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# Purpose and contents of the Hydrogeologic Map of Croatia, Scale 1 : 200,000

Ante ŠARIN

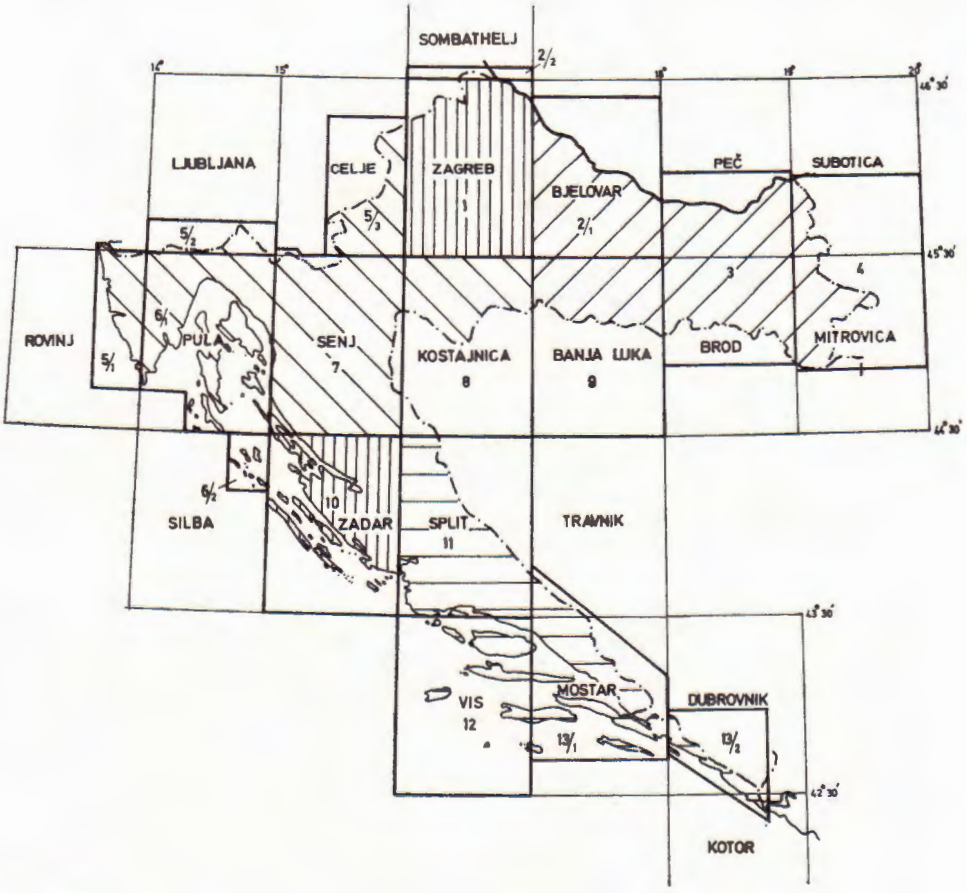
*Institute of Geology, Sachsova 2, P. p. 283, YU—41000 Zagreb*

The entire territory of S.R. Croatia is being hydrogeologically mapped using the scale 1:200,000. The map is complex, composed of several special hydrogeologic maps. It introduces certain new cartographic features: differentiation of rock units into fourteen hydrogeologic classes, a new approach to hydrogeologic cartography in karst regions, application of a suitable international classification of thermomineral waters, showing of the chemistry and quality of both ground and surface waters. The legend of the map is included.

## INTRODUCTION

Since the use of ground water as a source of geothermal energy and valuable mineral water may probably replace most of the present exploitation of oil and natural gas in the future in Croatia, INA-NAFTAPLIN in Zagreb, the largest Yugoslav oil company, is planning to extend its activity into this branch of industry and is therefore carrying out the complex research of porous media, but this time from the ground-water aspect. As a result, the company has accepted an offer submitted by the Institute of Geology in Zagreb to execute a modern hydrogeologic map of Croatia using the scale 1:200,000. So far, the Institute of Geology has furnished a comprehensive study-plan (Šarin, 1976) and two pilot sections (Šarin & al., 1976; Fritz & al., 1976). Four more sections will be completed by July 1977 covering, together with the pilot sections, 27,330 km², or 48% of the territory of S.R. Croatia (Text-fig. 1). The completion of the mapping of the whole territory is scheduled for mid 1979.

Some fifteen years ago there was an attempt for systematic hydrogeologic mapping of Yugoslavia using the scale 1:100,000 but it soon proved abortive. In Croatia, this attempt resulted in the mapping of only one section covering an area of about 1,100 km², or 2% of the entire territory, and the map itself was executed in preliminary form, on a heliographic copy, scale 1:50,000 (Prvanović, 1965). In addition, a part of the hydrogeologic cartographic elements have been displayed in various maps of different scales prepared within so-called regional hydrogeologic studies that covered most of the considered territory and within other hydrogeologic explorations used for various water-supply, hydro-power, or land reclamation projects.




LEGEND
LEGENDA

1, 10 Pilot sections, completed in 1976
*Ogledni listovi, završeni u 1976. godini*

2, 3, 4, 9 Northeastern Croatia, mapping in 1976/77
*Sjeveroistočna Hrvatska, izrada karte u 1976/77. godini*

11, 12, 13 Southeastern Croatia, mapping in 1977/78
*Jugoistočna Hrvatska, izrada karte u 1977/78. godini*

5, 6, 7, 8 Central and Western Croatia, mapping in 1978/79
*Središnja i Zapadna Hrvatska, izrada karte u 1978/79. godini*

Fig. 1. Time table of mapping
Slika 1. Vremenski plan izrade karte

A special hydrogeologic map that encompasses the entire Dinarides and is aimed exclusively at the study of hydrogeology of karst terrains was edited by Herak & Bahun (1974). This map offers a valuable contribution to the hydrogeologic cartography of Croatia and is included in the map under discussion. One small-scale hydrogeologic map, scale 1:1,350,000, was also made (Miletić & al., 1975). It shows the feasibility of ground-water supply in Croatia.

ACKNOWLEDGEMENT

The author greatly appreciates the cooperation of H. Urbiha, petroleum geologist from INA-NAFTAPLIN, who, as the project supervisor of the reported map, was not only a *spiritus movens* of the entire project but also frequently helped the author, who is in charge of project managing, to solve many scientific and technical problems. It is a pleasure to also acknowledge a significant contribution to the realization of the project provided by J. Vugrinec, head of the Exploration Service of INA-NAFTAPLIN, and by Ž. Babić, director of the Engineering Geology and Hydrogeology Division of the Institute of Geology. Without their aid and stimulation, the project might never have been put into operation. The suggestions given by F. Fritz, senior geologist from the Institute of Geology during the materialization of some ideas for karst regions, are deeply appreciated. Also, thanks are extended to V. Barić, T. Kolander, and D. Singer, cartographic and technical draftsmen, who executed most of the drawings needed for both this paper and the entire project.

Special appreciation is extended to M. Herak, Member of the Yugoslav Academy of Sciences and Arts and professor of geology at the Faculty of Science in Zagreb, for his valuable advice. The author is pleased to acknowledge the interest shown by Prof. H. Karrenberg from the Geologisches Landesamt Nordrhein-Westfalien, Krefeld, F.R. Germany, during a long discussion concerning the concept of the Hydrogeologic Map of Croatia, as well as to L. Monition and M. Albinet from the Bureau de Recherches Géologiques et Minières, Orléans, France, for their participation at a similar discussion. It should be mentioned that one of the constituent parts of the map — the map of vulnerability of aquifers to pollution — was inspired by ideas provided by B.R.G.M. hydrogeologists (Albinet & Margat, 1970).

