

CHAPTER 2

SHORT HISTORY OF THE HYDROGEOLOGICAL INVESTIGATIONS OF THE KARST IN ROMANIA

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Investigation of karst areas is a multi-disciplinary approach, which is the reason why in these areas the efforts of landforms investigators, cavers, geologists, hydrologists and hydrogeologists interpenetrate, one being unable to specify exactly where some of them start, and where others end. This is also the case of the research performed in karst areas of Romania, where the first information on karst springs and groundwater flow has been provided by geographers, geologists and cavers.

In the year 1863, the Austrian geographer A. SCHMIDL has published in Vienna the work "Das Bihar Gebirge and der Grenze von Ungarn und Siebenburgen", the first extensive geographical study addressing the karstology and the speleology of an area within the territory of our country. The author provides a detailed description of the karst in the mountains Bihar, Vlădeasa and Codru Moma, of the main karst springs, of the mineral and thermal springs in those mountain bodies and in Beiuș basin.

In the year 1901, the Romanian geologist S. MIHUȚIA has performed the first tracer testing of an underground stream course in Romania. By labeling the water of Țarina stream with charcoal powder, he outlined the hydrologic connection between Câmpeneasca cave, in Vașcău karst plateau, and the Boiu spring, next to Vașcău town (S. MIHUȚIA, 1904).

In 1908, Marghițaș and Buhui dams are built on Buhui stream, the lakes being the only ones in Romania placed on limestones. Downstream Buhui lake, controlled water by the dam is then distributed in the limestones area and feeds, together with Certej spring, the underground flow of Buhui cave. At the end of the cave there is an artificial underground lake, its water supply Anina town through an artificial gallery, of 1.3 km long (V. SENCU, 1967).

EM. PROTOPOPESCU-PACHE, in his studies undertaken in Mangalia area, sets the water drainage to the springs of sulphurous bath in the South, as well as the springs placed to the East, towards the sea, to Constanta highway, by marking with uranite the waters overflowed from Kara-Oban lake in the nearby ponor (R. COCÂRDEL, EM. PROTOPOPESCU-PACHE, 1955).

The first systematic hydrologic investigation of the landforms in the karst areas of Romania has been performed by the Institute of Speleology "Emil Racovita" (ISER) and by the Institute of Geography. Starting from the very first papers published by the scientists of those two institutes, M. ȘERBAN, D. COMAN and I. VIEHMAN (Bihar Mountains, 1957), T. RUSU, GH. RACOVÎȚĂ and D. COMAN (Bihar Mountains, 1970), I. VIEHMAN (Bihar Mountains, 1958, 1966), V. SENCU, (Anina area, 1970, 1978, 1986), T. RUSU (Pădurea Craiului Mountains, 1960-1988), V. TRUFAȘ (Sebeș Mountains, 1965) and from ISPIF, BIȘIR and M. PASCU (Cerna area, 1967, 1969), there can be noticed their obvious concern for identifying the groundwater flow paths, fluorescein tracer tests being performed in this respect.

Over the time interval 1960-1988, the Pădurea Craiului Mountains karst areas have been subject to detailed karst topography and hydrology investigations conducted by T. RUSU, who performed a multitude of fluorescein tracer tests, by which he outlined the main karst flow directions. The integral publication of those results occurred in the year 1988.

The Institute of speleology "Emil Racovita", specifically its research worker I. POVARĂ, has carried out over the period 1965-2007 an extensive activity of investigating the karst hydrogeology of Cerna stream catchment area, of Mehedinți

Mountains and Plateau, West Jiu area and South Dobrogea. T. CONSTANTINESCU performed tracer tests in Piatra Craiului Massif, G. DIACONU in Motru Sec area and I. POVARĂ and V. HOROI in Ardeu watershed. The chemistry of the karst waters in Pădurea Craiului, Cerna trough and Mangalia area made the object of very detailed studies signed by C. MARIN.

