

STUDY OF VALENT AND STRUCTURAL STATE OF IRON IONS IN TEKTITES AND IMPACTITE GLASSES

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There are two groups of natural silicate glasses resulting from high energetic impact of cosmic bodies. The first one is impactites located near and directly in impact crater. And the second one is tektites which were formed after rocks had melted and then ejected and quenched in the atmosphere [1]. Tektites form several vast strewn fields (hundreds square kilometers) on the Earth's surface. High melting temperature and high quenching rate are characteristic for tektites formation process.

High temperature processes in silicate glasses are followed by redox reaction involving variable-valence elements, iron in first. Study of valent and structural state of iron atoms can lead to a better understanding of the glasses formation process. Mössbauer spectroscopy is one of the most powerful methods for determination of the iron atoms valence and coordination. Natural silicate glasses of impact origin have been investigated using Mössbauer spectroscopy on nuclei ^{57}Fe . There are tektites from Central Europe (moldavites) and from Indo-China (indochinites), impactites from Elgytygyn crater (Chukot Peninsula) and tektite-like glasses from Zhamanshin crater (Kazakhstan).

Mössbauer spectra of glasses have been obtained under room temperature in absorption geometry. Spectra have been processed and analyzed by means of a reconstruction of two independent distribution functions of hyperfine parameters (Fe^{3+} and Fe^{2+}). When processing the form of distribution function was not fixed. More physically and mathematically valid model of processing Mössbauer spectra has been chosen during the investigations.

Distribution of the partial spectra hyperfine parameters is described by monomodal distribution function (fig.1).

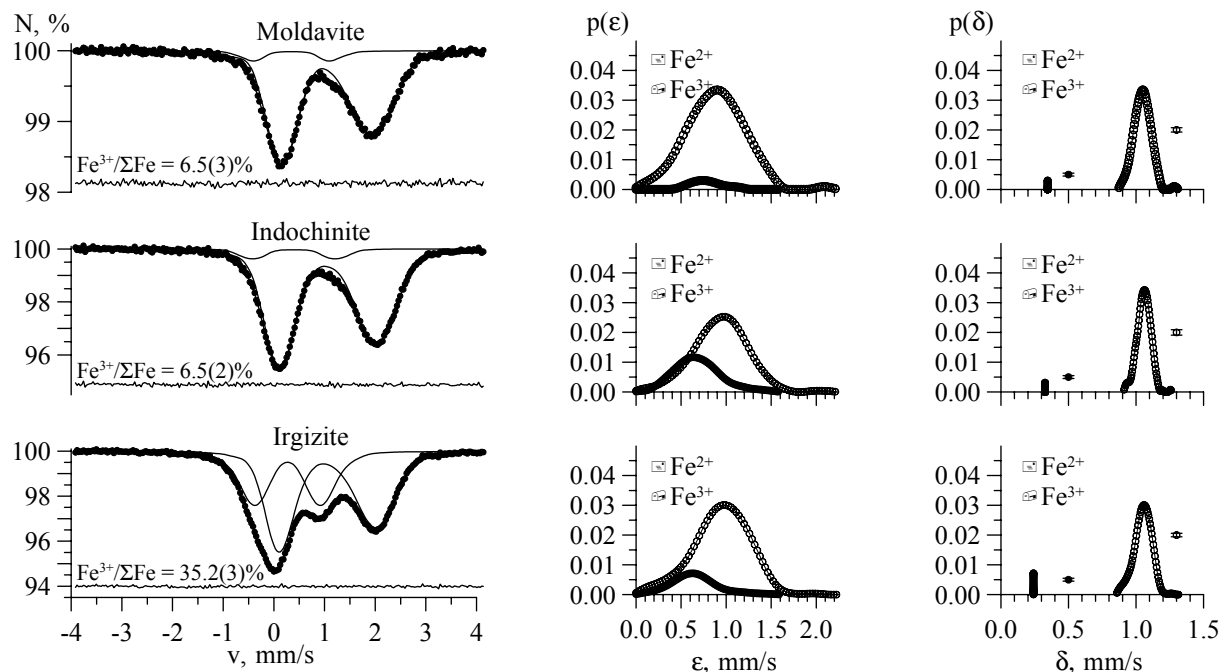


Fig.1. Typical Mössbauer spectra and hyperfine parameter distribution functions for Fe^{2+} and Fe^{3+}

Hyperfine parameters of Mössbauer spectra and relative ferrous and ferric contents have been obtained during the research. Relative ferrous and ferric contents have been evaluated by relative intensity of the corresponding partial spectra. Fe^{3+} ions content in moldavites and indochinites is noticeably lower (by 4÷10 %) than in impactites and irgizites (16÷35 %) (fig.2).

