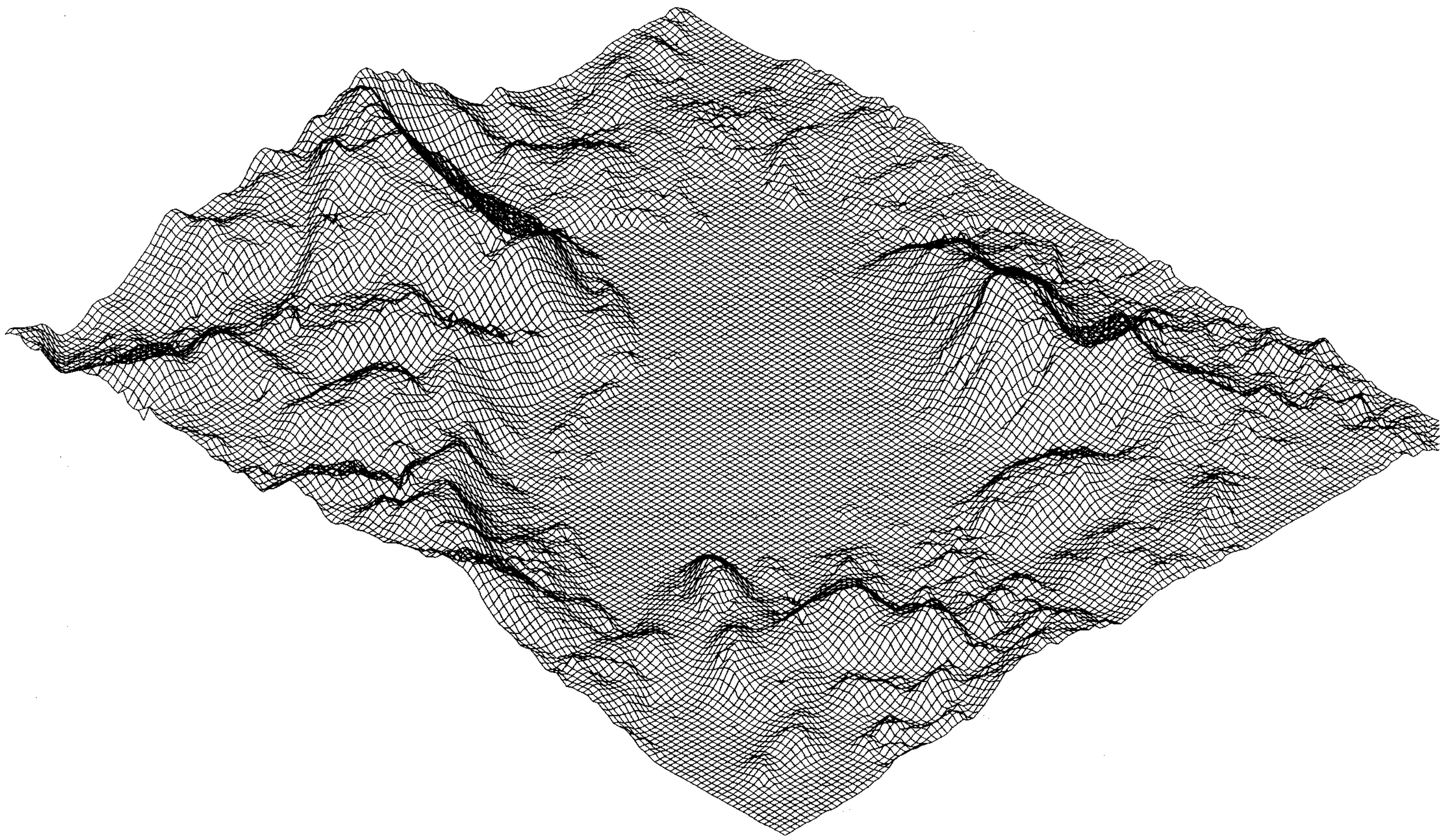
Speleological Association of Slovenia
and
Karst Research Institute ZRC SAZU

2nd INTERNATIONAL KARSTOLOGICAL SCHOOL

Classical Karst



GUIDE-BOOKLET FOR THE EXCURSIONS

Postojna, June 27 - 30, 1994

2nd INTERNATIONAL KARSTOLOGICAL SCHOOL
Classical Karst

Contents

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INTRODUCTION

The 1st International Karstological School last year was dedicated to Kras, to the landscape which gave the name to term "kras" and to the related science - karstology. The purpose of our international summer schools is to acquaint the participants with the entire Slovene classical karst. For this reason we selected as a basic topic of this year the karst poljes.

Karst polje is one of the rudimentary and at the same time the most noticeable karst morphological feature of Dinaric karst, consequently of the Slovene classical karst. As in many karst types the karst poljes did not develop they are extremely important for cognition of the classical karst and its morphological, and in particular hydrological genesis.

The expression "polje" itself is the word that arises from the Slavic languages and has its meaning in today's slovene language too. Moreover polje is the morphological feature where human activity and karst nature are the most tightly associated. From old the karst poljes with the flat surfaces, covered by the sediments, attracted the farmers and at the same time discourage them due to threatening and unpredictable floods, to settle or to cultivate them more intensively. An important role of this year's karstological school is to throw light upon this relation and at the same time the relation man - nature is an important element entitling the incorporation of this international school to UNESCO.

Andrej Kranjc

PROGRAM OF THE 2nd INTERNATIONAL KARSTOLOGICAL SCHOOL
Postojna, June 27 - 30, 1994

MONDAY, June 27

9.00 opening
10.00 coffee break
Lectures

10.30 Ivan Gams, TYPES OF POLJES IN SLOVENIA AND THEIR INFLUENCE ON LAND USE
11.00 France Šušteršič, POLJES AND CAVES OF NOTRANJSKA
11.30 Jože Čar, STRUCTURE OF IDRIJA FAULT ZONE ON PLANINSKO POLJE

13.00 Field work - Planinsko polje.

20.00 reception in the Jama hotel given by the President of the Slovene Commission to UNESCO Prof. Dr. Peter Tancig and the mayor of Postojna Mr. Josip Bajc

TUESDAY, June 28

Lectures

8.00 Ognjen Bonacci, HYDROLOGY OF KARST SPRING GRADOLE
8.30 Andrej Mihevc, RELIEF AT THE PONORS OF THE KARST RIVERS - COMPARISON BETWEEN THE CONTACT KARST AND KARST POLJES. THE EXAMPLES FROM SLOVENIA
9.00 Jurij Kunaver: THE GEOMORPHOLOGY OF THE TRANSITIONAL AND STEPPE-LIKE TYPE OF KARST OF PODGORJE AND KRAŠKI ROB (KARST EDGE)
9.30 Paolo Forti, KARST HYDROTHERMAL SYSTEMS
10.00 Break
10.30 Branka Berce-Bratko, MAN AND KARST
11.00 Ines Ožbolt, MENTAL PERCEPTION OF THE KARST
11.30 Bojan Žnidaršič, GEOGRAPHICAL NAMES IN NOTRANJSKI PARK

13.00 Field work - Cerkniško and Loško polje.

WEDNESDAY, June 29

Lectures

8.00	Andrej Kranjc, KARST POLJES MELIORATIONS AND REGULATIONS
8.30	Janja Kogovšek, SINKING RIVERS WATER QUALITY - PIVKA RIVER CASE STUDY
9.00	Tadej Slabe, SPELEOGENETICAL SIGNIFICANCE OF ROCKY RELIEF IN SOME CAVES OF NOTRANJSKA
9.30	Pavel Bosak, THE EVOLUTION OF KARST AND CAVES IN THE KONEPRUSY REGION (BOHEMIAN KARST, CZECH REPUBLIC)
10.00	Break
10.30	Andrej Gosar, APPLICATION OF GEOPHYSICAL METHODS IN KARST HYDROGEOLOGY AND ENGINEERING GEOLOGY
11.00	Daniel Rojšek, VELIKA VODA - REKA - A KARST RIVER
11.30	The conclusion of the Symposium
13.00	Field work - Notranjsko podolje and Rovte Contact Karst

THURSDAY, June 30

8.00 - 20.00	A whole-day excursion to karst poljes of Dolenjska

All the lectures will take place in Club Room of the Jama hotel

The departure to the field work and the final excursion will start from the Jama Parking place

On Tuesday and Wednesday evening there is the time at disposal for meetings of the international commissions and organizations or slides, videofilms etc. projection.

A B S T R A C T S

MAN AND KARST

Branka Berce-Bratko*

The relationship between man and environment is basic for landscapes, either cultural or protected. The Karst as such is partially man's design created by use of the area.

Landscape definitions are evoking different images, and could be explained as visually-aesthetic element of the nature, as artist's image or an own pleasant experience, but less and less we associate the landscape with man's survival. Landscape is an expression of a place's regional context especially in the absence of distinguishing architectural styles. Regional context as its overall character, its geomorphology, water regime, soils and plants, animals and inhabitants represent regional "personality".

The research to this fundamental relationship emphasized identity. From anthropological identity to physical and social identity. A part of that was research on cultural landscape mapping, bioregionalism, and Risk assessment mapping as an example of MAB Reserve Buffer Zone Cerkniško polje.

Villages around Cerkniško plain and with this we became aware that all the research is only a memory, that being aware of past architectural values enables new guidelines for new developments. It represents an internal identity entered into the place, enhancing it and leaving signs of ancestors. High level of identity with landscape has enhanced the proper way of constructing, settlements design. This practice has enabled low level of erosion. The man and landscape are an entity. In the Notranjski Park area an old expression says: "everything is only returning, therefor such a research ought to be a base for new developments, like rehabilitation, re-instating genuine identity to people and places. This is not a conservation activity of the past but realization of past anticipations. The man is degrading places and mirrors its own limitations. The life is changing very quickly, settlements are loosing character and domestic appearance. Research of ethnoscapes is research of people and landscapes, their inter-relationships and it will be shown on Cerkniško polje, with particular reference to Žerovnica settlement and facing problems of eco-tourism. Special interest is education for environment and how to educate inhabitants and visitors to enhance protected landscape as a

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part of MAB Programme NOTRANJSKI KRAS. Special presentation of the research of identity in its widest sense are geographical names in Notranjski park and Mental perception of the Karst as essential parts of the research study: MAN and KARST.

HYDROLOGY OF KARST SPRING GRADOLE

Ognjen Bonacci*

The paper discussed the results of a hydrogeological and hydrological analyses of the Gradole karst spring. Main goal of investigations was determination of catchment boundaries and area in order to protect spring water quality. The underground watershed has been determined by geological and hydrogeological methods. The control used was the hydrologic water budget analysis appropriate for karst basins with limited data. The catchment of Gradole spring is defined as 104 km_2. The Gradole spring water has been used as the drinking water supply. The capacity of the spring Gradole is limited and does not exceed 10 m_3/s. All discharges which exceed this amount flow to the surface through other intermittent springs in the vicinity of Gradole spring. Measured minimum, average and maximum discharges in 1987-1992 period are: 0,28 m_3/s, 1,80 m_3/s, 8,68 m_3/s respectively. During the hot and dry period of year there is a shortage of water for water supply. In this period an attempt to recharge the karst underground aquifer was made.

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THE EVOLUTION OF KARST AND CAVES IN THE KONEPRUSY REGION (BOHEMIAN KARST, CZECH REPUBLIC)

Pavel Bosak*

Karst evolution. Lower Devonian - freshwater vadose and phreatic karstification connected with reef emergence and origin of freshwater lens - several phases in the interval of Pragian (Lower Devonian) to Givetian (Middle Devonian) - infill of clayey dolostone to dolomitic claystone, dark coloured - size milimetres to first tens of centimetres - depositional paleokarst. Pre-Cenomanian - not known subsurface karst forms - relics of surface forms and kaolinic sands in depressions. Paleogene - intensive karstification under the cover of Upper Cretaceous clastic sediments - intensive weathering of Cretaceous sediments - appearance of ponors - development of basic network of passages led to the origin of extensive caves - various fill, at the present time reworked completely. Miocene - gradual diminution of karstification - main periods of fossilization since upper Middle Miocene - speleothem origin - large lakes in caves - displacement by neotectonic movements. Pliocene to Early Pleistocene - continuing fossilization (Middle Pliocene and Biharian phases) - last neotectonic movements during Biharian (cca 1,1 Ma). Pleistocene to Holocene - intensive backward erosion at the end of Biharian - superficial karstification (epikarst zone) - maybe inserted slope caves - karstification up to local base level.

Paleohydrogeological Model. (1) Predisposed network of Lower - Middle Devonian diagenetic porosity - several times utilized by all younger karstification phases, (2) Evolution of some karstic porosity to macroporosity during pre-Cenomanian evolution of landscape, (3) Destruction of platform cover of Upper Cretaceous sediments under wet and hot climate (Paleocene, Eocene, Oligocene) and (*) evolution of ponors in multiple ranks and multiple lines at margins of limestone core of synclines, (*) evolution of infiltration routes under a cover of permeable Cenomanian sediments, (4) Evolution of cave systems - deep phreatic cave horizons with multiple loops and local horizontal features - followed main tectonic scheme - NNE-SSW to NNW-SSE tension open lines and WNW-ESE to WSW-ENE compressional faults to overthrusts - main charasteristics: - in areas close to ponors - circular,

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mostly phreatic tunnels, increasing diametre with increasing distance from ponors, - in area of main hydraulic barrier - irregular maze to labyrinth caves, vertical with subhorizontal "levels" - morphology of shallow phreatic to vadose lake-filled rooms, (5) Main hydraulic barrier - the Očkov Overthrust - upwell of water - increase in piezometric level - water discharged by this thrust line in NW and SE direction, (6) Evolution of lower deep phreatic cave horizons in dependance to decrease of piezometric level - ?owing to climate aridization and/or ?deepening of regional base level - maybe uplift connected with volcanic phases - lowering of piezometric level marked by precipitates of Fe inside the carbonate massif - retreat of limestone slopes and shift of ponors in the centripetal manner.

STRUCTURE OF IDRIJA FAULT ZONE ON PLANINSKO POLJE

Jože Čar*

The Idrija fault is one of the strongest and morphologically the most distinctive tectonic zone in the area of Southern Alps. It passes from the Rezija valley, cuts the whole western Slovenia and continues at Prezid in Croatia. In extremely complicated wider fault zone of the Idrija fault there are big karst poljes, namely Planinsko and Cerkniško polje, Loška dolina and Babno polje. The wider fault zone was mapped in detail on Planinsko polje and its vicinity in particular. The Idrija fault is a wrench of continental character this is why in its inner and outer and wider fault zone richly developed various forms of broken, collapsed and fissured zones having strong influence on polje's origin and on its hydrological properties.

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KARST HYDROTHERMAL SYSTEMS

Paolo Forti*

Thermal karst systems may represent an important economic resource from the point of view of the hydrogeology and of the hosted ore deposits. Nevertheless general papers on this topic are very scarce in the international literature and completely lacking in the italian one.

In the past every time a cave showed strange morphologies or was infilled by exotic deposits like uncommon speleothems or several different minerals it was normal consider it developed under hydrothermal conditions.

In reality, in the last years the improvement of our knowledge on the different and time to time more complex speleogenetic mechanisms demonstrated that several previously supposed hydrothermal karst system should be developed in a normal environment.

In theory a cave may be regarded to as hydrothermal in origin (or part origin) if thermal fluids (normally hot water) flowed inside it (or part of it) at least during a period of its development.

Even if this definition is very simple the criteria by which a cave may be regarded as thermal are rather complicated and often non conclusive: the most certain of which (though uncommon) is hot water flowing inside the cave.

In the literature several papers exist on peculiar thermal karst systems, but very few of them give a general overview on this topic (Ford & Williams, 1989).

Moreover most of the research deals with the morphology of these cavities. From this point of view the hydrothermal caves may be subdivided into two categories (Muller & Salvary, 1977): monogenic hydrothermal caves, consisting of a large basal chamber from which a branching pattern of rising bell shaped passages have grown; the second category consist of 2D- and 3D- maze caves. The possibility of evolution of the different types of hydrothermal caves depend upon the fracturation of the rocks, the presence of an overlying watershed, the kind of feeding and discharge and other parameters (Muller & Salvary, 1977; Dubliansky, 1980; Bakalowicz et Al., 1987).

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Until now only a few papers have been produced on the peculiar speleothems growing in the hydrothermal caves and none of them has a general approach (Hill & Forti, 1986); on the contrary a wide bibliography exists on the ore deposits (Missisippi Valley Type) related with thermal karst systems (Dzulynsky & Sass-Gustkiewicz, 1989).

A general study was never performed to relate morphologies and chemical deposits of the thermal karst with the speleogenetic mechanisms which may be active in the different zones of the aquifer.

In reality due to the complexity and the variability of the thermal fluids, there are plenty of different chemical-physical reactions which are possibly active in such an environment: anyway some of them may be regarded as the most important, because they are active singularly or combined with some others at least in part of most of the hydrothermal caves.

Some of them cause net dissolution, or net deposition, but most of them are responsible for incongruent dissolution (deposition and dissolution in the mean time). Normally these mechanisms may be active only in a definite part of the aquifer and therefore their effects are possibly indicators of the conditions in which the cave developed.

Therefore it would be extremely important to define the interrelations existing between speleogenetic mechanisms, aquifer zones and evolved morphologies and/or chemical deposits: in the present paper a first schematic attempt of such classification is proposed for discussion.

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TYPES OF POLJES IN SLOVENIA AND THEIR INFLUENCE ON LAND USE

Ivan Gams*

The poljes bottom in Slovenia are at the most used on the gravel, sand and thick loam soil on the alluvial plains and the least on the shallow stony rendzina and flooded areas. The deposition of river load is mostly connected with the polje types (border, piedmont, peripheral, overflow, base level polje). For instance, in the border and piedmont polje bottom is more frequent the gravel and sand deposition and floods are often in the baselevel and overflow polje. These correlations are shown in the case of the poljes in the Dinaric Karst and Alps in Slovenia. The largest poljes belong to the combined types.

APPLICATION OF GEOPHYSICAL METHODS IN KARST HYDROGEOLOGY AND ENGINEERING GEOLOGY

Andrej Gosar**

In karst areas, regional geophysical surveys are centred on the assessment of karstified permeable zones, verification of the structural-tectonic position of limestones with respect to their basement and determination of the spatial distribution of carbonate rock complexes. Regional gravity and (aero)magnetic maps are useful for studying the relief of impermeable basement rocks, whose dips control the general directions of ground-water flow in a limestone block and for location of tectonic lines. Zones of intensive karstification are usually associated with faults and especially with intersections of tectonic systems.

Detailed geophysical methods are applied to study surface (sinkholes, depressions) and underground (caverns, ground-water conduits, underground streams) karst formations. Because these forms appear as electrical more conductive zones concerning adjacent undisturbed

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limestones, geoelectrical methods are the most important. Vertical electrical sounding (VES) provides information on intensity of karstification in a vertical section that is normally composed of four principal layers: near surface clayey sediments, dry karstified limestone, water-bearing karstified limestone and solid unkarstified limestone. Direction of ground-water flow can be determined with mise-à-la-masse method, measurements of spontaneous potential (SP), very low frequency (VLF) electromagnetic method and with geothermal methods. Induced polarization (IP), VES and SP methods provide valuable information about the overburden sediments that control the infiltration of surface water into limestones and about bauxite deposits.

A special task for geophysics on karst is locating and tracing cavities (channels and caves). If they are filled with water, geoelectrical methods are applied as in tracing conductive zones. In case of dry, isolated cavities microgravimetry or ground penetrating radar (GPR) is used. Fractures and karstified zones in general are investigated also by reflection and refraction seismics and gravimetry combined with resistivity methods.

In Slovenian karst researches from Institute of Geology, Geotechnics and Geophysics from Ljubljana successfully applied geophysical methods for several times in solving different problems including: - determination of the base of karstification with vertical electrical sounding, - tracing of ground-water flow with SP, mise-à-la-masse and geothermal methods, - surveying of bedrock (sinkholes, depressions) on karst fields with resistivity profiling, - investigations of karstified tectonic zones (also under flysch deposits) with reflection and refraction seismics combined with vertical electrical sounding, - location of caves with ground penetrating radar and gravimetry, - studying of bauxite deposits with different geoelectrical methods.

SINKING RIVERS WATER QUALITY - PIVKA RIVER CASE STUDY

Kogovšek Janja*

The paper deals with the water quality of the Pivka sinking stream at its ponor to Postojnska jama. On its superficial way towards the ponor Pivka receives the waste communal and industrial waters of the villages, only the waste waters of Postojna are being treated. By various methods of sampling we tried to encompass the majority of properties of Pivka, its water quality respectively. Seasonal observations evidence the oscillations of particular parameters during the observations and specially called the attenion to critical situations which occur during winter and summer drought. They are conditioned by low water level and sinking of Pivka in upper part of its bed. The hazard is reflected in the content of dissolved oxygen, COD and BOD. Detailed systematic observations during 24 hours gave the quality properties during low winter and summer water level as well at increasing and decreasing of the discharge.

The Pivka quality downstream, in Pivka and Planinska jama depends on the water quality at the ponor. Known and unknown underground tributaries with pollution or dilution effects, autopurification processes active on the Pivka underground flow have impact on this quality.

KARST POLJES MELIORATIONS AND REGULATIONS

Andrej Kranjc*

With the economical and technical development pressure of agrarian population on farming land, including the wishes to protect the cultivated land against floods and to cultivate new lands, increased at the end of 18th Century. Such trends were specially strong on the karst poljes with larger flat soil bottom and at the same time more often flooded. During 19th century more plans to prevent floods on Cerkniškio polje primarily were elaborated.

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In 1886 the Ministry for Agriculture entrusted to V. Putick the preparation of the projects to abolish the floods on the karst poljes of Carniola. Putick made a project "Generalproject zur unschädlichen Ableitung der Hochwässer aus den Kesselthälern von Planina, Zirknitz und Laas-Altenmarkt in Innerkrain" (1888), but it was not adopted. Nevertheless some proposals were realized under his direction already, and some of them much later. Most of the visible meliorations on our karst poljes are in this way or that way connected with Putick's activity. Putick's influence was large enough and he was asked to make plans and even to realize them on some other karst poljes in Slovenia too. In the meantime other engineers were recruted to make the meliorations on other poljes, specially in the background of Krka river springs. During the 20th Century plans for the meliorations of karst poljes included also the plans to make water accumulations for HE power stations (Planinsko polje) or to change them into permanent lakes (Cerkniško polje).