In 1974, M. BLEAHU publishes "Karstic morphology", an encyclopaedia about the karst and its genesis, a work of a highly positive impact on researching the karst in Romania.

Starting from the year 1970, the Hydrogeological survey department of Prospektiuni S.A. company has carried out a constant activity aimed at investigating the carbonate rocks areas, in order to complete hydrogeological maps, to compute the water budget, to assess the groundwater resources, to delineate the main karst flow paths and to outline the groundwater chemistry. Those investigation projects addressed most karst areas in Romania, being performed by: G. SIMION (Mehedinți Mountains, Cerna-Jiul de Vest area), I. LAZU (Mehedinți Mountains), M. FERU (Mangalia area), NICOLLE & I. ORĂȘEANU (Pădurea Craiului, Codru Moma, Bihor Vlădeasa, Trascău Mountains, Poieni plateau, Rapolt crystalline limestones outcrop, Dâmbovicioara Pasasage, Postăvarul Massif, Reșița-Oravița area, Teliuc-Ghelar zone, Mangalia area), E. ANGHEL (Moneasa and Teliuc-Ghelar areas), A. IURKIEWICZ (Pădurea Craiului and Vâlcan Mountains, Reșița-Moldova Nouă area), N. TERTELEAC (Codru Moma, Dâmbovicioara Passage), GH. PONTA (Codru Moma, Cernișoara-Jiul de Vest area), ELENA & R. STRUSIEVICI (Cernișoara-Jiul de Vest area), RUXANDRA & D. C. SLĂVOACĂ (Vâlcan and Bucegi Mountains, Mehedinți Mountains and Plateau, Cernișoara-Jiul de Vest area), RĂDIȚA & G. BANDRABUR (Petrești-Tureni area, Babadag Basin, Poiana Ruscă Massif, Mehedinți Mountains and Plateau, Sebeș Mountains, Parâng and Căpățâni Mountains, Cernișoara-Jiul de Vest area), MIRELA & C. PANAITESCU (Perșani Mountains), G. DRAGOMIR (Hăghimaș Mountains), G. DRAGOMIR and C. NAN (Reșița-Anina area), A. ROTARU (Anina-Nera area), A. ANGHELI (Nera-Dunăre area) and E. CĂPRARU (SW Vașcău Plateau).

In order to delineate the groundwater flow paths, the company Prospektiuni S.A. has performed about 170 tracer tests, many of them in cooperation with the Tracer group of Institute of Physics and Nuclear Energy (IFIN) led by E. GAȘPAR. For these tracer tests, there have been initially used radioactive tracers (Iodine-131, Bromide-82), and after the year 1980, activable tracers (In-EDTA, Dy-EDTA, La-EDTA), fluorescent tracers (fluorescein, rhodamine B) and whitening optic agents (stralex). To some of the tracer tests performed in Apuseni Mountains, there has also taken part a group from the High School Institute in Baia Mare, led by I. POP.

In 1970, D. I. SLĂVOACĂ, I. ORĂȘEANU, E. GAȘPAR and AL. BULGĂR (1985), confirm the continuity of limestone in the Danubian Unit under crystalline schists in Motru Sec- Baia de Aramă by labelling with Iodine-131, demonstrating thus, based on a hydrogeological method, the presence of the Gettic Nappe. A marking done 29 years later, in 1998, by G. & RĂDIȚA BANDRABUR, D. C. & RUXANDRA SLĂVOACĂ (1998-1999), in between the lost Prejna river at Balta and Bârza spring, supports the continuity to South-West of the same tectonic structure. Another labelling, contributing to confirming regional geological structures, was done in Bihor Mountains, the hydrological connection between the losses at Valea Seacă stream and the spring of Crișu Băița stream confirming the continuity of the Bihor Unit limestones under the permian sandstones of Arieșeni Nappe at Tapul peak (I. ORĂȘEANU, E. GAȘPAR, I. POP. T. TĂNASE, 1991).

