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Subterranean stream piracy in the upper basin of the Somesul Cald Valley Area, Bihor Mountains, Romania

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Abstract :
A tracing experiment with uranine proved, for the first time, the underground connection between the Valea Ponorului stream sink and Alunul Mic and Humpleu springs (karstic diffluence). Correlated with hydrochemical and stable isotopes data, this experiment completed the picture of an important cave system and karst water reservoir.

Résumé :
Une expérience de traçage à la fluorescéine a, pour la première fois, prouvé la liaison souterraine entre la perte de la vallée Ponorului et les résurgences Alunul Mic et Humpleu (diffluence karstique). En corrélation avec des données hydrochimiques et des mesures d'isotopes stables, ce traçage a rendu plus complète la connaissance d'un important réservoir d'eau karstique.

I. GEOLOGICAL DATA

Situated in the central part of the western Carpathians (BLEAHU *et al.*, 1976, 1985), the Bihor mountains present large karstifiable surfaces. One of the most representative (Fig. 1) is the upper basin of the Somesul Cald valley (GLIGAN, 1987). In the area, the Bihor unit and posttectonic cover formations outcrop with Palaeozoic, Mesozoic, Tertiary and Quarternary sedimentary formations which have metamorphic rocks as basement (MANTEA, 1985). In the Mesozoic deposits several Triassic, Jurassic and Cretaceous formations have been separated.

The detrital rock deposits, which continue with quartzitic conglomerates and a sequence of argillaceous shales, of Skythian age (about 70 m thick), associated with Permian deposits or crystalline formations, form the main impervious rocks under the limestones.

More details about the regional geology appeared in PONTA & SELIŞCAN (1992).

II. GROUND WATERS IN KARSTIFIED FISSURED ROCKS

The impervious beds between the two aquiferous sertes, formed by H ettangian-Lower Sinemurian age deposits, are known as an aquifuge or sometimes aquiclude formation. The impermeability is partial, especially due to the discontinuity of the formation as a result of the fractures, which allow intercommunication between the two aquifers.

The exchanges are preferentially directed from the Triassic to the Jurassic and Cretaceous. Due to this fact, in general, the discharge of the springs situated in the Upper Aquiferous Series, being a very productive karstic aquifer, is higher than the discharge in the Lower Aquiferous Series, being a medium productive karstic aquifer.

HI. THE UPPER BASIN OF THE SOMESUL CALD VALLEY AREA

The upper basin of the Somesul Cald valley area, with 20 km^2 of limestone outcrop, is formed by 2.5 km^2 of

