

HRVATSKI GEOLOŠKI INSTITUT
CROATIAN GEOLOGICAL SURVEY

godišnje izvješće **2006**
annual report



IZDAVAČ – PUBLISHER:

Hrvatski geološki institut – *Croatian Geological Survey*
Sachsova 2, HR-10000 Zagreb, Hrvatska (*Croatia*)
Ravnatelj (*Director*) Josip HALAMIĆ

UREDNICI – EDITORS:

Tvrtko KORBAR & Josip TERZIĆ

TEHNIČKI UREDNIK – TECHNICAL EDITOR:

Mario DOLIĆ

UREDNIČKI ODBOR – EDITORIAL BOARD:

Željka BRKIĆ
Renato BULJAN
Tonči GRGASOVIĆ
Josip HALAMIĆ
Ivan HEĆIMOVIĆ
Antun HUSINEC
Domagoj JAMIČIĆ
Georg KOCH
Alisa MARTEK
Slobodan MIKO
Ante PAVIČIĆ
Zoran PEH
Damir SLOVENEC
Marko ŠPARICA
Ivo VELIĆ

PRIJEVOD NA ENGLESKI JEZIK – ENGLISH TRANSLATION:

Zoran PEH

LEKTURA ENGLESKOGA JEZIKA – ENGLISH LANGUAGE EDITING:

DIACRITECH Language Editing

TISAK – PRINTING:

PagiGRAF, M. Bogovića 40, Samobor, Hrvatska (*Croatia*)

NAKLADA – EDITION:

400 primjeraka (*copies*)

NASLOVNICA – COVER:

Kamenica - Ravni Žakan (*Kornati*)

Kamenica - The island of Ravni Žakan (*Kornati archipelago*)

ISBN 978-953-6907-16-8

ISSN 1846-629X

Uvodnik	2
Introduction	2
Organizacijska struktura, zaposlenici i proračun	6
Organizational scheme, employees and budget	6
Zavod za geologiju	8
Department of Geology	8
Zavod za hidrogeologiju i inženjersku geologiju	12
Department of Hydrogeology and Engineering Geology	12
Zavod za mineralne sirovine	16
Department of Mineral Resources	16
Geološka služba	20
Geological Survey	20
Knjižnica Hrvatskoga geološkog instituta	23
Library of the HGI-CGS	23
Geološke karte - posebni projekti MZOŠ RH	
Geological maps - special projects funded by the Ministry of Science, Education and Sports of the Republic of Croatia	
Osnovna geološka karta Republike Hrvatske 1:50.000 Basic Geological Map of the Republic of Croatia 1:50,000	25
Osnovna inženjerskogeološka karta Republike Hrvatske 1:100.000 Basic Engineering-Geological Map of the Republic of Croatia 1:100,000	27
Osnovna hidrogeološka karta Republike Hrvatske 1:100.000 Basic Hydrogeological Map of the Republic of Croatia 1:100,000	29
Osnovna geokemijska karta Republike Hrvatske Basic Geochemical Map of the Republic of Croatia	31
Strukturno-geomorfološka karta Republike Hrvatske 1:100.000 Structural-Geomorphological Map of the Republic of Croatia 1:100,000	33
Karta mineralnih sirovina Republike Hrvatske Map of the Mineral Resources of the Republic of Croatia	35
Tektonska karta Republike Hrvatske 1:300.000 Tectonic Map of the Republic of Croatia 1:300,000	36
Ostali projekti MZOŠ RH	
Other projects funded by the Ministry of Science, Education, and Sports of the Republic of Croatia	
Stratigrafska evolucija trijasa Hrvatske Stratigraphic evolution of the Triassic in Croatia	38
Odraz paleoklimatskih promjena u jursko-krednim sedimentima krških Dinarida Sedimentary record of Jurassic-Cretaceous climatic changes in Karst Dinarides	39
Holocensi sedimenti kao zapis promjena u okolišu jadranskih sljevova Holocene sediments as a record of changes in catchments of the Adriatic coastal region	40
Stratigrafija naslaga krede u okviru geodinamike jadranskog područja Hrvatske Stratigraphy and geodynamic context of Cretaceous deposits in the northeastern Adriatic region	41
Mezozojske magmatske, plaštne i piroklastične stijene sjeverozapadne Hrvatske Mesozoic igneous, mantle, and pyroclastic rocks of northwestern Croatia	42
Mikrofossilne zajednice u karbonatnim naslagama krških Dinarida Microfossil assemblages in the carbonate sedimentary rocks of the Karst Dinarides	43
Međunarodni projekti	
International projects	
Greenhouse and transitional climates in 50 m.y. carbonate record of the late Jurassic-early Cretaceous Dinaric platform, Croatia	44
KATER II project	45
Bibliografija djelatnika HGI-CGS 2006.	46
Bibliography of HGI-CGS staff in 2006	46



Dr. sc. Josip HALAMIĆ
Ravnatelj (*Director*)

UVODNIK

Protekla godina bila je u znaku prijave novih znanstveno-istraživačkih projekata pri Ministarstvu znanosti, obrazovanja i športa Republike Hrvatske za sljedeći petogodišnji ciklus. Budući da su istraživanja u okviru Programa geoloških karata Republike Hrvatske temeljna djelatnost Hrvatskoga geološkog instituta (HGI-CGS) i da se na njima temelji cjelokupna znanstvena djelatnost naše kuće, bilo je od velike važnosti da predloženi projekti budu prihvaćeni od strane Ministarstva. U okviru Programa predloženo je osam temeljnih projekata:

- Osnovna geološka karta RH 1:50.000
The basic geological map of the Republic of Croatia, scale 1:50,000
- Osnovna geokemijska karta RH
The basic geochemical map of the Republic of Croatia
- Osnovna hidrogeološka karta RH 1:100.000
The basic hydrogeologic map of the Republic of Croatia, scale 1:100,000
- Osnovna inženjersko-geološka karta RH 1:100.000
The basic engineering geological map of the Republic of Croatia, scale 1:100,000
- Karta mineralnih sirovina RH
The map of mineral resources of the Republic of Croatia
- Geotermalna karta RH
The geothermal map of the Republic of Croatia
- Strukturno-geomorfološka karta RH 1:100.000
The structural-geomorphological map of the Republic of Croatia, scale 1:100,000
- Tektonska karta RH 1:300.000
The tectonic map of the Republic of Croatia, scale 1:300,000

Svi projekti prihvaćeni su kao posebni projekti za financiranje u narednom istraživačkom ciklusu. Svrstavanjem tih projekata u kategoriju posebnih, učinjen je prvi korak prema nalaženju trajnog rješenja za sustavno i stabilno financiranje izrade geoloških podloga koje su od strateškog interesa za našu zemlju.

INTRODUCTION

The last year was marked by application of new research projects to the Ministry of Science, Education, and Sports of the Republic of Croatia with regard to the coming five-year period. Since the research work within the framework of the current Program of Geological Maps of the Republic of Croatia represents the fundamental activity of the Croatian Geological Survey (HGI-CGS), which is the pillar of the overall scientific business of our company, we recognized the paramount importance in accepting the proposed projects by the responsible ministry. Eight basic projects were proposed under the program framework:

All proposed projects were found eligible for financing in the forthcoming research period as special projects. Labeling the above projects as special is the first step toward realization of the permanent solution for systematic and stable funding of production of the geological thematic maps, which have the strategic interest of our country.

Geološke karte i geopodatci upotrebljavaju se kao temelj za daljnja istraživanja u svrhu održivog razvoja te što boljeg iskorištavanja geološkog potencijala i mineralnih resursa (nafte, plina, arhitektonskog i tehničko-građevinskog kamena, te ostalih građevinskih i industrijskih materijala). Na rezultatima geoloških istraživanja temelje se i procjene zaliha pitke vode i procjene opasnosti od prirodnih hazarda (klizišta, odrona i dr.).

Osim toga, geološke karte služe kao podloga pri zaštiti podzemnih voda, danas jednog od strateških resursa u svijetu, zaštiti tala, te zaštiti čovjekove okoline u cjelini. U narednom razdoblju nastojat ćemo da Program geoloških karata RH bude prepoznat od strane Vlade RH kao program od strateškog interesa za državu, a ujedno i za geoznanost u zemlji uopće.



Međunarodna aktivnost

HGI-CGS je na Generalnoj skupštini EuroGeoSurveys-a 26. ožujka 2006. godine u Bruxellesu jednoglasno primljen u EGS, kao trideseta punopravna članica. Time je otvorena nova stranica na polju međunarodne suradnje sa srodnim institucijama diljem Europe. Na Generalnoj skupštini, koja je održana tijekom rujna u Bukureštu, usvojen je strateški akcijski plan EGS-a za razdoblje od 2006. do 2011. godine. Ovdje ćemo istaknuti samo neke od glavnih strateških ciljeva tog plana:

- zajednički rad na razvoju europske geološke infrastrukture;
- podržavanje EuroGeoSurveys-a kao organizacije koja promovira ulogu geologije pri donošenju političkih odluka;
- identificiranje najpogodnijih instrumenata za olakšavanje izvođenja velikih projekata kroz uključivanje što većeg broja članica EGS-a i poticanje zajedničkih istraživanja za izvođenje istih;
- razvoj zajedničkog interesa EGS-a kanaliziranog kroz nacionalne geološke službe, a u službi definiranja EU politike.

Geological maps and geological data are used as a base for further investigations, with the purpose of sustainable development and better exploitation of mineral resources (oil, gas, building, and dimension stone as well as other building and industrial commodities). Solutions achieved by geological investigations represent the starting point, as in evaluation of drinking water supplies and the danger of natural hazards (landslides, slope failures etc.).

Besides, geological maps serve as a backing in protection of groundwater, which is one of the strategic resources in the modern world, as well as, in soil protection and protection of the human environment in general. In the future we shall do our best to make the program of geological maps recognizable by the government as a strategically important program, not only for the country, but also for Croatian geosciences in general.

International activity

HGI-CGS was privileged to join unanimously the EuroGeoSurveys organization at the general assembly held on March 26, in Brussels, becoming its thirtieth full member. Thus, a new page had opened in the field of international cooperation of HGI-CGS with congenial institutions across Europe. In Bucharest, during September last year, the EGS action plan was accepted for the period 2006-2011. Here, we shall only place emphasis on a few main goals included in the strategic plan:

- Teamwork on the development of European geologic infrastructure*
- Assistance to EuroGeoSurveys, as the organization that promotes the role of geology in making political decisions*
- Identification of the most expedient instruments, to alleviate the running of capital projects through inclusion of the ever increasing number of EuroGeoSurveys (EGS) members, and instigation of joint research for their realization*
- Development of common EGS awareness canalized through national geologic surveys, on assistance to a proper definition of European Union (EU) politics.*

U veljači 2006. godine HGI-CGS je postao član „Geoscience Information Consortium“ osnovanim od strane 25 geoloških službi iz Europe, Sjeverne Amerike, Azije, Afrike i Australije. Na radnim sastancima konzorcija, koji se sastaje jednom godišnje, razmjenjuju se iskustva geoloških službi vezana za informacijske sustave. Naša djelatnica Ajka Šorša je aktivno sudjelovala u radu konzorcija koji je održan u svibnju 2006. u Varšavi. Tamo je prezentirana struktura naše Geološke službe te daljnji planovi za razvoj Geološkog informacijskog sustava.

In February 2006, the Croatian Geological Survey became the member of the Geoscience Information Consortium, which was established on behalf of 25 geological surveys from Europe, North America, Asia, Africa, and Australia. Working meetings of consortiums, assembling once a year, are designed for geological surveys to exchange their knowledge and practices with reference to the information systems. Our member of staff, Ms. Ajka Šorša, actively attended the sessions at the consortium held during May 2006, in Warsaw. She presented the structure of our geological survey and exposed the plans for further development of the Geological Information System.

24. kolovoza 2006. godine u Zagrebu je potpisana Sporazum o zajedničkoj suradnji između Geologische Bundesanstalt (GBA) iz Beča i HGI-CGS. To je treći sporazum takve vrste, a već prije je potpisana s Geološkom službom R. Slovenije i Geološkom službom R. Mađarske. Potpisani sporazum omogućit će još bolju suradnju između GBA i HGI-CGS na polju razmjene iskustava izrade geoloških karata i informatičke obrade podataka.

HGI-CGS je u suradnji s Hrvatskim geografskim društvom organizirao 24. i 25. kolovoza 2006. godine stručnu, geološko-geografsku postkongresnu ekskurziju po sjevernoj Hrvatskoj za 75 sudionika skupa HUNGE 2006: VIII. World Meeting of Hungarian Geoscientists: „Energy Resources – Pannonian Region“ Pécs, Hungary.

HGI-CGS, Hrvatsko geološko društvo i Rudarsko-geološko-naftni fakultet iz Zagreba organizirali su od 8. do 12. svibnja radionicu na temu određivanja starosti sedimenata metodom luminescencije pod naslovom "Ice Age Earth". Predavači su bili prof. dr. Manfred Frechen i mr. sc. Björn Machalett (Leibniz Institute for Applied Geosciences), te prof. dr. Erzsébet Horváth (ELTE, Budapest).

On August 24, 2006, Memorandum of Understanding between Geologische Bundesanstalt (GBA) from Vienna and HGI-CGS was signed in Zagreb. This was the third agreement of that kind since the former two, which had already been duly signed with the Geological Survey of Slovenia and Geological Survey of Hungary, respectively. This agreement will enable still better cooperation with GBA and HGI-CGS concerning the exchange of experience in construction of geological maps, data processing, and information system development.

HGI-CGS together with the Hungarian Geographical Society organized an expert geological-geographical post-Congress excursion to northern Croatia on August 24 and 25, 2006. The excursion included 75 participants from the conference HUNGE 2006: VIII World Meeting of Hungarian Geoscientists: "Energy Resources - Pannonian Region" Pécs, Hungary.

HGI-CGS, Croatian Geological Society, and Faculty of Mining, Geology, and Petroleum Engineering from Zagreb jointly organized the thematic Workshop on determining the age of sediments by the method of luminescence held under the title "Ice Age Earth" between May 8 and 12, 2006 in Zagreb. Lectors invited were Prof. Dr. Manfred Frechen and Mr. sc. Björn Machalett (Leibniz Institute for Applied Geosciences), and Prof. Dr. Erzsébet Horváth (ELTE, Budapest).

Planirane aktivnosti u 2007. godini

Težište aktivnosti tijekom 2007. godine bit će znanstveno-istraživački rad na Programu geoloških karata R. Hrvatske koji je odobren za razdoblje od pet godina. To podrazumijeva završetak izrade Uputa za izradu karata i početak rada na finalizaciji pojedinih listova geoloških i tematskih karata po projektima. U tom smislu svi listovi karata bit će izrađeni u digitalnom formatu s pratećim bazama podataka koje će ujedno biti sastavni dio Geološkog informacijskog sustava (GIS). Pošto izrada GIS-a nije adekvatno pratila istraživačke radove na pojedinim projektima, koji već traju određeni niz godina, potrebno je u narednom razdoblju sustavno popunjavati pojedine baze podataka unutar GIS-a s podatcima prikupljenim tijekom prijašnjih istraživanja. To ujedno zahtijeva i završetak izrade kompletног GIS-a (II faza) čime će biti omogućen pristup geopodatcima putem intraneta i interneta.

Strukturiranje Geološke službe R. Hrvatske i prilagođavanje europskim standardima uvjetuje i reviziju Zakona o geološkim istraživanjima. Taj zakonski akt koji je sada na snazi treba prilagoditi današnjim potrebama geološke struke.

Planned activities for the year 2007

During the year 2007, activities will be focused on the scientific work and investigations within the Program of Geological Maps of the Republic of Croatia, which has been approved for the period of five years. This implies completion of the Manual for the construction of maps and beginning the finalization of single sheets of geological and thematic maps under the umbrella of individual research projects. In that sense, all map sheets will be assembled in digital format with accompanying databases. The latter form the integral part of the Geological Information System (GIS). Given that the construction of GIS was not performed in union with research works under individual projects going on for a number of years, it is mandatory, in the forthcoming period, to regularly fill in the GIS databases with data collected during the previous investigation cycles. This also implies the completion of the entire GIS (phase II), allowing the approach to geological data via both the internet and intranet.

Structuring of the Geological survey of the Republic of Croatia and adjusting to European standards, call upon the revision of the Law on geological activity. The currently functioning act must be accustomed to the contemporary needs of the geological profession.



ORGANIZACIJSKA STRUKTURA, ZAPOSLENICI I PRORAČUN

ORGANIZATIONAL SCHEME, EMPLOYEES AND BUDGET

RAVNATELJ / DIRECTOR:

Dr. sc. Josip HALAMIĆ

tel: (+385 1) 6160-749

fax: (+385 1) 6144-718

e-mail: josip.halamic@hgi-cgs.hr

Zamjenica ravnatelja / Director deputy: Dr. sc. Željka BRKIĆ

Pomoćnici ravnatelja / Director assistants:

za financijsko-ekonomske poslove Slobodan DUKOVČIĆ

for financial-economic business

za koordinaciju poslovanja s tržištem Dr. sc. Saša MESIĆ

for coordination of business with the market

UPRAVNO VIJEĆE - GOVERNING BOARD

Prof. dr. sc. Dražen VIKIĆ TOPIĆ (MZOŠ*), predsjednik - Chairman

Akademik Ivan GUŠIĆ (PMF*)

Prof. dr. sc. Davor PAVELIĆ (RGNF*)

Dr. sc. Renato BULJAN (HGI-CGS)

Dr. sc. Tvrko KORBAR (HGI-CGS)

ZNANSTVENO VIJEĆE - SCIENTIFIC COUNCIL

Dr. sc. Zoran PEH, predsjednik - Chairman

Dr. sc. Željka BRKIĆ, zamjenica predsjednika - Chairman deputy

Dr. sc. Renato BULJAN

Dr. sc. Josip HALAMIĆ

Mr. sc. Ozren HASAN

Dr. sc. Ivan HEĆIMOVIĆ

Dr. sc. Domagoj JAMIČIĆ

Dr. sc. Tvrko KORBAR, tajnik - Secretary

Dr. sc. Marijan KOVAČIĆ

Mr. sc. Slobodan MIKO

Dr. sc. Ante PAVIČIĆ

Dr. sc. Ivan SLIŠKOVIĆ

Dr. sc. Marko ŠPARICA

Mr. sc. Josip TERZIĆ, tajnik - Secretary

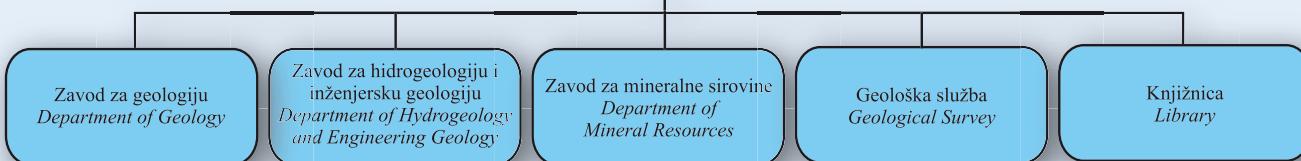
Dr. sc. Ivo VELIĆ

*MZOŠ - Ministry of Science, Education and Sports of the Republic of Croatia

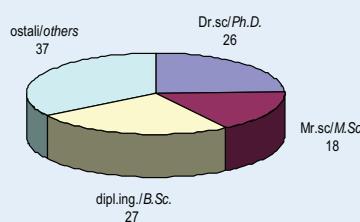
*PMF - Faculty of Science, University of Zagreb, Croatia

*RGNF - Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, Croatia

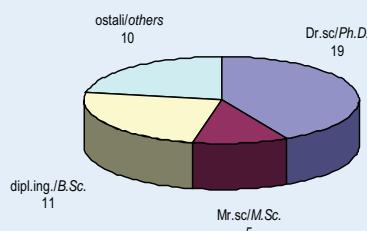
HGI - CGS



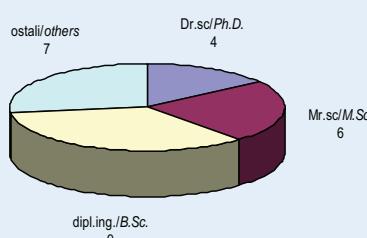
108 zaposlenika HGI-CGS
108 employees of HGI-CGS



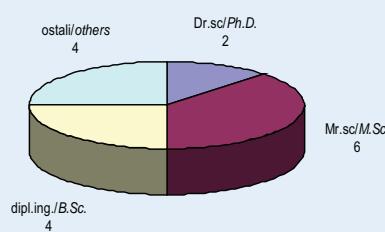
Zavod za geologiju
Department of Geology



Zavod za hidrogeologiju i inženjersku geologiju
Department of Hydrogeology and Engineering Geology



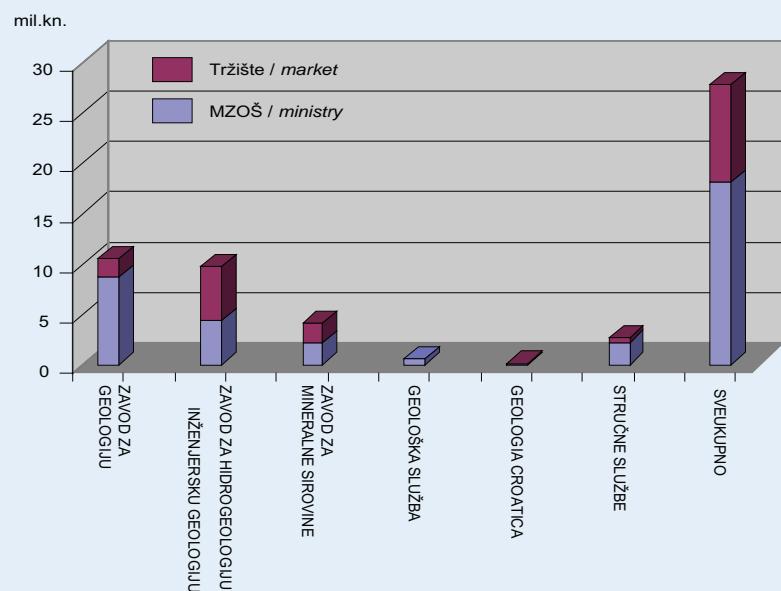
Zavod za mineralne sirovine
Department of Mineral Resources



broj zaposlenika po Zavodima
number of employees per departments



PRIHODI INSTITUTA BUDGET OF HGI-CGS



* Podaci iz prosinca 2006.