The National Institute of Hydrology and Water Management (INHWM), specifically its research workers P. NIȚĂ, AL. BULGĂR, P. MIȚĂ, DIACONU V., OANCEA V. performed hydrologic investigations, together with tracer tests. The group in INHWM, including A. ȚENU, F. D. DAVIDESCU and ANA SLĂVESCU, has completed investigations addressing the karst water dynamics by means of environmental isotopes. Detailed studies addressed the investigation of the karst aquifers in South Dobrogea, Valachian Platform and the origin of the thermal water at Geoagiu and Felix-1 Mai Spa.

The tracer labellings performed by Institute of Study and Design for Land Reclamation (ISPIF), especially by M. Pascu, highlight the un-

derground connexion between losses in Jiul de Vest watershed and Cerna spring and between losses in flow of Motru Sec river and springs in Baia de Aramă area. Were also established sanitary and hydrogeological protection areas of Runcu and Jaleş springs in Vâlcan Mountains (R. PASCU, DANA VELICIU, 2000).

The investigation of the karst aquifers in South Dobrogea focused the interest of a multitude of scientists, among which we mention: R. CIOCÂRDEL and EM. PROTOPOPESCU-PACHE (1955), C. DRAGOMIRESCU (1971), I. NAINER (1971-1973), N. PITU (1980), V. MOLDOVEANU (1987-1988), F. ZAMFIRESCU, A. DANCHIV, M. ALBU, M. ENĂCHESCU and V. MOLDOVEANU (1993), F. ZAMFIRESCU, V. MOLDOVEANU, C. DINU, N. PITU, M. ALBU, A. DANCHIV and H. NASH (1994).

Contributions to the investigation of Mangalia area are due to GH. VASILESCU and SILVIA MATEI (1967), A. ȚENU and G. NEACȘU (1968), I. NIȚĂ (1971), M. FLORIAN and GABRIELA POPESCU-DUMITRESCU (1972), I. IANCULESCU (1980), E. GAȘPAR and I. ORĂȘEANU (1987), I. ORĂȘEANU (1993, 1994), V. MOLDOVEANU, C. DINU, P. GEORGESCU and V. NICULESCU (1988-1990), M. FERU and ANA CAPOTĂ (1991), M. FERU (1993), I. POVARĂ (1994), C. MARIN and TUDORA NICOLESCU (1993), T. PARKER (1994).

Consistent data regarding geological structure and hydrogeology of karst reservoirs has brought by drilling wells performed by Foradex SA (former ISEM company), Enterprise for Driling and Special Geological Works (ISLGC) and Institute of Balneology and Physiotherapy (IBF)

Starting with 1970, the Institute of Atomic Physics, later named Institute of Physics and Nuclear Energy, has brought major contributions, by the team led by E. GAȘPAR, to developing and applying marking technologies with radioactive and activable tracers in the study of karstic aquifers. In a permanent cooperation with researchers from institutes involved in the study of karstic areas, the team of tracers took part in a large number of markings, highly contributing to knowing the dynamics of underground waters in all areas of carbonate waters in Romania. In this team there were and

there are following researchers: R. CATILINA, S. CRĂCIUN, LUCREȚIA DINESCU, R. GAȘPAR, M. MIDOIU, MARIA PASCU, B. PĂUNICĂ, G. POPOVICI, C. STANCA, P. STĂNESCU, T. TĂNASE, L. TIMOFTE.

E. GAȘPAR is the author of "Modern trends in tracer hydrology" (1987) and "Tracers in aquifer systems" (1994), reference books in using tracers in hydrology. He has also published, on his own or with other co-authors, several articles on results of tracer tests and was constantly interested in finding new labelling technologies and new tracers to explore the dynamics of underground waters.

