A comparative study of magnetic and nonmagnetic phases in Atlanta (EL6): representative of EL parent body. Z.A. Lavrentjeva, A.Yu. Lyul, N.A. Shubina, G.M. Kolesov. V.I. Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Moscow, Russian Academy of Sciences, 117975, Moscow, Russia.

Introduction. Enstatite chondrites are an invaluable source of information concerning the chemical and physical processes that were active in the solar nebula and also for understanding metamorphism under reducing conditions during the early periods of the solar system. Temperature minima were determined from the enstatite-diopside solvus of Carlson (1) and indicate that the EL6 chondrites have been metamorphosed at the temperatures exceeding 900-1000^{o}C. The temperature of the enstatite-plagioclase-quartz eutectic (1090^{o}C), appropriate for EL6 plagioclase compositions, was used as the metamorphic maxima. Nitrogen fugacities determined for sinoite (Si_2N_2O) (2) bearing EL6 chondrites (f_{N_2} =10^{-1} at 1050^{o} C) indicate that EL6 meteorites either formed in a nebula of high pressure or more likely, are products of metamorphism.

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 using a technique for numerical substraction of the matrix element backgrounds (3). The tables show the average element enrichment factors relative to C1 (4).

Results and discussion. 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 the 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). 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). Neither the Eu anomaly nor the light REE depletion can readily explained by nebular condensation at least in solar gas (5). Atlanta was examined by Keil, Rubin (6,7,8) and were found to be free of oldhamite. Perhaps the positive and the negative Eu-anomalies in grain-sized fractions REE patterns are associated with plagioclase. Maximum metamorphic temperatures can be established by the enstatite – silica – albite (ESA) eutectic. If all three of these phases are present and if metamorphic temperatures exceeded the eutectic value, a silicate melt would be formed. Little evidence for such an igneous event - textural or otherwise – has been found in the enstatite chondrites that contain enstatite, silica and albite. While this does not preclude such an event it does suggest that most E-chondrites experienced temperatures less than ESA eutectic. However it is interesting to note that Atlanta (EL6) and Blithfield (EL6) do not contain free silica. An igneous event at the ESA eutectic or even slightly higher that fractionates the melt from the source region would leave an E-chondrite assemblage depleted in free silica. Therefore the absence of free silica in these two meteorites suggests that they may have undergone an igneous event (2).

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

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

Fractions (μ)	*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 (μ)	*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