AN OXYGEN ISOTOPIC LINK BETWEEN RUMURUTI AND ORDINARY CHONDRITES FROM OMAN: EVIDENCE FROM THE CHONDRULES IN DHOFAR 1671 (R3.6). ARSHAD ALI[1], SOBHI J. NASIR[1] and IFFAT JABEEN[2], [1]Earth Sciences Research Centre (ESRC), Sultan Qaboos University, Al-Khodh, Muscat 123, Sultanate of Oman (arshadali@squ.edu.om, sobhi@squ.edu.om) , [2]Department of Earth Sciences, Western University, 1151 Richmond St. N., London, ON, N6A 5B7 Canada (ijabeen67@gmail.com).

Introduction: The link between Rumuruti chondrites (RCs) and ordinary chondrite (OCs) has been continuously discussed, ever since after the recognition of the former as a distinct group; mainly on the basis of their oxygen isotope compositions in different components [1-5]. The chondrules are micrometer- to millimeter-sized astrophysical objects and represent the major constituents of RCs (mean diameter = 400 μm; [6]), OCs (L-H-LL = 450–550 μm; [6]) and other chondrite groups. Most of them comprised mainly of olivine and low-Ca pyroxene embedded in varying abundances of fine- to coarse-grained matrix materials (e.g., RCs = 42 vol%, OCs = 12 vol%; [7]). Our recent studies on oxygen isotope compositions in Dhofar 1671 (R3.6; [5]) and OCs (H5, L6; [8]) are the basis of this abstract. Precise oxygen isotope data of these meteorites were obtained using the methodology adopted by [9]. These meteorites are recent finds from the deserts of Oman.

Review of the OCs (H5, L6): The bulk chemical compositions of recent OC finds (H5, L6; [8]) generally reflect isochemical features which is consistent with the progressive thermal metamorphism of a common, unequilibrated starting material [8]. The oxygen isotope data also demonstrate that the isotopic equilibrium during progressive thermal metamorphism had been attained following a mass-dependent isotope fractionation trend [8]. Both groups show a ~slope-1/2 line on a three-isotope plot.

Review of the Dhofar 1671 (R3.6): It is a brecciated meteorite, like most of other RCs, has recently been reclassified as a Rumuruti meteorite (originally classified as CV3; MB 101) having petrologic type of R3.6. A detailed petrographic account is given elsewhere [5]. The major and REE compositions [5] are generally in agreement with average values of the RCs [10]. The chondrules of different types such as porphyritic-olivine-pyroxene (POP), radial pyroxene (RP) and barred olivine (BO) are embedded in proportionately equal volume of matrix [8]. The chondrules containing different types of olivines are shown in Fig. 1. Chondrules that do not contain zoned olivines (i.e., Fe-poor cores and Fe-rich rims) appear to have a surrounding fine-grained accretionary rim (Fig. 1a), while others with zoned olivines appear to lack these accretionary rims. Precise oxygen isotope compositions of bulk materials, matrix and chondrules are reported in [5]. In the following section, we will discuss the possible relationship between RCs and OCs using bulk oxygen isotope compositions of chondrules (Table 1) in Dhofar 1671 taken from [5].

Discussion: When we plotted the bulk oxygen isotope compositions of OCs (H5, L6; [8]) with those of chondrules in Dhofar 1671 (Table 1), we found that, chondrules are connecting the L6 OCs line with the RCs (Fig. 2). In addition, the distinguishing characteristic of the Dhofar 1671 data of bulk materials, some fine- & coarse-grained matrices along with few chon-

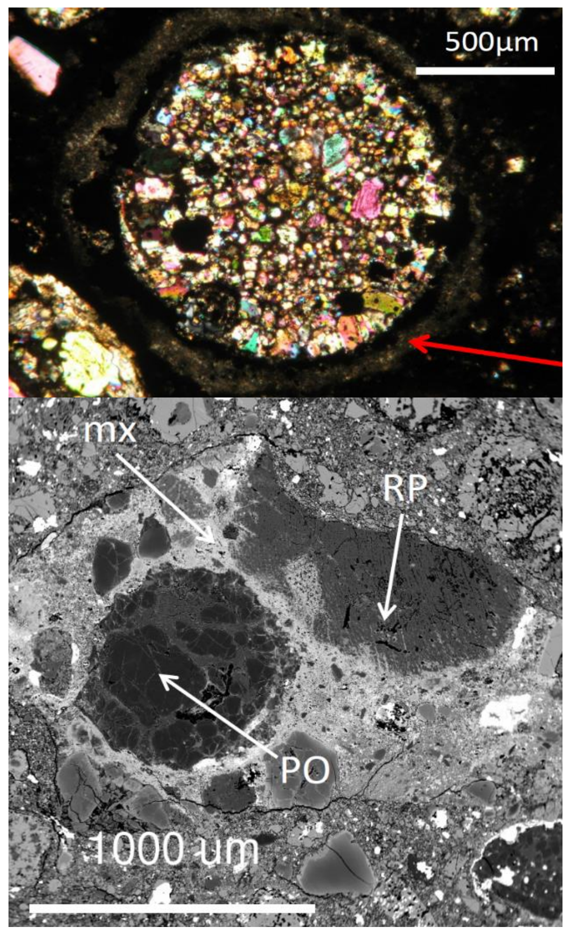

Fig. 1. Images of chondrules in Dhofar 1671, (a) POP chondrule with a fine-grained accretionary rim (red arrow) shown in transmitted light; (b) BSE image of a lithiclast consisting of a PO, RP chondrule in a ferroan matrix (mx).

drules is their identical elevated Δ^{17}O values (i.e., +2.2 ‰ to +2.9 ‰; 5]. The slope-1/2 line of RCs is constructed from the data of fine-grained matrix of Dhofar 1671 [5] given its spread in δ^{18}O relative to the coarse-grained matrix data [5].