Hydrogeological research of karstic areas to point out still waters is the topic of articles published by M. PASCU, C. MOISSIU and ALINA MOISESCU in 1984 (Scropoasa supplies, Izvorul Minunilor at Stâna de Vale, Bârza-Topleț and Murighiol), EUGENIA PÂRVĂNESCU and A. PÂRVĂNESCU in 1991 ("Șapte Izvoare Reci", Scropoasa area), ILEANA TIȚA and V. MICULA in 1998 („Hera spring" in Vlădeasa Massif) and I. ORĂȘEANU the same year (Bihor Vlădeasa and Codru Moma mountains).

Starting with 1983, the review "Theoretical and Applied Karstology" is being published, with works presented at seminars on this topic, organised by Emil Racoviță Institute of Speology and S.C. Prospectiuni S.A. In 1987, E. GAȘPAR and I. ORĂȘEANU publish in this series an article about natural and artificial tracers used in the study of karst hydrodynamics, A. IURKIEWICZ and A. MANGIN publish in 1994 a synthesis of using the systemic analysis in the study of karstic aquifers in Vâlcan mountains, while in 1995, A. ȚENU and F. DAVIDESCU publish another synthesis on using the environmental isotopes in the study of carbonate karstic aquifers in Romania. In 1991 and 1996, I. ORĂȘEANU publishes in the same review hydrogeological maps at 1:50,000 scale, of Pădurea Craiului and Bihor Vlădeasa Mountains.

In 1985, the Geological Institute of Romania publishes the Vașcău sheet of the hydrological map of Romania, at 1:50,000 scale, drafting by GH. PONTA, M. BLEAHU, S. PANIN and I. ORĂȘEANU.

In 2002, A. ISTRATE, in the "Hydrokarstic systems of Bucegi Mountains" publishes the results of his research in the high watershed of Ialomița river.

The knowledge of karstic hydrographs of Apuseni Mountains was supported by a major contribution of

works undertaken by L. VĂLENAȘ, B. ONAC, P. COCEAN, E. SILVESTRU and P. E. DAMM.

We also need to mention the key contribution in exploring and researching the karst in Romania of amateur speleologists. In many cases, the caves and avens they have found supported the researchers in exploring this invaluable asset.

Hydrogeological knowledge of karst areas were the object of PhD Thesis performed by T. RUSU (1979), A. ȚENU (1979), N. PITU (1981), I. POVARĂ (1997), V. MOLDOVEANU (1999), I. ORĂȘEANU (2000), G. ISTRATE (2001), A. IURKIEWICZ (2004), and A. ROTARU (2009).

The largest karst springs in the Carpathian Orogene have 1-2 m³/s average flow rates (table 1), their occurrence being related to the presence of unary karst type systems, with homogeneous limestone bodies extending over large surfaces (the springs in downstream gorges of Dâmbovița stream, Ochiu Beilului spring in Banat Mountains, Boiu spring in Vașcău Plateau), or to of a widely developed non-karst catchment area within the binary karst systems (Cerna spring, Bârza spring, springs in Vâlcan Mountains). In Apuseni Mountains, although carbonate rocks extend over large areas, the tectonic structural pattern to which they had been subjected has resulted in a kaleidoscope-like structure, where carbonate deposits are scattered within the bulk of other deposits. This structural framework did not favor the development of large extent karst systems, so that flow rates of the most important springs do not exceed 500-600 l/s as mean annual discharge.

The largest distance between sinking points and outlets, recorded as a result of the tracer tests performed in Romania so far, is 23.6 km (table 2). It was reached along the connection between losses of Cerna river in Bobotului gorges and Neptun springs in Băile Herculane spa (G. SIMION, E. GASPĂR, 1976). The flow path between the sinking point of Prejna stream in Mehedinți Plateau and Bârza spring in Mehedinți Mountains is 22.0 km long (G. BANDRABUR et al, 1998-1999), thus being the second longest.

