CRYSTALLIZATION EXPERIMENTS OF DAR AL GANI MARTIAN METEOITES: A PRELIMINARY REPORT. E. Koizumi[1], T. Mikouchi[1], A. Monkawa[1], M. Miyamoto[1], [1]Department of Earth and Planetary Science, Graduate School of Science, University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-0033, Japan, E-mail: koi@space.eps.s.u-tokyo.ac.jp

Introduction: Recently, a lot of basaltic shergottites have been found from the desert areas in northern Africa and Middle East Asia. Most of them contain large olivine grains that are not present in the previously known basaltic shergottites (except for EETA79001). These olivine grains are mostly Mg-rich, but they show different mineralogical features in each meteorite. Dar al Gani 476 and its paired samples are mainly composed of olivine, pyroxene and plagioclase (now transformed into “maskelynite”). Olivine is present as a megacryst, and its core is too Mg-poor to be in equilibrium with its bulk composition. Pyroxene in Dar al Ganis are more Mg-rich than those of the other basaltic shergottites, and rather similar to those in lherzolitic shergottites [1,2]. Therefore, Dar al Ganis are believed to offer significant information on the relationship between lherzolitic shergottites and basaltic shergottites or other martian meteorites. Oxygen fugacity under which Dar al Gani crystallized was estimated about QFM-2.3 [3]. In this abstract, we present the initial results of our ongoing crystallization experiments on the bulk composition of Dar al Gani shergottites to advance understanding of the formation of these meteorites.

Experiments: The starting composition having the average bulk compositions of Dar al Gani 476 and 489 [4,5] were prepared (Table 1). Na and P are lower than those of the bulk Dar al Ganis because of the problem on the process of making the glass, but both elements hardly affect mineral crystallization except late-stage minerals. Pellets of the starting material were suspended in vertical furnaces at 1450^{o}C for 48 hours for homogenization, and then quenched to room temperature. Glass charges were put back into the furnace and held for another 48 hours at the target temperature, then quenched in air and analyzed by electron microprobe. The oxygen fugacity was controlled at IW+1.5 by gas mixture of H_2-CO_2.

Table 1. Bulk compositions of QUE94201 and synthetic glass starting material

	Bulk composition of Dar al Gani meteorites	*Synthetic glass composition*	Dar al Gani 476 groundmass composition
SiO_2	48.32	49.12	52.61
TiO_2	0.38	0.83	0.33
Al_2O_3	4.43	5.30	6.63
FeO	16.84	15.31	13.20
MnO	0.44	0.48	0.44
MgO	20.05	20.06	17.82
CaO	8.01	8.06	7.20
Na_2O	0.55	0.09	0.77
K_2O	0.04	0.04	0.03
Cr_2O_3	0.53	0.50	0.50
P_2O_5	0.42	0.14	0.39
Total	100.01	100.03	100.02

Table 2. Phase assemblage of the crystallization experiments.

Temperature(^{o}C)	*Phase*
1425	Glass
1400	Olivine, Glass
1375	Olivine, Glass
1350	Olivine, Glass
1300	Olivine, Pyroxene, Opaque, Glass

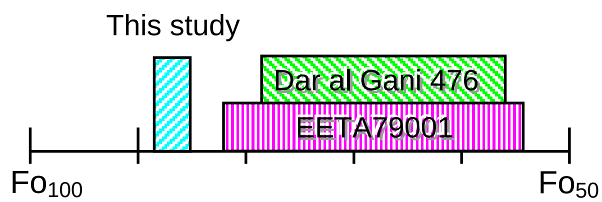

Fig. 1. Comparison of olivine compositions between isothermal runs, Dar al Gani 476 and EETA79001 (lithology A).

Results: Table 2 gives the phase assemblage of a series of these experiments. In the 1425^{o}C experiment, no minerals crystallized. Olivine crystallized in the experiment at 1400^{o}C and lower temperatures. Therefore, liquidus temperature of this composition is between 1425 and 1400^{o}C. The size of olivine is ~200 µm at the largest size. Many orthopyroxene grains (~ a few tens of µm) and opaque mineral (chromite) (<10 µm) crystallized at 1300^{o}C. All olivine is homogeneous in the same experiment and its Fe content increase as temperature becomes lower (Fo_{88} at 1400^{o}C, Fo_{87} at 1375^{o}C, Fo_{86} at 1350^{o}C, and Fo_{85} at 1300^{o}C). Olivine in the 1300^{o}C experiment is still more Mg-rich than that of the olivine cores in Dar al Gani 476 (Fo_{76} to Fo_{58}) (Fig. 1) [1]. The partition coefficients of Cr (0.51) and Ca (0.03) between olivine and glass are similar to the reported values (e.g., Irving et al.), as well as that of major elements (Fe/Mg: 0.34). This indicates that olivine in the experiments was fairly in equilibrium with the melt. Pyroxene composition that crystallized at 1300^{o}C is in the orthopyroxene range (crystal structural analysis is required to conclude this) (Fig. 2). Pyroxene is more Mg-rich than that in natural

Dar al Gani 476 by about 8% of the enstatite component. We also compared the experiment results with EETA79001 (lithology A) because pyroxene and olivine compositions in this meteorite are more Mg-rich than those of Dar al Gani meteorites. Pyroxene composition of EETA79001 is more Mg-rich than that of Dar al Gani 476, but more Mg-poor than synthetic pyroxene (Fig. 2) (though more magnesian pyroxene reported by [7]). Al contents of pyroxene in both Dar al Gani 476 and EETA79001 are higher than that of the run product (Fig.3).