* Data on December 2006.

ZAVOD ZA GEOLOGIJU

DEPARTMENT OF GEOLOGY

Godišnje izvješće 2006.

Predstojnik Zavoda / Head of Department:

Dr. sc. Ivan HEĆIMOVIĆ

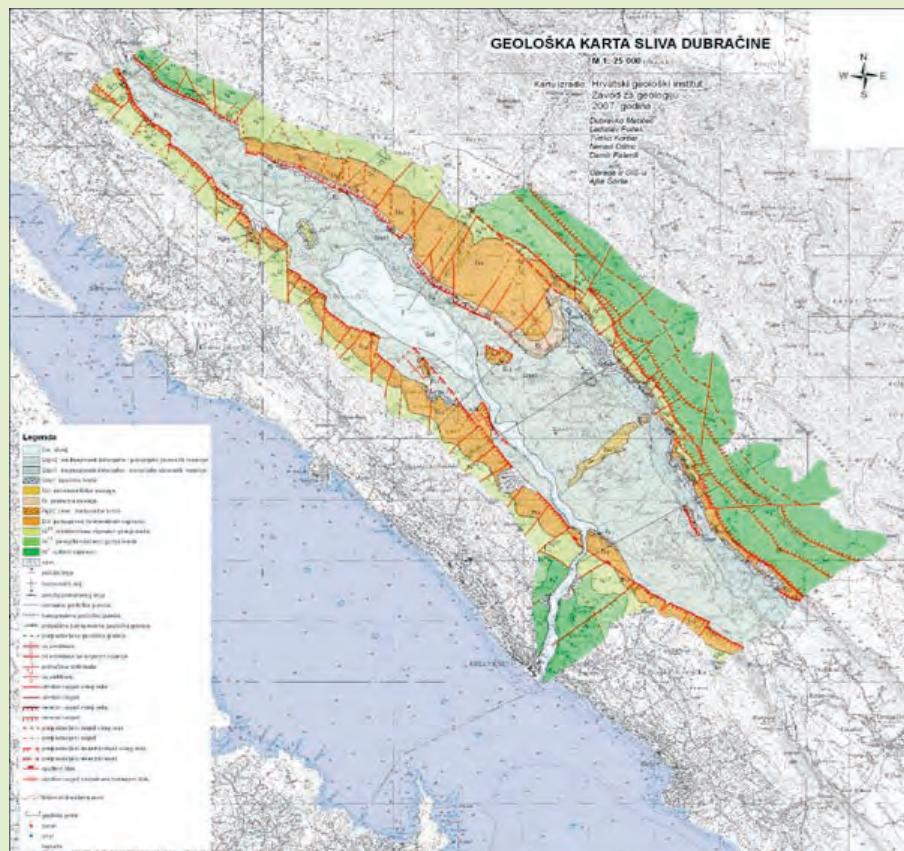
tel: (+385 1) 6160-710

fax: (+385 1) 6144-718

e-mail: ivan.hecimovic@hgi-cgs.hr

Poznato je da o geološkoj građi u velikoj mjeri ovise privredni, a time i društveni razvoj nekog kraja ili države. Uvid u geološku građu terena najbolje se stječe kroz geološke karte. Stoga je temeljna djelatnost Zavoda za geologiju izrada osnovnih i tematskih geoloških karata u području Republike Hrvatske. Izrada geoloških karata, odnosno provedba geoloških istraživanja ima za cilj što bolje spoznati geološku građu Republike Hrvatske u svrhu optimalnog gospodarenja poznatim prirodnim bogatstvima, ali i pronaalaženja novih u svrhu aktivne zaštite okoliša i izrade raznovrsnih prostornih planova. Tu djelatnost Zavod ostvaruje kroz znanstvene projekte, primjenjena istraživanja i međunarodnu suradnju.

It is well known that the economical and social development of a country, or a state, is at significant rate dependent on its geological setting. Understanding of the geological setting is best acquired through various geological maps. Thus, the basic activity of the Department of Geology is represented by construction and publication of basic and thematic geological maps of the territory of the Republic of Croatia. Production of geological maps, that is, implementation of comprehensive geological research is aimed at retrieving the improved knowledge of the geological setting of the Republic of Croatia, with the purpose of optimal management of the known natural resources and finding of new ones, respectively. Also, it is targeted toward active protection of the natural environment and diverse physical planning. This activity is performed in the Department through scientific research projects, applied research, and by international cooperation.



Terenska istraživanja i geološka karta slijeva Dubračine (Vinodol).
Fieldwork and geological map of Dubračina river drainage system (Vinodol).



Znanstveni projekti:

Temeljna djelatnost Zavoda finansirana je od strane Ministarstva znanosti, obrazovanja i športa i to kroz glavni projekt:

- Osnovna geološka karta Republike Hrvatske 1:50.000 (Dr. sc. Marko Šparica);

te kroz projekte izrade tematskih karata:

- Osnovna geokemijska karta Republike Hrvatske (Dr. sc. Josip Halamić);
- Strukturno-geomorfološka karta Republike Hrvatske 1:100.000 (Dr. sc. Ivan Hećimović);
- Tektonska karta Republike Hrvatske 1:300.000 (Dr. sc. Domagoj Jamičić).

Ministarstvo znanosti, obrazovanja i športa osim temeljnih projekata izrade geoloških karata sudjeluje i u financiranju znanstvenih istraživanja koja se u Zavodu izvode u okviru sljedećih projekata:

- „Stratigrafska evolucija trijasa Hrvatske“ (Dr. sc. Tonći Grgasović),
- „Odraž paleoklimatskih promjena u jursko-krednim sedimentima Krških Dinarida“ (Dr. sc. Antun Husinec),
- „Holocenski sedimenti kao zapis promjena u okolišu Jadranskih sljevova“ (Dr. sc. Georg Koch),
- „Stratigrafija naslaga krede u okviru geodinamike jadranskog područja Hrvatske“ (Dr. sc. Tvrto Korbar),
- „Mezozojske magmatske, plaštne i piroklastične stijene sjeverozapadne Hrvatske“ (Dr. sc. Damir Slovenec),
- „Mikrofossilne zajednice u karbonatnim naslagama krških Dinarida“ (Dr. sc. Ivo Velić)

Izrada karata odnosno provedba projekata baziра se na znanstvenim istraživanjima s naglaskom na lito- i biostratigrafska istraživanja, paleontološka i sedimentološka istraživanja u najširem smislu, mineraloško-petrografska istraživanja, strukturno-geomorfološka i strukturno-tektonika istraživanja, geokemijska istraživanja te laboratorijska sedimentno-petrografska, paleontološka i kemijska istraživanja.

Scientific projects:

The Ministry of Science, Education, and Sports of the Republic of Croatia fund the basic activity of the Department via the main project:

- *The basic geological map of the Republic of Croatia, scale 1:50,000 (Dr. Marko Šparica), together with other projects in the form of thematic geological maps:*
- *The basic geochemical map of the Republic of Croatia (Dr. Josip Halamić);*
- *The structural-geomorphological map of the Republic of Croatia, scale 1:100,000 (Dr. Ivan Hećimović);*
- *The tectonic map of the Republic of Croatia, scale 1:300,000 (Dr. Domagoj Jamičić).*

Beside the four basic projects concerned with construction of geological maps, the Ministry of Science, Education, and Sports also participates in funding the scientific research work carried out in the Department with reference to the following projects:

- *Stratigraphic evolution of the Triassic in Croatia (Dr. Tonći Grgasović),*
- *Sedimentary record of Jurassic-Cretaceous climatic changes in karst Dinarides (Dr. Antun Husinec),*
- *Holocene sediments as a record of changes in the environment of Adriatic drainage basins (Dr. Georg Koch),*
- *Stratigraphy and geodynamic context of Cretaceous deposits in the NE Adriatic region (Dr. Tvrto Korbar),*
- *Mesozoic igneous, mantle, and pyroclastic rocks of NW Croatia. (Dr. Damir Slovenec).,*
- *Microfossil assemblages in the carbonate sedimentary rocks of the Karst Dinarides (Dr. Ivo Velić)*

The project implementation resulting in the construction of maps is based on scientific investigations whose emphasis is laid on litho- and biostratigraphic research, paleontologic and sedimentologic research in a broader sense, structural-geomorphologic and structural-tectonic research, as well as laboratory examination, including sedimentary-petrographic, paleontologic, and chemical analysis.

Primijenjena istraživanja:

Primijenjena istraživanja se baziraju na izradi geoloških karata svih mjerila, vrsta i namjena, na izradi geoloških studija iz naftno-geološke problematike, studija iz domene zaštite okoliša i prostornog planiranja te izradi studija za sve ostale djelatnosti za koje je potrebna geološka osnova.

U 2006. godini glavna aktivnost Zavoda na izradi primijenjenih istraživanja bila je usmjerena na izradu geoloških karata za potrebe inženjerskog geoloških studija, i to za jadransku autocestu na dionici Split-Ploče, za urbaniziranu podsljemensku zonu, Vinodolsku dolinu te za hidrogeološku studiju odlagališta otpada Lećevica.

Od istraživanja koja imaju izravnu i trenutačnu primjenu treba spomenuti palinološke analize koje za potrebe INA-Naftaplina stručnjaci Zavoda rade u okviru naftno-geoloških radova INA-koncesije u Siriji, a sastoje se od istraživanja bušotinskih uzoraka paleozojsko-mezozojskih naslaga istražnih blokova Hayam i Aphantia. Cilj palinoloških istraživanja je palinostratigrafska odredba starosti sedimenta na temelju biostratigrafije palinomorfa, palinofaciesna interpretacija taložnog prostora na temelju primarne faciesne distribucije akvatičkih i terestričkih palinomorfa i palinološko-organsko faciesna odredba tipa palinološkog kerogena i pripadajuća termička zrelost na temelju ukupne palinološke organske tvari. Rezultati dosadašnjih palinoloških istraživanja paleozojsko-mezozojskih naslaga istraživanih blokova po pojedinim bušotinama su sljedeći:

Palinostratigrafija – Na temelju palinomorfa, datirane su naslage silura, donjeg karbona, donjeg perma, svih katova trijasa kao i naslage jure i donje krede u rasponu apt-alb.

Palinofacies – Palinofaciesnim analizama utvrđeni su taložni okoliši: proksimalnog šelfa (u siluru), terestričko-akvatički (u gornjem paleozoiku), plimne ravnice (donji trijas), okoliš plitkog subtidalnog do laguna i supratidalnog (ladinik, karnik), marinskog ingressija (norik, ret) te proksimalnog do umjerenog distalnog šelfa (u juri i kredi).

Applied researches:

Applied research is based on the geological maps of all scales, purposes, and scope, on publication of geological studies in the field of oil and gas production, studies in the domain of environmental protection and physical planning, and for all other activities needing the geological background.

During the year 2006, the main activity of the Department was aimed at construction of geological maps, for the needs of engineering geological studies, particularly concerning the Split-Ploče section of the Adriatic highway, for the urban zone on the slopes of the Medvednica Mt., the Vinodol valley, and for the hydrogeologic study of the Lećevica waste deposit.

Among research work with direct and immediate application it is worth mentioning that the palinologic analysis was carried out by the experts of this Department for the purpose of INA-Naftaplin. This work was performed under the umbrella of the oil and gas research of INA-allowance in Syria, and includes investigations of borehole samples from Palaeozoic-Mesozoic sedimentary rocks and research blocks of Hayam and Aphantia. The scope of palinologic analysis is the palinostratigraphic determination of the age of sedimentary rocks, based on the biostratigraphy of palinomorphs, palinofacies interpretation of sedimentary environment using primary facies distribution of aquatic and terrestrial palinomorphs, and palinologic-organic facies determination of the type of palinologic kerogen and pertinent thermal maturity, based on the total palinologic organic matter. Results of former palinologic investigations of the drilled Palaeozoic-Mesozoic sedimentary rocks are as follows:

Palinostratigraphy – based on the palinomorphs the age is determined as Silurian, Lower Carboniferous, Lower Permian, all series of Triassic, as well as, those of Jurassic and Cretaceous (ranging from Aptian to Albian) sedimentary rocks;

Palinofacies – the following palaeo-sedimentary environments are determined using paleofacies analysis: proximal shelf (Silurian), terrestrial-aquatic (Upper Palaeozoic), tidal-flat (Early Triassic and Anisian), shallow subtidal to lagoonal, supratidal (Ladinian and Carnian), marine ingestions (Norian and Rhaetian), and proximal to moderate distal shelf (Jurassic and Cretaceous);



1

Marinski fitoplankton (Acritharcha) *Multiplicispheridium* sp. Silur. Scale bar 20 µm.
Marine phytoplankton (Acritharcha) *Multiplicispheridium* sp. Silurian.

2

Karnički supratidalno-lagunarni palinofacies - palinološki kerogen iz kojeg se generira nafta i plin.
Carnian supratidal-lagoonal palynofacies - palinologic kerogen is oil and gas prone.

3

Gimnospermski pelud *Hamiapollenites insolitus*. Donji perm.
Gymnospermous pollen *Hamiapollenites insolitus*. Lower Permian.

Palinološko-organski facijes (palinološki kerogen)
 - glavni potencijal generiranja ugljikovodika nalazi se u trijaskim naslagama, najvećim dijelom unutarladiničko-karničkog horizonta za kojega je znakovit amorfni (generiranje nafte) i miješani amorfno/strukturirani (generiranje nafte i plina) palinološki kerogen.

Međunarodna suradnja:

Djelatnici Zavoda za geologiju tijekom 2006. godine sudjelovali su na međunarodnim projektima kojima su obuhvaćena sljedeća istraživanja:

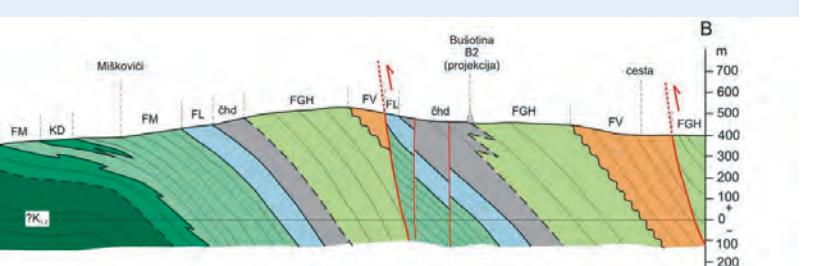
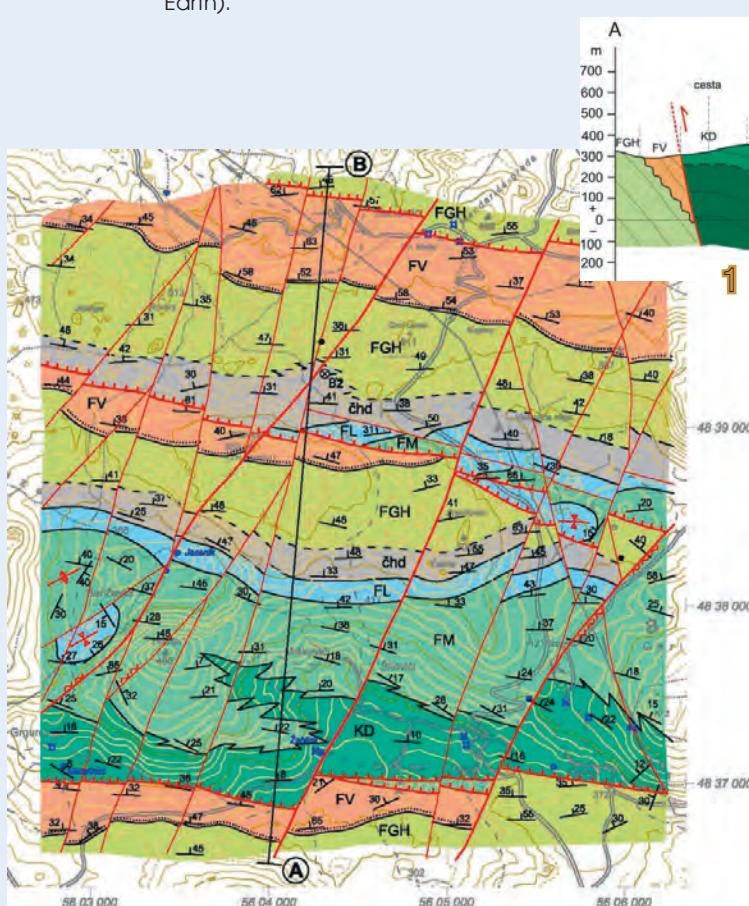
- istraživanja teških kovina u sedimentima rijeke Drave (sa Slovenijom);
- istraživanja peloida Jadranskog mora (sa Slovenijom);
- usklađivanje geoloških karata u pograničnim područjima (s Mađarskom i Slovenijom);
- priprema za izradu geološke karte Europe 1:1.000.000
- pripreme za izradu digitalne geološke karte svijeta 1:1.000.000 (OneGeology inicijativa pokrenuta je na poziv Britanske geološke službe kao zajednički doprinos nacionalnih geoloških službi Međunarodnoj godini planeta Zemlje (International Year of Planet Earth).

Palinologic-organic facies (palinologic kerogene)
 - the main hydrocarbon generation potential has been found within the Triassic rocks, mostly in the Ladinian-Carnian layers, which are characteristic for their amorphous (oil prone) and mixed amorphous-structured (oil and gas prone) palinologic kerogen.

International cooperation:

During the year 2006, the Department staff actively participated in international projects that embraced the following investigations:

- Investigation of heavy metals in sediments of the Drava River (together with Slovenia);
- Investigation of peloids in the Adriatic Sea (in cooperation with Slovenia);
- Arrangements for production of a geologic map of Europe, scale 1:1,000,000
- Adjustment of geological maps in border areas (with Hungary and Slovenia);
- Arrangements for production of a digital geologic map of the world, scale 1:1,000,000 (OneGeology initiative answered the call of the British Geological Survey, as a joint contribution of national geological surveys to the International Year of Planet Earth)



1

Geološka karta i profil - temelj za hidrogeološka istraživanja na predloženom području centra za gospodarenje otpadom Splitsko-dalmatinske Županije (Lećevica).

Geological map and section - a background for the hydrogeologic study on the proposed location for waste deposit of the Splitsko-dalmatinska County (Lećevica).

2

Geološka istraživanja u okviru inženjerskog geoloških radova za urbaniziranu podsljemensku zonu (Zagreb).

Geological fieldwork for engineering geological purpose in the urban zone of Medvednica Mt. (Zagreb).



ZAVOD ZA HIDROGEOLOGIJU I INŽENJERSKU GEOLOGIJU

*DEPARTMENT OF HYDROGEOLOGY
AND ENGINEERING GEOLOGY*

Predstojnik Zavoda / Head of Department: Dr. sc. Željka BRKIĆ

tel: (+385 1) 6144-715

fax: (+385 1) 6144-713

e-mail: zeljka.brkic@hgi-cgs.hr

Zavod za hidrogeologiju i inženjersku geologiju bavi se geološkim inženjerstvom – primjenjenim geološkim istraživanjima. U sklopu hidrogeoloških istraživanja proučavaju se hidrogeološke značajke tala i stijenskih masa, dinamika, kemijski i zalihe podzemne vode. U okviru inženjerskogeoloških istraživanja izrađuju se inženjerskogeološke karte raznih mjerila s popratni tumačima i bazama podataka, s prikazom inženjerskogeoloških odlika stijenskih masa i tala, te egzogenetskih procesa i pojava. Zavod je opremljen hidrogeokemijskim laboratorijem s instrumentima za mjerjenje kemijskih, fizikalno-kemijskih i fizikalnih parametara vode. Sva istraživanja obavljaju se u GIS okruženju, popraćena su odgovarajućom softverskom podrškom, grafikom i bazama podataka. Rezultati istraživanja često imaju izravnu primjenu u vodnom gospodarstvu, građevinarstvu, pri izradi prostornih planova, u elektroprivredi, rudarstvu, a posebice u zaštiti okoliša.

Već godinama, Zavod je sudjelovao u brojnim hidrogeološkim međunarodnim projektima. Konačem 2006. godine završen je međunarodni projekt KATER II (KArlst waTER research program). Istraživači Zavoda su uključeni i u rad međunarodnog projekta IAEA u okviru kojeg se istražuje područje Gacke i slijeva Vranskog polja (kod Biograda). Prikupljuju se uzorci vode na izvorima, hidrokemijske analize voda obrađuju se u Institutu, a analize izotopa rade partneri u Beču, Rijeci i Institutu Ruđer Bošković. Tako se u 2006 na spomenutim međunarodnim projektima surađivalo s kolegama iz Austrije, Slovenije i Italije.

