PROCEEDINGS OF THE 6TH INTERNATIONAL SYMPOSIUM ON WATER TRACING
KARLSRUHE / GERMANY / 21-26 SEPTEMBER 1992

Tracer Hydrology

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OFFPRINT

A. A. BALKEMA / ROTTERDAM / BROOKFIELD / 1992

Tracer Hydrology, Hötzl & Werner (eds) © 1992 Balkema, Rotterdam. ISBN 90 5410 084 2

The hydrogeology of Padiş karstic plateau – Bihor Mountains, Rumania

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ABSTRACT: A tracing experiment with uranine, which proved the underground connection between a stream sink of Padiş karstic plateau with Poiana Ponor and Galbena springs, correlated with a discharge diagrame and hydrochemical data, completed the picture of an important karst water reservoir.

1. GEOLOGICAL DATA

Situated in the central part of the Western Carphatians, the Bihor Mountains present large karstifyable surfaces. The most representative one is the Padiş karstic plateau.

In the area, the Bihor unit and posttectonic cover formations outcrop with Paleozoic, Mesozoic, Tertiary and Quaternary sedimentary formations that have methamorphic rocks in the basement (Mantea 1985). In the Mesozoic deposits several Triassic, Jurassic and Cretaceous formations have been separated.

The detrital rocks deposits, which continues with quartzitic sandstones and a sequence of silty shales, of Werfenian- Lower Anisian, or only Werfenian age (about 7o m thick), associated with Permian deposits or Cristallyne formations form the main impervious rocks in the basement of the limestones.

The Middle Triassic Deposits are represented by almost exclusively carbonatic formatios, which appears as an alternation of Gutenstein Limestones (whose thickness does not exceed 150 m), dolomites of Anisian age (60 m thick) and Weterstein reef limestones, which can reach 300 m in thickness. These carbonatic deposits form the Lower Aquiferous Serie (aprox. 500 m thick).

Following the old Kimmeric movements, on the whole territory of the Bihor Mts.,due to the relief uplift, new sources of detrital sediments appear, dominantly continental.

Detrital Formation (Hettangian - Lower Sinemurian) attain 160 m in thick and is build up of quartzose conglomerates, quartzitic sandstones and shales. These deposits form the impervious rocks between the Triassic and Jurassic limestones, separating the Lower Aquiferous Serie from the Upper Aquiferous Serie.

Calcareous formation up to 45 m thick, that is considered equivalent of Gresten Limestones (Upper Sinemurian - Carixian age) and the Middle Jurassic deposits occupy reduced areas and are not very thick, being formed by a succesion of grey-blackish limestones, marly limestones and encrinitic limestones.

The Upper Jurassic formations occupy remarkable areas and are represented exclusively by limestones. The thickness of the Upper Jurassic is generally variable, but not exceed 300 m.

After the Upper Jurassic sedimentation, the new Kimmerian phase, determinated the exondation of the territory and create favourable conditions for the bauxites ore emplacement (Neocomian age), which is overlie by the suite of the Eo-Cretaceous limestones. All these limestones of Jurassic and Cretaceous age form the Upper Aquiferous Serie (450 m thick).

2.GROUNDWATERS IN KARSTIFIED FISSURED ROCKS

The impervious bed between the two aquiferous series, formed by Hettangian- Lower Sinemurian age deposits are known as a aquifuge or some time aquiclude formation . In between two impervious rocks, the Lower Aquiferous Serie is like a confined aquifer being contained like a sandwich between relatively impervious rocks. The impermeability of the impervious rocks is partially, especially due to the discontinuity of the formation as a result of the fractures, which allows an intercommunication between the two aquifers, being preferentially directed from the Triassic to the Jurassic and Cretaceous. Due this fact, in general the discharge of the springs situated in the Upper Aquiferious Serie is higher, being separated as Highly Productive Karstic Aquifers, while the Lower Aquiferous Serie is Lower or Medium Productive Karstic Aquifer.

2.1. The Padiş - Cetatile Ponorului karstic plateau

The Padiş-Cetatile Ponorului karstic plateau, with a 54 km^2 of limestone outcro, is formed by 23.5 km^2 Triassic limestones and 30.5 km^2 Jurassic and Cretaceous ones.

In this area 26 stream-sinks and 18 karstic springs have been identified.

The main sinking area is situated on Triassic limestones.

The watershed in the central part of the plateau established by a sequence of tracer injection places (Oraseanu,1985), show the preferential discharge direction to West and South. According to the geological and tectonical map a dispersion of the discharges, can not be observed, the cachment areas being well individualized. The existence of the watershed in that place is determined by the outcrop of the Hettangian-Sinemurian deposits (situated at the East side of the Oşelu spring, whch continue under the Quaternary deposits.

