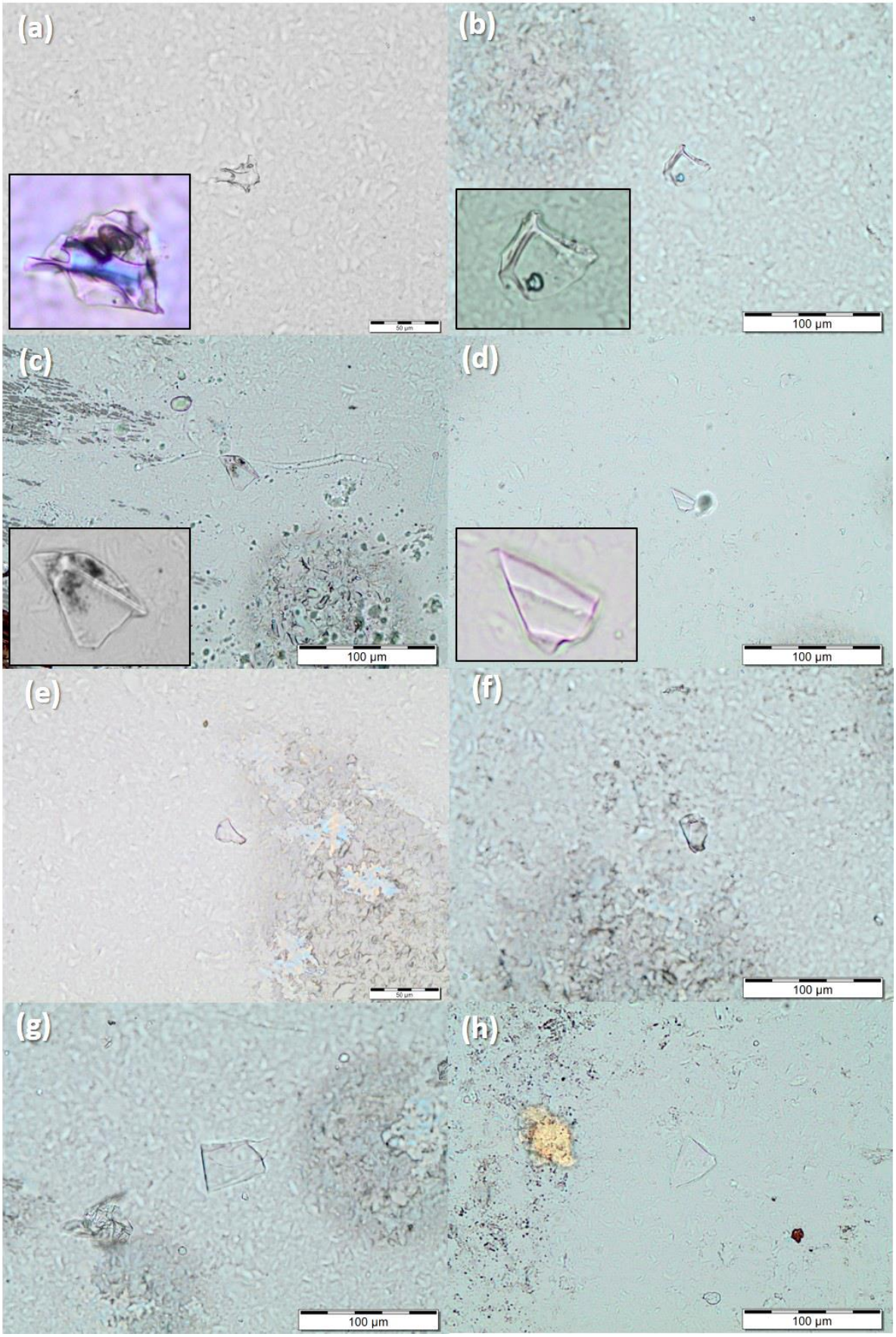
Supplementary Fig. S3. QUB-1872 tephra shards (top left: post-analysis).



