Estimation of soils pollution and model of catastrophic chemicalization

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Abstract
The scheme of environment ecosystems catastrophic destruction is suggested during natural leaching of metals and salts. The special attention is given to a problem of threat estimation of soils and plants chemicalization. The universal model for the description of catastrophic danger of technogenic chemicalization of biosphere is suggested.
Keywords: MINERAL DEPOSITS, DEVELOPMENT CONCEPT, MOUNTAIN MANUFACTURE, ENVIRONMENT, CHEMICALIZATION

The growth of scientific and technological progress and increase of population of the Earth demand ever-increasing consumption of mineral resources. About 80-85% of the total oil volume, about half of the coal and iron ore extracted in the human history have been consumed only for the last 30-40 years. The consumption of various metals, fertilizers and other minerals increased 3-5 times.

As modern technology of development and processing of mineral deposits is not perfect and rejectous million tons of gas- and vaporous, liquid and solid wastes, causing total pollution are released into environment. Location layout of mining and processing enterprises, as well as their impact on environmental pollution, air, water and arable land [1-4].

Taking into account the fact, that the dumping sites and tailings have a negative impact on the environment, emerged an urgent need to carry out environmental-economic assessment. This assessment allows to define the environment protection with combined account of natural and anthropogenic influence mechanisms, as well as the quantitative use of mineral resources deposits, thereby to assess the avoided ecological damage to the environment.

Soils pollution assessment must be performed not only in technogenic field but mainly by its response to impact using value of its ecological potential [5-9].

There were selected three sites (zones) in vicinity of mining enterprise for quality determination of soils degraded by dust emissions. Base site 3 is located at distance of 20 km, and others – closely to open-cast at distances 10 km (site 2) and 5 km (site 1). In each site 10 samples of trees and bushes leafs were collected [10]. Leafs investigation were performed during summer season in one-month interval. Averaging data allows to estimate variation of metals concentration with distance from the source (Table 1).

It is determined that iron and copper concentration in vegetation is changing with distance from source in parabolic dependence (Fig. 1).

Table 1. Content of minerals in vegetation, mg/kg anhydrous substance

Site	Metals	
	iron oxide	copper oxide
	bushes	
1	280	30
2	120	15
3	20	10
	trees	
1	410	39
2	190	19
3	70	9

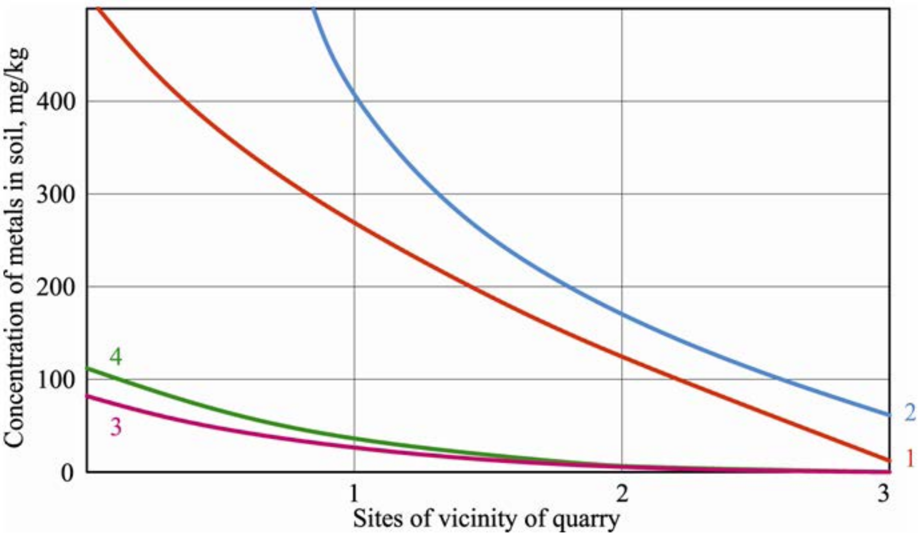

Figure 1. Variation of metal concentration in vegetation with distance of dust source: 1 – iron in bushes; 2 – iron in trees; 3- copper in bushes; 4 – copper in trees

Metals are greatly accumulated on the leaves of trees and bushes. Both vegetation groups choose iron over copper, which is explained by higher copper mobility in propagation of metals in solutions of natural leaching [11, 12]. Average content of metals in vegetation changes less considerable: 162-450 mg/kg for iron, 4,5-6,7 for copper, 12-32 for zinc, 53-80 for manganese, 1,8-3,0 for nickel.

Soil dilution by toxic substances causes significant reduction in crop yields. At 20% of dilution soil productivity is less than 30% from basic value, and only 10% at 50% dilution.

Content of iron in human organism variates from 4 to 7g. Daily maintenance of human in iron is 11-30 mg [13].

Metals influence on biota structures is universal and characterized by regular reduction in yields and vital activity.

Metals getting in soils with fine dust particles are accumulated in upper, accumulational horizon and crop yelds reduction is observed.

Total soils pollution is dangerous not only by technogenic effect but also response to impact in consequence of synergetic effects phenomena of combined influence of their components.

Anthropogenic effect of metallic toxicants on biota is divided in insignificant, moderate and ultimate.

Mechanics of metals accumulation, assimilation and transformation in borders of system “enterprise – medium – biota” is described by model:

$$M_b = M_{b.base}\left(1 - \frac{Q_t k_f k_{am} k_a k_c}{k_{sd}}\right), \quad (1)$$

where M_b – is the mass of living material on the territory, weight units; $M_{b.base}$ – is the mass of living material before technogenic effect, weight units; Q_t – is the amount of generated toxicants, weight units; k_f – is the soil filtration coefficient; k_{am} – is the coefficient of toxicants transmission in aqueous medium; k_a - is the coefficient of toxicants assimilation; k_c - is the coefficient of collective toxicants influence; k_{sd} - is the coefficient of soil depth or invaded zone influence.

The proposed model describes the state of not only plants, but also representatives of living matter, including humans, considering the individual characteristics [14-15].

Thus, the influence reduction of processes of extraction and processing of ores on the ecosystem of the natural environment is possible after:

- conversion from ecologically and socially dangerous methods of open pit and underground mining to the physical, technical and physical-chemical geotechnologies (borehole hydraulic mining, underground leaching, underground coal gasification, underground melting of sulfur, the use of coal-bed methane, coal-water fuels, etc.);
- development of high-performance complex processing technologies and opening of the mineral grains of middle quality and hardly separated ores, as well as technogenic materials;
- development of complex waste-free closed systems of final products separation obtaining;
- development of fundamentally new technologies of mineral raw materials processing - in the first place using biological organisms, plasma-chemical reactions, etc.;
- development of new deep mineral deposits and the bottom of World ocean;
- involvement in the industrial use of unconventional energy resources (solar, wind, tides, etc.).

Conclusions

Implementation of the latest technologies can radically change our understanding of the quantitative and qualitative characteristics of the mineral resources of the planet and fully confirm the thesis of Academician A.E. Fersman that the future of geology is in technology.

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