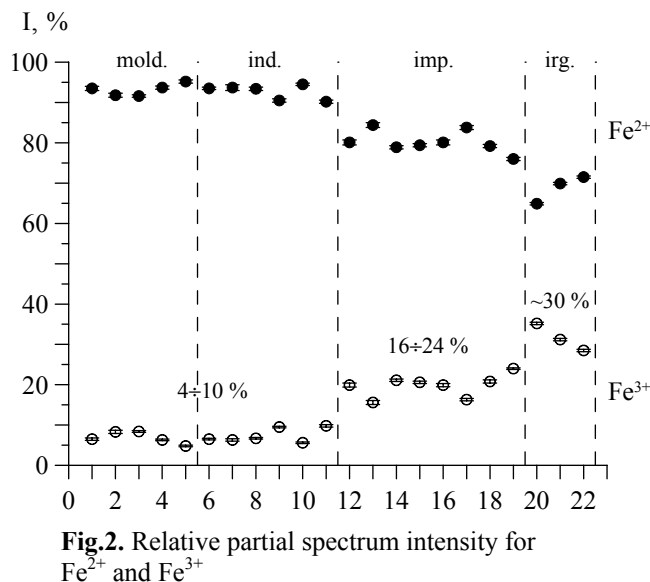


Fig.2. Relative partial spectrum intensity for Fe^{2+} and Fe^{3+}

This difference is caused by higher formation temperature. Mössbauer line shifts of Fe^{3+} ions in tektites (with the exception of Muong Nong type indochinite) fall into intervals typical for octahedral oxygen coordination, in impactites – tetrahedral one and in the rest glasses – fall into the border of these intervals [2]. It points out the distribution of ions on tetrahedral, five-coordinated and octahedral positions. Mössbauer line shifts of Fe^{2+} ions in all glasses point out the distribution of ions on five-coordinated and octahedral positions (fig.3).

Average quadrupole shifts and its distribution function width (not shown) in moldavites are less than in the other samples (fig.4). This is the evidence of more ordered environment of ferrous ions in these glasses.

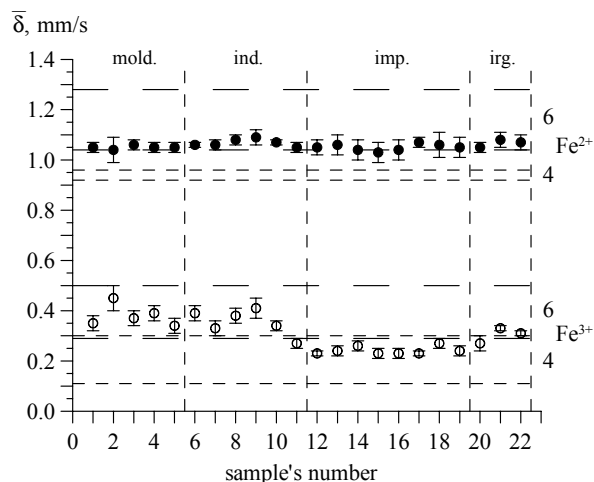


Fig.3. Average Mössbauer line shifts of Fe^{2+} and Fe^{3+} .

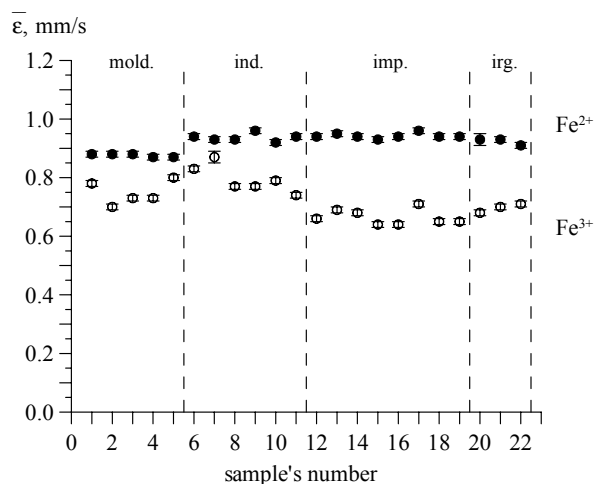


Fig.4. Average quadrupole shifts for Fe^{2+} and Fe^{3+} .

References

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