The department of hydrogeology and engineering geology deals with the geological engineering – applied geological research. In the framework of hydrogeologic investigations, studies of the hydrogeological characteristics of soils and rock masses, as well as, of dynamics, chemical processes, and storage of groundwater, are included. The engineering geological research deals with characteristics of a specific area, production of engineering geological maps, with interpreters and databases, with analysis and appropriate demonstration of engineering geological attributes of the rocks and soils, together with exogenic processes and phenomena. The department is furnished with a hydrogeochemical laboratory, equipped with instruments for analyzing chemical, physical-chemical, and physical parameters of water. All investigations are performed within the GIS environment, associated with suitable software, databases and graphical description. Results of investigations performed are often directly applied in water management, civil engineering, space planning, electric power industry, mining industry, and particularly in the protection of environment.

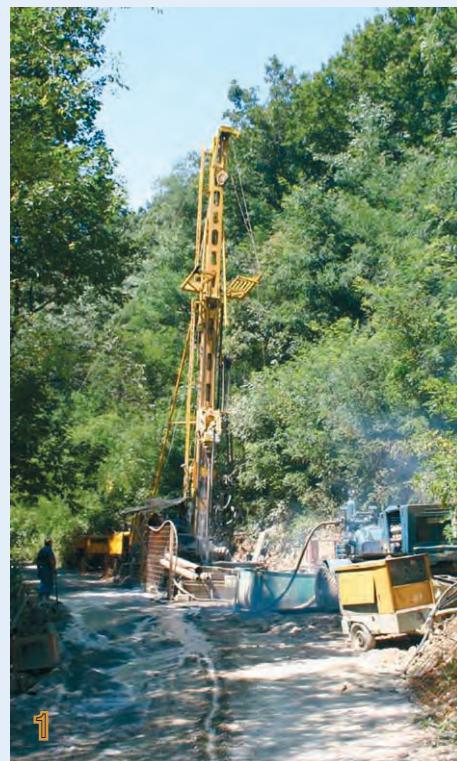
For years, the Department participated in numerous hydrogeological international projects. The close of the year 2006 was marked by the conclusion of the international project KATER II (KArlst waTER research program). Researchers are also included into joint efforts of the international project IAEA, working in the area of the Gacka and Vransko Polje drainage system (nearby Biograd). The water samples are collected at the springs and their hydrogeochemical analysis is performed in the Institute, whereas, isotope analysis is handed over to the partners in Vienna, Rijeka, and to the Institute of Ruđer Bošković in Zagreb. During 2006, within mentioned international projects, there was cooperation with colleagues from Austria, Slovenia and Italy.

U Zavodu za hidrogeologiju i inženjersku geologiju provode se istraživanja na dva znanstvena projekta:

- Osnovna hidrogeološka karta Republike Hrvatske (Dr. sc. Ante Pavičić);
- Osnovna inženjerskogeološka karta Republike Hrvatske (Dr. sc. Renato Buljan).

Tijekom 2006. godine istraživači zavoda sudjelovali su i na više gospodarskih projekata od kojih se mogu izdvajati:

- Hidrogeološka istraživanja za potrebe regionalnog vodovoda Moslavačke Posavine;
- Hidrogeološka istraživanja izvorišta Koreničko vrelo;
- Hidrogeološka istraživanja na području vrela Baških Oštarija;
- Hidrogeološka istraživanja crpilišta Pašino vrelo u Kostajnici;
- Hidrogeološka istraživanja na području Čare na Korčuli;
- Hidrogeološka istraživanja na Papuku;
- Izrada elaborata zaštitnih zona izvorišta „Velika i Mala Reka“-Sv. Ivan Zelina;
- Izrada detaljne inženjerskogeološke karte „Podsljemenske urbanizirane zone“-I. faza;
- Inženjerskogeološka istraživanja na trasi Jadran-ske autoceste, dionica Senj-Žuta Lokva;
- Inženjerskogeološka istraživanja na trasi autoceste Zagreb-Split-Dubrovnik, dionica Ravča-Ploče (sjeverna varijanta).



Two basic scientific projects are ongoing at the Department of hydrogeology and engineering geology:

- *The basic hydrogeological map of the Republic of Croatia, scale 1:100,000 (Dr. Ante Pavičić);*
- *The basic engineering geological map of the Republic of Croatia, scale 1:100,000 (Dr. Renato Buljan).*

During the year 2006, the research team actively participated in a number of enterprise projects such as:

- *Hydrogeological investigations for the purpose of a regional water supply in the Moslavačka Posavina area;*
- *Hydrogeological investigations of the ground-water source area of Koreničko Vrelo;*
- *Hydrogeological investigations in the area of the Baške Oštarije springs;*
- *Hydrogeological investigations of the pumping station of Pašino Vrelo in Kostajnica;*
- *Hydrogeological investigations in the area of Čara on the Island of Korčula;*
- *Hydrogeological investigations on the Papuk Mt.;*
- *Expert report on protection zones of the source area of "Velika and Mala Reka" - Sv. Ivan Zelina;*
- *Small-scale engineering geological map of the "Urban zone on the Medvednica Mt. slopes" - stage I;*
- *Engineering geological investigations at the Adriatic highway, section Senj - Žuta Lokva;*
- *Engineering geological investigations at the Zagreb-Split-Dubrovnik highway, section Ravča-Ploče (northern alternative).*



1

Bušenje istraživačke bušotine.
Drilling of the exploratory borehole.

2

Pojava obilježivača na izvoru Veličanke.
Appearance of the tracer at the Veličanka spring.

Vodoistražni radovi na Papuku

Vodoistražni radovi na Papuku nastavak su hidrogeoloških istraživanja koja se za potrebe Hrvatskih voda sustavno izvode od 2004. godine. Cilj im je nalaženje dodatnih količina podzemne vode za vodoopskrbni sustav Požeštine. U 2006. godini izvedena su dva istražna zdenca i trasiranje špilje Uvraljka.

Izvedbom istražne bušotine PV-1 (dubine 150 m) uz izvor Veličanke 2005., dobiveni su značajni geološki podatci. Izvor se napaja iz karbonatnog vodonosnika, a ne kroz permo-trijaske kvarne pješčenjake. Povoljna geološka građa potaknula je izvođenje istražnog zdenca dubine 100 m. Osnovna namjena bila je ispitati mogućnost dobivanja veće količine podzemne vode od one koja slobodno istječe na samom izvoru, na račun statičkih rezervi vodonosnika. Pokusno crpljenje je izvedeno u uvjetima izrazito niskih voda u prosincu 2006. Tijekom konstantnog crpljenja količinom 16,5 L/s u trajanju od 6:30 sati, protok izvora Veličanke pao je na 2 L/s. Sam izvor i ispitivani zdenac daval su 18,5 L/s uz sniženje od 3,8 m. Budući je na početku testiranja izdašnost izvora Veličanke iznosila oko 14,4 L/s, crpljenjem je ostvareno povećanje dotoka od 4,1 L/s. Hidraulička vodljivost stijenske mase je u rasponu od $8,95 \cdot 10^{-5}$ do $9,96 \cdot 10^{-5}$ m/s. Iz ispitivanog zdenca teoretski bi se moglo crpiti 40 L/s uz sniženje oko 17,6 m. Za konačnu ocjenu pozitivnih efekata, odnosno mogućeg povećanja izdašnosti potrebno je izvesti pokusno crpljenje s jačom crpkom.

Istražni zdenac BD-1 (dubok 100 m) izведен je u dolini Dubočanke sjeverno od Velike, a zahvatio je dolomite i vapnence srednjeg trijas-a. Hidraulička vodljivost stijenske mase je u rasponu od $2,55 \cdot 10^{-6}$ do $2,60 \cdot 10^{-6}$ m/s, a teoretski bi se moglo dobiti 4 L/s podzemne vode uz sniženje od oko 25 m. Osnovni problem ispitivane lokacije jest glinovita isplina kaverni (promjera do 4 m), koju nije bilo moguće isprati.

Trasiranje špilje Uvraljke izvedeno je s 3,5 kg Na-floresceina (uranin). Premda su postojeće spoznaje upućivale na smjer podzemnog otjecanja prema izvoru Kovačica, pojавa traser-a registrirana je samo na izvoru Veličanke. Prva pojавa traser-a zabilježena je nakon 36 sati. S obzirom da je Veličanka od ponora udaljena 3110m, prividna brzina toka je 2,27 cm/s. Maksimalna koncentracija traser-a od 0,3103 mg/L zabilježena je 26.03. u 6 sati, 86 sati nakon ubacivanja. Na Veličanki je isteklo oko 3,008 kg boje, odnosno prinos traser-a bio je 86 %.

Water research on the Papuk Mt.

Water research on the Papuk Mt. is the continuation of hydrogeological investigations carried out regularly for the "Hrvatske Vode" from the year 2004. Research works are aimed at finding additional amounts of drinking water for the water supply system of Požeština. During 2006, two research wells were drilled for the purpose of tracing the Uvraljka cave.

The research borehole PV-1 (150 m depth) near the Veličanka spring, drilled during 2005, has provided important geological data. The spring recharges from the carbonate-rock aquifer, avoiding the Permian-Triassic quartz sandstones. The favorable geological setting instigated the construction of a research well with a 100 m depth. The fundamental purpose of the well was to scan the possibility of obtaining greater quantities of water with respect to that freely discharging at the mouth of the spring, on account of static water reserves in an aquifer. Experimental pumping was carried out under conditions of extremely low water in December 2006. With continuous pumping with 16.5 L/s for a period of six and a half hours, the spring discharge decreased to 2 L/s. Both the spring and the investigated well had the yield of 18.5 L/s with a drawdown of 3.8 m. Given that the spring yield was 14.4 L/s in the beginning of the test, the pumping resulted in increasing the recharge by 4.1 L/s. Hydraulic conductivity of the solid rock ranged from $8,95 \cdot 10^{-5}$ to $9,96 \cdot 10^{-5}$ m/s. Theoretically, the tested well could yield 40 L/s with drawdown of about 17.6 m. In the final analysis it was necessary to evaluate the positive effects of pumping through experimental pumping, using a more powerful water pump.

The test well BD-1 (100 m depth) was drilled in the Dubočanka valley, north of Velika, passing through dolomites and limestones of the Middle Triassic. Hydraulic conductivity of rocks ranged from $2,55 \cdot 10^{-6}$ to $2,60 \cdot 10^{-6}$ m/s yielding, in theory, up to 4 L/s of groundwater with a drawdown of about 25 m. The main problem of the tested location was a clayey infill in the caverns (up to 4 m in diameter) that was impossible to wash out.

Tracing of the Uvraljka cave was performed with 3.5 kg of Na fluoresceine (uranine). Although the recent facts indicated that the direction of underground flow was toward the Kovačica spring, the occurrence of a tracer was registered only at the mouth of the Veličanka spring. The first occurrence of the tracer was recorded after 36 hours. With regard to the fact that Veličanka was 3110 m far from the swallow-hole the apparent flow velocity was 2.27 cm/s. Maximum concentration of the tracer of 0.3103 mg/L was recorded on March 26 at 06:00, that is, 86 hours after the tracer was poured. At the mouth of the Veličanka spring, 3.008 kg of dye flowed out, which referred to 86% of the transport of the tracer.

Tunel "Vratnik"

Tijekom 2006. godine nastavljena su inženjersko-geološka istraživanja u sklopu izrade geotehničkih projekata budućih autocesta. Obavljena su istraživanja na dionici "Senj-Žuta Lokva". Projektiранa trasa najvećim dijelom prolazi kroz vapnence i dolomite jurske starosti. Tunel „Vratnik“ se nalazi sjeverno od vrha Vratnik, dužine je 3420m, a maksimalni nadstoj je 260 m.

Takav složeni objekt zahtijevao je ozbiljan pristup i detaljna istraživanja geološke građe područja, tektonike, razina podzemne vode, očekivanih kategorija stijenske mase itd. Korišteni su podatci seismotektonskih, hidrogeoloških, tektonskih, sedimentoloških, stratigrafskih i inženjerskogeoloških istraživanja. Rezultati su prikazani na kartama i profilima M 1:5000 i 1:2000. Spoznaje o inženjerskogeološkim značajkama temeljene su na geofizičkim istraživanjima (plitka refleksija i geoelektrika), istraživačkim bušotinama i laboratorijskim ispitivanjima.

Podatci su obrađeni računalnim i statističkim metodama, a rezultati su uvršteni u klasifikacije stijenskih masa koje se primjenjuju u tunelogradnji. Uspješnost prognoze stanja stijene na niveleti tunela potvrđena je brojnim primjerima, a temelji se upravo na detaljnim i multidisciplinarnim geološkim istraživanjima. Svi prikupljeni podaci biti će ugrađeni u Osnovnu inženjerskogeološku kartu ovog područja i predstavljaju temelj novih spoznaja.

Tunnel "Vratnik"

During 2006, engineering geological research was continued within the framework of geotechnical projects, with regard to the construction of future highways. The research work was completed at the "Senj-Žuta Lokva" section. The projected route, more often than not, crossed terrains built of limestones and dolomites of the Jurassic age. The tunnel "Vratnik" is situated north of the Vratnik summit. Its length is 3420 m with a maximum overburden amounting to 260 m.

Such a complex object entailed a serious approach and detailed research work of the geological setting in the area, including tectonics, groundwater level, rock mass classification, and so on. The results were represented on maps and profiles, scale 1:5,000 and 1:2,000. Ideas about the engineering geological characteristics were based on geophysical investigations (shallow seismic reflection and geoelectrics), research boreholes, and laboratory analyses.

Data were processed using statistical methods, and computed values were included in the rock mass classifications used in tunnel building. Prognostication success relating to the rock conditions on the tunnel level was confirmed by detailed and multidisciplinary geological investigations. All collected data, demonstrating the base of accumulated knowledge and new ideas will be ingrained in the Basic engineering geological map of the investigated area.



Istraživanja područja budućeg tunela "Vratnik".
Exploration on future "Vratnik" tunnel area.

ZAVOD ZA MINERALNE SIROVINE

DEPARTMENT OF MINERAL RESOURCES

Predstojnik Zavoda / Head of Department:

Mr. sc. Slobodan MIKO

tel: (+385 1) 6160-745

fax: (+385 1) 6144-716

e-mail: slobodan.miko@hgi-cgs.hr

Istraživači Zavoda za mineralne sirovine provode istraživanja, daju informacije i stručna mišljena za potrebe eksploatacije i primjene mineralnih sirovina, te provode anorganska geokemijska istraživanja u okolišu. Istraživači Zavoda pronalaze i procjenjuju područja s potencijalnim izvorima mineralnih sirovina, rješavaju probleme vezane za njihovu genezu znanstvenim metodama, te izrađuju elaborate o rezervama i studije o utjecaju na okoliš. Geokemijska istraživanja provode se kroz analizu tla, vode, vodotočnih nanosa i jezerskih sedimenata, koji imaju bitnu ulogu u istraživanju čovjekovog utjecaja na okoliš. Ova istraživanja usmjerena su na utvrđivanja koncentracija i raspodjelu kemijskih elemenata pomoću geokemijskog kartiranja i detaljnijih kemijskih analiza. Geokemijska istraživanja usmjerena su na krški prostor RH. Sva istraživanja provode se uz korištenje GIS alata i suvremenih analitičkih tehnika, kao i klasičnih geoloških metoda. Istraživači zavoda za mineralne sirovine sudjeluju u izvedbi četiri znanstvena projekta koje financira MZOŠ.

1. Karta mineralnih sirovina RH (Dr. sc. Zoran Peh);
2. Osnovna geokemijska karta RH (Dr. sc. Josip Halamić);
3. Holocensi sedimenti kao zapis promjena u okolišu Jadranskih sljevova (Dr. sc. Georg Koch);
4. Zaštita okoliša pri eksploataciji nemetalnih mineralnih sirovina u kršu (Dr. sc. Darko Vrkljan).

The research team of the department of mineral resources is engaged in various investigations, and provides information and expert opinions for the purpose of exploitation and application of mineral resources, and also carries out geochemical investigations in the environment. They discover and evaluate areas with potential deposits of mineral ores, solve the problems associated with their genesis using scientific methods, and write articles on reserves of mineral resources, as well as, studies on the environmental impact. Geochemical investigations are carried out through soil analysis, analysis of water, and stream and lake sediments, which is important for amassing knowledge on human impact on the environment. These investigations are aimed at establishing the content and distribution of chemical elements through geochemical mapping and detailed chemical analysis. Geochemical research is directed to the karst areas of the country. All research work is performed using GIS tools and modern analytic techniques as well as classical geological methods. Researchers of this department participate in four scientific projects funded by the Ministry of Science, Education and Sports:

1. Map of the mineral resources of the Republic of Croatia (Dr. Zoran Peh);
2. Basic geochemical map of the Republic of Croatia (Dr. Josip Halamić);
3. Holocene sediments as a record of change in the Adriatic drainage system environment (Dr. Georg Koch);
4. Protection of environment during exploitation of nonmetallic mineral resources in the karst areas (Dr. Darko Vrkljan).



Karta mineralnih sirovina Međimurske županije.
Map of mineral resources of Međimurje County.

Istraživanja mineralnih sirovina

S obzirom na geološku građu i nastanak, Hrvatska ima široku osnovu nemetalnih mineralnih sirovina u čijim istraživanjima sudjeluje i Zavod za mineralne sirovine. Istraživanja obuhvaćaju ležišta kvarcnog pjeska, bentonita, keramičkih i ciglarskih glina, gipsa, tufa, lapora, dolomita, vapnenca, eruptivnih materijala, šljunka, arhitektonskoga kamena i morske soli. Nemetalni mineralni resursi Hrvatske omogućuju već tradicionalno intenzivnu eksploataciju i preradu nemetalnih sirovina u industriji i graditeljstvu.

Uloga Zavoda za mineralne sirovine je priprema odgovarajućih znanstveno utemeljenih podataka o mineralnim sirovinama i njihovom pojavitvivanju.

Na temelju kompilacije baze općih podataka za mineralne sirovine Republike Hrvatske u kojoj su prikupljeni podaci o preko 4500 eksploatacijskih polja, ležišta i pojava metalnih, nemetalnih i energetskih mineralnih sirovina, u tijeku je izrada karte mineralne potencijalnosti u kombinaciji s litološkim i formacijskim geološkim kartama i odgovarajućim Tumačima za područje Dalmacije (Listovi Zadar, Split, Sinj, Vis, Makarska i Dubrovnik) i Sjeverozapadne Hrvatske (List Zagreb), M 1:200.000. Izrađene su karte potencijalnosti za Šibensko-kninsku i Međimursku županiju na temelju prostorne analize u GIS-u, te su izrađene namjenske karte potencijalnosti mineralnih sirovina koje daju različite zone potencijalnosti s obzirom na uvjete korištenja prostora. U tijeku je razvoj intelligentnog GIS modela pomoću Arc-WofE (Weights of Evidence-Rasuđivanja na bazi prethodnih slučajeva) za određivanje najpovoljnijih lokacija za eksploataciju tehničko-građevnog kamena na prostoru Dalmacije. Generirani model će koristi tematske karte koji uključuju distribuciju postojećih eksploatacijskih polja, gustoću stanovništva, transportnu mrežu te karte geološke potencijalnosti mineralnih sirovina.

Baze podatka mineralnih sirovina i izrađeni modeli poslužit će kao podloga za upravljanje i donošenje odluka za korištenje zemljišta na razini županijskih prostornih planova, za izradu strategije gospodarenja mineralnih sirovina, za utvrđivanje utjecaja na okoliš, za održivo gospodarenje mineralnim sirovinama i njihovo očuvanje za buduće generacije.

Mineral resources research

With regard to its geological setting and genesis, the Republic of Croatia is endowed with an extensive background of nonmetallic mineral resources. The department of mineral resources takes its part in their research, which includes deposits of quartz sand, bentonite, clays for ceramic and brick production, gypsum, tuff, marl, dolomite, limestone, igneous rocks, gravel, building stone, and sea salt. Nonmetallic mineral resources of Croatia allow the already traditional exploitation and processing of nonmetallic raw materials in industry and construction works.

