ANALYSIS OF SECTIONED AEROGEL TRACKS OF COMET WILD 2 PARTICLES WITH C60-TOF-SIMS.

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Introduction: The Stardust mission returned material from comet Wild 2 captured in aerogel. The analysis of these samples is a challenging task, especially for organic compounds. Driven by the impact explosion, some if not most of the surviving organics are found in the neighboring aerogel [1,2]. There is intrinsic contamination in the aerogel [2,3] and further terrestrial contamination should be avoided by analyzing samples as unaltered as possible, i.e., not pressed or embedded. Preferably, the spatial resolution should be on the scale of the (sub-)micrometer sized surviving cometary particles. Finally, minimal sample consumption allows comprehensive examination with additional methods. Meeting all these needs is very challenging (e.g., two-step laser mass spectrometry is limited to spatial resolution >10µm [1,2]).

Method: Recent developments in time-of-flight secondary ion mass spectrometry (ToF-SIMS) offer a viable new approach. Using cluster ions as the primary beam enables a gentle and efficient desorption of large molecules from the sample surface while a spatial resolution of down to one micrometer or less can be achieved. C_{60} clusters have been shown to be most efficient for detecting organic compounds [e.g., 4], but also many major and some minor and trace elements can be measured at the same time with high accuracy [5]. For this study we use one of our ToF-SIMS instruments equipped with a 40kV C_{60} primary ion gun. We have previously demonstrated that some organics, including polycyclic aromatic hydrocarbons (PAHs), can be easily detected as intact molecules with only minor fragmentation [6]. We have also measured aerogel surface exposed to the cometary particle flux [7] and found indications for an enrichment in organics relative to unexposed blank flight aerogel.

Results: We analyzed a longitudinal section of track 15 (tile C2012) including adjacent aerogel. The untreated sample is held in place by a covering grid. We found organic compounds at constant background levels throughout the aerogel with no apparent enrichment towards the cometary track. This includes the characteristic PAHs naphthalene, phenanthrene and pyrene. Several micrometer sized enrichments of Na, Mg, Al, and K indicate inorganic cometary material stuck in the track walls.

Discussion: While organics dispersed into the surrounding aerogel have been identified in more than half of the tracks examined for this feature [1,8], not all tracks show them [8]. Since bulbous tracks indicate a violent explosion upon particle entry their impactors are thought of being rich in volatile and organic components. Our analyzed track, however, is of carrot shape and at only 250µm in length rather short. Therefore, it is reasonable that the impacting cometary particle contained only very few volatile and organic components, in accordance with our results.

Further optimizations to our instrument are planned to improve our detection threshold for organics. We plan to analyze more tracks, especially of the bulbous type.

References: [1] Sandford S. A., et al. 2006. *Science* 314:1720–1724. [2] Clemett S. J., et al. 2010. *MAPS* 45:701–722. [3] Sandford S. A., et al. 2010. *MAPS* 45:406–433. [4] Fletcher J. S., et al. 2006. *Appl. Surf. Sci.* 252:6513–6516. [5] Henkel T., et al. 2009. *Rapid Commun. Mass Spectrom.* 23:3355–3360. [6] Rost D., et al. 2010. *LPSC* 41: #1973. [7] Rost D., et al. 2009. *LPSC* 40: #2480. [8] Bajt S., et al. 2009. *MAPS* 44:471–484.