The higher difference in level recorded as a result of the performed tracer tests is 775 m between Balta Cerbului ponor and Seven Cold Springs in Mehedinți Mountains (I. POVARĂ, 1980), followed by 700 m elevation drop between Scorota ponor in Retezat Mountains and Cerna spring in Godeanu Mountains (G. PONTA et al., 1984).

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No.	Source	Morphologic unit	Q			n _v	Bf	Period of observation	References
			mean	min	max				
			m ³ /sec						
1	Cerna Spring	Cerna Mountains	1.985	0.6	5.70	9.5		XI.1981–XII.1982	A. Bulgăr et al., 1984
2	Bârza	Mehedinți Mountains	1.755	1.362	3.17	2.3	0.621	X.1997–IX.1998	G. Bandrabur et al.1998–1999
3	Izvarna	Vâlcan Mountains	1.571	0.722	4.76	5.6	0.5–0.9	1957–1964	A. Iurkiewicz, A. Mangin, 1994
4	Pârunsă	Vâlcan Mountains	1.493	0.146	5.62	38.5	0.240	1971–1972	A. Iurkiewicz, A. Mangin, 1994
5	Vâlceaua	Vâlcan Mountains	1.181	0.240	3.2	13.3	0.25–0.7	1957–1964	A. Iurkiewicz, A. Mangin, 1994
6	Jaleș	Vâlcan Mountains	0.964	0.190	3.58	18.8	0.25–0.7	1971–1972	A. Iurkiewicz, A. Mangin, 1994
7	Springs in Dâmbovița	Dâmbovicioara trench	0.800*					X.1979–IX.1980	I. Orășeanu et al., 1984
8	Ochiu Beului	Banat Mountains	0.712	0.156	9.46	60.0	0.200	1973–1974	Iurkiewicz & Orășeanu 1995
9	Boiu spring	Vaşcău Plateau	0.587	0.070	5.40	77.1	0.140	X.1997–IX.1998	I. Orășeanu, 2000
10	Galbena	Bihor Mountains	0.550**					X.1984–IX.1985	I. Orășeanu, 1996
11	Tăuz	Bihor Mountains	0.529	0.068	4.64	62.2	0.310	X.1984–IX.1985	I. Orășeanu, 1996
12	Roșia	Pădurea Craiului Mts.	0.522	0.078	14.30	183.0	0.201	X.1982–IX.1983	I. Orășeanu, 1991
13	Oșelu	Bihor Mountains	0.300**					X.1984–IX.1985	I. Orășeanu, 1996
14	Bigăr	Banat Mountains	0.483	0.042	3.2	76.0	0.219	1973–1974	Iurkiewicz & Orășeanu 1995
15	Păuleasa	Bihor Mountains	0.477	0.180	1.92	10.7	0.416	X.1984–IX.1985	I. Orășeanu, 1996
16	Ovid+Muncel springs	Mehedinți Plateau	0.423*	0.061	1.07	17.5	0.31–0.42	1978–1987	A. Bulgăr, unpublished
17	Scropoasa	Bucegi Mountains	0.406	0.210	0.980	1.9	0.492	1980–1983	A.Istrate
18	Șura Mare cave	Sebeș Mountains	0.378	0.108	1.44	13.3	0.431	X.2002–IX.2003	G. & R. Bandrabur, present volume
19	Aștileu	Pădurea Craiului Mts.	0.356	0.074	3.41	46.0	0.303	X.1982–IX.1983	I. Orășeanu, 1991
20	Izbândiș	Pădurea Craiului Mts.	0.346	0.049	3.98	81.2	0.171	X.1982–IX.1983	I. Orășeanu, 1991
21	Gâlgoaic	Dâmbovicioara trench	0.318	0.180	0.430	2.4	0.722	X.1979–IX.1980	I. Orășeanu et al., 1984
22	Brătcănilor	Pădurea Craiului Mts.	0.305	0.068	2.41	36.0	0.404	X.1982–IX.1983	I. Orășeanu, 1991
23	Alunu Mic	Vlădeasa Massif	0.306	0.002	3.16	1580	0.088	X.1984–IX.1985	I. Orășeanu, 1996
24	Izverna	Mehedinți Plateau	0.301	0.038	2.25	59.3	0.230	X.1997–IX.1998	G. Bandrabur et al, present volume

n_v, (Q_{max}/Q_{min}); B_f, base flow index (the ratio between Q_{mean} of the drought month and Q mean annual).

