CORRECTED CHEMICAL SIGNATURES IN STARDUST GLASS REVEAL WILD 2 PARTICLES THAT RESEMBLE MATRIX GRAINS OF AGGREGATE IDPs. Frans J. M. Rietmeijer, Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque NM 87131-0001, USA, fransjmr@unm.edu.

Introduction: The Stardust mission obtained the first dust samples in the coma of an active comet for laboratory analyses. Earlier chemical data on dust from an active comet came from the GIOTTO and VEGA missions to comet Halley [1]. For decades aggregate interplanetary dust particles (IDPs) were available from parent bodies other than those of meteorites [2], *i.e.* comets or comet-like bodies. Comet Halley and aggregate IDPs consist of nanometer scale entities that include ultrafine-grained and coarse-grained principal components (PCs), GEMS, Mg-rich olivine and pyroxenes, and Fe,Ni-sulfides [3].

Hypothesis & Model: Similar entities define the "weakly constructed mixtures of nanometer scale grains' of comet Wild 2 but grains with these entities were iso-chemically modified during hypervelocity capture whereby all original petrological properties were lost except silicates >500 nm and 'FeS' grains >100 nm [4-7]. However, their bulk chemical signatures were preserved in vesicular Si-rich glass with numerous ~1 to ~100 nm Fe-Ni-S inclusions.

Melting and mixing of nanometer scale Wild 2 grains and silica melt is represented in a mixing diagram Fe and Mg both as a function of Si (el%) (Fig. 1); Mg represents the "silicate" fraction assimilated in Si-rich glass and Fe represents the numerous Fe-Ni metal and Fe-Ni-S compound grains (dotted lines) that precipitated from immiscible sulfide melts.

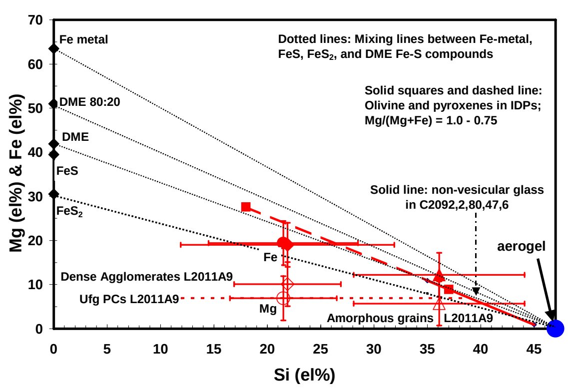

Figure 1: Fe & Mg vs. Si (el %) showing Si-rich glass compositions as a function of decreasing size of Fe-Ni metal and Fe-Ni-S grains including deep metastable eutectic Fe-S compositions [4] and 'silicate entities' in aggregate IDP L2011A9 (red; Mg: open symbols, Fe: closed symbols). Blue dot represents pure aerogel.

Macroscopically the Si-rich glass particles are irregular somewhat porous clumps [4]. The textures show (**1**) a core of vesicular Si-rich glass with numerous Fe-Ni-S inclusions, (**2**) a narrow rim of massive (non-vesicular) Si-rich glass mostly without inclusions, and (**3**) flight aerogel. All boundaries are sharp.

Data: The analytical procedures are described in refs 4 &7. Each data point in the following figures represents either a glass or an inclusion ± matrix composition obtained using a focused probe size. Here I report results for two allocations of a bulbous Type B track, C2092,2,80,46,1 (entrance hole) and C2092,2,80,47,6 (~575 microns below the hole)

Results: The Mg and Fe data in the mixing diagrams (Fig. 2) show similarities and differences in element distributions. Differences, *e.g.* shifting Mg glass compositions, are track-characteristic. Similarities indicate

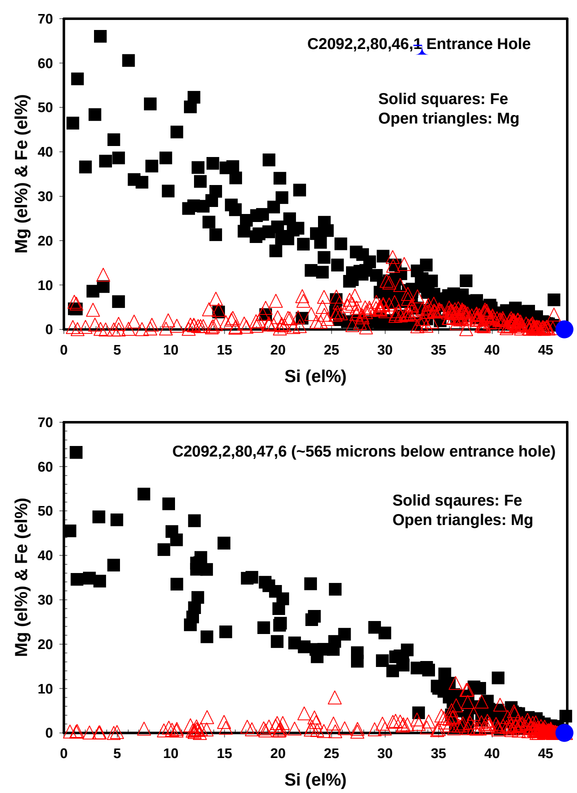

Figure 2: Mixing diagram showing Fe (black squares) and Mg (open triangles) vs. Si (el %) at the entrance hole (top) and ~565 μm down track #80 (cell C2092) (bottom).

common chemical properties, *viz.* Mg,Fe Wild 2 silicates (crystalline, amorphous, or both), Fe-(Ni)-S compounds and Fe(Ni)-metal. Both allocations have low-Mg contents at Si <12-el% (Fig. 2) that cannot be from ‘silicate entities’ (Fig 1). Sodium, Al, Mg, S, Cl, K, Ca, Cr, Mn, Fe and Ni, when plotted as a function of Si (el%) show a flat distribution at very low but measurable abundances that is Si-independent in (**1**) vesicular Si-glass, (**2**) massive glass rim, 42≤ Si ≤45 el%, and (**3**) flight aerogel, Si >45 el%, that is not pure silica. The results suggest a chemical background.

