SIMULATING THE ORGANIC AND VOLATILE CONTRIBUTIONS TO PLANETARY SURFACES AND ATMOSPHERES FROM EXTRATERRESTRIAL DUST

R. C. Wilson, V.K.Pearson, D.C. Turner, G.H. Morgan, I.A. Franchi, I.P.Wright and I. Gilmour. Planetary and Space Sciences Research Institute, Open University, Milton Keynes, UK. E-mail: r.c.wilson@open.ac.uk

Introduction: Extraterrestrial dust particles (EDPs) experience aerodynamic breaking upon atmospheric entry, subjecting particles to flash heating. At the predicted entry heating temperatures [1], EDP volatiles and organics will be evaporated [2, 3] and deposited into the Earth's atmosphere [4,5] and surface, thus contributing to the global inventory of organic species.

Detailed analysis of meteoritic organics has been hindered by the lack of sensitivity of conventional GC-MS methods. Py-GCxGC-TOFMS is well suited to extraterrestrial sample analysis as very small samples can be pyrolysed (<1mg). The GCxGC system can separate species that co-elute on a conventional GC-MS whilst the TOFMS allows increased sensitivity across the whole mass range. This approach has been used to simulate the flash heating event experienced by EDPs upon atmospheric entry, and to identify the nature of vapourised species.

Experimental Techniques: Samples were flash heated using a Pyrola 2000 Filament Pulse Pyrolyser (Pyrolab, Sweden), as described previously [6], at temperatures comparable to those modeled by Love and Brownlee (1991). Offline flash heating was repeated until 10mg of each residue was collected for evolved gas analysis. Additional pyrolysis experiments were repeated online coupled to a Pegasus 4D GCxGC-TOFMS (LECO, Corporation), allowing characterisation of volatile-organic and high molecular weight organic components evaporated during simulations.

Results: We have been able to successfully identify, and in part quantify, volatiles and organics released during these simulations. Liberated organics include a range of aliphatic and aromatic species [6]. In particular, aliphatic and aromatic alcohols, carboxylic acids, nitrogen containing compounds (amino acid derivatives, amines, amides, nitriles and nitrogen and sulphur-nitrogen heterocycles and their derivatives) and 1-4 ringed PAHs and their associated alkylated species.

We have applied organic maturity parameters including the methyl naphthalene ratio, which displays a marked change with increasing flash heating temperature. Such ratios are regarded as indicators of thermal instability in organic-rich geological samples and can be applied here to determine the extent of organic alteration through flash heating.

References: [1] Love S. G. and Brownlee D.E. 1991. *Icarus*, 89:26-43. [2] Rodante F. 1992. *Thermochim. Acta*, 200:47-60. [3] Anders E. 1989. *Nature*, 342:255-257. [4] Matrajt G. et al. 2003. *Meteoritics and Planet. Sci.*, 38:1585-1600. [5] Glavin D. P. et al. 2004. *Adv. Space. Res.*, 33: 106-113. [6] Wilson R. C. et al. 2007. *LPSC XXXVIII*, abstract 1799.