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Quantitative and qualitative assessment of the groundwater system behavior to support Brownfield regeneration of Hunedoara (Romania) former steel production site

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Located in the Western part of Romania, the study area is the Hunedoara former steel industry site. The current contamination status of the subsurface shows a real threat due to the contribution of more than 100 years of steel production, ironworks operations, coke products generation, and recovery of recycling materials. Analyses performed in 2007 indicated high contaminations with heavy metals like copper, lead, cadmium, manganese, and chromium. As the contamination of the soil and groundwater severe, brownfield regeneration of this site is essential for a sustainable land management.

Intelligent remediation techniques with regard to phytoremediation and soil washing with recycled solutions could be applied. However, these techniques could be correctly chosen and applied if a reliable image of the hydrological, geological, hydrogeological, pedological settings exits and after a deep understanding of the contamination mechanisms. As consequence the development of a groundwater flow and contaminant transport model for this area is compulsory.

Hunedoara County has a complex geological structure, made by crystalline-Mesozoic units belonging to Southern Carpathians and by sedimentary-volcanic units of Western Carpathians. The site area is shaped by the presence of alluvial deposits from the Superior Holocene. From the lithologic point of view, covered by a thick layer of clay a sandy formation is located at depths bellow 10 m. The two strata are covering an extended carbonate media. The main aquifer is represented by a groundwater body located under the clay layer. The groundwater table of the superficial aquifer is located at about 10 m depth.

The one layer groundwater flow model simulating aquifer behavior covers about 1,2 km2. Its conceptual model relies on a 3D geological model made by using 7 accurate geological cross-sections of the studied domain. Detailed geological data was provided by direct-push core sampling correlated with the penetration time and with electrical conductivity tests.

One important role in the spatial distribution of the contaminants is played by the hydro-stratigraphical features of the site. In situ testing of hydraulic conductivity has been performed by injecting water under a specified pressure (4-5 bar) into the aquifer. The interpretation provides in a preliminary stage a relative profile of hydraulic conductivity. By means of several slug tests, the results are translated into absolute values of hydraulic conductivity. The calibrated flow model represents the first step for the quantitative assessment of the groundwater parameters. Correlating the surface and soil distribution of the pollutants, a multi-component transport model is currently set-up in order to quantify the spatial distribution of the contaminated area.