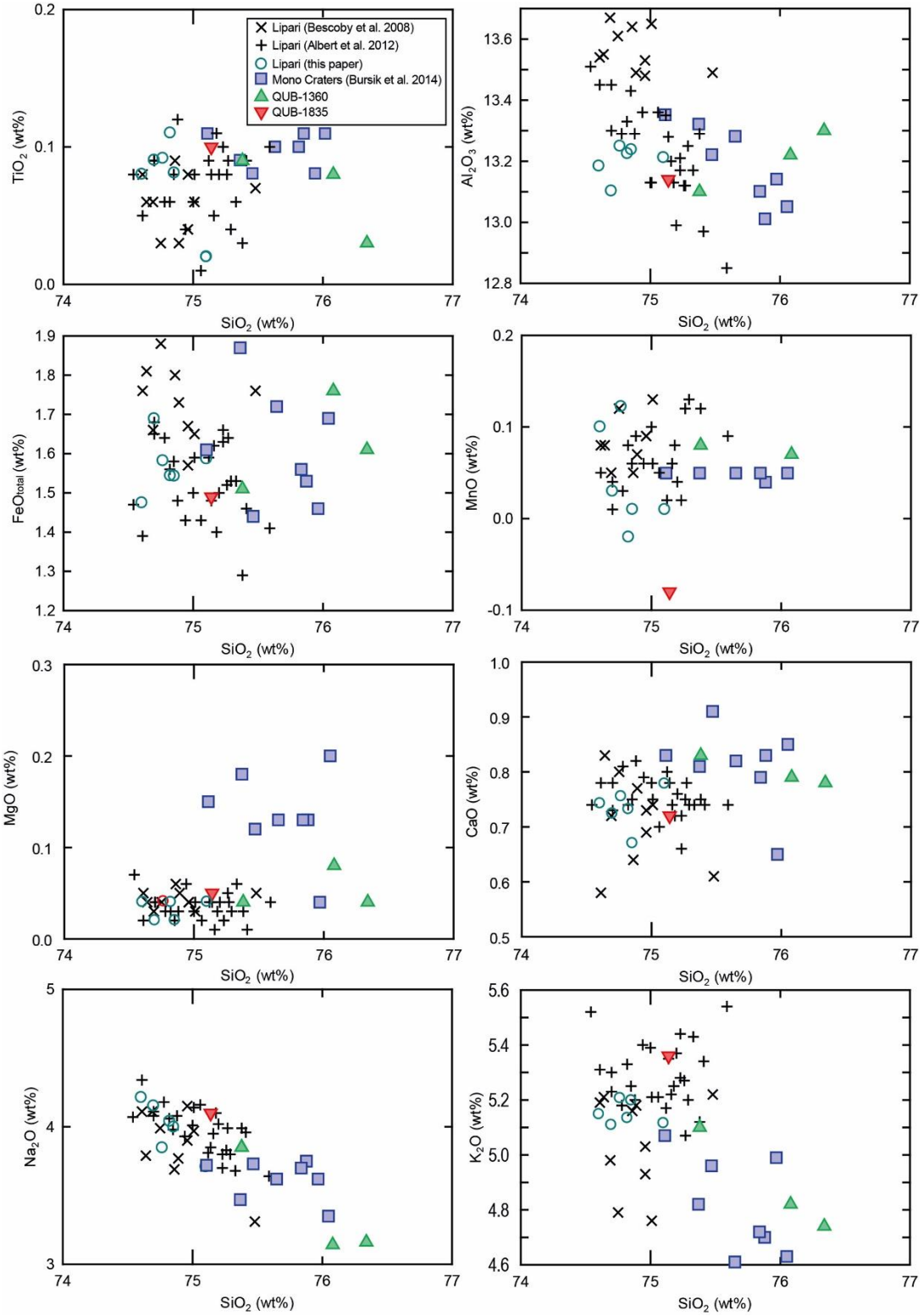
Supplementary Fig. S4. QUB-1873 tephra shard.



