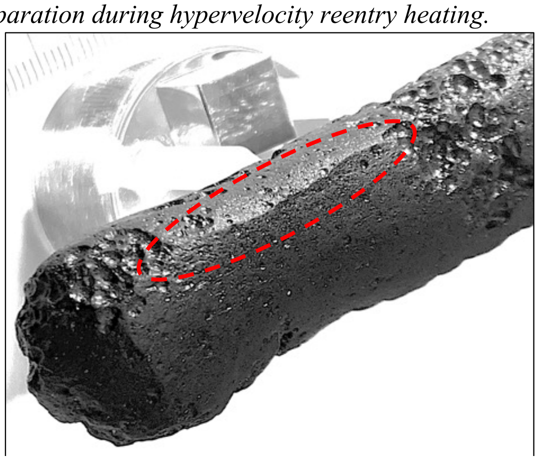
INDOCHINITE TEKTITE POST-SOLIDUS ALTERATION. T. H. S. HARRIS[1] [1]GE Astro Space Div., Lockheed Martin, Boeing Helicopter, retired (thsharris1@icloud.com, Brooklyn NY)

Introduction: Formed as early-ejected melt from planetary impacts, tektites are devolatilized and quenched to solid in vacuum as their defining characteristics. The process requires sufficient initial speed for extended loiter above the atmosphere, and cold view factor exposure while in vacuum. Highly ablated tektites are known to be solid upon reentry onset, while lessor ablated fragment-form AAT of S.E. Asia reveal post-fracture visco-plastic strain, evidence of heating and reshaping from a brittle solid state.

The Indochinite subfamily of Australasian tektites (AAT) are often assumed to lie near their source because they appear unablated or only mildly ablated. Tektite ablation during reentry into the standard atmospheric column is a product of speed and sin(θ), where θ is the flight path angle from horizontal per 1960s NASA research [1, 2]. Earth's rotation was typically not considered in the 1960s simplified two-body gravity treatments for tektite suborbital fall patterns as explained in [3, 4], where ablation regime data and suborbital analysis indicate the AAT source region coincident with the N. American Great Lakes.

Irregular and/or tumbling shapes will spread frictional heating over more of their surface area during reentry, reducing or eliminating ablation even at larger fractions of Earth's escape speed or Kinetic Energy (KE), as discussed in [1, 2, 6]. The contorted shapes of Indochinite AAT are typically assumed to be post-depositional imprints, in conflict with the observed feature set for several reasons explained in [6].

Figure 1*. A roughly cylindrical 9 cm long elongate exhibits ridge segments sub-parallel to its long axis in relatively unpitted or 'bald' surface regions. Fragments of hollow spheroidal tektites often contain similar post-solidus visco-plastic imprinting consistent with flow separation during hypervelocity reentry heating.*



Observed Feature Set: Indochinite 'fragment-form' Australasian tektites indicate post-solidus alteration from externally applied mechanical forces to generate fracture, followed by rapid (fractional second) heat deposition across bulk mass (body-applied heating), often observable on hollow spheroid fragment and other splashform shapes. Figure 1 presents aerodynamic shaping on a cylindrical 'elongate' tektite.

Convoluted imprint. Tektite alteration via explosive heat deposition and subsequent visco-plastic momentum imprinting via high-voltage arcing through the tektite's plasma sheath as suggested in [6] is problematic. This requires a high-energy reservoir near the tektite descent corridor over the S.E. Asia region, probably *many hours after* the causal event. It does explain the pristine heat glaze on may indochinite fragment-forms, where no steady state hypervelocity flow field would establish around a rapidly tumbling irregular shape and the brief heating pulse of several thousand degrees would distribute across the full tektite surface to minimize melting.

Descent-phase disruption of indochinite AAT before or during reentry may correspond with the rapid heat and humidity pulse after the blast, as required to laterize the top of impact clastic unit 2 at Huai Om Thailand where tektite fragments are found, per [7]. Before active dissection could take effect, the tropical landscape with tektite topping at Huai Om was covered with meters of fining-upward angular quartz sand, the rapid regional laterization engine perhaps the sand weight atop a highly compressed, wet atmosphere?

Post-fracture visco-plastic shapes. Common indochinite AAT morphometric trends include fragments of hollow spheroids with out-of-plane visco-plastic deflection on apparent fracture planes. Sometimes this manifests as raised rims at a pock in the spheroidal shell per Fig. 2A, or more commonly as raised rims around concave bubble margins per Figure 2B, 2C/D. Figure 2B & 2C/D could be evidence of a warm core upon fracture of the cooler outer spheroidal tektite volume, while the unique feature of Figure 2A lacks such explanation. All specimens are shown with a 1 cm scale cube for reference.

Reentry heating at tektite speeds lasts for a few tens of seconds, largely insufficient for bulk heating of the overall tektite mass to produce body-heated visco-plastic effects. Figures 3 and 4 may result from stress-generated cracks and differential erosion for striae relief, but this is not always the case per [6]. Radiant flux of high-voltage arcing could produce these effects on cold glass in *millisecond* timescales, along with second-timescale chill upon arc termination.

