OXYGEN ISOTOPE ANATOMY OF A COMPOUND CAI-CHONDRULE INCLUSION FROM EFREMOVKA. J. Aléon[1] and M. Bourot-Denise[2]. [1]CSNSM, Bat 104, 91405 Orsay Campus, France. Jerome.Aleon@csnsm.in2p3.fr. [2]LMCM, Museum National d'Histoire Naturelle, 61 rue Buffon, 75005 Paris, France.

Introduction: We recently reported the discovery of E-MNHN-002, a compound Ca-Al-rich Inclusion (CAI) - chondrule object from the reduced CV3 chondrite Efremovka, composed of an amoeboid olivine aggregate (AOA) core surrounded by a type I chondrule mantle [1]. Its petrographic study indicates that a Ca-Al-rich AOA accreted an olivine + metal mantle akin to the precursors of type I chondrules and that this compound precursor underwent partial melting in the conditions of chondrule formation with inward diffusion of SiO_2 condensed from the nebular gas and concomitant outward diffusion of refractory elements. To confirm this interpretation and obtain new insights on CAI and chondrule formation we performed a detailed O isotopic study of E-MNHN-002 and several neighbouring chondrules by multicollector SIMS with the IMS 1270 ion microprobe at the CRPG national facility in Nancy, France, using well-established analytical procedures. Typical errors were between 0.3‰ and 1‰ (2σ), allowing a detailed study of small mass fractionation effects.

Results and discussion: O isotopes in E-MNHN-002 plot along a slope 1.0 line [2] with the innermost AOA spinels (sp) being the most ^{16}O-rich minerals ($\delta^{17}O \approx \delta^{18}O < -40‰$). An O isotope exchange with a ^{16}O-poor outer reservoir is recorded by ^{16}O depletions correlated with both mineralogy [sp < olivine < pyroxene (px) < plagioclase (plag)] and position in the inclusion (interior < exterior). Minerals in the chondrule mantle lay at the ^{16}O-poor end of the trend with low-Ca px being systematically the most ^{16}O-depleted mineral (apart from mesostasis) and having O isotopic compositions similar to those observed in chondrules ($-13‰ < \delta^{17}O \approx \delta^{18}O < -9‰$)[3]. This distribution of O isotopic compositions indicates that O isotope exchange occurred during the melting event that formed the chondrule mantle. The correlation with the mineralogy and the analogy with chondrule observations, support the suggestion that ^{16}O-poor nebular SiO gas condensed as SiO_2 into a ^{16}O-rich partial melt. Mesostasis in the chondrule portion appears to be mass fractionated relative to the rest of the object ($\delta^{18}O = +5.61‰$; $\delta^{17}O = +0.28‰$) and plot on the Carbonaceous Chondrite Anhydrous Minerals (CCAM) mixing line [4]. The comparison with several mesostasis-rich type I chondrules suggests that this mass fractionation could be due to evaporation of the residual melt during cooling.

Similarly to coarse-grained type B CAIs, intergrown plag and cpx are ^{16}O-enriched to different degrees, with plag systematically ^{16}O-depleted relative to cpx, although the isotopic difference is much smaller than that in type B CAIs. This suggests a comparable O isotope exchange process, albeit with a different amplitude, possibly due to different cooling rates, as suggested by grain size differences (E-MNHN-002 being much more fine-grained than type B CAIs).

E-MNHN-002 thus presents O isotopic characteristics both of chondrules and CAIs and may shed light on the formation of both types of objects.

References: [1] Aléon J. and Bourot-Denise M. 2008. *LPSC* 39, 1638. [2] Young E. D. and Russell S. S. 1998. *Science* 282, 452. [3] Chaussidon M. et al. 2008. *GCA* 72, 1924. [4] Clayton R. N. et al. 1977 *EPSL* 34, 209.