ORDINARY CHONDRITE CHONDRULES: OXYGEN ISOTOPE VARIATIONS. K. Metzler[1], A. Pack[2], and D. C. Hezel[3], [1]Institut für Planetologie, Westfälische Wilhelms-Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany (knut.metzler@uni-muenster.de). [2]Geowissenschaftliches Zentrum, Abteilung Isotopengeologie, Georg-August-Universität Göttingen, Goldschmidtstr. 1, 37077 Göttingen, Germany. [3]Institut für Geologie und Mineralogie, Universität zu Köln, Zülpicher Str. 49b, 50674 Köln, Germany.

Introduction: Chondrules from ordinary chondrites (OCs) plot above the terrestrial fractionation line in the oxygen 3-isotope diagram, falling along a correlation line [e.g. 1-3]. This line with a slope between 0.63 and 0.77 for unequilibrated OCs [2-4] can be interpreted as a mixing line between ^{16}O-rich chondrule material and a ^{16}O-poor component, e.g. nebular gas [e.g. 5]. It is argued by [7-8] that exchange reactions with ^{16}O-poor fluids on the parent body can also explain the above correlation. It was shown by [6,8] that LL3 chondrule mesostasis is usually enriched in heavy oxygen compared to co-crystallized olivine and pyroxene. This indicates that chondrule mesostasis was altered to some extent on the parent body, leading to an increase of ^{17,18}O. Although this alteration may have somewhat modified the original mixing line, it cannot be the general reason for its slope and extension. Most reported mesostasis δ^{18}O values are between 3 and 10‰, i.e. just in the range of bulk LL3 chondrule values (4-9‰ [3]) and hence cannot have shifted original bulk chondrule values considerably. Although some mesostasis δ^{18}O values are as high as 17‰ [6], mass balance considerations reveal that the influence of such enhanced δ^{18}O values on bulk chondrule values should be small, since the modal amount of mesostasis rarely exceeds 15 vol%.

A systematic dependence of oxygen isotopic composition on chondrule size was described by several authors. A <u>negative</u> size vs. δ^{18}O correlation was observed in the LL3.4 chondrite Chainpur by [7] and in a cluster chondrite clast from NWA 5205 (LL3.7) [3], but not in Parnallee (LL3.6) [9] or Bo Xian (LL3.9) [10]. The variation in Chainpur might reflect a more extensive exchange of smaller chondrules with surrounding ^{17,18}O-rich material due to their larger surface/volume ratio [7]. If this interpretation is right, this exchange should have occurred when chondrules where molten, since parent body processes probably influenced the oxygen isotopy of bulk chondrules only marginally (see above). On the contrary, a <u>positive</u> size vs. δ^{18}O correlation was observed in the H chondrites Dhajala (H3.8) and Weston (H4) [5]. No correlation at all between size and δ^{18}O was found by [11] in a set of size-sorted chondrules from Tieschitz (H/L3.6).

Samples and analytical methods: To further investigate this unexpected relationships between size and O-isotopic composition, we separated 49 chondrules from 4 different OCs (H, L, L/LL, LL) [12]. The investigated samples are (number/size range of chondrules): NWA 2465 H4 (13/0.5-2.9 mm); Saratov L4 (12/0.4-2.3 mm); Bjurböle L/LL4 (11/0.4-2.4 mm); NWA 7545 LL4 (13/0.4-2.9 mm). All chondrules were documented by micro-computed tomography (µ-CT). Their bulk oxygen isotopic compositions were measured by IR laser fluorination. Oxygen isotope values for their host meteorites were obtained by the same method.

Results: As expected, chondrules from the investigated OCs plot along mixing lines in the oxygen 3-isotope diagram with variable positive slopes. Although our bulk oxygen isotope data for Bjurböle and Saratov are indistinguishable within errors from literature values [5], the investigated chondrules from all 4 samples show higher δ^{18}O values than their bulk meteorites. A similar observation for H chondrites was already described in [5]. Either the majority of the small (< 500 µm) non-analyzed chondrules and/or interchondrule matrix should represent the complementary component to yield the comparatively low δ^{18}O values of the bulk meteorites.

In case of the investigated L4, L/LL4, and LL4 samples we could not observe any distinct correlation between chondrule size and oxygen isotopic composition. However, the H4 chondrite shows a well-defined positive correlation, confirming similar observations on other H chondrites [5].

Conclusions: If the OC chondrules mixing line in the oxygen 3-isotope diagram formed by the interaction of chondrule melts and their nebular surroundings, and if the observed size vs. δ^{18}O correlations reflect more severe reactions of small chondrules during this process, then chondrules from LL chondrites [e.g. 3] and H chondrites exchanged with very different oxygen isotope reservoirs. In this case the H-reservoir was distinctly more ^{16}O-rich compared to that of LL chondrites [12]. The difference in δ^{18}O values between large (~2mm) chondrules from the LL chondrite NWA 5205 [3] and the H4 chondrite NWA 2465 is large (~4‰; δ^{18}O: ~6‰ vs. ~10‰). This indicates that chondrules from the various OC chemical groups cannot stem from a common chondrule reservoir.

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