## CONTENTS OF THE MAP

The Hydrogeologic Map of Croatia, scale 1:200,000, is a complex map composed — for each section — of five main maps, columnar hydrogeologic section, and textual explanation with additional maps and ground-water inventory data. The main maps are:

Basic Hydrogeologic Map, scale 1:200,000, showing lithostratigraphic units classified into hydrogeologic classes, depth to water and to confined aquifer in karst regions, isopach contour lines of the first aquifer, water-table and piezometric surface contour lines, ground-water connections determined by tracers, surface and ground-water divides, civil engineering, mining and geologic structures related to ground water or providing hydrogeologic data, hydrogeologic and speleologic phenomena, gages, meteorologic stations, hydrologic data, lithostratigraphic contacts and symbols, structural-geology elements.

Map of Water Quality and Vulnerability of Aquifers to Pollution, scale 1:500,000, showing quality of water for

domestic use and for irrigation, both for ground and surface waters, vulnerability of the first aquifer to pollution from surface effluents, and areas without pollution hazard due to the lack of aquifer or bad quality of ground water.

Map of Thermomineral Properties of Waters, scale 1:500,000, showing thermal, mineral, saline, fresh, and cold ground waters; also major chemical constituents or common ions, particularly active mineral constituents, hydrogeochemical zones, i. e. areas where a particular chemical type of water prevails.

Map of Hydrogeologic Function of Rock Complexes in Karst Regions, scale 1:1,000,000, showing various underground barriers to ground-water flow and areas composed of permeable rocks.

Map of Relief and Precipitation, scale 1:1,000,000, where relief features are indicated by differently colored altitudes. The map also includes isohyets of mean annual precipitation.

Complete topography is shown on all the maps.

The hydrogeologic columnar section shows the lithostratigraphic units of the basic hydrogeologic map in a manner presented in common geologic columnar sections, except here, the units are colored in accord with their hydrogeologic properties.

The explanation, written in a concise form (15 to 20 pages), contains: introduction; basic data, sources of data, numbering system of inventoried water structures and phenomena, their number and kinds, chemical analyses of water; geographic features: geographic position, relief, hydrography, climate; geology: lithostratigraphy, geologic structure, geomorphology; hydrogeologic conditions: hydrogeologic characteristics of each hydrogeologic or physiographic region and, as a conclusive summary, most important hydrogeologic features of the entire mapped area.

The appendixes of the explanation contain: map of water hardness, scale 1:500,000; map of water corrosion and incrustability, scale 1:500,000; list of chemical analyses of ground and surface waters with a situation map, scale 1:500,000; ground-water inventory data with a situation map, scale 1:200,000. The chemical analyses contain the data of water temperature, water chemistry, and chemical quality. Within the inventory of ground-water data, basic data of each ground-water and related phenomenon or structure are listed. For a drilled production water well, for instance, the following data are listed: indication number on the situation map, original number (within its source of information), site, particular characteristics (such as: thermomineral), use, depth, maximum yield, a »yes« if any of the following data exists within the source of information: lithologic log, electrical log, grain-size analyses, pumping test data, computed hydrogeologic parameters, chemical analysis; moreover, the source of data (original publication or document, personal communication, etc.). The other ground-water and related phenomena and structures are represented by similar basic data.

## FORM AND LEGEND OF THE MAP

All the main maps and the hydrogeologic columnar section appear on one sheet of paper 100 cm long by 70 cm wide (Text-fig. 2). The map of hydrogeologic function of rock complexes in karst regions will be presented only on those sections where such terrains occur. The entire territory of Croatia will be shown on thirteen sections although it completely or partially occupies twenty-two sections of the corresponding geographic map of Yugoslavia, scale 1:200,000 (Text-fig. 1).

Each section of the hydrogeologic map is accompanied by its textual explanation within which are incorporated the corresponding additional maps and tabular data.

The main maps and columnar section are presented in color schemes (see legend in Plates). The additional maps, except the situation map of inventoried ground-water phenomena and structures, are shown in black and white. In the ground-water inventory map, the symbols of all inventoried phenomena and structures are shown in the same form and color as on the basic hydrogeologic map. The legend of additional maps is not included in this paper.

In designing the legend of the basic hydrogeologic map, the concept of the International Hydrogeological Map of Europe, scale 1:1,500,000 (K a r r e n b e r g & al.; D e u t l o f f & al., 1970) has been followed: porous or intergranular aquifers are shown in blue, fissured ones in green, and nonaquiferous formations in brown; moreover, the symbols of surface water phenomena are blue, that of ground waters are violet, ground and surface water structures are red, geologic symbols are black. The form of most of symbols is of the same origin as well. It should be noted that this standard has been recommended for worldwide use by the International Association of Hydrogeologists and the International Association of Hydrological Sciences (A n o n., 1970). Nevertheless, many symbols had to be modified, subdivided, or completely redesigned to suit the concept of the Hydrogeologic Map of Croatia.

The criteria used for the determination of water quality for irrigation are those applied in the U.S.A. (H e m, 1959) and which suit the pedological and climatic conditions of Croatia.* The ideas expressed by French hydrogeologists (A l b i n e t & M a r g a t, 1970) are applied in a modified form in defining the vulnerability of aquifers to pollution.

## METHOD OF WORK

The hydrogeologic map under discussion has been conceived almost entirely on the basis of earlier field exploration. The collecting of a small number of surface water samples for chemical analysis and limited hydrogeologic reconnaissance are the only field work envisaged. Most of the work, then, will be concentrated on desk work: compiling of a new geologic map, scale 1:200,000, that will suit the demands of

* Dr. B. P u š i ć, Institute of Soil Pedology and Technology, Zagreb, personal communication.

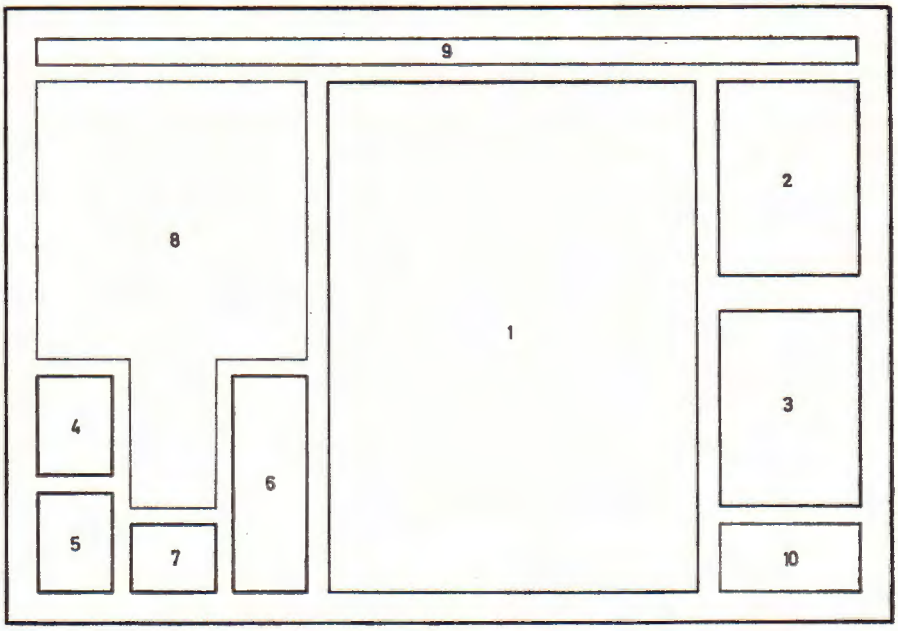



Fig. 2. Distribution of main constituents of the Hydrogeologic Map of Croatia, Scale 1:200,000

