EXTRATERRESTRIAL AND TERRESTRIAL CHROMITE GRAINS IN MIDDLE ORDOVICIAN LIMESTONES OF SWEDEN AND CHINA: SOME PECULIARITIES OF DISTRIBUTIONS. V.A. Alexeev, Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, Moscow 119991 Russia; e-mail: AVAL37@chgnet.ru

Introduction: The parent asteroid of L-chondrites catastrophically broke up in the asteroid belt 470 ± 6 Ma [1]. The fact that this event caused the delivery of the asteroid's fragments to the Earth soon after destruction of the asteroid was confirmed by the unusually large occurrence of fossil meteorites in marine limestone in southern Sweden. In the Thorsberg quarry, more than 80 fossil L-chondrites were found in the mid-Ordovician sediments (~470 Myr) [2-4].

In the Thorsberg quarry, together with the meteorites, relict sediment-dispersed extraterrestrial chromite (SEC) and "other" Cr-rich spinel (OC) grains were also found. The OC grains have mainly terrestrial origin. In the other places of Sweden and China, analogous grains were also found in the sediment layers of the same age as that of the layers where the fossil meteorites were discovered [5, 6].

The wide occurrence of fossil meteorites and relict chromite grains gave the grounds to suppose that the flux of extraterrestrial material to the Earth during the formation period of Ordovician sediments was enhanced by up to two orders of magnitude compared to the present [5].

The possibility of origin of all fossil meteorites in and near Thorsberg quarry as a consequence of fall the single meteorite shower has been discussed in [7-9]. Here we compare the distributions of the extraterrestrial and terrestrial chromite grains in the Ordovician layers of quarries of Sweden and China, according to data [6, 10, 11].

Data: Distributions of the SEC and OC chromite grains through mid-Ordovician strata in Sweden and China are shown in **Fig.** One can see, the layers coeval with the layers containing the fossil meteorites are enriched by extraterrestrial chromite grains. However, the some layers are also enriched by terrestrial chromite grains. According to [6], "the coexistence in some beds of high concentrations of chondritic chromite and terrestrial Cr-rich spinels, however, indicates that redistribution of heavy minerals on the sea floor, related to changes in sea level and sea-floor erosion and currents, must also be considered". Below we shall consider the relationship SEC and OC grain concentrations in different layers.

Discussion: Abundances of the extraterrestrial and terrestrial chromite grains in the quarries of Sweden and China are shown in the **Table**. Here, the layers coeval with the layers containing the fossil meteorites in the Thorsberg quarry are designated by the FM symbol. The layers formed during other time are designated by the NFM symbol. Concentration of the SEC grains in the sample of limestone will be equal to N_{SEC}/M, where N_{SEC} is number of the SEC grains found in the sample with mass of M. Concentration of the SEC grains in the FM and NFM layers we shall designate as $(N_{SEC}/M)_{FM}$ and $(N_{SEC}/M)_{NFM}$, respectively. The ratio of these concentrations we shall denote as a factor of enrichment $K_{SEC} = (N_{SEC}/M)_{FM}/(N_{SEC}/M)_{NFM}$. So, for quarries of Thorsberg and Hällekis the value of $K_{SEC} = 49 \pm 13$. From data of the Table, we can see that values K_{SEC} for all considered quarries are identical within the limits of $\pm 1\sigma$ and the average value of $K_{SEC} = 40 \pm 8$. In other words, the layers coeval with the layers containing the fossil meteorites have the concentration of the SEC grains in 40 times above in comparison with the layers which have formed during other time.

However, we see similar enrichment and for chromite grains of a terrestrial origin. The average value of enrichment factor for OC grains is $K_{OC}=23 \pm 7$.

Conclusions: Comparison of concentration of the SEC and OC grains in the different layers of the mid-Ordovician in the quarries of Sweden and China allows to suppose that the flux of extraterrestrial micrometeorites on all Earth after disruption of the L-chondrite parent body has increased approximately in 2-3 times, but not in two orders of magnitude. Some sorting and reworking of heavy minerals, including not only SEC but also OC grains could significantly increase the concentrations of these grains in the strata.