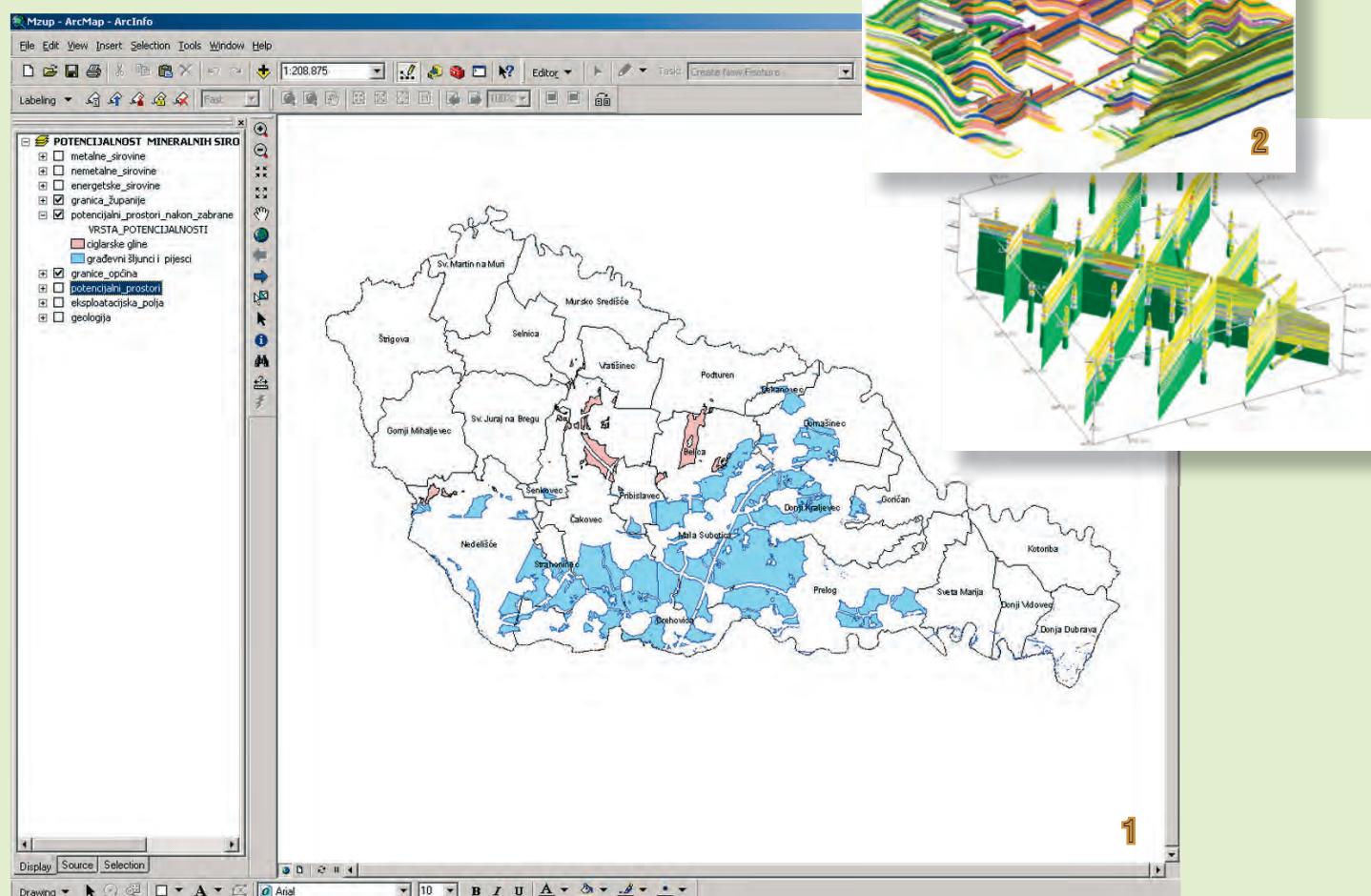
The role of the Department of Mineral Resources is the preparation of relevant scientifically based databases of mineral resources and their occurrences.

On the basis of the compiled database containing general information about mineral resources of a country with over 4,500 exploitation fields, deposits, and occurrences of metallic, nonmetallic, and energy mineral resources, the map of mineral potentiality is currently under construction in combination with lithologic maps, formation geological maps, and relevant explanation books for the area of Dalmatia (sheets of Zadar, Split, Sinj, Vis, Makarska, and Dubrovnik) and Northern Croatia (sheet of Zagreb), scale 1:200,000. The mineral potentiality maps were constructed for Šibenik-Knin and Međimurje counties based on space analysis in GIS. Also, thematic mineral potentiality maps were constructed displaying various zones of potentiality with regard to the sustainable environment use and protection. An intelligent GIS model with the help of Arc-WofE (Weights of Evidence) is currently being developed in the department. Its purpose is to define the most favorable locations for exploitation of technical stone in Dalmatia. The generated model will make use of thematic maps that include distribution of existing exploitation fields, population density, traffic network, and maps of geological potentiality of mineral resources.

Mineral resource databases will serve as a background for management and decision making for land use at the level of county physical planning, for making the strategies of mineral resource management, for establishing the degree of environmental impact, for sustainable management of mineral resources and their protection for future generations.

Djelatnici zavoda provode i detaljna istraživanja pojedinih ležišta nemetalnih mineralnih sirovina, kao što su ležišta opekarskih glina, građevno-tehničkog kamenja i sirovine za cementnu industriju. U suradnji s drugim relevantnim organizacijama i pojedinicima izrađuju studije utjecaja na okoliš. Tijekom 2006 Zavod je radio na istraživanju opekarskih glina za potrebe Wienerbergera d.o.o. iz Karlovca, KIO-Keramike, IGM Slavonije (Nexe Grupa), te staklarskog pijeska s Lipik-glas d.o.o. iz Lipika. Za potrebe Našicecementa d.o.o. (Nexe Grupa) i njihove sirovine za cement izrađen je digitalni 3D model s bazom podataka pomoću softverskih modela Rockworks2006, RockPlot 2005 i ArcMap Spatial Analyst za ležišta Bukova glava i Vranović (na temelju 220 istražnih bušotina).

The Department staff performs detailed research work of individual nonmetallic mineral deposits, such as, deposits of brick clay, building stone, and raw material for the cement industry. In cooperation with other relevant organizations and individuals they realize studies about environmental impact. During the year 2006, this department investigated all the brick clay, answering the requests of Wienerberger d.o.o. from Karlovac, KIO-Keramika, IGM Slavonija (Nexe Group), as well as, glass sand with Lipik-glas d.o.o. from Lipik. For Našicecement d.o.o. (nexx Group) and its cement raw material, the digital 3D model with a relevant database has been constructed using software models, such as, Rockworks 2006, RockPlot 2005, and ArcMap Spatial Analyst for the deposits of Bukova Glava and Vranić (based on 220 research boreholes).

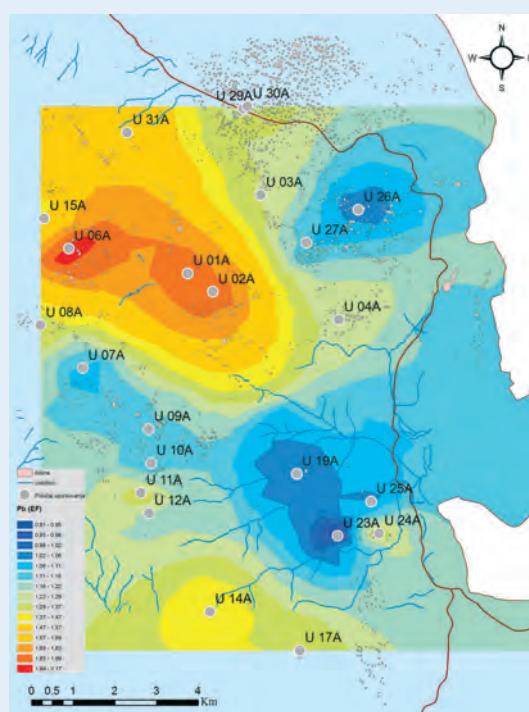


1 Karta potencijalnosti za opekarsku glinu, šljunak i pijesak Međimurske županije.
Map of potentiality for brick clay, gravel and sand of Međimurje County.

2 3D litološki model ležišta Bukova glava (Našicecement d.o.o.) na temelju podataka 220 istražnih bušotina (programi: Rockworks 2006 i ArcMap Spatial Analyst).
3D lithologic model of the Bukova glava deposit (Našicecement Ltd.) based on the data collected at 220 research boreholes (software: Rockworks 2006 and ArcMap Spatial Analyst).

Geokemijska istraživanja okoliša

Veći dio zemljine površine sadrži zapis antropogenih i klimatskih utjecaja. Sedimenti jezera, aluvijalnih i ponornih naplavnih ravnica i priobalnih zaljeva koji imaju dotok slatke vode krških prostora objedinjuju i arhiviraju promjene u sljevovima te bilježe i tijek akumulacije teških metala. Geokemijska istraživanja usmjerena su na krš budući da je on tokom holocena zahvaćen intenzivnom erozijom (naročito u posljednjih 2000 godina), te industrijskim i poljoprivrednom aktivnošću u proteklom stoljeću. Holocene sedimenti su zapis promjena u okolišu i predstavljaju potencijalne nositelje toksičnih kemikalija. Stoga područja s neprekinitim taloženjem sedimenta omogućuju rekonstrukciju klimatskih promjena i promjena u upotrebi zemljišta u osjetljivim okolišima. Rezultati geokemijskih istraživanja doprinose poznavanju odnosa kemijskog statusa voda i sedimenta, te promjena u upotrebi zemljišta nastalih kao posljedica klimatskih promjena i djelovanja čovjeka. Geokemijskim istraživanjima rješavaju se pitanja: (1) kako su klima i ljudi promijenili bilance voda, sedimenata i kemijskih supstanci za vrijeme holocena u jadranskom krškom prostoru i kakve su posljedice tih promjena, (2) kako promjene klime, upotrebe zemljišta i razine mora utječu na ukupnu raspodjelu sedimenta i kemijskih elementa u priobalnim područjima, te u jezerskim i kopnenim okolišima (sljevovima), i (3) kako se dobivene spoznaje o dinamici erozijskih, sedimentacijskih i biokemijskih procesa mogu primjeniti u gospodarenju kršom. Sustrojna u geokemijskim istraživanjima ostvarena je s Hrvatskim vodama i INA-Naftaplinom.



Environmental geochemistry

Most part of the country contains the record of anthropogenic and climatic impacts. Lake sediments, alluvial, and sinkhole floodplain sediments, as well as, coastal bay characteristics for their inflow of sweetwater from karst hinterland bring together and archive the changes in catchment areas recording the direction and accumulation of heavy metals. Geochemical investigations are directed to karst, as the karst is affected by intensive erosion during the Holocene (during the last 2.000 years in particular), as well as, by industrial and agricultural activity in the last century. Holocene sediments are the record of changes in the environment representing potential carriers of toxic chemicals. Thus the areas with uninterrupted sedimentation of sediments enable reconstruction of climatic changes and changes in land use in sensitive areas. Results of geochemical investigations contribute to our insight into the relationship between chemical states of water and sediment as well as to understanding the changes in land use caused by climate changes and human activity. Geochemical investigations serve to answer the questions of (1) how climate and humanity changed the balance of waters, sediments, and chemical substances, during Holocene, in the Adriatic karst area and what are the consequences to suffer, (2) how the climate changes, changes in land use, and changes of sea level affect the bulk distribution of sediments, and chemical elements in the coastal areas and in lake and land environments (river catchments), and (3) how the assessed knowledge on dynamics of erosive, sedimentary, and biochemical processes can be applied to karst management. Geochemical research work is achieved by cooperation with Hrvatske vode and INA-Naftaplin.

Karta distribucije faktora (EF) obogaćenja za olov tj. odnosa Pb/Sc u površinskim tlima u odnosu na Pb/Sc u dubljim horizontima tla na području Une.
Map of the enrichment factor (EF) distribution for lead, that is, ratio of Pb/Sc in the topmost soil horizon in relation to deeper soil horizons in the river Una area.

GEOLOŠKA SLUŽBA

GEOLOGICAL SURVEY

Voditelj službe / Head of the survey: Dr. sc. Josip HALAMIĆ

tel: (+385 1) 6160-749

fax: (+385 1) 6144-718

e-mail: josip.halamic@hgi-cgs.hr

Tijekom 2006. godine težište rada u Geološkoj službi bila je razrada i provedba I faze Geološkog informacijskog sustava. Taj sustav treba omogućiti potporu u istraživanju, projektiranju, izgradnji, održavanju, praćenju i razmjjeni informacija, kako unutar instituta, tako i na razini države.

Geološki informacijski sustav

Organizacija podataka izrađena je u ESRI softver-u ArcGIS. Prostorni prikaz podataka prilagođen je mjerilima od 1:25.000 do 1:300.000, a određen je u 5 zoni Gauss-Krüger-ove pravokutne mreže, centralnim meridijanom 15° istočno od Greenwich-a i Bessel-ovim elipsoidom. Posao izrade Geološkog informacijskog sustava povjeren je poduzeću GIS-DATA iz Zagreba.

Model podataka

Logički model podataka poslužio je kao temelj za izradu fizičkog modela baze podataka u formi Enterprise Geodatabase. Struktura se generira iz XML file-a u prostornoj ArcSDE bazi, koja u podlozi ima MS SQL Server 2000. Baza se sastoji od skupova podataka u formi Feature dataset-ova definiranih tematskim cjelinama, koji sadrže određene klase feature-a (point, line, poligon), samostojče tablice statičkih i dinamičkih podataka, relacije s definiranim tipom, ključevima (Key) i pravilima (Cardinality). U najvećoj mogućoj mjeri su ponuđene mogućnosti unosa kroz domene, a definirane su i mjerne jedinice i rasponi unosa u numerička polja.

Opis strukture baze podataka sadrži:

- naziv polja (field name - korišteni znakovi i njihov broj prilagođeni bazi),
- širinu polja (precision/length),
- broj decimalnih mjesta (scale),
- tip polja (data type),
- objašnjenje i/ili predefinirane mogućnosti unosa (domain).

In 2006, emphasis was laid on elaboration and implementation of the first phase of the Geological Information System. This system should ensure support not only in investigation, planning, building, maintenance, monitoring, and information exchanging, both inside and outside of the Institute, but also at the state-level information.

Geological Information System

The database has made in the ESRI software ArcGIS. Spatial data display was adjusted according to the scales 1:25,000 and 1:300,000 and defined within the fifth zone of the Gauss-Krueger rectangular grid with the central meridian, 15° east of Greenwich and Bessel ellipsoid. The building of the Geological Information System was entrusted to GISDATA from Zagreb.

The data model

The logical model of the database has served as the basis for the physical database model construction in the form of the Enterprise Geodatabase. The data structure was generated from an XML file in the ArcSDE spatial data server on the MS SQL database server 2000. The database consists of data clusters in the shape of Feature datasets defined by thematic units, which contain defined feature categories (point, line, polygon), autonomous tables of static and dynamic data, relationships with defined types, keys, and rules (Cardinalities). The possibilities of the data input were offered to the maximum through the domains, even as the measure units and range of input into numeric fields are also simultaneously defined.

Description of the database structure:

- Field name (used symbols and their number adjusted to the database)
- Field width (precision/length)
- Number of decimals (scale)
- Field type (data type)
- Explanation and/or predefined input options (domain)

Uz svako polje (atribut) navedeno je prema potrebi: kratko objašnjenje, mjerna jedinica i/ili mogućnost unosa (domain). Nazivi domena, u kojima su definirane mogućnosti unosa, pisane su kurzivom (italic) i uz svaku tablicu su u nastavku prikazane predviđene vrijednosti, šifra i opis.

Geološki informacijski sustav sastoji se od sljedećih tematskih cjelina:

1. Geologija

- Geološka karta 1:300.000,
- Tektonika karta 1:300.000,
- Osnovna geološka karta 1:100.000,
- Osnovna geološka karta 1:50.000,
- Strukturno-geomorfološka karta 1:100.000.

2. Hidrogeologija

- Hidrogeološka karta 1:300.000,
- Osnovna hidrogeološka karta 1:100.000 s bankom hidrogeoloških podataka,
- Geotermalna karta 1:100.000.

3. Inženjerskogeološka karta

- Inženjerskogeološka karta 1:300.000,
- Osnovna inženjerskogeološka karta 1:100.000.

4. Mineralne sirovine

- Katastar mineralnih sirovina,
- Karte potencijalnosti.

5. Geokemijska karta

- Baza terenskih istraživanja i rezultati analiza,
- Interpretacijske karte distribucije kemijskih elemenata.

Digitalni terenski dnevnik

Izrada predloška digitalne verzije terenskog dnevnika i standardizacija unosa podataka je dio projekta informatizacije cijelog Hrvatskog geološkog instituta.

Elektronički terenski dnevnik za Osnovnu geološku kartu 1:50.000 izrađen je u MsAccess-u. Ms Access izabran je zato što je kompatibilan s ArcGIS-om i dostupan je na svakom računalu. Svi upisani podatci u terenskom dnevniku mogu se odmah pretraživati i to ne samo tablično u samom predlošku, nego analitički i grafički u ArcGIS-u, tj. na geološkoj karti.

Opći dio obvezan je za upis terenskih podataka. Većina podataka za upis mora se izabrati iz odgovarajućih tablica koje su pomoću Lookup Wizarda spojene s poljem u formi. Time je unos nestandardiziranih podataka sveden na najmanju moguću mjeru.

Tablice s popisom vrsta stijena, starosti i litostratigrafskih jedinica organizirane su u vidu kataloga i za sada radne, jer treba usuglasti nazivlje i standarde za navedene podatke. Osnovna forma terenskog dnevnika povezana je sa specijalističkim podbaza-ma.

Each field (attribute) is provided, if needed, with short explanation, measure unit and/or input option (domain). The domain titles with defined input options are written in italics, and, additionally, each table has anticipated values, codes, and description as its extension.

The Geological Information System is composed of the following thematic units.

1. Geology

- Geological map, scale 1:300,000
- Tectonic map, scale 1:300,000
- Basic geological map, scale 1:100,000
- Basic geological map, scale 1:50,000
- Structural-geomorphological map, scale 1:100,000

2. Hydrogeology

- Hydrogeologic map, scale 1:300,000
- Basic hydrogeologic map, scale 1:100,000, including hydrogeological database
- Geothermal map, scale 1:100,000

3. Engineering geological map

- Engineering-geological map, scale 1:300,000
- Basic engineering-geological map, scale 1:100,000

4. Mineral resources

- Cadastre of mineral resources
- Potentiability maps

5. Geochemical map

- Database of field investigations and analytical results
- Chemical elements distribution maps

Digital field book

The digital field book development and standardization of the data entry is a part of the informatization of the whole Croatian Geological Survey.

The electronic field book for the Basic geological map 1:50.000 is created in the Ms Access. Ms Access was chosen because of its compatibility with ArcGIS and availability in each computer. All input data could be retrieved immediately, not only as tabular data in the templates, but also as analytical and graphical data in the ArcGIS software, i.e. in a geological map.

The general part of the field book is mandatory for the field data entry. Majority of the data has to be selected in specific tables which are connected by a Lookup Wizard to a field in the form. Thus, the entry of unstandardized data is reduced to minimum.

The tables containing the list of rock types, stratigraphic ages and lithostratigraphic units are organized in the form of a catalogue. In order to harmonize terminology and standardization of the data tables are represented as a temporary document (draft version). The basic form of the field book is linked to specialized subdatabases.

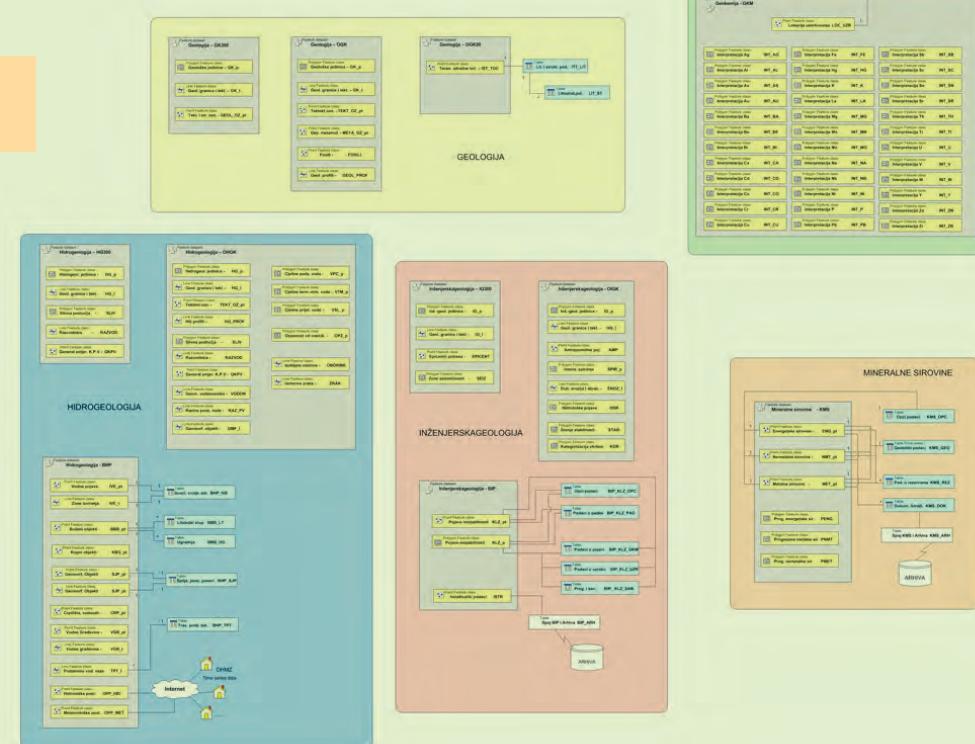
Digitalni terenski dnevnik se od ove godine u Hrvatskom geološkom institutu počeo koristiti u radu. Osim unosa podataka na ovogodišnjim projektima, započelo se i s unosom starih podataka. To je dugotrajan i mukotrpan posao čiji će se pravi rezultati vidjeti tek u budućnosti. Hrvatski geološki institut ubrzano se uključuje u svjetske informatičke trendove. Sljedeća generacija geoloških karata i izvješća trebala bi biti generirana iz digitalne baze podataka.

