HOW WERE TEKTITES FORMED AND EJECTED? E. R. D. Scott, Hawai'i Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology, University of Hawai'i at Manoa, Honolulu, Hawai'i 96822, USA, (escott@pgd.hawaii.edu).

Four tektite strewnfields and many kinds of tektite-like glasses were formed by impact melting of sediments and ejection of glasses over distances of up to 10^4 km [1, 2]. Three of the tektite-producing impacts formed craters 10-90 km in diameter; a source crater for the Australasian tektites has not been identified.

Two major constraints on tektite formation have not been addressed: the remarkable absence of target fragments and the lack of projectile contamination, which are characteristic features of most other impact melts. Traces of shocked grains are found in Muong Nong types but are absent in other tektites [1]. Iridium concentrations indicate the presence of <0.01-0.001% projectile, whereas most other terrestrial and lunar impact melts contain much higher inferred concentrations [3,4]. The lack of siderophiles in impact melts from one crater might be attributed to an achondritic or low-Ir iron projectile [4], but it is unlikely that all four projectiles were Ir-poor. However, normal Ir-bearing impact melts have not yet been identified at any tektite-forming sites. High-velocity projectiles, such as comets, can also form low-Ir impact melts.

Nearly all authors favoring an impact origin for tektites infer that melting was due to shock compression of the target by the projectile. But the absence in tektites of unmelted target grains and projectile material is very difficult to reconcile with this origin. If tektites had formed by jetting at the projectile-target interface as many argue [5], they should be especially rich in siderophiles from the projectile [6, 7]. Near surface materials that are rapidly ejected by spallation are relatively lightly shocked. The bulk of the impact melts, which form subsequently, are intimate mixtures of melts and shocked and unshocked clasts from diverse depths. Thus alternative impact processes for melting and jecting tektites should be explored.

On Earth, the atmosphere plays a major role in heating and transporting target materials in impacts of sub-km and km projectiles. On Venus, craters <30 km in diameter are rare, unusually shallow, and multiple or complex and irregular in shape [8, 9] due to projectile flattening by the atmosphere and catastrophic fragmentation and explosion [9-11]. On Earth, a high proportion of craters in the size range 0.1-10 km were formed by iron meteoroids [4] and some small fresh, terrestrial craters like the 14 km Zhamanshin structure are unusually shallow and irregularly shaped, rather than bowl shaped [12]. Both features are consistent with atmospheric fragmentation, which enhances atmospheric heating.

Interactions between atmosphere and projectile are complex and difficult to model [13] and several possible processes might have been involved in forming and ejecting tektites. Tektites may have formed by radiative heating from the atmospheric plume [14, 15] or surface material may have been injected by impact-generated winds into hot ionized trailing wakes. Catastrophic atmospheric disruption of stony asteroids generates peak shock pressures >1 GPa in surface rock on Venus [10] but melting would require much higher pressures.

The absence of a well-defined crater for the Australasian tektites was attributed by Wasson [14] to a comet that fragmented before reaching Earth forming numerous small craters. However, an asteroid that catastrophically fragmented close to the surface may have been responsible. Even if a crater did form it might be shallow and complex like Zhamanshin [12], where tektite-like irghizites deficient in Ir [4], are found.

Conclusion: The lack of projectile material and target fragments implies that tektites did not form by shock compression. A more plausible explanation is that surface sediments were melted prior to ejection by an impact-heated atmosphere or after ejection inside the hot trailing wake of the projectile.

References: [1] Glass B.P. (1982) *Introduction to Planetary Geology*, Cambridge, pp. 145-172. [2] Koeberl C. (1994) *Geol. Soc. Amer. Spec. Paper 293*, 133-151. [3] Koeberl C. (1998) *Geol. Soc. Lond. Spec. Pub. 140*, 133-153. [4] Palme H. (1982) *Geol. Soc. Amer. Spec. Paper 190*, 223-233. [5] Vickery A, M, (1989) *LPS XX*, 1154-1155. [6] Melosh H. J. (1989) *Impact Cratering*, Oxford. [7] Melosh H. J. (1998) *MAPS 33*, A104. [8] Schaber G. G. et al. (1992) *JGR 97*, 13,257-13,301. [9] Herrick R. and Phillips R. J. (1994) *Icarus 112*, 253-281. [10] Zahnle K. J. (1992) *JGR 97*, 10,243-10, 255. [11] Lyne J. E. et al. (1996) *JGR 101*, 23,207-23,212. [12] Garvin J. B. and Schnetzler C. C. (1994) *Geol. Soc. Amer. Spec. Paper 293*, 249-257. [13] Schultz P.H. (1992) *JGR 97*, 975-1005. [14] Wasson J.T. (1995) *LPS XXVI*, 1469-1470. [15] Boslough M. B. and Crawford D. A. (1996) *LPS XXVII*, 135-136.