MINERALOGY AND GEOCHEMISTRY OF SHERGOTTITE RBT 04262. M. Anand[1,2], S. James[2], R. C. Greenwood[3], D, Johnson[3], I. A. Franchi[3] and M.M. Grady[3,2], [1]Department of Earth and Environmental Sciences, The Open University, Milton Keynes, MK7 6AA, UK (M.Anand@open.ac.uk), [2]Department of Mineralogy, The Natural History Museum, Cromwell Road, London, SW7 5BD, UK, [3]Planetary and Space Science Research Institute, The Open University, Milton Keynes, MK7 6AA, UK.

Introduction: RBT 04262 is a newly discovered Martian meteorite from Roberts Massif in Antarctica, which belongs to the shergottite group of Martian meteorites [1]. It is a crystalline, coarse-grained olivine-bearing basaltic shergottite. The Meteorite Working Group (MWG) allocated us two polished sections (RBT 04262,22 & RBT 04262,32), and 1 g rock chip (RBT 04262,14) for carrying out petrological and geochemical investigations.

Petrography and Mineral Chemistry: The rock primarily consists of a coarse-grained mineral assemblage of olivine, pyroxene, and maskelynite. Oxides (Cr-spinel and ilmenite), phosphates, and sulfides occur as minor mineral phases (Fig. 1). Shock effects are evident in the form of extensive cracks in mineral grains and conversion of plagioclase to maskelynite. The mineralogy, Fe to Mn ratios in pyroxene and olivine, oxygen isotopic composition ($\delta^{17}O_{SMOW}$ = 2.617 ‰; $\delta^{18}O_{SMOW}$ = 4.430 ‰; $\Delta^{17}O$ = 0.313) confirm the Martian origin for this sample.

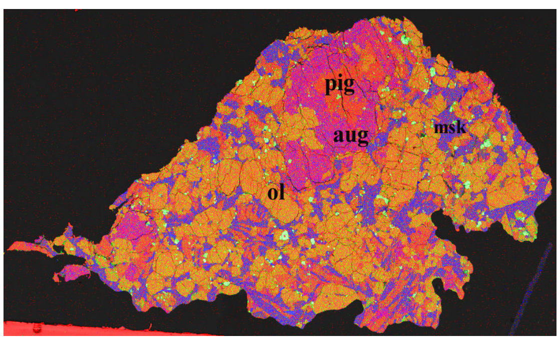

Fig. 1 False colour x-ray map of RBT 04262. Orange = olivine; pink = augite; red = pigeonite; blue = maskelynite, white = oxides. The width of the image is ~ 1 inch.

The modal mineralogy of RBT 04262 is dominated by cumulus olivine and pyroxene (~70%) followed by plagioclase (~30%). Olivine is commonly present as euhedral grains frequently associated with Cr-rich spinel. Both low-Ca (pigeonite) and high-Ca (augite) pyroxene occur in the rock. The pigeonite and augite compositional ranges are $Wo_{3-20}En_{62-50}Fs_{35-30}$ and $Wo_{29-40}En_{50-41}Fs_{21-19}$, respectively (Fig. 2). Olivine grains also show compositional variations in terms of Fe-Mg (Fo_{67-54}). The CaO and MnO contents in olivines vary from 0.09 to 0.36 wt% and 0.53 to 0.73 wt%, respectively. Plagioclase feldspar composition varies from An_{47} to An_{59}. Opaque minerals are abundant and Cr-rich spinel phases are most common, followed by ilmenite. Partially re-crystallized melt-inclusions rich in late-stage fractionates such as K-rich feldspathic glass, phosphates and opaque oxides occur inside olivine and pyroxene grains.

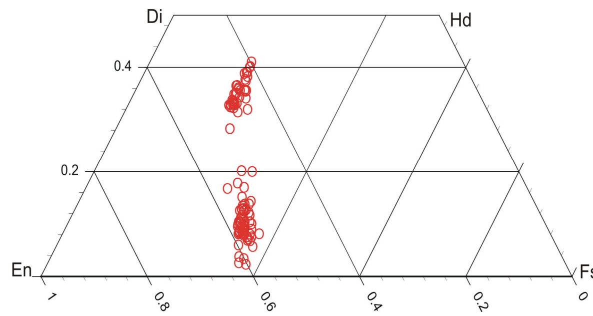

Fig. 2 Variation in pyroxene composition in RBT 04262

Bulk-rock Major- and Trace-element chemistry:

~ 300 mg of rock was powdered for bulk-geochemical work. The major- and trace-element composition of RBT 04262 was determined using an Axial Varian Vista Pro ICP-AES and a Varian 810 ICP-MS

