THE MARTHA'S VINEYARD TEKTITE REVISITED: A DISTINCT SUBCATEGORY OF NORTH AMERICAN TEKTITE S. J. Jaret[1], R. S. Harris[2], E. T. Rasbury[1], and E. F. Albin[3], [1]Department of Geosciences, Stony Brook University, Stony Brook, New York, 11974 steven.jaret@stonybrook.edu, [2]Department of Space Sciences, Fernbank Science Center, 156 Heaton Park Drive, Atlanta, GA 30307, [3]Department of Space Studies, American Public University, Charles Town, WV, 25414.

Introduction: Tektites, a specific type of impact glass, are formed by quenching impact melt from terrestrial impact structures, and occur as part of the distal ejecta deposits [1-3]. Today, tektites occur in four strewn fields (Ivory Coast, Central European, North American, and Australasian,) associated with the Bosumtwi, Ries, Chesapeake Bay, and an unidentified impact structure, respectively. Compositionally, tektites are unlike other non-impact glasses as they typically have higher SiO_2 and FeO contents and relatively lower alkali and volatile element concentrations [2-3].

The North American strewn field, the only strewn field in the Western Hemisphere, is dominated by two subcategories: georgiaites (found in East-Central GA) and bediasites (found in east Texas near College Station). Microtektites and tektite fragments have been found in sediments in Barbados [4-5] as well as in sediments from the DSDP Site 612 off the coast of New Jersey, all of which have chemistries consistent with a coastal plain sedimentary target, but subtle measurable differences from the georgiaties and bediasites [5]. There have been reports of tektites recovered in Cuba, which are also likely part of the North American strewn field but little is known about these tektites. Lastly, one tektite has been found at Grey Head, Martha's Vineyard [6-7].

The Martha's Vineyard tektite shares many similar characteristics with georgiaites. Major elemental geochemistry is nearly identical to georgiatites and it also appears translucent olive green, suggesting similar iron content and oxidation states. Likewise it has a K-Ar age of 34 Ma identical to all of the N. American tektites [7-8]. However, only one was recovered (and it was not in place), and the Martha's Vineyard tektite has widely been considered to be a humanly-transported georgiaite. Albin [9, 11] noted however, slight variations in major element chemistry (particularly enrichment in Ca concentration) and suggested that it may in fact be a distinct tektite.

Samples and Methods: Here we present new trace element geochemistry for the Martha's Vineyard and georgia tektites. We analyzed two georgiaites (GA21 and GA30) from the Fernbank Science Center collection in Atlanta, and the Martha's Vineyard tektite currently in the Smithsonian National Museum of Natural History's collection (catalog #2082). Analyses were conducted in the Facility for Isotope Research and Student Training (FIRST Lab) at Stony Brook University. Concentrations were measured using laser-ablation mass spectrometry on an Agilent 7500 quadrupole ICP-MS with a New Wave 213 laser. The values reported for each sample is based on 15 spots each having a diameter of 120 μm and a 40 sec dwell time. All analyses were run using He as the carrier gas, and data reduction was conducted in the Iolite software [10].

Results: The Martha's Vineyard tektite has nearly identical trace element concentrations as the georgiaites (Figure 1-2). All are consistent with melting of eastern US coastal plain sediments and a Chesapeake Bay Impact Structure source.

However, the Martha's Vineyard tektite shows significant differences from georgiaties in four elements: Zn, Sb, Pb, and U (Figure 3).

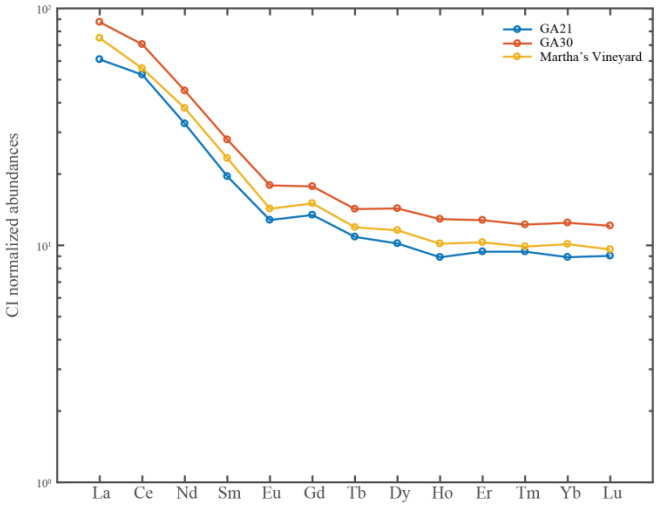

Figure 1: Chondrite Normalized Rare Earth Element patterns of the Martha's Vineyard and Georgia tektites. Martha's Vineyard falls within the range of Georgiaites measured and it is not distinguishable.

