Geophysical Research Abstracts
Vol. 20, EGU2018-6896-1, 2018
EGU General Assembly 2018

Advanced redox zonation of the San Pedro Sula alluvial aquifer using multivariate geostatistics

Diego Di Curzio, Sergio Rusi, and Patrizio Signanini

"G. d'Annunzio" University of Chieti-Pescara, Engineering and Geology Department (InGeo), Chieti, Italy (diego.dicurzio@unich.it; s.rusi@unich.it; signanin@unich.it)

In developing countries, the incorrect wastewater management and the land use distribu-tion lead to severe environmental problems, creating heavy eutrophication condition in surface-water. The organic matter produced in the eutrophicated streams, where surface-water is in direct connection with groundwater, can be transferred to the aquifer. The oxidation of this organic matter triggers the redox processes (Terminal Electron Accepting Processes, TEAPs) in groundwater, mobilizing redox-sensitive compounds, such as Mn and Fe. This issue indeed complicates the groundwater exploitation and management. For this reason, the definition of the redox zonation within an aquifer can be an effective tool for the identification of the pollution sources and for the conceptual model refinement, when remediation strategies need to be planned.
The study area is the San Pedro Sula aquifer (Honduras), which is a multi-layer alluvial aquifer characterized by well-known surface-water/groundwater interactions and by heavy polluted streams. Here, high concentrations of Mn and Fe were found in the aquifer, especially near the eutrophicated rivers.
The redox zonation is generally aimed to identify homogenous zones characterized by a predominant TEAP, although the redox processes are dynamic reactions. For this reason, the Multi-Collocated Factorial Kriging (MCFK), a multivariate geostatistical method (Sollitto et al. 2010), has been applied to chemico-physical parameters (temperature, pH, turbidity) analytes (Mn, Fe, NO_3, NH_4, PO_4) diagnostic of the redox processes, measured in 93 wells collected in 2 monitoring rounds (wet and dry season). In this way, it has been possible to get a deeper insight into the spatial relationships among the different considered parameters and to overcome the predominant TEAP concept, characterizing a specific area. In addition, the distance from the surface-water has been selected as an auxiliary variable, essential to perform the MCFK, because the eutrophicated rivers have been considered one of the most important pollution sources. This multivariate geostatistical method requires 3 main steps: 1) the Gaussian anamorphosis to transform raw variables into Gaussian transformed variables; 2) the Linear Model of Coregionalization fitting, including the variogram models of both direct and cross-variograms; 3) the extraction and interpolation of the sets of scale-dependent regionalized factors.
At a short range, the first results show a strong relation of Mn concentration with redox processes, which may be ascribed to the organic matter transfer from heavy polluted surface-water to the aquifer. At the same time, the relation between Fe and turbidity can be due to a fine colloidal phase developed when different groundwaters, characterized by distinct redox conditions, mix up in the wells. Contrariwise, at a wider range, Fe seems to be related with redox processes, near an additional pollution source detected in the northern part of the study area.

References

Sollitto D., Romic M., Castrignanò A., Romic D., Bakic H. (2010). Assessing heavy metal contamination in soils of the Zagreb region (Northwest Croatia) using multivariate geo-statistics. Catena 80, 182-194.