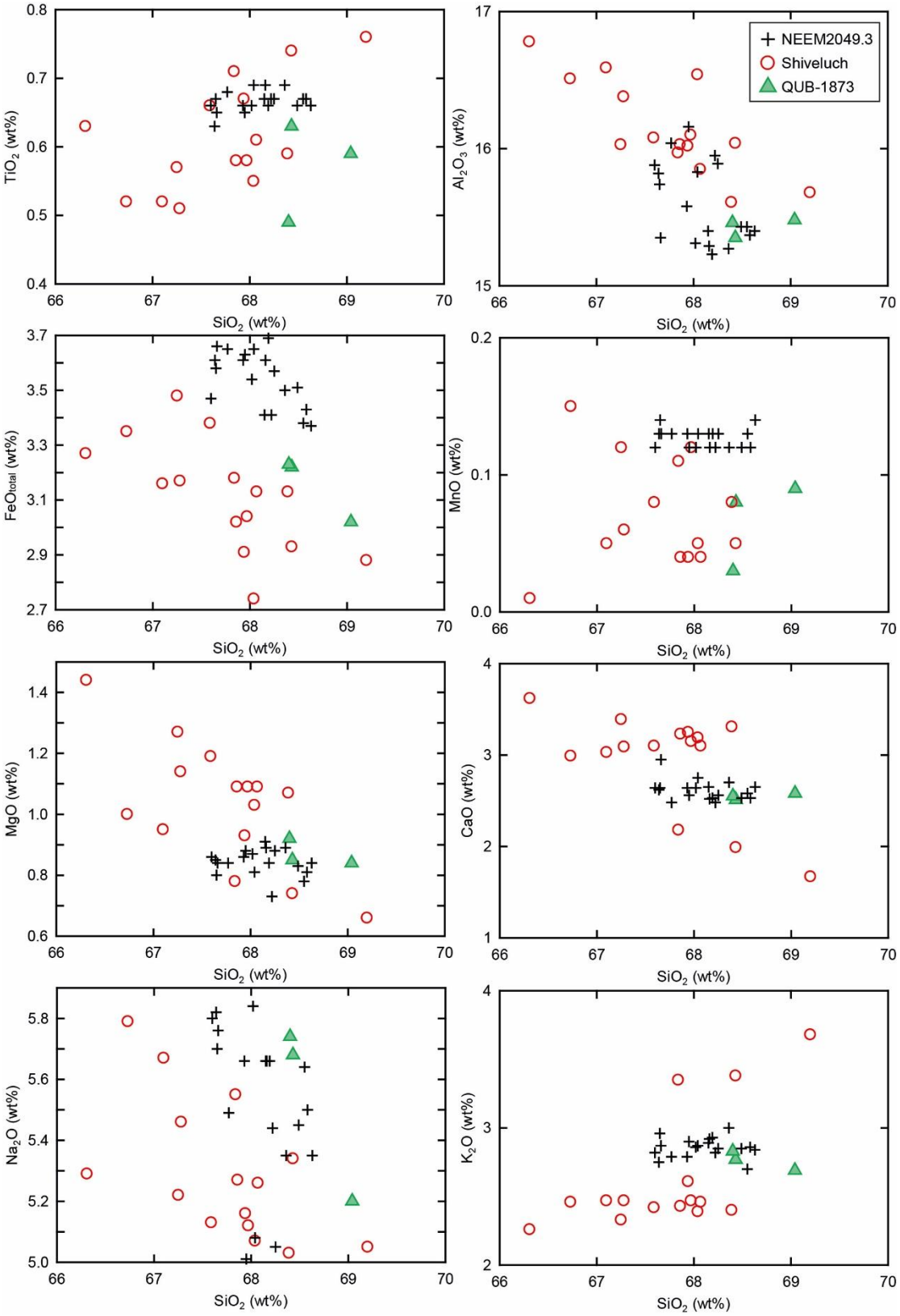
Supplementary Fig. S5. QUB-1974 tephra shard.



