Precious metals (Pt, Pd, Au, Ag) in copper-pyritic deposits of the South Urals

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The numerous deposits of base metals in South Urals have a great importance for producing raw materials of copper, zinc, lead, as well as of gold and silver. Now an interest has raised to the platinum metals distribution in copper-pyritic ores. During a long time the Urals wasknown as the platinum province, but there were no systematic studies of platinum metals in copper-pyritic ores

Our investigation of precious metals was carried out on the example of two types of deposits. The first type (Sibay and Alexandrinskoe deposits) is associated with the sodium liparite-basalt volcanites in the primary eugeosynclines. The second type (Bakr-Tau, Tash-Tau) is connected with the potassium-sodium andesite-dacite volcanites of the ancient islands arc.

Observations with a microscope have shown that the mineral composition of ores and mineral associations in these deposits are similar, but the ratio of major sulphides (pyrite, sphalerite, chalcopyrite, galena) differs. In ores of the Sibay deposit there are also pyrrhotite and magnetite. The ores of Alexandrinskoe and Bakr-Tau deposits are enriched by chalcopyrite, bornite, fahlore in association with pyrite and baryte.

Spectrochemical and chemical analyses were most useful for revealing the distribution of precious metals in ores, ore minerals and technological concentrates. More than 100 analyses have shown that Pt, Pd, Au, Ag are present in both types of deposits without regard to their mineral composition. The distribution of Pt and Au is irregular, Pd and Ag were found in all samples but in various quantities. The Pt content varies from 0.002 to 0.06 ppm in the first type of deposits (Table 1) and from. 0.002 to 1.2 ppm in the second typo (Table 2). The Pd content is higher: from 0.002 to 0.22 in Sibay and Alexandrinskoe and from 0.02 to 0.9 ppm in Bakr-Tau and Tash-Tau deposits. The copper and zinc concentrates from all deposits are richer in Pt and Pd, than other technological products and ore minerals. The copper and copper-zinc ores and their concentrates are rich in gold and silver. The Au content in ores of the first type of deposits is lower (from 0.1 to 7.3 ppm). The Ag content varies

TABLE 1. The Pt, Pd, Au, Ag - values in ores of the deposits Sibay and Alexandrinskoe

Product	DEPOSITS							
	Sibay				Alexandrinskoe			
	Pt	Pd	Au	Ag	Pt	Pd	Au	Ag
Cu ores	0.008	0.03	0.2	4.0	0.008–0.012	0.002–0.006	2.9–5.8	
47–90								
Cu concentrate	0.013–0.025	0.015–0.12		17.0–106	0.024	0.20		105
Cu-Zn ores	0.009	0.02	1.5–2.0	10.0–21; 260	0.008–0.06	0.01–0.22	0–7.3	58–68
Zn concentrate	0.0033–0.01	0.015–0.05		50–52	0.01	0.02		72
Pyritic ores	0.003–0.015	0.03–0.12		2.0–3.6	0.016	0.016		16
Chalcopyrite + pyrrhotite		0.07	0.1–0.6	1.0–5.0				
Chalcopyrite + magnetite		0.015		1.0				
Magnetite	0.002	0.04		1.0				

All figures in ppm

TABLE 2. The Pt, Pd, Au, Ag values in ores of the deposits Bakr-Tau and Tash-Tau

	DEPOSITS							
	Bakr-Tau				Tash-Tau			
Product	Pt	Pd	Au	Ag	Pt	Pd	Au	Ag
Cu ore	0.003	0.04	2.9	48.0				
Cu concentrate	0.005–0.01	0.04	13.0	280.0	0.08	0.9		
Zn ore	0.002	0.03	8.4	120.2				
Zn concentrate	0.004–0.009	0.01–0.08	6.8–10.6	130.0				
Cu-Zn ore	0.002–0.006	0.03–0.04	5.9–12.3	120.0–290.0	0.002; 0.8–1.2	0.02; 0.25–0.34	2.0	38.0–46.0
Pyritic concentrate	0.003–0.007	0.02	2.1	16.0		0.05		

All figures in ppm

from 1.0 to 50 ppm, rare 100–260 ppm (Sibay deposit) and from 16 to 105 ppm (Alexandrinskoe). The relatively high contents of Au and Ag (2.1–13.0 ppm and 16.0–290 ppm respectively) were revealed in ores of the Bakr-Tau deposit.

Our study leads to the conclusion that the platinum metals occur in sulphides in the disseminated form. Relatively high contents of Pt and Pd in ores of the Tash-Tau permit to suppose that in this deposit these elements way be found in the mineral form. The Au and Ag contents and their distribution point that these elements occur in ores both in disseminated and mineral forms. It is evidenced also by finding a native gold and Ag-bearing fahlore in ores of Bakr-Tau and other deposits.

The higher contents of precious metals are connected with the potassium-sodium andesite-dacite volcanism in ancient islands arcs. The copper-pyritic deposits of the South Urals are characterized by the palladium specialization.