*) cumulated flow; **) expeditionary measurements

Table 1 Largest springs in Romanian Carpathian Orogene (mean annual discharge more than 300 l/s)

	Insurgence		Resurgence		L, ΔH, m		Tracer	T, hours	V, km/day	Year	Author (s) of labelling	References
	H, m		H, m		km	m						
A												
1	Bobotului gorges	Godeanu Mts.	375	Neptun Springs	Cernei Mts	148	23,60	227	T	1976	G.Simion, E.Gaspar	Simion, 1988 *)
2	Prejna stream	Mehediinți Plateau	450	Bârza Spring	Mehediinți Mts.	180	22.00	270	F	1998	G.Bandrabur, D. Slăvoacă	Bandrabur et al,1998-1999
3	Bâlta stream	Vâlcan Mts.	420	Isvarna Spring	Vâlcan Mts.	200	19.70	220	In	1991	A.Iurkiewicz, E.Gaspar	Iurkiewicz, Mangin, 1994
4	Bistrița stream	Vâlcan Mts.,	325	Isvarna Spring	Vâlcan Mts.	200	15.60	125	In	1985	D. Rădulescu, E. Gaspar	Rădulescu et al., 1987
5	Scorota ponor	Retezat Mts.	1410	Cerna Spring	Godeanu Mts.	710	13.35	700	In	240	(1)	Ponta et al., 1984
6	Sușița Verde stream	Vâlcan Mts.	437	Balaure Spring	Vâlcan Mts.	285	12.70	152	In	264	A.Iurkiewicz, E.Gaspar	Iurkiewicz, Mangin, 1994
7	Iuta creek	Cernei Mts.	370	Seven Cold Springs	Cernei Mts..	200	12.40	170	I, F	177	E. Gaspar et al.	Povară, 1980
8	Jidantul (Caprei) creek	Vâlcan Mts.	1185	Cerna Spring	Godeanu Mts.	710	12.10	475	F	282	I. Povară et al	Povară, 1980
9	Pestișului stream	Păd.Crai. Mts.	325	Aștileu Spring	Păd. Craiului Mts.	250	11.55	75	In	2040	I.Orășeanu, E. Gaspar	Orășeanu,1991
10	Ursului creek	Vâlcan Mts.	1180	Cerna Spring	Godeanu Mts.	710	10.95	470	F	228	Constantinescu, et al	Povară, 1980
11	Poienile Țesnei ponor	Cernei Mts.	320	Hercules Spring	Cernei Mts.	155	10.25	165	I	210	G.Simion, E.Gaspar	Povară, 1980
12	Părgavu stream	Vâlcan Mts.	370	Isvama Spring s	Vâlcan Mts.	200	10.00	170	In	216	D. Rădulescu, E. Gaspar	Rădulescu et al., 1987
13	Știrbu creek	Vâlcan Mts.	1170	Cerna Spring	Godeanu Mts.	710	9.90	460	F	268	I. Povară et al.	Povară, 1980
14	Izvoarele ponor	Mehediinți Mts.	580	Baia de Aramă catchment	Mehediinți Plateau	275	9,32	305	In	368	G. Diaconu, E. Gaspar	Diaconu, 1989 *)
15	Gorganu creek	Mehediinți Plateau	495	Bolborosu Spring	Mehediinți Plateau	280	8.65	215	I	96	(2)	Slăvoacă et al., 1985
16	Poienii stream	Păd.Crai. Mts.	390	Aștileu Spring	Păd. Craiului Mts.	250	8.35	140	In	768	I.Orășeanu, E. Gaspar	Orășeanu, 1991
17	Ponor of Priga creek	Văscău Plateau	640	Sfârșele Spring	Văscău Plateau	295	8.30	345	I	168	I. Orășeanu	Orășeanu, 2000