THE GEOMORPHOLOGY OF THE TRANSITIONAL AND STEPPE-LIKE TYPE OF KARST OF PODGORJE AND KRAŠKI ROB (KARST EDGE)

Jurij Kunaver*

The region of the southwestern Slovene Dinaric karst plateaus which is represented with POdgorski kras as the biggest area has a typical transitional and steppe-like nature, from higher to lower karstic plateaus and finally to the flysch region, along the coast in the western Slovenian Istria. The main character of the country is the frequent interruption of the low lying karstified plateaus with vertical structural steps or escarpements. The area is therefor also called Kraški rob (The Karst Edge). It extends from Socerb on NW to Golič on SE and in the altitude from about 400 m to nearly 900 m, with the highest point on Slavnik, 1001 m. This block which belongs to the Čičarija imbricate structure, has a thrusting geological structure and intercalations of the flysch between the limestone thrust folds and nappes. Typical are the elongated limestone stipes which are interrupted by very narrow stripes of flysch.

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Geologically the region is the youngest part of the westernmost Dinaric geologic belt with the transitions from Lower to Upper Cretaceous and in continuation, from Lower to Middle Paleocene to the Upper one and to Eocene flysch. The surface of the karst plateaus shows a clear evidence of the recent, presumably Pleistocene and partly Holocene river drainage and has a fluvial karstic nature. There is a clear evidence of a continuously changing relation between the karstic and flysch regions, the later being under the influence of more dynamic erosional and denudational processes and therefore being a subject of the territorial diminishing. The karst area as a whole has a shallow character lacking deeper karst depressions. The shallow dolines mostly transformed by man express frequency of up to $54/km^2$. Some parts of the surface are stony but the reforestation and abandoning of the intensive agriculture cause the changing of the landscape. Except of the plateaus where the flysch bases are used for settlements and fields, the limestone walls between them with concave rock shelters or abris on their bottom exposed to SW, are the second most impressive feature in the region. The walls which are the result of recumbent folds, continue from the Triest Karst along the border with flysch to Croatian Istria. Except the rock shelters also the caves are to be found near the thrust plane on the contact of the limestone rock and the flysch at the base of the walls.

RELIEF AT THE PONORS OF THE KARST RIVERS - COMPARISON BETWEEN THE CONTACT KARST AND KARST POLJES. THE EXAMPLES FROM SLOVENIA

Andrej Mihevc*

Along allogenic rivers, flowing to the karst, bigger depression forms developed, usually called blind valleys. More accurate view shows that they differ among them considerably. Various depression forms may be morphologically distinguished and genetically founded. These are the ponor steepheads, ponor valleys, blind valleys with corrosionally widened bottom. These shapes originated under the influence of the fluvial inflow but they are controlled by hydrological properties of the karst where they sink.

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Karst poljes are bigger depression forms where superficial streams exist. The corrosionally levelled karst poljes bottoms are formed at the level of karst water. At the ponors the impact of bigger karst water gradient is shown evidencing the property of the karst lying below the ponors.

This is why at the ponors on karst poljes the relief forms develop that are similar to the forms of the contact karst.

MENTAL PERCEPTION OF THE KARST

Ines Ožbolt*

From the work in the Project of Notranjski Park the difference between general perception in a certain area and the perception of the same area on individual level is clearly evident.

Where spatial management or planning is concerned the mental image is merely ignored, although it is well known that this particular image is of vital importance for the people living in the area. This is the main reason that we propose the preliminary study of perception of the place from the point of view of inhabitants and visitors before any of the planning procedures take place.

The perception is one of the basic functions of man's orientation in a place and has great impact. Its importance orientation in a place and has great impact. Its importance should be considered in the procedure of physical planning. The identity of territory has impacts on visual and sensual perception of a specific area. The area which is heterogeneous has its identity which has a higher degree of recognition for people than an area lacking variety.

The Notranjski Park has great diversity of landscapes and is interesting ether for research or exploration in a view of professional responsible for the establishment of the park. The project begins with the testing of the Karst landscape. One method is used for the entire area of the Notranjski park. We intend to determine, weather the Karst, as a land, has an identity of it's own, which is different from the identity of other regions both in the natural and social point of view. We intend to determine, weather the people of this region differ their home from other landscapes both visualy and mentaly. It also concerns us, how Karst is interpreted by the natives and the tourists, and what are the differences between the impressions of professionals and "laic-s".

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The participants of the International Karstological School will be asked to fill in questionnaires on recognition and mental image of the Karst. They will represent the first pilot group, the one representing professionals, second group are visitors, the third are indigenous people.

Tasks of the project:
- to establish the existence or non-existence of difference between mental image of the Karst phenomena and other geological features and areas,
- to establish which are basic expressions interconnecting the Karst as such and the Karst phenomena,
- to establish the mental image of the Notranjski Park according to their professional experience and the knowledge,
- to evaluate the Karst as the place of pleasant or non-pleasant experience,
- to establish which elements of the Karst are the most important for its recognition; elements of macro-reliefs or micro-reliefs,
- to establish the existence or non-existence of differences between mental images among three pilot groups.

Methods used:
1. "knowledge questionnaire" (open and closed questions),
2. scales of measures for cognition (semantic differential),
3. association tests,
4. photo-questionnaire.

Sample:
Group of professionals (people researching or studying Karst).
Group of visitors (enthusiasts, tourists enjoying the Karst).
Group of indigenous people (people living in the Karst area perceiving it as home environment).

Procedure:
The results will be reached by questionnaire, which is the same for all pilot groups with contents: knowledge, association, perception, recognition, and assessments.

Results:
Mathematical and statistical methods will be used to generate research result and to establish the level of achieved aims (factor-analysis, variance analysis with F test used).

VELIKA VODA - REKA - A KARST RIVER

Daniel Rojšek*

Velika voda - Reka river is known in natural sciences and literature from antiquity. In the Postojna Karst Institute rich bibliography of 189 units exists.

Hydrogeographical features of the Velika voda - Reka fluvio-karst basin have been studied and published, but the river regime of 30 years period (1953-1982) has been proceeded for this occasion.

Hydrogeographical characteristics of the Velika voda - Reka fluvio-karst drainage area and of the matični Kras flowing-through karst area will be presented in the communication. Hydrogeographical heritage of the area will be mentioned, too.

SPELEOGENETICAL SIGNIFICANCE OF ROCKY RELIEF IN SOME CAVES OF NOTRANJSKA

Tadej Slabe**

Studying the origin and formation of the cave rocky forms it was proved that combined into rocky relief they are frequently an important speleogenetical factor. This cognition is confirmed by study of rocky relief in selected caves of Notranjska. The results may be used to define the origin and development of this morphogenetically joint karst area (Fig. 1). I have chosen the caves at the inflow (Križna jama) and outflow (ponor caves Mala Karlovica and Zelške jame) sides of the Cerknica lake and active effluent cave Planinska jama where the waters of Pivka and Rak flow together. At NW, higher part of Notranjska lowered surface, it means at the border of Črni vrh polje (Gams 1974) I have studied Ciganska jama near Predgriže. Logaška jama is an old cave lying on Logatec karst plain.

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POLJES AND CAVES OF NOTRANJSKA

France Šušteršič*

The Eastern (Cerknica) branch of Ljubljanica basin encompasses four well pronounced poljes, and additional five closed basins which display at least some properties of poljes. Though similar by their origin the poljes display different morphology which is due to local conditions. The same goes for the caves. Among them appear a number of caves which cannot be related to the present hydrological situation.

GEOGRAPHICAL NAMES IN NOTRANJSKI PARK

Bojan Žnidaršič**

As the basis for the research in the area of Notranjski Regional Park computer aided data base was formed in which available geographical names were used a base. All parameters important for the context and statistics of geographical names were analytically assessed.

Particular names ascribed by people were either for the purpose of orientation or rational-logical organisation of space. For the purpose of this particular research project two divisions were made:
- visual (structure and relief)
- substance (structure and quality).

The most important characteristics (i.e. use of place) are evident in place names. Nomination of names for certain parts have different background as they have continuing history and could be ascribed to different circumstances as well. Geographical names represent the use of the place, predominantly its use in the past. As such they are a part of a cultural heritage.

In the introduction the purpose of the research was presented as well as the hypothesis. The applicability of such kind of the research in different levels was evaluated. In the disposition of the research the

*FNT, VTOZD Montanistika,
odsek za geologijo
Ljubljana
**Area Pro d.o.o.
Cerknica (Slovenia)

contents of inventory phase and analytical levels chosen were justified. Following the description of the procedure the detailed structuring of parameters was presented. The method of data collection and assessments pursued were described precisely. The instructions are given for relations and connections of geographical names in the data base.

All important parameters are evaluated (there are 72 parameters), 11 content, structures:

- level of altitude,
- exposition,
- use,
- partitions,
- peaks,
- valleys,
- waters,
- microrelief features,
- routes,
- settlements,
- objects - buildings.

The main part of the research consists of contents analysis by statistical assessments. The findings are shown in graphs and charts, in five charts all available geographical names (5392) are stated, different names of places (4446) and the difference between those two categories (946). The Chart of most common place names and the chart of "naming" diversity of places was produced (149). With the help of 14 graphs the percentage of each parameter were presented.

The summary of inventory work used as the basis for the continuation of the research - second phase definiton. Three new substances were suggested: spatial, socio-economic and linguistic. In the first phase one of the possible structural results is presented.

For the one of the possible structure research the study of the impact for the karst phenomena on naming geographical places. Therefore for the second International Karstological School the research results are summarized, and geographical names steaming from karst phenomena are presented. As a starting point was a question: where, how much, and with which elements of the area studied the karst phenomena appear as the basis for naming the places. This way 306 names based on karst phenomena were identified.

The study has appendix supporting the transparency of the approach, summary and literature used, where all available bibliography is collected. The aim of the study was to put together all available knowledge, experiences, and achievements of all authors dealing with this particular problem of geographical names in Slovenia.

Field-work Schedule

No special equipment is required for the field-work. We shall travel by bus and walk only 2 km at once. The only inconvenience that threatens may be the summer storms.

MONDAY, June 27: **PLANINSKO POLJE**

Departure at 13.00

Entrance to Planinska jama, steephead valley, spring of Malni and steephead valley, Laze village and ponor side of polje, ponors at Milavčevi ključi, Idrija fault line and connected tectonics, ponors Pod Stenami.

19.30 return to Postojna

TUESDAY, June 28: **CERKNIŠKO POLJE**

Departure at 13.00

Ponor side of polje, entrance of Mala and Velika Karlovica caves, ponors at Vodonos, springs Obrh and Cemun, Loško polje, entrance to Golobina cave, spring of Žerovnica, surface river Cerkniščica at Bloke.

20.30 return to Postojna.

WEDNESDAY, June 29: **HOTEDRŠICA AND LOGATEC BORDER POLJES**

Departure at 13.00

Border of Planinsko polje, Hotenjski ravnik flat corrosional surface, Hotedršica alluvial fan, Logatec border polje, Rovte contact karst, springs of Ljubljanica at Vrhnika and Bistra.

20.30 return to Postojna.

THURSDAY, June 30: **KARST POLJES OF DOLENJSKA**

Start at 8.00, return at 20.00

Ljubljana Moor, Grosuplje basin, Radensko polje, Čušperk, Ilova gora, Ciganska jama, Zagradec, Mlačevo, Žalna, Žalnsko polje, Luče, Škrjančeva jama,(catavothre), val clos and Krke resurgence, Dobrepolje, Ribniško polje, Tentera (cave), Ribnica, ponor of Bistrica river, Rakitnice resurgences, Rakitnica ponors.

Lunch time

Kočevsko polje, caves at Klinja vas, Željne, Ciganska jama, Kočevje, Livold, Kočevska reka, Glažuta, Loški Potok, Bloško polje, Cerknica, Postojna.

20.00 return to Postojna.

The sources from which the annexes to the field-work are used:

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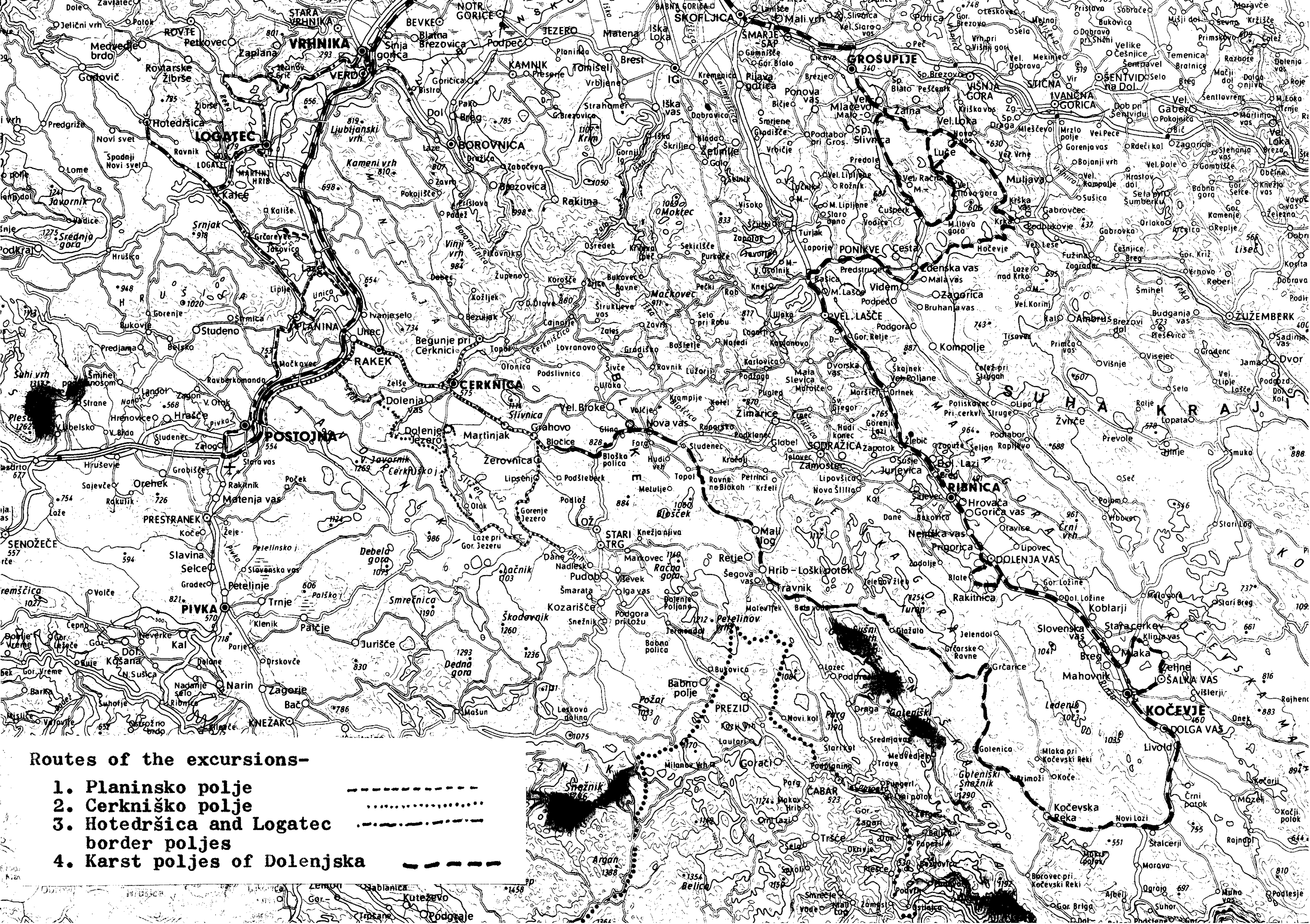
Novak, Dušan, 1987: Podzemeljski vodni tokovi na Dolenjskem.- Dolenjski kras, 2, 23-27, Novo mesto



Routes of the excursions-

1. Planinsko polje
2. Cerkniško polje
3. Hotedršica and Logatec border poljes
4. Karst poljes of Dolenjska

Fig. 2

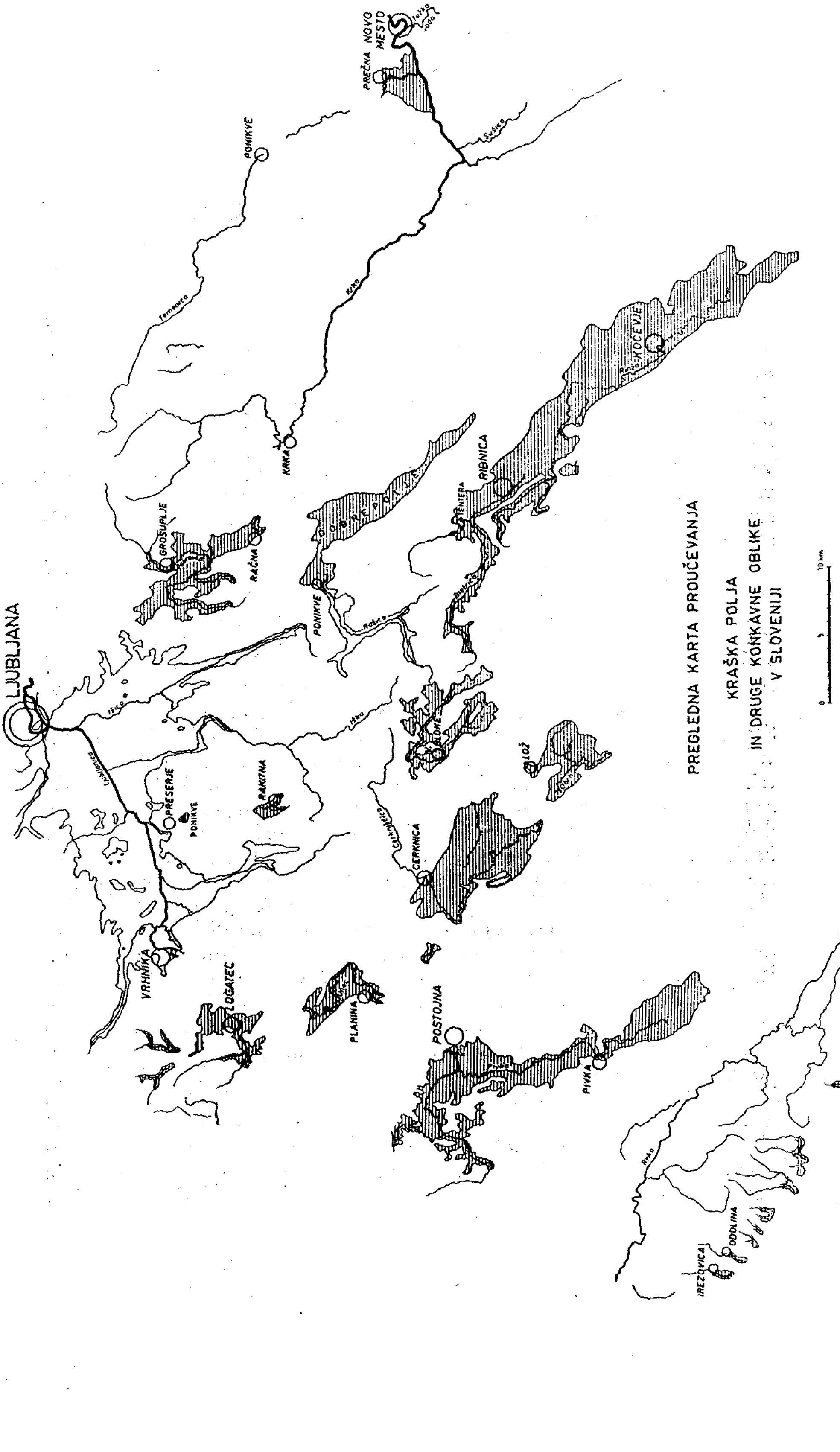
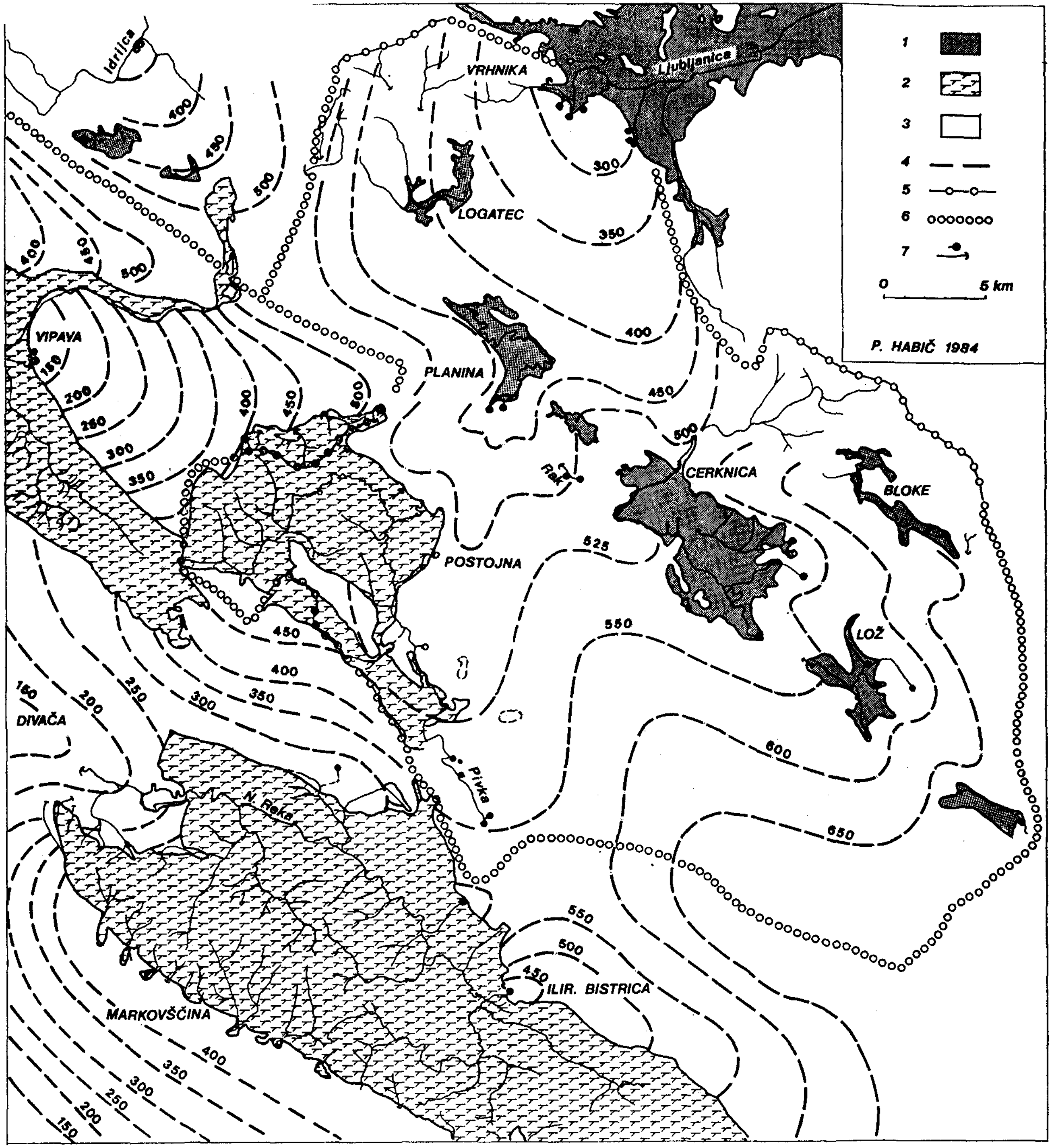

