

SUPPLEMENTARY INFORMATION, FIGURES, AND MOVIES

Impact Origin

The Argentine glasses exhibit clear evidence for an impact origin including high pressures and temperatures, as well as rapid quenching as documented in references in the text. In addition, many samples display evidence for a dynamic mode of emplacement, including the trapping of soils in seams (folded over) and mixtures of different degrees of melting. Bulk analyses further reveal that their compositions do not match the sediments in which they are found (Schultz et al., 2006) due to incorporation materials from depth. Moreover, these glasses are considered “melt matrix breccias” because they contain clasts, but here the entrained clasts typically represent individual minerals from the loessoid deposits. Finally, some of the melts exceed 1m in diameter. Such observations should remove any questions related to alternative origins, e.g., products of fires, fulgurites, or air burst radiation. Finally, we note that the plant-entrained glasses discussed here were sampled from horizons containing numerous examples in exposed sections (see Figure DR1), i.e., not random samples from the sequence. We refer readers to cited references in the body of the text for examples of shocked minerals that have been previously presented. One of the glasses containing the leaf fragments (Fig. 1, main body of the text) also contained PDF's (the same sample shown in Schultz *et al.*, 2006, Figure 11).

Methods

Encapsulated fragments of plant matter were identified in freshly fractured internal surfaces of impact glasses using extended depth-of-field optical microscopy and then analytical analyses. To determine the nature and abundance of any associated organic species, we used two-step laser desorption/laser ionization mass spectrometry (μ -L²MS). Field emission scanning electron microscopy (FESEM) with light element energy dispersive X-ray spectrometry (EDX) was then used to determine microscale textural and elemental composition. Finally selected sub-samples were extracted and microtomed in epoxy for nanoscale mineralogical and chemical characterization using transmission electron microscopy (TEM) and EDX.