Table 1 Major, trace and REEs in RBT 04262

Majors/Minors	Wt %	Traces	ppm
SiO_2	47.6	Ba	12.8
Al_2O_3	3.32	Be	0.153
FeO (t)	20.6	Bi	<0.05
MgO	21.6	Cd	0.042
CaO	5.66	Co	63.4
Na_2O	0.590	Cr	7152
K_2O	0.080	Cs	0.290
TiO_2	0.430	Cu	6.59
P_2O_5	0.390	Ga	8.20
MnO	0.530	Hf	0.974
		Li	4.30
Total	**100.7**	Mo	0.400
		Ni	291
REEs	**ppm**	Pb	<0.018
La	1.15	Rb	4.03
Ce	2.81	S	1703
Pr	0.414	Sb	0.083
Nd	2.07	Sc	31.0
Sm	0.810	Sn	<0.110
Eu	0.314	Sr	22.2
Gd	1.36	Th	0.257
Tb	0.264	Tl	0.051
Dy	1.75	U	0.058
Ho	0.396	V	218
Er	1.07	W	0.380
Tm	0.155	Y	9.29
Yb	0.960	Zn	73.7
Lu	0.145	Zr	23.1

(Table 1). Major elements were determined by ICP-AES following a lithium metaborate fusion of 40 mg powdered rock sample in a Pt/Au crucible and re-dissolution in dilute nitric acid. Primary calibrations were against international Certified Reference Materials (CRM). Other CRMs were used as a check, and where samples fell outside the primary calibration range. Trace-element concentrations were determined on a 200 mg powdered rock sample by ICP-AES and ICP-MS after digestion by hydrofluoric and perchloric acids and re-dissolution in dilute nitric acid. The instruments were calibrated with synthetic standards, and a number of CRMs were also prepared to check data quality and to correct for any matrix effects.

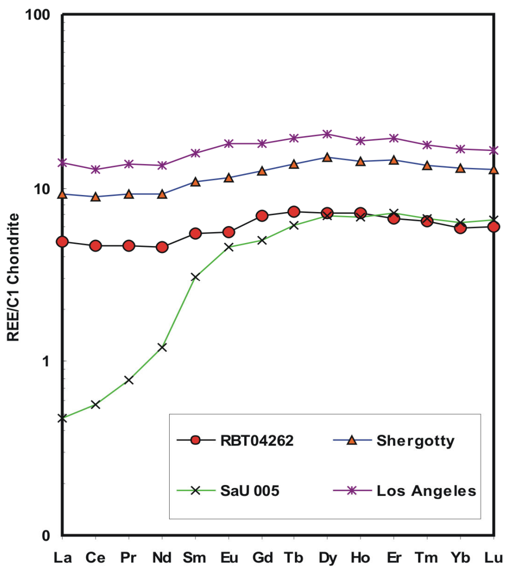

Fig. 3 Chondrite-normalized REE profile for RBT 04262 compared to other shergottites.

In terms of major and trace elements (21.6 wt% MgO, 3.32 wt% Al_2O_3, 31 ppm Sc), RBT 04262 is similar to olivine-phyric shergottites. The bulk-rock Mg# is ~65, most similar to Martian meteorite SaU 005. However, the highest Fo content measured in our RBT sections is only 64, too low to be in equilibrium with bulk-rock Mg# of 65. The original description of this meteorite [1] reported slightly higher Fo content in the olivines (Fo 72). Even this is too low to be in equilibrium with the bulk rock. These calculations along with textural observation clearly suggest that RBT 04262 is an olivine cumulate.

In terms of REEs, RBT 04262 is most similar to basaltic shergottites, Shergotty, Zagami, and Los Angles but has the lowest REE content among them and plots sub-parallel to these samples on a chondrite-normalized REE diagram (Fig. 3). This is consistent with the olivine cumulate nature of RBT 04262.

Summary: RBT 04262 is a new member of the basaltic shergottite group of Martian meteorites. Texturally and mineralogically, this rock is an olivine cumulate. In terms of major element chemistry, it appears more akin to basaltic shergottites, SaU 005 and DaG 476 but in terms of REE’s it appears to be related to basaltic shergottites, Shergotty and Zagami via an olivine accumulation process.

During the next phase of the investigation of RBT 04262 we intend to determine the light element stable isotopic compositions of different components within the meteorite, in order to search for the signatures of primary magmatic carbon, as well as trapped martian atmospheric gases. Measurement of these parameters will enable further comparison of RBT 04262 with the different shergottites sub-groups.

References: [1] Ant. Met. News Lett. (2007), 30(1).