High precision O isotope analyses link comet Wild 2 with an IDP of probable cometary origin

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Recent studies of comet particles from Wild 2 (Stardust Mission) have shown that bodies from the outer solar system share certain mineralogic and isotopic characteristics to meteoritic components [1]. In particular, [2] argued that Mg# (= [MgO]/[MgO+FeO] molar %) and $\Delta^{17}O$ (= $\delta^{17}O - 0.52\times \delta^{18}O$) relationships among Wild 2 particles are smilar to those of chondrules in CR chondrites and Tagish Lake-like chondrite WIS 91600 [3-4]. However, close examination of their distributions show some differences, indicating that Wild 2 particles formed in a more oxidized environment. In order to explore further the origin of particles from the outer solar system, we analysed individual particles from a giant cluster interplanetary dust particle (GC-IDP), which is likely to have a cometary origin [5], for their oxygen isotope and elemental compositions.

Four particles from GC-IDP were selected. TEM-EDS analyses indicate that they are 3 pyroxenes and 1 olivine, of 5 to 40 µm in size and with Mg# varying from 90 to 99. Oxygen 3-isotope ratios were measured using the IMS 1280 at the WiscSIMS lab with the primary beam diameter of 1.5 µm and intensity at 3 pA according to the methods in [2]. Typical internal precisions are 1.2‰, 2.5‰ and 2.6‰ (2σ) for $\delta^{18}O$, $\delta^{17}O$, $\Delta^{17}O$, respectively.

Results show that the O-isotope ratios of four particles from the GC-IDP are within the same range as the ^{16}O-poor FeO-poor Wild 2 particles, with $\delta^{18}O$ varying from from –6.1 ± 0.9‰ to –2.5 ± 1.3‰ and $\Delta^{17}O$ between –3.2 ± 1.5‰ and –0.4 ± 1.5‰ and also align on the slope 1 PCM line. The Mg# - $\Delta^{17}O$ relationship in the GC-IDP particles is similar to Wild 2 particles, which suggests a similar origin for GC-IDP and Wild 2, in good agreement with anhydrous IDP analyses by [6] and [7]. A larger number of analyses is required to fully address their possible link to other meteoritic components.

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