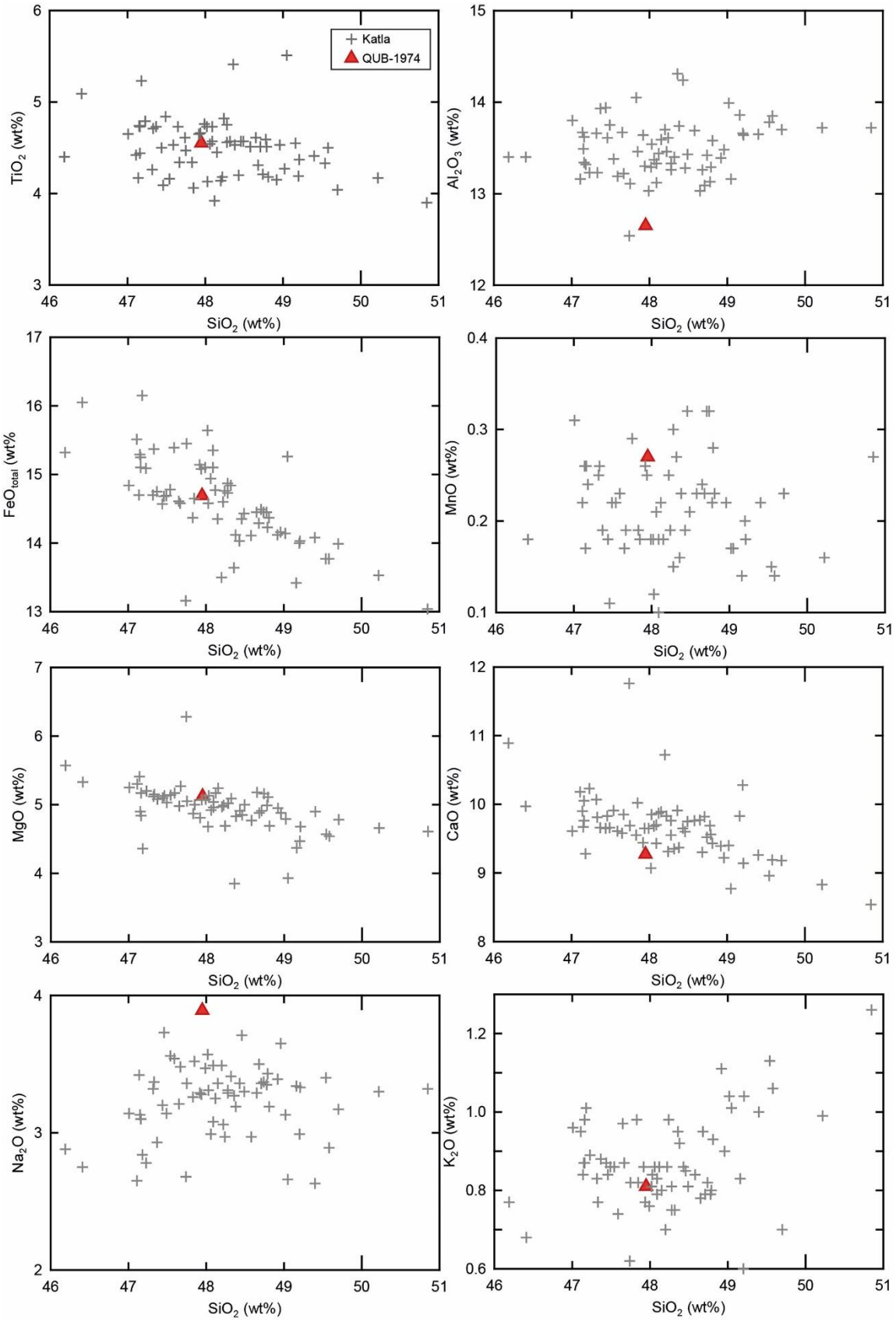
Supplementary Fig. S6. QUB-1880 (a-d) tephra shards and (g-h) possible tephra shards.



