TEKTITES OF WESTERN BELIZE – CHARACTERISTICS AND POSSIBLE ORIGIN. D. T. King, Jr.[1], J. H. Cornec[2], L. W. Petruny[1], and H. Zou[1] [1]Geosciences, Auburn University, Auburn, AL 36849-5305 USA [kingdat@auburn.edu], [2]Denver, Colorado USA [jcornec13@gmail.com].

Introduction: In the 1990s, three tektites found among glassy archaeological objects at Tikal, Guatemala were studied by Hildebrand et al. [1]. They concluded that the tektites were from an impact within upper crustal rocks of 'intermediate' composition in the Central American region about 800 ky ago. Subsequently, Izett and Meeker [2] studied two similar western Belize tektites, one found by J. Cornec near San Ignacio and one found by A. Ford in an archaeological site a few km away. Both tektites have ages like those in [1] and have 'andesitic' compositions [2]. Since 1990, J. Cornec and others have recovered hundreds of tektites, mostly in the 1-3 cm size range, from an area in western Belize (Fig. 1). This area has been referred to as a potential strewn field [3], the limits of which may extend farther than its known present limits.

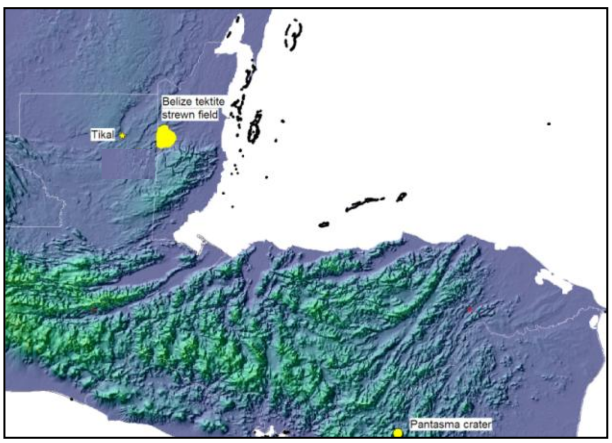

Fig. 1. Location of possible strewn field in western Belize (yellow spot) and possible impact structure (Pantasma crater, Nicaragua) discussed in the text.

Recent work on Belize tektites by Koeberl and Glass [3, 4] indicates that their average composition is significantly different from similarly aged Australasian tektites (including high Na) and that their petrography suggests that they are not far-traveled from their source crater. Petrographic features include schlieren, vesicles and rare opaque grains and grains of lechatelierite, toasted quartz, and quartz with ballen [3]. Analysis of Rb-Sr and Sm-Nd isotopic compositions of several Belize tektites indicates a unique composition among tektites from other strewn fields, and specifically that Belize tektite originated from a 'volcanic' target [4].

Possible Target Area: Cornec and Povenmire [5, 6] have discussed a possible source crater, 12-km diameter structure in the Jinotega District of northern Nicaragua (Fig. 1). Named for a nearby town, Pantasma is a circular feature developed in a Cenozoic volcanic terrain (Fig. 2). This feature, which is about 500 km from the tektites in western Belize, is the nearest candidate impact site so far suggested [5, 6].

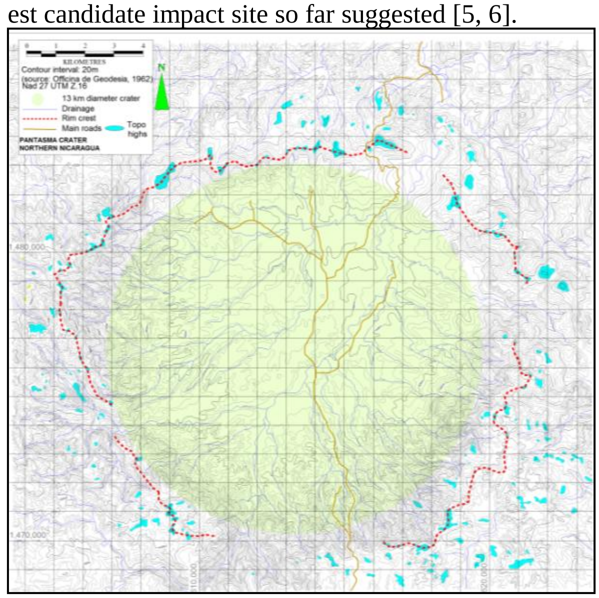

Fig. 2. Topographic map of 12-km bowl-shaped feature that has been suggested as a possible impact structure (Pantasma) in northern Nicaragua, ~ 140 km north of Managua.

In 2015, J. Cornec returned bedrock samples taken from within Pantasma and those were studied petrographically for this report. PAN-1 is a rhyolitic welded tuff with breccia vein and PAN-2 is a fine, high-alkali andesitic breccia. Petrography of both samples revealed that they are dominated by fine plagioclase feldspars, and these feldspars do not display obvious shock features or effects.

Geochemical analysis (ICP-MS, by ALS USA, Inc.) showed that main oxides (avg. of PAN-1 and 2; normalized wt. %) are: Al_2O_3(14.83); CaO(2.25); Fe_2O_3(7.41); K_2O(2.31); MgO(1.08); MnO(1.06); Na_2O(4.79); P_2O_5(0.29); SiO_2(64.92); SrO(0.04); and TiO_2(0.95). The most abundant trace elements (avg. ppm) are: As(16.7); Ba(696); Ce(33.5); Cr(15); Ga(13.95); La(15.9); Li(25); Nd(21.6); Rb(46.2); Sc(17.5); Sr(275); V(58.5); Y(32); Zn(93.5); and Zr(147).