PREGLEDNA KARTA PROUČEVANJA
KRAŠKA POLJA
IN DRUGE KONKAVNE OBLIKE
V SLOVENIJI
Karta 1
LJUBLJANA
GROSUPLJE
RAČNA
KRKA
PONIKVE
PREČNA
NOVO MESTO
RIBNICA
KOČEVJE
PONIKVE
BLOKE
LOŽ
CERKNICA
PRESERJE
RAKITNA
VRHNIKA
LOGATEC
PLANINA
POSTOJNA
PIVKA
ODOLINA

Fig. 3



Sl. 14. Razporeditev nizkih voda v Notranjskem krasu
1 — kraška polja in kotlina Ljubljanskega barja, a!
2 — fliš, nepropustno površje
3 — kras, apnenec in dolomit
4 — hidroizohipse nizke vode v krasu
5 — površinsko razvodje
6 — kraško razvodje
7 — kraški izvir in ponikalnica

Fig. 14. Distribution of low waters on Notrajsko karst
1 — karst poljes and basin of Ljubljana Moor, allu
2 — flysch, impermeable surface
3 — karst, limestone and dolomite
4 — hydro-contour-lines of low water in karst
5 — superficial watershed
6 — karst watershed
7 — karst spring and sinking stream

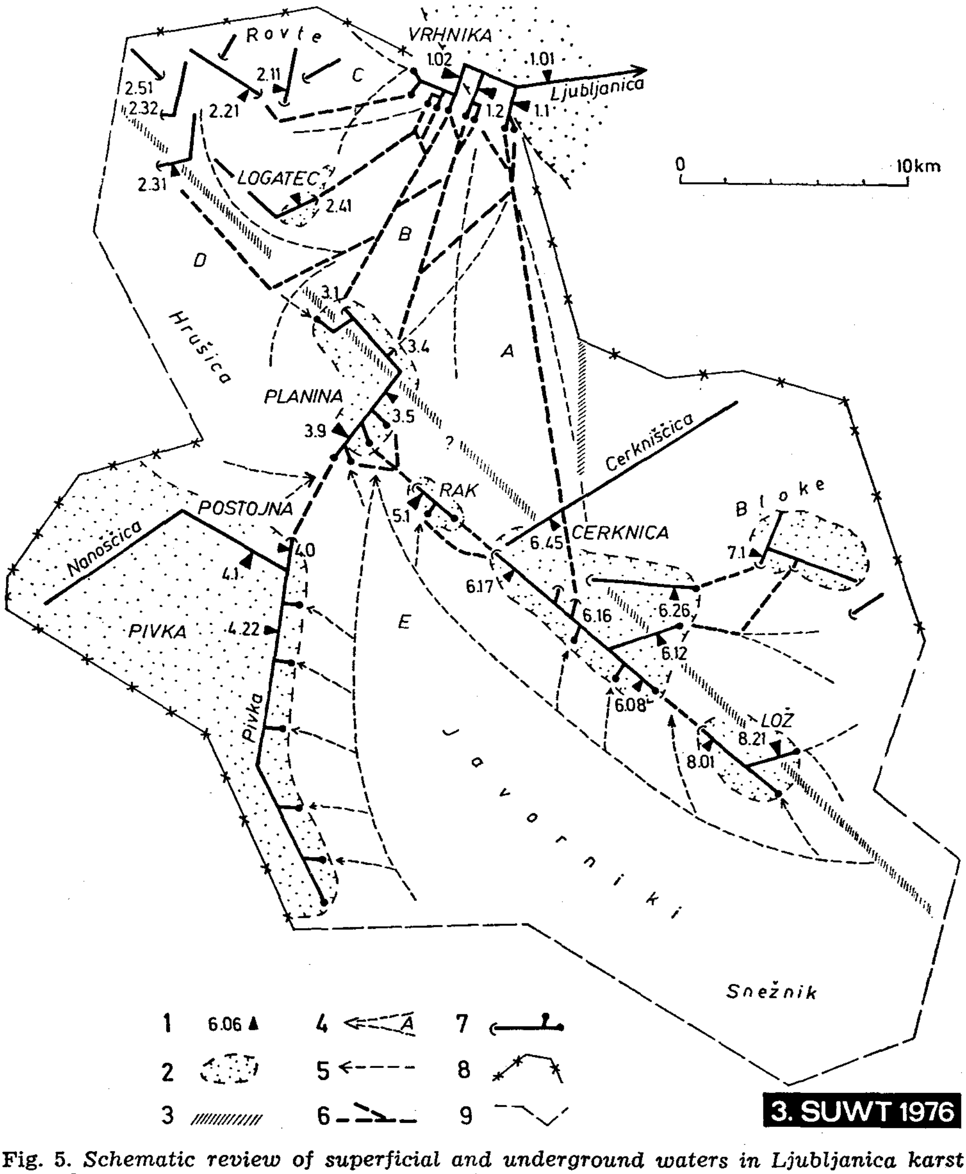


Fig. 5. *Schematic review of superficial and underground waters in Ljubljanica karst river basin.* 1 — important gauging stations, 2 — karst polje with sediment, 3 — central hydrogeologic relative barrier, 4 — intake area of permanent karst springs, 5 — periodic high water discharges of karst water, 6 — underground water connections, 7 — superficial stream with springs and ponors, 8 — superficial watershed, 9 — supposed karst watershed.

Sl. 5. *Shema površinskih in podzemeljskih voda v kraškem porečju Ljubljanice.* 1 — važnejše vodomerne postaje, 2 — kraško polje z naplavino, 3 — osrednja hidrogeološka pregrada, relativna bariera, 4 — zbirno območje stalnih kraških izvirov, 5 — občasni visokovodni prelivi kraške vode, 6 — podzemeljske vodne zveze, 7 — površinski tok z izviri in ponori, 8 — površinsko razvodje, 9 — kraško predpostavljeno razvodje.

Fig. 5

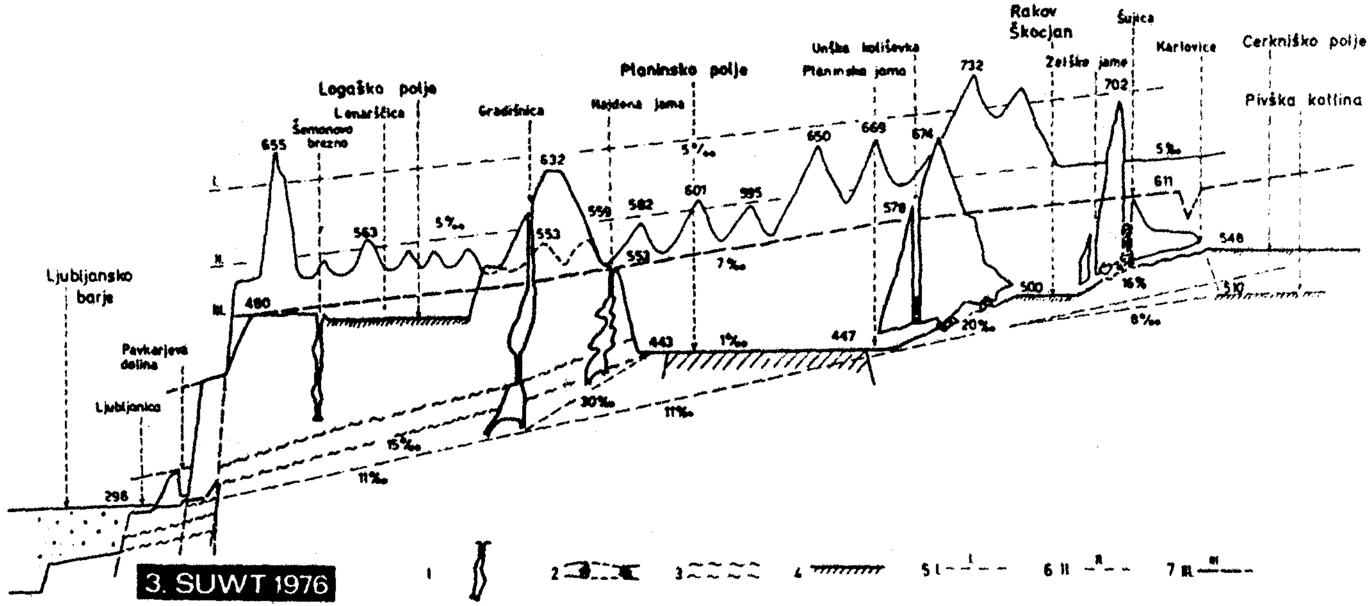
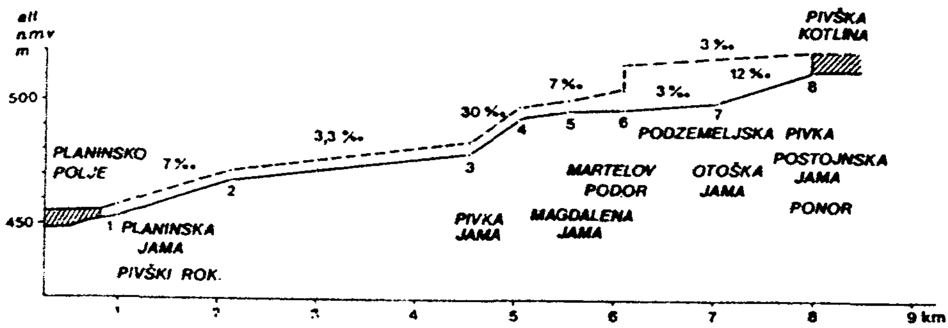


Fig. 2. *Longitudinal cross section of central part of Ljubljanica karst river basin.* 1 — active cave or pothole, 2 — unknown parts within known active caves, 3 — the supposed zone of former active caves between Planinsko polje and Ljubljansko barje (Ljubljana Moor), 4 — karst polje's bottom, 5 — Gradišče relief level, 6 — Bodiški vrh relief level, 7 — Dolina relief level.

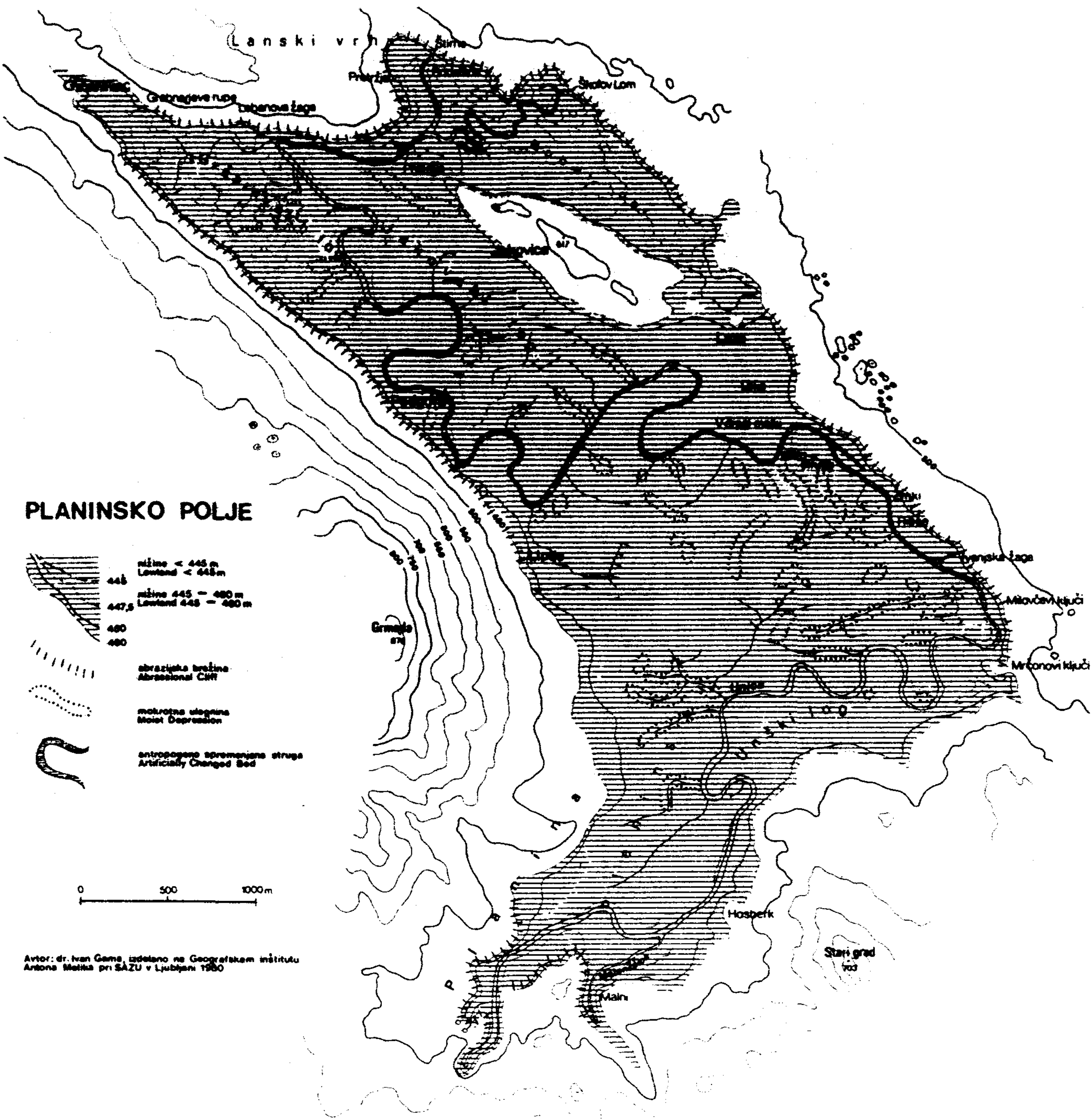
Sl. 2. *Vzdolžni prerez osrednjega dela kraškega porečja Ljubljanice.* 1 — vodna jama ali brezno, 2 — neznani odseki v znanih vodnih jamah, 3 — predvidena cona nekdanjih vodnih jam med Planinskim poljem in Ljubljanskim barjem, 4 — dno kraškega polja, 5 — Gradiška reliefna stopnja, 6 — Bodiška reliefna stopnja, 7 — Dolinska reliefna stopnja.

Fig. 6



Sl. 8. Strmci nizke in visoke vode med Pivško kotlino in Planinskim poljem
Fig. 8. Low and high water gradients between Pivka basin and Planina polje

Fig. 7



..OSKA KARTA
..LOGICAL MAP

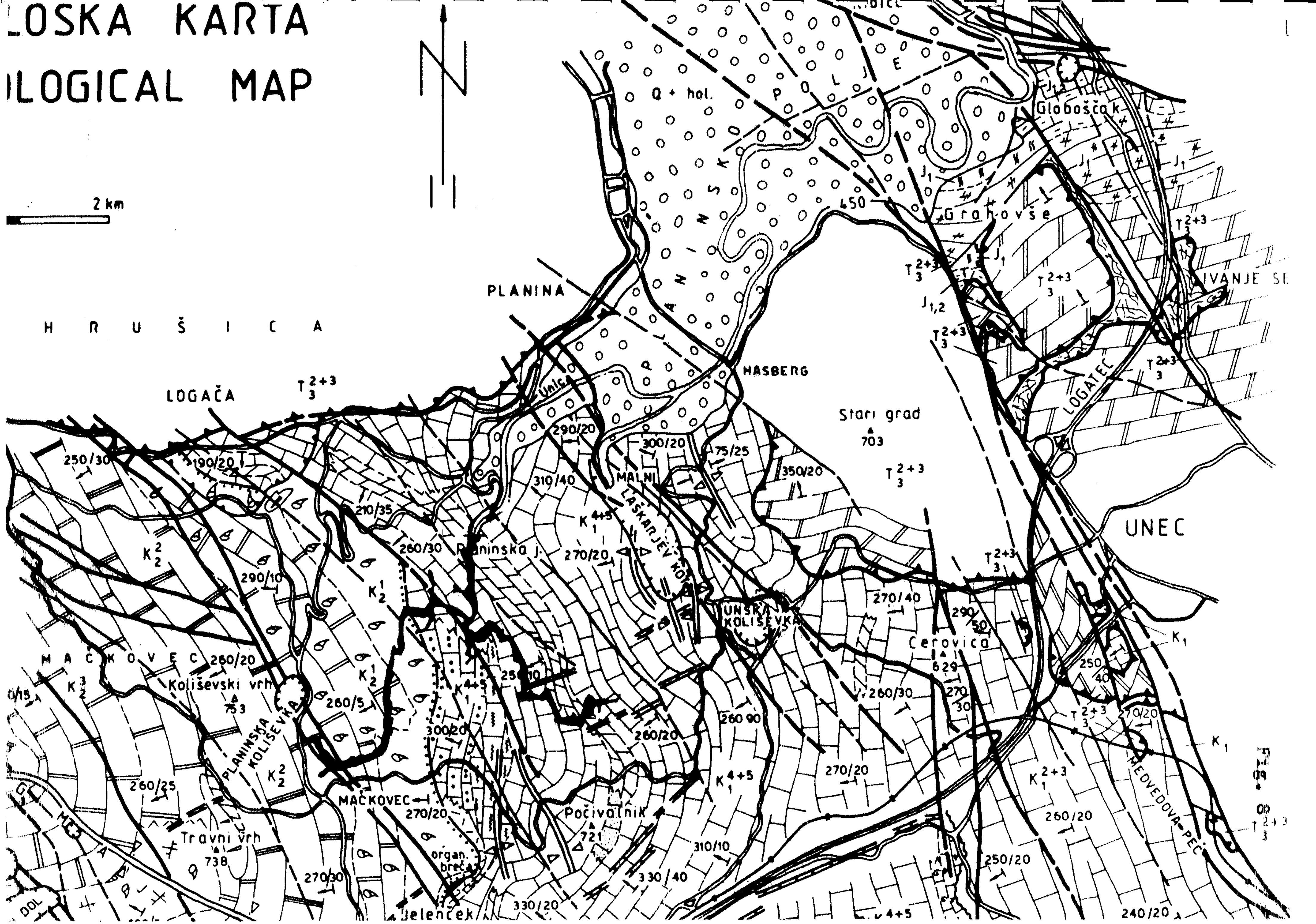
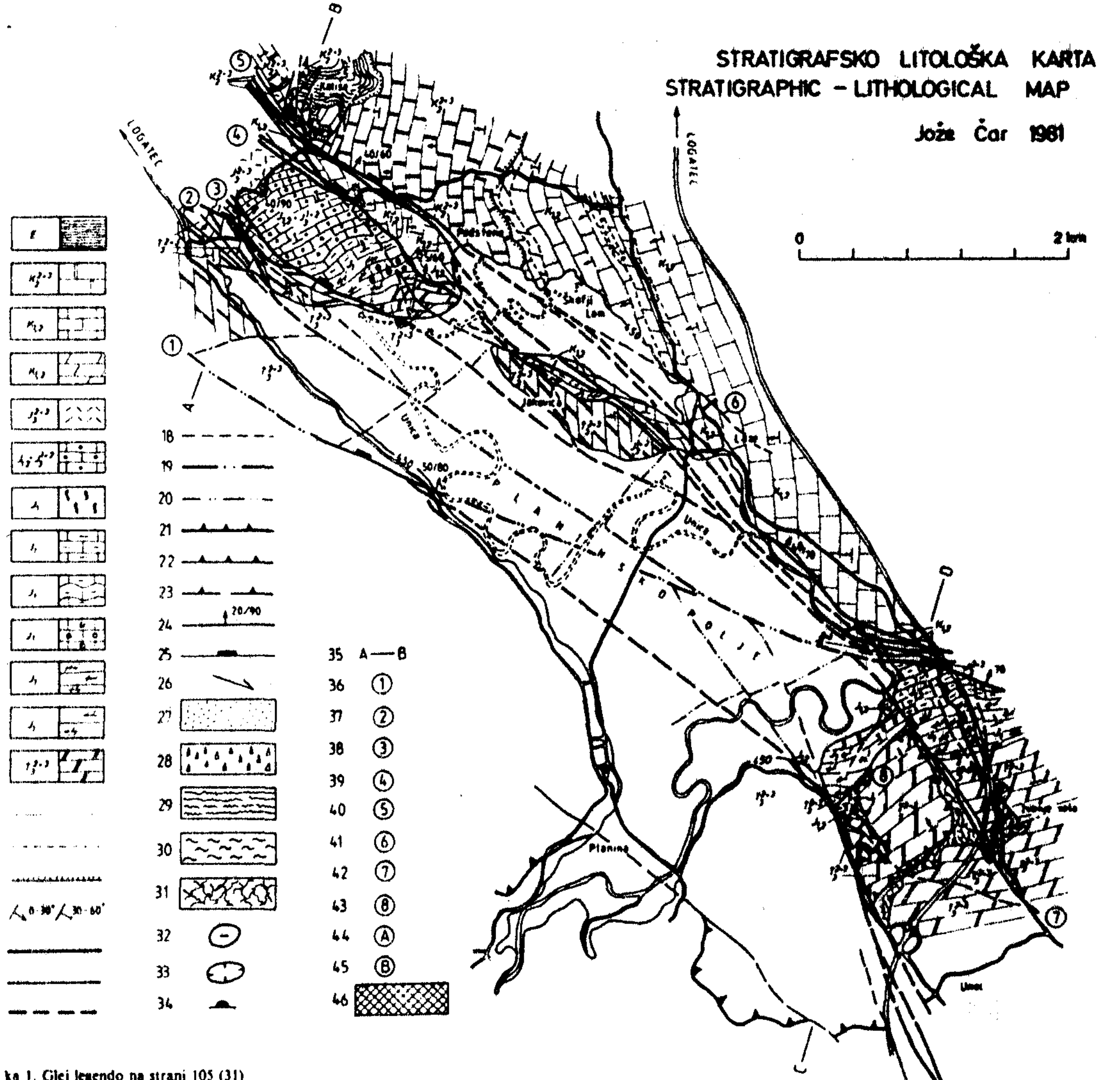


Fig. 8



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t. 1. See Legend on Page 105 (31)

