REE and Some Other Trace Element Distributions of Mineral Separates in Atlanta (EL6).

Z.A. Lavrentjeva, A.Yu. Lyul, N.A. Shubina, G.M. Kolesov. Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Moscow 119991 Russia.

Abstract. We have analysed by NAA Atlanta EL6 chondrite for 18 trace elements. The chemical compositions of the magnetic and nonmagnetic fractions were examined, to assess the effects of nebular fractionation and metamorphism.

Introduction. Enstatite chondrites are the most reduced chondrites, and classified into the high-siderophile group EH and low-siderophile group EL (1). Texturally the EL chondrites appear to have experienced much higher levels of metamorphic alteration then EL chondrites of similar equilibration temperatures. Many of the enstatite chondrite is breccias (Atlanta EL6, Hvittis EL6, Blithfield EL6 et al.) (2). A reconstruction of the thermal history of brecciaed EL6 chondrites (3,4) proposes that accretion and subsequent thermal metamorphism of the EL6 parent body caused in to be heated to temperatures of ca. 1273K. The Atlanta enstatite chondrite consists of iron-free enstatite with minor plagioclase, troilite and metal and number of rare trace minerals (alabandine, daubreelite, sphalerite) that reflect the highly reducing conditions under which this meteorite formed (5).

Samples and method. In the present paper the results of elemental abundances in separated grain-sized magnetic and nonmagnetic fractions**,** enstatite from Atlanta are reported. The fractions were selected by handpicking under microscope and by particle-size analysis. Their elemental composition was determined by INAA. The tables show the average element enrichment factors relative to C1 (6).

Results and discussion. REE measurements in Atlanta show that all fractions with negative and positive Eu-anomalies are deficient in light REE [Lu (A) / Lu(C1)] / [La(A)/La(C1)] mean = 3 (magnetic) and 1.7 (nonmagnetic fractions). Atlanta was examined by Keil (5) and Rubin (7, 8) and were found to be free of oldhamite. Perhaps the positive and negative Eu-anomalies in grain-sized fractions REE patterns are associated with plagioclase. The pure (yellow) enstatite has a Eu maximum [(Eu(A)/Eu(C1)]/[(Sm(A)/Sm(C1)] = 3 and depleted in light REE [(Lu(A)/Lu(C1)]/[(La(A)/La(C1)]=7. Neither the Eu anomaly nor the light REE depletion can readily explained by nebular condensation at least in solar gas (9). Of 12 grain-sized fractions of Atlanta EL6 analyzed for siderophile elements, 6 magnetic (metal, schreibersite) fractions have ratios [(Fe/Ni) A/ (Fe/Ni) C1] = 0.7 (mean) less than cosmic and nonmagnetic (sulfides, silicates) fractions – 2.4(mean) greater then cosmic. The pure (yellow) enstatite has ratio Fe/Ni = 9.4 (17.4 cosmic) less than cosmic. This fact supports the opinion that, the main process controlling of composition magnetic phase was sulfurization of metal in protoplanetary nebula. The Atlanta enstatite chondrite show a typically igneous siderophile element pattern with Ir more depleted than Au and Ni (magnetic fractions – Ir (1.9 – 6.0 xC1), Au (2.8 – 10.0 xC1), Ni (3.5 – 6.7 xC1); nonmagnetic fractions – Ir (0.04 – 0.3 xC1), Au (0.05 – 0.5 xC1), Ni (0.04 – 0.3 xC1).

Conclusions. From observed differences of compositions of magnetic and nonmagnetic fractions it follows that our trace element data accord with this idea that Atlanta EL6 reflect main process – sulfurization of metal in protoplanetary nebula and, perhaps, that it may have undergone an igneous event.