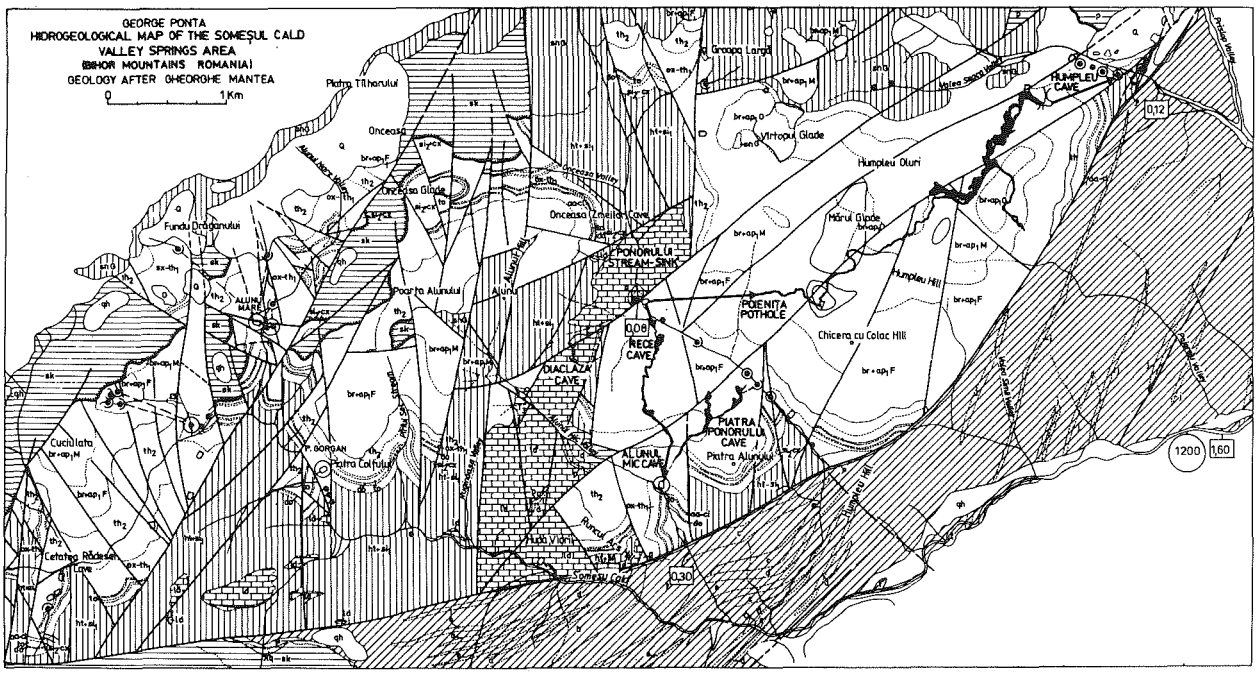


Figure 1 : Hydrogeological map of the Somesul Cald valley springs area.

Triassic limestones and 17.5 km^2 of Jurassic and Cretaceous ones.

In this area, 14 stream sinks and 15 karstic springs have been identified. The main sinking area is situated at the contact between the Triassic limestones and the Cretaceous ones or on the Jurassic carbonate deposits.

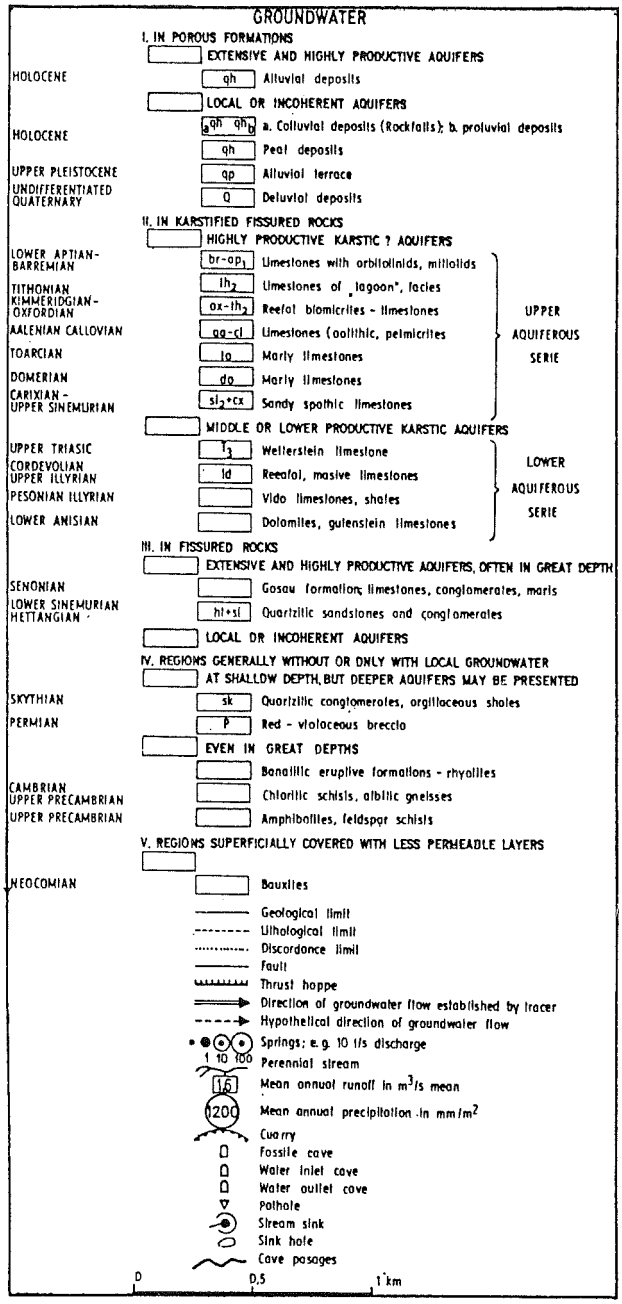
The watershed in the central part of the area, established by a tracing experiment (ORASEANU, 1985), shows a preferential flow direction to the South, towards the Alunul Mic spring. According to the geological and tectonic map, a dispersion (of the discharges) can be observed, but the catchment areas are well individualized. The flow path reveals the strong dependence on the tectonic structures.