We estimated the bulk composition of the groundmass of Dar al Gani 476 by the multianalysis by electron microprobe. More than 1,500 points of groundmass were analyzed by grid and the average of these compositions is shown in Table 1. Si is more enriched and Mg and Fe are poorer than the bulk Dar al Ganis. The obtained composition is broadly similar to that estimated by the mixing calculation by [4]. As is pointed out by [4], molar Fe/Mg of the bulk Dar al Ganis and the obtained groundmass composition is nearly identical (molar Fe/Mg = 0.16).

Discussions: We found that olivine crystallized as a liquidus phase from the bulk Dar al Gani meteorites in our experiments. However, the olivine composition in this study is more Mg-rich (Fo_{88-85}) than that in natural meteorites (Fo_{78-56}), suggesting that the bulk composition does not represent the parent melt of Dar al Gani meteorites. The pyroxene composition that crystallized after olivine in our experiments is also more Mg-rich than that of Dar al Gani 476. The calculation result by the MELTS [8] shows the liquidus phase of the groundmass composition is also olivine, whose composition (Fo_{88}) is equal to that of olivine crystallized from the bulk composition of whole meteorites. This is because there is no difference in the Fe/Mg ratio between the bulk and groundmass compositions. These results indicate that the Fe/Mg ratio of the bulk composition of both whole meteorites and the groundmass is lower than that of the parent melt of pyroxene. Hence, pyroxene in the groundmass is likely to include mafic cumulus component regardless of the origin of olivine. Thus, the parent melt of the groundmass needs to be more Fe- and Al-rich. We are planning to estimate the parent melt composition of the groundmass.

References:

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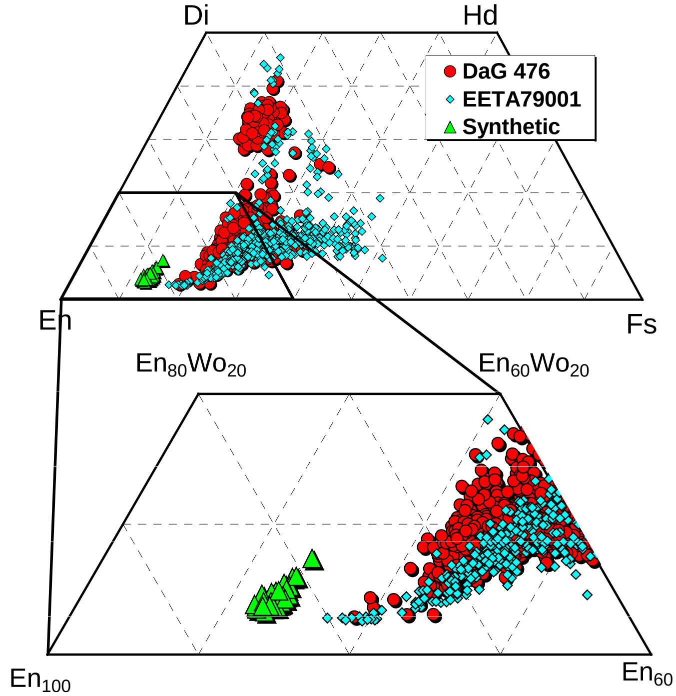

Fig. 2. Pyroxene quadrilateral comparing synthetic pyroxene with Dar al Gani 476 and EETA79001 (lithology A) pyroxenes.

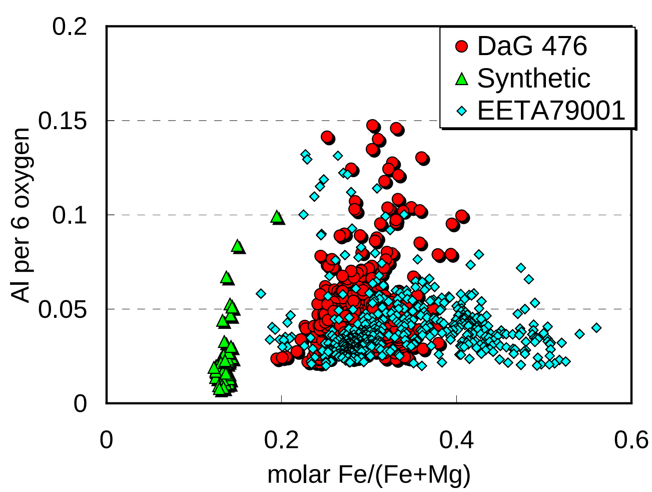

Fig. 3. Comparison of Al contents of pyroxene between synthetic and two martian meteorites.