Geochemistry in space

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At present time geochemistry solves the problems of the existing natural scientific disciplines. However this approach isn't the only one of its kind. If we consider that all the chemical elements exist in nature not as a mixture of atoms and compounds but in the form of spatially organized geochemical fields, then it is possible to treat the environment as a result of the interaction of a combination of geochemical fields of chemical elements and their compounds. Different abundances, chemical and physical properties define a variety of fields of elements. The difference in mass, spatial structure, dynamics makes the field of iron different from the field of carbon, the field of gold – from that of helium, and so on.

The proposed approach has important corollaries in terms of theoretical geochemistry. In particular it allows to overcome the important paradigm, according to which the concentration of chemical elements at every point of space is estimated on the statistical basis, and to replace it by a new paradigm in which the content of any element at the particular point of space is a function of the coordinates of this point.

As a result of our efforts in this area we have come to two important conclusions: 1) geochemical fields are regular organized and exhibit themselves in space as the hierarchical fractal structures; 2) the fields can be identified, typified and studied by means of mathematical modeling using the concept of field theory.

The proposed approach does not contradict with the basic scientific concepts and opens broad prospects for purely geochemical studies in both theoretical and practical aspects.

Extremophile bacteria: Ultimate sink for U(VI) from contaminated mine water?

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In order to better develop remediation technologies for cleaning mine water and sediment originated from mining activities further understanding of the key biogeochemical processes that control transport and fate is needed. The distinction and quantification between biological and physical chemical processes is an area that needs attention if microbes are to be used as potential remediation technology. We present the findings of a study of bacterial interaction with uranium in aqueous environment.

To this aim, the behaviour of 2 strains of the chemolithotrophic acidophile, *Acidithiobacillus ferrooxidans* (Type strain NCIMB 8455 from acid bituminous coal mine effluent, and NCIMB 13538 isolated from an abandoned uranium mine in Dera Ghazi Khan, Pakistan) towards the presence of U(VI) were studied under various environmental conditions. In order to understand the biotic and abiotic contributions to the removal of U(VI) from mine water, the constructed systems were analysed by ICP-MS, FT-IR, potentiometric titrations and XPS and EXAFS. Changes in O_2 consumption and bacterial biomass were also studied. The presence of Fe(III) was also carefully monitored.

Results showed that both the presence of bacterial biomass and Fe(III) have an effect on the removal and speciation of U(VI) from solution at acidic pH. It also demonstrated that although the bacteria is capable to accumulate U (VI) there is a significant amount of U (VI) immobilised by Fe(III) precipitates. The study allowed also to establish the adequate parameters for the potential use of this bacteria on the clean-up of mine water and sediments at very acidic conditions.