Analyses of Belize Tektites: For this report, three Belize tektites (BZTK-1, 2, and 3) were analyzed geochemically and three (B1, 2, and 3) were studied petrographically. Geochemical analysis (ICP-MS, by ALS USA, Inc.) showed that main oxides (avg. of

BZTK1-3; normalized wt. %) are: Al_2O_3(16.91); CaO(4.79); Fe_2O_3(7.76); K_2O(1.91); MgO(1.84); MnO(0.17); Na_2O(3.75); P_2O_5(0.16); SiO_2(61.66); SrO(0.04); and TiO_2(0.91). The most abundant trace elements (avg. ppm) are: Ba(698); Ce(42.33); Co(13); Cr(30); Ga(15.97); La(20.7); Li(23.3); Ni(76.7); Nd(25.8); Rb(40.6); Sc(17); Sr(378); V(84); Y(35.2); Zn(28.3); and Zr(170). Petrographic analysis of doubly polished thin sections of B1, 2, and 3 shows relatively low content of small vesicles (avg. = 0.6 mm), rare schlieren, rare opaque grains, and rare grains of lechatelierite and quartz with toasting and ballen (Fig. 3). Bubbles attend some impact-affected quartz grains. No feldspar grains were observed.

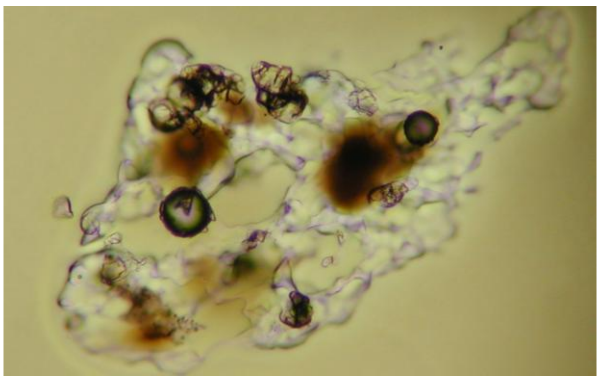

Fig. 3. Embayed quartz grain showing splotches of toasting and ballen and attendant bubbles. In pale brown tektite glass. Tektite B3. Grain is 40 µm long.

Stratigraphy of Tektite Occurrence: In western Belize, the informal Red Bank group (Miocene?) is a very thick, gray-brown bentonitic clay unit that crops out over a wide area, including the tektite-bearing area. Atop the Red Bank group is an erosional surface that is the base for discontinuous residual sedimentary deposits, including red sandy stream-bar deposits (~ 1-2 m thick). Based on field observations, we think most western Belize tektites come from within the weathered, upper surface residuum of the Red Bank group, including the red sandy deposits. Supporting evidence is adhered to some tektite surfaces. If unabraded, these surfaces are characterized by numerous, relatively deep pits, and sediment trapped in those pits can help connect to source beds. For example, Fig. 4 shows the surface of tektite B3, which displays sand grains of the size and shape typical of sand grains in the red sandy deposits sitting in surface pits. Other tektites have grey clay in surface pits. However, some tektites are abraded and their surface pits strongly degraded, so this method does not apply in those instances. An unnamed coarse, clay-rich chert-pebble conglomerate lies atop the Red Bank group (and the red sandy deposits), but so far that conglomerate has not yielded any tektites.

Fig. 4. Pitted surface, tektite B3, 1.3 cm across, showing pinkish-red pit-fillings consisting of quartz grains and clay akin to the red sandy deposit noted above.

Discussion: Geochemical analysis of both PAN and BZTK samples are generally consistent with a rhyolitic-andesitic volcanic terrain [cf. data in 7]. There is a strong positive correlation between main-oxide abundances and trace-element values of PAN versus BZTK samples ($r^2 > 0.96$) suggestive of a possible relationship. Of note in this regard are consistently elevated values of some oxides (Na, K, and Ba) and the fact that some trace elements including REEs are remarkably consistent in both bedrock and tektite samples. However, BZTK tektites are depleted relative to bedrock samples in As, Cs, and Zn (as in Chesapeake Bay tektites [cf. 8]); and there is elevated Cr, Co, and Ni in the tektites (that may be meteoritic in origin, as in Ivory Coast tektites [cf. 9]). Even though the data suggest a local volcanic terrain as the target material, the data do not prove – but also they do not rule out – Pantasma as the source crater. Field observations and sediment in tektite surface pits suggests the stratigraphic source is likely among residual sediments situated on the disconformity atop the Red Bank group.

References: [1] Hildebrand A.G. et al. (1994) LPSC, p.549. [2] Izett G.A. & Meeker G.P. (1995) GSA Abst., p.A-207. [3] Koeberl C. & Glass B.P. (2014) MetSoc.#5034. [4] Koeberl C. et al. (2015) MetSoc.#5320. [5] Povenmire H. et al. (2011) LPSC#1224. [6] Cornec J. et al. (2015) LPSC#1123. [7] Winter J.D. (2009) *Principles of Igneous and Metamorphic Petrology*. [8] Deutsch A. & Koeberl C. (2006) *Met. & Planet. Sci.* 41: 689-703. [9] Dai X. et al. (2005) *Met. & Planet. Sci.* 40: 1493-1511.

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