

Supplementary Information Appendix

Manuscript: “Unique formation of organic glass from a human brain in the Vesuvius eruption of 79CE”

Guido Giordano^{1*}, Alessandra Pensa^{1,2}, Alessandro Vona¹, Danilo Di Genova^{3,4}, Raschid Al-Mukadam³, Claudia Romano¹, Joachim Deubener³, Alessandro Frontoni¹, PierPaolo Petrone⁵

*Corresponding author. Email: guido.giordano@uniroma3.it

Figure SI1: Microtomographic images of C1 sample

a) External reconstruction of the shape of the fragment. b) 3D view of the voids distribution inside the sample; the colour code indicates the dimensions ranging from 0.01 mm (blue) to 0.2 mm (red). c) Cross sections along cartesian planes showing density variations: grey - average density, black - higher density; white - lighter density. d) Cross sections along cartesian plains showing voids shape, dimensions and spatial distribution (colour code as in (b)).

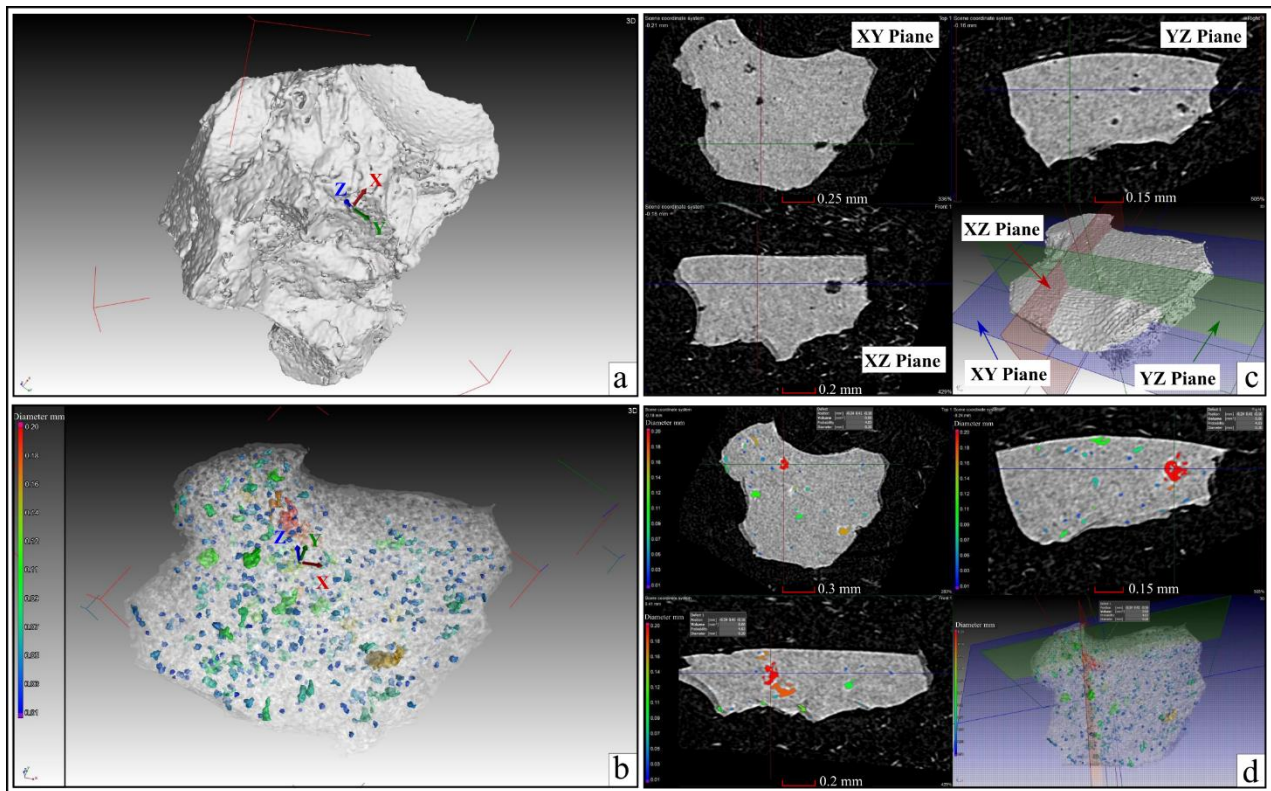


Figure SI2: EDS analysis of the composition of the vitrified brain

a) FE-SEM image of pristine C1 sample; the red cross indicates the point on groundmass chosen for the EDS analysis shown in b). b) C and O are the main constituents with a minor proportion of Na, Cl, K, Mg, Al and Si.

