

ANOMALOUS OXYGEN IN SPINELS FROM A MURRAY SEPARATE; Ernst Zinner, McDonnell Center for the Space Sciences and Physics Department, Washington University, St. Louis, MO 63130, USA, and **Tang Ming**, Enrico Fermi Institute and Department of Chemistry, University of Chicago, Chicago, IL 60637, USA.

Spinel is the mineral most enriched in ^{16}O among the anhydrous minerals of carbonaceous chondrites. Previous measurements of mineral separates from Allende inclusions and from Murchison matrix yielded spinel oxygen isotopic compositions at the end-point of the ^{16}O -rich mixing line [1,2]. Ion probe measurements of individual spinel grains from a Murchison acid residue (CFOc) showed a range of O isotopic compositions along the mixing line [3] from almost no ^{16}O -excess to ^{16}O -excesses greater than that of the Murchison spinel-rich residue 2C10c [2]. Greater ^{16}O -excesses than in the Murchison bulk spinel fraction have also been observed in a few individual hibonite crystals from Murchison [4]. While the spinels studied by McKeegan [3] were $\sim 15\text{-}30\mu\text{m}$ in size, larger crystals ($85\text{-}325\mu\text{m}$) extracted from Murchison by freeze-thaw disaggregation followed by heavy liquid separation gave values plotting close to the intercept of the mixing line and the terrestrial fractionation line [5].

Here we report ion probe isotopic measurements of O in the Murray acid residue CF [6], which is enriched $\sim 20,000$ -fold in anomalous Ne and Xe (Ne-E and Xe-S) [6]. It consists to 80-90% of Mg, Al-spinel grains with an average size of $1000\text{-}2000\text{ \AA}$ [7], the rest is mostly carbon and SiC whose large isotopic anomalies in C, N and Si are evidence for its presolar origin [8]. The technique for the O isotopic measurements have been described previously [3]. Different agglomerates $5\text{-}10\mu\text{m}$ in size pressed into Au were measured along with Burma spinel grains as terrestrial standard. Oxygen was measured as negative secondary ions produced by Cs^+ bombardment at a mass resolving power high enough to separate $^{17}\text{O}^-$ from $^{16}\text{OH}^-$. Because the first runs on CF showed apparent ^{17}O excesses relative to all previously measured samples, great care was taken to rule out undercorrection of the ^{17}O signal for the tail of the $^{16}\text{OH}^-$ peak. The correction relies on the assumption that the peak shape of the $^{16}\text{OH}^-$ peak is the same as that of $^{16}\text{O}^-$. To check the validity of this assumption, high mass resolution spectra were taken before and after measurements on CF agglomerates under conditions that the valley between the $^{17}\text{O}^-$ and $^{16}\text{O}^-$ peaks was only $10/100$ of the $^{17}\text{O}^-$ signal. Furthermore, measurements on a Murchison acid residue for which the $^{16}\text{OH}^-/^{17}\text{O}^-$ ratio was considerably higher than for the Murray CF samples (60-80 compared to 10-20) did not show any apparent ^{17}O excess due to incorrect subtraction of the $^{16}\text{OH}^-$ interference.

Data on different CF agglomerates are given in Fig. 1 along with the results of individual measurements of Burma spinel grains used for normalization. The normalization to the SMOW standard was made by equating the weighted average of all Burma spinel measurements to its known O isotopic composition [3]. Also shown is the O isotopic composition of the spinel-rich acid residue 2C10c from Murchison [2]. The CF compositions are strikingly different from any O isotopic compositions seen before. All previously measured spinel points lie on the slope unity ^{16}O -rich mixing line [1, 2, 3, 5]. The data points for CF, while showing approximately the same range in $\delta^{18}\text{O}$, exhibit large ^{17}O excesses relative to the mixing line. Almost all points lie above the terrestrial fractionation line and cannot be derived from any previously known isotopic composition by isotopic mass fractionation. In order to check whether the large ^{17}O excesses in CF could be carried by the SiC, a much purer SiC sample from Murchison [9] was analyzed. Although, relative to the C^- signal, the O^- signal was smaller by more than a factor of 35 than in CF, no systematic deviation from the slope unity line was found in this sample. It is most likely that the compositions measured in CF represent those of the $1000\text{-}2000\text{ \AA}$ spinel grains. Since several thousands of grains were consumed during each isotopic analysis, the O isotopic variations among individual grains must be much larger than those of the CF data points in Fig. 1. Our data, combined with previous measurements [2, 3, 5] indicate the presence of different spinel populations in CM2 meteorites that have different sizes and different O isotopic compositions. The population comprising the smallest grains shows the most anomalous compositions. Although the association of spinel with interstellar SiC in residue CF is probably just the result of

chemical processing, if any of the spinels are of presolar origin, the small spinel grains of residue CF are the most likely candidates.