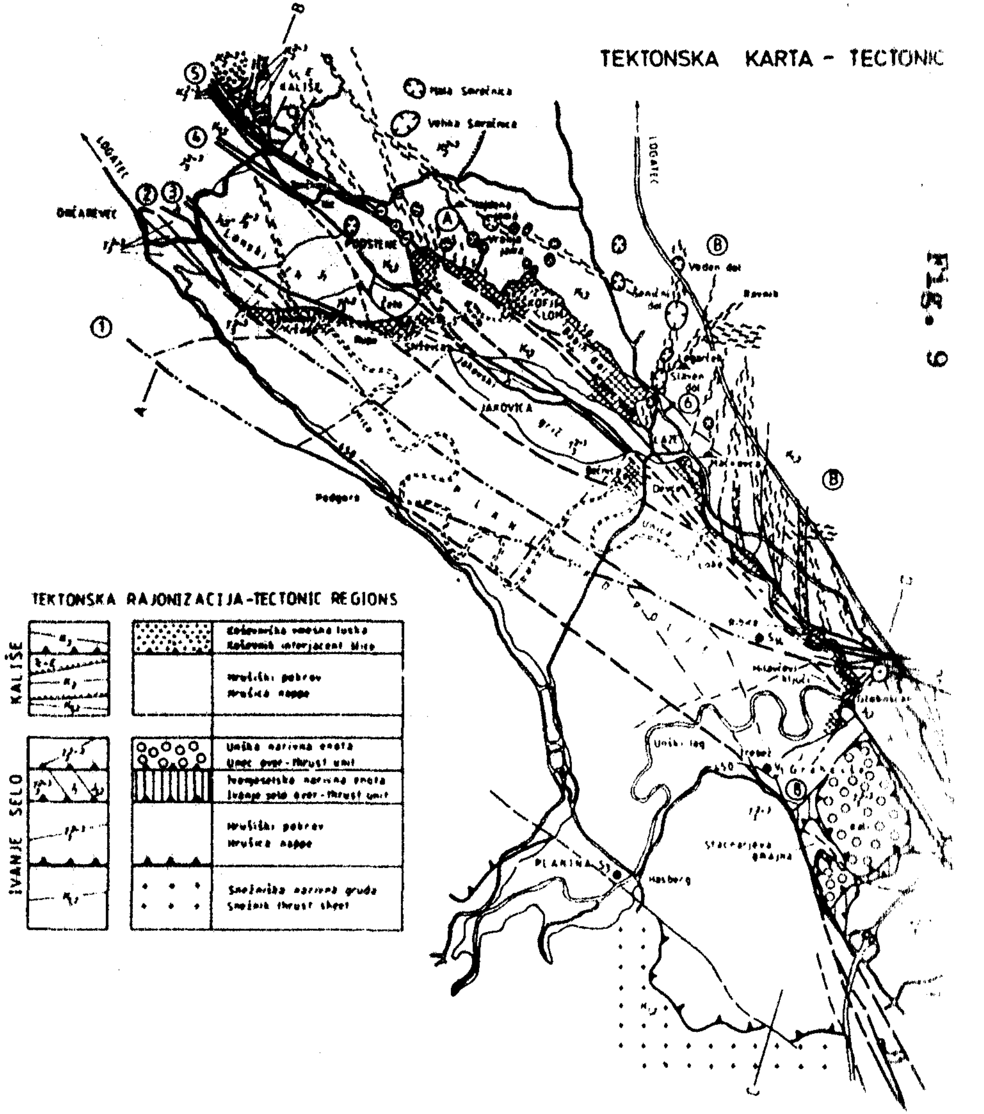


Fig. 9

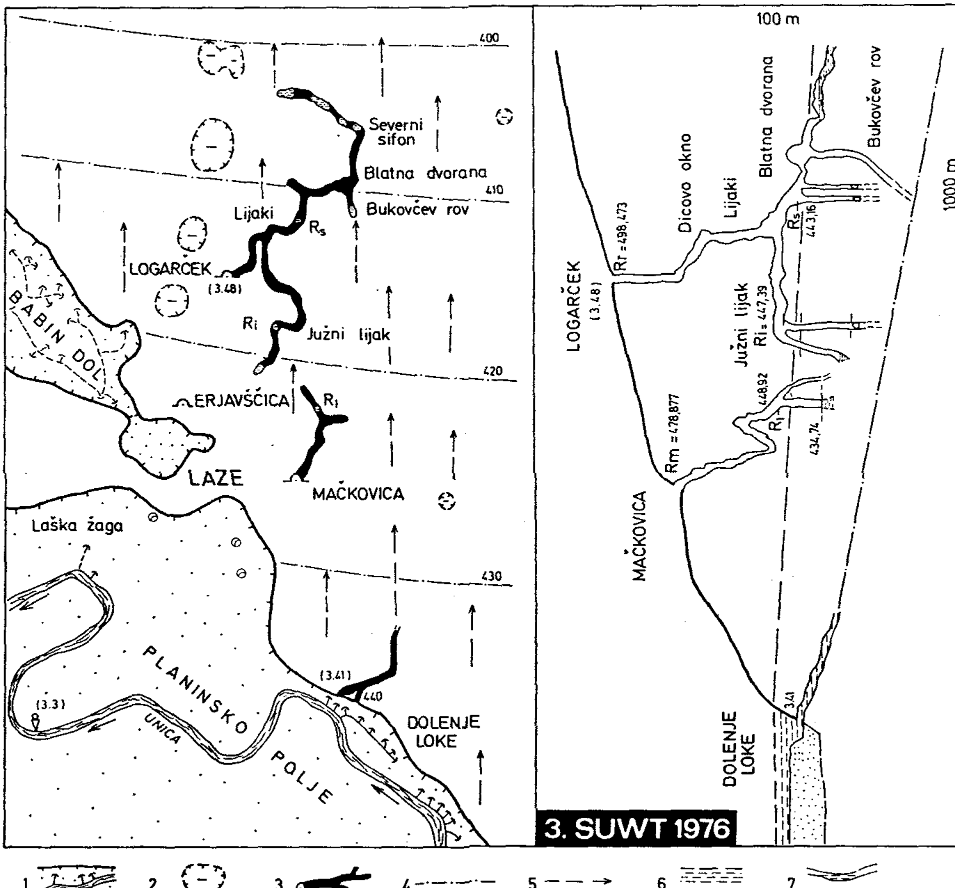
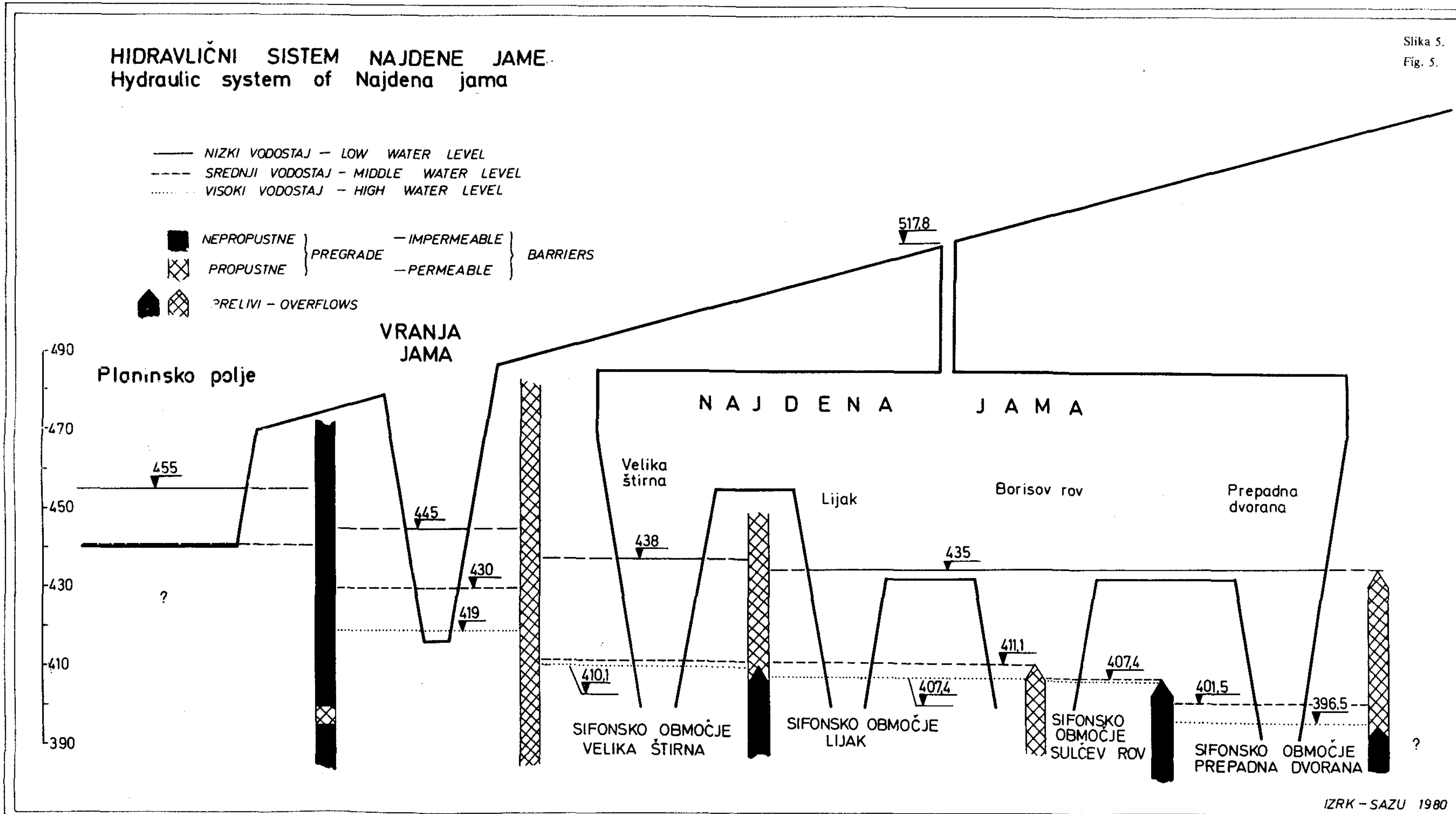


Fig. 19. *The situation and cross section of caves at eastern Planinsko polje border.* 1 — karst polje's border with superficial river bed and swallow-holes, 2 — collapsed dolines, 3 — simplified caves ground plan, 4 — lowest known karst water level — hydrocontour lines, 5 — direction of karst water outflow, 6 — the floods altitude on polje and in caves, 7 — the pools of caught water in the cave, simplified cave's cross section.

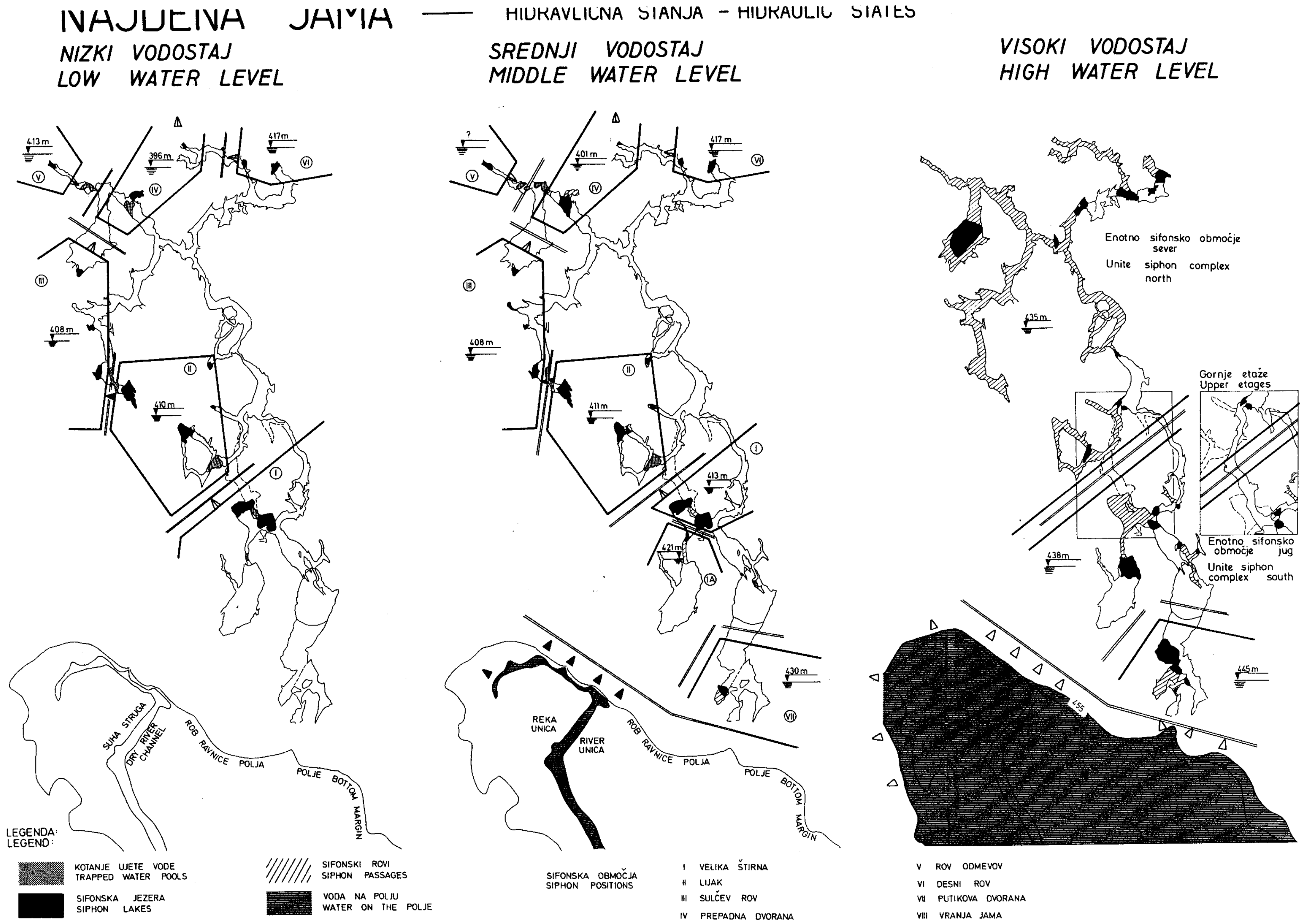
Sl. 19. *Položaj in prerez jam ob vzhodnem robu Planinskega polja.* 1 — rob kraškega polja s površinsko strugo in požiralniki, 2 — udornice, 3 — poenostavljeni tloris jame, 4 — najnižja znana gladina kraške vode — hidroizohipsa, 5 — smer odtoka kraške vode, 6 — višina poplave na polju in v jamah, 7 — bazeni ujete vode v jami, poenostavljeni prerez jame.

Fig. 11



Slika 5.
Fig. 5.
HIDRAVLIČNI SISTEM NAJDENE JAME
Hydraulic system of Najdena jama
NIZKI VODOSTAJ – LOW WATER LEVEL
SREDNJI VODOSTAJ – MIDDLE WATER LEVEL
VISOKI VODOSTAJ – HIGH WATER LEVEL
NEPROPUSTNE
PROPUSTNE
PREGRADE
– IMPERMEABLE
– PERMEABLE
BARRIERS
PRELIVI – OVERFLOWS
VRANJA JAMA
Planinsko polje
NAJDENA JAMA
Velika štirna
Lijak
Borisov rov
Prepadna dvorana
490
470
450
430
410
390
517,8
455
445
430
419
438
435
411,1
410,1
407,4
407,4
401,5
396,5
?
SIFONSKO OBMOČJE VELIKA ŠTIRNA
SIFONSKO OBMOČJE LIJAK
SIFONSKO OBMOČJE SULČEV ROV
SIFONSKO OBMOČJE PREPADNA DVORANA
IZRK – SAZU 1980

Fig. 12

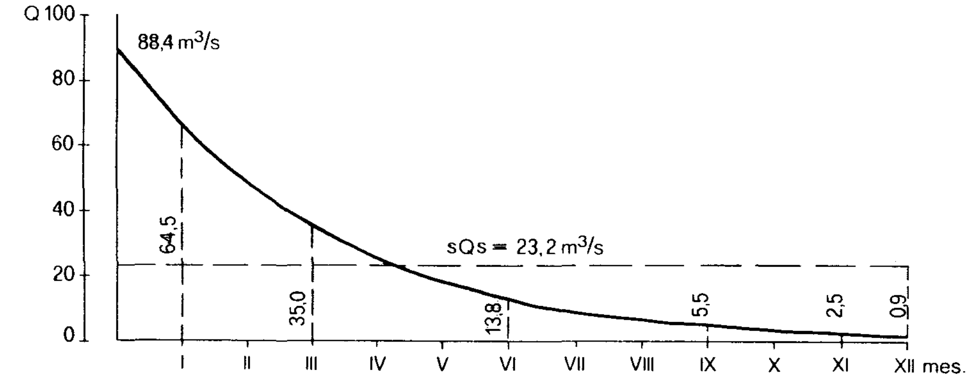


Slika 4. Soodvisnost vodostajev na Planinskem polju in v Najdeni jami.

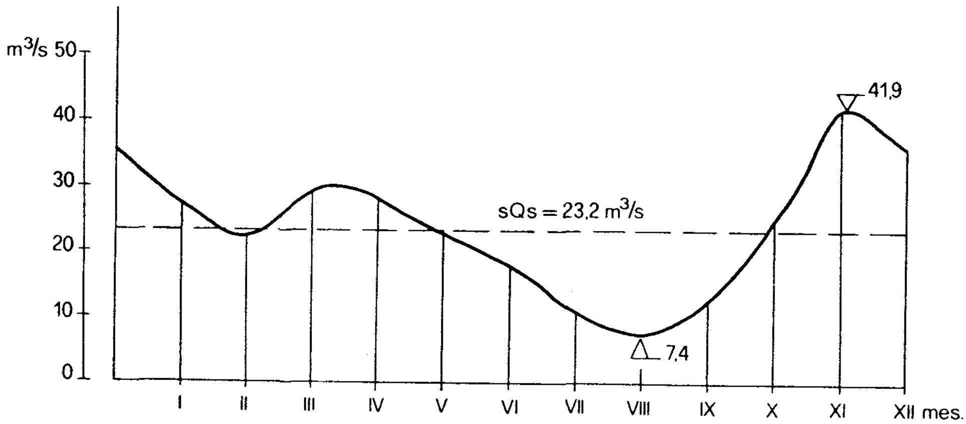
Fig. 4. Covariation of water levels in Planina polje and in Najdena jama.

Diagram 1. Trajanje pretokov in mesečni pretoki Unice – Hasberk v 40-letnem razdobju.
Diagram 1. Duration of Discharge and Monthly Discharge at Hasberk in 40-years Period.

Trajanje pretokov Unice – v. p. Hasberk



Mesečni pretok Unice – v. p. Hasberk



Vir: Poročila SUWT, 1974
Geografski inštitut Antona Melika, SAZU

Tabela 1. *Poprečno letno število dni z vodno gladino v.p. Unica-Hasberk (1949–1977)*
Table 1. *Overage yearly number of days with water level at the gauge station at the Unica-Hasberk (1949–1977)*

Mesec	Višina vodne gladine – Altitude of water level						
	<447,0	447,0–448,0 m	448,0–449,0 m	449,0–450,0 m	450,0–451,0 m	451,0–452,0 m	Skupno >447,0 m
I	26,6	3,2	1,2				4,4
II	25,1	2,8	0,3				3,1
III	27,0	3,7	0,3				4,0
IV	24,7	3,5	0,7	0,5	0,5	0,1	5,3
V	28,8	1,7	0,1	0,2	0,2		2,2
VI	29,2	0,8					0,8
VII	30,8	0,2					0,2
VIII	30,6	0,4					0,4
IX	27,6	2,0	0,4				2,4
X	26,8	3,6	0,4	0,2			4,2
XI	23,6	5,1	1,2	0,1			6,4
XII	23,1	6,1	1,7	0,1			7,9
Letno	323,8	33,1	6,3	1,1	0,7	0,1	41,3

Fig. 14

Tabela 2. *Padavine in potencialna evapotranspiracija v Planini (1931–1960)*
Table 2. *Precipitation and potential evapotranspiration at Planina (1931–1960)*

Mesec Month	Padavine, mm Precipitation mm	Potencialna evapotranspiracija Potential evapotranspiration mm	Razlika Difference
I	134	0	134,0
II	126	0,8	125,2
III	119	17,3	101,7
IV	126	40,7	85,3
V	150	78,7	72,3
VI	163	104,8	58,2
VII	150	114,8	35,2
VIII	137	103,7	33,3
IX	168	72,8	95,2
X	194	42,3	151,7
XI	184	21,2	162,8
XII	170	3,0	167,0
I–XII	1821	600,2	1223,9
IV–IX	894	515,5	379,5

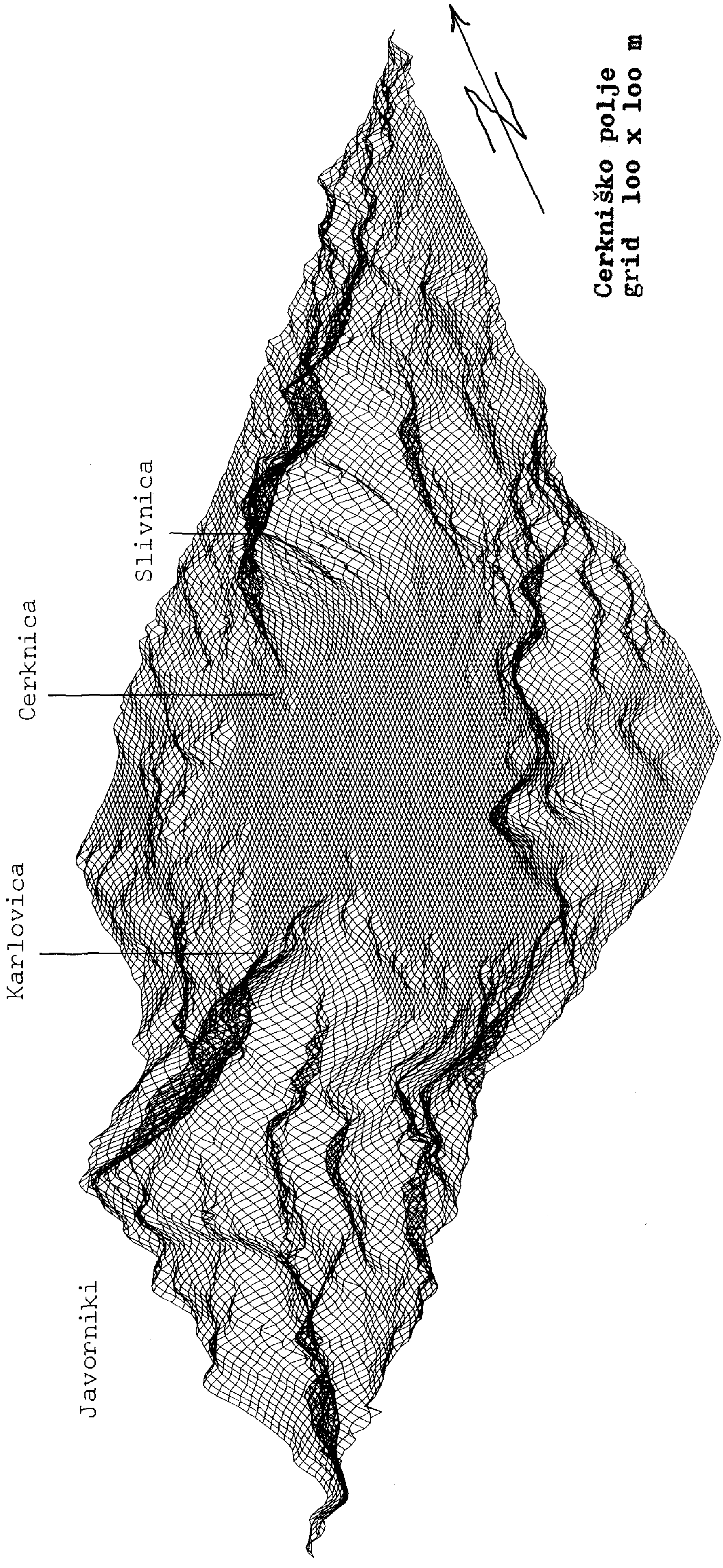
Tabela 3. *Mesečni koeficienti odtoka padavinske vode, pretoka Unice in njenega vodostaja nad 446 m*
Table 3. *Monthly coefficients of drainage, flow of the Unica and its water level above 447 m (the highest value = 12)*

