

Environmental geochemistry of nanoparticles: analytical determination and extraction

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The most dangerous are the mobile forms of chemical elements which migrate into soils and ground water. The neogenic metallo-organic forms are actively involved into biocenoses and have a negative impact on the ecosystem. The most migratory are the nano-size particle fractions (below 1000 nm) which form ion, molecular and colloid systems.

Application of modern technique and methods of direct visual observation of nano-particles has allowed to observe particles with size up to 0,25 nm by SEM analysis. But determination of chemical composition of nano-particles has some difficulties. In the course of microprobe analysis due to extra small size of nano-particles the probe burns through them and does not give opportunity to evaluate their chemical composition independently from the matrix. Analytical sensitivity is 0,01% and at the same time local composition of single particles of the sample does not reflect geochemical specificity of the whole rock.

It was necessary to find a way to separate fraction which consists of dispersed elements, i.e., to concentrate them by separation from the mineral matrix of

a rock. As a basis for the method of separation of particles with the size less than 1mkm is taken the fact that under special conditions nano-particles can form in water colloid solutions which are stable for a long time. It is possible to separate colloid particles from water only using different coagulants or by means of ultra centrifugation. Appliance of filters with pores 1mkm for filtration allows to adhere to the upper particle size: all the particles in the solution are of nano size – up to 1 mkm. And after the evaporation of water from the solution a substation mass is measured. The fraction obtained in this way was called nano-dispersed fraction or nano-fraction. In nano-fraction chemical elements are in ionic, molecular and colloid form; it makes 0,01-6 weight.% of the samples. Then colloid-salt water solution of nano-fraction is analyzed by ISP MC method. Analysis of nano-fraction water solutions maximizes the possibilities of the ISP MC method because no chemical reagents are used and they don't negatively affect the result. The method allows to lower by 2-3 orders of magnitude the detection limits for a wide range of elements: (whole sample/nano-fraction, ppm):

U-0,01/0,00002; TI-0,03/0,00006; Mo-1,0/0,0002;
Cd-0,1/0,0006; Hg-0,005/0,0005; Te-1,0/0,002; Sb-
0,1/0,0006; Bi-0,2/0,0001; As-0,6/0,001; Se-0,5/0,01.

The analysis of behavior of mobile forms of elements will give possibilities of: understanding and monitoring processes in the bio-geo-sphere and ecosystems related to the transport and distribution of trace elements; explanation of potential hazards and health

effects due to metal pollution; reinforcement of the scientific influence on policy and strategy for solving global ecological problems and for sustainability; improvement and restoration of contaminated environments and restoration of urban areas; reducing the impact of toxic elements that may exist in mobile and bioactive forms.

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