

AIRESITES: A NEW CLASS OF LATE MIOCENE TEKTITES FROM ARGENTINA. R. S. Harris and P. H. Schultz, Dept. of Geological Sciences, Brown University, Providence, RI 02912 (Scott_Harris@brown.edu)

Introduction: We report the discovery of two tektites (Fig. 1A) collected in the vicinity of Bahía Blanca, Buenos Aires Province (BPA), Argentina. The smaller tektite (T2) has an elongate, teardrop form ~2 mm long. The larger one (T1) appears to be a classic disc-shaped tektite ~2 mm in diameter. Both are black in reflected light and exhibit the grooved and pitted surface sculpting common to tektites[1]. We propose that the name “airesites” be applied to these tektites and any *bona fide* tektites subsequently found in BAP.

Unlike other tektites, T1 and T2 were discovered attached to a ~2 cm long piece of impact glass (Fig. 2B). The impact glass (BB-T) is typical of the 5.28 Ma melt breccias that occur in Miocene-Pliocene sediments over a large region of southern BAP [2]. We are aware of no other tektites that have been found so intimately associated with proximal impact melt. The tektites appear to have collided with BB-T while both were still molten, and the bottom of T2 flowed almost 2mm into BB-T (Fig. 1C)

Because of their unique chemistry and association with the proximal melt, these airesites provide some rare opportunities to gain insights into the nature and location of the impact and into the formation and distribution of all tektites.

Major Element Composition: One thin section was made from T1 while T2 was sacrificed to produce 60 μm thick wafers for FTIR. The tektite glass is brownish-yellow in transmitted light (Fig. 2). Electron microprobe analyses were carried out for T1 on a Cameca Camebax using the silica glass routine described by [3]. The average normalized composition of 13 points is given in Table 1. The composition of the proximal melt is also reported.

Table 1. Average Normalized Compositions of Airesite (T1) Glass (wt%) and Impact Melt Breccia (BB-T)

	T1	BB-T
SiO ₂	54.0	63.9
Al ₂ O ₃	15.7	15.4
TiO ₂	0.72	0.94
MgO	3.42	3.14
FeO	4.54	5.01
CaO	9.36	5.80
Na ₂ O	9.27	1.32
K ₂ O	2.44	3.96
P ₂ O ₅	0.46	0.57
MnO	0.09	0.22

These tektites are alkaline-rich with Na₂O + K₂O > 11 wt%. Their average composition is equivalent to tephriphanolite (TAS classification). A large center of Jurassic to Quaternary alkaline volcanics lies just over 600 km to south [4,5]. Therefore, it is possible that the impact could have occurred in sediments derived from those volcanics. However, it is also possible that excess Na was derived from seawater during a marine impact.

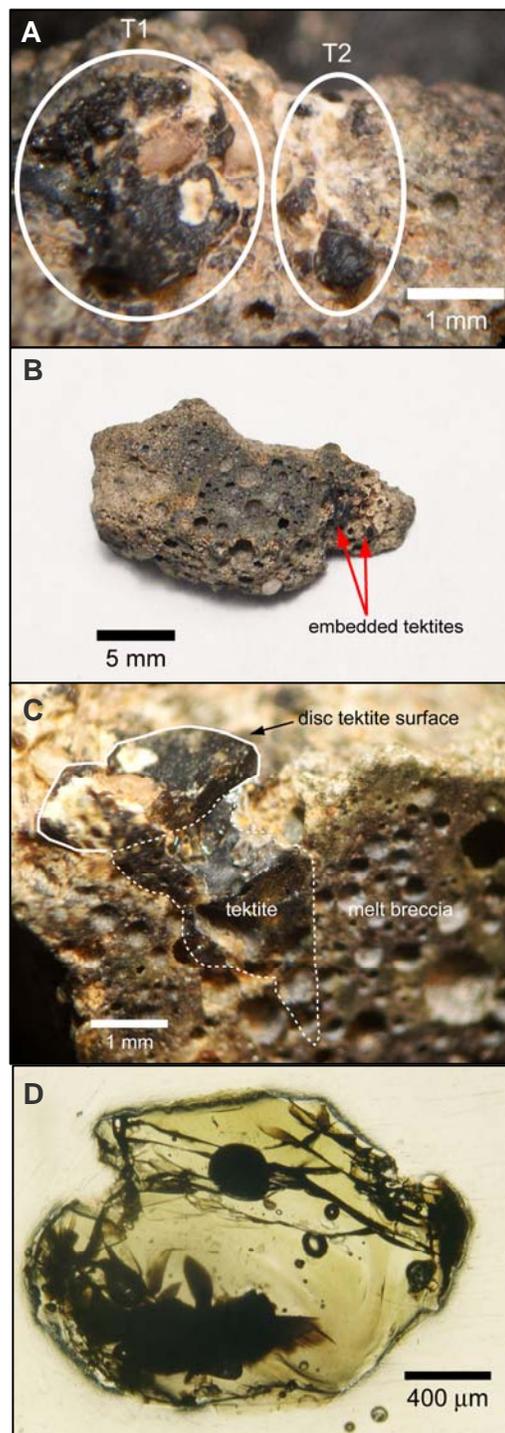


Figure 1. A-C) Photographs of splash form airesites and the impact melt breccia they collided with during the impact event. D) Plane-polarized light photomicrograph of a section cut through T1. The contact with BB-T was along the bottom and right sides.