In addition to O, the Mg and Si isotopic compositions of CF were also measured. Positive secondary ions were produced by an O⁻ primary beam and Burma spinel and synthetic SiC served as normalization standards. The results on three agglomerates are given in Table 1 as delta values relative to the terrestrial compositions. In view of the oxygen data, the Mg is surprisingly normal. It shows some mass fractionation in favor of the heavy isotopes but no non-linear effects. The mass fractionation is smaller than the range found in "normal" CAIs [10] and falls by far short of the extreme values observed in spinel from a hibonite bearing Murchison inclusion [11]. In contrast to the Mg data, the Si points fall significantly above the terrestrial fractionation line and confirm the large Si isotopic anomalies in SiC obtained previously with negative secondary ions (see Fig. 1 of [8]).

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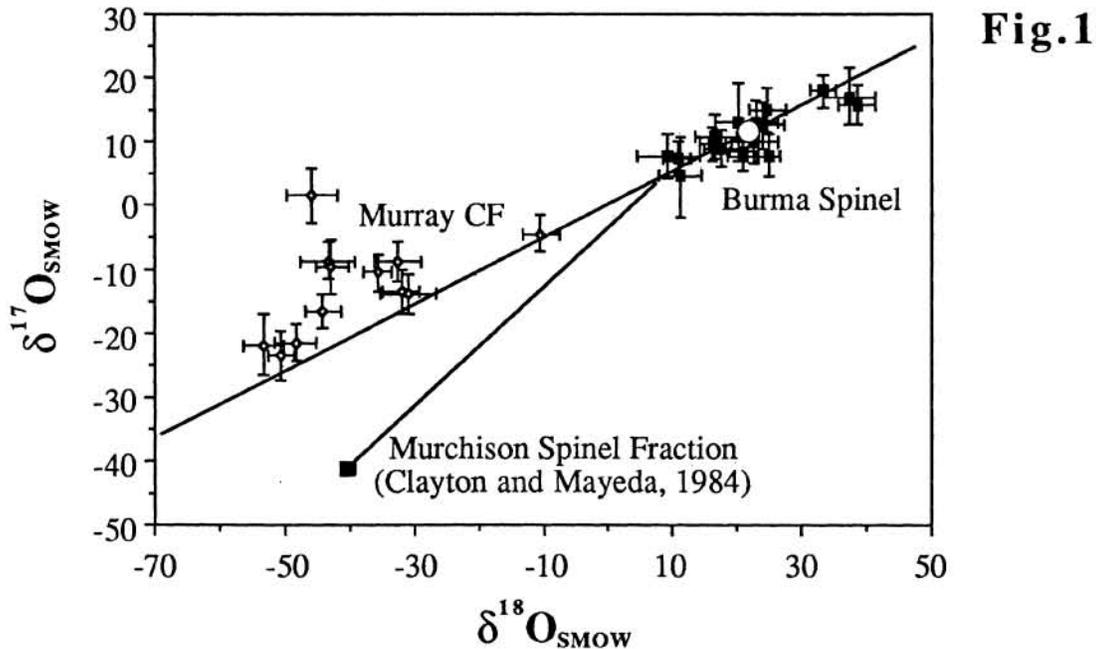


Table 1. Mg and Si isotopic composition of Murray CF

Agglomerate	$\delta^{25}\text{Mg}$ $\pm 1\sigma$	$\delta^{26}\text{Mg}$ $\pm 1\sigma$	$\delta^{29}\text{Si}$ $\pm 1\sigma$	$\delta^{30}\text{Si}$ $\pm 1\sigma$
1	$4.68 \pm .71$	$9.75 \pm .45$	24.78 ± 2.04	36.08 ± 2.72
2	$6.48 \pm .78$	$13.49 \pm .74$	22.80 ± 2.80	34.11 ± 2.60
3	$6.41 \pm .76$	$13.96 \pm .73$	29.09 ± 2.28	43.26 ± 1.69