ON THE DECOUPLING OF MICROTEKTITES FROM THE EJECTA PLUME. R.D.Lorenz, Lunar and Planetary Lab, Department of Planetary Sciences, University of Arizona, Tucson, AZ 85721-0092. (rlorenz@lpl.arizona.edu)

Introduction: Cratering on planetary bodies with atmospheres entails significant interaction of ejecta with the atmosphere. In addition to the obvious (to remote sensing) proximal effects associated with blast and wake scouring and the restraint of the ejecta curtain to form lobate blankets rather than rays, the atmosphere as a whole controls the expansion of the impact fireball and the subsequent release of fine particulates entrained in, or condensing from, it. The details of this process must control the distribution of microtektites which are distributed on exoatmospheric (i.e. ballistic) trajectories after release. Here I aim to connect the distribution of launch parameters (velocity, angle, altitude) with the particle size : this association should shed light on the plume expansion and particle launch process.

Constraints: There are 3 principal lines of evidence which allow us to place constraints on the ejecta launch parameters. These are :

1. The thickness of microspherule and ejecta layers from a handful of terrestrial impact craters (e.g. Chicxulub; Bosumtwi; the as-yet source crater of the Australasian microtektites [1] and the recently-discovered UK ejecta layer, probably from Manicouagan [2]) As yet there is only limited data on the variation of size with distance from the source. Relationships between ejecta thickness and distance exist in the literature (e.g. see summary in [3]) and provide lower limits on the required launch velocity. However, it is typically assumed for these investigations that the particles are launched from a point source.

2. The shape and estimated thickness of dark parabolic ejecta deposits of fresh craters on Venus, observed in Magellan radar imagery, e.g. [4]. The shape of these deposits, where exoatmospherically-dispersed ejecta is winnowed in the zonal wind field, can be fit by models indicating the amount and size of ejecta particles as a function of distance from the source crater [4,5].

3. The expansion of the fireball associated with impacts of comet Shoemaker-Levy 9 with Jupiter, as observed by the Hubble Space Telescope.

Method: The problem does not appear to lend itself to analytic solution. The parameter space is therefore being explored numerically – similar approaches have been used to study volcanic ejecta dispersal on Mars [6] and eruption plumes on Io [7]. Each bin in the impact ejecta size distribution can be associated with an angle and speed distribution. It is assumed that ejecta is launched in a radially symmetric fashion (i.e. that the azimuth distribution of the launch velocity is flat).

The particles are launched at some altitude, travel near-ballistically until they reach some altitude where they are rapidly decelerated and fall at terminal velocity. During their descent to the ground they are displaced horizontally by a wind field.

Since the distance over which sub-mm grains or drops can travel through the atmosphere is extremely small (compared with the >100km dispersal distances associated with Venus dark parabolar, for example) the grains must be launched at very high altitude. At such altitudes the plume must have expanded considerably beyond the size of the crater itself. But some obvious questions are whether the size-distance relationship inferred from these parabolae is consistent with simple drag in an adiabatically expanding plume, or whether the expansion and release must be more complex. Similarly, are the particles launched isotropically, or are they collimated in elevation ?.

Prospective: The modeling work identified here is presently underway – preliminary results will be available at the meeting. New data may help shed light on this problem : in particular

1) identification and recovery of microtektites from other terrestrial craters, in particular if size variation with distance can be determined
2) further analysis of Magellan radar data, to interpret not only the shape of the parabolic features but also the radiometric effect of the ejecta layer on the emissivity and backscatter, which must constrain the thickness and particle size of the layer. [8]

It may be that information on the wind field as a function of latitude can be recovered from the dispacements of falling ejecta.

3) observations of the surface of Saturn’s moon Titan which has a thick atmosphere [9]. The large scale height of this atmosphere makes it perhaps unlikely that parabolic ejecta features form as on Venus, but the characteris-

tics of wind streaks downwind of craters can probably be interpreted as dumping of ejecta from the fireball. (This is not the case on energetic Mars, where most wind streaks appear to be post-cratering Aeolian features.)

It is worth making the additional remark that plume interactions have been considered in the so-called 'hyper-ballistic' dispersal of Copernican ejecta on the moon [10].

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