

PARTIAL MELTING OF AUBRITE PARENT BODY: EVIDENCE FROM THE TRACE ELEMENT CONTENTS IN METAL AND SILICATE OF THE NORTON COUNTY AUBRITE. A. Yu. Lyul, Z.A. Lavrentjeva and G.M. Kolesov, Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Kosygin Str. 19, Moscow, 119991. ugeochem@geochem.home.chg.ru

INTRODUCTION. The origin of aubrites containing a lot of unique minerals formed under the highly reducing conditions and their genetic relationship to E-chondrites is controversial so far. The aubrite formation basic models suggest that ones may have originated by fractional crystallization from the E chondrites composition magma [1], or by igneous processes in a differentiated body [2], or by direct condensation at high pressure from the gas of the initial cosmic composition [3]. However, numerous data of the REE patterns in aubritic minerals will not be fitted to one of the aforementioned models and it was concluded that a short non-equilibrium melting event, rather than a large degree of equilibrium melting, is the best explanation for processes that have been acted on the aubrite parent body [4,5]. Within the framework of the partial melting model for a parent body, the existence of metal particles in aubrites with the igneous and non-igneous abundance patterns of siderophile elements provide the best explanation [6,7].

As was earlier established, the siderophile abundance patterns for individual metal particles from Norton County aubrite closely resemble those for the metal of EH chondrites while the same patterns for small grains are consistent with those for the magmatic groups of iron meteorites and pallasites [7,8]. To verify an assumption concerning a partial melting of aubrites, the trace element contents in a suite of the Norton County silicate fractions was determined by INAA [9].

SAMPLES. With this purpose, the matrix clasts, grains of pure (without inclusions) and altered "rusty" enstatite, as well as a samples with different contents of accessory minerals were selected by handpicking under microscope from the four grain-sized silicate fractions of Norton County. A brief description of investigated samples and the trace element contents are given in Table.

RESULTS AND DISCUSSION. The data summarized in Table show that the Na, Cr, La, Sm, Yb and Lu contents increase with decreasing the grain size of samples: that is with increasing of the accessory mineral abundance. In spite of the fact that the Sc, Ca, Fe, Co and Ni contents are not depend on the grain size, the finest fraction is enriched in ones as well in Zn, Se, Au and Ir. As the above listed element contents in a pure enstatite is much lower than in ones with inclusions, one might say that accessory minerals are the host phases for many trace elements, including REE. The pure and altered enstatite fractions are greatly dissimilar in their trace

element contents except for refractory lithophiles Ca, Sc, Yb and Lu (see Table). In many respects these differences resemble those for Murray CM chondrules altered in a varying degree by aqueous processes [10]. The REE pattern for pure enstatite (Fig.1a) with noticeable enrichment in heavy REE is common for minerals of the pyroxene group.

Except for pure and altered enstatite all other analyzed fractions are greatly enriched in REE having the light-REE depleted patterns with a pronounced negative Eu anomaly (Fig.2a). The REE pattern complementary to aforementioned ones has been observed in the Bishopville plagioclase [5]. It means that REE fractionation was occurred rather on the aubrite parent body than during condensation of elements in a solar nebula. As the oldhamite in aubrites has the relatively flat REE patterns with only a slight negative Eu anomaly [5], it is supposed that the REE patterns in the enstatite with inclusions of accessory mineral and clasts are roughly in agreement with models which assume the plagioclase separation during the partial melting of a aubrite parent body. The data obtained show the two trends of REE fractionation in the Norton County enstatite, one of them has been established in a solar nebula, whereas another in a parent body. The similar trends in siderophile element fractionations were also observed in metal of Norton County (Fig. 1b, 2b). Thus, both metal and silicate of the Norton County aubrite haven't been fully melted on a parent body.

CONCLUSIONS. The two trends in a lithophile and siderophile element fractionations were established on the basis of the trace element contents in metal and silicate of the Norton County aubrite. A primary fractionation of elements took place in a solar nebula, whereas a secondary on a parent body. The results obtained provide the additional evidence for partial melting on a parent body of aubrites.

The work was supported from RFFI grant № 06-03-32869.

References. [1]. Watters T.R. & Prinz M. (1979) *Proc. Lunar Sci. Conf.*, 10th, 1073-1093. [2] Wolf R. et al. (1983) *GCA*, 47, 2257-2271. [3] Sears D. (1983) *Icarus*, 43, 184-202. [4] Lodders K. et al. (1993) *Meteoritics*, 29, 538-551. [5] Floss C. et al. (1990) *GCA*, 54, 3553-3558. [6] Casanova I. et al. (1993) *GCA*, 57, 675-682. [7] Lyul A.Yu. et al. (2007) *LPSC, XXXVIII*, # 1059. [8] Kelly W.R. & Wasson J.T. (1972) *GCA*, 41, 93-111. [9] Shubina N.A. & Kolesov G.M. (2003) *Zh. Anal. Chem.*, 58, 980-985. (in Russian). [10] Rubin A.E., & Wasson J.T. (1983) *GCA*, 50, 307-315. [11] Wanke H. et al. (1970) *Proc. Apollo II Lunar Conf.*, 931-935.