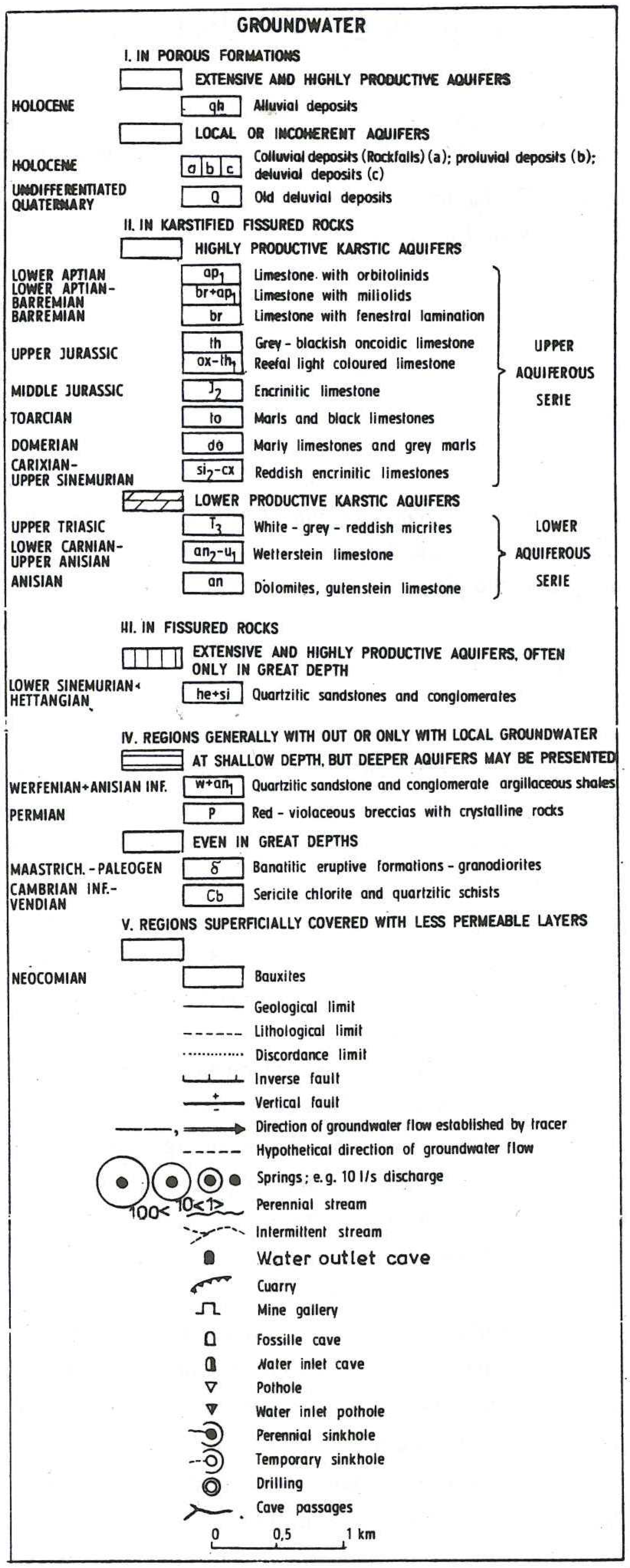
The flow path reveals the strong dependence on the tectonic structures.

The Boga spring runs the waters from a 4.5 km^2 catchment area of Triassic limestones, the main stream sinks being in Varasoaia, with a total discharge of 60 l/s, the waters being gathered on impervious formations, and will control the high level of Boga spring discharge, which is between 100-500 l/s.

The same discharges of the streams sinks can be observed in the Padis-Tringhieşti area (aprox. 50 l/s), which were tested with a dye tracing experiment. The tracer appears in the Poiana Ponor spring and the river after 1 km of subaerial course sink once again, to be found in the cave of Cetatile Ponorului, like a subterranean cave stream, which end in a sump after two km of passages, the waters coming out finally through the Galbena spring.

The Poiana Ponor stream-sink, is formed along a fault which put in contact the Triassic and Jurassic limestones, being in the same time a connection between the Lower and Upper Aquiferous Series.

A combined hydrodinamic and hydrogeochemical studies concerns the variations of chemical composition of the Poiana Ponor and Galbena springs was done during a tracing experiment.