18	Sușița Seacă, up.Tâlnicioara	Vâlcan Mts.	450	Balaure Spring	Văscău Mts.	285	8.20	165	Dy	1990	A.Iurkiewicz, E.Gaspar	Iurkiewicz, Mangin, 1994
19	Losses of Sfârș creek	Văscău Plateau	667	Boiu Spring	Văscău Plateau	300	8.025	367	In	1632	I. Orășeanu	Orășeanu, 2000
20	Poienile Țesnei ponor	Cernei Mts.	320	Seven Hot Springs	Cernei Mts.	169	7.62	151	I	145	G.Simion, E.Gaspar	Povară, 1980
21	Ponor of Fântâna Lorilor	Văscău Plateau	613	Boiu spring	Văscău Plateau	300	7.60	331	I	216	(3)	Orășeanu, 2000
22	Motru Sec stream	Mehediinți Plateau	350	Bolborosu Spring	Mehediinți Plateau	280	7.40	70	In	120	(2)	Slăvoacă et al., 1985
23	Poiana Mușuroaie	Mehediinți Mts.	870	Bârza spring	Mehediinți Mts.	240	7.20	630	I	168	I. Povară, E. Gaspar	Povară , 1980
24	Sușița Seacă (quarry area)	Vâlcan Mts.	400	Balaure Spring	Vâlcan Mts.	285	7.20	115	In	1990	A.Iurkiewicz, E.Gaspar	Iurkiewicz, Mangin, 1994
25	Cuceș ponor	Reșița-Moldova zone		Bigăr Spring	Reșița-Moldova N		7.00	390	F	432	V. Sencu	Sencu, 1986
B												
1	Balta Cerbului ponor	Mehediinți Mts.	950	Seven Cold Springs	Mehediinți Mts.	175	1,85	775	F	40	I. Povară	Povară, 1980
2	Scorota ponor	Retezat Mts.	1410	Cerna Spring	Godeanu Mts.	710	13.35	700	In	240	(1)	Ponta et al., 1984
3	Muncelu cave	Bihor Mts.	1100	Blidaru Spring	Bihor Mts.	435	3.88	665	I	147	(4)	Orășeanu et al., 1991
4	Poiana Mușuroaie	Mehediinți Mts.	870	Bârza spring	Mehediinți Mts.	240	7.20	630	I	168	I. Povară, E. Gaspar	Povară, 1980
5	Vărășoia ponor	Bihor Mts.	1290	Boga Spring	Bihor Mts.	675	2.17	615	B	15	(4)	Orășeanu et al., 1991
6	Ponor of Mohilii creek	Mehediinți Mts.	1050	Isvarna Cave	Mehediinți Mts	450	2.55	600	F	137	I. Povară	Povară, 1980

H-elevation, in meters a.s.l., L-horizontal distance between losses and Spring s, ΔH-Difference in level between resurgence and resurgence; T-time of first arrival of tracer; V-apparent velocity.

Tracers: T= Tritium; F=Fluoreseceine, R=Rhodamine B, I=I-131, In= In-EDTA, Dy=Dysprosium EDTA. *) Unpublished report. Authors of labellings: (1) G. Ponta, E. Gaspar, R. Strusiewicz; (2) D.I. Slăvoacă, E. Gaspar, I. Orășeanu, A. Bulgăr; (3) I. Orășeanu, E. Gaspar, T. Tănase, Gh. Ponta, N. Tertealeac, G. Halasi; (4) I. Orășeanu, E. Gaspar, I. Pop, T. Tănase

Table 2. Largest lengths (A) and difference in level (B) recorded in tracing operations

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