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^{16}O-Rich Silicate Minerals in Antarctic Micrometeorites

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Micrometeorites (MMs) are cosmic dust particles in the < 1 mm size-range. Unmelted MMs, typically larger in size, show mineralogy and compositions of early-formed solids from the protoplanetary disk, specifically chondrules [1-4]. We report oxygen isotopes measured on rare silicate minerals within unmelted MMs that exhibit ^{16}O-rich compositions.

Initial mineralogy and chemical compositions of 80 MM particles (<150 μm) within the CP94-050 mount collected from Cap Prud'homme, Antarctica [5] were investigated using an electron probe micro-analyzer. Subsequently, oxygen isotope compositions of several olivine and pyroxene grains were acquired using the nano-scale Secondary Ion Mass Spectrometer (NanoSIMS) 50L.

Nine olivine grains within the CP94-050 suite have δ^{18}O and δ^{17}O values from -14.16 ‰ to +11.80 ‰ and from -8.65 ‰ to +7.56 ‰, respectively (Figure 1). We identified a unique olivine grain in particle 60 that shows an extremely ^{16}O-rich composition with δ^{18}O = -55.09 ± 4.17 ‰ and δ^{17}O = -60.49 ± 6.59 ‰. The single pyroxene grain measured within the CP94-050 suite in particle 27 also shows ^{16}O-rich composition with a δ^{18}O = -20.94 ± 2.81 ‰ and δ^{17}O = -24.6 ± 5.57 ‰.

The MM minerals reported here show similar O isotope compositions to literature data on chondrules and ameboid olivine aggregates in CM, CR, CV, and CO carbonaceous chondrites [1-9]. The ^{16}O excesses in particles 27 and 60 indicate that they are similar in their oxygen composition to refractory calcium-, aluminum-rich inclusions (CAIs). Thus, the first formed silicate solids in the early solar system history are well-preserved in the CP94-050 suite.

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Figure 1