

PREFACE TO VOLUME V

Water is an essential component of ecosystems and man's health. As the world population is growing, the need for more food, man's shift to urban areas and the progressive industrialisation all affect water resources in a qualitative and quantitative way. Connected to these general developments the following problems arise:

- water exploitation increasingly concentrates on local areas with high water demands at low cost;
- urbanisation contributes to the disequilibrium of groundwater recharge, either by sealing the surface against infiltration or by leakage processes from the underground water transport system;
- the groundwater quality is affected by leakage and accidental spills of liquid and solid wastes gathered in a few places, generally untreated or unconditionally released, thus presenting serious dangers of pollution;
- the excessive use of agrochemicals influences the natural functioning of both the soil and the aquifer, thus hampering the self-attenuation processes;
- emissions from fuel and waste combustion are concentrated in few places, in the vicinity of the emission source provoking strong and quasi immediate contamination, also in the more distant surroundings slowly increasing impacts on water resources and ecosystems by dry or wet deposition;
- the expansion of man's activities in arid and semi-arid regions often lead to the deterioration of resources, either by overexploitation or by desertification;
- deforestation disturbs the water balance and water quality, and enhances erosion.

Since water resources react on changes of land and water use with a long delay time, man's activities should be better adapted to basic hydrodynamic conditions in order to better satisfy the needs of a safe drinking water supply, flood protection, and the food and industrial production. Such basic hydrodynamic conditions comprise e.g. resource replenishment, steady state or transient dynamics and chemical stratification, which all may contribute to develop exploration and exploitation strategies that guarantee sustainable water availability in a qualitative and quantitative way.

It is well known that remediation techniques of water resources imply costly but crucial efforts with often low efficiency to restore the health of ecosystems and to provide a healthy water supply on the basis of existing guidelines. To avoid such efforts fundamental and process-oriented research on the physical, chemical, microbial and hydraulic behaviour of water resources must advance to provide effective and long-term strategies of water resource protection.

Hydrogeological research is strongly interdisciplinary and based on geological, hydraulic, hydrochemical, microbial and isotopic research, each with its specific efficiency and scope of application.

- geological investigations provide essential boundary conditions for setting up and developing conceptual models for strategic mathematical modelling,
- hydraulic investigations provide system inherent parameters, generally based on local information, that must be extrapolated into time and space and, therefore, need long-term data series; these are to be processed statistically by mathematical models to approach a better understanding of the system dynamics;
- environmental isotopes introduce space and time integral information that may close the gap and provide the link between missing data series;
- hydrochemistry brings information on the reactive behaviour of water constituents and certain compounds in the water reservoir;
- microbial and chemical studies are needed to understand the resilience (natural attenuation capacity) of water resources.

Since in many areas of the world relevant long-term data on water resources are missing, the traditional and isotope methods in combination with mathematical modelling often answer pressing questions about groundwater origin, chemical reactions, fluxes, ages and mixing processes occurring in reservoirs, naturally and caused by man. Only on this basis can relevant strategies for exploration, exploitation and protection of subsurface waters be developed.

This volume aims to demonstrate how the choice of applying combined disciplines and methods should be made in the case of specific, man-made perturbations of the natural environment.

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