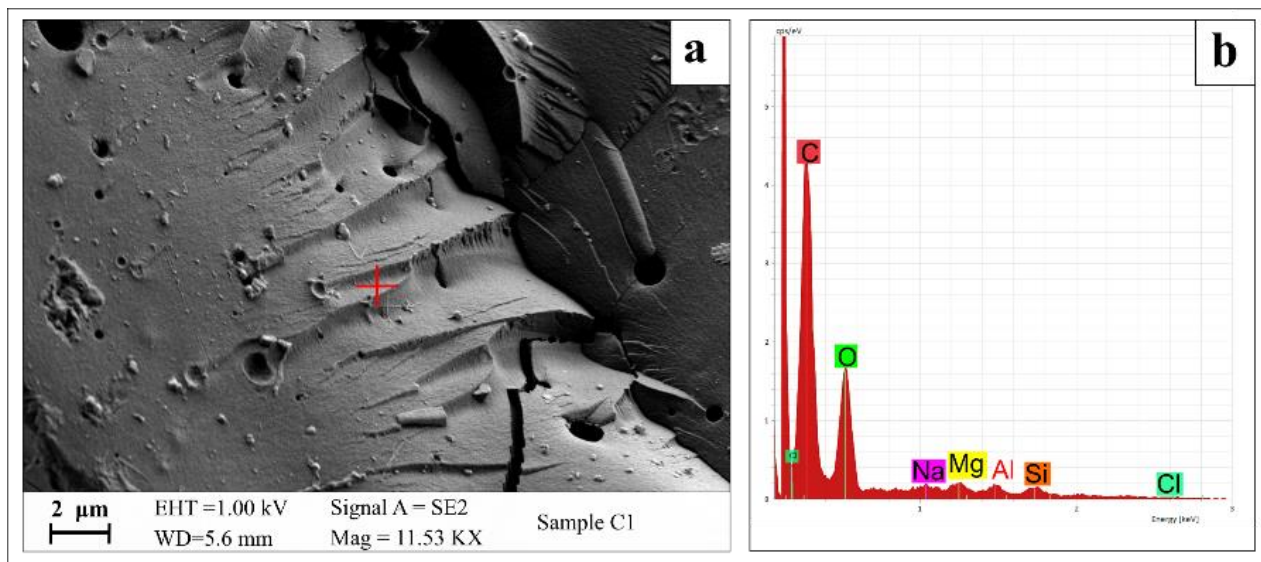


Figure SI3: C1 sample C-DSC results after run#1,#2 at 520 °C, run#3 at 620 °C and run#4 at 670 °C.

C-DSC signals of C1 sample exposed to progressively higher temperatures at constant heating rates of 25 K min⁻¹. Upward and downward peaks correspond to endothermic and exothermic events, respectively.

