OXYGEN THREE ISOTOPE RATIOS IN FIVE COMET PARTICLES FROM STARDUST TRACKS 149 AND 172.

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Introduction: By returning particles from the Wild 2 comet, the Stardust mission has offered a unique opportunity to examine materials from the outer Solar System. Wild 2 has a large variety of objects (e.g. CAIs, chondrules, LIME (low-iron manganese-enriched) olivine [1]). [2] applied the relationship between Mg# and O isotopic ratios among crystalline silicate particles and suggested a similarity to chondrules in CR3 chondrites [e.g. 3]. To further explore this relationship, we report O isotope analyses of five new particles.

Samples: Two olivine and two pyroxene fragments were selected from Track 149, and a pyroxene fragment was selected from Track 172. T149A and T149G are Fo_{85} and Fo_{86}, respectively, and T149E, T149M, and T172B are enstatite with compositions $En_{98}Wo_{1.2}$, $En_{92}Wo_{2.7}$, and $En_{99}Wo_{0.1}$, respectively.

Analytical conditions: Analyses were performed using the WiscSIMS IMS 1280 secondary ion mass spectrometer. Analytical procedures are similar to [2] using combined Faraday cup and electron multipliers in multicollection mode. A Cs^+ primary beam intensity was set at 3 pA for a 1.5 µm diameter spot. Modification of the DPRIM5 deflector allowed for precise primary beam aiming [4]. One to six analyses were performed on each comet particle (particle diameters: ~3 to 15 µm). For each comet particle, unknown measurements were bracketed by analyses of a San Carlos olivine standard that were mounted within 500 µm from each particle. Pyroxene and olivine standards of various Mg# were analyzed to correct for matrix effects. Precision and reproducibility of analyses were ~1 ‰ on $\delta^{18}O$ and ~2 ‰ on $\delta^{17}O$.

Results and Discussions: Results on Track 149 particles show there is a correlation between Mg# and O isotopes, with $\Delta^{17}O$ ($=\delta^{17}O - 0.52 \times \delta^{18}O$) generally increasing from –7 ‰ to 0.6 ‰ as Mg# decreases from 99 to 85, which is similar to that observed among CR3 chondrules [3-4]. T172B appeared to be a unique pyroxene grain that shows a $\Delta^{17}O$ of -22.3 ± 1.9 ‰ (Mg# = 99). This is the first ^{16}O-rich pyroxene found among Stardust particles with O isotope ratios similar to CAI-like particles [5], as well as LIME olivine and related grains [2, 6]. No significant amounts of Al_2O_3 and CaO were detected in this grain, distinguishing it from pyroxene in CAIs, AOAs and chondrule-like objects. It is likely this particle formed by condensation rather than from a melt, similar to that proposed for LIME olivine [7].

References: [1] Joswiak D. J. et al. (2012) *Meteoritics & Planetary Science*, 47, 471-524. [2] Nakashima D. et al. Earth Planet. Sci. Lett. 357-358, 355-365. [3] Tenner et al. (2015) *Geochimica and Cosmochimica Acta*, 148, 228-250. [4] Defouilloy et al. (2015) *46th Lunar and Planetary Science Conference* (2015), Abstract #1415. [5] McKeegan et al. (2006) *Science*, 315, 1724. [6] Nakamura-Messenger et al. (2011) *Meteoritics & Planetary Science*, 46: 1033–1051. [7] Ebel et al. (2012), *Meteoritics & Planetary Science*, 47, 585-593.