Mesec Month	Koeficient odtoka padavinske vode (1930–1960) Coefficient of the drainage (1930–1960)	Koeficient mesečnega pretoka Unice (40 let) Coefficient of the flow of the Unica (40 years)	Vodostaj Unice nad 447 m Water level of the Unica 447 m (1949–1977)
II	8	5	6
III	7	9–10	7
IV	5	9–10	10
V	4	6	4
VI	3	4	3
VII	2	2	1
VIII	1	1	2
IX	6	3	5
X	10	7	8
XI	11	12	11
XII	12	11	12

Tabela 4. *Vodostaj Unice pod mostom pri Hasberku*
Table 4. *Water level of the Unica below the bridge at Hasberk*

Vodostaj – Water level	Razdobje – Period	Letno število dni Yearly number of days
<447 m	1970–1977	307,4
	1949–1977	323,9
447–448 m	1970–1977	39,7
	1949–1977	33,0
448–449 m	1970–1977	12,0
	1949–1977	6,6
449–450 m	1970–1977	2,7
	1949–1977	1,2
450–451 m	1970–1977	2,5
	1949–1977	0,7
451–452 m	1970–1977	0,2
	1949–1977	0,1

Fig. 15



Cerkniško polje
grid 1oo x 1oo m

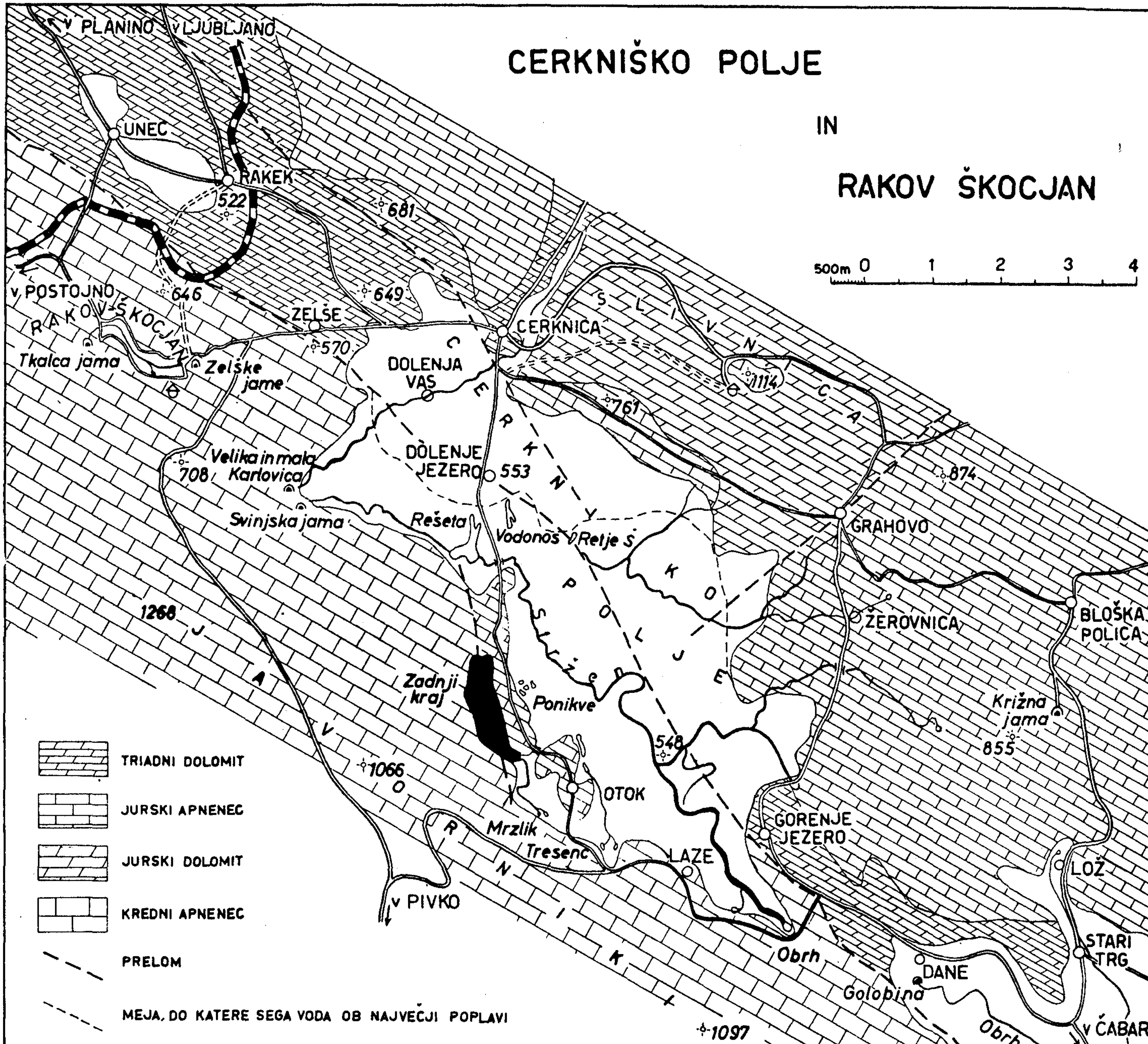
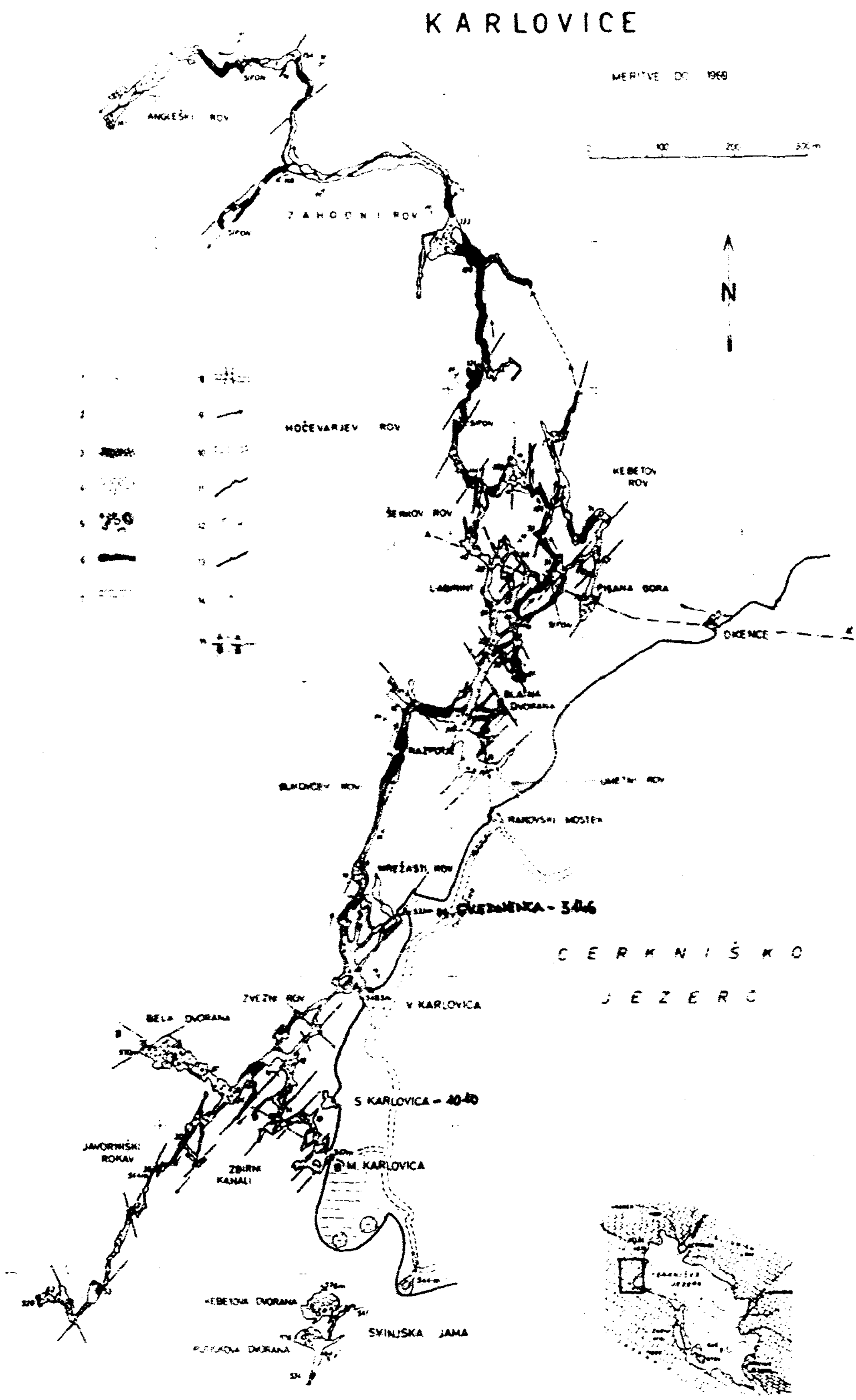

CERKNIŠKO POLJE
IN
RAKOV ŠKOCJAN
500m 0 1 2 3 4
v PLANINO
v LJUBLJANO
UNEC
RAKEK
522
681
646
649
v POSTOJNO
RAKOV ŠKOCJAN
Tkalca jama
Zelške jame
ZELŠE
570
CERKNIŠKO JEZERO
CERKNICA
DOLENJA VAS
SLIVNICA
1114
761
DOLENJE JEZERO
553
Velika in mala Karlovica
708
Svinjska jama
Rešeta
Vodonos
Retje
874
GRAHOVO
KOZJE
POLJE
ŽEROVNICA
BLOŠKA POLICA
1268
JAVORNIK
Zadnji kraj
Ponikve
Stržen
Križna jama
855
548
1066
OTOK
GORENJE JEZERO
Mrzlik
Tresenc
LAZE
LOŽ
v PIVKO
STARI TRG
Obrh
DANE
Golobina
1097
v ČABAR
TRIADNI DOLOMIT
JURSKI APNENEC
JURSKI DOLOMIT
KREDNI APNENEC
PRELOM
MEJA, DO KATERE SEGA VODA OB NAJVEČJI POPLAVI

Fig. 17



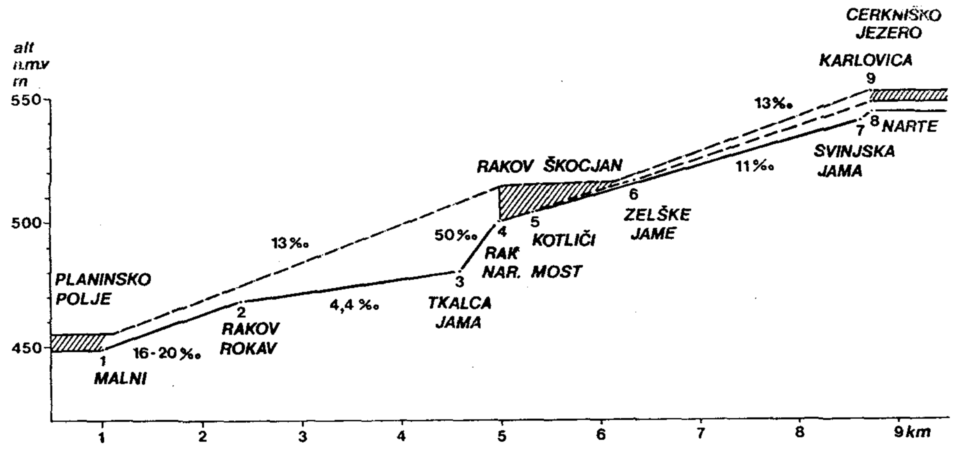
Tlorisi jam ob ponorni strani Cerkniškega polja

1 — skalno dno v rovih, 2 — ilovica in grušč, 3 — podorne skale, 4 — tla iz sige, 5 — kapniki, 6 — jezera ob nizki vodi, 7 — vodna struga in brzice, 8 — sifon, 9 — smer vodnega toka, 10 — vodna struga na površju, 11 — skalni rob polja, 12 — smer in vpad skladov, 13 — prelom, 14 — poligonske točke 15 — A — A' in B — B' so prečni profili na sl. 2

The Ground Sketch of the Caves at the Caves at the Ponor Side of the Cerknica Polje

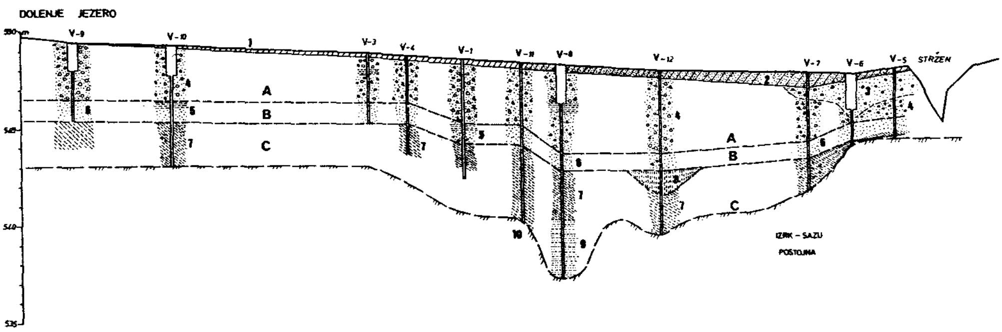
1 — the rocky floor in the channels, 2 — loam and scree, 3 — breakdown rocks, 4 — the floor covered with sinter, 5 — formations, 6 — lakes at low water, 7 — the water bed and rapids, 8 — siphon, 9 — the direction of water current, 10 — the river bed on the surface of the polje, 11 — the rocky edge of the polje, 12 strike and dip of beds 13 — fault, 14 — polygonic points, 15 — A — A' and B — B' are cross sections in fig. 2

Fig. 18



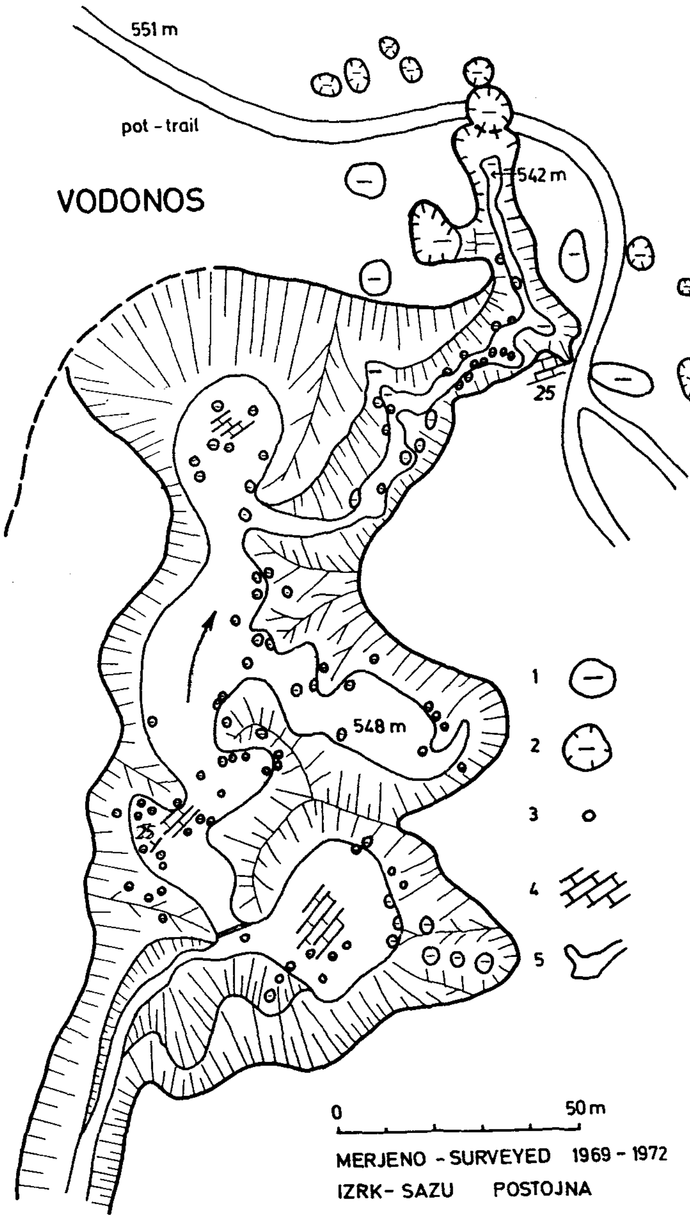
Sl. 7. Strmci kraške vode med Cerkniškim jezerom in Planinskim poljem
Fig. 7. Karst water gradients between Cerknica lake and Planina polje

Fig. 19



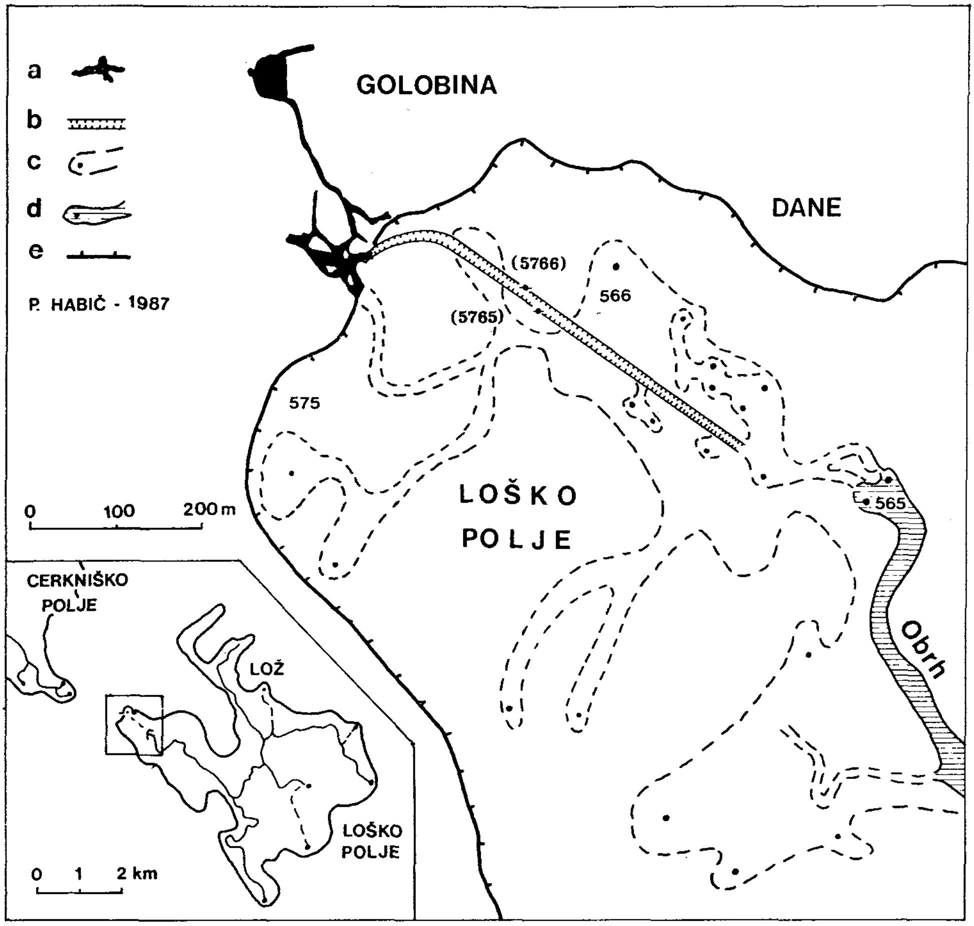
Sl. 10. Naplavine med Dolenjim jezerom in strugo Stržena ugotovljene z ročnimi vrtinami V 1 — V 12; podrobnejši opis plasti glej v tekstu
1 — humus, 2 — rjavkasta ilovica s hišicami polžev, 3 — siva ilovica s hišicami polžev, 4 — dolomitni grušč, pesek in siva ilovica, 5 in 6 — rumenkasta ilovica in droben kremenov pesek, 7 in 8 — rjava peščena ilovica, pesek, prod in preperel grušč, 9 — pasovita sivorjava ilovica s peskom, A — mlajši zasip, B — jezerski sedimenti, C — starejši zasip

Fig. 10. Sediments between Dolenje jezero village and Stržen creek bed, based on bore-holes V 1 — V 12; detailed description of the layers in the text
1 — humus, 2 — brownish loam with snail shells, 3 — grey loam with snail shells, 4 — dolomite rubbles, sand and grey loam, 5 and 6 — yellowish loam and silt, 7 and 8 — brown sandy loam, sand and gravel, weathered rubbles, 9 — greybrown varved loam with sand, A — younger fluvial fill, B — lake sediments, C — older fluvial fill



Sl. 28. Morfologija Vodonosa
1 — stari ugrezi v okolici ponikve, 2 — sveži ugrezi v okolici ponikve, 3 — grezi v ponikvi, 4 — razkrita skalna podlaga, 5 — obod ponikve

Fig. 28. Morphology of Vodonos ponor
1 — old sinkholes in the ponor vicinity, 2 — recent sinkholes in the ponor vicinity, 3 — sinkholes in the ponor, 4 — exposed rocky bottom, 5 — ponor boundary

