ON THE STUDY OF DISSEMINATED ORGANIC MATTER IN BLACK SHALE COMPLEX ORES AND ITS INTERACTION WITH GOLD

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The carbonbearing matter of so called “black shale” multimetal complex ores is known as involving great difficulties in chemical analysis, mineral economic estimates on technological processing of such ores.

The Sukhoy Log (Eastern Siberia) golden ore deposit rocks were taken as example of our study in order to elaborate the scheme of chemical accumulation of disseminated organic matter (DOM) as well as for DOM nature investigation and its connection with gold, the latter being a component of rock samples. The known scheme of DOM studies of ores, rock and bottom sediments [1] includes the successive sample treatment by low-boiling organic solvents leading to the bitumoid extraction. The next stage provides for the humine acid extraction as a result of 0.1 M alcali solution treatment. After the quantitative removal of named components the subsequent DOM is concentrated to the next state: mineral components of the sample are removed on boiling in 20% HCl with Fe and Al carbonates and oxides dissolution terminated by silicate withdrawal by HF treatment.

The organic matter of the integrated ore sample from dril-holes № 10, 36 (Sukhoy Log ore deposit) having the gold content of $1{,}8.10^{-4}$% was studied in this work. According to CHNS-elemental analysis rather high carbon content (C_{tot}=2.75%; C_{org}=1.45%) and sulfur (0.645%) were found.

According to the published data [2] the content of bitumoids extracted from Sukhoy Log rocks is within the range of 0.002 - 0.004 mass %, the latter being “very low” as to N.B.Vassoevich [3] classification. As a result of these data the special bituminological analysis of rock samples was not performed. Their testing on humine acid (HA) content presented no positive results, indicating on high grade metamorphism of organic matter.

The latter conclusion was corroborated by the X-ray analysis of DOM concentrates performed on X-ray diffractometer DRON-4 in Vernadsky Institute by use of procedure applied for amorphous carbonbearing substance structure estimation [4]. It was established that Sukhoi Log rocks contain the carbonbearing matter consisting as much as 90% of aromatic structure components providing support for the high grade metamorphism of these rocks.

DOM accumulation in the process of chemical phase analysis i.e. succesive treatment of the sample by chemical reagents was accomplished by a number of stages along the dissolution process of inorganic rock components. The traditional DOM accumulation scheme [1] was modified by the incorporation of sulfide sulfur dissolution procedure after the carbonate removal. The ore sample was treated by the reduction mixture consisting of Cr(II) in the medium of HCl, pyridine and alcohol resulting in the reduction of sulfide sulfur to H_2S and the removal of the latter [5]. The sample is separated on two fractions: “light” one, being enriched by carbon amount (C_{org}=9.8%) and “heavy” one enriched by silicates but still containing a substantial organic carbon (C_{org}=1.3%). According to gold determination in both fractions the predominant gold amount (about 87%) is found in the “heavy” fraction.

Ore samples after this procedure were subjected to the next stages of carbonbearing matter accumulation such as the successive treatment of 5% and concentrated HF in order to remove the silicates of different solubility.

IR-spectrometry was applied to the study of the functional groups in the initial sample and those received in the DOM accumulation. Fig. presents the following IR-spectra:(1) initial rock sample; (2) ”heavy” silicate fraction; (3) ”heavy” fraction after 5% HF treatment; (4) ”light” carbon enriched fraction after 5% HF treatment; (5) final DOM concentrate. The first three spectra are markedly similar to the quartzite IR-spectrum (not presented) and characterised by peculiar 1169 and 1080 cm^{-1} absorption bands as well as two doublets: 800,780 cm^{-1} and 520,470 cm^{-1}. 1030 cm^{-1} absorption band in spectra 1 and 2 indicates that the initial rock and the ”heavy” fraction contain some clay minerals of the smectite group being dissolved after 5% HF treatment [3] of the “heavy” fraction. The spectrum of the initial rock has also 1450 and 880 cm^{-1} absorption bands, the latter disappearing after the first acid

treatment. These bands indicate the carbonate ion group frequencies. 1720-1600 cm^{-1} absorption bands peculiar of dissociated and not dissociated HA carboxyl groups clearly exhibited in their spectra were found to be weakly expressed in " light" fraction spectrum (not presented) and are more displayed only after 5% HF treatment when the carbon content is increased up to 59.0% [4]. Here along with the silicate component decrease (1230 and 1100 cm^{-1}) we observe the increase of absorption on 1630 and especially on 1590 cm^{-1} at the expense of carbonyl group content as well as 1750 cm^{-1} absorption band occurrence, the latter being the indicator of carboxyl group oscillation in aromatic acid.

DOM concentrate present a final product of phase chemical analysis (5). It is seen that silicate rock absorption bands disappear completely and only 1630 and 1590 cm^{-1} characteristic bands corresponding to the carbonyl group oscillations are present. At the same time the DOM accumulation is concordant with gold accumulation; so in the DOM concentrate (2-2.5% of the total sample mass) up to 80% of gold amount of the initial rock sample was retained. Thus can the gold retainment take place within analytical procedures as well as in technological processes and be resulted in the underdetermination and underwithdrawal of gold/ Conclusevily the organic matter destruction should be carried out at initial stages of gold quantitative determination or its technological withdrawal from carbonbearing ores.

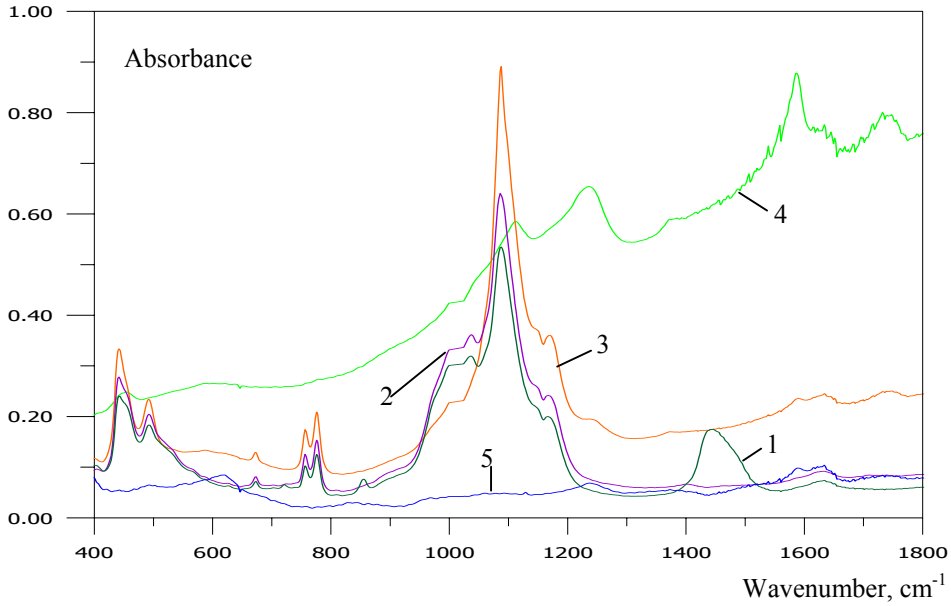

Fig. IR spectra:
1. Initial rock of Sukhoy Log ore deposit;
2. "heavy" silicate fraction;
3. "heavy" silicate fraction treated by 5% HF;
4. "light" fraction enriched in carbon after 5% HF treatment;
5. DOM concentrate.

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