The Alunul Mic spring (Pestera cu Oase - The bons' cave) tans the waters of the Valea Ponorului stream sink (ORASEANU, 1985), which has a total discharge of 701/s, the waters being gathered on impervious formations and Triassic limestones. It controls the Alunul Mic spring high discharge, between 100-500 1/s.

On October, 8, 1991, at 15.00 p.m., 1 kg of uranine was injected into the Valea Ponorului stream sink. The rainfalls of those days are reflected in the general foret of the graph (Fig. 2). The tracer reappeared in the Alunul Mic spring after 17 hours (Table 1), the graph presenting one pulse of high amplitude. The storage in the karstic aquifer is reduced and is strongly influenced by the proportion of the rainfall input which tans off.

Name of the point	Alt. m	Q l/s	Aerial distance km	Difference level m	Mean Transit Duration h	Flow Velocity m/h
Valea Ponorului stream sink	1130	70				
Alunul Mic spring	1100	130	1.5	30	12	125
Humpleu springs	975	100	4.5	55	24	187.5

Table 1 .



Legend of Fig. 1

The lag between the input event and the output response is very short.

The flatter graph shows that the reappearance of the tracer in the Humpleu springs occurred later, after 27 hours; the storage conditions are different, the vadose flow being longer.

This karstic diffluence controlled the formation of two important cave systems : Humpleu-Poienita cave system, 30 km long, and Piatra Ponorului cave system, with 4 km of passages.

The stable isotopes composition ranges between -11 and -8 for $^{18}0$ and between -90 and -65 for ^{2}H for stream sinks and springs (Fig. 3). The stable isotopes measurements show a dispersion of the concentration of $^{18}0$ and ^{2}H (Fig. 4), according to the altitude of the springs and stream sinks.

The TDS of the springs waters ranges between 233 mg/l and 285 mg/l, very close to the TDS of the stream sink (219 mg/l), confirming once again the high speed flow of the underground stream through the limestones.

V. ACKNOWLEDGEMENTS

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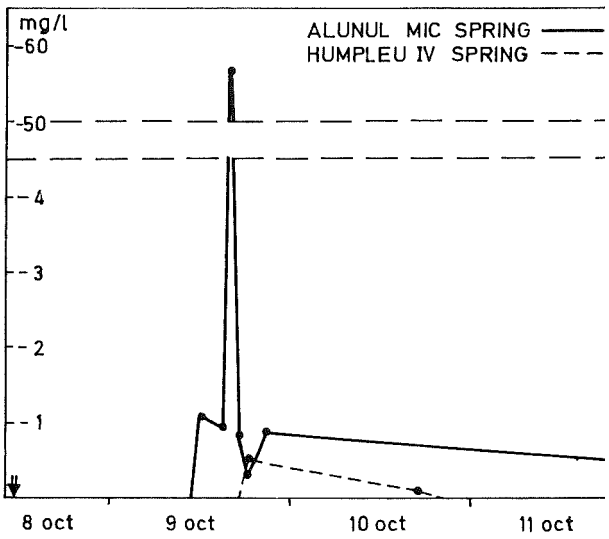

Figure 2 : Moment of injection of 1 kg uranine - October 8, 15.00 p.m., Ponorului valley stream sink