Furthermore, most of the bulk, fine- and coarse-grained data of Dhofar 1671 fall along the trend shown by previous studies [10 and references therein; not shown here for simplicity]. Similar to the seemingly strong link revealed by chondrules in Dhofar 1671 with the OCs from Oman; it has recently been reported that Dhofar 1671 is also related to components of other RCs, and OCs [5]. It is important to note that the isotopic equilibrium had been achieved on parent asteroidal bodies of both chondritic groups during the thermal metamorphism (Fig. 2).

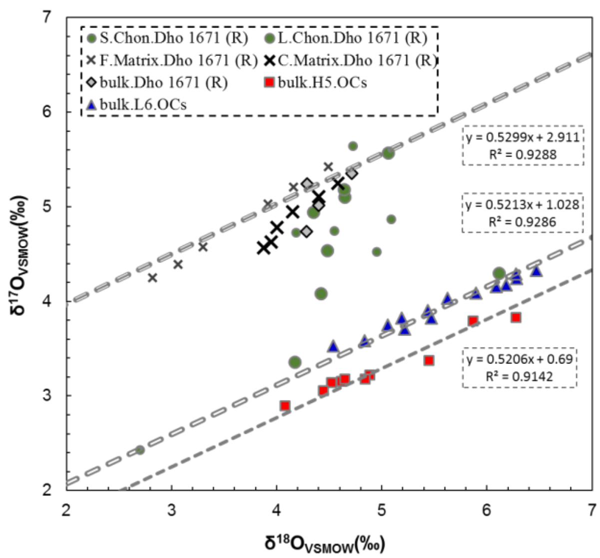

Fig. 2. Plot of oxygen isotope data of OCs (H5, L6) taken from [8] and various components separated from the Dhofar 1671 (R3.6) such as bulk, matrix, & chondrules [5]. S.Chond. = small chondrules. L.Chond. = large chondrules. F = fine-grained. C = coarse-grained.

As discussed in [5], the short mixing trajectory shown by mainly large chondrules between the OCs and RCs (Fig. 2) suggests that OCs chondrule precursors could have interacted with a ^{17}O-enriched gas (probably H_2O) reservoir; leading to shift Δ^{17}O values from OCs (~1 ‰) to that of the RCs (~3 ‰) in the solar nebula; followed by aqueous alteration on an asteroidal setting. Such high ^{17}O-bearing matrix components had, similarly, taken part in the formation of magnetites in OCs [e.g., Semarkona LL3.0 and Ngawi LL3.6; 10] and RCs [e.g., PCA91241 R3.6-8; 1] on an asteroid. The abundance of matrix in RCs (42 vol%) relative to the OCs (12 vol%), confirmed that the former are apparently more oxidized and ^{17}O-rich. It is quite possible that these isotopic exchange processes could have occurred simultaneously as "exotic" clasts in brecciated samples formed such as NWA 10214 (LL3-6; [4]), Parnallee (LL3; [12]), PCA91241 (R3.8-6; [1]), and Dhofar 1671 (R3.6; [5]).

Conclusions: We conclude that the chondrules in Dhofar 1671 unequivocally show a genetic relationship between their host rock and the OCs found in Oman, especially the L6 type. The chondrule precursors of OCs (probably L type) could have underwent an isotopic exchange with ^{17}O-enriched gas in the solar nebula. Isotopic equilibrium at parent asteroidal bodies had possibly been achieved during the thermal metamorphism. Authors recommend to carry out a comprehensive in-situ isotope analyses of different types of chondrules in Dhofar 1671 to further investigate the relationship between RCs and OCs.

Table 1: Oxygen isotope compositions of bulk chondrules in Dhofar 1671.

Chondrule	NCA	Mass (mg)	Mass/C (µg)	δ^{17}O (‰)	δ^{18}O (‰)	Δ^{17}O (‰)
(Small)						
1	10	0.85	85	4.524	4.953	1.934
2	11	1.11	101	4.724	4.185	2.532
3	8	1.07	134	2.426	2.702	1.014
4	7	0.96	137	4.743	4.547	2.362
5	4	0.86	215	5.641	4.728	3.161
6	4	0.94	235	4.867	5.087	2.205
(Large)						
1	3	0.97	310	4.080	4.422	1.767
2	2	0.77	385	5.182	4.643	2.749
3	2	1.01	505	5.101	4.649	2.665
4	1	0.68	680	4.943	4.350	2.664
5	1	0.98	980	5.571	5.064	2.917
6	1	1.03	1030	3.359	4.175	1.177
7*	1	1.09	1090	4.536	4.484	2.189
8	1	1.50	1500	4.299	6.116	1.105

NCA = number of chondrules lased in a single analysis. Mass/C = mass per chondrule. * = broken fragment of a chondrule. Data source = [8].

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