Planirane aktivnosti

U 2007. godini glavne aktivnosti unutar Geološke službe bit će usmjerenе na izradu II faze Geološkog informacijskog sustava i na njegovu provedbu. To podrazumijeva veliki angažman oko unosa postojećih podataka u formirane podbaze tog sustava. Osim toga, planirano je skeniranje i pohranjivanje na elektronski medij svih starih elaborata, izvješća i studija koji se sada nalaze u papirnatom obliku u Fondu stručne dokumentacije Instituta. Tako obrađeni podatci bit će uklopljeni u Geološki informacijski sustav što će olakšati pretraživanje i korištenje postojeće fondovske dokumentacije.

Na međunarodnom planu u 2007. godini planira se potpisivanje Sporazuma o suradnji s Geološkom službom Republike Bosne i Hercegovine i Republike Poljske. Aktivno ćemo sudjelovati i u ostvarivanju međunarodnog projekta OneGeology. S geološkim službama Republike Mađarske i Republike Slovenije radit će se na usklađivanju pograničnih listova geoloških karata u mjerilu 1:100.000.

Shema geološkog informacijskog sustava.
Geological information system scheme.



Digital field book is in use from the beginning of this year. Aside from input of the current mapping project field data the entry of the old field data has also begun. That is a very hard and time-consuming work which visible results only in the near future. The Croatian Geological Survey try hastily to follow the world's newest Information Technology trends. The next generation of the geological maps and geological reports should have been generated from the digital database.

Planned activities

The main activities of the Geological Survey during the year 2007 will be directed to construction and implementation of the II phase of the Geological Information System. This implies great effort to input the existing data into the sub-databases of the newly created system. Besides, it is also planned scanning and storing on the electronic medium all old studies and reports, now existing in a written form in the Library fund of the Institute. Data processed in this way will be incorporated in the Geological Information System, which will facilitate browsing and use of the current fund's documentation.

At the international level the signing of the Cooperation Agreement with the Geological Survey of Bosnia and Herzegovina is planned in 2007. We shall actively participate in the implementation of the OneGeology project. In cooperation with Geological Surveys of Hungary and Slovenia we will synchronize the transboundary geological maps, scale 1:100,000.

KNJIŽNICA HRVATSKOGA GEOLOŠKOG INSTITUTA

LIBRARY OF THE HGI-CGS

Voditeljica knjižnice / Head of the Library: Mr. sc. Alisa MARTEK

tel: (+385 1) 6160-786

fax: (+385 1) 6144-718

e-mail: alisa.martek@hgi-cgs.hr

Knjižnica Hrvatskoga geološkog instituta posjeđuje veliki fond iz područja geoznanosti i geološkog inženjerstva. U 2006. godini fond je činilo 3426 svezaka knjiga i ukupno 930 naslova časopisa, od kojih je u 2006. redovito stizalo 165 naslova u tiskanom obliku, a 575 u zbirkama elektroničkih časopisa. Ponosni smo na najstarije dokumente koji datiraju iz sredine 19. stoljeća. U knjižnici se nabavljaju knjige i časopisi za potrebe rada na projektima Hrvatskog geološkog instituta. Knjižnica aktivno sudjeluje u međuknjižničnoj posudbi.

Kao rezultat rada na Tempus projektu pod nazivom „Model sveučilišnog knjižničnog sustava Sveučilišta u Zagrebu“, koji je trajao do 14. listopada 2006. a na kojem je sudjelovala mr. sc Alisa Martek, objavljena je knjiga u izdanju Nacionalne i sveučilišne knjižnice u Zagrebu.

HGI-CGS library has large collection of literature on geosciences and geological engineering. There are 3426 titles of books and 930 journal titles out of which in 2006 we received 165 print titles and 575 e-journals in electronic collections. We are especially proud of the oldest documents in the library dating back to the middle 19th century. In the library books and journals are purchased for the Croatian Geological Survey projects. The library participates actively in interlibrary loan.

A book was published as a result of the Tempus project "A Model of the University of Zagreb Library System". The project ended 14th October 2006 and Alisa Martek, the head librarian participated actively.

ELEKTRONIČKI ČASOPISI I BAZE PODATAKA KOJIMA KNJIŽNICA OMOGUĆUJE PRISTUP ELECTRONIC JOURNALS AND DATA BASES WHICH ACCESS IS ENABLED BY THE LIBRARY

SCIENCE DIRECT (<http://www.sciencedirect.com>)

SPRINGER LINK (<http://www.springerlink.com>)

WILEY INTERSCIENCE (<http://www3.interscience.wiley.com/>)

BLACKWELL SYNERGY (<http://www.blackwell-synergy.com/>)

CAMBRIDGE UNIVERSITY PRESS (<http://journals.cambridge.org/>)

OXFORD UNIVERSITY PRESS (<http://www.oxfordjournals.org/>)

SCOPUS (<http://www.scopus.com/>)

EBSCO baze podataka (<http://search.epnet.com>)

OVIDove BAZE PODATAKA (<http://gateway.ovid.com/autologin.html>)

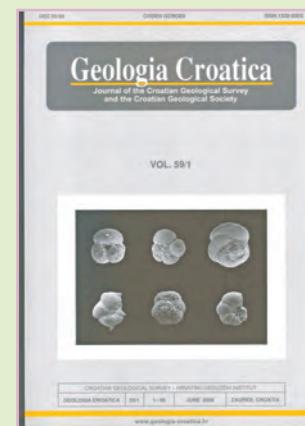
WEB OF SCIENCE (<http://wos.irb.hr/>)

ENGINEERING VILLAGE 2 (<http://www.engineeringvillage.com/>)

SCIRUS (<http://www.scirus.com>)

GEOLOGIA CROATICA

Geologija Croatica je znanstveni časopis Hrvatskog geološkog instituta i Hrvatskoga geološkog društva koji se bavi svim aspektima geoznanosti. Članci koji prolaze međunarodnu recenziju izdaju se dvaput godišnje na engleskom jeziku. Urednici su dr. sc. Ivo Velić i dr. sc. Igor Vlahović. Za više informacija molimo obratite se tajnici časopisa mr. sc. Alisi Martek (tel. 01/6160786) ili elektroničkom poštom alisa.martek@hgi-cgs.hr te na mrežnoj stranici časopisa: www.geologiacroatica.hr



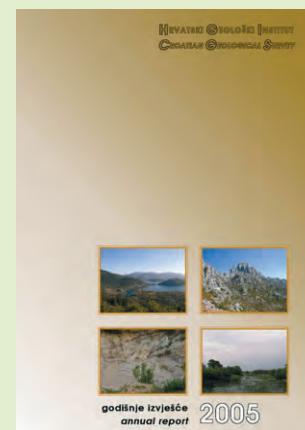
Geologija Croatica is the scientific journal of the Croatian Geological Survey, and the Croatian Geological Society which is devoted to all aspects of geosciences. Its articles have international review and are published twice a year in English. The editors are Dr. Ivo Velić and Dr. Igor Vlahović. More information can be had from the secretary of the magazine Alisa Martek, MLIS on tel. 01/6160786 or on e-mail alisa.martek@hgi-cgs.hr or at the web site of the magazine: www.geologiacroatica.hr

Prikaz publikacija izdanih u HGI-CGS Presentation of the publications published in HGI-CGS:

Više informacija kod voditeljice knjižnice / More information at the library
Alise Martek, tel. 01/6160-786 ili elektroničkom poštom alisa.martek@hgi-cgs.hr



Milan Herak
Medvednica - Zagonetno zagrebačko gorje
Enigmatic Zagreb Mountains
ISBN 953-154-709-2



Ranko Biondić & Tvrtnko Korbar
HRVATSKI GEOLOŠKI INSTITUT - Godišnje izvješće 2005.
CROATIAN GEOLOGICAL SURVEY - Annual report 2005
ISBN 953-6907-13-5

GEOLOŠKE KARTE

POSEBNI PROJEKTI MZOŠ RH

GEOLOGICAL MAPS

SPECIAL PROJECTS FUNDED BY THE MINISTRY OF SCIENCE,
EDUCATION, AND SPORTS OF THE REPUBLIC OF CROATIA

Osnovna geološka karta Republike Hrvatske 1:50.000

Basic geological map of the Republic of Croatia 1:50,000

Glavni istraživač/Main researcher: Dr. sc. Marko ŠPARICA (marko.sparica@hgi-cgs.hr)

Osnovna geološka karta Republike Hrvatske, mjera 1:50.000, čini kontinuirani znanstvenoistraživački projekt, koji se temelji na sustavnim geološkim istraživanjima u Hrvatskoj.

Budući da je Osnovna geološka karta konceptualno temeljena na litostратigrafskoj analizi, to je čini primarnim elementom za ocjenu ekonomskog potencijala svake regije, pa je stoga nezaobilazan preduvjet za kvalitetno upravljanje prirodnim resursima i zaštitu okoliša cjelokupnog državnog teritorija Republike Hrvatske.

Suvremeni rad na Osnovnoj geološkoj karti podrazumijeva izradu sustavnih i koherentnih baza podataka te obradu podataka u GIS sustavu, čime takva karta postaje digitalna podloga za sva daljnja specijalistička i detaljna istraživanja, odnosno osnova za izradu specijalističkih i drugih karata. Time karta doprinosi integraciji fundamentalnih i primjenjenih istraživanja.

Geološka istraživanja u okviru projekta podijeljena su u dva geološki definirana prostora: "Dinaridi" (zapadna i južna Hrvatska) i "Panon" (središnja i sjeverna Hrvatska). Daljnja podijela obuhvaća potprojekte, koji su prostorno definirani odabranim listovima topografske podloge.

Tijekom 2006. godine napravljene su analize postojećih podataka kao i sveobuhvatne kabinetske pripreme za terenska geološka istraživanja u području zapadne Slavonije, Žumberačko-medvedničkog gorja, Istre i Kvarnera. Ta istraživanja čine završne radove koji će kroz sljedećih pet godina rezultirati izradom Osnovne geološke karte 1:50.000 i pripadajućih tumača na sljedećim listovima: Požega-3 i 4; Zagreb-1, 2 i 3; Ivanić Grad-1; Rijeka-1, and 4; Rovinj-1, 2, and 3; Cres-2, 3, and 4; Rab-1 and 3, and Silba-1.

The Basic geological map of the Republic of Croatia, scale 1:50,000, is a continuing scientific project, which is based on systematic geological research in Croatia.

As the basic geological map is conceptually based on lithostratigraphic analysis, the map should necessarily contain lithostratigraphic data for evaluating the economical potential of any region, for managing natural resources, and for protecting the environment on the entire territory of the Republic of Croatia.

Preparation of the basic geological map involves data processing in the GIS system, and the digital database of the map, which facilitate creation of specialized and need-based maps. Thus the map contributes to the integration of the fundamental and applied geological investigations.

The geological investigations within the project are grouped into two geologically defined domains: "Dinarides" (western and southern parts of Croatia) and "Pannonia" (middle and northern parts of Croatia). Further subdivision comprises subprojects, which are spatially defined according to the selected sheets of the topographic background.

During 2006, we focused our efforts on the analysis of the existing data, to prepare geological investigations in the field, in the areas of western Slavonia, Žumberak, and Medvednica Mts., Istrian peninsula and Kvarner. Completion of these investigations, in the next five years, would enable the production of the Basic geological map, scale 1:50,000 and its explanatory notes for the areas covered by the following sheets: Požega-3 and 4; Zagreb-1, 2, and 3; Ivanić Grad-1; Rijeka-1, and 4; Rovinj-1, 2, and 3; Cres-2, 3, and 4; Rab-1 and 3, and Silba-1.

Pored toga, pristupilo se i informatičkoj obradi terenskih podataka. Tako je u okviru potprojekta "Fliš Istre" obrađen prostor koji obuhvaća 10 sekcija mjerila 1:25.000. U prvoj fazi georeferencirani su svi terenski podatci, kako točke opažanja tako i snimljeni stratimetrijski stupovi. Nakon toga pristupilo se digitalnoj obradi svih prikupljenih podataka, ponajprije onih pridobivenih terenskim istraživanjima te svih onih koji su proizašli iz provedenih analitičkih postupaka. U narednoj fazi slijedi vektORIZACIJA te završna obrada geološke karte.

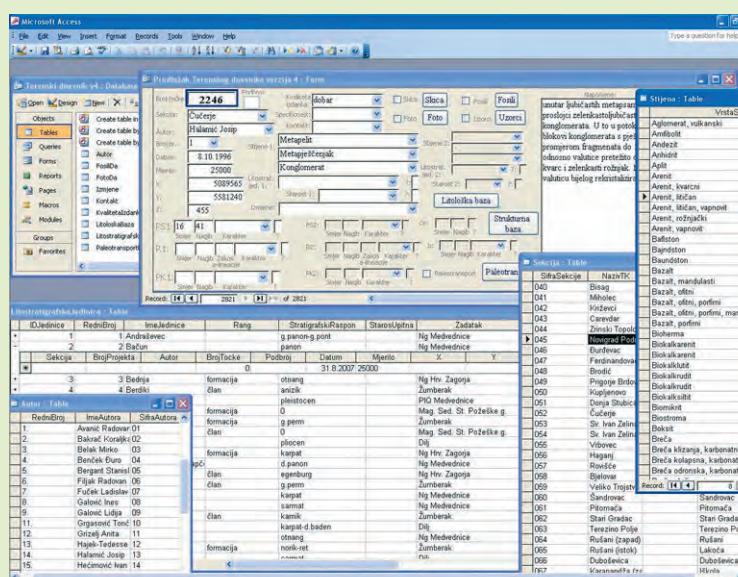
Tijekom 2007. godine u "Dinaridima" se planira intenzivirati terenska istraživanja u središnjoj Istri i na otoku Krku, te započeti s istraživanjima na Čićariji i otoku Rabu. U području "Panona" će se tijekom 2007. godine izvoditi geološka istraživanja kvarternih naslaga i to u zapadnom dijelu Brodskog posavljia, u Karlovačkoj depresiji te u širem području Dugoselskog praga. U konačnom stupnju obrade je jedan od geološki naj složenijih prostora u Hrvatskoj – Medvednica. Istraživanja će se izvoditi i u Dilj gori (Slavonija), Hrvatskom zagorju i karbonatnim stijenama Žumberka.

Istovremeno će se na oba područja nastaviti s digitalizacijom i popunjavanjem baze podataka s postojećim geološkim podatcima prikupljenim tijekom istraživanja prethodnih godina.

In addition, the field data were processed during the last year. Accordingly, the area containing 10 sections, scale 25,000, was processed within the subproject "Istrian Flysch". In the first phase all data were georeferenced, including both points of observation and results of stratimetric profiling. In the next phase all data were digitally processed, particularly field data and data obtained from the completed analytical procedures. The forthcoming phase will include vectorization and final construction of the geological map.

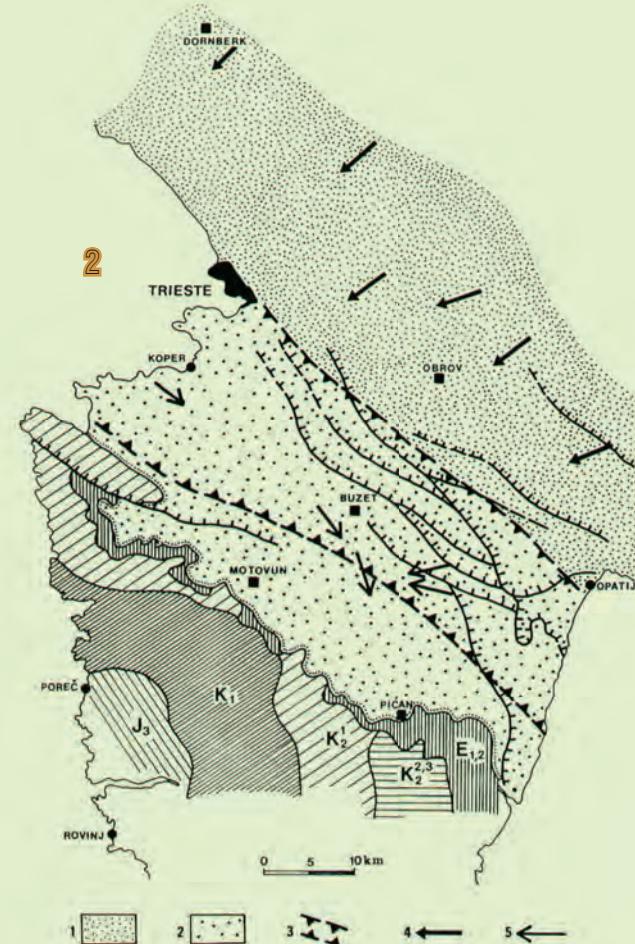
During the year 2007 in Dinarides field work is planned in Central Istria and on the Krk Island. Also, investigation will be initiated on the Čićarija Mt. and Rab Island. The "Pannonia" area will see the commencement of an investigation on the Quaternary sediments in the western part of Brodsko Posavlje, in the Karlovac Depression and in the broader area of the Dugo Selo dip-slip. One of the most complex geological areas in Croatia – the Medvednica Mt. – is in the final stage of analysis. Research work will also include Dilj Mt. (Slavonija), Croatian Zagorje, and carbonate rocks of Žumberak.

Simultaneously, data from both areas will be further digitally processed and filled in the databases together with the existing geological data, collected during earlier investigations.



1 Novi digitalni terenski dnevnik.
New digital field book.

2 Pregledna karta istarskog fliša.
View map of Istrian Flysch.



Osnovna inženjerskogeološka karta Republike Hrvatske 1:100.000

Basic engineering-geological map of the Republic of Croatia 1:100,000

Glavni istraživač/Main researcher: Dr. sc. Renato BULJAN (renato.buljan@hgi-cgs.hr)

Projekt Osnovne inženjerskogeološke karte Republike Hrvatske (OIGK RH), M 1:100.000, zasnovan je na izradi inženjerskogeoloških (IG) karata na temelju IG značajki prostora. Uz IG karte izrađuju se tumači i baze podataka.

Cilj istraživanja je interdisciplinarno korištenje IG podataka u prostornom planiranju, zaštiti okoliša i ocjeni pogodnosti terena za izgradnju infrastrukturnih objekata. Proučavanje IG svojstava stijenskih masa i talaa, te procesa koji na njih utječu, neophodno je pri projektiranju u brojnim drugim strukama, kao npr. U građevinarstvu, elektro-energetskoj industriji, vodnom gospodarstvu, itd.

Na temelju raznovrsnih podataka iz geološke struke (geološke građe, geofizičkih parametara, geotehničkih in situ i laboratorijskih podataka itd.) skupljenih u inženjerskogeološkom modelu, rješavaju se brojni praktični problemi. Povećanjem saznanja vezanih uz inženjersku geologiju moguće je procijeniti vjerojatnost (hazard i rizik) određene inženjerskogeološke pojave, npr. klizišta. Na taj način izrada OIGK doprinosi razvoju Republike Hrvatske. OIGK se izrađuje u skladu s postojećim Uputama. Istraživanja su uskladjena s preporukama International Association of Engineering Geology and the Environment (IAEG), International Society for Rock Mechanics (ISRM) i International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE).

This project (OIGK, scale 1:100,000) is included in the fundamental research activity that is carried under the umbrella of the Croatian Geological Institute whose scope is investigation of engineering geological (EG) characteristics of a terrain, construction of EG maps, and relevant explanation in books and databases.

The scope of investigation is the interdisciplinary use of EG data in space planning, environment protection, and evaluation of terrain suitability for building of infrastructure objects. The research of EG properties of soils or rock masses, as well as of the processes involved, can be used in a design in many other disciplines, such as civil engineering, electric power industry, water management etc.

Based on different data (geological setting, geo-physical parameters geotechnical in situ and laboratory testing etc.) put together in an EG model, many practical problems can be solved. By an increase in EG knowledge it is possible to estimate probability (hazard and risk) of some EG phenomenon, such as landslide. OIGK ought to improve development and progress of the Republic of Croatia. OIGK is an all-inclusive multifaceted map. Its construction is carried out according to Instructions. The research is being realized according to recommendations of the International Association of Engineering Geology and the Environment (IAEG), International Society for Rock Mechanics (ISRM), and International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE).

Projekt OIGK se provodi u GIS okruženju (ArcGIS, ESRI), što podrazumijeva korištenje baza podataka. Rad je usmjeren u dva regionalna potprojekta: „Krš Dinarida“ i „Hrvatsko područje Panonskog bazena“.

U kršu Dinarida u tijeku je nastavak radova na listovima Rijeka, Crikvenica, Rab, Delnice, Ogulin, Rovinj, Pula, Split i Primošten. U Panonskom bazenu također se nastavljaju radovi iz prethodnih godina, prvenstveno na listovima Varaždin, Ivanić Grad, Čakovec i Sisak.