*Slika 2. Raspored glavnih sastavnih dijelova Hidrogeološke karte SR Hrvatske, mjerilo 1:200.000*

1 Basic Hydrogeologic Map, scale 1:200,000
*Osnovna hidrogeološka karta, mjerilo 1:200.000*

2 Map of Water Quality and Vulnerability of Aquifers to Pollution, scale 1:500,000
*Karta kvalitete voda i ugroženosti vodonosnika od zagađenja, mjerilo 1:500.000*

3 Map of Thermomineral Properties of Waters, scale 1:500,000
*Karta termomineralnih svojstava voda, mjerilo 1:500.000*

4 Map of Hydrogeologic Function of Rock Complexes in Karst Regions, scale 1:1,000,000
*Karta hidrogeološke funkcije terena u krškim područjima, mjerilo 1:1,000.000*

5 Map of Relief and Precipitation, scale 1:1,000,000
*Karta reljefa i padalina, mjerilo 1:1,000.000*

6 Hydrogeologic Columnar Section
*Hidrogeološki stup*

7 Situation Map
*Situaciona karta*

8 Legend
*Legenda*

9 Map and section titles, name of financing company and executing institute
*Naziv karte i lista, naziv naručitelja i izvođača*

10 Names of redactors (editors), authors, collaborators, consultants, and supervisors, place and year of publication
*Imena redaktora (nosioca zadatka), autora, suradnika, savjetnika i nadzornih inženjera, mjesto i godina tiska*

the hydrogeologic map; collection of numerous ground-water and related data scattered in a great number of studies, technical reports, and archives; interpretation of these data; selection of the data for presentation on the map; and the drawing up of all the mentioned constituent parts of the complex map.

This work concept could not be successfully materialized were it not for the existence of a number of wide-range hydrogeologic studies which cover about 90% of the territory of Croatia. These studies include the inventory of ground-water phenomena and structures, hydrogeologic field mapping, geophysical exploration, construction of exploratory boreholes, observation and production water wells, test pumping, chemical analyses of ground waters, tracing of underground hydraulic connections in karst regions, long-term monitoring of ground-water level fluctuation, and comprehensive annual and final reports in which the hydrogeology of studied areas is described. The textual explanations and collected data are a more valid contribution to the hydrogeology of the studied areas than the hydrogeologic maps drawn within these studies.

## PURPOSE OF THE MAP

The decision of INA-NAFTAPLIN to finance the execution of the map, from the standpoint of that company, is very understandable. The phenomena and principles affecting the occurrence, percolation, properties and possibility of use of deep ground waters are mostly manifested on the land surface or close to it, i. e., in the portion of the Earth's rock mantle, the subject of common hydrogeologic explorations. Given the fact that a hydrogeologic map is a graphic presentation of the accumulated knowledge of general or specific hydrogeologic conditions of a mapped area, its execution is a necessary preparatory step toward the up-to-date development of deep thermal or mineral ground waters.

In addition to these long-term goals, a complex hydrogeologic map can facilitate the solution of a number of everyday problems with which an oil company is usually confronted: the supply of good-quality water for the secondary recovery, supply of drinking water for the drilling personnel and neighbouring inhabitants who usually lack either enough water or potable water, ground-water pollution problems, etc.

The map provides a great number of data in relation to ground waters, hydraulic structures, and porous media where ground water occurs. These data are presented partly in original, rough, form and partly in modified, processed, form. They are shown in a technically and graphically obvious manner making the map usable for projects concerning water supply, construction of hydro-power plants, reclamation, physical medicine, urban planning, and environmental problems.

In ground-water supply projects, the map can be useful since it provides a very specified hydrogeologic classification of rock units (fourteen classes) in comparison with previous hydrogeologic maps in Croatia where only four classes were displayed. Moreover, the map of vulnerability of aquifers to pollution from surface sources will be indisputably used in future evaluations of optimum sites for ground-water supply

because it reflects the properties of porous media with regard to any casual pollution from the surface. This map, however, does not show the present degree of aquifer pollution. Of similar importance for ground-water supply evaluation is the obvious indication of depths to water or to aquifer in karst regions and so-called »sterile« zones in the coastal karst where there is no possibility to tap sufficient quantities of good-quality ground water even for minor water supply schemes. Water-supply experts will presumably be anxious to learn the quality of both ground and surface waters for domestic use and irrigation.

The planners of hydroelectric plants will secure considerable knowledge of the distribution of hydrogeologically different rock units within drainage basins, particularly in the areas planned for the construction of surface storages and dams.

Agricultural experts will, for the first time, obtain an integral review of the quality of ground and surface waters for irrigation. The balneologists and producers of mineral waters will benefit from the fact that this hydrogeologic map is the first map which shows thermomineral waters presented according to the classification that is in standard use by major European producers of mineral waters and has been proposed for our country by the Institute of Physical Medicine and Rehabilitation at the Medical Faculty in Zagreb (Novak, 1968). This classification is applied in a slightly modified form on the map. The map of vulnerability of aquifers to pollution will be useful to ecologists. This map can also be used by the planners of urban and industrial complexes.

Finally, by financing the execution of the discussed map, INA-NAFTAPLIN supports the development of the hydrogeology, a very new technical and scientific branch of applied geology. Specifically, each new hydrogeologic map, which is not a mere repetition of previous achievements in this field of work, marks a new step in the development of hydrogeologic cartography; and the hydrogeologic map under consideration introduces several new cartographic features (Šarin & Urbiha, 1977) that will be briefly mentioned in continuation.

## CONCLUSION

The lack of modern small- and medium-scale hydrogeologic maps in Croatia is evident. The hydrogeologic map under consideration and presently in progress may fulfill demands not only of its sponsor, INA-NAFTAPLIN in Zagreb, but also of a large number of other users. Although following suggestions for the execution of hydrogeologic map (Anon., 1970; Karrenberg & al.), this map introduces several novelties in hydrogeologic carthography (Šarin & Urbiha, 1977).

Instead of dividing the rock units into six hydrogeologic classes (Karrenberg & al.), fourteen classes are indicated thereby allowing the possibility of introducing two more classes. The map provides a separate differentiation of Quaternary deposits (four classes) from the other clastic deposits having intergranular or porous aquifers (four classes) and of carbonate rocks with cavernous or karst aquifers (three classes) from the remaining rock units containing fissured aquifers (two or, pos-

sibly, three classes). Crystalline rocks are also shown separately. In addition, the manner in which the depth to water or to confined aquifers in karst regions is shown is completely new. Finally, there is the interpretation of hydrogeologic function of rock complexes, for which a special small-scale map is reserved (a negligable modification of a map edited by Herak & Bahun, 1974). All these elements provide quick, clear, and broad information regarding the hydrogeology of a mapped area, particularly in karst regions, but, naturally, in combination with all the other cartographic elements presented.

A similar effect can be achieved in the study of the chemistry of ground waters and of their interrelation with surface waters when applying the classification of thermomineral waters that is a modification of the one proposed by the Institute of Physical Medicine and Rehabilitation at the Medical Faculty in Zagreb (Novak, 1968). This classification was prepared according to recommendations given by the International Society of Medical Hydrology for the International Register of Spas and Medical Waters as early as in 1931. By applying this classification, the Hydrogeologic Map of Croatia fulfills the needs of those who make major use of thermomineral waters — the producers of mineral waters and institutions of physical medicine — because their own classification is used and, moreover, it is suitable from the hydrogeologic standpoint.