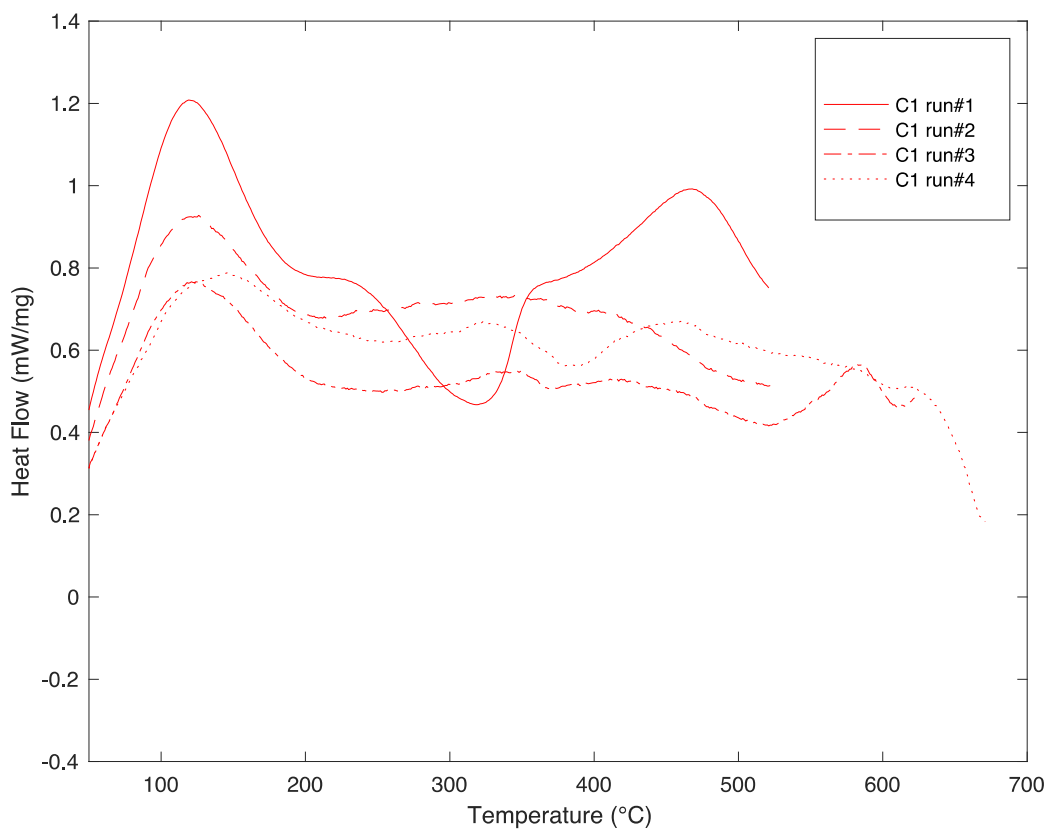
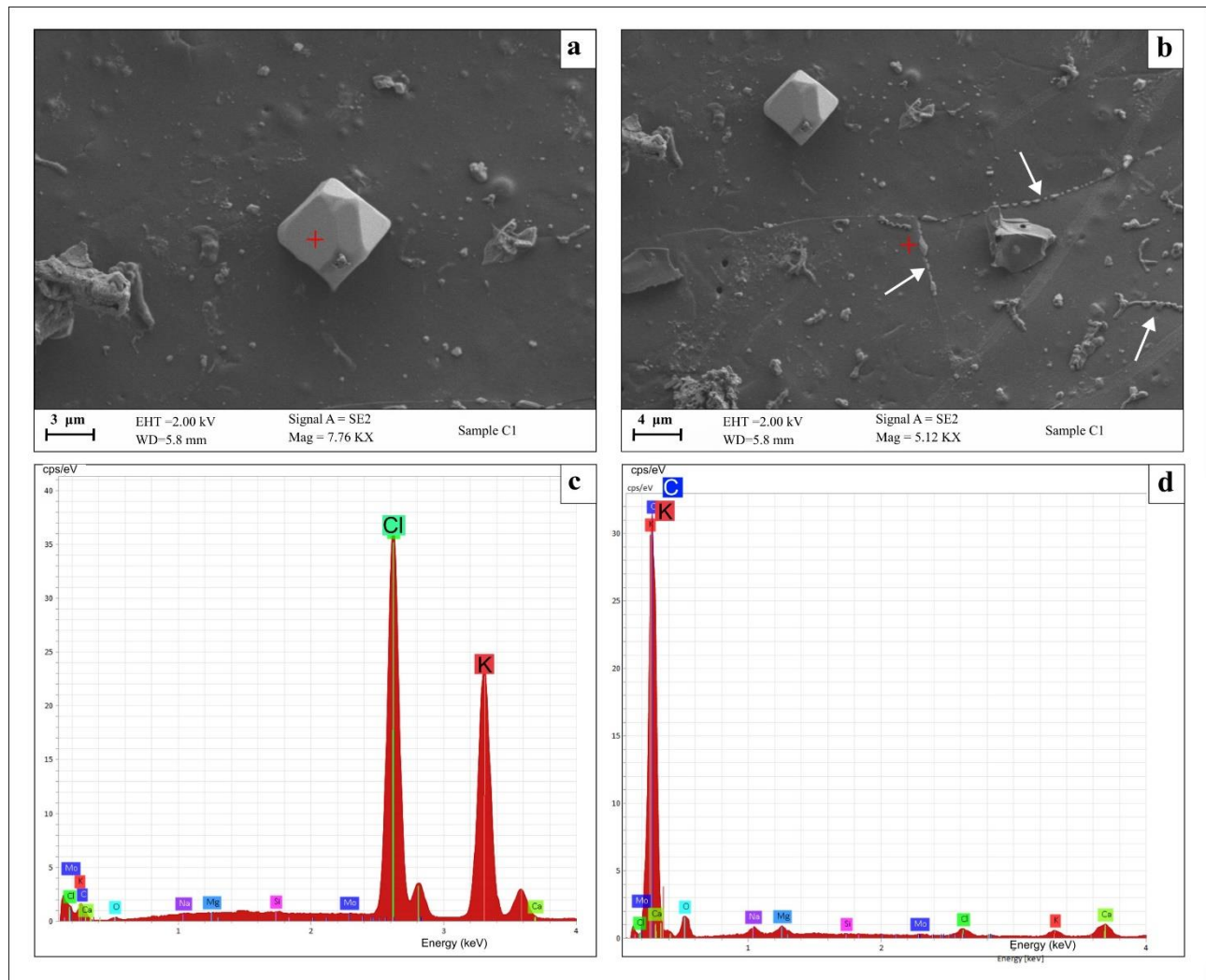
