

ANALOGUES FOR WILD2: CARBONACEOUS CHONDRITES SHOT INTO AEROGEL

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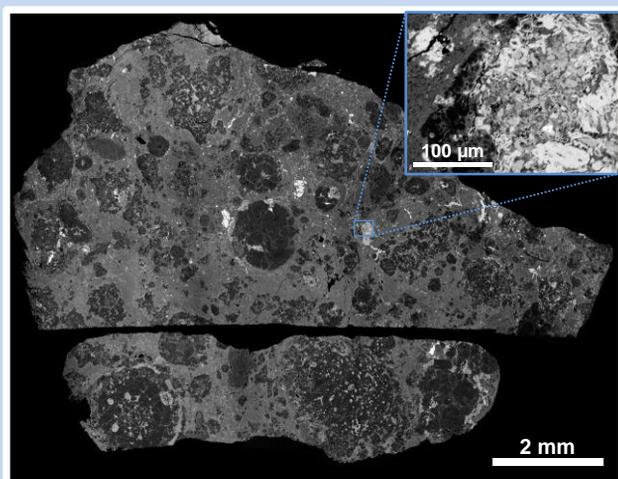
Introduction

Terminal grains in *Stardust* kestones provide the most pristine cometary material for study collected from Comet Wild2. Investigation of these particles has revealed increasing evidence of similarities between the Wild2 constituents and carbonaceous chondrites [1-4]. One of the many affinities include iron oxides [5-7] such as magnetite and magnetite-hematite mixtures found along track walls [6,8], and magnetite found in terminal grains [5,9,10], which are consistent with carbonaceous chondrite matrix material.

In order to identify the closest chondrite analogues for Wild2 we are studying mineralogically characterised chondrite powders shot into aerogel, and then prepared as kestones, analogous to the way Wild2 samples were captured by *Stardust* and subsequently analysed.



▲ A keystone was prepared from the aerogel, at the University of California at Berkeley, using similar techniques to *Stardust* samples [12]. The 650 μm track contains a ~30 μm terminal grain of CR2 material. Our XRF analysis revealed a grain with Fe-rich composition.

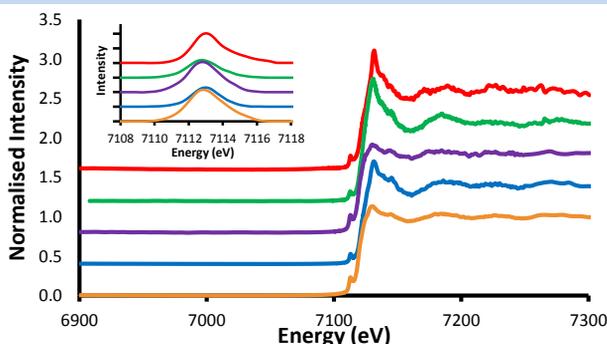
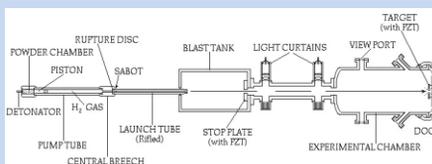


▲ BSE image of NWA 10256 CR2 chondrite meteorite, consisting of chondrule pyroxene ($En_{89-98}Wo_{0-1}Fs_{1-10}$) and olivine (Fe_{91-99}). The meteorite is 42% a matrix of fayalitic olivines (Fe_{50-66}), and Fe-sulphides, metals, and oxides (inset). The thin section was characterised at the University of Leicester using a Phillips XL30 ESEM with Oxford INCA 350 EDX system.

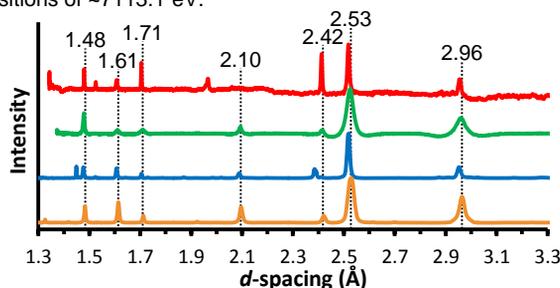
X-ray microfocus spectroscopy is performed using the I-18 Beamline at the *Diamond Light Source* Synchrotron. Measurements include Fe-K XAS spectra ranging 7000-7300 eV at resolution 1.0-3.5 eV, with a resolution of 0.1 eV over the XANES region of 7090-7145 eV, and transmission-XRD taken at 13 keV, with observable d -spacings ranging 9-1.5 Å, corresponding to $2\theta = 5.5^\circ$ to 38.4° .

Comparisons can be made with reference materials, observing the XANES pre-edge and absorption edge position and analysis of the XRD 2θ peaks, to identify the mineralogy of the cometary grains.

► Interior parts of the CR2 chondrite sample were ground into a powder with grain size 25-200 μm. Half of the powders were fired into aerogel of density gradient 25-55 mgcm⁻³ at speeds of 6.1-6.3 kms⁻¹, using a light-gas gun at the University of Kent [11].



▲ Fe-K XAS plots comparing the CR2 terminal grain (Tg) to terminal grains in *Stardust* tracks #178 and #187, plus a CR2 magnetite and powdered magnetite standard, showing similar structure. Inset shows the $1s \rightarrow 3d$ pre-edge centroids (baseline subtracted) at energy positions of ~7113.1 eV.



▲ SR-XRD identification of magnetite in the light-gas gun shot terminal grain (Tg) of CR2 powdered material, by comparison of the 2θ peaks to a powdered magnetite standard. The SR-XRD of the CR2 magnetite is also identical to the SR-XRD measurements of terminal grains in *Stardust* tracks #178 and #187.

Conclusion

We have used synchrotron Fe-K XAS and X-ray Diffraction, and other techniques, to show the presence of magnetite in terminal grains from *Stardust* cometary tracks and compared them to analogous CR2 chondrite material. Future analysis will include chondrites such as NWA 4502 (CV3). The magnetite is assumed to be the result of the hydrous alteration of co-existing ferromagnesian minerals, also abundant in the Wild2 grains [10].