

Meteoroids and IDPs of cometary origin: lessons from Stardust

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The aerogel collector on board Stardust's spacecraft recovered thousands of particles from comet 81P/Wild 2 larger than $1 \mu\text{m}$ (Hörtz et al., 2006). Despite that the initial structure of the largest cometary fragments impacting the aerogel (just in the right diameter range to be called meteoroids) was not preserved, the study of the excavated tracks and the surviving mineral grains provide valuable clues on the structure of cometary meteoroids reaching the Earth and their link with IDPs. The fine texture and mineralogy of recovered mineral grains together with the evidence of an enrichment in the moderately volatile elements like e.g. Na and K (Flynn et al., 2006) indicates that 81P/Wild 2 materials formed at low enough temperature to allow their condensation and, at the same time, they were never heated sufficiently to lose these volatile elements. Depletion of moderately volatile elements from the inner nebula and subsequent transport by intense X winds and turbulence towards the regions where comets formed would explain the overabundances observed in these primitive objects. On average IDPs are also enriched over the CI carbonaceous chondrites "cosmic or solar" values (Rietmeijer, 1999; Flynn et al., 2003). By studying meteor spectra was also found a Na overabundance over the CI value for meteoroids coming from different comets (Trigo-Rodríguez et al., 2004).

Anhydrous interplanetary dust particles (IDPs) are usually considered cometary dust and that hydrated IDPs as being debris from hydrated asteroids. Rietmeijer et al. (2004) pointed out that this notion presumes that aqueous alteration is not occurring in comets. We think that aqueous alteration can be nowadays a substantial process in comets subjected to an important degree of irradiative and collisional heating, and

even probably also occurred after accretion as consequence of heating by radioactive decay (Merk and Prialnik, 2006). Recent orbital evidence on the cometary nature of CI carbonaceous chondrite Orgueil is pointing in such direction (Bland et al., 2006). In fact, the important differences in tensile strength of cometary meteoroids studied by Trigo-Rodríguez and Llorca (2006) is evidence of important structural differences among comets probably depending of very different evolutionary histories. Hydrated carbonaceous chondrites like e.g. CM and CI groups would be in this picture coming from transition bodies that accreted important amounts of water and organic compounds, but were moderately affected and devolatilised by collisional heating.

On the other hand, it is usually stated in the literature that the flux of asteroidal IDPs is higher than this one coming from comets. Although this is strongly dependent of the range of masses we consider, such a claim is underestimating two important facts. 1) Several meteoroid streams of cometary origin are intercepting the Earth with relative velocities ($v < 25$ km/s) that are in the expected range for IDP survival to atmospheric entry (Trigo-Rodríguez and Llorca, 2006). 2) Even those cometary meteoroid streams that are exhibiting very high geocentric velocities are suffering collisions with interplanetary dust. This is a natural pathway to reduce the relative encounter velocity of the fragments with the Earth (Trigo-Rodríguez et al., 2005). The importance of comets as source of low-relative velocity meteoroids is also supported by the orbital evidence collected during the last decades by the IAU meteor database (Linblad et al., 2003; Starczewski and Jopek, 2004). Consequently, we think that more accurate quantifications of the ratio of cometary and asteroidal –origin IDPs require integrating the available evidence from meteoroid, IDP, and carbonaceous chondrites fields.

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