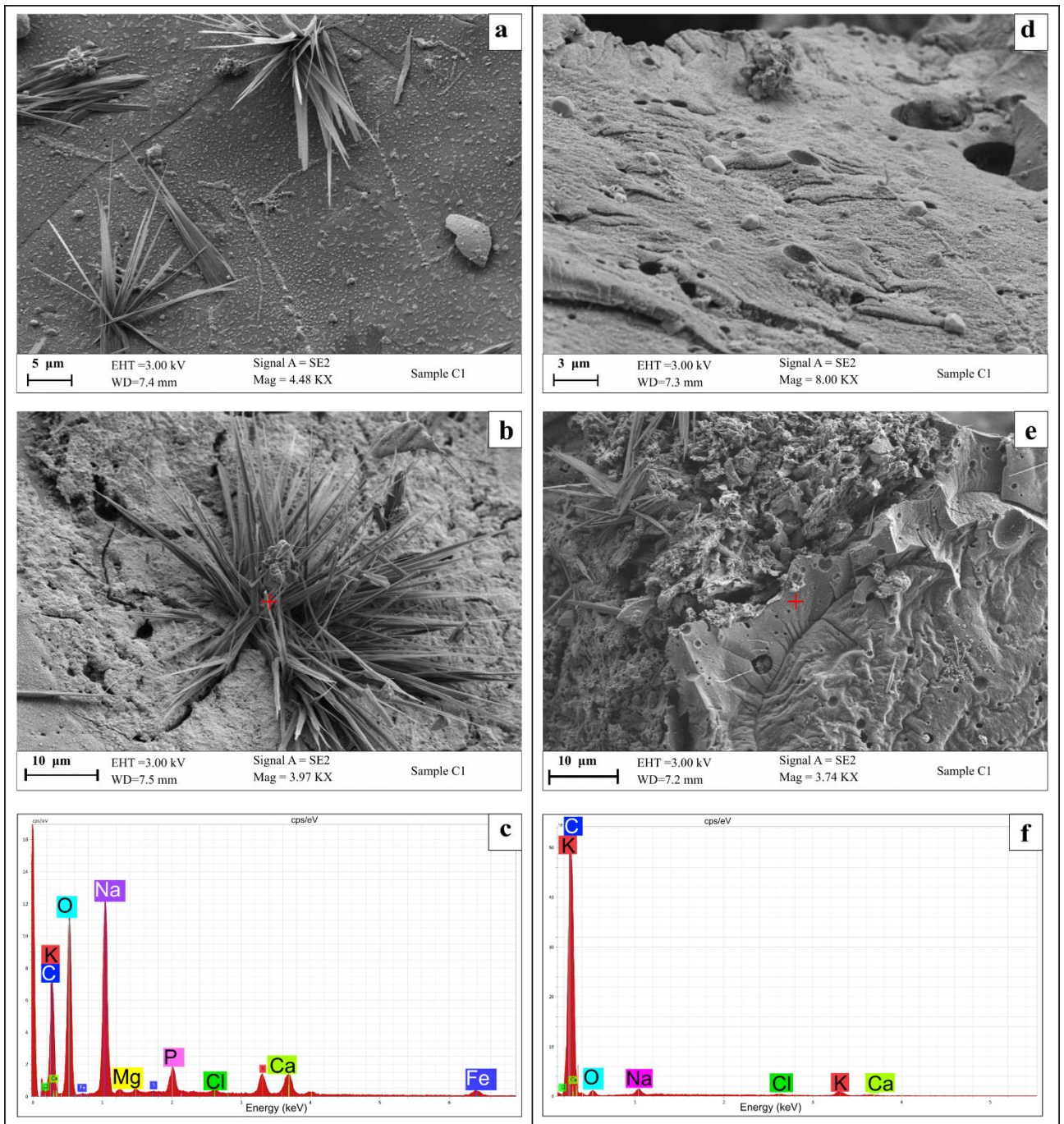


