PHOTOCHEMICAL ISOTOPE EFFECTS IN THE EARLY SOLAR SYSTEM. R.N.Clayton, Enrico Fermi Institute, University of Chicago, Chicago IL 60637. E-mail: r-clayton@uchicago.edu.

There is increasing consensus on the role of photochemistry in establishing the large non-mass-dependent (NMD) isotopic variations observed in oxygen in solar system materials. A prime candidate process is isotopic self-shielding in the photolysis of gaseous carbon monoxide. Still at issue are the questions of where and when this might have occurred. One class of models requires low temperatures, so that atomic oxygen, enriched in ^{17}O and ^{18}O, combines with H_2, and is trapped as water ice to form an isotopically distinct reservoir, which can later undergo evaporation and chemical interaction with oxygen of solar system composition to produce slope-1 linear mixing arrays. In the model of Yurimoto and Kuramoto [1], this "cold place" is the molecular cloud from which the solar nebula formed; in the model of Lyons and Young [2], the "cold place" is the solar nebula at tens of Astronomical Units (AU) from the Sun. In these models, the UV light required for photolysis is probably produced primarily by bright, young neighboring stars. A third scenario is based on the X-wind model of Shu et al. [3], in which the young Sun is the light source, and photochemistry occurs at about 1500K at a distance of <0.05 AU from the Sun. All of these models are compatible with the Genesis observation that the solid bodies of the inner solar system are enriched in ^{17}O and ^{18}O relative to the present-day Sun (and the average solar system) [4]. Only the X-wind picture accounts in a natural way for the chemical and isotopic evidence that primitive meteoritic CAIs are primary condensates from a solar gas [5]. The main reason that the location is important is the possible distinction between the inner and outer solar system. The "cold" models require that all planetary matter has gone through the NMD processing, whereas the X-wind model might affect only the inner solar system plus whatever material was ejected to great distances, as in Inti, the CAI found in the Stardust collection [6]. A critical test of this question lies in the isotopic composition of solar nitrogen, which is still in dispute [7,8,9]. Recent measurements of nitrogen isotope abundances in meteorites have shown enhancements of the $^{15}N/^{14}N$ ratio by factors of >2, [10,11], which may be beyond what can be achieved by low-temperature ion-molecule chemistry, and may require another mechanism, such as photochemistry.

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