

O AND Mn-Cr ISOTOPE SYSTEMATICS OF A FAYALITE-SILICA PARTICLE FROM COMET WILD 2

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Introduction: The two terminal particles (TPs) in Stardust Track C2054,5,26 are $\sim 15 \mu\text{m}$ assemblages of fayalite and silica [1]. Similar assemblages are seen in UOCs and could have formed by aqueous alteration [2] or, alternatively, by high-temperature processes [3]. An Ada TP also contains cubanite, which likely formed by low-temperature aqueous processes [4], lending support to an aqueous origin for the Ada TPs either on the comet or a prior asteroidal parent body. The O isotopic composition of an Ada TP will give clues to the source region of the conjectured water sampled by Wild 2: $\Delta^{17}\text{O} \approx -1.8$ to -0.1‰ is seen in secondary phases in CCs and $+5\text{‰}$ in OCs [e.g. 5], $+86\text{‰}$ in purported outer nebular water [6]. The Mn-Cr system, which can constrain Ada's formation time, was recently measured [7] but no meaningful constraints were found.

Methods: A small block containing the potted butt of an Ada terminal fragment was cut from its epoxy bullet and mounted in indium, alongside synthetic fayalite [8] for a Cr isotope standard and natural fayalite and quartz for O isotope standards. Using the UH Cameca ims 1280, we multicollected ^{16}O , ^{17}O , and ^{18}O in both fayalite and silica in Ada, using a $\sim 25 \text{ pA Cs}^+$ primary beam focused to $\sim 2 \mu\text{m}$ and ~ 5500 mass-resolving power for $^{17}\text{O}^-$ to minimize interference from $^{16}\text{OH}^-$. We made sure we cleanly measured the desired phase by later imaging in an SEM. Next, we measured ^{52}Cr and ^{53}Cr by multicollection followed by peak-jumping to ^{55}Mn , using a $\sim 35 \text{ pA }^{16}\text{O}^-$ primary beam focused to $\sim 2 \mu\text{m}$. We first collected raster ion images of ^{52}Cr and ^{55}Mn to determine locations of high Mn/Cr for our spot analyses. We later measured the Mn-Cr relative sensitivity factor [8] in the synthetic fayalite by electron probe and applied this factor to the Ada measurements. We analyzed the data using a maximum likelihood method to account for the reproducibility and mass-dependent fractionation seen in the standards.

Results: Ada silica has O composition (‰): $\delta^{18}\text{O} = 7.4 \pm 1.8$, $\delta^{17}\text{O} = -0.4 \pm 2.8$, $\Delta^{17}\text{O} = -4.3 \pm 2.9$ (all errors 2σ). The fayalite is: $\delta^{18}\text{O} = -0.1 \pm 1.9$, $\delta^{17}\text{O} = -0.3 \pm 2.4$, $\Delta^{17}\text{O} = -0.2 \pm 2.5$. The Mn/Cr ratios of the measured fayalite were too low (≤ 100 , but consistent with Mn/Cr in similar objects in Krymka [2]) to usefully constrain Ada's initial $^{53}\text{Mn}/^{55}\text{Mn}$ relative to aqueous alteration products in meteorites (2-3 \times more data is needed). Our measurements are consistent with previous NanoSIMS analyses of O [9] and Mn-Cr [7] made in the other Ada TP.

Discussion: Ada's O isotopic composition is consistent with secondary minerals in CCs [e.g. 5] and is inconsistent with secondary minerals in UOCs [e.g. 5] and cosmic symplectite [6]. The O compositions of ferromagnesian silicates in comet Wild 2 also show similarities to CCs [10]. Ada is one of the few purported aqueous alteration products found so far in the comet Wild 2 samples. Further analyses of its Mn-Cr systematics (e.g. on a remicrotomed face) will constrain Ada's formation time relative to secondary minerals found in meteorites.

References: [1] Joswiak, D. J. et al. 2012. *MAPS* 47, 471. [2] Wasson, J. T. & Krot, A. N. 1994. *EPSL* 122, 403. [3] Brigham, H. et al. 1986. *GCA* 50, 1655. [4] Berger, E. L. et al. 2011. *GCA* 75, 3501. [5] Doyle, P. M. et al. 2014. #1726. *45th LPSC*. [6] Seto, Y. et al. 2008. *GCA* 72, 2723. [7] Matzel, J. E. P. et al. 2014. #1645, *45th LPSC* [8] Doyle, P. M. et al. 2013. Abstract #1792. *44th LPSC*. [9] Matrajt, G. et al. 2008. *MAPS* 43, 315. [10] Nakashima, D. et al. 2012. *EPSL* 357, 355.