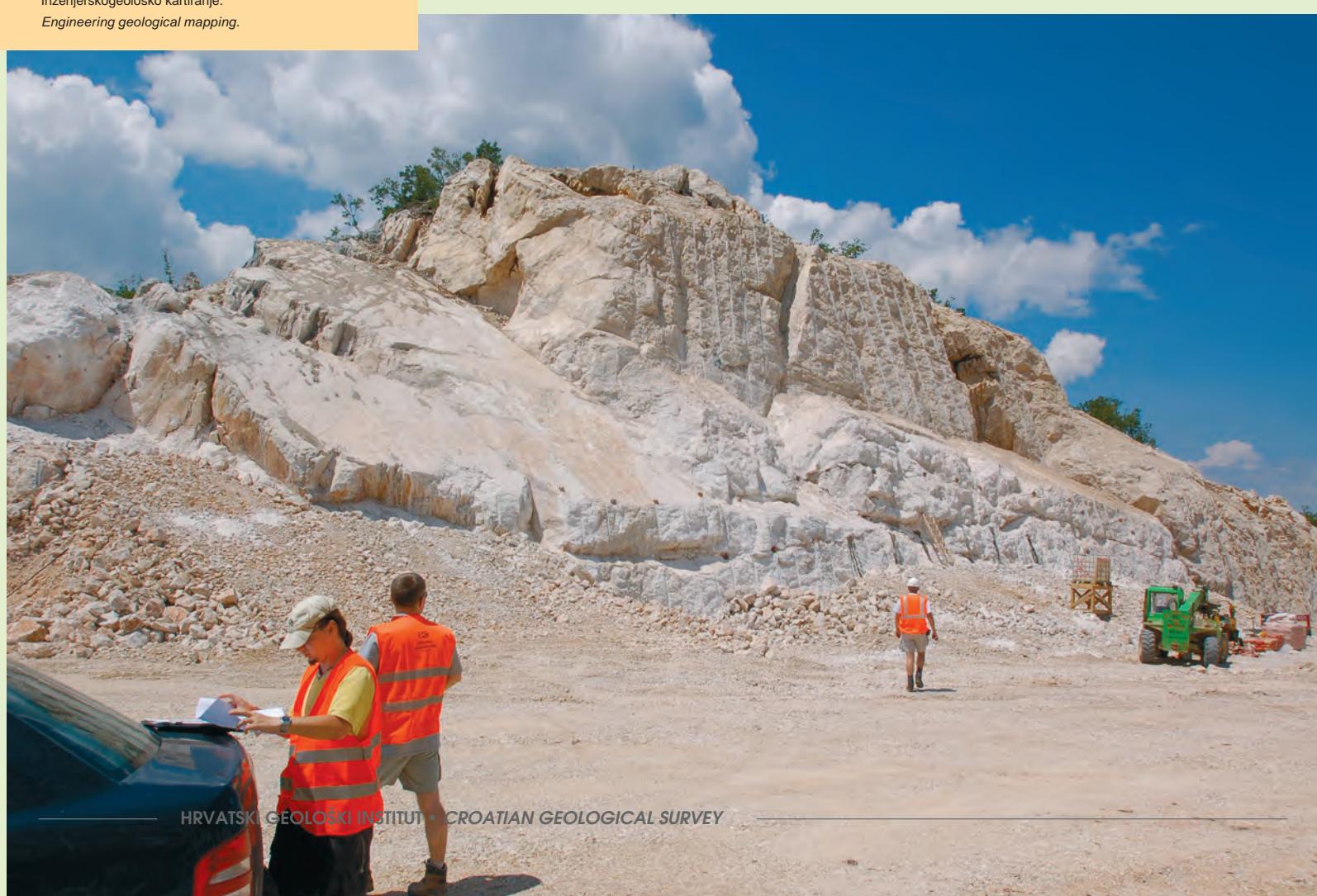
Više županija je koristilo rezultate istraživanja na OIGK RH pri izradi svojih prostornih planova. Inženjerskogeološka istraživačka ekipa sastoji se od osam istraživača, a osim prostornog planiranja i same izrade IG karata, rezultati njihovog rada postižu široku primjenu u različitim područjima, a posebno na autocestama. Suradnja s gospodarstvom omogućila je dodatno prikupljanje podataka za izradu OIGK.

The OIGK project is being developed in a GIS environment (ArcGIS, ESRI) what implies the use of databases. Research work is directed to two regional projects: "Dinaric karst" and "Croatian part of Pannonian basin".

The current investigations in Dinaric karst are performed on sheets: Rijeka, Crikvenica, Rab, Delnice, Ogulin, Rovinj, Pula, Split and Primošten. In the Pannonian basin there is also continuation of research on a few sheets: Varaždin, Ivanić Grad, Čakovec and Sisak.

Results achieved on the OIGK RH research are utilized for urban planning in several counties. The EG research team consist of eight researchers, and except for urban planning, their results have wide application in many different area. Motorway construction is most important in last few years. Cooperation with state economy and business enabled collection of the additional data necessary to assemble the OIGK RH.

Inženjerskogeološko kartiranje.
Engineering geological mapping.



Osnovna hidrogeološka karta Republike Hrvatske 1:100.000

Basic hydrogeological map of the Republic of Croatia 1:100,000

Glavni istraživač/Main researcher: Dr. sc. Ante PAVIČIĆ (ante.pavicic@hgi-cgs.hr)

Osnovna hidrogeološka karta Republike Hrvatske (OHGK RH) temeljni je projekt za istraživanje podzemnih voda. Cilj istraživanja je izrada OHGK M 1:100.000. Radovi se izvode po područjima, prema programu i uputama. Cijeli sustav se prikazuje digitalno ArcGIS softverom.

Projekt je podijeljen na krška područja Dinarida i Panonski bazen. Prethodno je OHGK završena u području Istre, Gorskog Kotara, Rijeke, Splita, Zagreba i Ivanić grada. Na području Panonskog bazena provedena su istraživanja savskog vodonosnika. Obavljeni su terenski radovi s „in situ“ mjerjenjem fizikalno-kemijskih parametara u piezometrima, uzimanje uzoraka vode za analizu kemijskog i izotopnog sastava. Cilj istraživanja je definiranje stratifikacije savskog vodonosnika, te napajanja i pražnjenja podzemnih voda korištenjem hidrogeokemijskih metoda. Provedena su istraživanja na području istočne Slavonije i varaždinskog područja. Rekognoscirano je varaždinsko područje s prikupljanjem podataka o onečišćivačima i uzimanjem uzoraka za kemijske i izotopne analize. U izradi su dvije doktorske disertacije. Jedna ima težiste na definiranju modela toka za varaždinski vododnosnik i karte osjetljivosti, ranjivosti i rizika, a druga se bavi podrijetlom nitrata pomoću stabilnih izotopa dušika u nesaturiranoj zoni, te općenito definiranjem hidrokemije vodonosnika i nesaturirane zone.

Istraživanja u kršu Dinarida izvode se po područjima. U području Gorskog kotara istraživanja su nastavljena u slijevu Gornje Dobre. U Hrvatskom primorju u slijevnom području izvora u Rijeci i Novljanskoj Žrnovnici. U Lici su izvođeni radovi u slijevu Gacke, gornjeg toka Like i Plitvičkih jezera. Izvedena su trasiranja u slijevu Gacke, u graničnom području jadranskog i crnomorskog slijeva i u slijevu Like. U srednjoj Dalmaciji je rađeno u Ravnim kotarima, a u Južnoj Dalmaciji na području Ploče, Metkovića, Imotskog i Vrgorca. Obrađeni su podatci trasiranja u slijevu Vrlike i Tihaljine. U tijeku je izrada jedne doktorske disertacije.

The main hydrogeological map of Croatia (OHGK RH) is a basic project concerned with investigations of ground water. The scope of investigations is the construction of OHGK scale 1:100,000. The research works are area-oriented and proceed according to the program and hydrogeological instructions. The entire system is represented digitally using ArcGIS Software.

The project is divided in two halves: the karst area of Dinarides and Pannonian basin. During the previous investigations OHGK was completed in the area of Istra, Gorski Kotar, Rijeka, Split, and Ivanić Grad. Investigations of the Sava aquifer were carried out in the Pannonian basin. These included field works with “in situ” gauge of physical-chemical parameters in piezometers and sampling of water for chemical and isotope analysis. Research was aimed at defining stratification of Sava aquifer, recharge and discharge of underground waters using hydrogeochemical methods. It was carried out in the area of eastern Slavonia and the city of Varaždin. The Varaždin area was thoroughly surveyed, which included data collection, describing various contributors to contamination, and sampling for chemical and isotope analysis. Two doctoral theses are under supervision. One of these is based on establishing the model of flow for the Varaždin aquifer and construction of the map of sensitivity, vulnerability, and risk, whereas, the other is concerned with origins of nitrates using stable nitrogen isotopes in an unsaturated zone; generally with the hydrogeochemistry of the aquifer and the unsaturated zone.

Research work in the Dinaride karst zone proceeded in accordance with the predefined areas. In the Gorski Kotar investigations are continuing in the Gornja Dobra catchment area. In Hrvatsko Primorje investigations proceed in the catchment area of the springs of Rijeka and Novljanska Žrnovnica. In Like the works have not only been carried out in the Gacka watershed, but also in the border areas between the catchment basins of Adriatic and Black Sea. In middle Dalmatia research was going on in the Ravni Kotari area, whereas, in southern Dalmatia the broad areas of Ploče, Metković, Imotski, and Vrgorac have been surveyed. Also, the tracer data from the catchments of Vrlika and Tihaljina were processed. One doctoral dissertation was made using the data collected and processed during these investigations.

Hidrogeolozi su uključeni u više međunarodnih projekata (EU COST 620; 621; 629; COST Action 629); IAEA-Application of Isotope Techniques to Investigate Water Resources in Karstic Area.; KArst waTER research program (KATER II – INTERREG III B CADSES Program), te aktivno sudjeluju na radionicama i kongresima. U sklopu Direktiva za vode EU, izdvojene su cjeline podzemne vode za područje Istre, Hrvatskoga primorja, Like, Ravnih kotara, Dalmacije i većih otoka, s prijedlogom monitoringa. Aktivno se radi na brojnim projektima u vodnom gospodarstvu, elektroprivredi, projektiranju odlagališta otpada i zaštitnih zona crpilišta, te odvodnji autocesta. Prikupljeni podatci uključuju se u izradu OHGK. Na projektu radi 18 ljudi, od čega 5 doktora znanosti, 4 magistra, 3 stručna suradnika, 2 znanstvena novaka i 4 tehničara.

Hydrogeologists partake in several international projects (EU COST 620; 621; 629; COST Action 629); IAEA-Application of Isotope Techniques to Investigate Water Resources in Karst Area.; KArst waTER research program (KATER II – INTERREG III B CADSES Program), and actively participate in workshops and conferences. Within the framework of Directives for waters EU they singled out underground waters for the areas of Istra, Hrvatsko Primorje, Lika, Ravn Kotari, Dalamtia, and major islands, with monitoring plans. Numerous projects are active in water management, electrical industry, waste disposal planning, protection of pump-zones, and systems of highway drainage. The collected data are included into OHGK. A team of 18 researchers is engaged in the project, including five doctors, four masters of sciences, three expert associates, two scientific novices, and four technicians.

Hidrogeološka terenska istraživanja.
Hydrogeological terrain research.



Osnovna geokemijska karta Republike Hrvatske Basic geochemical map of the Republic of Croatia

Glavni istraživač/Main researcher: Dr. sc. Josip HALAMIĆ (josip.halamic@hgi-cgs.hr)

Geokemijska istraživanja u proteklom razdoblju bila su bazirana na uzorkovanju tala u pravilnoj mreži 5x5 km. Uzeti uzorak na definiranoj lokaciji činio je kompozit od pet uzoraka na dubini od 0-25 cm. Tijekom 2005. godine završeno je uzorkovanje čitavog teritorija Republike Hrvatske što je podudarno s istekom tog istraživačkog razdoblja. Ukupan broj uzetih uzoraka iznosi 2900. Svi uzorci su kemijski analizirani na set od 41 kemijskog elementa. Podatci terenskog i laboratorijskog ispitivanja pohranjeni u elektronske baze podataka koje će biti sastavni dio Geološkog informacijskog sustava. Tijekom 2006. godine počeo je kabinetski rad na pripremi Geokemijskog atlasa Republike Hrvatske (popunjavanje i uređivanje elektroničkih baza podataka, statistička obrada analitičkih podataka i izrada standarda za generiranje karata distribucije kemijskih elemenata u GIS-u).

Osim radova na izradi Geokemijskog atlasa djelatnici tima za geokemijsku nastavili su s uzorkovanjem najrecentnijeg mulja rijeka Drave i Mure u okviru pilot projekta monitoringa opterećenja tih dviju rijeka teškim metalima. 2006. godina bila je treća godina uzorkovanja. Uzorci se prikupljaju dva puta godišnje u razmaku od 6 mjeseci; jednom u proljeće i jednom u kasnu jesen. Nakon pripreme (mokro sijanje na frakciju <0,045 mm i homogeniziranje) uzorci su analizirani na set od 36 kemijskih elemenata (analitička tehnika ICP-MS).

U prvom tromjesečju 2006. godine počeo je novi ciklus prijave znanstveno-istraživačkih projekata koje financira Ministarstvo znanosti, obrazovanja i športa. U okviru Geokemijske karte Republike Hrvatske, kao nastavak dosadašnjih istraživanja te slijedom izrade Europskog geokemijskog atlasa koji je završen 2006. godine, prijavljen je i prihvaćen novi petogodišnji projekt.

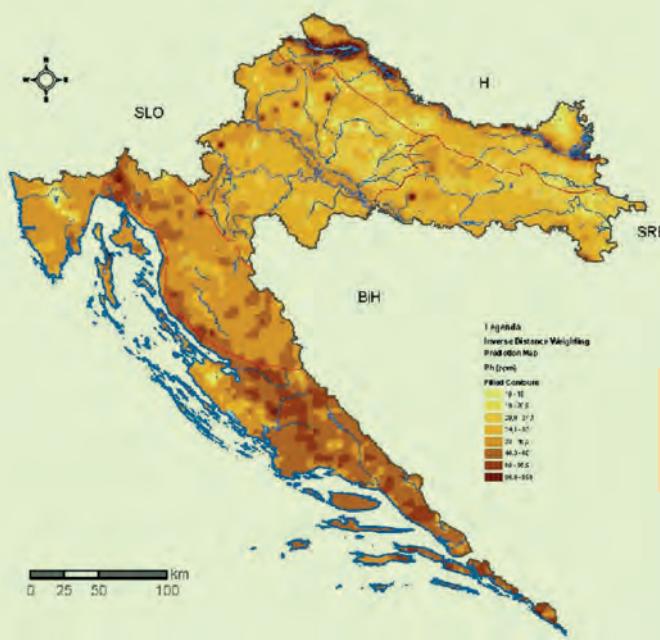
Geochemical investigations during the last period were based on soil sampling in the regular grid 5x5 km. The sample taken at the predefined location represented the composite of five subsamples from the depth of 0-25 cm. During 2005, the sampling of the entire territory of RH was completed, which was concurrent with expiration of the last research period. The total samples collected were 2900. All samples were chemically analyzed up to 41 chemical elements. The field and laboratory data were stored in electronic databases intended to form the constituent part of the Geological Information System. The preliminary works on the Geochemical Atlas of RH started during 2006 (feeding and organization of electronic databases, statistical treatment of analytical data, the setup of standards for generation of maps representing the spatial distribution of chemical elements in GIS).

Besides the work relating to the construction of the Geochemical Atlas, the geochemical research team continued with sampling of the most recent alluvial sediments of the Drava and Mura Rivers, within the pilot project of monitoring their pollution by heavy metals. The year 2006 was the third year of sampling. Samples were collected twice a year with a half-year period, once during the springtime, and once during late autumn. After the preparation (wet-sieve fraction< 0.045 mm and homogenization) the samples were analyzed up to 36 chemical elements (analytical technique ICP-MS).

The first term of the year saw the inauguration of the new cycle of application of scientific projects funded by the Ministry of Science, Education, and Sports. The new five-year project was applied and accepted under the title Geochemical Map of RH as the continuation of previous investigations and following the drift of construction of the European Geochemical Atlas.

Najveći dio dosadašnjih istraživanja bio je usmjeren na ukupni (near total) kemijski sastav tla iz kojeg nije bilo moguće utvrditi antropogene doprinose, pogotovo atmofilnih elemenata (Cd, Zn, Cu, Pb i Hg prema definiciji Convention on Long Range Transboundary Air Pollution- UN/ECE). Prethodna geokemijska istraživanja tala utvrdila su postojanje anomalnih ili povišenih koncentracija pojedinih potencijalno toksičnih elemenata (As, Cd, Pb, Zn i Hg). Rezultati tih istraživanja upućuju na to da kemijski sastav vodotočnih sedimenata, sedimenata poplavnih ravnica, humusa i tla u velikoj mjeri ovisi o otopljenim tvarima koje su u ciklusu trošenja, transporta i sedimentacije vezane uz slijevna područja manjih i većih vodotoka (drenažni bazeni). Te tvari su različitog geogenog podrijetla (različiti produkti trošenja različitih matičnih stijena), ali i posljedica različitih klimatskih i hidrogeoloških uvjeta. S druge strane, promjena kemijskog sastava može biti posljedica antropogenog unosa potencijalno toksičnih elemenata ili antropogena promjena kiselosti tla. Stoga procjena kritičnih opterećenja pojedinim elementima u tragovima zahtjeva istraživanje koje se temelji na istraživanju elemenata koji su prisutni i dostupni u otopini i u tlu (biodostupni).

Predloženo istraživanje temeljit će se na analizi raznovrsnih medija uzorkovanja potočnih i riječnih sljevova područja R. Hrvatske. Čitav državni teritorij bit će podijeljen na oko 150 pojedinačnih sljevova ujednačene veličine. Mediji uzorkovanja u tako odabranim sljevovima bit će: vodotočni sedimenti, sedimenti poplavnih ravnica s tri dubinska nivoa (40-50cm, 50-70cm i 80-100cm), tlo (dubine: 0-2cm, 40-50cm i 80-100cm) i humus. Uzorkovanje, priprema i analitika provoditi će se prema Uputama EGS (FOREGS) Working Group kao i prema europski usvojenim metodologijama i standardima za takvu vrstu istraživanja.



HRVATSKI GEOLOŠKI INSTITUT • CROATIAN GEOLOGICAL SURVEY

The most part of the former investigations was aimed at the near total chemical composition of soils, which, however, did not allow determination of anthropogenic inputs, particularly of atmophile elements (Cd, Zn, Cu, Pb, and Hg, according to definition of Convention on Long Range Transboundary Air Pollution- UN/ECE). Previous geochemical investigation of soils confirmed the presence of anomalous or elevated concentration of individual potentially toxic elements (As, Cd, Pb, Zn, and Hg). Results of these investigations point to the fact that chemical composition of stream sediments, floodplain sediments, humus, and soils greatly depend on dissolved matter, which in the cycle of weathering, transport, and sedimentation derives from the low- to middle-order drainage basins (minor to major streams). These substances derive their origin not only from various parent materials (different weathering products of a variety of parent rocks), but can also suffer the effects of changing climate and hydrogeologic conditions. On the other side, alteration of chemical composition can result from the anthropogenic impact of potentially toxic elements or man-made alteration of the soil acidity. Therefore, evaluation of critical loadings by certain trace elements requires investigations based on soluble elements available in water and soils (bioavailability).

Proposed exploration will be based on analysis of diverse sampling media in stream and river drainage basins in RH. The entire state territory will be divided into about 150 separate catchment areas of similar size. Sampling media in the selected drainage basins will be: stream sediments, floodplain sediments with three depth horizons (40-50cm, 50-70cm, and 80-100cm), soil (depth: 0-2 cm, 40-50 cm, and 80-100 cm), and humus. Sampling, sample preparation, and analysis will be carried out after Directions EGS (FOREGS) Working Group, as well as, according to European accepted methodologies and standards for this type of investigation.

Primjer karte raspodjele olova za budući Geokemijski atlas Republike Hrvatske.
Example of the map of distribution of lead for the future Geochemical atlas of Republic of Croatia.

Strukturno-geomorfološka karta Republike Hrvatske 1:100.000

Structural-geomorphological map of the Republic of Croatia 1:100,000

Glavni istraživač/Main researcher: Dr. sc. Ivan HEĆIMOVIĆ (ivan.hecimovic@hgi-cgs.hr)

Istraživanja u sklopu ovog projekta imaju za cilj pridobiti nove geološke podatke koji se nisu mogli ustanoviti geološkim kartiranjem ili nekom drugom primijenjenom geološkom metodom te su kao takvi izravna dopuna Osnovnoj geološkoj karti 1:50.000. Svrha provedbe istraživanja je bolje upoznavanje strukturalnih odnosa i neotektonskih aktivnosti, odnosno definiranje recentnog strukturnog sklopa.

Strukturno-geomorfološka istraživanja zasnivaju se na proučavanju reljefa odnosno na utvrđivanju veze između najmlađih tektonskih pokreta i reljefa. Budući da je reljef nastao kao posljedica međudjelovanja egzogenih procesa i najmlađe tektonskih aktivnosti, a uvjetovan je geološkom građom - litološkim sastavom, njegovim se proučavanjem mogu dobiti značajni podatci o strukturalnim odnosima, najmlađim tektonskim pokretima i geomorfološkim procesima kojima je reljef oblikovan. Istraživanja se provode metodom sveobuhvatne kvalitativne i kvantitativne geomorfološke razrade. Dobiveni podatci u znanstvenoj domeni pridonose boljem i točnijem utvrđivanju položaja, tipa i karaktera struktura i rasjeda, spoznaji karaktera i intenziteta neotektonskih pokreta te veličine najmlađih tektonskih pomaka. Rezultati strukturno-geomorfoloških istraživanja, osim što su izravna dopuna Osnovnoj geološkoj karti RH 1:50.000, primjenljivi su i u raznim geološkim, hidrogeološkim i inženjerskogeološkim radovima, u prostornom planiranju, zaštiti okoliša te traženju lokacija za eksploataciju različitih mineralnih sirovina i pitke vode.