In June, 18, 20.00 p.m., 1991, 2 kg of Uranine was injected in the Tringhieşti stream-sink. The rainfalls from those days are reflected in the general form of the grapf (Fig.2.d). The appeareance of the tracer in the Poiana Ponor spring was after 14 hours (Table 1), the grapf presenting 3 pulses of different amplitudes, the storage of

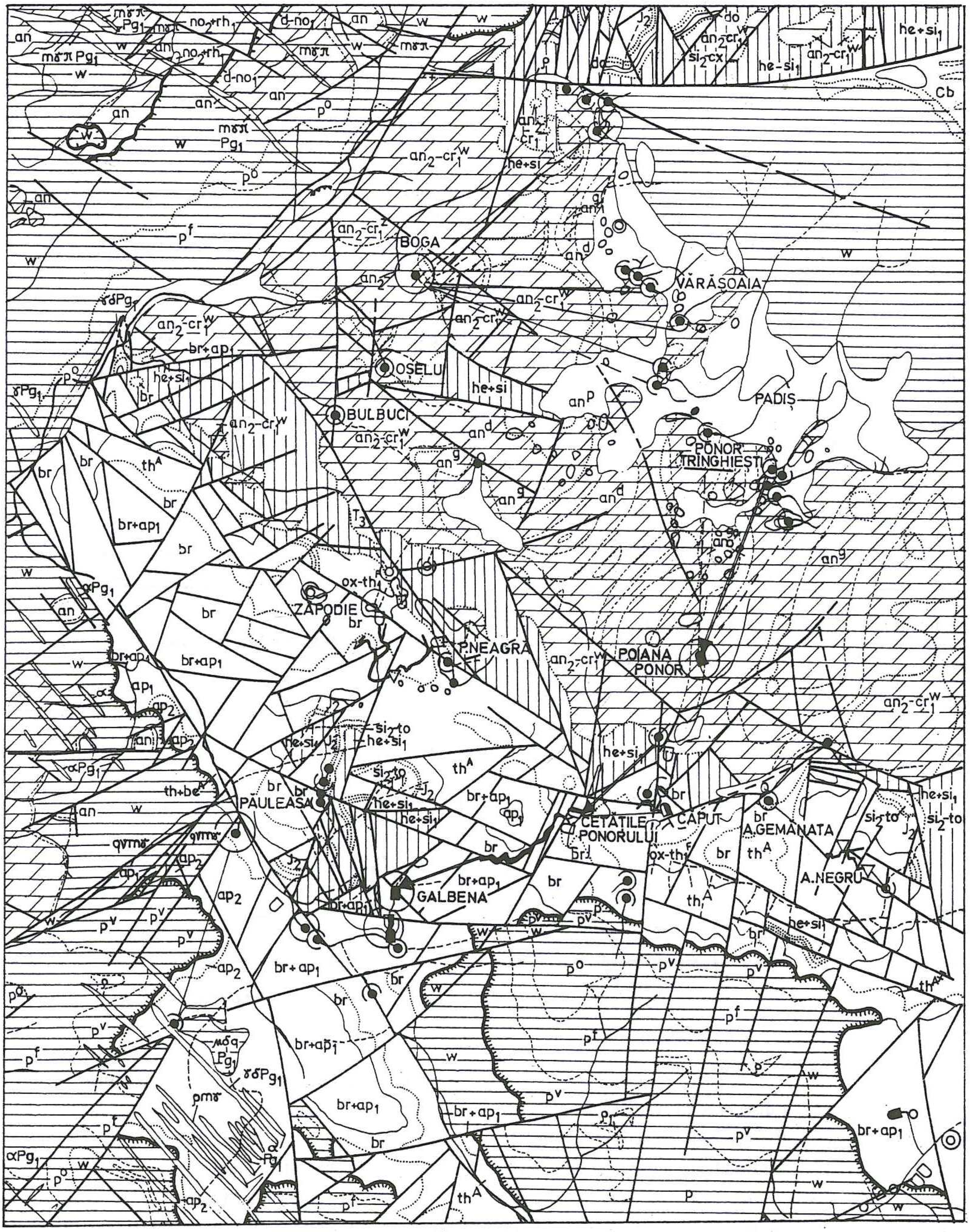


Fig.1

the limestone massif being reduced.

The flood hydrograpf of the Poiana Ponor and Galbena springs, seems to be of a vadose cave stream and tend to be peacked and similar to a surface river. The storage is strongly influenced by the proportion of the rainfall input that runs off and the lag between the input event and the output response is very short (Fig.2 a).