Figure SI4: SEM image analyses and EDS results of sample C1 after run#2 at 520 °C, run#3 at 620 °C and run#4 at 670 °C.

- **Fig. SI4.1 SEM images and EDS analysis of products of C-DSC run#2 heat treatment at 520 °C of sample C1:** Images and analysis after C-DSC run#2 heat treatment at 520°C of C1 brain chip sample displayed. a) SEM image showing the crystallization of perfectly euhedral white cubic KCl crystals that were not present at the pre-run stage. b) EDS spectrum of newly formed crystals showing their KCl composition (EDS spot indicated by the cross in (a)). c) SEM image showing the neural axons structures that have survived (white arrows), but visibly altered and sporadically twisted. d) EDS spectrum of the groundmass indicates C and K as the main constituents (EDS spot indicated by the cross in (c)).



- Fig. SI4.2 SEM images and EDS analysis of products of C-DSC heat treatment at 620°C of sample C1:** This showed significant changes in the structures present on the surface of the fragment. The axons and other previously visible structures were destroyed or only weakly visible. a) SEM image showing the groundmass intensely tiled and almost completely covered by flat concretions. b) SEM image showing a needle-like flower structure that has formed. These needle-like structures are evenly distributed and scattered over the surface and are related to fractures and sources of degassing. c) EDS analysis of needle-like structures (red cross in (b)) indicates that they contain less C, compared to the groundmass (f), large amounts of K, Na and O, and subordinate amounts of Ca and P. d) SEM image showing that KCl crystals that formed in this run are smaller than those that formed during run#2. e) SEM image showing morphological structures with smooth and plastic aspects, attributable to fluidal behaviour/relaxation, probably due to the very high temperature. f) EDS analysis of groundmass (red cross in (e)) indicates C and K as the main constituents."



- Fig. SI4.3 SEM images and EDS analysis of products of C-DSC heat treatment at 670°C of sample C1.** a) SEM image showing large increase in flat concretions that cover the groundmass completely. b) SEM image showing the axon-like structures (white arrows). These are rare, fragmented and strongly altered. The squared solid to the right of the axon is a KCl crystal. c) SEM image showing KCl crystals (white arrows). These are scarce and very small in size with respect to those that formed during run#2 and run#3. There are more needle-like structures dispersed all over the sample surface due to the increase in sources of degassing. d) SEM image showing step-like fractures and plastic morphologies with smooth aspect, attributable to fluidal behaviour.

