CARBONACEOUS CHONDRITES AS AN ANALOGUE FOR *STARDUST* COMET GRAINS

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Introduction: The *Stardust* mission to Comet Wild2 has provided unaltered cometary material for study in the form of terminal grains. Investigation of these has shown similarities with carbonaceous chondrites including chondrule and CAI fragments [1-3] and the range of olivine $Fo_{3\text{-}100}$ and pyroxene compositions [4-5]. Iron oxides, particularly magnetite in terminal grains, have also been identified in *Stardust* keystones which by analogy with carbonaceous chondrites is evidence for water-rock reaction on the parent body [6-8]. In order to explore the closest chondrite analogues to Wild2, we have shot characterised CR2 and CV3 powders into aereogel and then analysed terminal grains using the same techniques as for *Stardust* grains [9].

Methods: A thin section and a 25 - 200 µm powder from Northwest Africa (NWA) 4502 (CV3) and NWA 10256 (CR2) were characterised using SEM-EDX. The powders were also examined with Raman spectroscopy then fired into aerogel of density 25-55 mg/cm^3 at speeds of 6.1-6.3 kms^{-1} [10-11]. The impact tracks were made into keystones, which were then analysed using *Diamond* synchrotron Fe-K XANES and SR-XRD, with a 3 µm spot size. A *Stardust* terminal grain, track C2009,20,77,1,6 (track #77), was examined with EDX-STEM for comparison.

Results: NWA 4502 has 38% matrix, 14% CAIs and 48% other chondrules. The chondrules contain pyroxene $En_{50\text{-}98}Wo_{0\text{-}34}Fs_{0\text{-}2}$ and olivine $Fo_{66\text{-}100}$, the matrix has FeNi sulfide, metal and olivine $Fo_{36\text{-}50}$, pyroxene $En_{64}Wo_{36}$. NWA 10256 has 42% matrix, 58% chondrules. Pyroxene $En_{27\text{-}99}Wo_{0\text{-}6}Fs_{1\text{-}67}$ and olivine $Fo_{66\text{-}99}$ are found in chondrules, with olivine $Fo_{41\text{-}81}$, Fe-sulfides, FeNi metal, and Fe-oxides in the matrix. Track #77 shows olivine $Fo_{71\text{-}74}$.

XANES and XRD: Two CR2 terminal grains (TG1, TG2) and a CV3 terminal grain (TG2) showed an Fe-K XANES match with olivine (Fig. 1A), with closely matching pre-edge and edge energies to the San Carlos standard and an olivine in the CR2 thin section. XRD confirmed this identification (Fig. 1B) with the 6 most intense peaks showing a close match to forsterite [12]. The unit cell dimensions for olivine increase as the Mg# decreases. Calculating unit cell dimensions from the XRD data and comparing with dimensions from the ICDD [12], then applying methods of [13] we calculate that the CR2 TG1 and TG2 are $Fo_{59.6}$ and the CV3 TG2 is $Fo_{43.4}$, with experimental error of ±1. Another of the CV3 grains showed a good match with magnetite with Fe-K XANES and XRD, similar to previous results [6].

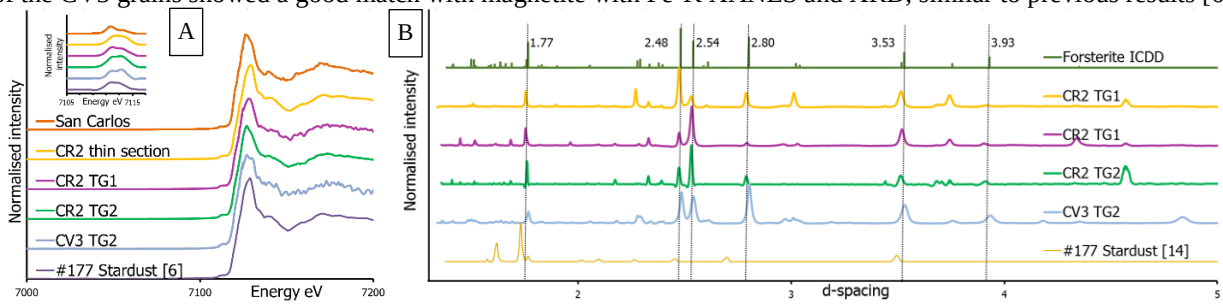

Fig. 1: **(**A) Fe-K XANES and (B) SR-XRD, of CR2 and CV3 terminal grains with a San Carlos olivine standard, forsterite from the ICDD [12] and comparison to a *Stardust* track #177 olivine grain [6,14].

Discussion: Our results together with those of [6] show carbonaceous chondrites as close analogues to the Wild2 terminal grains. Matrix olivine ranges of CR2 $Fo_{54\text{-}99}$ and CV3 $Fo_{3\text{-}99}$ were reported by [5]. The olivine in our shots is likely from the matrices of the CR2 and CV3 as the chondrules typically have a higher Mg content. The lack of phyllosilicates suggests the Wild2 material is anhydrous [5] although they may be destroyed during collection [15]. Finding magnetite in the CV3 keystone supports the idea that it is preferentially preserved during capture [6].

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