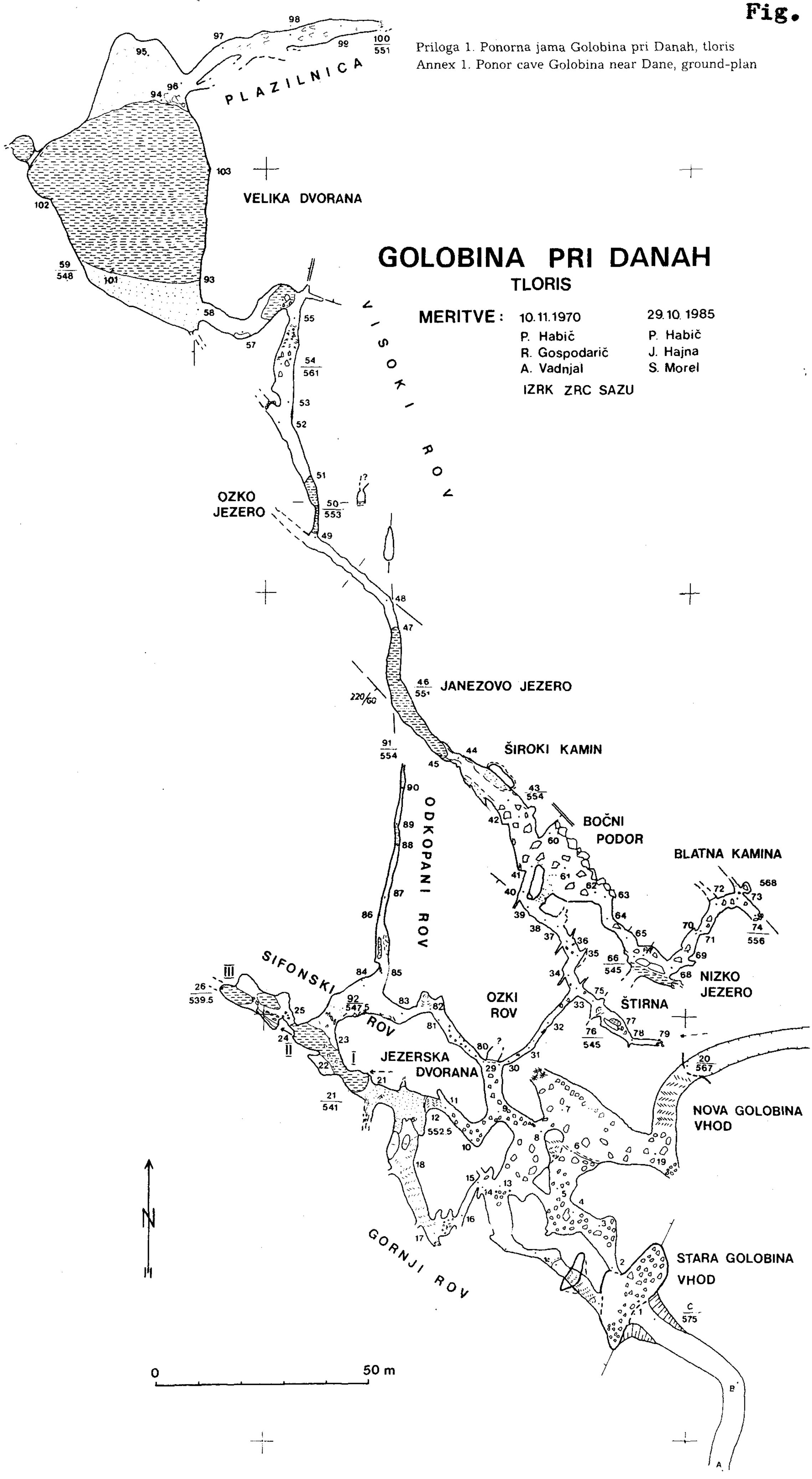


Sl. 1. Položaj Golobine in požiralnikov na Loškem polju
a — jama, b — umetni kanal, c — občasni požiralniki, d — stalni požiralniki, e — skalni obod polja

Fig. 1. Golobina and swallow holes situation on Loško polje
a — cave, b — artificial channel, c — periodical swallow holes, d — permanent swallow holes, e — rocky polje's border

Fig. 22

Priloga 1. Ponorna jama Golobina pri Danah, tloris
Annex 1. Ponor cave Golobina near Dane, ground-plan



3. SUWT 1976

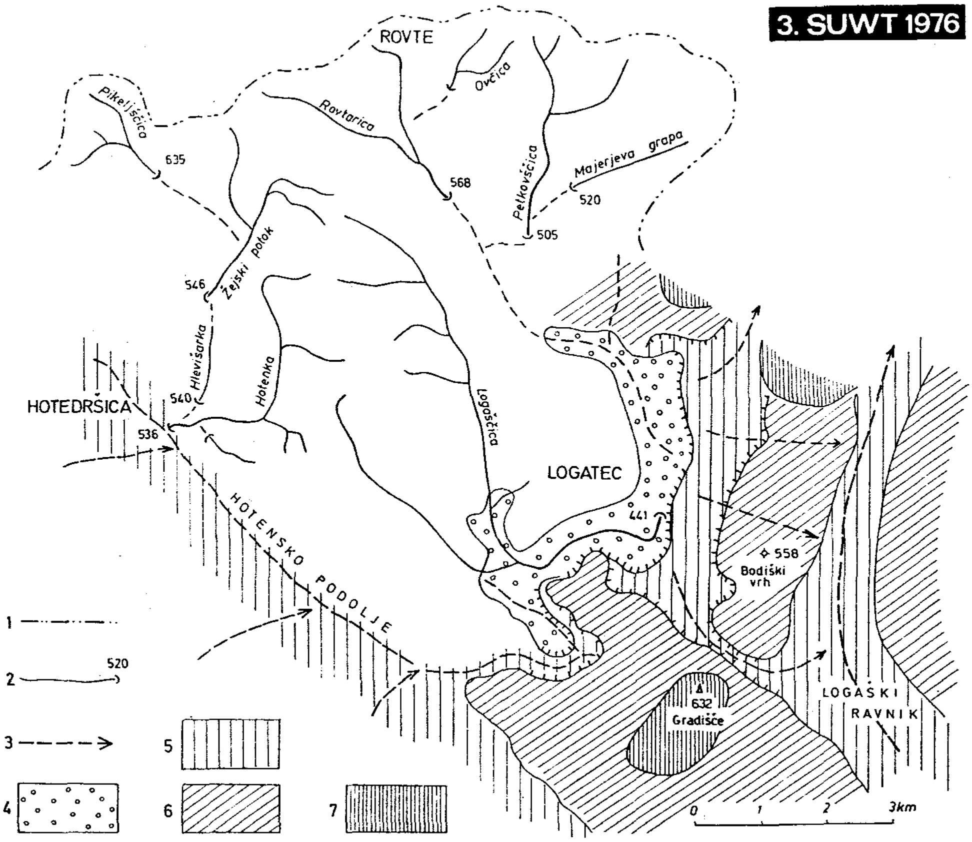
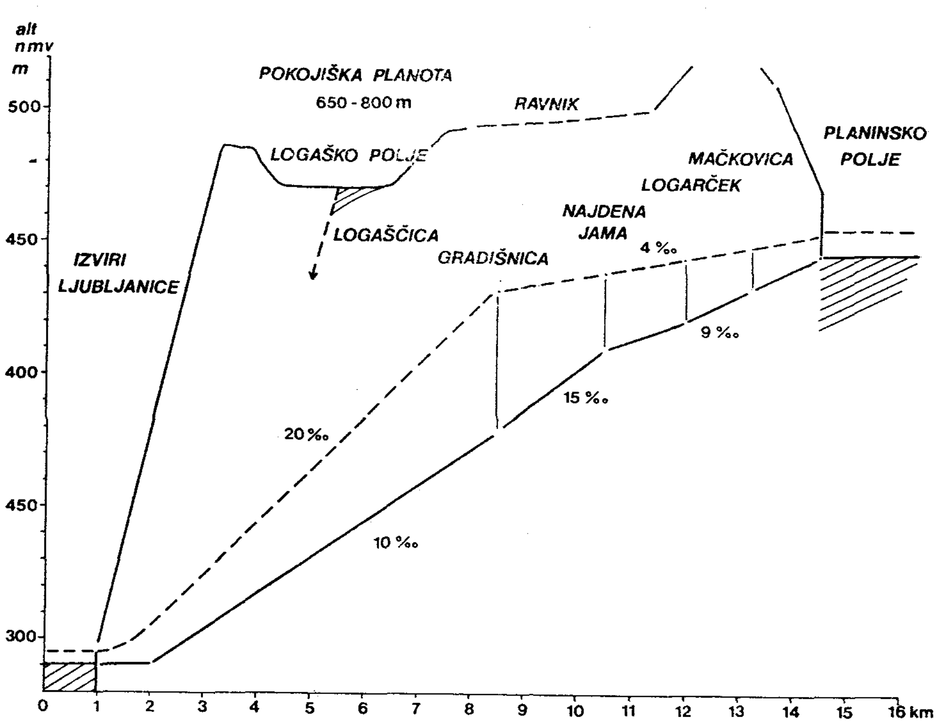


Fig. 3. *Sinking streams and dry valleys on Logatec—Rovte plateau.* 1 — superficial watershed, 2 — sinking stream with the ponor's sea level, 3 — dry valley, 4 — Quaternary sediments on marginal karst polje, 5 — Dolina or Ravnik relief level, 6 — Bodiški vrh level, 7 — Gradišče level.

Sl. 3. *Ponikalnice in suhe doline na Logaško-rovtarski planoti.* 1 — površinsko razvodje, 2 — ponikalnica z nadmorsko višino ponora, 3 — suha dolina, 4 — kvartarne naplavine na robnem kraškem polju, 5 — Dolinska ali Ravniška reliefna stopnja, 6 — Bodiška stopnja, 7 — Gradiška stopnja.



Sl. 4. Strmci nizkih in visokih voda med Planinskim poljem in izviri Ljubljanice

Fig. 4. Gradients of low and high waters between Planina polje and Ljubljanica springs

3. SUWT 1976

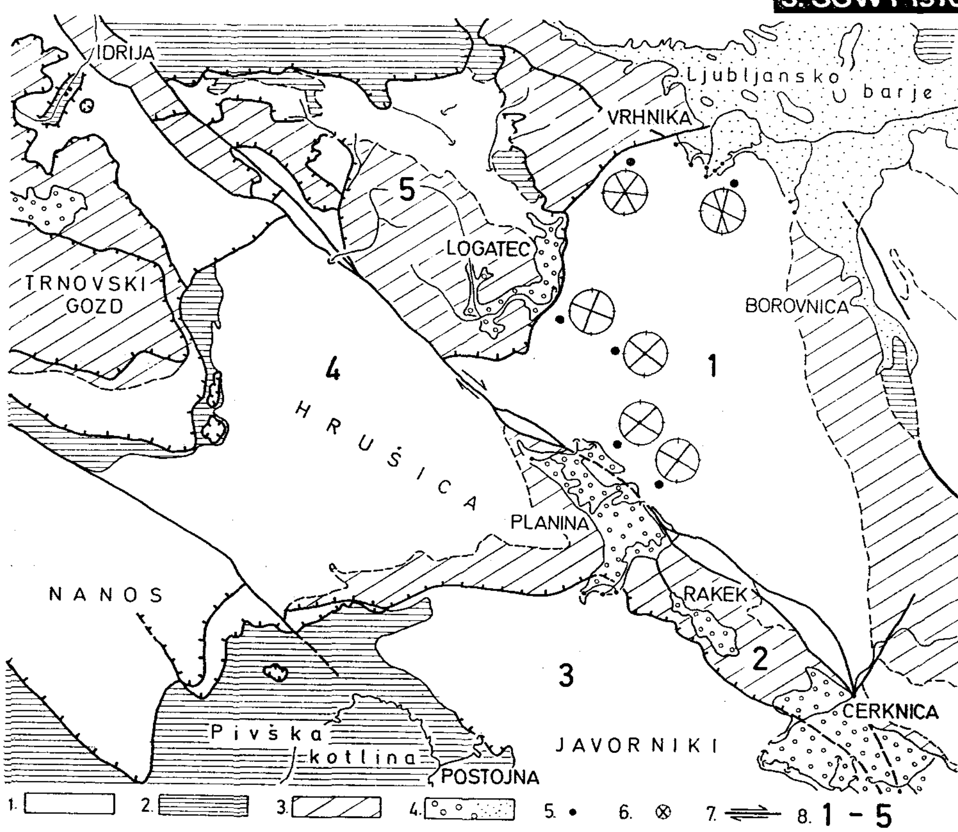
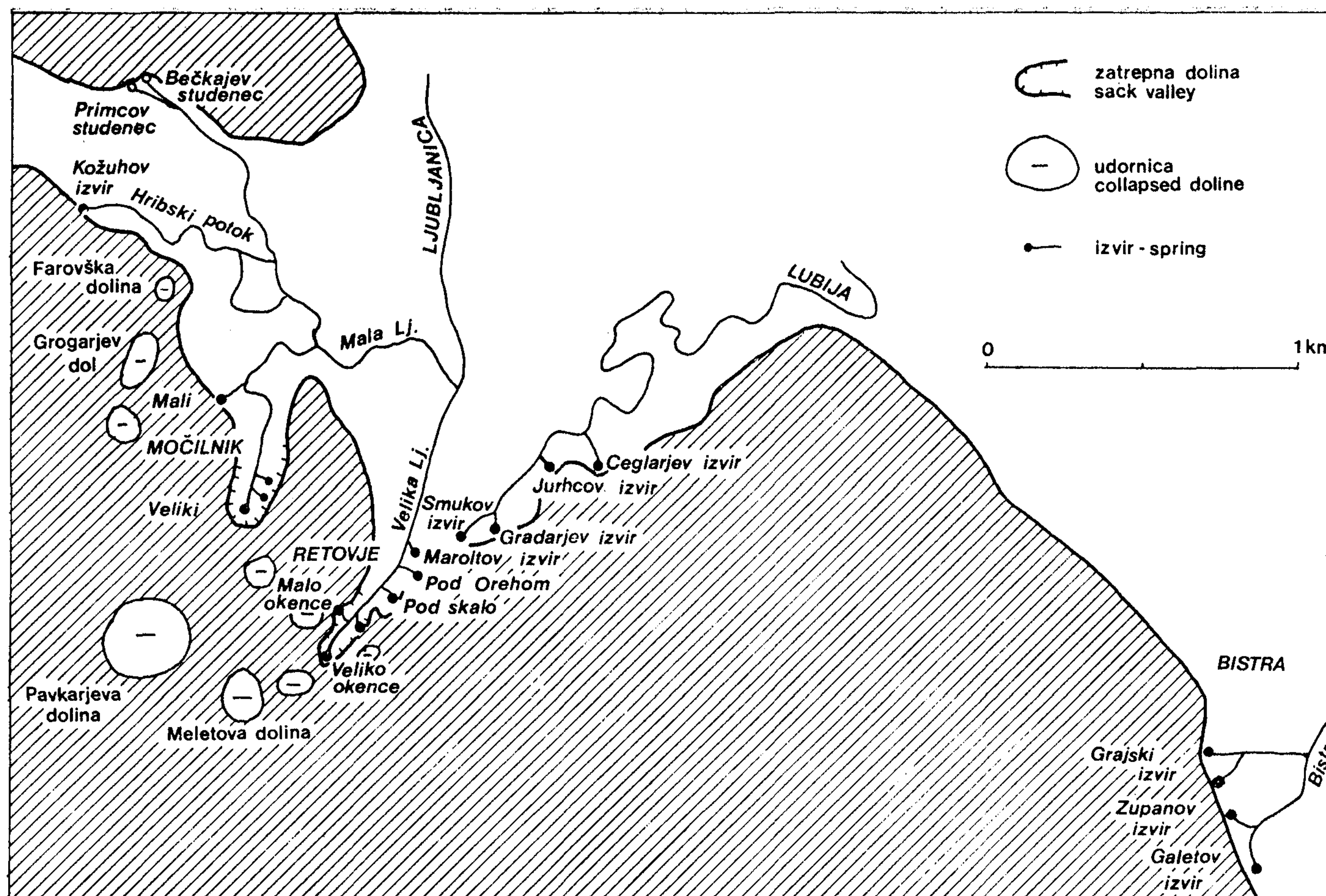


Fig. 6. *Hydrogeologic units in the central part of Ljubljanica karst river basin.* 1 — limestone, 2 — impermeable rocks (schists, e. c.), 3 — dolomite, 4 — sediments on the karst poljes and moor, 5 — location of rupture survey, 6 — rupture diagrams, simplified, 7 — Idrija wrench fault (⇆) and other faults, 8 — hydrogeologic units: **(1)** — Vrhnika-Cerknica block, **(2)** — Rakek-Cerknica imbricate structure, **(3)** — Javorniki-Snežnik block, **(4)** — Hrušica-block, **(5)** — Idrija-Žiri nappes area (all after S. BUSER 1965).

Sl. 6. *Hidrogeološke enote v osrednjem delu kraškega porečja Ljubljanice.* 1 — apnenec, 2 — nepropustne kamnine (skrilavci in drugo), 3 — dolomit, 4 — naplavine na kraških poljih in barju, 5 — lokacija merjenih ruptur, 6 — diagrami ruptur, poenostavljeni, 7 — Idrijski zmik (⇆) in drugi prelomi, 8 — hidrogeološke enote: **(1)** — Vrhniško-cerkniška gruda, **(2)** — Rakeško-cerkniška gruda, **(3)** — Javorniško-snežniška gruda, **(4)** — Hrušica, **(5)** — Idrijsko-žirovsko ozemlje pokrovov (vse po S. BUSERJU 1965).

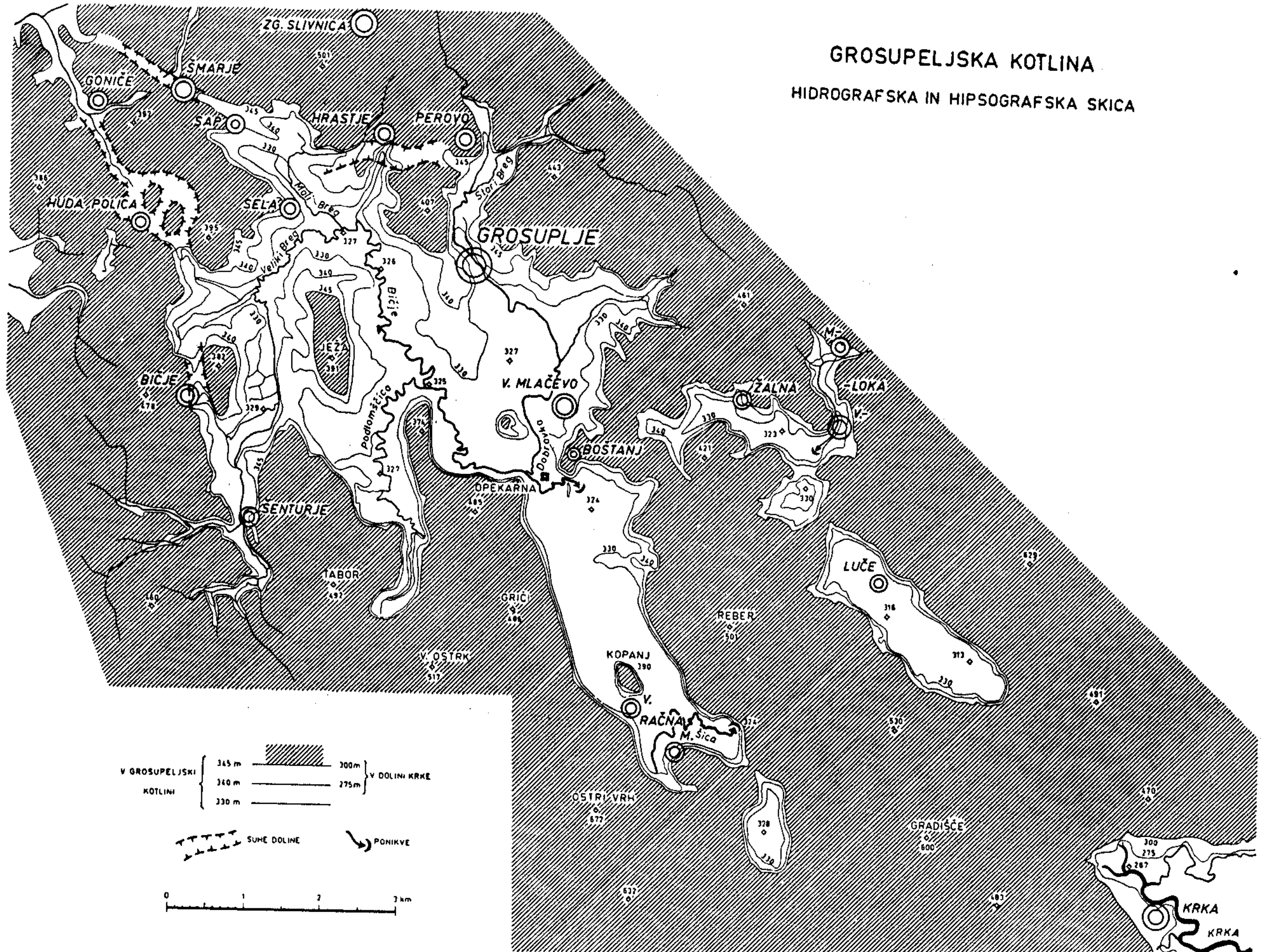
Fig. 26



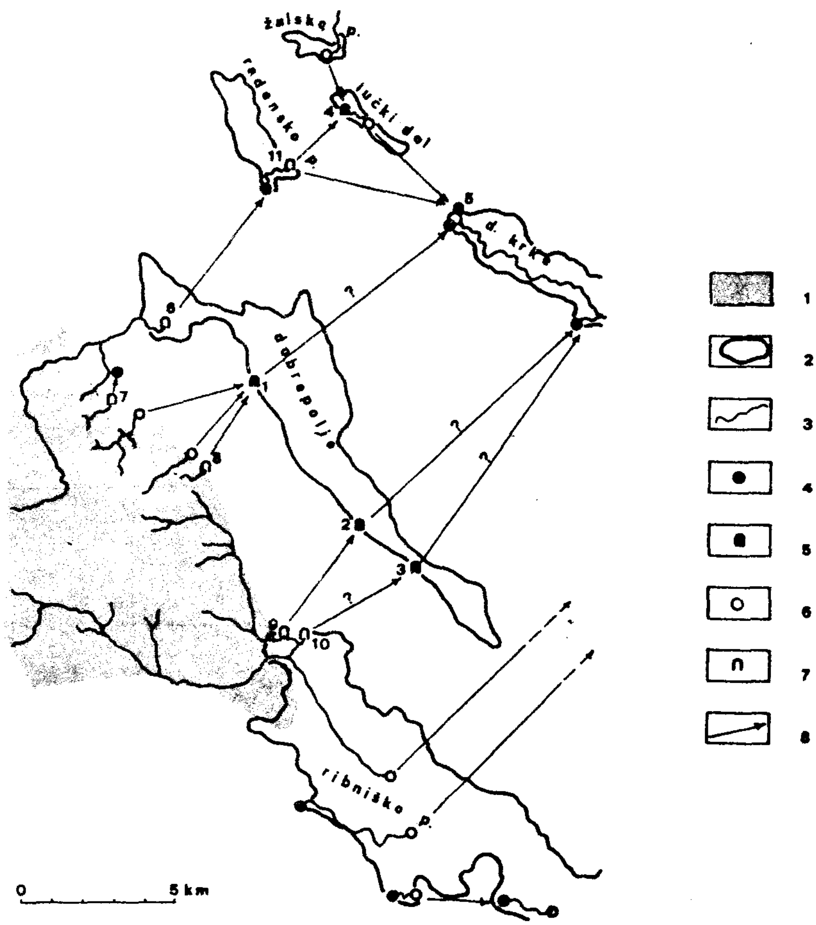
Sl. 1. Razpored izvirov Ljubljanice, Lubije in Bistre

Fig. 1. Ljubljanica, Lubija and Bistra springs distribution

Fig. 27



Pod. 88. **Grosupeljska kotlina**



Andrej **KRANJC: Skica ka referatu »Istorijske metode istraživanja kraških voda na Dolenjskom (Slovenija)«**

Andrej KRANJC: A drawing enclosed to the report »Historical Methods of Water Investigations in Dolenjsko (Slovenia)«

LEGENDA:

1 = erozijski relief, 2 = kraško polje, 3 ' površinski vodotok, 4 = kraško vrelo, 5 = izvorna pećina, 6 = ponor, 7 = ponorna pećina, 8 = podzemna vodena veza

Izvorne pećine: 1 — Podpeška pećina, 2 — Kompoljska pećina, 3 — Potiskavška pećina, 4 — Lučka pećina, 5 — Krška pećina,
Ponorne pećine: 6 — Ponor Rašice, 7 — Vratnica, 8 — Finkova pećina, 9 — Tentera, 10 — Griška pećina, 11 — Zatočna pećina.