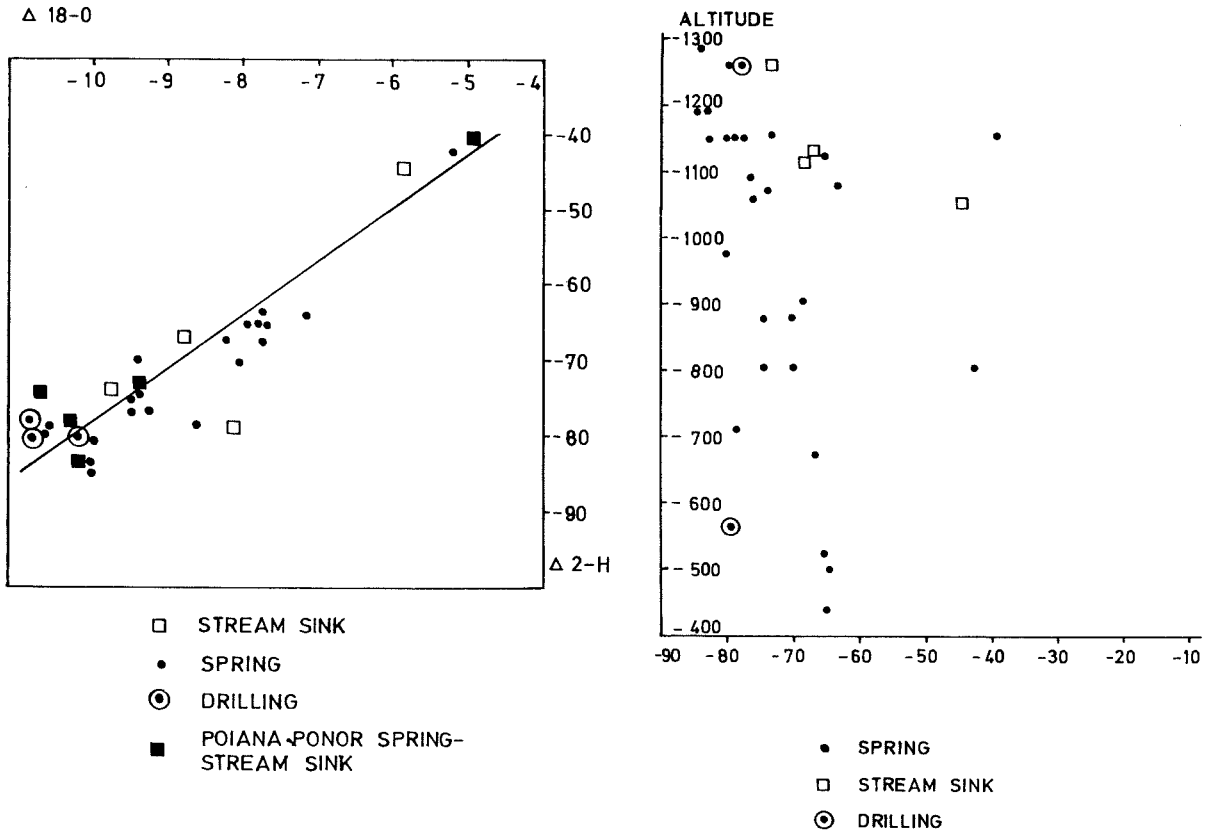

Figure 3 : Stable isotopes composition

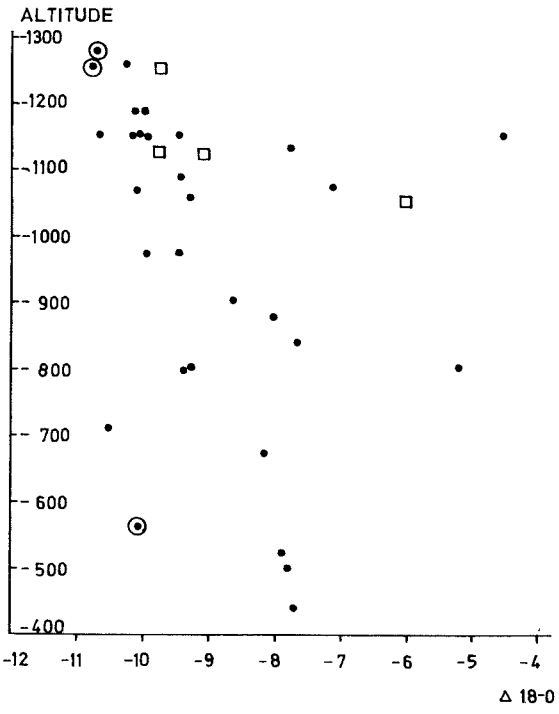

Figure 4 : Relationships between stable isotopes and altitudes of springs and stream sinks of Bihor mountains

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