Among the new features the map introduces is a strong emphasis on the chemistry and chemical quality of both ground and surface waters. In this manner, the interrelation between these waters may be studied and better understood. A vast list of inventoried ground-water and related data and their locations using a great number of different symbols provides any future researcher with a good opportunity to obtain a comprehensive knowledge of previously executed hydrogeologic and related explorations. The integral legend for all the main maps is included in the Plates of this paper.

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## Svrha i sadržaj hidrogeološke karte SR Hrvatske, M 1 : 200.000

*A. Šarin*

Na zahtjev INA-NAFTAPLINA iz Zagreba, Zavod za geološka istraživanja u Zagrebu izrađuje Hidrogeološku kartu SR Hrvatske, mjerila 1:200.000. Izrađen je projekt ove karte, te dva ogledna lista: Zagreb i Zadar; četiri daljnja lista bit će završena sredinom 1977. godine, a preostalih sedam listova do sredine 1979. godine. Time će biti pokriven čitav teritorij SR Hrvatske (sl. 1).

Ova je karta složenog tipa; sastoji se — za svaki od 13 listova — od pet glavnih karata, hidrogeološkog stupa, tumača, dopunskih karata i hidrogeološkog katastra. Glavne karte i stup smješteni su na jednom listu papira, veličine 100x70 cm (sl. 2). Dopunske karte i katastar uključeni su u kratki tumač.

Glavne karte su slijedeće: (1) Osnovna hidrogeološka karta, M 1:200.000; (2) Karta kvalitete voda i ugroženosti vodonosnika od zagađenja, M 1:500.000; (3) Karta termomineralnih svojstava voda, M 1:500.000; (4) Karta hidrogeoloških funkcija terena u krškim područjima, M 1:1,000.000; (5) Karte reljefa i padalina, M 1:1,000.000. Sve su karte obojene. Na tablama je dana cijela legenda glavnih karata i ona odražava sadržaj tih karata. Hidrogeološki stup je obojen u skladu s osnovnom hidrogeološkom kartom.

Zamišljeno je, i ostvaruje se, da se razmatrana karta izradi gotovo isključivo na podacima ranijih terenskih radova, naročito onih koji su obuhvaćeni regionalnim hidrogeološkim istraživanjima. Ti će radovi biti reinterpretirani u skladu s — za ovu priliku posebno izrađenom — kompilacionom geološkom podlogom u mjerilu 1:200.000.

Razmatrana karta potrebna je investitoru, INA-NAFTAPLINU, koji namjerava u budućnosti proširiti djelatnost rada na korištenje termomineralnih voda, pa vrši odgovarajuće pripreme, a i za rješavanje niza problema iz dnevne prakse: opskrbu vodom za sekundarno pridobivanje nafte, opskrbu vodom za piće svojih radnika i okolnog stanovništva, ekoloških problema, i dr. Ovakva karta može pružiti vrijedne podatke vodoprivrednim stručnjacima — kod planiranja i izvedbe vodoopskrbnih zahvata, hidroenergetskih radova, korištenja i zaštite podzemnih voda; zatim pedolozima — kvaliteta podzemnih i površinskih voda za navodnjavanje, balneolozima — termomineralna svojstva podzemnih voda i hidrogeo-

loški uvjeti njihova pojavljivanja; urbanistima — kod prostornih planiranja potencijalnih zagađivača i sl.; te ekolozima — također kod razmatranja problema zagađivanja podzemnih voda.

Hidrogeološka karta SR Hrvatske M 1:200.000 predstavlja i naš znanstveni doprinos svjetskoj hidrogeološkoj kartografiji, jer donosi nekoliko kartografskih noviteta. Tako su litostratigrafske jedinice razvrstane u 14 hidrogeoloških klasa, za razliku od 4 klase — kako se provodilo ranije u nas, ili na 6 klasa — kako se izrađuje Međunarodna hidrogeološka karta Evrope (K a r r e n b e r g & al.). Kvartarne naslage izdvojene su od ostalih nevezanih klastičnih naslaga (ukupno 8 klasa), a kavernozne od ostalih pukotinskih stijena (ukupno 5 klasa). Posebna klasa rezervirana je za kristalinske stijene. Svaka je klasa posebno i uočljivo obojena.

Za područje krša prikazuju se kombinacijom boja i specifične šrafure istovremeno provodnost vodonosnika i dubina do vode, ili pak hidrogeološka svojstva nepropusnog pokrova i dubina do vodonosnika. Na karti sitnog mjerila prikazuju se funkcije krških terena: vodonosnici, barijere, kao i karakter barijera (neznatna modifikacija uspjele karte koju su postavili i redigirali H e r a k & B a h u n, 1974).

S namjerom da se ova karta što više približi njenim korisnicima, kod interpretacije termomineralnih svojstava podzemnih voda korištena je klasifikacija termomineralnih voda koju primjenjuju upravo korisnici takvih voda: proizvođači stolnih mineralnih voda, liječilišta i odgovarajuće medicinske institucije (N o v a k, 1968). Vlastitim grafičkim rješenjima postignuti su izvjesni kartografski efekti i s hidrogeološkog aspekta.

Također se po prvi puta istovremeno prikazuje kvaliteta i kemijski sastav podzemnih i površinskih voda.

Uključenje katastarskih karata (mjerilo 1:200.000) i osnovnih podataka svih podzemnih vodnih pojava i građevina obuhvaćenih katastrom, pretpostavlja se, pomoći će kod budućih hidrogeoloških istraživanja za bilo koju svrhu.

Za našu hidrogeološku kartografiju vrijedno je spomenuti uvođenje prikaza kvalitetne vode za piće i navodnjavanje, te obrada hidrogeoloških aspekata zagađenja prvog vodonosnika iz površine. Ova potonja karta inspirirana je radovima francuskih hidrogeologa (A l b i n e t & M a r g a t, 1970).

*Primljeno 23. 03. 1977.*

**Basic Hydrogeologic Map, Scale 1:200,000**
**Osnovna hidrogeološka karta, mjerilo 1:200.000**

HYDROGEOLOGIC PROPERTIES OF LITHOSTRATIGRAPHIC UNITS
*HIDROGEOLOSKA SVOJSTVA LITOSTRATIGRAFSKIH JEDINICA*

| | Transmissivity<br>*Provodnost* | | Kind of Rocks<br>*Vrsta stijena* | |
|---|---|---|---|---|
| (blue*)<br>*(plavo*)* | High to very high<br>*Dobra do vrlo dobra* | Quaternary deposits<br>*Kvartarne naslage* | Clastic deposits containing intergranular aquifers<br>*Klastične naslage s međuzrnskim vodonosnicima* | Permeable and water-bearing rocks<br>*Propusne i vodonosne stijene* |
| (light blue)<br>*(svijetloplavo)* | Medium<br>*Srednja* | | | |
| (very light blue)<br>*(vrlo svijetloplavo)* | Low<br>*Slaba* | | | |
| (light bluish violet)<br>*(svijetloplavkasto-ljubičasto)* | Medium<br>*Srednja* | Remaining loose or semicemented clastic deposits<br>*Ostale nevezane ili poluvezane klastične naslage* | | |
| (very light bluish violet)<br>*(vrlo svijetloplavkasto-ljubičasto)* | Low to very low<br>*Slaba do vrlo slaba* | | | |
| (green)<br>*(zeleno)* | High to very high<br>*Dobra do vrlo dobra* | Carbonate rocks<br>*Karbonatne stijene* | Rocks containing cavernous and fissured aquifers<br>*Stijene s kavernoznim i pukotinskim vodonosnicima* | |
| (light green)<br>*(svijetlozeleno)* | Medium<br>*Srednja* | | | |
| (very light green)<br>*(vrlo svijetlozeleno)* | Low to very low<br>*Slaba do vrlo slaba* | | | |
| (light bluish green)<br>*(svijetloplavkasto-zeleno)* | Low to medium<br>*Slaba do srednja* | Remaining fissured rocks<br>*Ostale pukotinske stijene* | | |
| (very light bluish green)<br>*(vrlo svijetloplavkasto zeleno)* | Low to very low<br>*Slaba do vrlo slaba* | | | |