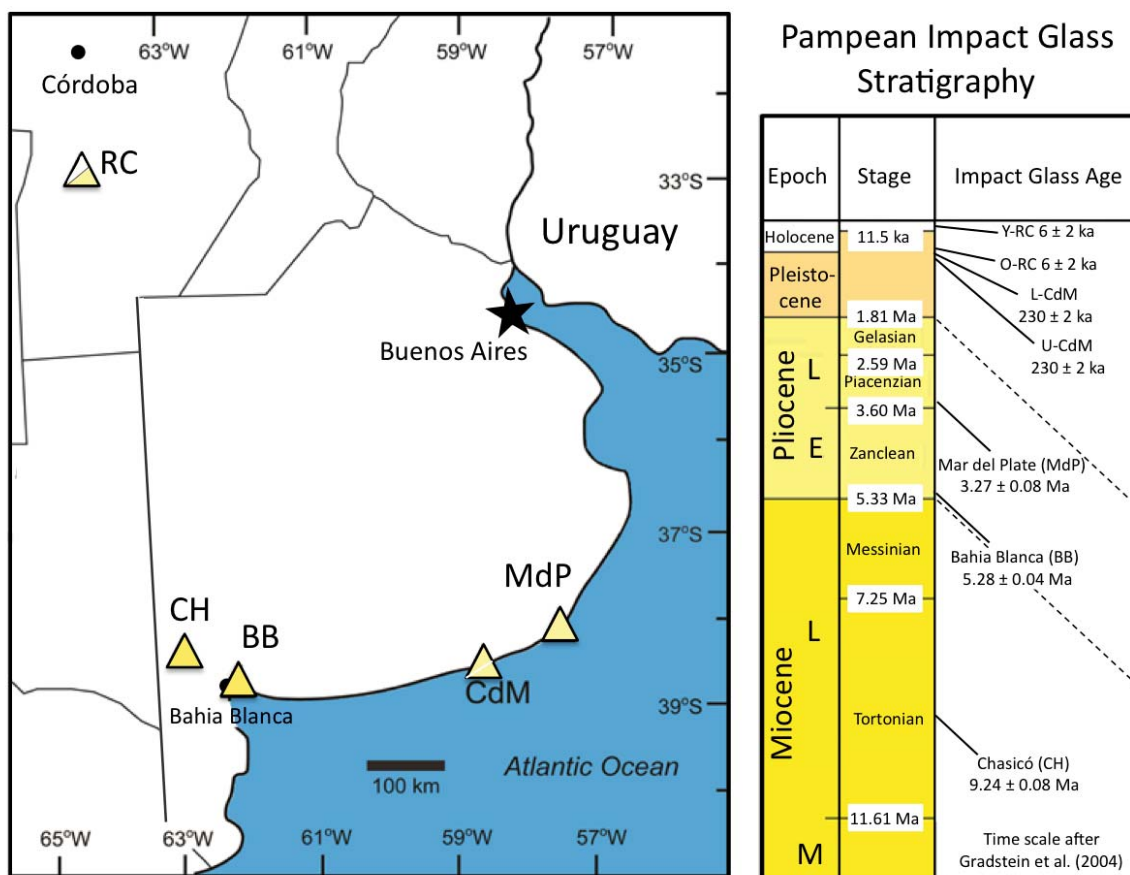


Figure DR1. Map of Argentina showing the general locations of sampled materials along with a general cross section. RC refers to Rio Cuarto, CdM refers to the region of Centinela del Mar (U-CdM from an upper layer; L-CdM from a lower layer in the same exposure); MdP, to the region near Mar del Plata (Chapadmalal); BB, to outcrops near Bahia Blanca; and CH, to the region of Chasicó. These layers generally occur in horizons generally consistent with the regional stratigraphy. Some isolated glasses, however, do occur out of sequence due to later reworking or transport.



Figure DR2. Sample of Mar del Plata (*MdP*) impact glass from which the organic mass spectra shown in Figure 5A were obtained. The region outlined in blue was analyzed using by μ -L²MS using VUV (118 nm) photoionization, while the region in red was analyzed using UV (266 nm photoionization). The leaf material lies directly above the interface with the impact glass as indicated by the white arrow. Prior to analysis, the sample was attached onto Al foil using CrystalBond™ thermal polymer.



Figure DR3. Macro-scale sample of preserved plant matter removed from *MdP* impact glass from which the organic mass spectra shown in Figure 5B were obtained. Unlike plant material shown in Fig. DR2, this material was located far from the surrounding interface with the impact glass and consequently experienced less thermal processing.



Figure DR4. Optical images of the opposing side of the freshly exposed leaf relic preserved in *MdP* in impact glass shown in Fig. 2A. Fragments of the leaf material have broken away during fracturing to reveal the underlying darkened, vesiculated, frothy rim of impact glass.

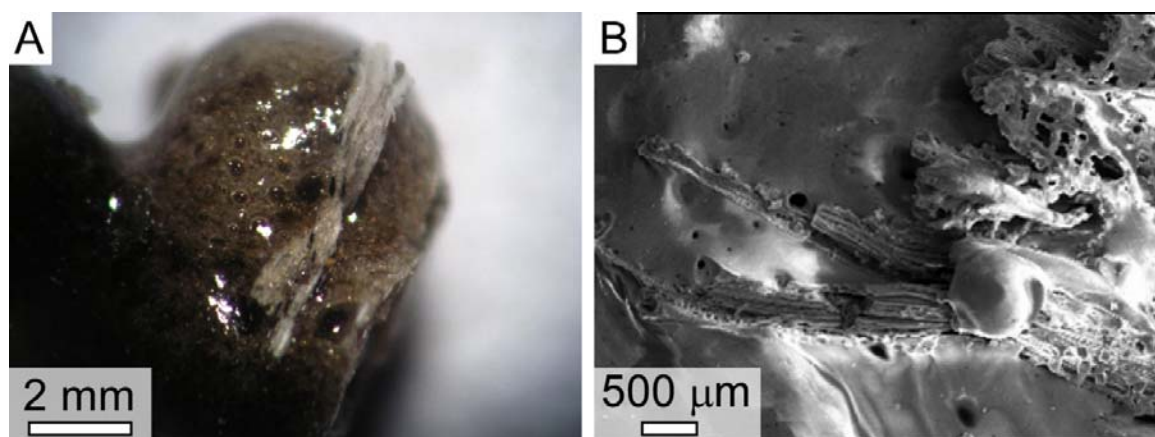


Figure DR5. Photograph (A) and backscattered SEM image (B) of glass produced from fusing fine-grained sediment and Pampas grass in a vertical tube furnace at 1600°C for one minute and quenched in air. The framework integrity and microstructural detail of the Pampas grass is similar to that observed in the Argentine impact melt breccias.

Movie DR1 (MovieDR1.mov): 3-D image reconstruction of image shown in Fig. DR1.

Movie DR2 (MovieDR2.mov): 3-D image reconstruction of image shown in Fig. 2A.

Movie DR3 (MovieDR3.mov): 3-D image reconstruction of image shown in Fig. DR3.