OXYGEN ISOTOPE EXCHANGE IN CAIS AND CHONDRULES: IMPLICATION FOR OXYGEN ISOTOPE RESERVOIRS IN THE SOLAR NEBULA. A. N. Krot[1], H. Yurimoto[2], I. D. Hutcheon[3], and E. R. D. Scott[1]. [1]HIGP/SOEST, USA. [2]Tokyo Institute of Technology, Japan. [3]LLNL, USA.

On a three-oxygen isotope diagram, compositions of CAIs, AOAs, and chondrules in primitive chondrites plot along a slope of ~1, with CAIs and AOAs enriched in ^{16}O compared to chondrules [1]. This mass-independent fractionation must have resulted from mixing of the ^{16}O-rich, solid and ^{16}O-poor, gaseous reservoirs in the solar nebula [1]. It has been suggested that the initial O-isotopic composition of the solar nebula was uniformly ^{16}O-rich (^{17}O ≤ -20‰) [2-4] and that the ^{16}O-poor (^{17}O > 0‰) gaseous reservoir formed over a life-time of the solar nebula by isotopic self-shielding in the UV photolysis of CO either at the X-point [3] or at the surface of the protoplanetary disk [4]. The alternative models invoke self-shielding of CO in the protosolar molecular cloud [5] or the initial O-isotopic heterogeneity (^{16}O-rich solids and ^{16}O-poor gas) of the solar nebula [6], and predict the very early generation of an ^{16}O-poor gaseous reservoir in the solar nebula. Such a reservoir could have been recorded by CAIs and chondrules, which represent the first solids formed in the solar nebula. The existence of an ^{16}O-rich, nebular gaseous reservoir can be inferred from ^{16}O-rich compositions of the refractory nebular condensates, CAIs and AOAs [7]. The existence of an ^{16}O-poor, nebular gaseous reservoir ~2-3 Myr after the onset of the CV CAI formation can be inferred from O-isotopic exchange recorded by the CR chondrules [8] and their absolute ages [9]. Coarse-grained CAIs in CVs have heterogeneous O-isotopic compositions: spinel and fassaite are enriched in ^{16}O, compared to anorthite and melilite. Due to the incomplete melting of the CV CAIs [10], their complex, multistage formation history [11], and the late-stage disturbance of their Al-Mg systematics [12], the nature and timing of this exchange remain controversial. Most CAIs in CRs [13], CHs [14], and COs (3.0) [15] are uniformly ^{16}O-enriched (^{17}O ≤ -20‰). The ^{16}O-rich, igneous CAIs in CRs have a canonical (^{26}Al/^{27}Al) ratio of ~5×10^{-5} [16], suggesting that they experienced early melting in an ^{16}O-rich gaseous reservoir. Some igneous CAIs in CRs, CHs, COs (3.0), and all CAIs in CBs [17] are ^{16}O-depleted (^{17}O > -10‰). Two ^{16}O-poor, Type C CAIs in CRs have low $(^{26}Al/^{27}Al)_0$ (<7×10^{-6}) [16], similar to those of the CR chondrules [18], suggesting that these CAIs experienced O-isotopic exchange during late-stage (>2.5 Myr after beginning of CAI formation) melting that overlapped with chondrule formation. Another ^{16}O-poor Type C CAI in CRs has a canonical $(^{26}Al/^{27}Al)_0$ ratio [$(4.0\pm1.8)\times10^{-5}$], suggesting the very early, i.e. at the beginning of CAI formation, existence of an ^{16}O-poor gaseous reservoir, consistent with models of [5] and [6].

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