POSSIBLE FORMATION OF LIBYAN DESERT GLASS BY A TUNGUSKA-LIKE AERIAL BURST*.

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Libyan Desert glass (LDG) consisting of samples ranging in size up to 22 kg is found in a region with dimensions of ≈50 km E-W and 130 km N-S in the Western Desert of Egypt. The process that formed these high (980 mg/g) SiO_2 glassy objects is poorly understood. Although most past researchers have attributed LDG to formation during a cratering event, there remains serious doubt that impact cratering can create such clast-free materials. We suggest that an aerial burst, similar to Tunguska but $\approx 10^4$ times larger, may have been responsible.

We agree with other recent authors who liken the 29-Ma-old Libyan Desert glass to the 0.77-Ma old layered tektites of Southeast Asia. It is instructive to compare these two materials, both the result of major accretionary events.

The evidence of flow in layered tektites consists of pronounced layering, the layers differing in color and in their bubble content. Most layered tektites show some curvature in the layers, and a small fraction shows recumbent folds. In some cases these folds are filled with bubble-rich “foam”. A study of remanent magnetization [1] show that the dip of the paleofield is, on average, about 20° relative to the layering. This is similar to that in SE Asia today, and supports the idea that these materials formed as a melt sheet.

According to Barnes and Underwood [2], the layering in LDG ranges from “indistinct to pronounced”. Weeks et al. [3] note that the LDG “may exhibit either a planar or linear fabric (or) both. We have studied 7 specimens of LDG chosen because they showed banding marked by color differences or differences in bubble content. Our survey shows that most large bubbles have aspect ratios >1.2 and that they show a preferred orientation. One of our samples shows pronounced clear and frothy parts joining at a linear boundary.

Weeks et al. [3] noted that all large (>0.5 kg) pieces of LDG consist of alternating 1-5-cm bands of clear and cloudy (bubble-rich) glass. A large 22-kg LDG specimen belonging to D. Futrell consists of 4-5-cm layers of lime-green glass alternating with white, cloudy layers of similar thickness. Interestingly, this specimen contains three sets of layers that are not parallel; we speculate that they reflect folding during differential flow. The magnetic remanence in LDG is weak [4], and the orientation relative to the layering is not known.

Characteristics indicating flow are less pronounced in LDG, suggesting that their viscosities were higher than in the melt that formed the layered tektites; this is not surprising, since much higher temperatures are required to produce low viscosities in the LDG compared to tektites, whose SiO_2 contents are ≈700 mg/g. The viscosity must be reduced to 50-100 poise for 100-200 s to yield tens of cm of flow for a small geographic slope [5]. Appropriate viscosities in the tektitic samples are obtained at about 2300-2400 K, but temperatures of 2800-3000 K are required for the LDG.

We suggest that the atmosphere has heated by a Tunguska-like event that generated turbulence to elevate desert sand and produce a radiation background that melted these particles. As noted by Wasson [5], to keep form a thin melt sheet and keep it hot enough to flow it is essential to heat the entire atmosphere, in which case the extra amount of heat necessary to melt one a few mm of aeolian sediments temporarily suspended in the atmosphere is negligible. We calculate that about 2.3E6 J cm^{-2} are required; if we assume that a 100X100-km portion of the atmosphere was brought to this temperature and that half the accretional energy went into heat, we calculate a total energy deposition of 4.6E20 J. By comparison, the amount of energy deposited during the Tunguska event has been estimated to be 5E16 J.

References: [1] de Gasparis A. A. et al. (1975) *Geology* 3, 605; [2] Barnes V. E. and Underwood J. R., *Earth Planet. Sci. Lett.* 30, 117 (1976); [3] Weeks R. A. et al., (1984) *J. Non-Cryst. Sol*. 67, 593; [4] De Gasparis A. A. (1975), Ph.D. Thesis, Univ. Pittsburgh; [5] Wasson J. T. (1995) *Lunar Planet. Sci.* **26**, 1469-1470.

*dedicated to the memory of Virgil E. Barnes (deceased 28 Jan. 1998)