LEGEND:

1 = erosional relief, 2 = karst polje, 3 = surface water course, 4 = karst spring, 5 = spring cave, 6 = swallow hole (ponor), 7 = ponor cave, 8 = underground water connection,
Spring caves: 1 — Podpeška pećina, 2 — Kompoljska pećina, 3 — Potiskavška pećina, 4 — Lučka pećina, 5 — Krška pećina,
Ponor caves: 6 — ponor Rašice, 7 — Vratnica, 8 — Finkova pećina, 9 — Tentera, 10 — Griška pećina, 11 — Zatočna pećina,

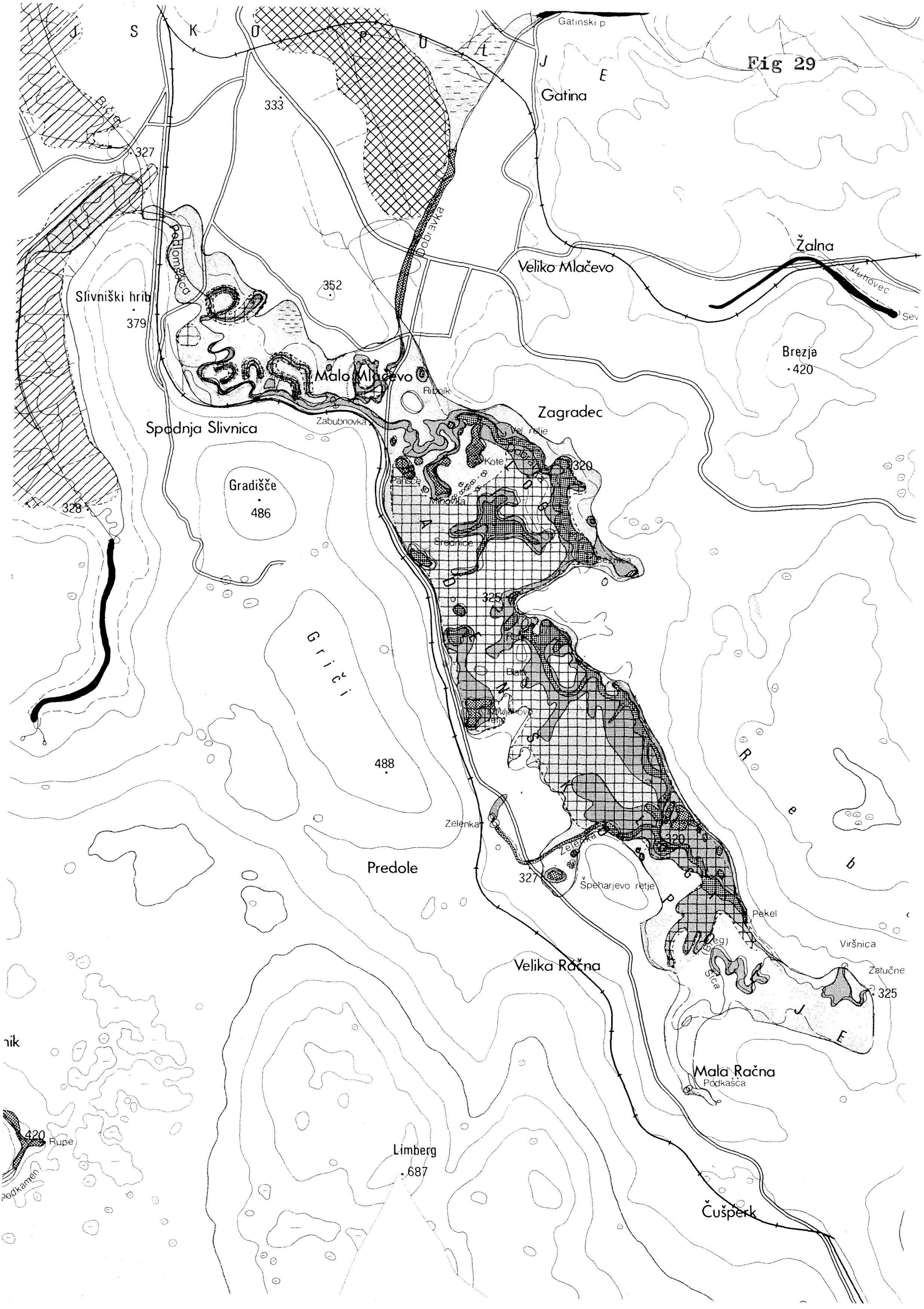
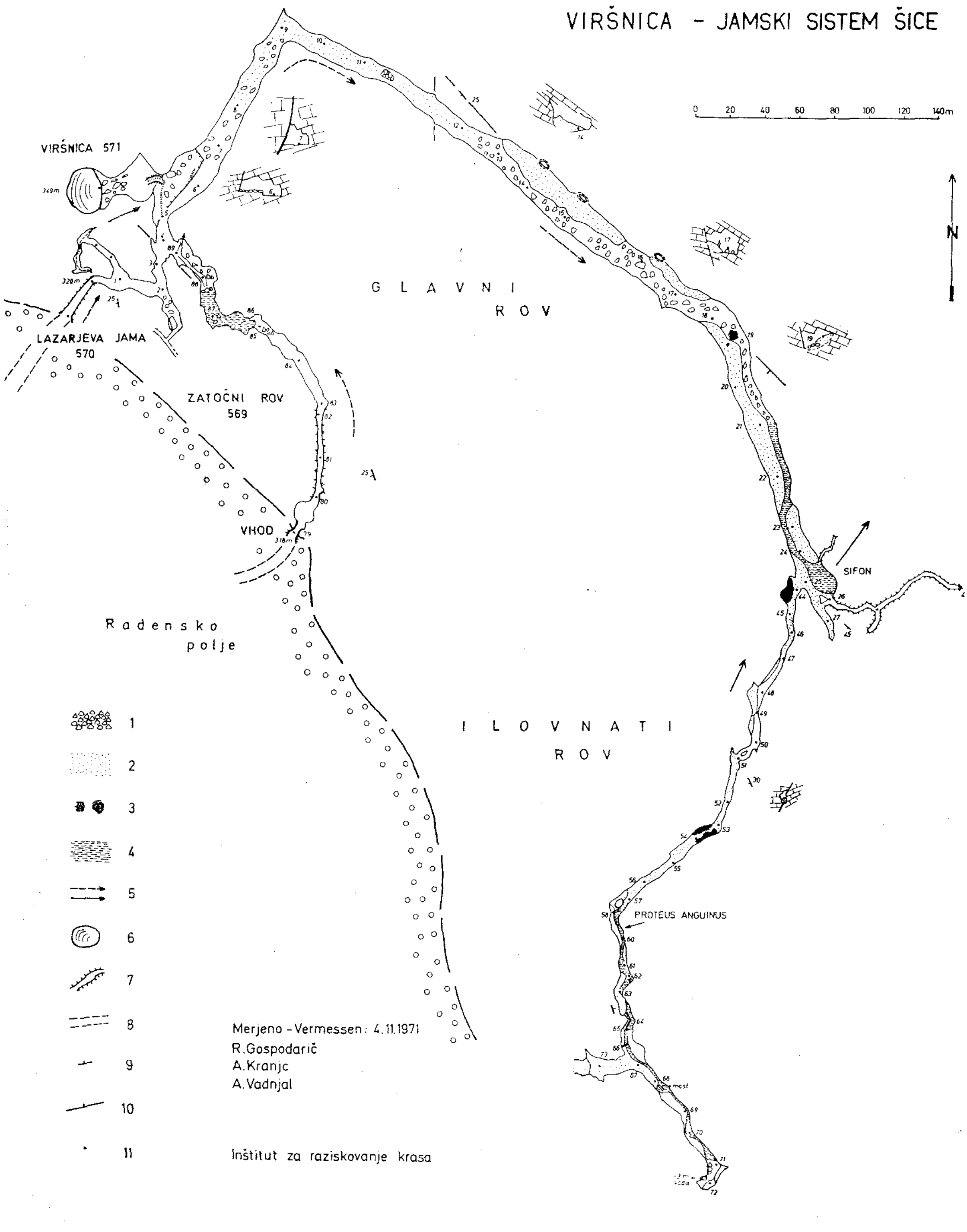

J S K O P O L J E
Gatinski p
Gatina
333
327
Slivniški hrib
379
Podlomščica
352
Dobravka
Veliko Mlačevo
Žalna
Muhovec
Brezje
420
Malo Mlačevo
Ribnik
Zagradec
Zabubnovka
Spodnja Slivnica
Vel. retje
Kote
320
Parisče
Mihovka
Gradišče
486
328
Srednice
Brežnica
325
Gričí
Blatt
488
Zelenka
Zelenka
320
Predole
327
Špeharjevo retje
Pekel
Viršnica
Zatučne
Velika Račna
325
R e b
nik
Mala Račna
Podkašča
420
Rupe
Podkamen
Limberg
687
Čušperk

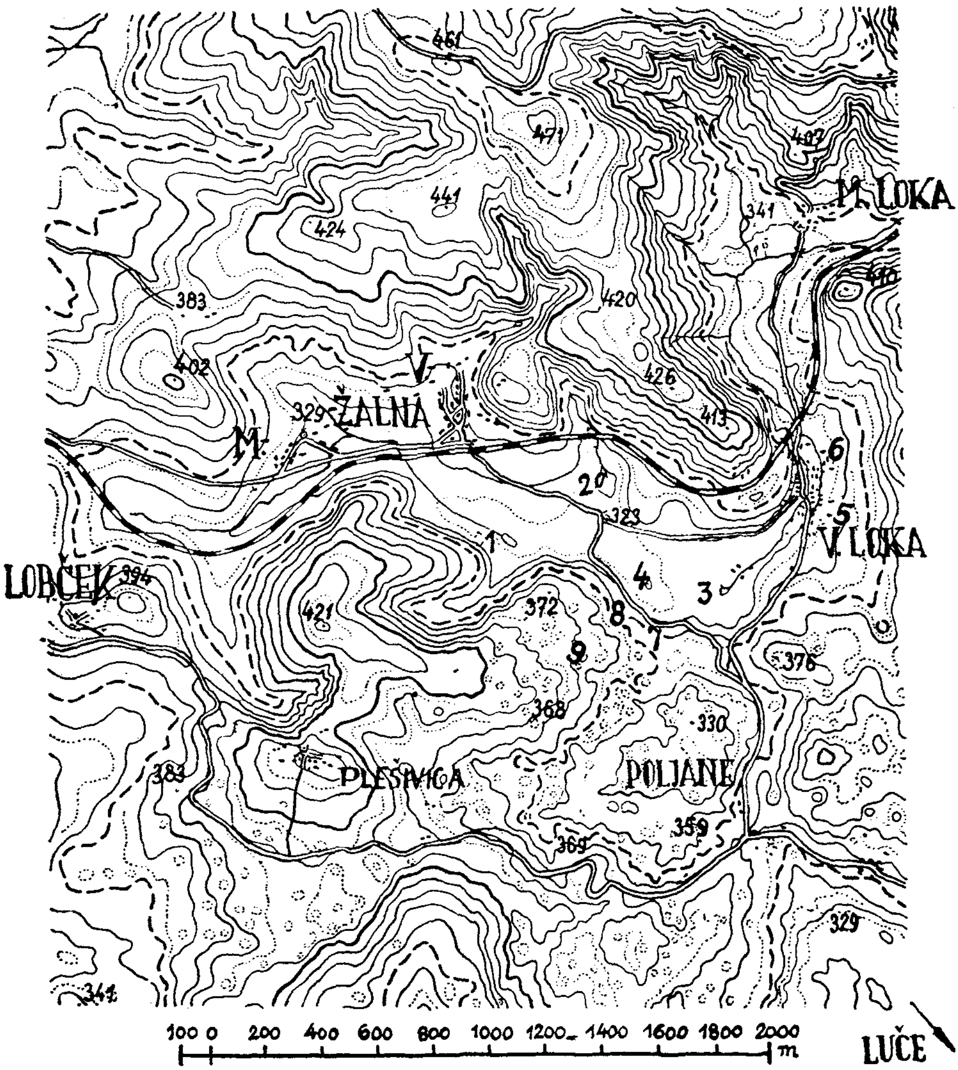
Fig 29



Sl. 1. — Abb. 1. Viršnica — jamski sistem Šice, tloris — Grundriss

1 podorne skale,	1 Versturzblöcke,
2 klastične naplavine,	2 klastische Einschwemmungen,
3 siga,	3 Sinter,
4 voda,	4 Wasser,
5 smer občasnih in stalnih vodotokov,	5 Richtung zeitweiligen und ständigen Wasserläufe,
6 udornica,	6 Versturzdoline,
7 umetne razširitve,	7 künstliche Erweiterungen,
8 površinsko vodno korito,	8 oberflächliche Wassergerinne,
9 smer in vpad plasti,	9 Richtung und Einfallen der Schichten,
10 prelom,	10 Verwerfung,
11 merilna točka	11 Vermessungspunkt.