The appearence of the tracer in the Galbena spring was after 40 hours, the graph being flatter, that proves that the storage condition are different, the vadose flow being

Table 1
Hydrogeological map of Padiş - Cetăţile Ponorului area

Injection Point Stream sink	Alt. m	Q l/s	Spring	Alt. m	Q l/s	Aerial Distance m	Difference level m	Mean Transit Time h	Flow Velocity m/s
Tringhieşti	1260	15	Poiana Ponor	1100	134	1980	160	96	20.62
			Galbena	800	228	5350	460	102	71.33

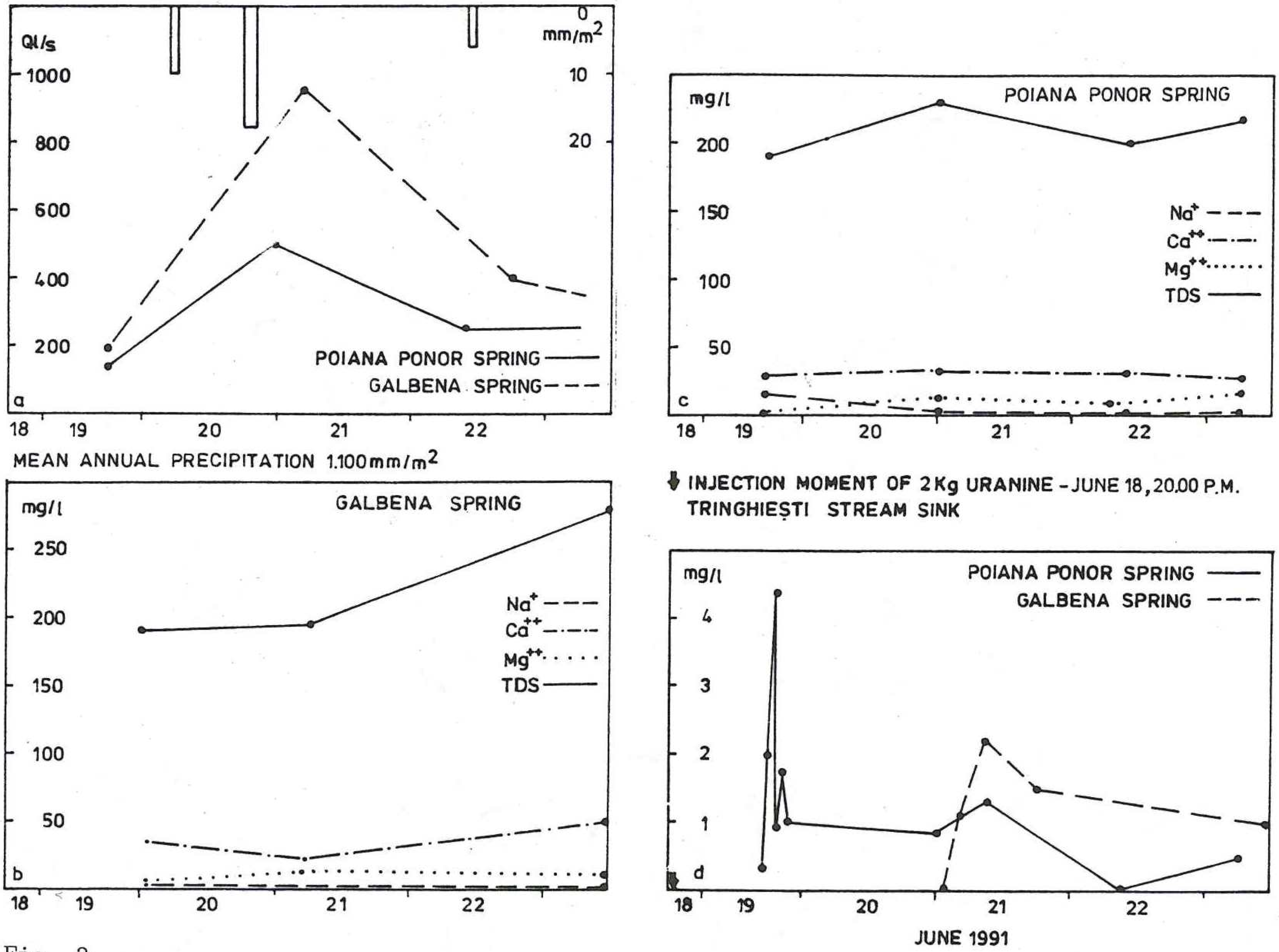


Fig. 2.

shorter.

The diagrams show a discharge of water with relatively low mineralised water of the aquifer reservoir during the rise of flow-rates. Once the flood peack is passed, the newly infiltrated water reaches the spring through the karstic fissures and rises the mineralisation. This rise is followed by a dilution of the mineralisation, which is caused by the end of the high water.

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