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Modelling of the heavy metals impact on aquifers by complex study of groundwater fauna and monitoring in GRID, MODEL-ACVASUB system

Abstract

At both national and European level, the use of groundwater increases continuously especially due to climate change and the considerable limitation in drinking water sources. The protection of aquifers became one of the priority objectives in the European politics. The heavy metals are the most toxic inorganic pollutants with severe impacts on groundwater ecosystems because of their reduced self-purification capacity. Heavy metals accumulate in water, sediments and in deep layers of soil. They pollute the groundwater and can migrate relatively large distances. The toxicity of heavy metals increases along trophic chains by bioaccumulation in groundwater organisms. Because of their reduced metabolism, the groundwater organisms have higher tendency of heavy metal bioaccumulation in comparison with their surface relatives. Therefore, the groundwater organisms are considered long-term indicators of pollution. The remediation of groundwater polluted with heavy metals is practically impossible and the hazardous effects of heavy metals on human health are largely known. Pollution prevention by continuous monitoring, and the identification of such heavy metal bioindicators in subsurface-surface ecotons, are the only methods that allow for a rigorous management of surface waters and prevention of aquifers pollution.

The MODEL-ACVASUB project looks upon the evaluation of quality of aquifers as drinking water sources, and the functioning of the groundwater ecosystems pollutes with mining waters in the catchment's area of the Arieș River. The study will focus on the communities in the surface-subsurface ecotone represented by the hyporheic environment, and on communities in the nearby wells. Polluted and unpolluted segments of the Arieș River will be monitored and other possible contaminants will be also considered. Biological, hydrochemical and sedimentological data, which will be acquired in time and space, will be used for modelling of dynamics (e.g. in frequency,

abundance) in the structure of biological groundwater communities under the impact of surface pollution. By using heavy metal-indicator species, past and present pollution events can be revealed without the use of chemical determination.

The project is structured in three main research directions, each with specific objectives: (I). 1. The present-state evaluation of aquifers and water sources (e.g. wells, streams) in Aries catchment's area; 2. The assessment of anthropogenic impact on groundwater; (II). 1. Monitoring of the quality of water and sediments and community composition in groundwater; 2. Determination of superoxid dismutase (SOD) activity as heavy metal-induced oxidative stress in crustaceans tissues and organic fluids; (III). 1. Activities of assessing the project results; dissemination of results in scientific publications, participations to conferences, organization of a workshop, publishing of the directory lines for the protection of aquifers polluted with heavy metals; integration of biological research in impact studies and the integrated management of groundwater. Sensitizing public opinion and population education regarding the protection of water sources and of surface streams.

This project is carried on under the auspices of the Water Framework Directive (2000/60/EC) that was implemented in Romania in 2004 and of which priority is linked to the protection of all surface and subsurface waters. The project aims to serve as tackling model for problems of groundwater pollution and impact on subterranean fauna, and it will be applied also for other catchment's areas in Romania. The project results and conclusions have to ensure improving of quality of groundwater as drinking water resource. A good and efficient management of groundwater can be achieved by good contaminant monitoring and the use of bioindicators, but also by developing of mathematical models that can be applied to other situations with other contaminants. The effects of pollution on groundwater have to be revealed to the public, from students as future specialists to local communities, for strengthening of the civic conscience and increasing of the interest for quality of the environment.

Objectives

- ◆ Multi-proxy, geological, hydrological, water chemistry (heavy metals, organic pollutants and micropollutants) and faunistic studies and their integration in an unitary evaluation system.
- ◆ Estimation of the pollution degree of the aquifer waters and sediments in time and space, which will be performed after the integration of the obtained data by the interpretation of the laboratory data.
- ◆ monitoring biological communities, and water and sediments chemistry in polluted and uncontaminated zones (repeated sampling and processing of samples in laboratory) Determination of superoxid dismutase (SOD) activity as heavy metal-induced oxidative stress in crustaceans tissues and organic fluids.
- ◆ Developing of sensors for heavy metals that will transmit the information in GRID system Construction of the MODEL-ACVASUB model

- ◆ Results dissemination (e.g. articles, communications, web page, course supports, workshop)