XANES AND EXAFS OF TRACKS 41, 134 AND 162 FROM THE STARDUST MISSION

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Introduction: The *Stardust* mission collected dust particles from the coma of Comet Wild2/81P. Particles were captured in aerogel with speeds of approximately 6 km/s. This high impact velocity has resulted in a range of capture heating effects that have altered the original cometary material [1,2]. We report synchrotron based analyses of the entrances of Tracks 41, 134 and 162 from the *Stardust* collector tray in order to help distinguish between the original cometary minerals and capture-related alteration.

Techniques: Beamline I18 at the *Diamond* synchrotron was used for X-ray Absorption Near-Edge Spectroscopy (XANES) and Extended X-ray Absorption Fine-Edge Structure (EXAFS) together with XRF mapping [3]. Absorption features around the edge (e.g. Fe K-edge) are dependent on the chemical environment around the central atom. The position of the edge is controlled by the charge state. EXAFS analyses have so far allowed us to distinguish between Fe-O and Fe-S chemical environments. Co-ordination environments were fitted to experimental data using *DL_EXCURV*. If an oxide is identified, the edge position from XANES can then be fitted to measure the proportions of ferric and ferrous oxide in the sample. Fe-oxide, sulphide and silicate standards were used for qualitative mineral identification and the calibration of the edge position for different oxidation states.

Results: EXAFS spectra generated at the mid section of Track 134 and the entrances of Tracks 41 and 162 have all shown the presence of oxidized iron. For instance, EXAFS of a hotspot in Track 162 produced a best fit to an Fe-O shell with O atoms located at 2.00 Å ±0.05. The edge position is close to that of Fe_2O_3. Other hotspots such as the mid track of Track 134 also show the presence of a ferric oxide but the edge position is closer to magnetite (Fe_3O_4). The terminal grain has a strong fit to an Fe-sulphide with an Fe-S shell located at 2.31 Å ±0.05. In Track 162, ferric iron is also associated with hotspots containing both Fe and Ni. Similarly, Track 41 apparently contains oxidised FeNi [3].

Discussion: Capture heating in aerogel has been shown to cause rapid oxidation of ferromagnesian minerals at track entrances [4]. We also seem to observe this effect in our samples but also further along tracks both as amorphous iron oxide and partial oxidation of other phases. *Stardust* tracks have a mixture of cometary iron oxides mixed in with ferric oxides formed during capture heating [3]. However, reduction associated with melting of FeNi sulphides during capture has also been described in some cometary tracks [2] suggesting a complex combination of alteration processes during capture that remains to be fully understood.

References: [1] Burchell M. J. et al. 2008. *Meteoritics & Planetary Science* 43**:**23-40. [2] Leroux H. et al. 1997. *Meteoritics & Planetary Science* 43:97–120. [3] Bridges J. C. et al. 2010. *Meteoritics & Planetary Science* 45**:**55-72. [4] Grossemy F. 2008. *Planetary and Space Science* 55:966-973.