REE AND SOME OTHER TRACE ELEMENT DISTRIBUTIONS OF MINERAL CONSTITUENTS IN ENSTATITE METEORITES.

Z.A. Lavrentjeva, A.Yu. Lyul. *Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, 117975, Moscow, Russia*

Introduction. The enstatite meteorites are the most reduced natural assemblages. They may be the meteorites that formed nearest the Sun [1].

Based on data of the trace element contents in Fe, Ni-phase of E chondrites, it was shown that this phase was not undergone the magmatic differentiation. The main process controlling the composition of Fe,Ni-phase of E chondrites was sulfurization of the metal in protoplanetary nebula. Some differences in the elemental distribution in Fe,Ni-phase of E chondrites are due to the metal-silicate fractionation while the metamorphism and chondrule formation did not influence significantly on composition of Fe,Ni-phase [2].

The analysis of the distribution of REE, Na and K in chondrules has been shown that chondrules were formed by two main processes: melting of the material-precursor and by condensation either from hot gas of protoplanetary nebula or from silicate vapor, formed in the process of vaporization in the period of chondrule formation. The observed differences in characteristics of chondrules of chondrites belonging to the various chemical groups are due to different astrophysical conditions of chondrule genesis, chemical and isotopic composition of precursor materials, initial temperatures and cooling rates of the melted chondrules. Chondrules of the E chondrites were mainly formed in “dense” gas-dust disk near the nebular equator [3,4].

Trace element content in chondrite matrix puts a strong constraints on nature and origin of major component of meteorites [5,6]. These data are also very important for development of the chondrite formation models and element fractionation processes [7,8].

Samples, methods. In the present paper the results of elemental abundances in different mineral fractions: of the fine-grained (1<d<45μm, “matrix”) enstatites, plagioclase and cristobalite of E-meteorites are reported. The fractions were isolated by hand and by physical separation methods and their elemental composition was determined by INAA. The average elemental enrichment factors relative to C1 chondrite[9] are given in the Table.

Results and discussion. A prominent fractionation between lithophile and siderophile elements is observed in fine-grained material of E chondrites and E achondrites. The fractions are enriched in lithophilic REE by factors (1.7 - 6.8)xC1 and are depleted in siderophilic Ni, Co, Fe, Au, Ir (0.01 – 1.0)xC1. Based on these data, the formation of E meteorites from material subjected to the fractionation metal-silicate is proposed. Fine-grained chondrite fractions differ in concentration of siderophile elements and in values of Ni/Co, Ni/Au, Ni/Ir ratios in EL chondrite, and considerable differences in these ratios in a unequilibrated EH chondrite. Distinction in the fractionation trends of siderophile elements can be associated by their redistribution between different phases of meteorites during metamorphism. Comparing to the fine-grained fractions and accessory minerals of enstatites and plagioclase is depleted in refractory elements, with exception of Sc (1.1-2.2) xC1. We have shown recently [10], that accessory minerals of Adhi Kot

EH4 are samples of high-temperature condensates from the solar nebula. The fine-grained fractions (1<d< 45 μm, "matrix") of E-meteorites are enriched in accessory minerals. The Norton County aubrite show a typically igneous siderophile element pattern, with Ir more depleted than Au and Ni. The fine-grained fractions 4, 5 (1<d<45μm) of Pesyanoe are enriched in heavy REE [Lu/Lu(C1)]/[La/La(C1)]=1.6; 2.7 relative to their abundances in Adhi Kot EH4, Pillistfer EL5, Norton County aubrite (0.6; 1.1; 1.0, accordingly) and have Eu – maximum [Eu/Eu(C1)]/ [Sm/Sm (C1)]=1.7 (fraction 5) and Eu-minimum -0.7 (fraction 4).

References: [1] Sears D.W., Kallemeyn G.W. and Wasson J.T. (1982) *Geochim. Cosmochim. Acta, 46,* 597. [2] Lavrukhina A.K., Lyul A.Yu., Baryshnikova G.V.(1982) *Geokhmia (in Russian), 5,* 645. [3] Lavrukhina A.K. (1989) *Geokhimia (in Russian), 9,* 1231. [4] Lavrukhina A.K. (1989) *Geokhimia (in Russian), 10,* 1407. [5] Alexander C. M.O.'D. (1995) *Geochim. Cosmochim. Acta, 59,* 3247. [6] Rambaldi E.R. et al. (1981) *Earth. Planet. Sci. Lett. 56,* 107. [7] Larimer J. W., Anders E. (1967) *Geochim. Cosmochim. Acta, 31,* 1239. [8] Wasson J.T., Kallemeyn G.W. (1988) *Phil. Trans. Roy. Soc. London, A325,* 535. [9] Anders E. and Grevesse N. (1989) *Geochim. Cosmochim. Acta, 53,* 197. [10] Lavrentjeva Z.A. (1997) *LPS XXVIII, CDROM*, # 1008.

Table. The average element enrichment factors of mineral fractions of enstatite meteorites.

	1<d<45 μm					Enstatite			Cristo-balite	Plagio-Clase
	1	2	3	4	5	1	2	3	1	2
La	2.6	3.0	5.3	1.0	1.2	1.2	-	<0.3	13.0	-
Sm	2.4	3.0	6.8	1.0	1.5	1.2	-	0.5	2.4	-
Eu	2.0	2.9	2.5	0.8	2.6	1.5	-	0.9	3.6	-
Yb	1.8	2.6	6.1	1.9	3.0	0.6	-	1.0	4.4	-
Lu	1.7	3.3	5.8	1.5	3.3	0.6	-	1.1	4.5	-
Na	2.2	2.5	0.6	1.3	1.5	1.0	1.0	0.2	15.2	1.2
Ca	3.0	3.0	1.6	1.6	1.9	-	0.8	0.9	1.9	-
Sc	1.1	1.7	1.6	1.7	1.6	1.1	2.2	1.5	0.5	2.2
Cr	1.3	2.5	0.7	0.6	0.4	0.9	0.4	0.03	0.02	0.2
Zn	1.5	-	0.2	0.1	0.01	0.9	-	<0.003	-	-
Se	1.6	0.9	0.5			0.8	0.09	<0.005	-	-
Br	0.08	0.3	0.05			0.2	0.2	0.01	-	0.6
Fe	0.4	0.05	0.08	0.08	0.06	0.2	0.01	0.002	0.05	0.02
Co	0.06	0.08	0.01	0.03	0.02	0.02	0.07	0.007	0.03	0.2
Ni	0.05	0.09	0.03	0.07	0.03	<0.008	0.09	<0.04	0.04	0.2
Au	1.0	0.09	0.1			0.1	0.1	<0.007	0.09	-
As	0.2	-	0.3			0.8	-	0.08	403	-
Ir	0.3	0.07	0.01			0.06	0.07	<0.01	0.10	0.3
Ba	130	-	-			50	-	-	5230	-

1 - Adhi Kot EH4; 2 - Pillistfer EL6; 3 - Norton County (aubrite); 4,5 – Pesyanoe (aubrite)