

NEW "FUN" INCLUSIONS FROM ALLENDE; Robert N. Clayton,¹ Toshiko K. Mayeda,¹ Ian D. Hutcheon,¹ Carol Molini-Velsko,² Lawrence Grossman,³ and Ahmed El Goresy.⁴ ¹Enrico Fermi Institute, University of Chicago, Chicago, IL 60637; ²Department of Chemistry, University of Chicago; ³Department of the Geophysical Sciences, University of Chicago; ⁴Max-Planck-Institut für Kernphysik, 6900 Heidelberg, West Germany.

"FUN" inclusions in Allende have provided a bewildering array of nuclear isotopic anomalies in a large number of elements (for a review, see (1)). Almost all of the data come from two inclusions, labelled C-1 and EK 1-4-1, of which the world's supply is virtually exhausted. Hence searches for new samples go on, using either oxygen isotopes (2) or magnesium isotopes (3) to identify them. During the past year, we have found two more FUN inclusions: CG-14 and EK 25 S2 TE (abbreviated here as TE), previously described by Dominik et al. (4). Their oxygen isotopic compositions are shown in Fig. 1. The anomalous composition of CG-14 was discovered during a routine search of many Allende inclusions. It was then recognized that CG-14 had an unusual mineralogy and texture, consisting of fields of olivine crystals and fields of spinel crystals, each poikilitically enclosed within fassaite. Melilite and anorthite were not present in the section studied. An apparently identical petrography had been described for TE, and therefore it was also analyzed isotopically to determine whether a relationship might exist between the isotopic anomaly and the unusual mineralogy/petrography. In this case, such a relationship apparently does exist, in contrast with the examples of C1 and EK 1-4-1, both of which were typical coarse-grained type B inclusions.

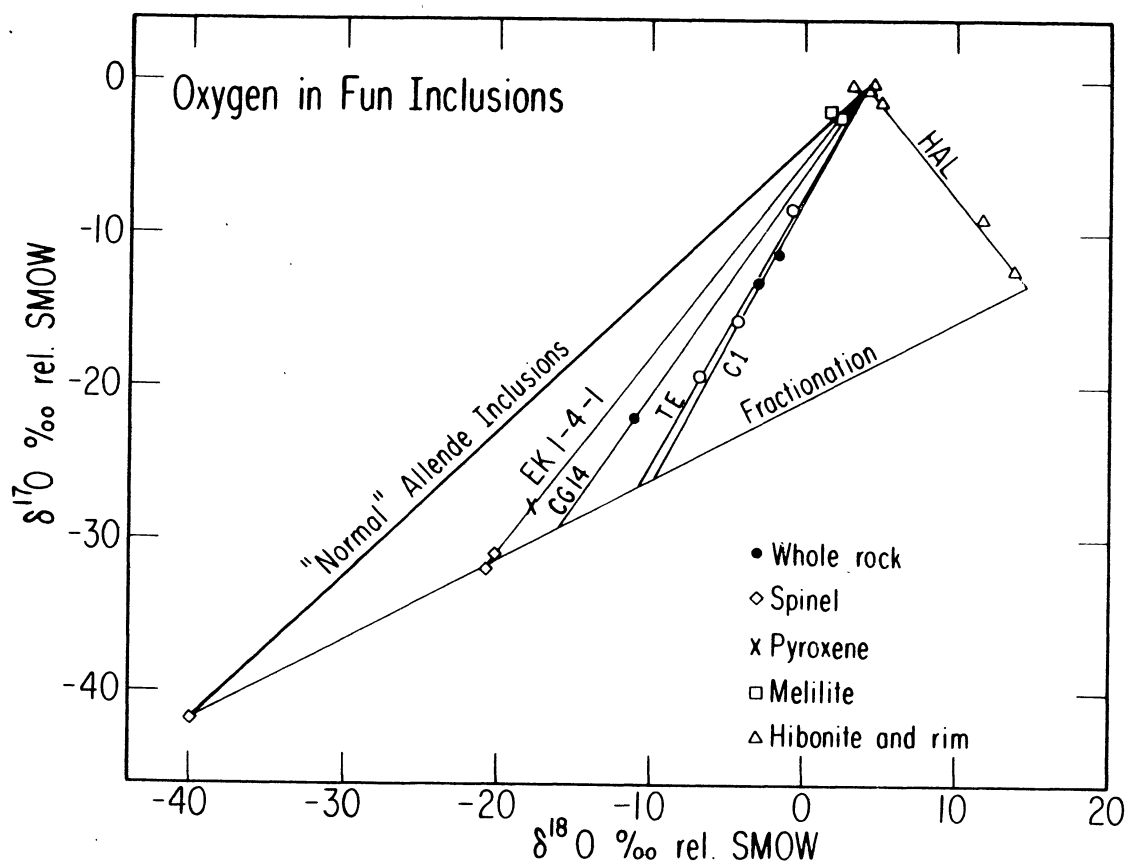


Fig. 1. Oxygen isotopic compositions of FUN inclusions in Allende

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For CG-14, only enough sample was available for a single oxygen and silicon isotope analysis. For TE, two analyses were done, first a bulk analysis, then a two-step BrF_5 reaction at 600°C and at 700°C , to effect a partial separation based on reactivity of the minerals. This procedure produced two different oxygen isotopic compositions, the lower temperature probably dominated by pyroxene, the higher by olivine and minor spinel. The mixing line from these three analyses is almost coincident with that for inclusion Cl, and converges in the low- ^{16}O direction with previously determined mixing lines from Allende inclusions.

Silicon isotopes are strongly fractionated in both inclusions, by about 7.5%/mass unit in CG-14, and 6%/mass unit in TE. CG-14 has an apparent excess of ^{29}Si of 0.3%, and TE has no measurable departure from the mass-fractionation line.

Magnesium isotopes are also strongly fractionated, by about 18%/mass unit in CG-14 and about 13%/mass unit in TE. No phases with high Al/Mg ratios were available to search for radiogenic ^{26}Mg .

Although the oxygen isotope fractionation is almost as large as that in inclusion Cl, the fractionations of silicon and magnesium are considerably smaller than in Cl. Thus there is not even a qualitative correction between the magnitudes of the fractionation effects in oxygen and in the other elements. There still appears to be a correlation between the magnitudes of the fractionation effects in silicon and magnesium.

Magnesium and silicon are isotopically homogeneous between olivine and pyroxene in TE, whereas oxygen isotopes are heterogeneously distributed among the different minerals, as has been observed in many Allende inclusions (5). A post-crystallization exchange of oxygen with a gaseous reservoir appears to be required to account for this heterogeneity.

No causal relationship has yet been recognized between the isotopic anomalies and the unusual mineralogy and texture of CG-14 and TE.

References

- (1) Lee T. (1979) *Rev. Geophys. Space Phys.* 17, 1591-1611.
- (2) Clayton R. N. and Mayeda T. K. (1977) *Geophys. Res. Lett.* 4, 295-298.
- (3) Wasserburg G. J., Lee T., and Papanastassiou D. A. (1977) *Geophys. Res. Lett.* 4, 299-302.
- (4) Dominik B., Jessberger E. K., Staudacher Th., Nagel K., and El Goresy A. (1978) *Proc. Lunar Planet. Sci. Conf.* 9th, 1249-1266.
- (5) Clayton R. N. and Mayeda T. K. (1977) *Earth Planet. Sci. Lett.* 34, 209-224.