Geophysical Research Abstracts, Vol. 7, 09085, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09085

Investigation of the transport and accumulation mechanisms of a herbicide in the river floodplain and groundwater system of the S. Alessio Plain, Lucca (Tuscany, Italy)

R. Rossetto (1), B. Bockelmann (2)

(1) Centre for Geotechnologies, University of Siena, Italy, (2) Hydroenvironmental Research Centre, Cardiff University, UK (rossetto@unisi.it / Fax: +39 055 9119439 / Phone: +39 055 9119434)

In the S. Alessio Plain, Lucca (Tuscany, Italy), groundwater is abstracted in a well field by means of ten vertical wells from a major sedimentary aquifer, which is hydraulically interconnected with the Serchio River. The S. Alessio abstraction area provides the water resources to the municipalities of Pisa, Livorno, and Lucca for an overall number of people of about 300,000. It is believed that the application of the herbicide terbuthylazine for agricultural purposes in the field nearby the abstraction area, as well as the interchange of herbicide-contaminated water between the river and the aquifer, might pose a threat to the groundwater resource. During the year 2003, concentration values exceeding the EU drinking water limit of 0.1 μg/l for herbicides were monitored in groundwater routine analyses. The authority currently managing the potable water distribution service commissioned studies to investigate the provenience and the mechanism of the aquifer contamination.

Hydrogeological, geological, and groundwater quality data were collected and analysed to produce a representative conceptual model of the investigated area. The geostatistical approach was used to prepare a spatial distributed data set starting from discrete measurement points. Then, a numerical model of the hydrogeological regime using the finite-difference code (Wang and Anderson 1982) MODFLOW (McDonald and Harbaugh 1984) was produced. Simulations were run to analyse the flow model

sensitivity, and a fully working calibrated and validated steady-state flow model was achieved. The code MODPATH (Pollock 1989) for particle tracking was used to define the well field respect area. The calibrated flow model was coupled to the MT3DMS (Zeng and Wang 1998) code to simulate the potential fate and transport of terbuthylazine below the water table. The results of the solute transport confirmed the existence of two mechanisms of groundwater contamination in the S. Alessio Plain: a) direct seepage through the unsaturated soil to the aquifer, and b) leakage of contaminated river water to the aquifer. Moreover, it was recognised that the bulk of the aquifer contamination was supplied via river leakage. Evidences allow to infer river water contamination is mainly caused by surface runoff ending in the upper reach of the Serchio River. Finally, this work provided an important base to conduct further modelling studies on the investigated area, involving a more sophisticated surface and groundwater modelling numerical code, and to produce a valuable groundwater-management tool for the S. Alessio well field.

References

European Union 1980. Council Directive 80/778/EEC of 15 July 1980 relating to the quality of water intended for human consumption.

European Union 1998. Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption.

European Union 2000. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

McDonald, M.G. and Harbaugh, A.W. 1984. A modular three-dimensional finite difference ground-water model. United States Geological Survey, Openfile Report No.6.

Pollock, D.W. 1989. Documentation of computer programs to compute and display pathlines using results from the U.S. Geological Survey modular three-dimensional finite difference ground-water model. United States Geological Survey Openfile Report 89-381.

Wang, H.F. and Anderson, M.P. 1982. Introduction to groundwater modeling. Finite difference and finite element methods. Freeman, New York, USA.

Zheng, C. and Wang, P.P. 1998. A modular three-dimensional multispecies transport model for simulation of advection, dispersion and chemical reactions of contaminants in groundwater systems. Documentation and User's Guide. Department of Geology and Mathematics, University of Alabama, USA.