Figure 2*. Evidence from N. E. Thailand of post-fracture visco-plastic deformation requiring tektite re-heating. A: Shell segment w/ through-wall raised-rim pock at scale cube. B, C and D are fragments of hollow spheroids, C and D are same specimen where both sub-planar surfaces have raised bubble rim margins.*

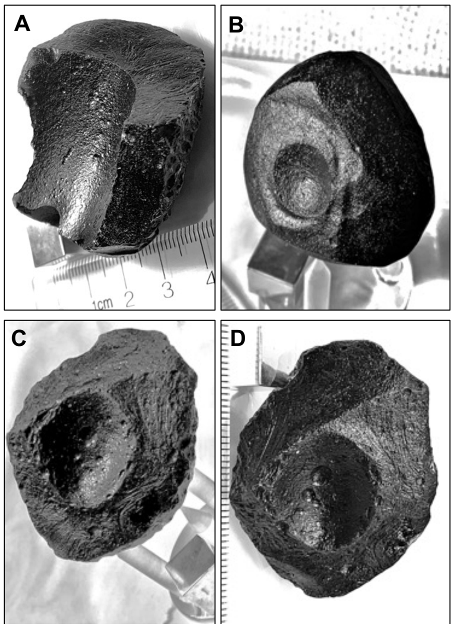


Figure 3*. A: Tektite shell fragment has melt 'tongue' extending from concave surface across part of the wall thickness, with a score across the root of the tongue. B: Closeup of fragment wall w/ scored tongue shows a sub-parallel striae bundle emanating from the score mark. Score mark excavation and sub-parallel striae are consistent with high-voltage arcing and magnetic field.*

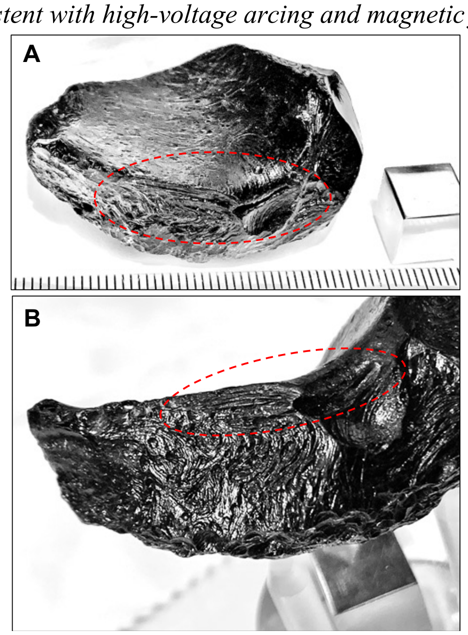
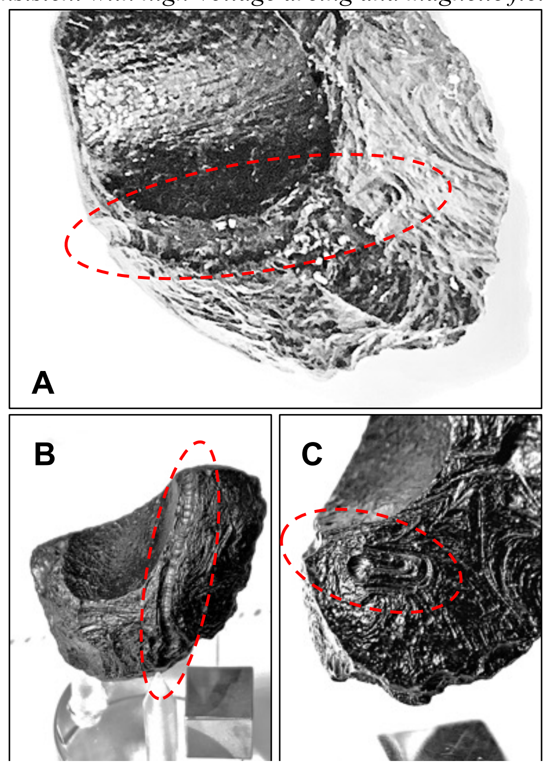


Figure 4*. A hollow tektite fragment exhibits a gouge along its wall beneath the concave surface in image A. The gouge, in a form often assumed to be post-depositional cracking eroded to width over time, travels from the convex, deeply pitted outer surface across the wall thickness and then parallel to the concave surface margin, lower to upper image B. Beneath the gouge on another apparent fracture surface in image C is a concentrated, closed-loop cluster of deep-relief striae consistent with high-voltage arcing and magnetic field.*



Summary: Simple or symmetric ablation on asymmetric Indochina tektites ('fragment-forms') should not be expected, while lack thereof should not be used for assumptions of Australasian tektite reentry speed. The feature-set convolution is complex. An energy reservoir must have existed over S.E. Asia along the tektite descent corridor in order to fragment this AAT subgroup *and* laterize the regional tektite-bearing surface *within hours* before uneroded burial, suggesting high-potential E-fields and full-height disruption of the atmospheric column from exosphere to surface.

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References: [1] Adams, Huffaker (1962) *NASA Technical Report R-149.* [2] Chapman, Larson, Anderson (1963) *NASA Technical Report R-134*. [3] Harris (2021) *LPSC 52,* Abstract #1008. [4] Harris 2022 *GSA Books 553* Ch 23. [5] Sepri, Chen, O'Keefe (1981) *JGR* vol. 86, No. B6, 5103-5111. [6] Harris (2021) *LPSC 52,* Abstract #1009. [7] Tada et al. (2022) *Meteoritics & Planet. Sci.* 57, Nr 10, 1879-1901.