AN EXTREMELY ^{17}O-RICH SILICA GRAIN FROM THE ORGUEIL METEORITE.

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Two types of μm-sized grains with extremely high $^{17}O/^{16}O$ ratios ($\delta^{17}O$>15,000‰) have been identified in meteorites. The first are so-called "extreme Group-1" presolar oxide and silicate grains, which also have $^{18}O/^{16}O$ ratios ranging from ~0.25 to 1.5 times solar [1-3]. A nova origin is preferred for these grains, supported in some cases by Mg and/or Si anomalies, but mass transfer in binary star systems has been suggested as well. The second are silica-rich grains with extremely large enrichments in both ^{17}O and ^{18}O found in the Murchison CM2 meteorite [4]. An irradiation origin in the early Solar System was preferred over a stellar nucleosynthetic origin. We report the discovery of a large silica grain in the Orgueil CI chondrite with highly enriched ^{17}O and moderately enriched ^{18}O. The origin of this grain is ambiguous.

The grain, ORG-b-21, was identified during an automated NanoSIMS ion imaging survey of an Orgueil acid residue rich in sub-μm Cr-rich spinel grains [5]. Images of O- and Cr-isotopes were acquired in order to search for grains enriched in ^{54}Cr [6]. In addition to identifying numerous small presolar oxide grains with a wide range of O-isotopic ratios, we also found a large elongated grain (~6μm × 1μm) with extremely high $^{17}O/^{16}O$ of ~ 10^{-2} and $^{18}O/^{16}O$ of ~ 4×10^{-3}. SEM-EDS showed that the grain is dominated by Si and O, with small amounts of C, Mg, Al, S and Cr. NanoSIMS data clearly show that these minor elements, with the possible exception of S, are from sub-μm contaminating grains. We thus infer the grain to be silica (SiO_2), though it is unclear how such a grain survived the acid treatments used to prepare the sample. Additional investigations by Raman and TEM are planned to better characterize its stoichiometry and structure. Despite the extreme O anomalies, Si and S were found to be isotopically normal within 1% and 3% errors, respectively.

The similarity of ORG-b-21's O-isotopic composition to extreme Group-1 presolar grains suggests a possible nova origin. However, its $^{18}O/^{16}O$ ratio is slightly higher than any previous putative nova grain. Moreover, models predict that only the most massive novae make ^{18}O-rich O and these are also predicted to produce anomalous Si and S isotopic ratios [2], which are not observed in our grain. On the other hand, the grain's chemical composition and $^{17}O/^{16}O$ ratio are similar to those of the unusual Murchison grains of [4], but its $^{18}O/^{17}O$ ratio of 0.4 is much lower than the uniform value of 1.65 seen for the Murchison grains. The O-isotopic compositions of the Murchison grains are well explained by irradiation of nebular gas by energetic particles from the young Sun. ORG-b-21's composition may have been produced by a similar process, though its distinct $^{18}O/^{17}O$ ratio would imply a different energy distribution of solar particles and how the anomalous O nuclei would be isolated and selectively condensed into solid silica is unexplained for either this grain or the Murchison grains of [4]. Additional searches for ^{17}O-rich silica grains in primitive meteorites are warranted.

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