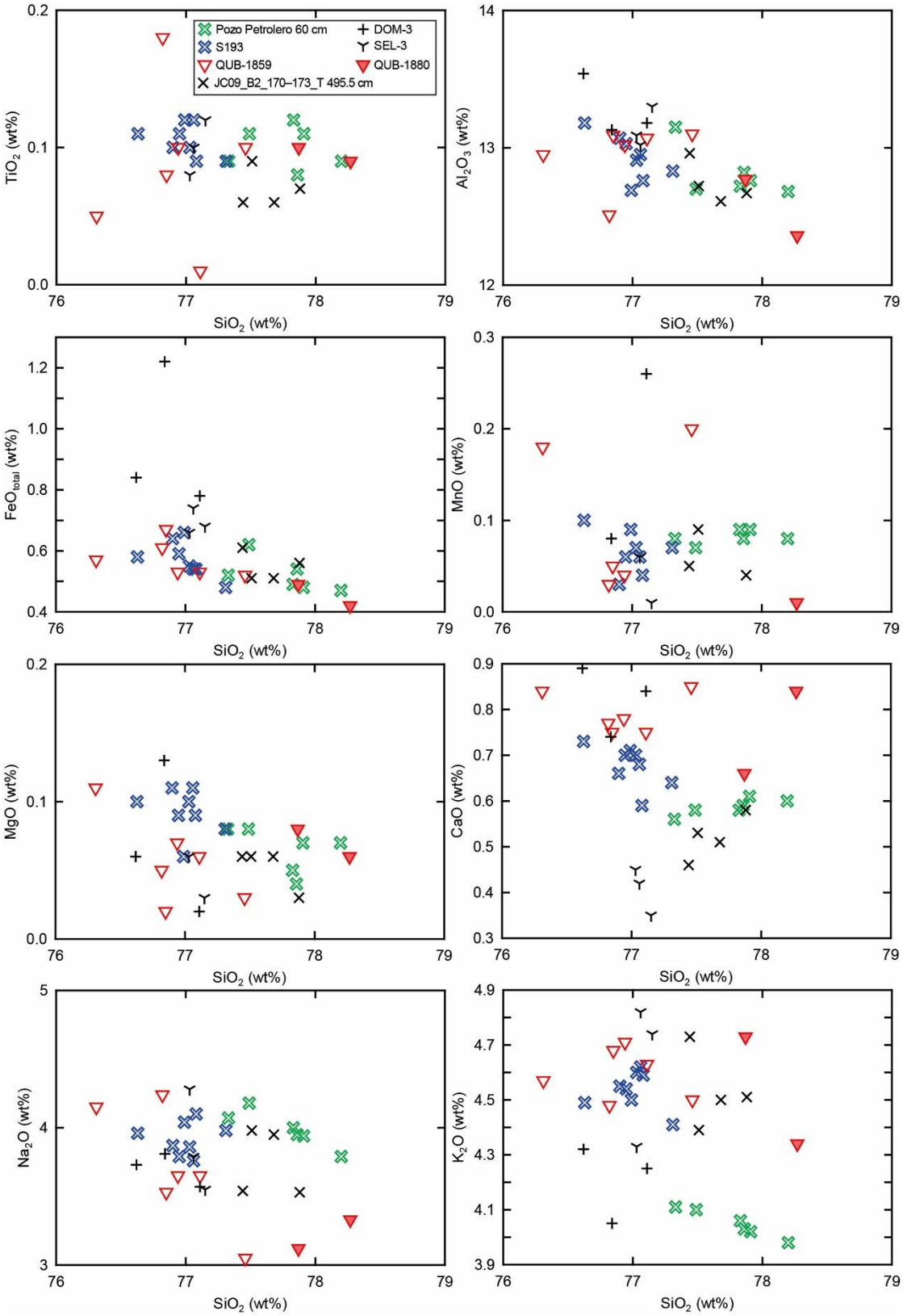
Supplementary Fig. S7. Major element geochemistry of QUB-1835 compared to Lipari reference material analysed with QUB-1835, and Lipari data reported by Bescoby et al. (2008) and Albert et al. (2012), and to selected data from the South Mono eruption, Mono Craters (Bursik et al. 2014). Also shown is the major element geochemistry of a tephra shard (QUB-1360) from the North Greenland Ice Core Project (NGRIP) ice core (Coulter et al. 2012).



