OBSERVATION OF ILMENITE AND HERCYNITE-LIKE PHASES IN THE FRAGMENT OF CHELYABINSK LL5 METEORITE USING SEM, XRD AND MÖSSBAUER SPECTROSCOPY.

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Introduction: Different fragments of Chelyabinsk LL5 ordinary chondrite demonstrated differences in lithology and content of the main iron-bearing phases such as olivine, pyroxene, troilite, metallic iron [1, 2]. However, there are other minor iron-bearing phases in ordinary chondrites. Observation of chromite $FeCr_2O_4$ and especially ilmenite $FeTiO_3$ and hercynite-like $FeAl_2O_4$ phases in one fragment of Chelyabinsk LL5 ordinary chondrite with mixed light and dark lithology using scanning electron microscopy (SEM), X-ray diffraction (XRD) and Mössbauer spectroscopy with a high velocity resolution is considered in the present work.

Results and discussion: Fragment of Chelyabinsk LL5 meteorite with mixed light and dark lithology was cut and polished surface was studied using optical microscopy and SEM with energy dispersive spectroscopy (EDS). Then powdered surface matter was analyzed using XRD powder diffraction and Mössbauer spectroscopy with a high velocity resolution. SEM analysis with EDS showed the presence of chromite and ilmenite grains in silicate matrix. Some amount of Al (~3 wt.%) in addition to Cr and Fe was found in chromite grains. This may be a result of the presence of minor content of hercynite and/or mixed Al-Cr spinel. Treatment of the XRD pattern using the Rietveld analysis permitted us to reveal the presence of minor iron-bearing phases including chromite, hercynite and ilmenite. Further the Mössbauer spectrum of Chelyabinsk LL5 fragment with mixed light and dark lithology measured with a high velocity resolution was fitted using a new fitting approach described in [3]. It was possible to reveal minor spectral components which Mössbauer hyperfine parameters were in agreement with previously published data for chromite, hercynite and ilmenite. These results demonstrated the possibility to observe minor content of chromite, hercynite-like and ilmenite phases in the complex systems such as ordinary chondrites on the basis of SEM, XRD and Mössbauer spectroscopy with a high velocity resolution.

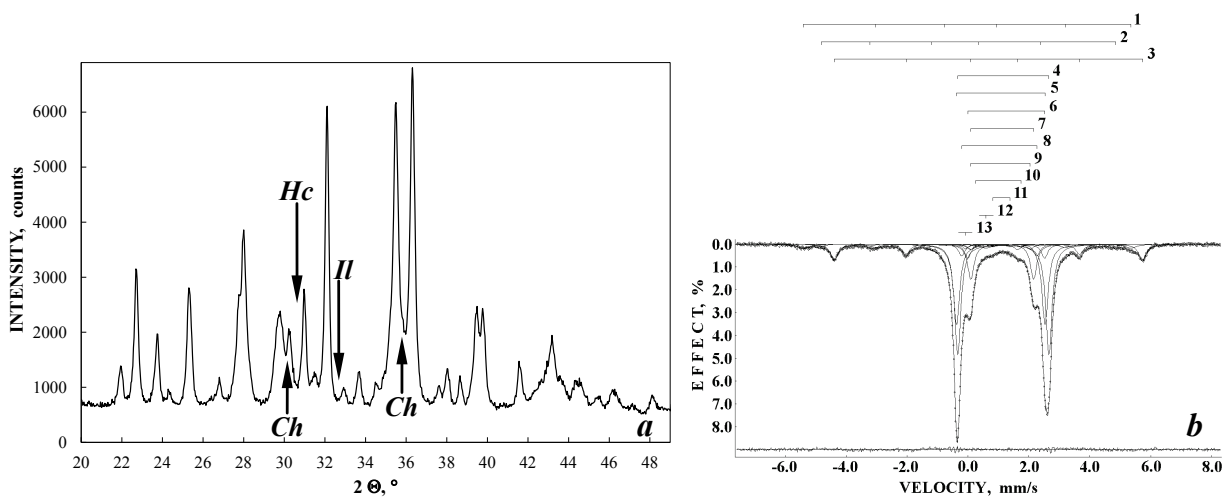

Figure 1. XRD pattern (***a***) and Mössbauer spectrum measured at 295 K with a high velocity resolution (***b***) of Chelyabinsk LL5 ordinary chondrite fragment with mixed light and dark lithology. Indicated selected XRD reflexes are chromite (***Ch***), hercynite (***Hc***) and ilmenite (***Il***). Obtained Mössbauer components are the results of the best fit: 1 – α-Fe(Ni, Co), 2 – γ-Fe(Ni, Co), 3 – troilite, 4, 5 – M1 and M2 sites in olivine, 6, 7 – M1 and M2 sites in orthopyroxene, 8, 9 – M1 and M2 sites in clinopyroxene, 10 – hercynite, 11 – ilmenite, 12 – chromite, 13 – paramagnetic γ-Fe(Ni, Co). Differential spectrum is shown below.

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