IRON DISTRIBUTION BETWEEN THE M1 AND M2 SITES IN SILICATES IN NORTHWEST AFRICA 6286 AND 7857 METEORITES EVALUATED USING XRD DATA AND MÖSSBAUER SPECTROSCOPY.

A. A. Maksimova, A. V. Chukin and M. I. Oshtrakh, Institute of Physics and Technology, Ural Federal University, Ekaterinburg, 620002, Russian Federation, E-Mail: oshtrakh@gmail.com.

Introduction: The Fe^{2+} and Mg^{2+} cations distribution between two non-equivalent M1 and M2 sites in silicates such as olivine $(Fe, Mg)_2SiO_4$, orthopyroxene $(Fe, Mg)SiO_3$ and clinopyroxene $(Fe, Ca, Mg)SiO_3$ from meteorites is of interest due to the possibility of its thermal history estimation. Therefore, the iron distribution between the M1 and M2 sites in silicates in fragments of Northwest Africa (NWA) 6286 LL6 and 7857 LL6 ordinary chondrites was studied using X-ray diffraction (XRD) and Mössbauer spectroscopy.

Experimental: The unit cell parameters of olivine, orthopyroxene and clinopyroxene in NWA 6286 and NWA 7857 meteorites were determined by means of X-ray diffraction using the Rietveld full profile analysis and ICDD PDF2 data. Mössbauer spectra of NWA 6286 and NWA 7857 ordinary chondrites were measured at room temperature with a high velocity resolution and then fitted taken into account the spectral components related to the M1 and M2 sites in silicates. Evaluation of the Fe^{2+} and Mg^{2+} cations distribution between the silicates M1 and M2 sites in NWA 6286 and NWA 7857 meteorites using XRD data was done in the same way as shown in [1] for Chelyabinsk LL5 ordinary chondrite. The iron parts in the M1 and M2 sites in olivine, orthopyroxene and clinopyroxene were determined from the Mössbauer spectra of NWA 6286 and NWA 7857 meteorites using the relative areas of corresponding spectral components.

Results: A comparison of the ratios of the Fe^{2+} parts in the M1 and M2 sites in silicates in NWA 6286 and NWA 7857 meteorites evaluated by XRD data and Mössbauer spectroscopy are shown in Table 1. The values of the iron occupations obtained by two different methods appeared to be close especially for olivine and orthopyroxene. Furthermore, the distribution coefficients (K_D) of the Fe^{2+} and Mg cations between the M1 and M2 sites in olivine and orthopyroxene of NWA 6286 and NWA 7857 meteorites as well as temperatures of cations equilibrium distribution (T_{eq}) were calculated using the iron occupations and the faylite and ferrosilite values (see Table 2).

Table 1. Estimation of the ratios of Fe^{2+} parts in the M1 and M2 sites in olivine, orthopyroxene and clinopyroxene in NWA 6286 LL6 and NWA 7857 LL6 meteorites using X-ray diffraction data and Mössbauer spectroscopy[a].

Method of estimation		Silicates in meteorites	
		NWA 6286 LL6	NWA 7857 LL6
		Olivine	
XRD	X_{Fe}^{M1}/X_{Fe}^{M2}	1.23	1.16
Mössbauer spectroscopy	A_{Fe}^{M1}/A_{Fe}^{M2}	1.19	1.22
		Orthopyroxene	
XRD	X_{Fe}^{M1}/X_{Fe}^{M2}	0.25	0.33
Mössbauer spectroscopy	A_{Fe}^{M1}/A_{Fe}^{M2}	0.26	0.34
		Clinopyroxene	
XRD	X_{Fe}^{M1}/X_{Fe}^{M2}	1.33	2.00
Mössbauer spectroscopy	A_{Fe}^{M1}/A_{Fe}^{M2}	1.30	2.43

[a] X_{Fe}^{M1} and X_{Fe}^{M2} are iron parts in the M1 and M2 sites in silicates; A_{Fe}^{M1} and A_{Fe}^{M2} are the relative areas of spectral components related to the M1 and M2 sites in silicates in the Mössbauer spectra of NWA 6286 LL6 and NWA 7857 LL6.

Table 2. The values of distribution coefficient and temperature of equilibrium cations distribution in olivine and orthopyroxene estimated for NWA 6286 LL6 and NWA 7857 LL6 meteorites using Mössbauer spectroscopy and X-ray diffraction data.

Silicates in meteorites	Mössbauer spectroscopy		XRD	
	K_D	T_{eq}, K	K_D	T_{eq}, K
Olivine				
NWA 6286 LL6	1.28	1006	1.34	862
NWA 7857 LL6	1.34	855	1.24	1180
Orthopyroxene				
NWA 6286 LL6	0.18	1052	0.17	1010
NWA 7857 LL6	0.25	1248	0.22	1169

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