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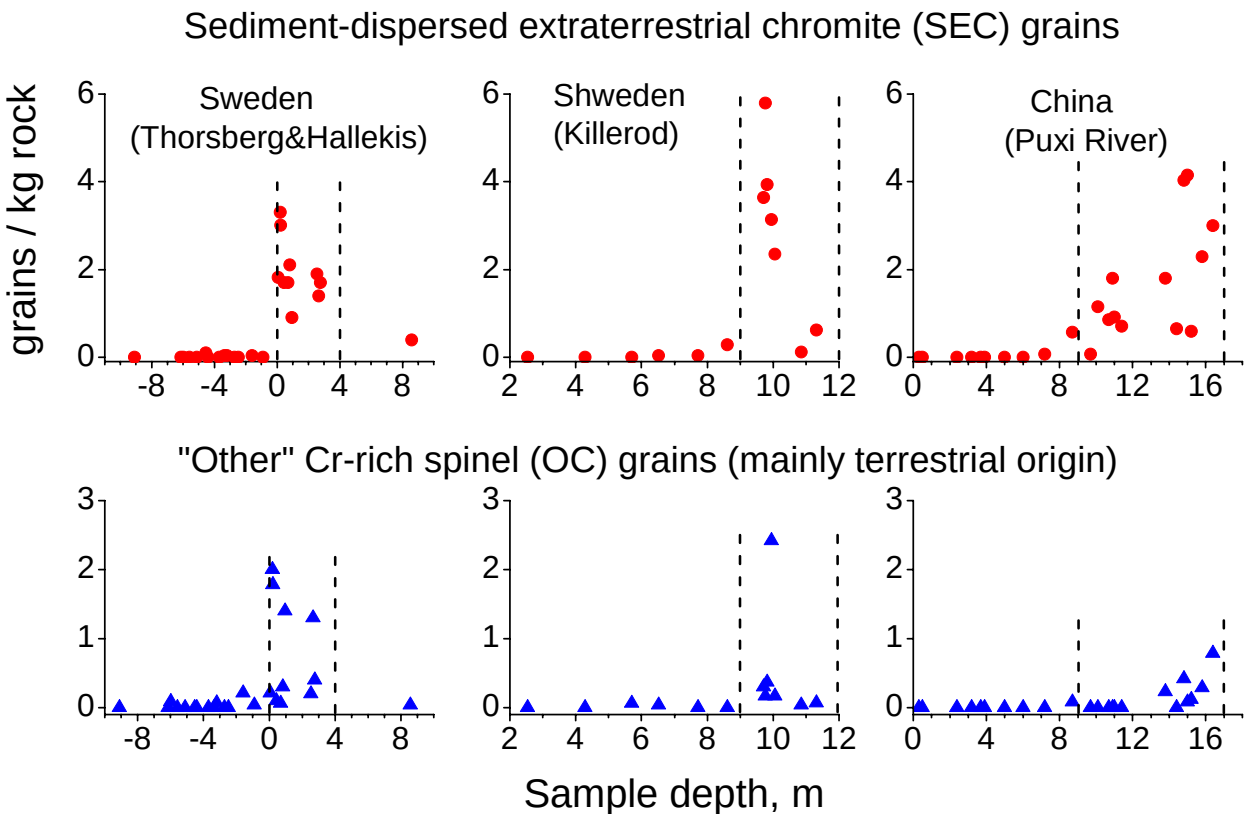

Fig. Distribution of the extraterrestrial (SEC) and terrestrial (OC) chromite grains through mid-Ordovician sections in Sweden and China. Dashed lines mark the intervals that correspond to time of accumulation of sediments with fossil meteorites in the Thorsberg quarry. (According to [6, 10, 11].)

Table. Abundance of the extraterrestrial (N_{SEC}) and terrestrial (N_{OC}) chromite grains in the quarries of Thorsberg, Hällekis, and Killeröd (Sweden) and in the Puxi River section (China). [1)]

Place	Layers [2)]	M, кг	N_{SEC}	N_{OC}	N_{SEC}/M, кг$^{-1}$	N_{OC}/M, кг$^{-1}$	K_{SEC} [3)]	K_{OC} [3)]
Thorsberg and Hällekis	FM	173.9	332	142	1.91 ± 0.11 [4)]	0.82 ± 0.07	49 ± 13	28 ± 9
	NFM	407.1	16	12	0.039 ± 0.010	0.029 ± 0.009		
Killeröd	FM	133.5	318	73	2.38 ± 0.14	0.55 ± 0.07	37 ± 12	42 ± 30
	NFM	153.4	10	2	0.065 ± 0.021	0.013 ± 0.010		
Puxi River	FM	165.3	283	25	1.71 ± 0.10	0.15 ± 0.03	26 ± 10	>5
	NFM	122.5	8	1	0.065 ± 0.023	<0.03		
All	FM	472.7	933	240	1.97 ± 0.07	0.51 ± 0.03	**40 ± 8**	**23 ± 7**
	NFM	682.9	34	15	0.050 ± 0.009	0.022 ± 0.006		

Notes: [1)] According to [6, 10, 11]. [2)] FM and NFM are the layers with and without fossil meteorites respectively (see Fig. 1). [3)] Enrichment factors: $K_{SEC} = (N_{SEC} / M)_{FM} / (N_{SEC} / M)_{NFM}$; $K_{OC} = (N_{OC} / M)_{FM} / (N_{OC} / M)_{NFM}$. [4)] Standard deviations (σ) have been calculated with use of the equation: $\sigma(N) = \sqrt{N}$.