Table of contents

Preface XI
Organization XIII

Methods

Movement of bacteriophage and fluorescent tracers through underground river sediments
M. Bricelj & M. Mišić 3

About the influence of the injection mode on tracer test results
S. Brouyère & C. Rentier 11

Laboratory tracer experiments in carbonate porous media from Slovenia
B. Čenčur Curk, M. Obal, J. Kogovšek & M. Veselič 19

In situ experimental evaluation of aquifer-tracers interaction: First results
A. Di Fazio & M. Benedini 27

The use of bacteriophages for multi-tracing in a lowland karst aquifer in western Ireland
D. Drew, N. Doerfliger & K. Formentin 33

Determination of bacteriophage migration and survival potential in karstic groundwaters
using batch agitated experiments and mineral colloidal particles
K. Formentin, P. Rossi, M. Aragno & I. Müller 39

Performance and persistence of Indium-EDTA as activable tracer in field experiments
E. Gaspar, R. D. Gaspar & I. Paunica 47

Activation analysis in investigation of hydrokarst systems
E. Gaspar, S. P. Stanescu & R. D. Gaspar 51

New fluorescent tracers
S. Hadi, Ch. Leibundgut, K. Friedrich & P. Maloszewski 55

Can $^{222}$Rn be used as a partitioning tracer to detect mineral oil contaminations?
D. Hunkeler, E. Hoehn, P. Höhener & J. Zeyer 63

A contribution to toxicity of fluorescent tracers
Ch. Leibundgut & S. Hadi 69

Sorption of Uranine and Eosine on an aquifer material containing high organic carbon
C. Mikulla, F. Einsiedl, Ch. Schlumprecht & S. Wohnlich 77
222Rn concentration variations owing to dynamic condition changes induced in the waters of the Apulian karst aquifer (Southern Italy)
T.Tadolini, M.Spizzico & D.Sciannamblo

Use of optical brighteners in applied hydrogeology
A.Uggeri & B.Vigna

Fluorescent polystyrene microspheres as tracers of colloidal and particulate materials: Examples of their use and developments in analytical technique
R.S.Ward, I.Harrison, R.U.Leader & A.T.Williams

The importance of tracer technology at combined borehole investigations
H.Zojer

Surface waters

Natural tracers – Indicators of the origin of the water of the Vrana Lake on Cres Island, Croatia
B.Biondić, S.Kapelj & S.Mesić

Field tracer tests for the simulation of pollutant dispersion in the Doller river (France)
O.François, P.Calmels & F.Merheb

Restoration of tritium inflow dynamics in regulated river systems
D.I.Gudkov & M.I.Kuz'menkov

Transport of Caesium radionuclides and Strontium-90 in the Dnieper water reservoirs within 10 year period after the Chernobyl nuclear accident

‘In situ’ determination of the dilution efficiency of submarine sewage outfall’s with the help of fluorescent dye tracers
J.Roldão, J.Pecly & L.Leal

Unsaturated zone

Tracer investigations in the unsaturated zone under different cultivation types in a mountainous catchment area
T.Harum, J.Fank & W.Stichler

Behaviour and comparison of dissolved silica and oxygen-18 as natural tracers during snowmelt
A.C.Hildebrand, M.Lindenlaub & Ch.Leibundgut

Water tracing tests in vadose zone
J.Kogovšek

Conceptual runoff model for small catchments in the crystalline border mountains of Styria, as developed from isotopic investigations of single hydrological events
D.Rank & W.Papesch