References. [1].Sears D.W. et al.(1982). *Geochim. Cosmochim. Acta, 46, 597.* [2]. Zhang Ya. et al. (1995). *J. Geophys. Res., 100, 9417.* [3]. Rubin A.E**.** *(1983). Proc. Lunar. Planet. Sci. Conf. 14 th, B293.* [4]. Rubin A.E. (1984) *Earth. Planet. Sci. Lett., 67, 273.* [5]. Keil R. (1968). *J. Geophys. Res, 22, 6945.* [6]. Anders E. and Grevesse N. (1989). *Geochim. Cosmochim. Acta, 53, 197.* [7]. Rubin A.E. (1983). *Meteoritics, 18, 113.* [8] Baynton W.V. (1975) *Geochim. Cosmochim. Acta, 39, 569.*

Table 1. The average element enrichment factors of magnetic fractions of Atlanta enstatite meteorite.

Fractions (µm)	*Na*	*Ca*	*Sc*	*Cr*	*Fe*	*Co*	*Ni*	*Zn*	*Se*	*Br*	*La*	*Sm*	*Eu*	*Tb*	*Yb*	*Lu*	*Ir*	*Au*
1<d<45	0.1	0.2	0.09	0.1	2.3	2.9	6.1	<0.03	<0.3	0.06	<0.4	0.5	<0.6	<0.8	1.5	<1.0	1.9	2.8
45<d<71	0.04	<0.2	0.002	0.1	4.3	5.8	6.6	0.1	<0.3		<0.3	0.3	<0.4	<0.8	0.8	<1.2	4.8	8.1
71<d<100	0.06	0.3	0.06	0.06	4.6	7.0	6.7	0.08	<0.1		0.5	0.5	0.3	0.6	0.8	0.7	6.0	10.0
100<d<160	0.07	0.3	0.1	0.05	4.2	6.3	4.8	0.06	<0.05		0.2	0.2	0.4	<0.8	<0.6	<0.7	4.8	7.9
160<d<260	0.09	0.6	0.3	0.1	3.8	5.8	4.6	0.1	0.08		0.3	0.2	<0.2	<0.8	0.6	1.2	4.4	5.8
260<d<360	0.8	0.8	1.2	0.6	2.8	4.3	3.5	<0.2	<0.5		<0.8	<0.7	0.9	<0.8	1.0	1.2	3.0	5.2

Table 2. The average element enrichment factors of nonmagnetic fractions of Atlanta enstatite meteorite.

Fractions (µm)	*Na*	*Ca*	*Sc*	*Cr*	*Fe*	*Co*	*Ni*	*Zn*	*Se*	*Br*	*La*	*Sm*	*Eu*	*Tb*	*Yb*	*Lu*	*Ir*	*Au*
1<d<45	0.7	0.7	1.7	6.3	1.4	0.2	0.3	0.03	2.9		1.5	1.8	2.0	2.1	2.2	2.0	0.04	0.05
45<d<71	0.8	1.0	2.3	1.9	0.5	0.2	0.2	<0.02	0.5	0.1	0.6	0.9	0.9	1.0	0.9	1.1	0.2	0.2
71<d<100	0.8	0.8	2.6	1.0	0.3	0.2	0.2	<0.02	0.4	0.02	0.8	1.0	0.9	0.9	0.9	1.0	0.2	0.2
100<d<160	0.9	1.8	2.4	1.2	0.3	0.2	0.2	0.03	0.5	0.07	0.6	0.7	0.7	0.9	1.2	1.3	0.2	0.2
160<d<260	0.8	1.4	2.7	2.7	0.7	0.3	0.4	0.1	1.3	0.1	0.7	1.0	1.5	1.3	1.5	1.5	0.3	0.3
260<d<360	1.4	1.0	1.9	2.6	0.7	0.3	0.4	0.05	1.0	0.1	0.6	1.0	0.6	0.9	0.08	0.9	0.3	0.5
Enstatite (yellow)	0.6	0.2	2.4	0.06	0.05	0.1	<0.02	<0.5	0.07	0.1	<0.2	<0.6	<0.7	<0.8	0.7	<0.02	<0.02	<0.02