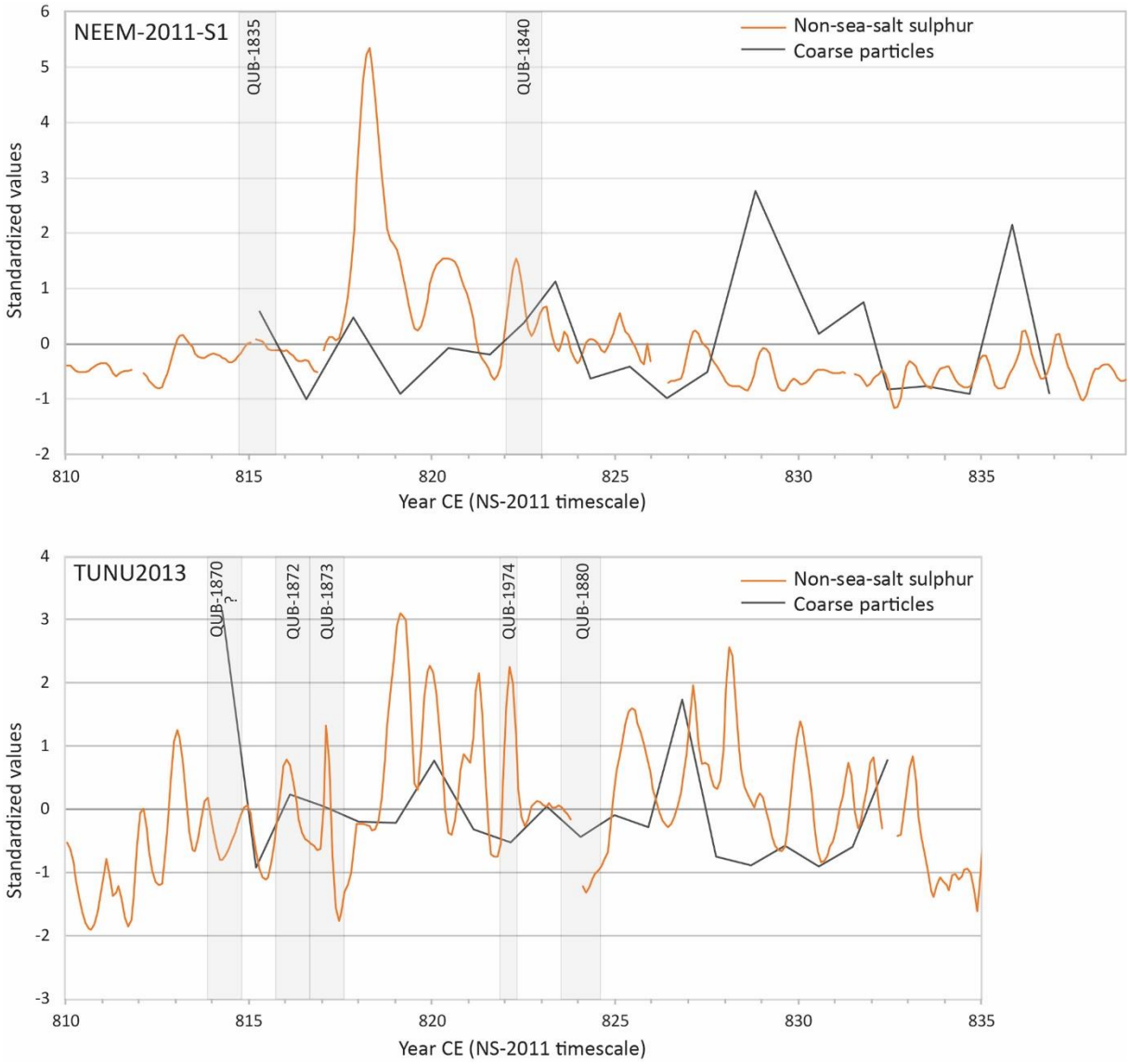
Supplementary Fig. S8. Major element geochemistry of QUB-1873 compared with NEEM2049.3 (Bourne et al. 2016) and selected data from various Shiveluch tephras (Ponomareva et al. 2015; Ponomareva et al. 2017).



Supplementary Fig. S9. Major element geochemistry of QUB-1974 compared with basaltic Katla data (Gudmundsdóttir et al. 2012).



Supplementary Fig. S10. Major element geochemistry of QUB-1880, compared with tephra found with El Chichón material in Mexico (Pozo Petrolero 60 cm: Nooren et al. 2009; S193: Post 2016), QUB-1859 (Sigl et al. 2015), and sparse cryptotephras identified in European terrestrial records (DOM-3: van den Bogaard & Schminke 2002; SEL-3: Vorren et al. 2007; JC09_B2_170–173_T 495.5 cm: Wulf et al. 2016).



Supplementary Fig. S11. Standardized non-sea-salt sulphur and coarse (>10 μm) particle concentrations in the NEEM-2011-S1 and TUNU2013 ice cores, showing the positions of ice core samples containing tephra or possible tephra. Data are standardized with respect to the sections of the ice cores presented here.

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