Investigation of preferential flow in the unsaturated zone using artificial tracers
S.Uhlenbrook & Ch.Leibundgut
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-situ tracer investigations on the water balance of an alternative surface covering system on a sanitary landfill</td>
<td>189</td>
</tr>
<tr>
<td><em>R. Zischak &amp; H. Hörtl</em></td>
<td></td>
</tr>
<tr>
<td><strong>Aquifer</strong></td>
<td></td>
</tr>
<tr>
<td>Karstic sources in Malatya Province, east of Turkey</td>
<td>199</td>
</tr>
<tr>
<td><em>I. Atalay</em></td>
<td></td>
</tr>
<tr>
<td>A negative dye tracing in the Grintovec massif (Kamnik Alps)</td>
<td>203</td>
</tr>
<tr>
<td><em>P. Audra</em></td>
<td></td>
</tr>
<tr>
<td>Ground water flow in the fresh water lens of northern Guam</td>
<td>205</td>
</tr>
<tr>
<td><em>W. L. Barner</em></td>
<td></td>
</tr>
<tr>
<td>Experiences in monitoring Timavo River (Classical Karst)</td>
<td>213</td>
</tr>
<tr>
<td><em>F. Cucchi, F. Giorgetti, E. Marinetti &amp; A. Kranjc</em></td>
<td></td>
</tr>
<tr>
<td>Tracer tests in the Joëu karstic system (Aran Valley, Central Pyrenees, NE Spain)</td>
<td>219</td>
</tr>
<tr>
<td><em>A. Freixes, M. Monterde &amp; J. Ramoneda</em></td>
<td></td>
</tr>
<tr>
<td>An example of geological investigation in a karst area in Lower Austria</td>
<td>227</td>
</tr>
<tr>
<td><em>G. Gangl</em></td>
<td></td>
</tr>
<tr>
<td>Karst water tracing in some of the speleological features (caves and pits) in Dinaric karst area in Croatia</td>
<td>229</td>
</tr>
<tr>
<td><em>M. Garašić</em></td>
<td></td>
</tr>
<tr>
<td>Isotopic and hydrochemical tracing for a Cambrian-Ordovician carbonate aquifer system of the semi-arid Datong area, China</td>
<td>237</td>
</tr>
<tr>
<td><em>Gu Wei-Zu, Ye Gui-Jun, Lin Zeng-Ping, Chang Guang-Ye, Fu Rong-An, Fei Guang-Chan, Jing Zhi-mno &amp; Zheng Ping-Sheng</em></td>
<td></td>
</tr>
<tr>
<td>Analysis of fracture-induced water mixing by natural tracers at a granitic pluton (El Berrocal, Spain)</td>
<td>245</td>
</tr>
<tr>
<td><em>J. Guimerà, L. Martinez &amp; P. Gómez</em></td>
<td></td>
</tr>
<tr>
<td>Properties of underground water flow in karst area near Lunan in Yunnan Province, China</td>
<td>255</td>
</tr>
<tr>
<td><em>J. Kogovšek, H. Liu &amp; M. Petrič</em></td>
<td></td>
</tr>
<tr>
<td>Preliminary results of the submarine outfall survey near Piran (northern Adriatic sea)</td>
<td>263</td>
</tr>
<tr>
<td><em>V. Malačić &amp; A. Vukovič</em></td>
<td></td>
</tr>
<tr>
<td>Separation of groundwater-flow components in a karstified aquifer using environmental tracers</td>
<td>269</td>
</tr>
<tr>
<td><em>R. Nativ, G. Günay, L. Tezcan, H. Hörtl, B. Reichert &amp; K. Solomon</em></td>
<td></td>
</tr>
<tr>
<td>Drainage basin boundaries of major karst springs in Croatia determined by means of groundwater tracing in their hinterland</td>
<td>273</td>
</tr>
<tr>
<td><em>A. Pavičić &amp; D. Ivičić</em></td>
<td></td>
</tr>
<tr>
<td>The Muschelkalk karst in Southwest Germany</td>
<td>279</td>
</tr>
<tr>
<td><em>T. Simon</em></td>
<td></td>
</tr>
</tbody>
</table>
Development of tracer techniques for natural and artificial recharge to confined and unconfined aquifers, India
B.S.Sukhija, D.V.Reddy & P.Nagabhushanam

Water balance investigations in the Bohinj region
N.Trišič, M.Bat, J.Polajnar & J.Pristov

The use of tracer tests in UK aquifers
A.T.Williams

Contamination transport and protection

Groundwater exploration and contaminant migration testing in a confined karst aquifer of the Swabian Jura (Germany)

Use of artificial and natural tracers for the estimation of urban groundwater contamination by chemical grout injections
M.Eiswirth, R.Ohlenbusch & K.Schnell

Agriculture – Potential polluter of waters in karst region in Slovenia
B.Matičič

Tracer tests applied to nitrate transfer and denitrification studies in a shaly aquifer (Coet-dan basin, Brittany, France)
H.Pauwels, W.Kloppmann, J.-C.Foucher, P.Lachassagne & A.Martelat

Tracer experiments on the site of NPP Jaslovske Bohunice – The Slovak Republic
J.Plško, M.Kostolanský, T.Kovács, J.Benko & J.Hulla

Microbiologic activities in karst aquifers with matrix porosity and consequences for ground water protection in the Franconian Alb, Germany
K.-P.Seiler & A.Hartmann

Simulation of pollutant-immission using geoelectric mapping of the migration of an artificially infiltrated salt tracer
R.Supper, W.F.H.Kollmann & A.Kuvaev

Environmental isotope studies and tracer testing to determine capture and protection zones in the Zechstein-Karst on the northern verge of the Thuringian Forest
C.Treskatis & K.Hartsch

Hydrogeological investigations at the mineral springs of Stuttgart (Muschelkalk karst, South West Germany) – New results
W.Ufrecht

The use of groundwater tracers for assessment of protection zones around water supply boreholes – A case study
R.S.Ward, A.T.Williams & D.S.Chadha

Development of a tracer test in a flooded uranium mine using Lycopodium clavatum
C.Wolkersdorfer, I.Trebušak & N.Feldner

VIII
Aquifer parameters and modelling

A deuterium-calibrated compartment model of transient flow in a regional aquifer system

M. E. Campana, W. R. Sadler, N. L. Ingraham & R. L. Jacobson

2D and 3D groundwater simulations to interpret tracer test results in heterogeneous geological contexts

A. Dassargues, S. Brouyère & G. Carabin

Interpretation of tracer tests in a granitic formation (El Berrocal site, Spain)


Geohydraulic parameters in hard rocks of SW-Germany determined by tracer tests

A. E. Jakowski & G. Ebhardt

Dual-tracer transport experiments in a heterogeneous porous aquifer: Retardation measurements at different scales and non-parametric numerical stochastic transport modelling

T. Ptak

Some aspects of the functioning of careos determined by tracer experiments: Example of La Alpujarra (Spain)

A. Pulido-Bosch, Y. Ben Sbih & A. Vallejos

Differentiation of flow components in a karst aquifer using the $\delta^{18}$O signature

M. Sauter

Simulation of cave hydrology using a conventional computer spreadsheet

J. D. Wilcock

Author index