S1. Instrumental equipment and standards

Quantitative Phase Analysis - X-Ray Powder Diffraction (QPA-XRPD)

XRPD data of mortar samples were collected using a Bragg–Brentano ϑ-ϑ diffractometer (PANalytical X'Pert PRO, Cu Kα radiation, 40 kV and 40 mA) equipped with a real-time multiple strip (RTMS) detector (PIXcel by PANalytical). Data acquisition was performed by operating a continuous scan in the range 3–85 [°2ϑ], with a virtual step scan of 0.02 [°2ϑ]. Diffraction patterns were interpreted with X'Pert HighScore Plus 3.0 software by PANalytical, qualitatively reconstructing mineral profiles of the compounds by comparison with Powder Diffraction File (PDF) databases from the International Centre for Diffraction Data (ICDD). Quantitative phase analysis (QPA) was then performed on the sole bulk samples using the Rietveld method [1]. Refinements were carried out with TOPAS software (v. 4.1) by Bruker AXS (Advanced X-ray Solutions). The determination of both crystalline and amorphous content was calculated by the addition of 20 wt% of zincite to the powders as an internal standard. The observed Bragg peaks in the powder patterns were modelled through a pseudo-Voigt function, fitting the background by a 12-coefficient Chebyshev polynomial. For each mineral phase, the lattice parameters, Lorentzian crystal sizes and scale factors were refined. Although samples were prepared with the backloading technique to minimize preferred orientation of crystallites a priori, during the refinement, any residual preferred orientation effect was modelled with the March Dollase algorithm [2]. The starting structural models for the refinements were taken from the International Crystal Structure Database (ICSD). The final mineralogical profile of the samples was outlined after the removal of alteration mineral phases. The percentiles of the remaining original mineral phases were then recalculated at 100% wt.

Polarized Light Optical Microscopy (PLM)

All mortar samples were analyzed by means of Polarized Light Microscopy (PLM) on 30 μm thin sections under a Leica DM790 P equipped with an integrated digital camera FLEXACAM I5.

Scanning Electron Microscopy (SEM) coupled with Energy-Dispersive X-Ray Spectroscopy (EDS)

SEM-EDS analyses were performed to obtain preliminary geochemical information on volcanic clasts included in the samples. The analytical instrument used for this analysis was a FEI Quanta 200 microscope, equipped with an Energy Dispersive X-ray detector (EDX) using an Oxford Xplore 30 EDX model coupled with the Oxford AztecLive software. Standarless semiquantitative analysis by Team EDAX software (based on ZAF correction and factory standardization data implemented in the software) was previously tested on two NIST certificated reference materials: SRM 2066 K411 and SRM 620. These materials are glasses with a chemical composition compatible with the volcanic tephra analyzed in this study. In particular, SRM 2066 K411 is a specific reference material for SEM-EDX analysis. NIST standards were adopted to verify the EDS accuracy as reported in [3, 4].

References

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