IN-SITU STUDY OF OXYGEN ISOTOPES IN GRAPHITE FROM L3 CHONDRITES: INDICATIONS FOR OXYGEN ISOTOPIC HETEROGENEITY. S. Mostefaoui, F.J. Stadermann, and A. El Goresy. Max-Planck-Institut für Kernphysik, Postfach 103980, 69029 Heidelberg, Germany (E-mail: smail@pluto.mpib-hd.mpg.de); McDonnell Center for the Space Sciences and Physics Department, Washington University, St. Louis, MO 63130, USA.

In a previous in-situ study of graphite-bearing assemblages in ordinary chondrites we found large H and N isotopic anomalies in a fine-grained graphite morphology from various chondrites. We interpreted these as the result of ion-molecule reactions in the interstellar molecular cloud (IMC) from which the solar system formed [1,2]. Here we report in-situ measurements of oxygen isotopes in graphite from the Khohar and Mezö-Madaras (L3) chondrites.

Oxygen isotopic measurements were conducted with the Washington University ion microprobe (a modified Cameca IMS-3F) using a Cs+ beam at high mass resolving power. Laboratory graphite was used as a standard to determine the instrumental mass fractionation. The meteoritic graphites are fine-grained and mixed with Fe-Ni metal (see [2]), and in most cases had been extensively sputtered. Thus, analyses contain contamination from the surrounding phases and the isotopic results must be considered with caution. Here, we report 22 measurements on 6 graphite assemblages from Khohar and 5 from Mezö-Madaras (both L3s).

The results show that all the graphites have normal oxygen isotopic signatures (i.e. no extreme deviation from the terrestrial standard). Since the SMOW-normalized oxygen isotopic composition of the terrestrial standard is not known, there is some uncertainty concerning the absolute δ-values for these measurements. However, the results clearly indicate variations in the isotopic compositions of the different graphites relative to each other in Khohar. These variations (along the terrestrial fractionation line) are on the order of 20% for the 18O/16O ratio. The graphites from Mezö-Madaras on the other hand have more homogeneous oxygen isotopic compositions.

The isotopic ratios in Khohar vary not only from one assemblage to another, but also within the same graphite assemblage. In one measurement of only 16O and 18O, we found 16O excesses of almost 100% in the first two blocks of a 15 block analysis, with δ18O increasing with time toward a normal ratio. This result hints at the presence of a small phase of isotopically anomalous material, that sputtered away during the measurement. However, since only two isotopes of oxygen were measured, we cannot be certain that the isotopic composition in fact lies off of the terrestrial mass fractionation line. Attempts to reproduce this result with a three-isotope oxygen measurement at the same location were not successful.

Although the data are rather limited, the results reported here are the first in-situ measurements of oxygen isotopic ratios in graphite from chondrites. Whereas H and N in graphite are enriched in D and 15N [2], oxygen isotopic ratios are normal. This is not unexpected, since O isotopic fractionation by ion-molecule reactions in the IMC is predicted to be small [3].

However, the O isotopic ratios in the graphite are more variable than in bulk ordinary chondrites [4]. This seems to reflect an intrinsic isotopic variation, which may be due to the presence of isotopically different graphite components that did not equilibrate with one another. The possible enhancement in 18O observed in one measurement of Khohar is intriguing and suggests the presence of an isotopically anomalous phase in the graphite. Unfortunately, because this phase appears to be very small, it cannot be measured in detail with current ion microprobes. Future work will include the measurement of H isotopes in graphite from Mezö-Madaras.