| | | | | |
|---|---|---|---|---|
| (yellow)<br>*(žuto)* |  | Very low or no<br>*Vrlo slaba ili nikakva* | Quaternary deposits<br>*Kvartarne naslage* | Mostly impermeable rocks with local aquifers<br>*Pretežno nepropusne stijene s vodonosnicima ograničenog značenja* | Generally impermeable rocks with local or no aquifers<br>*Uglavnom nepropusne stijene s vodonosnicima ograničenog značenja i bez vodonosnika* |
| (light orange)<br>*(svijetlonarančasto)* |  | Very low or no**<br>*Vrlo slaba ili nikakva*** | Crystalline rocks**<br>*Kristalinske stijene*** | | |
| (very light brown)<br>*(vrlo svijetlosmeđe)* |  | Very low<br>*Vrlo slaba* | Impermeable rocks with occasional permeable interbeds<br>*Nepropusne stijene s rijetkim propusnim ulošcima* | | |
| (light brown)<br>*(svijetlosmeđe)* |  | Not transmissive<br>*Nikakva* | Impermeable rocks without aquifers<br>*Nepropusne stijene bez vodonosnika* | | |

* Lighter than symbols for water
*Svjetlije nego za vodne oznake*

** Fissured and slightly transmissive only near the land surface
*Raspucane i vrlo slabo provodne samo blizu površine terena*

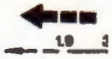
(Corresponding lithostratigraphic symbols and generalized lithology are added to each hydrogeologic class)
*Odgovarajuće litostratigrafske oznake i općenit litološki opis dodaju se uz svaku hidrogeološku klasu)*

## GROUND WATER

### *PODZEMNA VODA*

(violet) *(ljubičasto)* — Direction of flow of low ground waters*
*Smjer protjecanja niskih podzemnih voda**

" — Underground hydraulic connection determined by tracer with apparent velocity of flow in cm/sec (1.9) and time of injection of tracer denoting month of year (3 indicates March)*
*Podzemna vodna veza određena bojom ili drugim sredstvima, s brzinom protjecanja u cm/sek (1,9) i vremenom ubacivanja boje (3 označava ožujak)**



" — Maximum water-table contour line, m*
*Maksimalna hidroizohipsa, m**



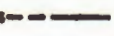
" — Maximum piezometric surface contour line, m*
*Maksimalna hidroizopijeza, m**



" — Boundary of flowing artesian aquifers
*Granica područja arteških vodonosnika*



" — Linear or undefined ground-water divide
*Linijska ili neodređena podzemna razvodnica*



" — Zonal ground-water divide
*Zonarna podzemna razvodnica*

(green) *(zeleno)* — Contour line of equal depth to the top of first aquifer, m*
*Izobata krovine prvog vodonosnika, m**



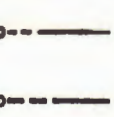
" — Contour line of equal depth to the base of first aquifer, m*
*Izobata podine prvog vodonosnika, m**

(green, light green, very light green — depending on transmissivity) *(zeleno, svijetlozeleno, vrlo svijetlozeleno — ovisno o provodnosti)*

<50 or unknown *ili nepoznata*
50—200
>200

Approximate depth to water table in karst aquifer, m
*Približna dubina do podzemne vode u krškom vodonosniku, m*

(brown, light brown, yellow — depending on covering aquiclude) *(smeđe, svijetlosmeđe, žuto — ovisno o nepropusnom pokrovu)*



<50
50—200
>200 or unknown *ili nepoznata*

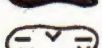
Approximate depth to first confined or semiconfined karst aquifer, m
*Približna dubina do prvog zatvorenog ili poluzatvorenog krškog vodonosnika, m*

## SURFACE WATER

### *POVRŠINSKA VODA*

(blue) *(plavo)* — Artificial lake, surface water storage
*Umjetno jezero, akumulacioni bazen*

" — Permanently inundated area
*Stalno plavljeni teren*



" — Boundary of temporary inundated area
*Granica povremeno plavljenog terena*

" — True water divide (ground and surface waters)
*Potpuna razvodnica*

" — Surface water divide
*Površinska razvodnica*

* Dashed if uncertain
*Crtkano, ako je pretpostavljeno*

(blue) *(plavo)* — Nonrecording stream gage *Vodokaz*

„ — Recording stream gage *Limnigraf*

„ — Meteorological station *Meteorološka stanica*

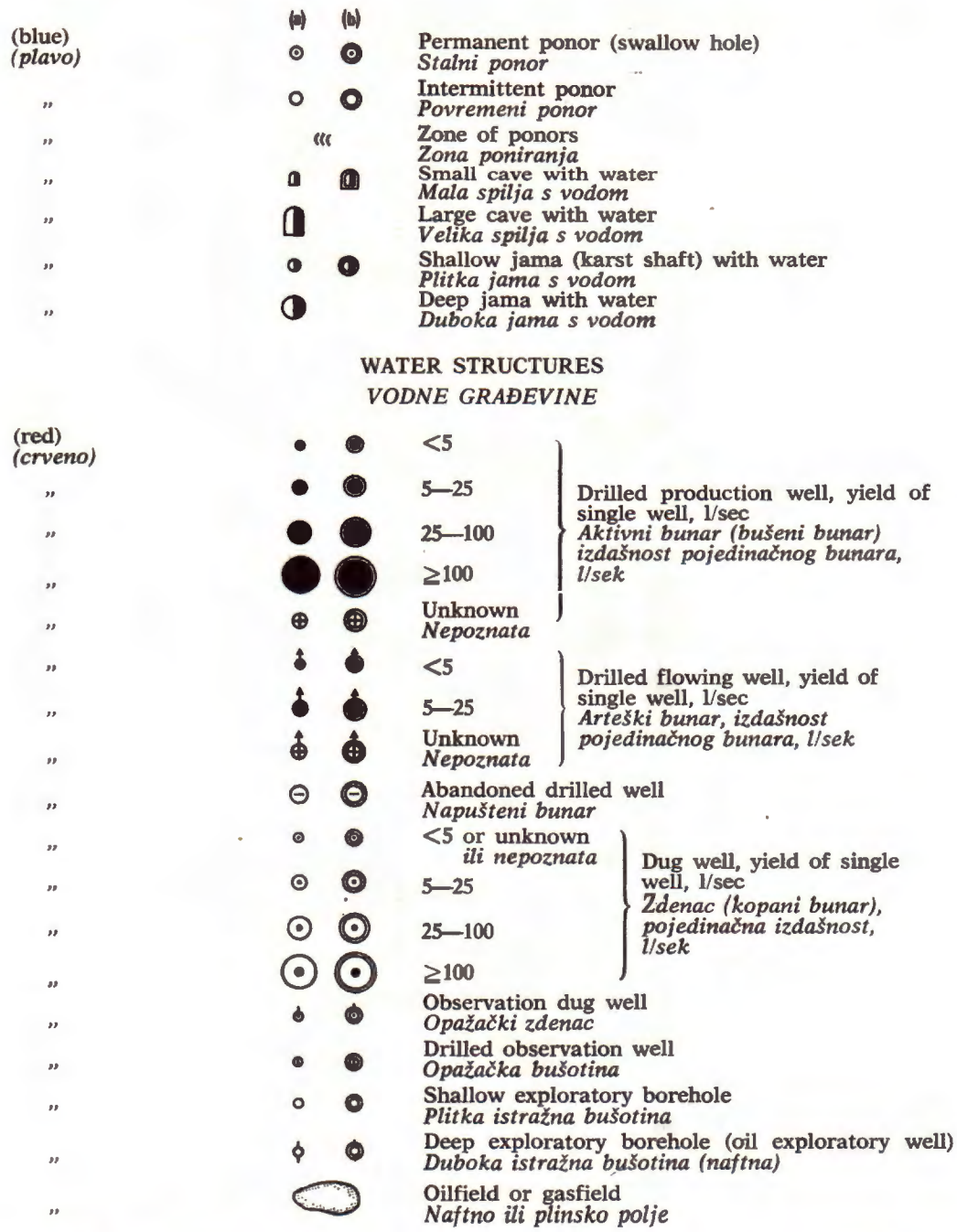
„ — 12.5 / 615 — Mean rate of stream flow, $m^3$/sec, and drainage area, $km^2$ *Srednja protoka, $m^3$/sek, te površina porječja, $km^2$*

