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NANOSIMS OXYGEN ISOTOPE ANALYSES ON GRIGG-SKJELLERUP COLLECTION IDPS.

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Introduction: The oxygen isotope composition of meteorites has revealed much about the origin and history of inner solar system materials and processes operating across a large volume of the protoplanetary disk. Our knowledge of oxygen isotope signatures beyond the asteroid belt is limited to a few analyses of particles from comet Wild2 [1-4] and anhydrous CP-IDPs [4-7]. Almost all such analyses studied large, ferromagnesian silicate crystals with the predominant fine-grained material largely overlooked. While the fine grain size of this material prohibits isotopic measurements on a grain by grain basis, the signature and variability of the bulk isotopic composition of this material offers insight into early solar system oxygen isotopic reservoirs. Here we present NanoSIMS 50L high precision three-oxygen isotope spot analyses on a set of Grigg-Skjellerup collection IDPs from a larger sample set previously characterised by SEM, Raman and NanoSIMS (C,N,O isotope mapping) [8]. All the IDPs are anhydrous fine-grained particles containing presolar grains emphasising the primitive nature of the samples [8].

Method: Particles were pressed into gold foil and a ≈ 50 pA probe was rastered over $5 \times 5 \mu\text{m}^2$ areas for analyses with ^{16}O measured on a Faraday cup and ^{17}O , ^{18}O and $^{24}\text{Mg}^{16}\text{O}$ on electron multipliers. The mass resolution was set to $>10,000$ (Cameca-definition). Isotope ratios ($\delta^{17}\text{O}$ and $\delta^{18}\text{O}$) were normalised to SMOW using analyses of San Carlos olivine. The mixed mineralogy of the fine-grained samples precludes any matrix effect correction, with variations between the olivine standard and the main phases in the IDPs thought to be negligible. Combined 2σ precision from sets of 5 analyses on Eagle Station yield $\pm 0.8\%$ for $\delta^{18}\text{O}$ and $\pm 1.2\%$ for $\delta^{17}\text{O}$, and mean values within 2σ of true.

Results: The IDPs display a wide range in $\delta^{18}\text{O}$ values from $\sim 0\%$ to $< -30\%$, plotting close to, or above the CCAM line. The offset from the CCAM line appears to be related to ^{16}OH interference revealed by a strong linear relationship with ^{16}OH abundances. The reason ^{16}OH is impacting the IDP results remains unclear as no such effect is observed for the olivine standard or Acfer094 matrix pressed into gold (despite similarly high ^{16}OH). $\delta^{18}\text{O}$ are far less susceptible to interference and therefore reflect the true values of the IDPs, most likely falling along the CCAM line. With two samples having $\delta^{18}\text{O}$ values of -25 and -31% , these results extend the limited range of oxygen isotopes previously reported for IDPs. While the mineralogical composition of each sputtered area is unknown, it may contain many thousands of small grains and it is therefore unlikely that such large variations are the result of random sampling of refractory ^{16}O -rich material. These results indicate a much larger range in bulk compositions of cometary materials compared to that from asteroids, recording more primitive signatures of reservoirs in the early solar system.

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