Explorations carried out under the umbrella of this project are aimed at acquiring new geological data not previously established by ordinary geological mapping or any other applied geological discipline. Thus they serve as a direct supplement to the Basic Geological Map, scale 1:50,000. The purpose of these investigations is a better understanding of structure relationships and neotectonic activity, that is, explanation of the recent tectonic setting.

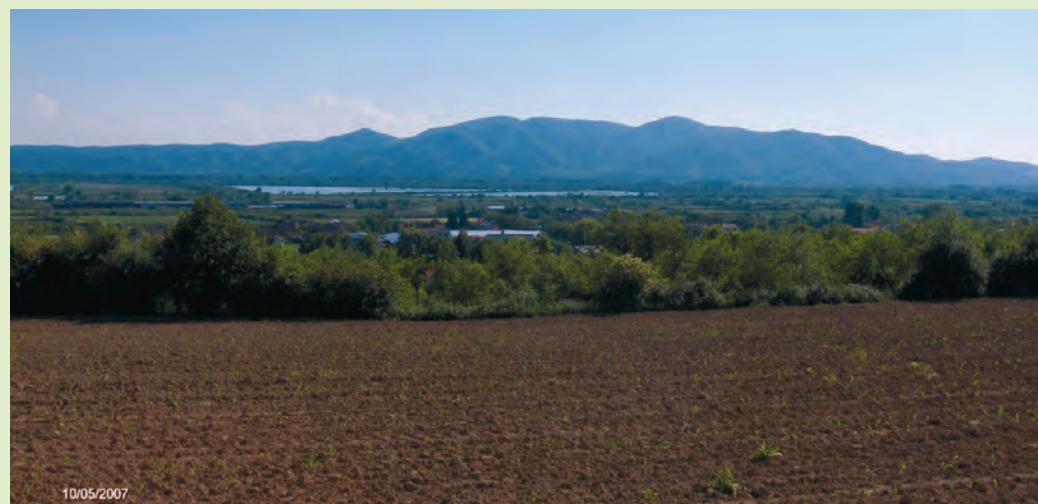
Structural-geomorphological investigations are based on the study of landforms, that is, finding the relationship between the youngest tectonic activity and landforms. As landscapes originate from the interplay of exogenetic processes and youngest tectonic activity, and are affected by geological setting - lithology in particular, it is only natural that they be thoroughly studied, to assess significant data about their structure relations, recent tectonic movements, and geomorphologic processes that have contributed to their shaping. Research works are performed using comprehensive qualitative and quantitative methods of geomorphologic exploration. Data acquired from the scientific domain contribute to better and more precise understanding of position, type, and character of structures and faults, and to understanding the character and intensity of neotectonic movements, and particularly the youngest tectonic shifts. The results of structural-geomorphological explorations are not only a direct supplement to the Basic Geological Map RH, scale 1:50,000, but are also applicable in diverse geologic, hydrogeologic, and engineering-geologic research works, in space planning, environment protection, and searching for locations, showing potential for exploitation of mineral resources and potable water.

U 2006. godini strukturno-geomorfološka istraživanja provedena su u dijelu Savskog sedimentacijskog bazena, između Nove Gradiške i Slavonskog Broda. To područje obilježava zaravnjenost i pokrivenost terena s najmlađim naslagama. Sukladno tome prisutni su i procesi akumulacije koji se očituju kroz formiranje fluvijalnog, barskog i jezerskog tipa reljefa. Provedenom geomorfološkom razradom prikupljeni su podatci koji ukazuju na stanje recentnih struktura i aktivnost najmlađih pokreta, i to u području koje je siromašno izravnim geološkim strukturnim pokazateljima.

Istraživanjima je ustanovljeno da je taj dio Savskog sedimentacijskog bazena predstavljen dvjema većim spuštenim morfostrukturama koje su imenovane Crnac polje i Jelas polje. Njihov okvir čine uzdužni rasjedi odnosno izdignute morfostrukture Požeške i Dilj gore na sjeveru te Motajice na jugu. Duž tih rasjeda, koji su pružanja generalno I-Z do SI-JZ, osim normalnih iskazuju se i reverzni odnosi. To se posebno odnosi na pojedine dionice duž rasjeda Oriovac-Sibinj - Podvinje gdje su rasjedi južnih vergencija, te na rasjede sjevernih vergencija na sjevernoj strani Motajice. Osim vertikalnih ustanovljena su i desna horizontalna kretanja i to duž rasjeda pružanja NW-SE. Ona se posebno iskazuju u rasjednim zonama kod Broda i Nove Gradiške te duž dionice rasjeda Staro Petrovo Selo - Kapela - Kobaš kojim su razdvojene navedene spuštene morfostrukture. Ovakav morfostrukturalni raspored ukazuje na to da je recentni strukturni sklop možda nastao kao posljedica transtenzijskih procesa.

Tijekom 2007. godine strukturno-geomorfološkim istraživanjima obuhvatiti će se područje Karlovačke depresije. Budući da će se istraživanja provoditi većim dijelom u zaravnjenom, najmlađim naslagama prekrivenom terenu, njihovom provedbom se očekuje dobivanje novih geoloških podataka u svrhu boljeg poznavanja strukturalnih odnosa u tom području.

Motajica
Motajica Mt.



10/05/2007

In 2006, structural-geomorphological explorations were performed in part of the Sava sedimentary basin between Nova Gradiška and Slavonski Brod. The area is distinguished by broad floodplain sediments covering the entire older terrain. Accordingly, the processes of accumulation are dominant and manifest through the formation of fluvial, pond, and lacustrine type of landscape. Geomorphologic analysis resulted in data indicating the shape of the recent structures and activity of the youngest movements, particularly in an area lacking in direct structure markers.

Results of investigations show that this part of the Sava sedimentary basin consists of two major subsided morphostructures named Crnac Polje and Jelas Polje. Their borders are defined by longitudinal faults or uplifted morphostructures of Požeška and Dilj Mts. in the north and Motajica Mt. in the south. Along these faults striking generally E-W to NE-SW both normal and reverse contacts are manifested. It is especially evident with certain sections of the Oriovac – Sibinj – Podvinje fault, where faults show southern vergence, and also with faults on the northern part of Motajica Mt., showing northern vergence. Apart from the vertical movements there also appear dextral horizontal movements along the faults striking NW-SE. These are especially evident in not only the fault zones near Slavonski Brod and Nova Gradiška, but also near along the fault section Staro Petrovo Selo – Kapela-Kobaš, which separates the aforementioned subsided morphostructures. This morphostructure arrangement points to the recent tectonic setting possibly originating as a result of transtensional movements.

In 2007, the structural-geomorphological investigations will surround the area of the Karlovac Depression. Given that the research work chiefly includes the floodplain covered by recently deposited material the assessment of new data will hopefully contribute to a better understanding of structure relationships in that area.

Karta mineralnih sirovina Republike Hrvatske

Map of the mineral resources of the Republic of Croatia

Glavni istraživač/Main researcher: Dr. sc. Zoran PEH (zoran.peh@hgi-cgs.hr)

Karta mineralnih sirovina (KMS) RH predstavlja cjelovit prikaz mineralno-sirovinskog potencijala Republike Hrvatske. Njen sadržaj vrjednovat će se prije svega u svjetlu strategije održivog razvoja koji povezuje upravljanje mineralnim sirovinama, njihovu eksploataciju i odnos prema okolišu. U tom smislu karta sadržava (višeslojni) pregled mineralnih sirovina čija su raznolikost, učestalost prostornog pojavljivanja, razlike u dimenzijama, te varijacije u mineralnom i kemijskom sastavu izravna posljedica geološke građe (litoloških i tektonskih odnosa) koja ima odlučujuću ulogu u genezi ležišta mineralnih sirovina. Stoga je geološka građa jedna od osnovnih sastavnica (slojeva) KMS i predstavlja osnovu za izradu njenog prognoznog dijela (karte potencijalnosti). Na osnovi geološke građe treba utvrditi zakonitosti pojavljivanja i prostorne raspodjele različitih mineralnih sirovina čime će se povećati mogućnost otkrivanja novih ležišta i proširenje već postojećih (mineralogenetska rajonizacija, zone potencijalnosti).

Tijekom 2006. godine dovršena je reorganizacija i modifikacija postojeće baze podataka (iz dBase u Access) i njeno uklapanje u GIS kako bi se pripremila osnova za izradu listova KMS i pratećih karata potencijalnosti mjerila 1:200.000.

Program radova na projektu za 2007. godinu predviđa izradu nekoliko listova KMS – Dubrovnik, Makarska, Vis, Sinj, Split te Zagreb. Osim toga istraživanja koja će se provesti u okviru projekta predviđaju i odgovore na probleme geneze i smještaja gline i pijeska u sjevernoj Hrvatskoj kao sirovine za proizvodnju opeke, te tehničkog i arhitektonsko-građevnog kamena u Dalmaciji (doktorska disertacija).

The map of mineral resources of RH (KMS) thoroughly represents the potentiality of mineral resources of RH. Its content will be evaluated primarily in the light of the strategy of sustainable development connecting management of mineral resources and their exploitation and rapport with the environment. In that sense the map contains a (multilayer) review of mineral resources whose diversity, abundance, dimensions, and variations in mineral and chemical composition are brought about as a direct result of geological setting (lithology and tectonics in particular) having a decisive role in the genesis of mineral deposits. Hence, the geological setting is one of the integral parts (layers) of KMS, representing the foundation for the construction of its prognostic part (map of potentiality). Based on the geological setting the map of mineral resources will illustrate the regularity of occurrence and spatial distribution of various mineral resources increasing the probability of detection of the new, and enlargement of the currently active deposits (mineralogenic regionalization, zones of potentiality).

During 2006, the existing database was reorganized and modified (from dBase to Access). That was essential to fit the mineral resources database into GIS, which must be arranged in the final analysis as the foundation for construction of individual sheets of KMS and relevant maps of potentiality, scale 1:200,000.

The program of research works on the project of KMS in the year 2007, anticipates the construction of a number of sheets of KMS – Dubrovnik, Makarska, Vis, Sinj, Split, and Zagreb. Besides, investigations will hopefully result with some answers to the problems of genesis and geological setting of clay and sand in northern Croatia, as a raw material for the brick and mortar industry, as well as building and dimension stone in Dalmatia (doctoral thesis).

Ležište gline Rečica-3 kod Karlovca (Q) - sirovina za proizvodnju opeke.

The clay deposits Rečica-3 near Karlovac (Quaternary) - raw material for brick industry.



Tektonska karta Republike Hrvatske 1:300.000

Tectonic map of the Republic of Croatia 1:300,000

Glavni istraživač/Main researcher: Dr. sc. Domagoj JAMIČIĆ (domagoj.jamicic@hgi-cgs.hr)

Projekt Tektonska karta Republike Hrvatske koja se izrađuje u mjerilu 1:300.000 je kontinuirani temeljni znanstveno-istraživački projekt. Cilj ovog projekta u 2007. godini je definirati strukturno-tektonске odnose u području Gorskog kotara i dijela Velebita te sustavnim i detaljnim radovima utvrditi tektonske odnose između pojedinih litostratigrafskih jedinica te definirati njihov strukturni sklop. Zatim, cilj projekta je utvrditi prisutne osnovne strukturne forme i pojasniti genezu njihovog tektonskog oblikovanja.

Tijekom 2006. godine djelomično je obrađeno područje potoka Jambrovca, na Požeškoj gori, zatim područje između Karlovaca i Velike Kapele, te Karlovca i Slunja. Mjereni su i definirani rasjedi i borane strukture. I ovdje je, kao i tijekom prethodnih godina, ustanovljeno postojanje najmanje tri tektonska događaja koji su, svaki zasebno, formirali strukture među kojima su najznačajniji rasjedi i borani oblici metarskih i dekametarskih dimenzija. Zapaženo je da najstarije strukture imaju pružanje sjever-jug, mlađe sjeverozapad-jugoistok i najmlađe istok-zapad. Zapise ova tri tektonska događaja nalazimo na većini promatranih lokaliteta. Prateći rasjedni sustavi, nastali tijekom ova tri tektonska događaja, sadržavaju linearne zapise tektonskog transporta na temelju kojih su dobivene glavne osi stresa.

Na jugozapadnim padinama Velebita definirane su kose i polegle (Karlobag, Klenovica, Kubus i Tulove grede) antiklinalne strukture dinarskog pružanja i jugozapadne vergencije međusobno odvojene reverznim rasjedima. Borani oblici pružanja sjever-jug i s njima udruženi pukotinski i rasjedni strukturni elementi zapažani su i na području Visa. Tako je u karbonatnim stijenama južno od Komiže ustanovljena polegla (?) antiklinala zapadne vergencije s osi pružanja sjever-jug. Struktura je dekametarskih dimenzija. Tektonski događaji koji su oblikovali ovu strukturu su sigurno stariji od tektonskih događaja koji su oblikovali osnovnu strukturu Visa. Oba događaja su nastalim formama ostavili zapise u obliku struktura koja se uočavaju u gipsu Komiže.

The project of the Tectonic Map of the Republic of Croatia, scale 1:300,000, represents the continued basic scientific project. Its scope in the year 2007 is to define structural-tectonic relationships in the area of Gorski Kotar and part of the Velebit Mt., and by systematic and detailed research works, to define the tectonic relationships between discrete lithostratigraphic units and define their structure setting. Further, the project is also aimed at defining the existing structural forms and explaining the genesis of their tectonic shaping.

In 2006, the area of the Jambrovac stream on the Požeška Mt., the area between Karlovac and Velika Kapela, as well as, between Karlovac and Slunj were partially researched. Faults and folded structures were measured and mapped. Here, as in the earlier works, were discovered, at least three tectonic events, which separately shaped the different structures; the most significant among them were the faults and folded forms of metric and decametric dimensions. It was noted that the oldest structures strike in north-south direction, whereas, the youngest, on the contrary, in east-west direction. The records of these three tectonic events could be found in the majority of observed spots. Accompanying fault systems, formed during these events, contained linear records of tectonic transport, which provided the data for the main axes of stress.

On the southwest slopes of the Velebit Mt. were registered isoclinal and recumbent (Karlobag, Klenovica, Kubus, and Tulove Grede) anticline structures of Dinaric strike and southwest vergence, mutually separated by reverse faults. Folded forms striking north-south with fracture and fault structure elements accompanying them are also observed on the island of Vis. In carbonate rocks south of Komiža is registered a recumbent (?) anticline of west vergence, its axis striking north-south. The structure is of decametric dimensions. Tectonic events that formed the structure are definitely older than those that formed the main structure of the island of Vis. Both events left their records in the shape of structures that can be observed in the gypsum occurrences near Komiža.

U 2007. godini planirana su strukturno – tektonska istraživanja u području Gorskog Kotara, Gračaca, Knina, Plješivice, te južnog Velebita gdje se javljaju strukture pružanja sjeverozapad-jugoistok i istok-zapad. Zbog toga će tijekom ovogodišnjih radova pažnja biti posvećena međusobnom tektonskom odnosu različitih strukturnih planova i indeksu deformiranosti pojedinih strukturnih oblika.

During 2007, the plan is to carry out structural-tectonic investigations in the areas of Gorski Kotar, Gračac, Knin, and Plješivica, as well as, on the southern Velebit Mt., where structures of northwest-southeast striking occur. That is the reason for laying emphasis on the mutual tectonic relationship of various structure levels and on the deformation index of distinct structure forms during this year's research works.



1



2

1

Krovinski dio polegle antiklinale pružanja SZ-JI u donjokrednim karbonatima. Usjek ceste kod Karlobaga.

The upper (hanging-wall) part of the recumbent anticline striking NW–SE, in the Lower Cretaceous carbonate rocks. Road cut near Karlobaga.

2

Tjemeni slojevi polegle antiklinale pružanja S-J u donjokrednim karbonatnim stijenama otoka Visa (uvala Pištica južno od Komiže).

The top layers of the recumbent anticline striking N–S in the Lower Cretaceous carbonate rocks of the island of Vis (the Pištica cove nearby Komiža).

OSTALI PROJEKTI MZOŠ RH

OTHER PROJECTS

FUNDED BY
THE MINISTRY OF SCIENCE, EDUCATION,
AND SPORTS OF THE REPUBLIC OF CROATIA

Stratigrafska evolucija trijasa Hrvatske Stratigraphic evolution of the Triassic in Croatia

Glavni istraživač/Main researcher: Dr. sc. Tonći GRGASOVIĆ (tonci.grgasovic@hgi-cgs.hr)

Trijasne naslage Hrvatske bile su do sada relativno slabije istražene u odnosu na druge mezozojske i kenozojske naslage. S druge strane, istraživanja trijasa u svijetu intenzivirala su se u sklopu uspostave nove globalne stratigrafske skale. Detaljna multidisciplinarna istraživanja pojedinih lokaliteta u sjevernoj (Zagorsko-srednjotransdanubijski dio Sava-zone) i južnoj Hrvatskoj (Vanjski Dinaridi) omogućit će priključak ovim istraživanjima. U istraživanjima stratigrafske evolucije trijasa težiće će biti na srednjem trijasu kao vremenu najvećih geoloških promjena, dok će se gornji trijas istraživati najviše u smislu utvrđivanja razlika između spomenutih geotektonskih cjelina. Biostratigrafska istraživanja na bazi različitih fosilnih skupina (vapnenačkih algi, foraminifera, palinomorfa, konodonata, radiolarija i dr.) omogućit će korelaciju plitkovodnih platformnih i dubljevodnih bazenskih naslaga, datiranje vulkanskih i piroklastičnih stijena koje se izmjenjuju sa sedimentnim stijenama, te unapređenje biostratigrafske podjele trijasa. Pojedini stratigrafski važni fosili detaljno će se obraditi. Sedimentološkim, palinofacijsnim, organsko-facijsnim i geokemijskim istraživanjima definirat će se razvoj facijesa karbonatne platforme i dubljeg mora, njihovi međusobni odnosi, sličnosti i razlike. Spomenuta istraživanja omogućit će interpretaciju stratigrafske evolucije područja Hrvatske kroz trijas, uz njenu korelaciju s evolucijom susjednih područja, te u konačnici razmatranje paleogeografskih odnosa u doba trijasa u ovom dijelu Tetisa.

Triassic succession in Croatia has been relatively underinvestigated compared to other Mesozoic and Cenozoic successions, whereas, investigations on the Triassic are increasing globally, with establishment of a new global stratigraphic scale. Detailed multidisciplinary investigations of selected localities in northern (Zagorje-Midtransdanubian part of the Sava-Zone) and southern Croatia (Outer Dinarides Mts.) may add new and critical information to global investigations. The focal point of the investigations of the stratigraphic evolution of Triassic will be the Middle Triassic, as a period of maximum geological changes, whereas, the Upper Triassic will be investigated for the differences between the two geotectonic units. Biostratigraphic investigations based on several fossil groups (calcareous algae, foraminifers, palynomorphs, conodonts, radiolarians, etc.) will enable the correlation between shallow-water platform and deeper-water basin strata, dating of magmatic and pyroclastic rocks that are interlayered with sedimentary ones, and an improvement in the Triassic biostratigraphy. Some stratigraphically important fossils will be examined in detail. Sedimentological, palynofacies, organic facies, and geochemical investigations will evaluate development of carbonate platform and deeper sea environments, their mutual relationships, similarities, and differences. These investigations will enable the interpretation of stratigraphic evolution of Croatian Triassic, as well as, its correlation with neighboring areas, and eventually the evaluation of paleogeographic relations during the Triassic, in this part of the Tethys Ocean.



1 Vapnenačka alga *Scindarella scopuliformis*
GRGASOVIĆ & SOKAĆ 2002 iz srednjeg trijasa (anizika) Ivanščice
Calcareous alga *Scindarella scopuliformis*
GRGASOVIĆ & SOKAĆ 2002 from the Middle Triassic (Anisian) of Ivanščica Mt.

2 Gornjotrijaski (karnički) dolomiti iz doline Slapnice (Žumberak)
Upper Triassic (Carnian) dolomites from Slapnica valley (Žumberak Mt.)



Odraz paleoklimatskih promjena u jursko-krednim sedimentima Sedimentary record of Jurassic-Cretaceous climatic changes in Karst Dinarides

Glavni istraživač/Main researcher: Dr. sc. Antun HUSINEC (antun.husinec@hgi-cgs.hr)

Projektom želimo dokazati da je odraz paleoklima, promjena morske razine i oceanskoga kemizma očuvan u gornjojursko-donjokrednom slijedu plitkomorskih naslaga krških Dinarida, te da nam može dati odgovore na pitanja o tome koja su razdoblja u evoluciji krških Dinarida bila obilježena "greenhouse", a koja globalno hladnijim, tzv. "prijezaznim" (greenhouse/icehouse) uvjetima. Mi želimo dokazati da sukcesija krških Dinarida sadrži sedimentološke i geokemijske pokazatelje lokalnih i globalnih paleoklimatskih događaja, te pokazatelje stanja zasićenosti karbonatom jursko-krednoga platformnoga mora.