Aerogel Background: Pre-flight aerogel contains chemical impurities at ppm levels [8] that are below the EDS detection levels; They were reported from TOF-SIMS analyses of flight aerogel in contact with Si-rich glass [9]. The Fe- & CI normalized abundances in flight aerogel in the allocations from track C2092,2,80 show similar, distinct distribution patterns (Fig. 3).

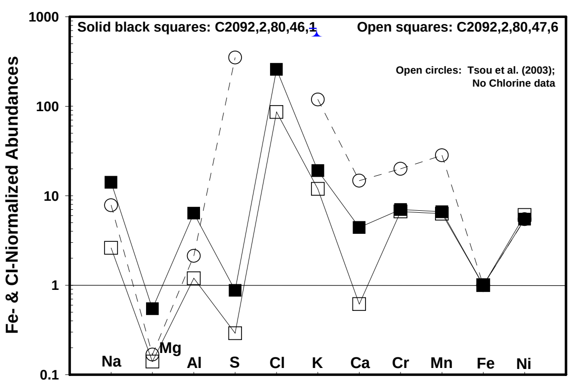

Figure 3: The Fe- & CI normalized abundances in flight aerogel in both allocations from track #80 (cell C2092) and in pre-flight aerogel [8].

These patterns resemble the normalized [10] flight aerogel distribution pattern in C2115,34,21,0,6 [9]. All three jagged patterns are similar to these normalized pre-flight aerogel [8] abundances. There is major difference for sulfur that might show the redistribution of Wild’s sulfur at element percent levels to greater distances from into flight aerogel. The shapes of the distribution patterns suggest that flight aerogel inherited enhanced pre-flight abundances albeit the concentration mechanism is uncertain. Thus, all data need to be corrected for the background levels of these elements.

Background corrections: Corrected for their background values, all K and Cl, and most Na are removed from the glass data. The glasses also become Cr-, Mn- and Ni-free; these elements are associated with Fe-metal and sulfides. *But what is to do about Si?*

The clue to a Si-background correction lies with the massive glass that is the “excess” amount of SiO_2 when Wild’s ‘silica’ was added to silica aerogel.

The aerogel melt silica contributing is estimated at <10%. With this and the Mg- and Fe-background correction the results now show the chemical signature attributable ultrafine-grained PCs and amorphous Si-rich Mg-Fe-Ca grains (red triangles), Fe,Ni-sulfides and metal in this Wild 2 dust grain (Fig. 4).

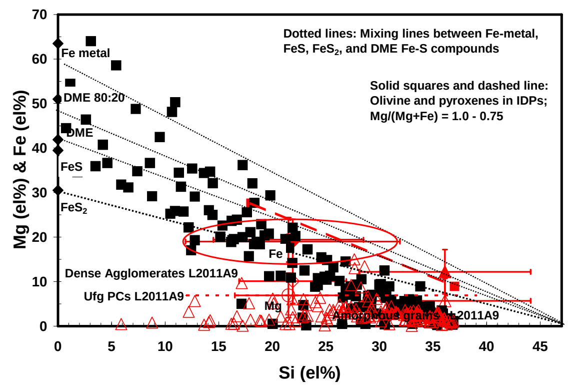

Figure 4: Mg- & Fe-background and silica corrected data in the Mg & Fe vs. Si (el%) mixing diagram for allocation C2092,2,80,46,1. The red ellipse shows where Fe can be from “silicate entities”, sulfides and metal.

Conclusions: After background and silica aerogel melt correction, the chemical signatures of individual Wild 2 dust reveal similarities within a track (this abstract), and differences among tracks, that were due to different mixtures of entities such as present in the matrix of aggregate IDPs. It will be possible to reconstruct the petrological properties of nanometer scale Wild 2 grains that were among the solar nebula grains in the Kuiper belt. From the chemical signatures alone GEMS-like object were present in comet Wild 2.

References: [1] Fomenkova M. N. et al. (1992) *Science, 258*, 266-269. [2] Mackinnon I. D. R. and Rietmeijer F. J. M. (1987) *Revs. Geophys., 25*, 1527-1553. [3] Rietmeijer F. J. M. (2002) *Chemie der Erde, 62*, 1-45. [4] Rietmeijer F. J. M. et al. (2008) *Meteoritics & Planet. Sci., 43,* 121-134. [5] Leroux H. et al. (2008) *Meteoritics & Planet. Sci., 43,* 97-120. [6] Tomeoka K. et al. (2008) *Meteoritics & Planet. Sci., 43*, 273-284. [7] Zolensky M. E. et al. (2006) *Science, 314*, 1735-1739. [8] Tsou P. et al. (2003) *JGR, 108*, E8113. [9] Stephan T. et al. (2008) *Meteoritics & Planet. Sci., 43*, 233-246. [10] Rietmeijer F. J. M. (2008) *Meteoritics & Planet. Sci.,* submitted.

This work was supported by grant NNX07AM65G through the NASA Stardust Analyses Program.