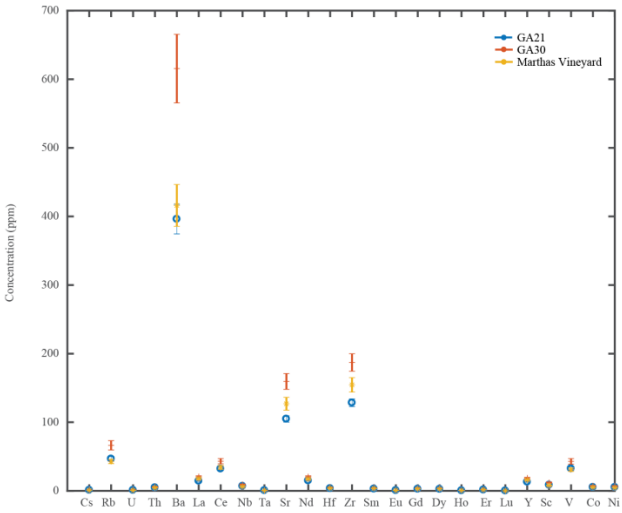

Figure 2: Trace element concentrations for the Martha's Vineyard and Georgia tektites.

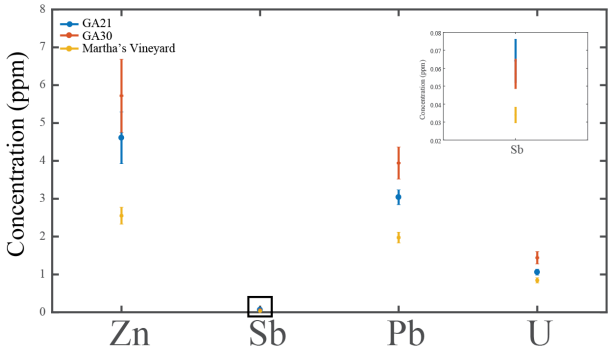

Figure 3: Comparison of moderately volatile elements, Zn, Sb, Pb, and U in Martha's Vineyard and Georgia tektites.

Discussion: Generally, georgiaites and the Martha's Vineyard tektite have trace element concentrations that cannot be distinguished based on these analyses. Some elements (particularly Zr, Hf, Sr and Rb) are not the same concentration in all tektites measured here. However, Albin et al., 2000, measured trace element concentrations of 24 georgiaties and showed that these elements in question typically vary within the georgiaites, likely due to varying degrees of incorporation of robust minerals such as zircon. Thus, the subtle differences here are not sufficient to characterize the Martha's Vineyard tektite as unique.

There are, however, important distinctions in the concentrations of moderately volatile elements between the Martha's Vineyard and Georgia tektites. Specifically, Martha's Vineyard is depleted in Zn, Sb, Pb, and U. These elements are known to be depleted in tektites and are particularly affected by heat-related loss during in the vapor plume [12]. Compared to the Exmore Breccias at Chesapeake Bay [13] generic N. American tektites are depleted in these elements and the different levels of depletion between the Martha's Vineyard and Georgiaites suggests different degrees of volatile loss. Such the case has been shown for Ivory Coast tektites [14] where different subcategories of tektites show different degrees of moderately volatile element depletion.

Zn isotope analyses of tektites has been shown to suggest loss of Zn during flight, in that tektites are heavily fractionated from target compositions [15]. Both Zn concentration depletion and isotopic fractionation has been attributed to Zn loss during melting or (more likely) during flight [15]. Therefore, we attribute the differential depletion of volatiles to be related to time of flight of the tektites.

Based on our new results, we suggest that the Martha's Vineyard Tektite is a distinct subcategory of North American tektite. This specimen is the only macrotektite recovered from north of the Chesapeake Bay Impact Structure. The Martha's Vineyard tektite was not collected in place, but rather was a loose pebble at the bottom of an erosional gully likely transported as part of the glacial sediment [6]. Although no other tektites have been found on Martha's Vineyard, it remains possible that other tektites may be found in similar glacial deposits in the Northeast.

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