MAGNESIUM ISOTOPES IN THE ULTRAREFRACTORY CAI EFREMOVKA 101.1 : EVIDENCE OF OPEN SYSTEM BEHAVIOR.

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Efremovka 101.1 is an unusual compact type A Calcium-Aluminum-rich Inclusion (CAI) with several lithological sub-units that may once have been individual free-floating CAIs in the early solar nebula [1]. All sub-units share an ultra-refractory Rare Earth Elements abundance pattern and an ultra-refractory fassaitic clinopyroxene enriched in Sc and Zr is locally observed [1]. E101.1 is surrounded by a well preserved Wark-Lovering rim (WLR) and a partially preserved olivine-rich accretionary rim (AR) In order to understand the formation of this enigmatic object and the implications for isotopic fluctuations in the nebular gas we started an exhaustive isotopic study of E101 using the UCLA IMS1270 ion microprobe combining O [2], Mg (this work) and Si isotopes [3]. 85 high precision Mg isotope analyses, spatially associated with O isotope analyses whenever possible, were obtained using a ~15 nA, ~30 µm O^- beam and simultaneous detection of ^{24}Mg, ^{25}Mg, ^{26}Mg and ^{27}Mg on four Faraday cups.

Mg isotopic analyses of E101.1 reveal a highly complex distribution of both Mg isotopic mass fractionation and ^{26}Mg excesses due to ^{26}Al decay. As a whole, different regions in the CAI have different Mg isotope systematics. This includes the rims, the different lithological sub-units of possible xenolithic origin, as well as different domains defined using O isotopes [2]. $\delta^{25}Mg$ values range from -6.5 ‰ (melilite in subinclusion 1) to +6.7 ‰ (spinel clusters in the host) with values in the rims clustering around 0‰. Initial $^{26}Al/^{27}Al$ ratios in sub-components range from supra-canonical (7.1×10^{-5} in the Sc-Zr-fs) down to 1.8×10^{-5} in disturbed melilite from the host. Olivine in the AR is enriched in ^{26}Mg by ~0.16‰. A more complete description of the isotope systematics will be presented at the meeting. To summarize, Mg isotopes suggest open-system behavior of Mg with evaporation as well as incorporation of light Mg possibly from the digestion of xenolithic inclusions or by direct condensation from nebular gas. The lightest components, sinuous fragments and possibly subinclusion 1, can probably be considered as xenoliths. E101.1 likely had an initial canonical $^{26}Al/^{27}Al$ ratio but secondary disturbances resulted in both higher and lower than canonical ratios in specific components. Mg isotopes in the WLR are in agreement with previous studies suggesting a younger age although some spinels having a larger ^{26}Mg excess may be derived from the interior. Comparison with O isotopes will also be presented at the meeting.

References: [1] El Goresy et al. 2002. *Geochim. Cosmochim. Acta* **66**, 1459-1491. [2] Aléon et al. 2010. *Meteorit. Planet Sci*. **45**, A7. [3] Marin-Carbonne et al. 2011, *this conference*.