Table. Minor and trace element contents in various fractions from the Norton County aubrite (data in $\mu\text{g/g}$, except for Fe and Ca)

No.*	1	2	3	4	5	6	7	8
	Fraction's size, μm				Enstatite		Clasts	
	<45	71-45	100-71	160-100	1	2	1	2
Na	3110	1820	1680	1160	1140	420	1480	1460
Ca,%	1.47	1.25	1.1	1.24	0.8	0.85	1.57	1.58
Sc	9.6	6.9	8.9	8.6	8.6	9.2	11.2	10.3
Cr	1820	955	900	630	75	145	1060	635
Zn	55	10	<3	<3	<1	<2	<0.5	50
Se	8.6	5.4	5.6	4.2	<0.1	1.2	12.2	4.5
Br	0.17	0.15	0.13	0.08	0.05	0.15	0.13	0.65
Fe,%	1.55	0.92	1.04	0.68	0.045	0.55	2.04	0.79
Co	5.5	2.3	2.3	2.3	0.35	3.5	4.7	5.5
Ni	390	140	155	130	<40	365	360	325
Au	0.02	0.004	0.003	<0.001	<0.001	<0.007	0.002	<0.005
As	0.6	<0.13	<0.04	<0.02	<0.15	<0.15	<0.04	<0.1
Ir	0.006	<0.005	<0.002	<0.003	<0.005	<0.002	<0.001	<0.001
La	1.25	0.72	0.67	0.44	0.06	0.15	0.68	0.51
Ce	3.8	2.2	1.9	0.38	<0.3	<0.7	1.9	1.6
Sm	0.98	0.68	0.52	0.067	0.067	0.11	0.48	0.4
Eu	0.14	0.078	0.13	0.084	0.036	0.015	0.065	0.058
Gd	1.3	0.9	0.7	<0.6	0.11	0.15	0.63	0.55
Tb	0.23	0.16	0.12	0.09	<0.02	<0.03	0.12	0.11
Yb	1.1	0.67	0.54	0.37	0.17	0.18	0.59	0.48
Lu	0.14	0.095	0.076	0.057	0.027	0.029	0.085	0.072

*) 1, 2, 3, 4 - enstatite with ~10%, ~9%, ~7% and ~5% accessory minerals, respectively; 5 - pure (without inclusions) enstatite, 6 - altered (rusty) enstatite; 7 - "matrix" clasts with isolated enstatite inclusions; 8 - "matrix" clasts with amorphous mantles.

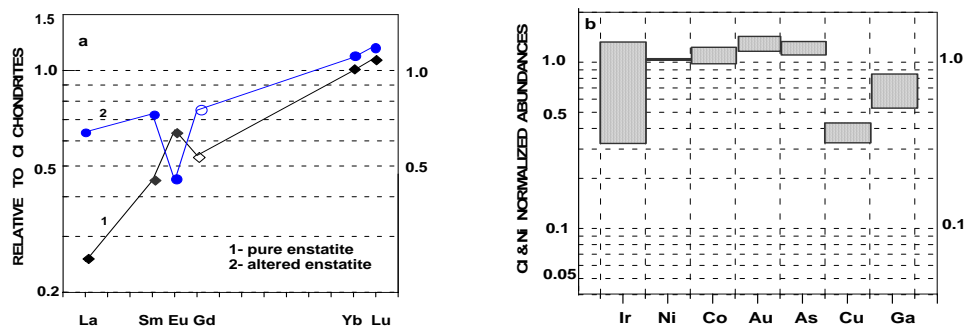


Fig 1. A primary fractionation of elements in enstatite (a) and in the individual metal particles (b) of Norton County. Shaded rectangles - abundance ranges for metal particles, data from [6,7].

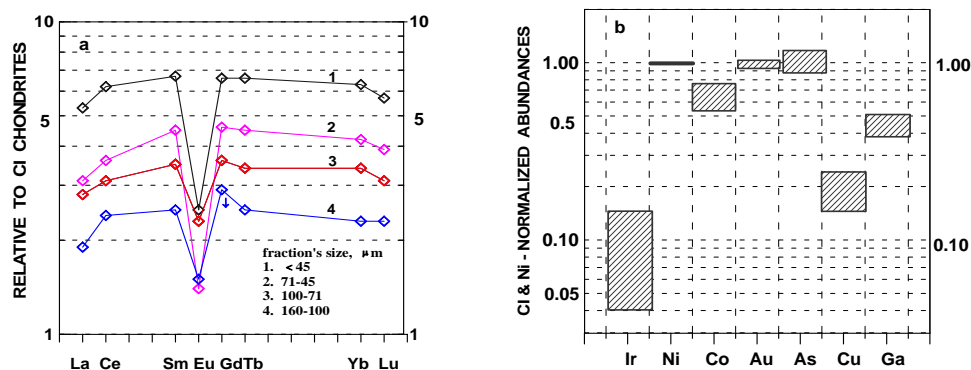


Fig.2. A secondary fractionation of elements in enstatite with the accessory mineral inclusions (a) and in small metal grains (b) of Norton County. Shaded rectangles - abundance ranges for metal grains, data from [7,11]