SUBOBITAL ANALYSIS OF NORTH AMERICAN TEKTITE TRANSPORT. T.H.S. Harris, GE Astro Space Div., Lockheed Martin, Boeing Helicopter, retired (thsharris1@icloud.com).

**Introduction:** Tektite and microtektite (μ-tektite) progeny of the ~35.5 Ma Chesapeake impact at Cape Charles, VA are collectively termed NAT, populating the N. American strewn field. The NAT case is unique among known tektite families with the source being close to the strewn field compared to the strewn field area, suggesting a possible near-vertical, energetic launch condition. Suborbital Analysis (SA) based on the ‘A-to-B’ suborbital problem [1,2] uses various diagrams to identify possible jetting scenarios from Cape Charles, Virginia, to populate the NAT strewn field.

The SA model applied to the NAT case considers target mass transport beyond the atmosphere via initial jetting, with subsequent tangential expansion into vacuum accounting for observed distribution. Each NAT fall site [3-6] has a launch solution curve of multiple loft duration A-to-B cases, enabling trend identification within the overall NAT transport scenario. Observation and mechanical viability drive the SA process as described, with illuminating results.

**Helix:** The NAT set is compared in a Helix plot, normalized to escape Kinetic Energy (KE), and launch angles of elevation and azimuth {EL, AZ}. The NAT Helix shows Georgiaite and Bediasite KE curve similarity:

Contemporary continental outlines produce minimal error in this case. Georgiaites (GA) and Bediasites (TX) were reduced to one case each (solid red and dashed black lines, respectively) to capture their trends. Micro-tektite launch solutions are pictured in purple. Reference compass points and unit escape KE circle surround the launch point A at compass center. Clustering around the ‘Up’ axis implies a possible near-vertical ejection for the ejecta set. For mechanical viability, speeds in any ‘primary’ jet must be sufficient to accommodate required launch vectors of all fall points B.

**Elevation and Kinetic Energy vs. Azimuth:** A pair of plots share common launch AZ ordinate axes from 30° through 180°, with upper frame of launch elevation EL and lower frame depicting required KE. Red 1st way (i.e. ‘short way’) solutions for GA and TX (triangle and circle markers) stay closely matched at high launch elevation, implying all azimuths may be available via tangential expansion into vacuum after atmospheric breach. Candidates for near-vertical jetting are selected along the red arcs at circled points #1 through #4 (135°, 120°, 105° and 90° azimuths respectively) in both plots. 3D jet diameter angles between GA and TX 1st way vectors are all less than 1° (i.e. < 1000 m dia. @ 60 km altitude). Blue and black curves at left represent solutions to the northern sites of the strewn field.

The NAT GA/TX jetting candidate cases #1 through #4 are chosen for higher launch EL than fall point solutions of similar AZ domain. The northern sites, DSDP site 612 and Martha’s Vineyard Massachusetts, have AZ maxima shown by vertical blue and black lines between the upper and lower frames.
Jetting Possibilities: Required launch vector magnitudes of ~8.2 km/s for DSDP 612 (frame A) and ~8.8 km/s for Martha’s Vineyard (frame B) are shown for their AZ maxima (i.e. minimum 3D angle from jetting candidates), each flanked by plotted GA (purple) and TX (red) launch magnitudes to their left and right respectively. The amount of each GA or TX vector in excess of the black vector magnitude (black dotted arc) is then compared to angular range from black center vector. Small green arcs represent sufficient delta-V to reach center vector upon post-breast tangential expansion, enabling population of those northern NAT fall points. Small grey counterpart arcs fail that bar.

Discussion: A narrow jet (<1° dia.) of ~300 to ~1000 m/s speed variation is implied per matching GA and TX 1st way launch solution curves across broad AZ domain. Microtekite distribution through jetting azimuth launch vectors at or below jet speed is explained for melt departing the jet through presumed high shear boundary conditions. 5 of 8 tested possibilities provide necessary delta-V to reach DSDP 612 (GA 90° AZ & all four TX AZ cases). One jet candidate shows sufficient delta-V to reach Martha’s Vineyard (TX 90° AZ).

Summary: An implied narrow jet (~1° dia.) of ~300 to 1000 m/s speed variation offers sufficient delta-V to close the angular gap between well populated GA/TX sub-strewn fields and ‘northern branch’ outlier launch vectors, with exotmospheric tangential expansion as a viable mechanism. Loft durations of 1.3-2.8 hrs. and 2.25-3.75 hrs. are implied, with launch of 52-69% escape KE (8.1 to 9.3 km/s) and 65-74% escape KE (9.0 to 9.6 km/s), for GA and TX NAT respectively. Target mass entrainment, acceleration and atmospheric breach are likely within ~10 seconds, satisfying the simplified two-body model impulsive launch assumption for the considered A-to-B suborbital solutions (i.e. 1.3 to 3.75-hour loft durations). Exposure of the melt to air during the process is unlikely, whereas excessive O ionization from involved seawater and high shear gradient in a proposed narrow 8.2 to 8.8 km/s jet explains microtekite Fe oxidation variably findings of Giuli et al. [7].