## WATER PHENOMENA
## *VODNE POJAVE*

| | (a) | (b) | | |
|---|---|---|---|---|
| (blue) *(plavo)* | • | • | <1 | Permanent (nonkarst) spring, minimum discharge, l/sec *Stalan (nekrški) izvor, najmanja izdašnost, l/sek* |
| „ | ● | ● | 1—10 | |
| „ | ● | ● | ≧10 | |
| „ | ● | ● | Unknown *Nepoznata* | |
| „ | ♀ | ♀ | <1 | Permanent karst spring, minimum discharge, l/sec *Stalan krški izvor, najmanja izdašnost, l/sek* |
| „ | ♀ | ♀ | 1—10 | |
| „ | ♀ | ♀ | 10—100 | |
| „ | ♀ | ♀ | 100—1000 | |
| „ | ♀ | | ≧1000 | |
| „ | ♀ | ♀ | Unknown *Nepoznata* | |
| „ | ♀ | ♀ | <1 | Intermittent karst spring, mean discharge, l/sec *Povremen krški izvor, srednja izdašnost, l/sek* |
| „ | ♀ | ♀ | 1—10 | |
| „ | ♀ | ♀ | 10—100 | |
| „ | ♀ | | 100—1000 | |
| „ | ♀ | ♀ | Unknown *Nepoznata* | |
| „ | ♀ | ♀ | Inundated karst spring *Poplavljen krški izvor* | |
| „ | ♀ | ♀ | Estavelle *Estavela* | |
| „ | ~ | ~ | Minor submarine spring *Vrulja manje izdašnosti* | |
| „ | ~ | | Major submarine spring *Vrulja veće izdašnosti* | |
| „ | | | Spring zone *Zona izviranja* | |

(a) Single phenomenon *Pojedinačna pojava*

(b) Group of phenomena *Skupina pojava*




(a) Single phenomenon or structure
*Pojedinačna pojava ili građevina*

(b) Group of phenomena or structures
*Skupina pojava ili građevina*

(red) *(crveno)* — For public waterworks* *Za javni vodovod**
„ — Without waterworks* *Bez vodovoda**
„ — Gallery *Galerija*
} Intake structure of ground water *Zahvat podzemne vode*

„ — <50
„ — ≥50
} Intake structure of surface water, capacity, l/sec *Zahvat površinske vode, kapacitet, l/sek*

„ — Active, under water *Aktivan, pod vodom*
„ — Active, permanently or mostly dry *Aktivan, stalno ili pretežno bez vode*
(red border, blue hatches) — *(crveni rub, plava šrafura)* — Abandoned, under water *Napušten, potopljen*
} Open pit (open cut) *Površinski kop*

(red) *(crveno)* — Active, permanently dewatered *Aktivan, stalno odvodnjavan*
„ — Active, mostly dry *Aktivan, uglavnom suh*
(red border, blue hatches) — *(crveni rub, plava šrafura)* — Abandoned, under water *Napušten, potopljen*
(red) *(crveno)* — Abandoned, dry *Napušten, nepotopljen*
} Mine *Rudnik (jamski radovi)*

„ — Minefield *Područje jamskih radova*
„ — Dam of hydroelectric plant *Brana za hidroelektričnu centralu*
„ — Dam for other purposes with volume of storage, $hm^3$ *Brana za druge svrhe s obujmom akumulacije, $hm^3$*
„ — Grout courtain *Injekciona zavjesa*
„ — Navigation or unspecified canal *Plovni ili neodređeni kanal*
„ — Irrigation canal *Kanal za navodnjavanje*
„ — Drainage canal *Odvodni kanal*
„ — Intake canal of hydroelectric plant *Derivacioni kanal hidroelektrične centrale*
„ — Drainage tunnel *Odvodni tunel*
„ — Power tunnel of hydroelectric plant *Dovodni tunel za hidroelektričnu centralu*

* The symbol corresponds in size to that indicating the spring with which it is combined
*Veličina oznake odgovara oznaci za izvor*

## GEOLOGY

### *GEOLOGIJA*

| | | |
|---|---|---|
| (black) *(crno)* |  | Normal lithostratigraphic contact or boundary of depth zones in karst regions* *Normalna litostratigrafska granica ili granica dubinske zone u krškim područjima** |
| „ |  | Erosional contact* *Erozijsko-diskordantna granica** |
| „ |  | Normal or undefined fault** *Normalni ili neodređeni rasjed*** |
| „ |  | Reverse fault** *Reversni rasjed*** |
| „ |  | Symmetrical or asymmetrical** *Uspravna ili kosa**<br>Overturned or recumbent** *Prebačena ili polegla**<br>} Anticline with direction of plunging *Os antiklinale sa smjerom tonjenja* |
| „ |  | Symmetrical or asymmetrical** *Uspravna ili kosa**<br>Overturned or recumbent** *Prebačena ili polegla**<br>} Syncline with direction of plunging *Os sinklinale sa smjerom tonjenja* |
| „ |  | Strike and dip of beds (inclined, vertical, overturned, and horizontal beds, respectively) *Položaj sloja (kos, uspravan, prebačen, odnosno vodoravan)* |
| „ |  | Doline (ponikva, sinkhole) *Ponikva (vrtača)* |
| „ |  | Small, dry cave *Mala spilja bez vode* |
| „ |  | Large, dry cave *Velika spilja bez vode* |
| „ |  | Shallow, dry jama (karst shaft) *Plitka jama bez vode* |
| „ |  | Deep, dry jama *Duboka jama bez vode* |

## TOPOGRAPHY AND HYDROGRAPHY

### *TOPOGRAFIJA I HIDROGRAFIJA*

(grey) *(sivo)* Topographic symbols (towns, villages, roads, land surface contour lines, etc.) and toponyms are the same as indicated on corresponding topographic map, scale 1:200,000
*Topografske oznake (gradovi, sela, ceste, izohipse itd.) i toponimi su isti kao i na odgovarajućoj topografskoj karti mjerila 1:200.000*

