ENRICHMENT OF L-ISOVALINE BY AQUEOUS ALTERATION ON CI AND CM METEORITE PARENT BODIES. D. P. Glavin and J. P. Dworkin. NASA Goddard Space Flight Center, Greenbelt MD 20771. E-mail: daniel.p.glavin@nasa.gov

Introduction: The finding of slight to significant enantiomeric excesses for several indigenous amino acids in the Murchison and Murray CM-type meteorites [1-3] could point toward an exogenous origin of biological homochirality on the early Earth. UV circularly polarized light (UV-CPL) in the presolar cloud has been proposed as one possible source of the initial amino acid symmetry [4]. However, in order to produce the largest 15.2% L-excess previously reported for isovaline in Murchison [3], more than 99% of the amino acid would have to be destroyed by UV-CPL [5]. Another possibility is that a small initial imbalance was amplified under aqueous conditions in the meteorite parent body [6, 7]. To investigate the role of aqueous alteration in amino acid asymmetry in carbonaceous meteorites, we studied the distribution and enantiomeric composition of the 5-carbon amino acids found in the aqueous altered CI Orgueil, CM meteorites Murchison and LEW 90500, and less altered CM LON 94102 and CR meteorites QUE 99177 and EET 92042 using liquid chromatography time of flight mass spectrometry [8].

Results and Discussion: We measured a large L-enantiomeric excess of the α-methyl amino acid isovaline in the CM meteorite Murchison (18.5 ± 2.6%) and the CI meteorite Orgueil (15.2 ± 4.0%). The excess found in Murchison is the largest reported for any meteorite. Interference from all other possible five carbon amino acid isomers, analytical biases, and terrestrial amino acid contamination were ruled out as a possible source of the L-excess. In contrast, we observed no L-isovaline enrichment for the most primitive unaltered Antarctic CR meteorites EET 92042 and QUE 99177. These results are inconsistent with UV-CPL as the primary mechanism for L-isovaline enrichment and indicate that amplification of a small initial imbalance occurred during an extended aqueous alteration phase on the meteorite parent bodies.

Conclusion: The large enantiomeric excesses in isovaline that have previously been detected in Murchison have now been independently confirmed by using a different analytical technique and the finding that the CI meteorite Orgueil also contains a similar enrichment of L-isovaline provides additional support that a wide variety of altered carbonaceous chondrites could have contributed meteoritic amino acids to the origin of homochirality on Earth and possibly elsewhere. The impact of extraterrestrial input versus local abiotic synthesis of asymmetric amino acids on the origin of homochirality in life on Earth is unknown. However, the fact that only L-amino acid excesses have been found in meteorites analyzed so far (no D-excesses) may indicate that the origin of life on Earth and possibly elsewhere in our solar system was biased toward L-amino acids from the very beginning.

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