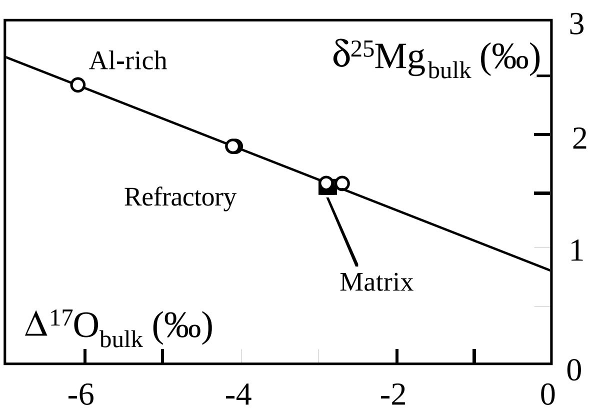
CORRELATED OXYGEN AND MAGNESIUM ISOTOPES IN ALLENDE CHONDRULES. R. D. Ash, A. Galy, E. D. Young, and R. K. O'Nions, Department of Earth Sciences, University of Oxford, Parks Road, Oxford OX1 3PR, UK (richarda@earth.ox.ac.uk).

Introduction: The origin of ^{16}O enrichments in refractory, early solar system materials has remained obscure. Models to explain this observation are supernova nucleosynthesis [1], non-mass dependent fractionation [2] and cosmic chemical memory [3]. We have combined two innovative techniques to determine oxygen isotope systematics and high precision magnesium isotope ratios to look for possible correlations between these isotope systems in chondrules in order to constrain these possible formation scenarios, as each would predict different magnesium isotope signatures. Supernova nucleosynthesis would result in ^{24}Mg correlations, non-mass dependent fractionations would result in no effect in Mg and cosmic chemical memory may result in systematic differences between refractory and non-refractory phases.

Samples and Methods: Chondrules were split in half with the larger portion being used for mineralogical characterisation and *in situ* O-isotopic measurement using the Oxford University UV laser fluorination facility [1], the rest was dissolved, solutions purified and analysed on a Nu Instruments MC ICP-MS. Initial results were reported in Houston this year [2,3].

Results and Discussion: On the basis of O isotopes the chondrules can be divided into two groups. One with oxygen isotopes which can be related by simple fractionation processes to the matrix, and a second which exhibit internal O-isotopic disequilibrium, with ^{16}O-rich compositions.



Those chondrules which constitute the "matrix" group are characterised by iron-rich primary silicates. These chondrules exhibit magnesium isotope abundances very similar to those determined for the matrix, showing only very small degrees of mass fractionation from the matrix composition, with $\delta^{26}Mg$ enrichments up to 0.3‰.

The ^{16}O-rich group are all refractory chondrules, with highly magnesian olivine (most Mg-rich >Fo99) or are aluminium-rich. The magnesium isotopes deviate from the matrix to a much greater degree. The ferromagnesian chondrules in this group are richer in Al than the "matrix-like" chondrules and deviate by *ca.*+1‰ in $\delta^{26}Mg$ from the matrix. The Al-rich chondrules are fractionated by up to 2‰ toward heavier compositions.

The figure shows the correlation between $\Delta^{17}O$ and $\delta^{25}Mg$. The $\Delta^{17}O$ value for the matrix is from [7]. This is the first correlation between oxygen isotopes and any other isotope system and has important implications for the understanding of the source of enrichments in ^{16}O.

Conclusions: The correlation of ^{16}O enrichments in chondrules which show chemical and isotopic evidence for evaporation is more consistent with cosmic chemical memory processes [3] than other possible formation scenarios (nucleosynthesis [1], non-mass dependent fractionation[2]). We envisage a reservoir of isotopically fractionated, refractory materials from the molecular cloud which became mixed with a larger reservoir of "normal" material during early solar system processes, such as CAI and chondrule formation. These effects were further obscured by parent body processing.

References: [1] Clayton R. N. et al. (1973) *Science 182*, 485. [2] Thiemens M. H. (1992) *Isotope Effects in Gas-Phase Chemistry*, (Kaye, ed.), ACS, Washington DC. [3] Clayton D. D. (1988) *Astrophys. J., 334*, 191. [4] Young E. D. et al. (1998) *GCA, 62*, 3161–3168. [5] Ash R. D. and Young E. D. (2000) *LPS XXXI*. [6] Galy et al. (2000) *LPS XXXI, 90*, 1151–1154. [7] Clayton R. N. and Mayeda T. K. (1999) *GCA., 63*, 2089–2104.