(blue) *(plavo)* Hydrographic symbols (streams, lakes, swamps, sea, etc.) and their names are the same as indicated on corresponding topographic map, scale 1:200,000
*Hidrografske oznake (vodotoci, jezera, močvare, more itd.) i njihovi nazivi su isti kao na odgovarajućoj topografskoj karti mjerila 1:200.000*

* Dashed if uncertain
*Crtkana, ako je pretpostavljena*

** Dashed if uncertain or covered
*Crtkana, ako je pretpostavljena ili pokrivena*

(a) Single phenomenon
*Pojedinačna pojava*

(b) Group of phenomena
*Skupina pojava*

## Map of Water Quality and Vulnerability of Aquifers to Pollution, Scale 1:500,000

## Karta kvalitete voda i ugroženosti vodonosnika od zagađenja, mjerilo 1:500.000

### QUALITY OF WATERS
### *KVALITETA VODA*

| | (a) (b) (c) | | |
|---|---|---|---|
| (black) *(crno)* |  | Good *Dobra* | Quality of ground water for irrigation *Kvaliteta podzemne vode za navodnjavanje* |
| „ | | Fair *Osrednja* | |
| „ | | Poor *Slaba* | |
| „ | | Very poor *Vrlo slaba* | |
| „ |  | Good *Dobra* | Quality of surface water for irrigation *Kvaliteta površinske vode za navodnjavanje* |
| „ | | Fair *Osrednja* | |
| „ | | Poor *Slaba* | |
| „ | | Very poor *Vrlo slaba* | |
| | (a) | Good *Dobra* | Quality of water for drinking *Kvaliteta vode za piće* |
| | (b) | Poor *Slaba* | |
| | (c) | Chemical analysis incomplete to determine quality of water for drinking — *Nepotpuna kemijska analiza za odredbu kvalitete vode za piće* | |
| „ | Fe | Iron (and manganese) content greater than permissible for drinking water — *Sadržaj željeza (i mangana) veći od dopuštenog za vodu za piće* | |
| (blue) *(plavo)* | • | Spring — *Izvor* | Water phenomenon or structure from where water sample was collected for chemical analysis *Vodna pojava ili građevina iz koje je uzet uzorak vode za kemijsku analizu* |
| „ | • | Cave or jama (karst shaft) *Spilja ili jama* | |
| (red) *(crveno)* | • | Drilled production well *Bunar (bušeni bunar)* | |
| „ | • | Dug well *Zdenac (kopani bunar)* | |
| „ | • | Shallow borehole *Plitka bušotina* | |
| „ | : | Deep borehole (oil well) *Duboka bušotina (naftna)* | |
| „ | • | Mine *Rudnik (jamski radovi)* | |
| (blue) *(plavo)* | ⌣ | Stream *Vodotok* | |
| „ | ◈ | Lake or swamp *Jezero ili močvara* | |

## VULNERABILITY OF AQUIFERS TO POLLUTION
## *UGROŽENOST VODONOSNIKA OD ZAGAĐENJA*

(very light red)
*(vrlo svijetlocrveno)*

Invulnerable
*Neugrožen*

(light red)
*(svijetlocrveno)*

Partially vulnerable
*Djelomično ugrožen*

(red)
*(crveno)*

Vulnerable
*Ugrožen*

(dark red)
*(tamnocrveno)*

Very vulnerable
*Vrlo ugrožen*

Vulnerability of first aquifer to pollution from surface effluents
*Ugroženost prvog vodonosnika od zagađenja iz površine*

(black)
*(crno)*

Area without aquifers usable for water supply (color of corresponding vulnerability is combined with black hatches)
*Područje bez vodonosnika iskoristivog za vodoopskrbu (pod crnom šrafurom dolazi boja odgovarajuće ugroženosti terena)*

„ ———— Boundary of aquifer vulnerability or usability (dashed if uncertain)
*Granica ugroženosti ili iskoristivosti vodonosnika (crtkana, ako je pretpostavljena)*

## TOPOGRAPHY AND HYDROGRAPHY
## *TOPOGRAFIJA I HIDROGRAFIJA*

(grey)
*(sivo)*

Topographic and hydrographic symbols and toponyms are the same as indicated on corresponding geographic map, scale 1:500,000
*Topografske i hidrografske oznake, te toponimi, isti su kao i na odgovarajućoj geografskoj karti mjerila 1:500.000*

## Map of Thermomineral Properties of Waters, Scale 1:500,000
## Karta termomineralnih svojstava voda, mjerilo 1:500.000

### TEMPERATURE OF GROUND WATER
### *TEMPERATURA PODZEMNE VODE*


(blue) *(plavo)* — <20°C — Cold water *Hladna voda*

(red) *(crveno)* — 20—34°C — Hypothermal *Hipoterma* — Warm water *Topla voda*

" — 34—38°C — Homoithermal *Homeoterma* — Warm water *Topla voda*

" — ≥38°C — Hyperthermal *Hiperterma* — Hot water *Vruća voda*

Thermal water *Toplica, termalna voda*

(The circles that bound the circular diagrams showing main chemical constituents of ground waters have a corresponding color with regard to water temperature. The rectangular diagrams representing surface waters are always bounded by a blue line.)

*(Krugovi, koji uokviruju kružne dijagrame koji pokazuju glavne kemijske sastojke podzemnih voda, obojeni su u skladu s temperaturom vode. Pravokutni dijagrami, koji predstavljaju površinske vode, uvijek su uokvireni plavom crtom.)*

### DISSOLVED SOLIDS
### *MINERALIZACIJA (OTOPLJENE SOLI)*

(a) <1000 mg/kg of dissolved solids *otopljenih soli* — Fresh water *Slatka voda*

(b) ≥1000 mg/kg of dissolved solids *otopljenih soli* — Mineral water (or saline water — in areas influenced by sea water) *Mineralna voda (ili slana voda — u područjima pod utjecajem mora)*

(above dark green, below light green) *(gore tamnozeleno, dolje svijetlozeleno)* — <250 mg/l of chlorides *klorida* — Fresh water *Slatka voda*

" — ≥250 mg/l of chlorides *klorida* — Saline water *Slana voda*

Chlorides content in areas influenced by sea water *Sadržaj klorida u područjima pod utjecajem mora*

## PARTICULARLY ACTIVE MINERAL CONSTITUENTS
## *NAROČITO AKTIVNI MINERALNI SASTOJCI*

| | | | Kind of water — *Vrsta vode* | |
|---|---|---|---|---|
| (red) *(crveno)* | $CO_2$ | ≧1000 mg/kg of carbon dioxide *ugljičnog dioksida* | Carbon dioxide (gaseous) *Kisela (kiselica)* | |
| „ | S | ≧10 mg/kg of hydrogene sulfide *sumporovodika* | Sulfurous *Sumporna* | |
| „ | Fe | ≧10 mg/kg of iron *željeza* | Iron (ferruginous) *Željezovita* | |
| „ | As | ≧0.7 mg/kg of arsenic *arsena* | Arsenic *Arsenska* | |
| „ | F | ≧2 mg/kg of fluorine *fluora* | Fluoric *Fluorna* | |
| „ | J | ≧1 mg/kg of iodine *joda* | Iodic *Jodna* | |
| „ | Rn | ≧100 μrd/l (2.7 nC/l) of radon *radona* | Radon *Radonska* | Radio-active *Radio-aktivna* |
| „ | Ra | ≧3.7 μrd/l (0.1 nC/l) of radium — *radija* | Radium *Radijeva* | |
| (black) *(crno)* | | Production of drinking mineral water *Proizvodnja mineralne vode za piće* | | |
| „ | | Health spa *Kupalište (lječilište)* | | |

## MAIN CHEMICAL CONSTITUENTS
## *GLAVNI KEMIJSKI SASTOJCI*


Main chemical constituents of ground waters are shown by circular diagrams. Main cations (Ca, Mg, Na+K) are indicated in sectors of the upper semicircle and main anions ($HCO_3+CO_3$, $SO_4$, $Cl+F+NO_3$) in sectors of the lower one. Angle of sectors is proportional to concentration expresed in terms of milligram equivalents per liter percent, meq/l%. Whole semicircle corresponds to 100 meq/l%. Cations and anions are arranged from left to wright in order of concentration. Sectors of ions with concentration greater than 20 meq/l% are indicated by corresponding colors; those with concentration less than 20 meq/l% are left colorless or white.

