SHOCK FABRICS IN FINE-GRAINED MICROMETEORITES.

M. D. Suttle[1,2], M. J. Genge[1,2] and S. Russell[2]. [1]Department of Earth Science and Engineering, Imperial College London, Exhibition Road, London SW7 2AZ, UK. [2]Department of Earth Science, The Natural History Museum, Cromwell Road, London SW7 2BW, UK. Email: *mds10@ic.ac.uk*

Introduction: The thermal decomposition of fine-grained micrometeorites during atmospheric entry proceeds by the loss of volatile phases, the generation of dehydration cracks and their progressive expansion into rounded vesicles or coalesced networks [1]. Since dehydration cracks result from loss of interlayer water in sheet silicates, cracks will form parallel to the [001] axis of phyllosilicates [2]. Thermally decomposed unmelted micrometeorites, bearing heat-induced void space therefore preserve microscale indications of relict sheet silicate orientation.

Methods: We examined 20 unmelted fine-grained Antarctic micrometeorites, image analysis techniques were employed to isolate void space (dehydration cracks and vesicles) from matrix. The Feret's diameter and angle for each void were measured and the cumulative data plotted as rose diagrams. Fabric maturity was estimated by calculating the entropy of each rose diagram, [3] this was then compared against a particle's Raman, mid-IR and geochemical parameters.

Results: We demonstrate the presence of aligned crack structures and by inference phyllosilicate phases in the majority (90%) of micrometeorites. The maturity of matrix fabric varies between specimens but is typically biaxial, with a dominant and recessive pair of preferred orientations, whose intersection angles are commonly <50°. In 40% of samples the dominant fabric lies parallel to the long axis of the micrometeorite grain, and is well-developed. A weak positive correlation ($R^2 = 0.39$) is observed between fabric maturity and the response of carbonaceous Raman R_1 peak parameters.

Discussion: The presence of biaxial fabrics suggests textures did not develop under uniaxial compaction pressure and instead result from successive impact events at oblique angles to the parent body's surface. This is consistent with models of parent body compaction due to shock [4]. Grains with well-developed fabrics, particularly those whose dominant fabric lies parallel to the long axis of the micrometeorite, were likely shocked several times prior to disruption, in these grains, pre-existing fabrics were important in defining fragmentation dynamics. The association of high R_1 and low FWHM-D Raman parameters, which indicate sample heating [5], with well-developed fabrics can be explained by either impact induced heating or by mature fabrics resulting in higher permeabilities and allowing heated atmospheric gases to rapidly enter particle cores during atmospheric entry. This would lead to higher temperatures and a greater degree of heating than in hydrated, compact, impermeable particles with weak fabrics which instead maintain strong thermal gradients during entry [6]. Although micrometeorites demonstrate phyllosilicate alignment, additional higher grade shock features (>S1), such as planar fractures in olivine are absent [7]. Since CM chondrites also display a near ubiquitous low shock state [8], we suggest the parent bodies of hydrated, primitive chondritic materials are likely rubble-pile asteroids, which cannot sustain high impact pressures without disrupting catastrophically.

References: [1] Toppani A. et al. 2001. *Meteoritics & Planetary Science* 36:1377-1396. [2] Nozaki W. et al. 2006. *Meteoritics & Planetary Science* 41:1095-1114. [3] Mohajeri N. et al. 2014. *Proceedings of the EuroGraphics 2014 on Urban Data Modelling and Visualisation*. No. EPFL-CONF-198289. [4] Davison T.M. et al. 2013. *Meteoritics & Planetary Science* 48:1894-1918. [5] Rahl J.M. et al. 2005. *Earth and Planetary Science Letters* 240:339-354. [6] Genge M.J. 2006. *Geochimica et cosmochimica acta* 70:2603-2621. [7] Tomeoka K. et al. 1999. *Geochimica et Cosmochimica Acta* 63:3683-3703. [8] Lindgren P. et al. 2015. *Geochimica et Cosmochimica Acta* 148:159-178.