Fig. 31

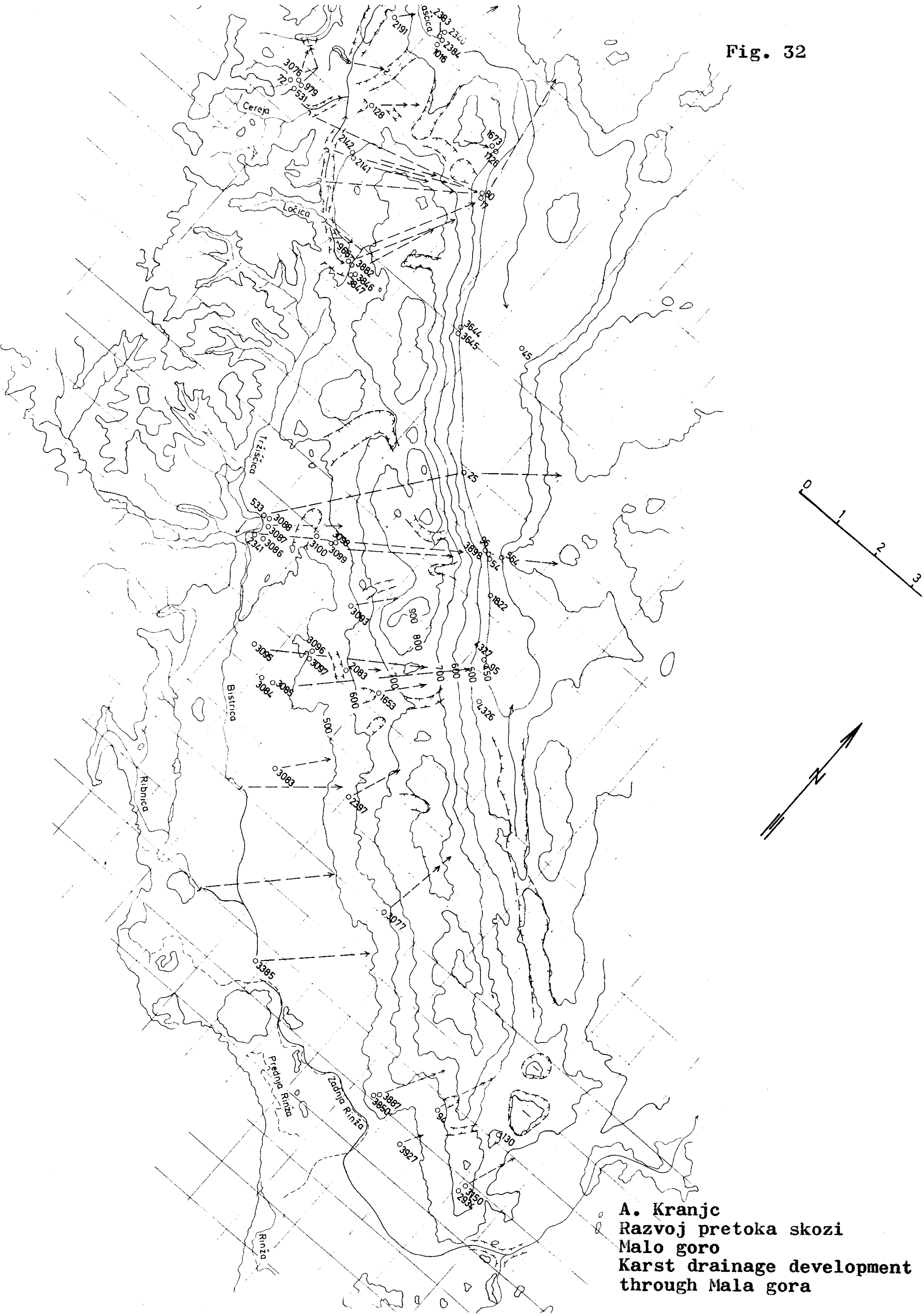


1 - 4 = požiralniki

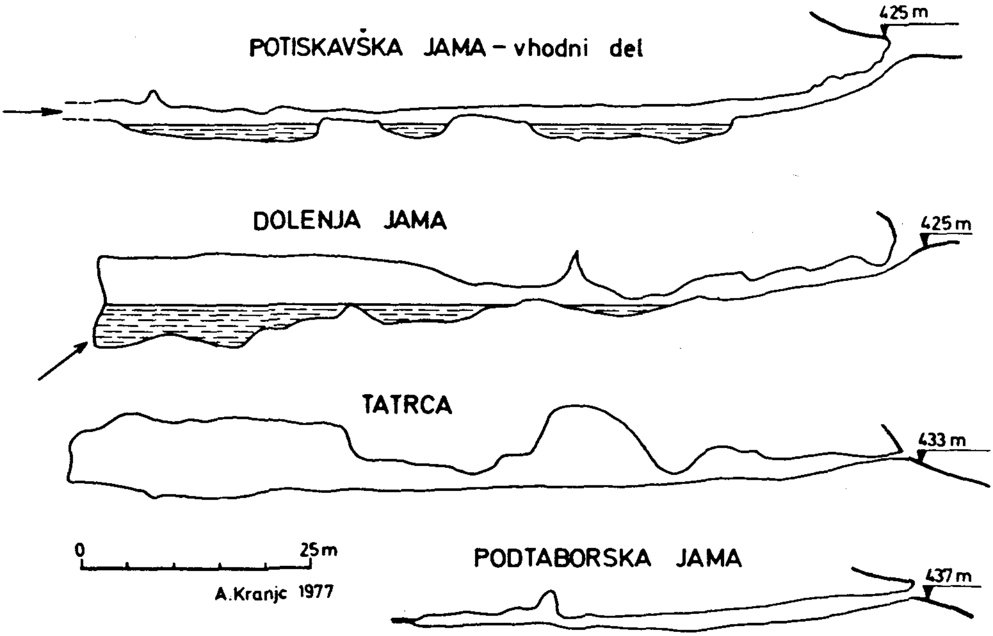
5 - 6 = bruhalnika

7 - 9 = jame

Fig. 32

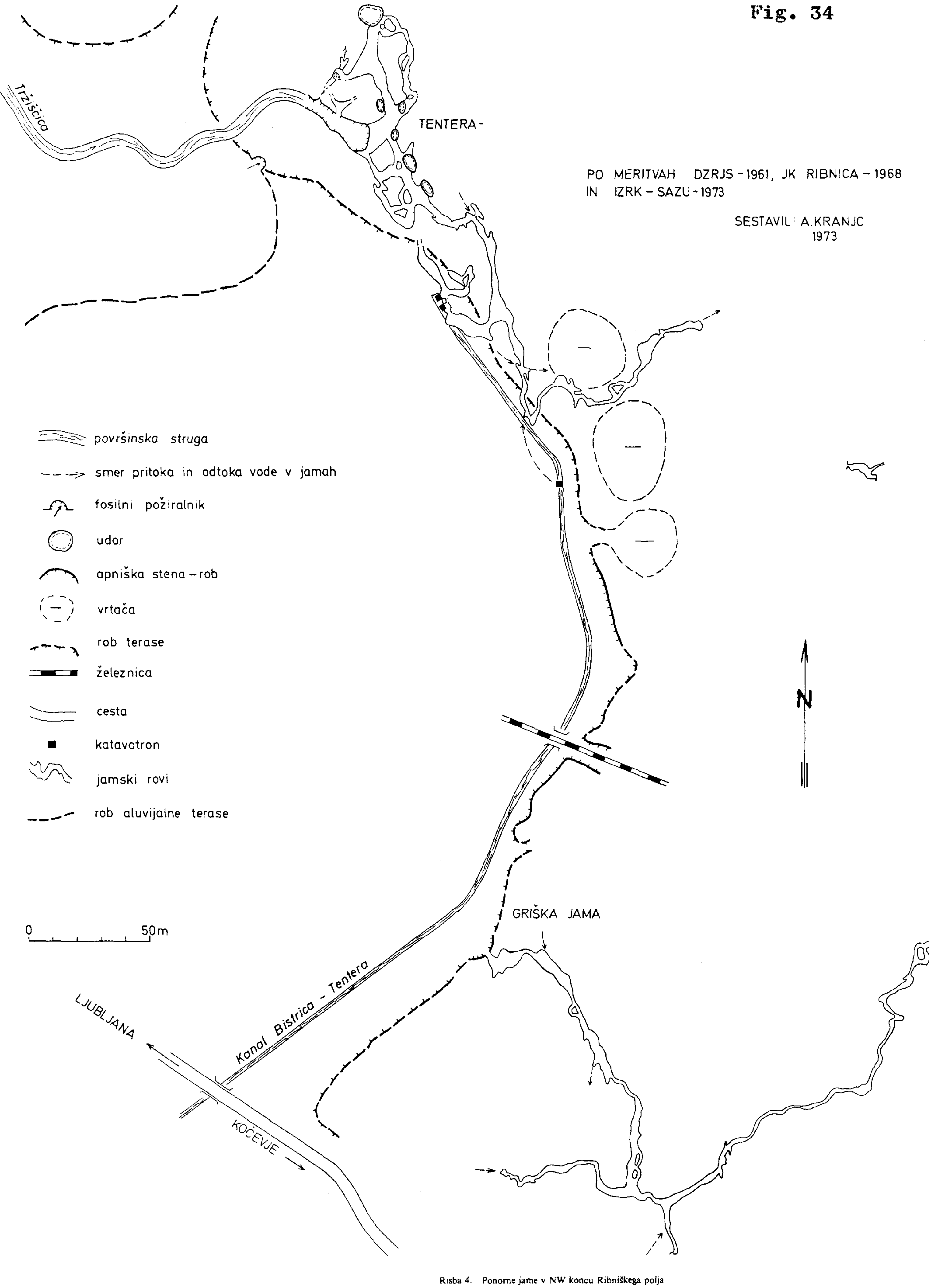


A. Kranjc
Razvoj pretoka skozi
Malo goro
Karst drainage development
through Mala gora



Risba 11. Primeri prerezov aktivnih in fosilnih izvirnih jam

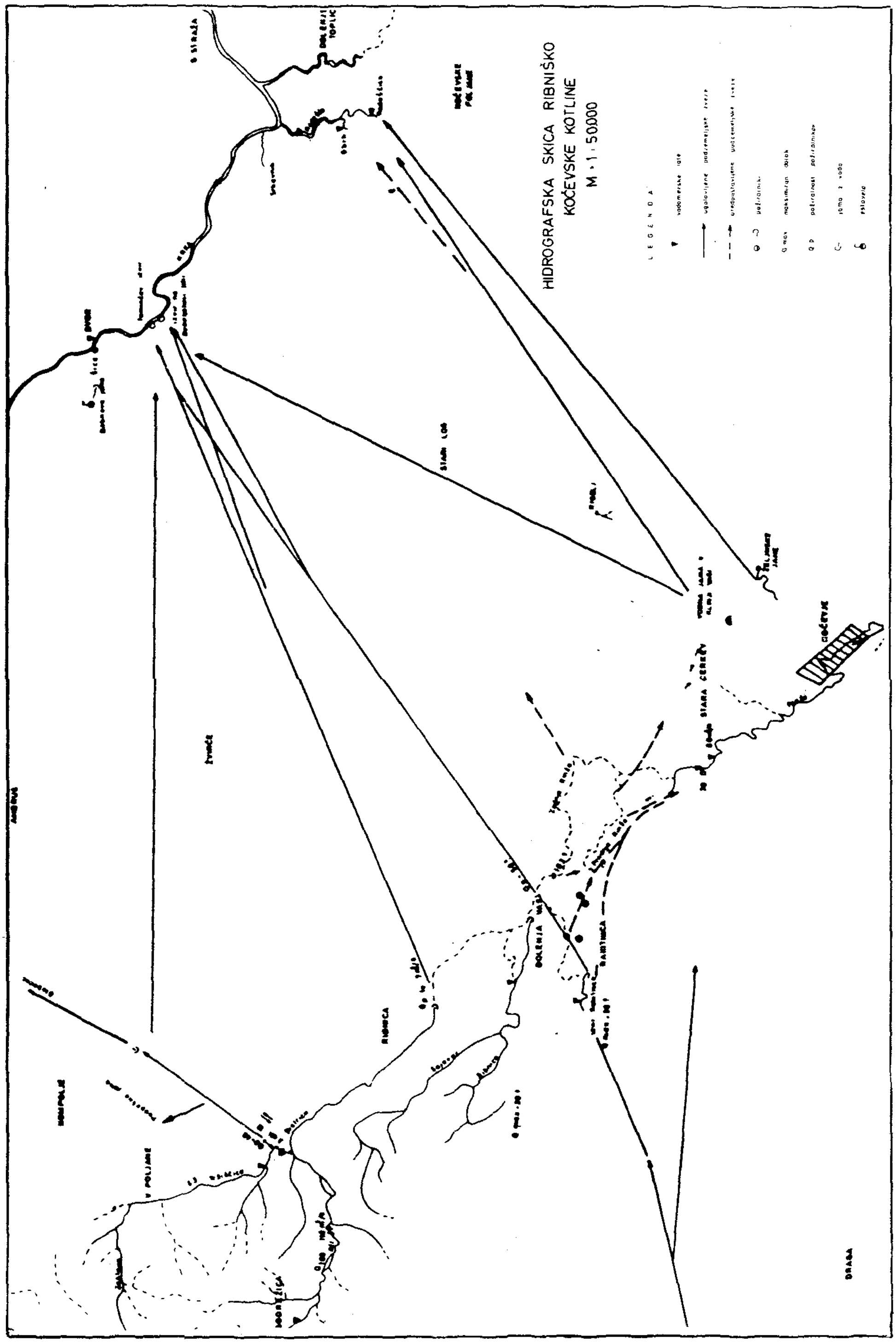
Drawing 11. Sections of active and fossil spring-caves

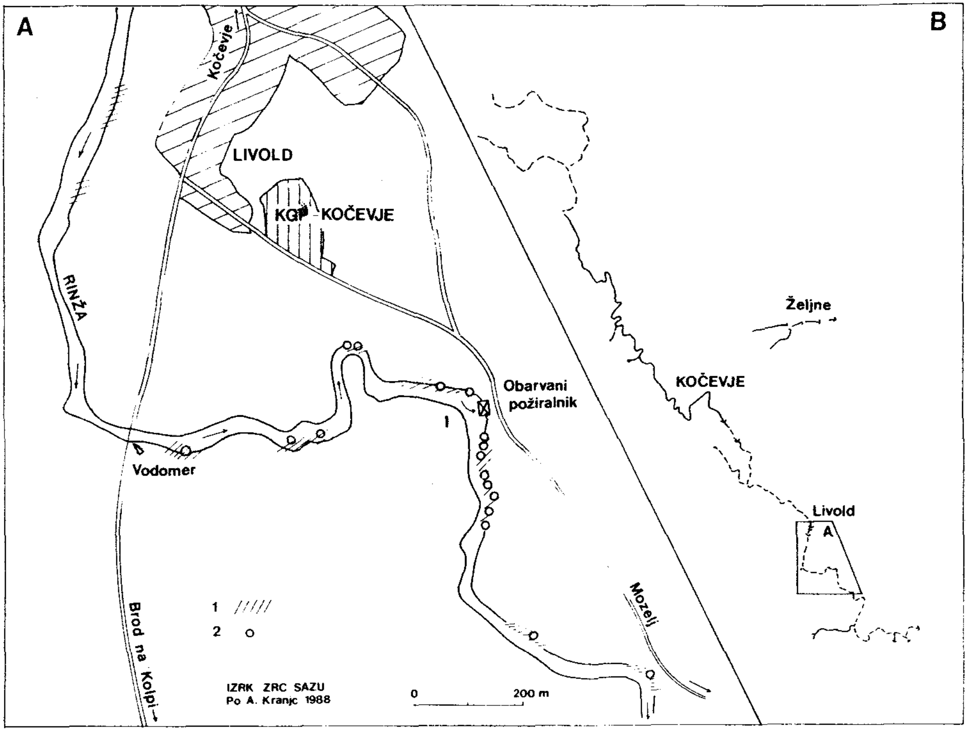


Risba 4. Ponorne jame v NW koncu Ribniškega polja

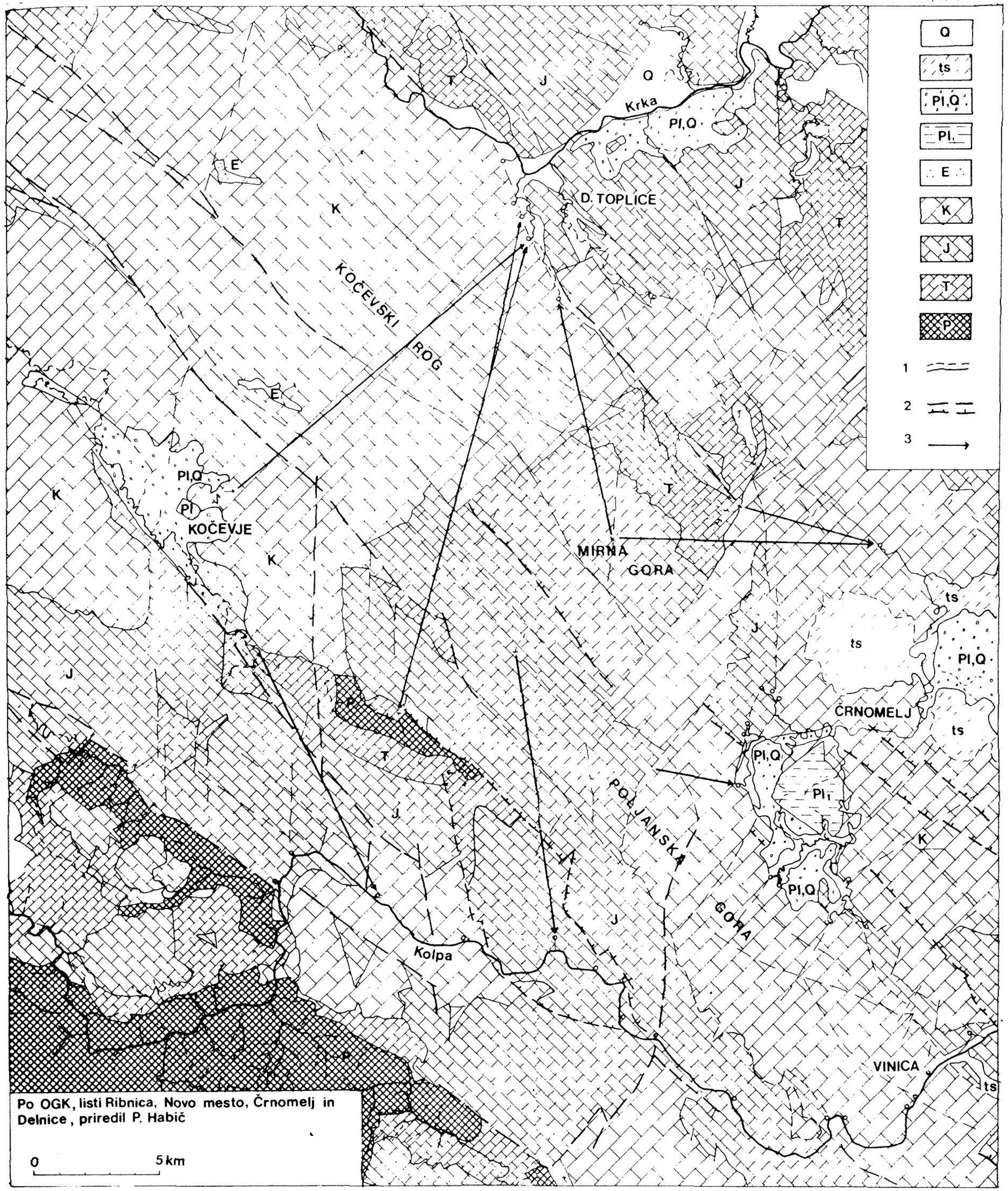
Drawing 4. Ponor caves in NW part of Ribniško polje

Fig. 35





Sl. 27 Ponori Rinže, A - ponori pri Livoldu, I - obarvani požiralnik, B - celotni tok Rinže
Fig. 27 Rinža ponors, A - ponors near Livold, I - dyed swallow holes, B - entire Rinža flow



Priloga 2 Hidrogeološka skica ozemlja med Krko in Kolpo

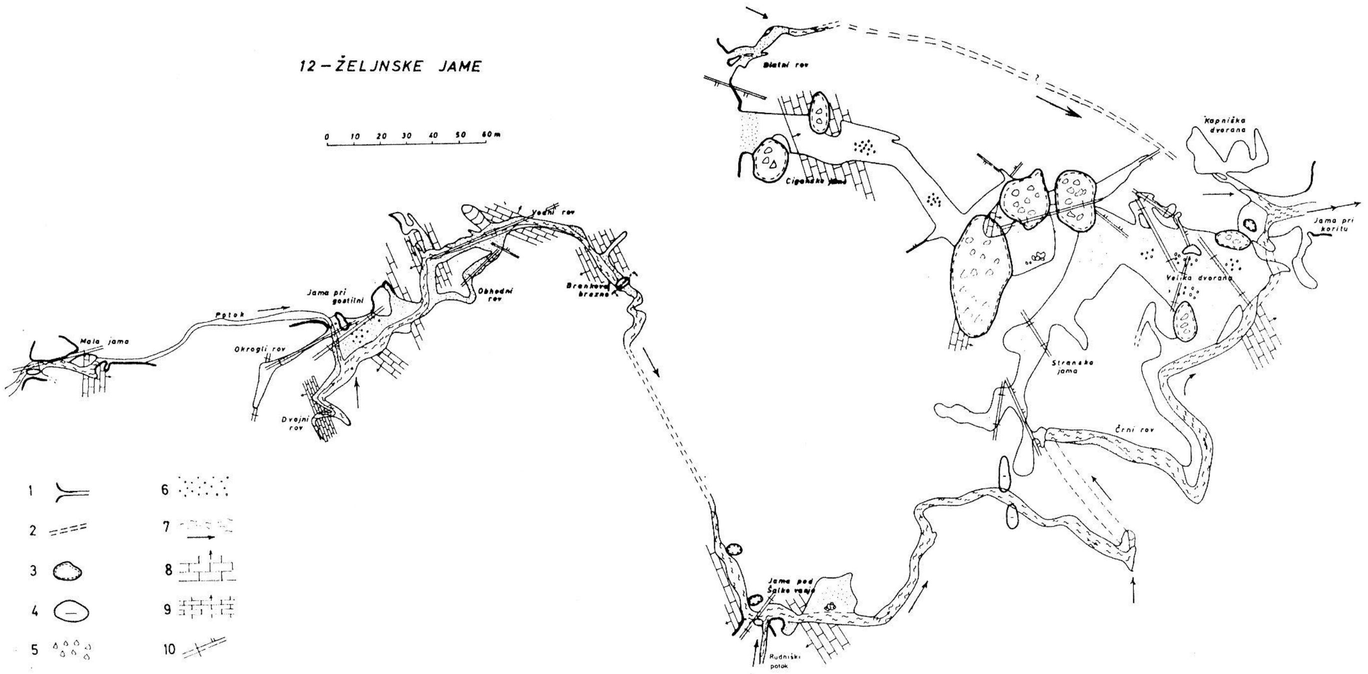
Q - rečne naplavine, prepustno do neprepustno,
ts - terra rossa, slabo prepustno,
PlQ - rdečkasto rjava ilovica, slabo prepustno - nerprepustno,
Pl_1 - pliocenski laporji s premogom, neprepustno,
E - rdečkast lapor, slabo do neprepustno
K - apnenci in dolomiti, dobro prepustno
J - apnenci in dolomiti, dobro prepustno,
T - dolomiti, delno prepustno,
P - kremenovi peščenjaki in glineni skrilavci, neprepustno,
1 - stratigrafska meja,
2 - prelom in nariv,
3 - dokazana podzemeljska vodna zveza.
4 - izvir, ponor

Annex 2 Hidrogeological sketch of the area between Krka and Kolpa

Q - fluvial sediments, permeable to impermeable,
ts - terra rossa, bnadly permeable,
PlQ - reddish brown loam, badly permeable - impermeable,
Pl_1 - Pliocene marls with coal, impermeable,
E - reddish marl, badly to impermeable
K - limestones and dolomites, badly permeable,
J - limestones and dolomites, well permeable,
T - *dolomites, partly permeable*
P - chert sandstones and clay shales, impermeable,
1 - stratigraphic boundary,
2 - fault aand overthrust,
3 - evidenced underground water connection,
4 - spring, ponor

Fig. 37

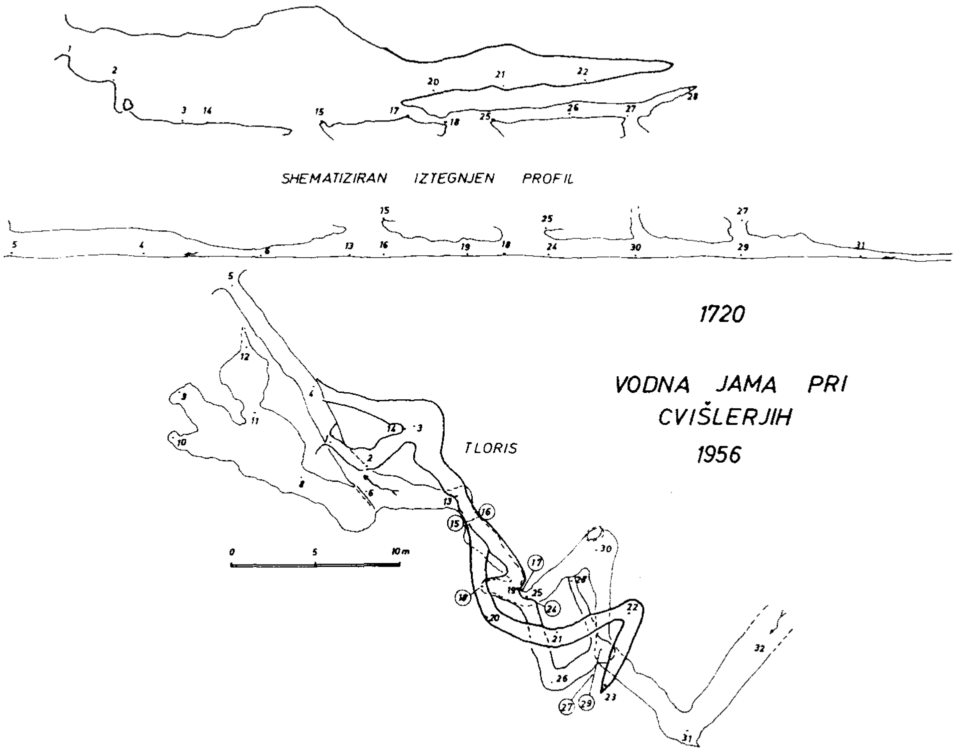
Fig. 38



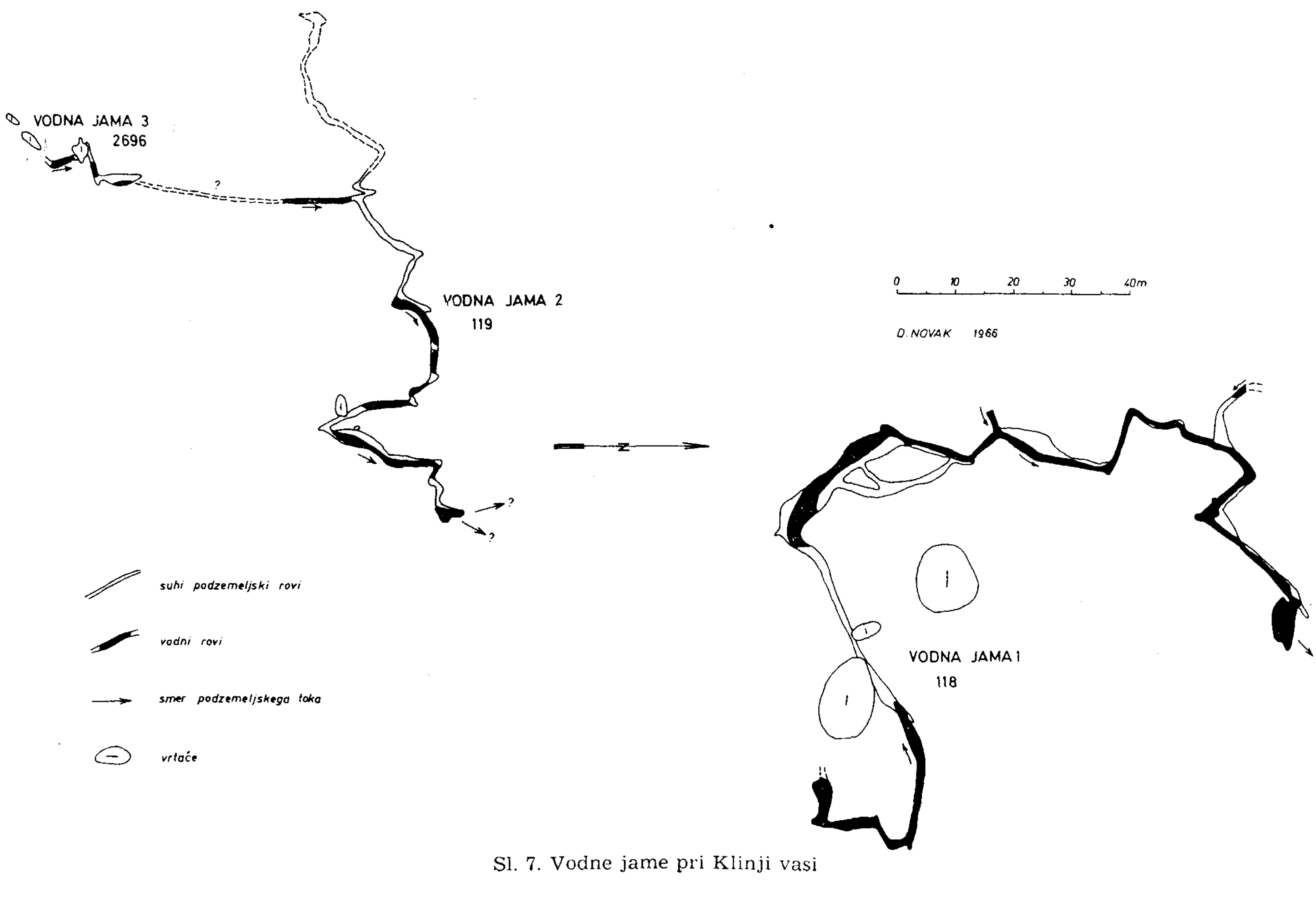
Sl. 2. Skica Željnskih jam

Legenda: 1 — vhodni deli jame, 2 — predpostavljena povezava, 3 — udorne vrtače s povezavo z jamo, 4 — vrtače; 5 — podorni grušč, 6 — prod in pesek, 7 — vodni tok, 8 — skladovit apnenec s smerjo vpada plasti, 9 — plastovit apnenec, 10 — prelomi in razpoke

Fig. 39



Sl. 6. Vodna jama pri Cvišlerjih



Sl. 7. Vodne jame pri Klinji vasi