Water Concentrations: A hallmark of tektites is their very low H₂O contents [6]. High microprobe totals suggest that the portions of T1 farthest away from the contact with the impact melt are dry. Transmission FTIR analyses were conducted using a Nicolet Nexus 870 Spectrometer. The 3500 cm⁻¹ region was used to determine the water concentration in glass from T2. Calculated concentrations range from 0.05 to 0.07 wt%. Therefore, these tektites have somewhat more water than Muong Nong tektites (0.020-0.035 wt% [6]). This is not surprising since the airesites' relationship with BB-T suggests that T1 and T2 probably did not travel a significant distance. Nevertheless, these tektites were able to dehydrate efficiently despite retaining high concentrations of other volatiles (i.e., Na and K). Either the alkali concentrations were initially so high that a significant loss appears negligible; or perhaps there is more involved in the issue of how tektites lose their volatiles than T, time, and distance.

Because T1 and T2 collided with BB-T, something occurred to their H₂O concentrations that is not observed in any other tektite group. Rather than gradually gaining small amounts of water near the tektite/air interface via hydration from the environment, these tektites readily diffused water across the tektite/impact melt contact. Consequently, portions of the tektite near the contact have between 0.5 wt% (FTIR) and 3 wt% (microprobe estimate) H₂O. Proximity to the hot impact melt and increasing H₂O appear to have altered the chemistry and thermal conditions of the tektite sufficient to nucleate dendritic pyroxene crystals which otherwise would not be expected in a tektite.

The unique relationship between these tektites and the impact melt allow a controversial question to be answered directly. Other workers [7] have pointed out that proximal impact glasses can have significant concentrations of H₂O. However, it has been debated whether that water is primary or derived from post-impact alteration or syn-impact hydrothermal processes. Because T1 and T2 have experienced the same environmental history as BB-T—and the tektite is nearly anhydrous—the FTIR determination of the H₂O concentration in the impact melt should reflect the original abundance. The results indicate that BB-T formed with ~2 to 3 wt% H₂O.

Relict minerals: The two tiny airesites alone contain nearly the full inventory of relict grains described over the entire Australasian strewn field [1,8]. The T1 thin section contains one chromite grain and a shocked Cr-spinel. Baddeleyite was identified by reflected-light microscopy on the periphery of a relict zircon. X-ray mapping shows that the zircon is mostly covered in a sheath of pure SiO₂. Only one lechatelierite grain is observed, but the glass contains numerous remnants of shocked plagioclase. A few rounded, granular particles composed of Al, Si, O are present and likely represent the decomposition of Al₂SiO₅ to corundum [8]. The aluminous micro-polishing solution used to prepare the sample is tagged with silver so that contamination can be distinguished from actual xenocrysts. One granular corundum spheroid has a spinel grain at its core. In that case, the corundum probably formed from the decomposition of spinel between 10 and 20 GPa [9]. T2 contains a single shocked quartz grain (Fig. 2) which appears white-opaque in reflected light. FTIR spectra show that the grain contains ~1 wt% H₂O. It may also contain coesite and stishovite which could

scavenge some water from the surrounding melt due to its high H₂O solubility.

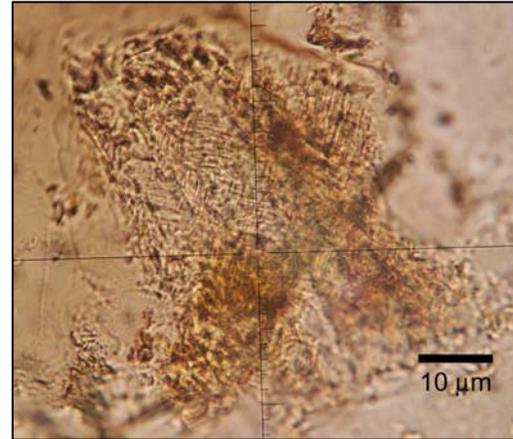


Figure 2. Plane-polarized light photomicrograph of shocked quartz grain containing multiple intersecting sets of fresh planar deformation features (PDFs).

A relatively large (60 μm) grain of Na-merrillite is found in T1. It contains tiny intergrowths of a Mg-free variety and submicron inclusions composed of Cu-bearing iron sulfide. This merrillite grain must have originated from the impactor and may contain chemical clues to its identify. If relatively large grains from the impactor can survive in tektites, questions should be raised about the origin other phases (e.g., chromite) in these and other tektite groups.

Implications: The identification of tektites formed by an impact at the Miocene-Pliocene boundary could provide a link to an enigmatic group of microtektites found in similar age sediments beneath the Tasman Sea [10]. Ratios of low-volatility elements in the airesites are generally similar to those ratios for the Tasman microtektites. Airesites have somewhat higher Na/K ratios, but that could result from preferential Na loss. A possible connection will be investigated with trace element analyses.

References: [1] Koeberl C. (1986) *Ann. Rev. Earth Planet. Sci.*, 14, 323-350. [2] Schultz P. H. et al. (2006) *Meteor. Planet. Sci.* (in press). [3] Devine J.D. (1995) *Am. Min.*, 80, 319-328. [4] Woolley A.R. (1987) *Alkaline rocks and carbonatites of the world*, British Museum, London. [5] Aragón E. (2003) *J. South Am. Earth Sci.*, 16, 91-103. [6] Beran A. and Koeberl C. (1997) *Meteor. Planet. Sci.*, 32, 211-216. [7] Osinski G. R. (2003) *Meteor. Planet. Sci.*, 38, 1641-1667. [8] Glass B.P. and Barlow R.A. (1979) *Meteoritics*, 14, 55-67. [9] Catti M. (1999) *Phys. Chem. Min.*, 26, 389-395. [10] Kelly D. C. and Elkins-Tanton L.T. (2004) *Meteor. Planet. Sci.*, 39, 1921-1930.

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