*Glavni kemijski sastojci podzemnih voda prikazani su kružnim dijagramima. Glavni kationi (Ca, Mg, Na+K) dani su u kružnim isječcima gornje polukružnice, a glavni anioni ($HCO_3+CO_3$, $SO_4$, $Cl+F+NO_3$) u isječcima donje polukružnice. Kutovi kružnih isječaka proporcionalni su koncentracijama iona izraženim u mval/l%. Cijela polukružnica odgovara 100 mval/l%. Kationi i anioni su poredani od lijeva na desno u skladu s koncentracijom. Isječci, koji prikazuju ione s koncentracijom većom od 20 mval/l%, obojeni su odgovarajućim bojama, dok su isječci s koncentracijama manjim od 20 mval/l% neobojeni, odnosno bijeli.*


Main chemical constituents of surface waters are shown by rectangular diagrams. The same principle is applied as for ground waters.

*Glavni kemijski sastojci površinskih voda prikazani su pomoću pravokutnih dijagrama. Isti je postupak primjenjen kao kod podzemnih voda.*

| | | |
|---|---|---|
| (light blue) *(svijetloplavo)* | Ca | Ion having concentration equal or greater than 20 meq/l% *Ion s koncentracijom jednakom ili većom od 20 mval/l%* |
| (light brown) *(svijetlosmeđe)* | Mg | |
| (dark green) *(tamnozeleno)* | Na+K | |
| (dark blue) *(tamnoplavo)* | $HCO_3+CO_3$ | |
| (yellow) *(žuto)* | $SO_4$ | |
| (light green) *(svijetlozeleno)* | $Cl+F+NO_3$ | |
| (colorless or white) *(bezbojno ili bijelo)* | | Ion having concentration smaller than 20 meq/l% *Ion s koncentracijom manjom od 20 mval/l%* |

(The circular and rectangular diagrams presented here relate to a calcium-magnesium bicarbonate water with the following concentration of main ions, in meq/l%: (1) Ca — 58.2, (2) Mg — 26.3, (3) Na+K — 15.5, (4) $HCO_3+CO_3$ — 75.8, (5) $Cl+F+NO_3$ — 14.4, (6) $SO_4$ — 9.8. Areas (1), (2) and (4) are indicated by corresponding colors and areas (3), (5), and (6) are colorless.)

*(Kružni i pravokutni dijagrami, koji su ovdje prikazani, odnose se na kalcijsko-magnezijsko hidrokarbonatnu vodu sa slijedećim sadržajem glavnih iona, u mval/l%: (1) Ca — 58,2; (2) Mg — 26,3; (3) Na+K — 15,5; (4) $HCO_3+CO_3$ — 75,8; (5) $Cl+F+NO_3$ — 14,4; (6) $SO_4$ — 9,8. Površine (1), (2) i (4) obojene su odgovarajućim bojama, a površine (3), (5) i (6) su neobojene.)*

## HYDROGEOCHEMICAL ZONES
## *HIDROGEOKEMIJSKE ZONE*

| | | |
|---|---|---|
| (very light blue) *(vrlo svijetloplavo)* | Calcium bicarbonate waters *Kalcijsko-hidrokarbonatne vode* | Prevailing chemical type of ground water within an area *Pretežni kemijski tip podzemne vode unutar nekog područja* |
| (light yellow) *(svijetložuto)* | Calcium sulfate waters *Kalcijsko-sulfatne vode* | |
| (very light violet) *(vrlo svijetloljubičasto)* | Sodium bicarbonate waters *Natrijsko-hidrokarbonatne vode* | |
| (very light green) *(vrlo svijetlozeleno)* | Sodium chloride waters *Natrijsko-kloridne vode* | |
| (colorless or white) *(bezbojno ili bijelo)* | Unknown or uncertain chemical type of water *Nepoznat ili nesiguran kemijski tip vode* | |

| | | |
|---|---|---|
| (blue) *(plavo)* | Spring *Izvor* | Water phenomenon or structure from where water sample was collected for chemical analysis *Vodna pojava ili građevina iz koje je uzet uzorak vode za kemijsku analizu* |
| " | Cave or jama (karst shaft) *Spilja ili jama* | |
| (red) *(crveno)* | Drilled production well *Bunar (bušeni bunar)* | |
| " | Dug well *Zdenac (kopani bunar)* | |
| " | Shallow borehole (observation or exploratory) *Plitka bušotina (opažačka ili istražna)* | |
| " | Deep borehole (oil well) *Duboka bušotina (naftna)* | |
| " | Mine *Rudnik (jamski radovi)* | |
| (blue) *(plavo)* | Stream *Vodotok* | |
| " | Lake or swamp *Jezero ili močvara* | |

## TOPOGRAPHY AND HYDROGRAPHY
## *TOPOGRAFIJA I HIDROGRAFIJA*

(grey) *(sivo)*

Topographic and hydrographic symbols and toponyms are the same as indicated on corresponding geographic map, scale 1:500,000

*Topografske i hidrografske oznake, te toponimi, isti su kao i na odgovarajućoj geografskoj karti mjerila 1:500.000*

## Map of Hydrogeologic Function of Rock Complexes in Karst Regions, Scale 1:1,000,000

## Karta hidrogeološke funkcije terena u krškim područjima, mjerilo 1:1,000.000

(dark brown) *(tamnosmeđe)* — True barrier to water flow (surface and ground-water divide) *Prava barijera (površinska i podzemna razvodnica)*

" — Full *Potpuna*

" — Partial *Djelomična*

" — Hanging *Viseća*

Underground barrier (barrier to ground-water percolation) *Podzemna barijera (barijera protjecanju podzemne vode)*

(light green) *(svijetlozeleno)* — Permeable rocks *Propusne stijene*

## Map of relief and precipitation, scale 1:1,000,000

## Karta reljefa i padalina, mjerilo 1:1,000.000

(whitish yellow) *(bjelkasto žuto)* — <100

(very light brown) *(vrlo svijetlosmeđe)* — 100—200

(light brown) *(svijetlosmeđe)* — 200—500

(brown) *(smeđe)* — 500—1000

(dark brown) *(tamnosmeđe)* — 1000—1500

(very dark brown) *(vrlo tamnosmeđe)* — >1500

Elevation above sea level, m *Nadmorska visina, m*

(blue) *(plavo)* — Mean annual isohyet for period 1931—1960 in millimeters; dashed if uncertain *Srednja godišnja izohijeta za razdoblje 1931—1960, mm; crtkana, ako je pretpostavljena*

(grey) *(sivo)* — Topographic and hydrographic symbols and toponyms of both maps are the same as indicated on corresponding geographic map, scale 1:1,000,000 *Topografske i hidrografske oznake, te toponimi obiju karata isti su kao na odgovarajućoj geografskoj karti, mjerila 1:1,000.000*