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^{57}Fe Mossbauer investigation of phase composition and structural state of natural ferrioxide pigments

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Because of its ultrafine (nanosize) dispersion and poor crystallization, the significant share of mineral matter in ore-bearing weathering crusts remains poorly studied so far. Pigment ores composed of iron oxihydroxides represent one of the least studied objects. The study of their mineralogy is of importance for estimating the pigment and technological properties of the corresponding mineral raw materials, understanding formation mechanisms of pigment ores, and elaborating criteria for predicting their deposits.
Numerous studies demonstrated that the most important characteristics of ultradispersed iron oxihydroxide mineral substances may be obtained by the Mössbauer ^{57}Fe spectroscopy, which is sensitive to local atomic environments of Fe ions and to peculiar features of the crystalline structure of the entire mineral matrix. Variations in size and structural characteristics of finely dispersed iron oxihydroxides result in irregular widening of bands in the Mössbauer spectra due to superposition of ion system spectra with effective continuous distributions of the superfine and quadrupole parameters of the nuclear sonde.
Samples of brown and yellow ferruginous ocherous ores and associated slightly ferruginous weathered rocks taken from deposits of the Zigazin–Komarovo iron-ore district in the South Urals served as the object for this study [1]. The Mössbauer ^{57}Fe spectra of the examined pigments were obtained from the MS-1104Em spectrometer at room temperature. The technique of construction and analysis of the magnetic superfine parameter distribution function was used for spectra processing. This procedure revealed three relatively contrasting modes of disordering of magnetic superfine sextet structure in spectra that are clearly correlative with different varieties of pigment ores. According to obtained data, the most important features are determined by the nanosize dispersion of individual particles, and the low crystallization degree of the constituting iron oxihydroxide phases. It may be assumed with high confidence that increase in the size of particles and crystallization degree of these phases results in transformation of spherical semiamorphous Fe-oxihydroxide into euhedral α-FeOOH crystallite, i.e. a valuable pigment raw material into typical brownstone ores.
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1. Lutoev V. P., Kochergin A. V., Lysyuk A. Yu., Silaev V. I., Golubev E. A., Suetin V. P. Phase Composition and Structural State of Natural Iron Oxide Pigments // Doklady Earth Sciences, 2009, Vol. 425A, No. 3, pp. 372–377.