Temeljem istraživanja unutarnjoplatformnog slijeda naslaga krških Dinarida, definirat će se li tijekom 60 milijuna godina dugotrajnog razdoblja gornje jure i donje krede, koje se uglavnom smatra "greenhouse" razdobljem, bilo i intervala koji su nastali tijekom glacioeustazije umjerenih amplituda, što bi upućivalo na postojanje leda na visokim zemljopisnim širinama. Ovo će biti jedno od prvih istraživanja koje će multidisciplinarnim pristupom, uz pomoć isključivo platformne ciklostratigrafije i stratigraskog modeliranja, te sedimentoloških i geokemijskih istraživanja, definirati paleoklimatske trendove, odnosno odnos između "greenhouse" i "prijezaznih" razdoblja tijekom gornje jure i donje krede. Ukoliko se pokaže uspješnim, ovaj bi pristup mogao postati općeprihvaćen i za ostatak mezozoika, kao i za kenozoik.

Ovaj projekt potencijalno će dati veliki doprinos razumijevanju paleoklima i klimatskog utjecaja na arhitekturu karbonatnih platformi. Izotopna i klimatska interpretacija dovest će do novih spoznaja o onome što se čini kao posljednja promjena iz aragonitičnih u kalcitična mora. Inovacija u ovome projektu je integracija stratigrafske analize, modeliranja, izotopnog pristupa i spektralne analize u praćenju evolucije klime tijekom gornje jure i donje krede, u razdoblju ključnom za genezu najvećih svjetskih karbonatnih ležišta.

Sveobuhvatna provjera rada i rezultata odvijat će se tijekom cijelog trajanja projekta kroz kontinuirano konzultiranje sa suradnicima i drugim istraživačima s američkih sveučilišta Virginia Tech i Johns Hopkins University, koji navedene metode koriste u svojim istraživanjima.

We propose that records of paleoclimate, ocean chemistry, and sea-level change are preserved in the succession of the Karst Dinarides. We propose to study the Late Jurassic-Early Cretaceous interval of dominantly shallow water carbonates, because they should record which intervals are likely to form under greenhouse and those that formed under globally cooler "transitional" conditions. The carbonates also should contain sedimentological and geochemical proxies of local and global events affecting the platform, as well as, evidence for carbonate saturation states of the platform waters.

This research project will use the platform of interior succession of the Karst Dinarides of Croatia, to evaluate whether the 60 m.y. long Late Jurassic-Early Cretaceous interval, long been considered to be greenhouse (Fischer 1982), has intervals recording moderate amplitude glacio-eustasy, implying some high-latitude ice. This will be one of the first studies to specifically use platform cyclostratigraphies coupled with synthetic stratigraphic modeling to specifically evaluate greenhouse versus transitional climate modes during Late Jurassic-Early Cretaceous. If successful, the approach also should be widely applicable to the remainder of the Mesozoic, as well as Cenozoic, in the future.

This project could potentially make major contributions to our understanding of paleoclimate and the climatic controls on carbonate platform architecture. The isotope and climatic interpretation will add a new wrinkle and some more information on what appears to be the last changeover from aragonite to calcite seas. The strength of this proposal is an attempt to integrate stratigraphic analysis, modeling, isotopic approaches, and spectral analysis, to track the evolution of climates during the Late Jurassic to Early Cretaceous interval, which is critical in terms of major carbonate platform reservoirs.

A comprehensive evaluation will be undertaken throughout the overall time of the project, through continuous feedback and consultations with collaborators and other researchers from Virginia Tech and Johns Hopkins University, who commonly use the described methods in their work.

Holocensi sedimenti kao zapis promjena u okolišu jadranskih sljevova

Holocene sediments as a record of changes in catchments of the Adriatic coastal region

Glavni istraživač/Main researcher: Dr. sc. Georg KOCH (georg.koch@hgi-cgs.hr)

Geoznanstveno poznavanje povijesti i zapisa o promjenama i fluktuacijama u okolišu kao i interakcije između čovjeka i okoliša poboljšava naše spoznaje o funkciranju geo-okolišnih sustava i njihovih reakcija na današnje i buduće utjecaje. Sedimenti i tla sadrže zapis povijesti antropogenih i klimatskih utjecaja u vremenu i intenzitetu. Izrada integriranih strategija za održivo gospodarenje krških i priobalnih područja Hrvatske zahtjeva istraživanje dugotrajnih međudjelovanja između prirodnog okoliša i ljudske aktivnosti. Poznavanje i razumijevanje mehanizama utjecaja klime na fluvijalne i krške krajobaze i sljevove nužno je za utvrđivanje geomorfoloških i stratigrafskih zapisa promjena klime i korištenja zemljišta, kao i za predviđanje budućih promjena klime i mogućeg utjecaja korištenja zemljišta. Budući da je geološki zapis temelj za takva istraživanja, unutar profila holocenskih sedimenata istraživati će se pokazatelji kao što su palinofacije, pougljena tvar, granulometrija, mineraloški sastav (XRD analize) i kemijski sastav (ICP-AES, AAS analize) u cilju rekonstrukcije zbivanja u ekosustavu krških terena i razvoja sljevova, utvrđivanja kompleksnih odnosa između tala, biljaka, klime i korištenja zemljišta, kao i karakterizacije antropogenih udjela teških kovina i specifičnih spojeva. To će omogućiti uvid u procese kemijskog trošenja u slijevu i pomoći pri rekonstrukciji frekvencija požarenja i njegovog utjecaja na dinamiku sedimentacije u istraživanim sljevovima. Starost sedimenata odrediti će se pomoću AMS 14C datiranja i palinoloških analiza. Za analizu dobivenih podataka koristiti će se detaljno geomorfološko kartiranje aluvijalnih naslaga te razne matematičke i statističke metode analize vremenskih serija podataka.

Predloženo istraživanje temelji se na pristupu istraživanja IGBP/PAGES projekata pod nazivom Focus 5 (HITE - Ljudski utjecaj na terestričke ekosustave i LIMPACS - Ljudski utjecaj na jezerske ekosustave), LOICZ projekta (Land Ocean Interactions in the Coastal Zone), te SedNet-a, koji promoviraju integralno korištenje okolišnih zapisa u interpretaciji stanja i procesa u prošlim i sadašnjim kopnenim i priobalnim ekosustavima u svrhu održivog gospodarenja.

Earth science system recognizes that knowledge of the history of environmental variability and human-environment interactions improves our understanding of the functioning of earth systems and their response to current and future impacts. The majority of the earth's surface yield a significant history of human impact, either in terms of timescale or intensity. Therefore, formulation of integrated strategies for preservation, conservation or sustainable management of Croatian karst and coastal ecosystems demands information about the long-term interactions between natural environment and human activities. Understanding how climate change influences to the fluvial landscapes is essential for predicting the impact on future changes in climate and land use, as well as, for deciphering the geomorphic and stratigraphic record of climate change. The geological record is an invaluable depository of past responses of earth systems to climatic- and land-use changes, as well as, accumulation of pollutants through Holocene, and can thus contribute toward improved predictions of future environmental conditions. Following identification of potential sediment accumulation sites from contrasting localities in the Croatian karst and Adriatic coastal region, the study will focus on collected sediment cores and source archival records of changing land-use, vegetation, and pollution for each catchment contributing sediment. The sediment cores will be subjected to high-resolution multi-proxy micropalaeontological and physical-chemical analyses. The proxies studied will include the microscopic analysis of pollen, charcoal, physical (granulometry), mineralogical (XRD powder diffraction), and chemical (ICP-AES and AAS) characterization of the core material. The age of sediments will be determined using AMS 14C dating. The methodological approaches will vary, from classic inductive interpretation of proxy records, geomorphologic mapping of the alluvium, to mathematical and statistical treatment of high-resolution time series.

The study will follow recommendations and will contribute to the IGBP/PAGES core projects Focus 5 (Human Impacts on Terrestrial Ecosystems and Human Impacts on Lake Ecosystems), LOICZ and SedNet, which promote the integrated use of environmental archives, which provide information about the state of terrestrial and coastal ecosystems and their sustainable management.

Stratigrafija naslaga krede u okviru geodinamike jadranskog područja Hrvatske *Stratigraphy and geodynamic context of Cretaceous deposits in the northeastern Adriatic region*

Glavni istraživač/Main researcher: Dr. sc. Tvrko KORBAR (tvrko.korbar@hgi-cgs.hr)

U recentnoj znanstvenoj literaturi još uvijek su suprotstavljena mišljenja o geološkoj evoluciji sjeveroistočnog jadranskog područja, što svjedoči o kompleksnosti geološke građe i nedovoljnoj istraženosti tog prostora. Iako je recentni morfostrukturni sklop vanjskih Dinarida i sjeveroistočnog dijela jadranskog predgorja završno oblikovan tijekom mlađih geoloških razdoblja, razumijevanju geološke evolucije tog složenog sustava pridonijet će bolje poznavanje svih sukcesivnih procesa u okviru regionalne geodinamike. Izražena lateralna facijesna diferencijacija unutar karbonatnih naslaga gornje krede odražava pojačanu sinsedimentacijsku, a recentni položaj pojedinih formacija snažnu post-krednu geodinamiku. Stoga poznavanje stratigrafije i rasprostranjenosti tih naslaga ima važnu ulogu pri rekonstrukciji regionalne geološke evolucije.

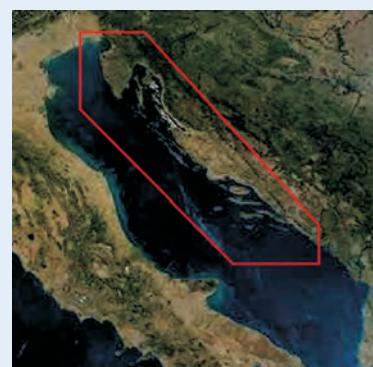
Datiranjem odabranih stratigrafskih horizonata pomoću izotopa stroncija, omogućena je bolja korelacija gornjokrednih plitkovodnih karbonata na istraživanom području s razvojem istodobnih naslaga na globalnom planu. Stabilni izotopi ugljika i kisika također su koristan korelacijski alat za pojedine horizonte krede. Analizom izotopnih zapisa unutar odabranih slijedova naslaga na istraživanom području, omogućiće se bolja korelacija s regionalnim/globalnim geološkim događajima.

Ekomska korisnost takvih istraživanja očituje se prije svega u prognoziranju položaja naftnogeološki perspektivnih naslaga u podzemlju, što predstavlja temelj za koncipiranje usmjerenih naftnogeoloških istraživanja jadranskog područja. Litostratigrafske jedinice definirane tijekom planiranih istraživanja bit će osnovni element buduće formacijske karte, koja je važan preduvjet za kvalitetno upravljanje prirodnim resursima i zaštitu okoliša tog područja.

A review of recent scientific literature reveals opposing interpretations of the geologic evolution of the northeastern Adriatic region. This reflects complexity of the geologic history of External Dinarides and the NE part of the Adriatic foreland. Even though the present day geomorphologic and structure makeup of the region is shaped by relatively recent geological processes, the understanding of its complex geologic history is dependent on reconstructing the succession of all events within the framework of regional geodynamic evolution. The pronounced lateral facies differentiation of Upper Cretaceous carbonates reflects synsedimentary dynamic, whereas, recent position of certain formations implies vigorous post-Cretaceous geodynamic. Thus, understanding the stratigraphy and lateral distribution of these deposits is crucial for reconstructing the regional geologic evolution of this area.

Recent dating of selected stratigraphic horizons using strontium isotopes provided better correlation between the Upper Cretaceous shallow-water carbonate deposits from this area and the coeval globally deposited strata. Stable isotopes of carbon and oxygen are also useful correlation tools for certain Cretaceous horizons, globally. Analysis of the isotopic record for selected successions of strata from the study area will allow for a better understanding of the deposition of these strata in relationship to some specific regional to global geologic events.

Economic and societal benefits from the investigations are primarily reflected in making predictions about the distribution of petroleum-prospective strata in the subsurface. Such predictions serve as a basis for focused petroleum exploration of the Adriatic region. New lithostratigraphic units will be basic elements for the construction of a future formation map as a necessary first step in the meaningful management of natural resources and environmental protection in the region.



Satelitska slika Jadranskog mora prikazuje područje istraživanja.
Satellite image of the Adriatic Sea showing the area of investigation.

Mezozojske magmatske, plaštne i piroklastične stijene

sjeverozapadne Hrvatske

Mesozoic igneous, mantle,

and pyroclastic rocks of northwestern Croatia

Glavni istraživač/Main researcher: Dr. sc. Damir SLOVENEC (damir.slovenec@hgi-cgs.hr)

Mezozojske plaštne, magmatske i piroklastične stijene koje relativno obilato izdanjuju na području sjeverozapadne Hrvatske nisu cijelovito i sustavno izučavane zbog čega postoje brojne nedorečenosti i kontroverze glede njihove geneze, geotektonске pripadnosti i sl. To se odnosi na nedostatak suvremenih petroloških i geokemijskih analitičkih podataka koji bi pomogli u rasvjetljavanju geneze, starosti kristalizacije, ikonskog geotektonskog položaja stijena, a time i cjelokupne geodinamske evolucije prostora.

Radi se o istraživanju složenih magmatskih i piroklastičnih kompleksa koji pripadaju različitim fazama alpinskog orogenskog ciklusa tijekom trijas, jure i donje krede. Zadovoljavajuća rješenja mogu ponuditi isključivo sustavna ciljana i specijalistička istraživanja temeljena na suvremenom pristupu i obradi terena te multidisciplinarnim laboratorijskim analitičkim metodama. Namjera je ovog projekta sveobuhvatno istražiti geokemijske i petrološke značajke stijena da bi se utvrdio geotektonski režim nastanka i smještavanja magmi, te na temelju egzaktnih analitičkih podataka predložio logički izveden model koji bi slikovito predočio geotektonsku evoluciju područja sjeverozapadne Hrvatske, utemeljenu na principima tektonike ploča. Takav složen, suvremen mineraloško-petrološko-geokemijski prikaz potkrijepljen izotopnim i geološkim starostima svih magmatskih i piroklastičnih kompleksa na području predloženom za istraživanja omogućiće formiranje bogate standardizirane baze podataka koja će predstavljati osnovu za karakterizaciju i valorizaciju gospodarski potencijalno zanimljivih mineralnih sirovina na području sjeverozapadne Hrvatske. Koreliranjem dobivenih rezultata s rezultatima sličnih magmatskih kompleksa na području Panonskog bazena, Dinarida i Alpa dobit će se širi regionalni značaj mezozojskih plaštih, magmatskih i piroklastičnih stijena sjeverozapadne Hrvatske.

Mesozoic, mantle, igneous, and pyroclastic rocks, which outcrop with relative abundance in the area of Northwestern Croatia have not been thoroughly and systematically studied so far, which is the reason why their genesis and geotectonic classification still abound with many controversies and disagreements. This relates to the lack of modern petrologic and geochemical analytical data, which would help enlighten genesis, age of crystallization, primordial geotectonic setting of rocks, and the complete geodynamic evolution of the whole area.

It is about the multifaceted igneous and pyroclastic complexes pertaining to various phases of alpine orogenic cycle during Triassic, Jurassic, and Lower Cretaceous. Satisfactory solutions can be offered solely by methodically targeted and specialist researches based on a modern approach, and analysis of the terrain as well as by multidisciplinary laboratory analytical methods. The purpose of this project is to comprehensively explore geochemical and petrologic characteristics of rocks as a means of understanding the geotectonic regime of genesis and emplacement of magmas, and to propose a logically deduced model by the exact analytical data, to concisely visualize geotectonic evolution of the area of Northern Croatia, in the light of plate tectonics. Such a complex, modern mineralogic-petrologic-geochemical representation corroborated by isotope and geological ages of all magmatic and pyroclastic complexes in the area, proposed for investigation, will render the possibility of developing the rich standardized database. The latter will represent the groundwork for characterization and evaluation of potentially interesting mineral resources in Northwestern Croatia, for industrial purposes. By correlating the acquired data with results of investigations of similar igneous complexes in the area including Pannonian basin, Dinarides, and Alps a broader regional significance of Mesozoic mantle, igneous, and pyroclastic rocks of Northwestern Croatia will be generated.

Mikrofossilne zajednice u karbonatnim naslagama krških Dinarida

Microfossil assemblages in the carbonate sedimentary rocks of the Karst Dinarides

Glavni istraživač/Main researcher: Dr. sc. Ivo VELIĆ (ivo.velic@hgi-cgs.hr)

Vapnenačke alge i bentičke foraminifere jedine su dvije fosilne skupine koje su kontinuirano vremenjski i prostorno prisutne u plitkomorskim karbonatima krških Dinarida. Zbog vrlo slabe zastupljenosti drugih skupina fosilnih organizama one su najvažniji, najčešće ključni i jedini čimbenici za određivanja starosti karbonatnih naslaga kao i za sva datiranja u širokome spektru fundamentalnih, razvojnih i primijenjenih istraživanja u krškom području. Zbog toga je njihovo istraživanje kontinuirani znanstveni proces.

Determinacijom poznatih i opisom novih taksona vapnenačkih alga i bentičkih foraminifera planira se obogatiti postojeće spoznaje o mikrofossilnim zajednicama i ostvariti detaljnija stratigrafska podjela u karbonatnim naslagama krških Dinarida. Time će se ostvariti i kvalitetnija biostratigrafska korelacija sa susjednim i širim tetiskim/mediteranskim plitkomorskim područjima. Dopunit će se paleobiogeografija najvažnijih vrsta alga i foraminifera, utvrditi paleookoliši njihovih biotopa te uz pomoć magnetostratigrafije u srednjo- i gornjojurskim naslagama utvrditi i njihova detaljna geokronologija.

Važnost predloženoga istraživanja očituje se u fundamentalnom i primijenjenom pogledu. U fundamentalnom važno je za: paleontologiju (opisima novih i revidiranjima ranije opisanih taksona), stratigrafiju (dvojako - u biostratigrafskoj i stratigrafskoj raščlambi, zatim za neophodna i važna datiranja događaja, faza i procesa) te za sedimentologiju, strukturu geologiju, tektoniku (npr. za izdizanja/nastajanja krških Dinarida), paleogeografsku, paleoklimatologiju i dr., a najvažnije u geološkom kartiranju. U primijenjenim istraživanjima kroz geološko kartiranje imat će široku primjenu u svim zahvatima u prostoru krškoga područja: prostornom planiranju, geološkom inženjerstvu, građevinarstvu, istraživanju pojave i ležišta mineralnih i drugih sirovina i poglavito zaštiti voda i općenito zaštiti okoliša u osjetljivim krškim ekosustavima.

Calcareous algae and benthic foraminifera are the only two fossil groups continuously, spatially, and temporally present within the Karst Dinarides carbonate rocks. As a consequence of scarce occurrence of other fossil groups they are most significant and frequently the sole elements used for determination of the age of carbonate deposits in the area, as well as, for geological dating, which are used for a variety of basic and applied investigations in the karst region. Therefore their investigation should be regarded as a continuous scientific process.

Determination of known taxa, evaluation of taxa found in the area of the Karst Dinarides for the first time, as well as description of completely new calcareous algae and benthic foraminifera, would enable even better biostratigraphic correlation with neighboring and wider Tethyan/Mediterranean shallow-marine areas during the Phanerozoic. Palaeobiogeography of the most important genera and species of calcareous algae and benthic foraminifera would be supplemented with new data, and biotopes and depositional environments of Palaeozoic to Tertiary rocks would be determined, with special emphasis on Jurassic and Cretaceous sequences of the Karst Dinarides. Magnetostatigraphic research within Middle and Upper Jurassic deposits should enable more precise stratigraphic subdivision. Annual reports, as well as publication of scientific papers in Croatian and international journals, including those covered by Current Contents database, represent the best methods of project evaluation. Importance of the proposed project may be evaluated from both the basic and applied aspects.

Anticipated basic scientific contribution will be important for palaeontology (description of new and revision of already described taxa), stratigraphy (biostratigraphy and stratigraphic subdivision), as well as, for very important dating of major events and processes in sedimentological, structural and tectonic research (e.g. for dating of the phases connected with the final uplift of the Dinarides), palaeogeography, palaeoclimatology, and, probably the most important, for production of the geological map. In the field of applied geology, results provided by the proposed project might be used for different projects in the karst area: spatial planning, geological engineering, civil engineering, investigation of mineral resources, and especially environmental protection of the vulnerable karst ecosystems.

MEĐUNARODNI PROJEKTI

INTERNATIONAL PROJECTS

*Greenhouse and transitional climates in 50 m.y. carbonate record of the late Jurassic-early Cretaceous Dinaric platform, Croatia
Joint U.S.-Croatian Cooperative Research Project - National Science Foundation (USA)*

Glavni istraživač/Main researcher: J. Fred READ (Virginia Tech, USA)
 and Antun HUSINEC (Croatian Geological Survey, Croatia)

This Joint U.S.-Croatian Cooperative Research Project will use parasequence-stacking patterns of the Dinaric carbonate platform, Croatia to track hot greenhouse versus cooler, transitional climate modes in the >50 m.y. duration, 2 km thick, Upper Jurassic-Lower Cretaceous succession. The interval is within the Middle Jurassic-Early Cretaceous "cool" mode for which the model and proxy data conflict. Tracking greenhouse versus transitional climates should be possible because Type I greenhouse platforms that formed on a relatively ice-free earth with small glacio-eustatic sea level changes are distinct from Type II platforms that formed under transitional climates with moderate amounts of polar ice; Type III (ice-house) platforms are absent from the Mesozoic.

Using detailed bed-by-bed measured sections of the superbly exposed Late Jurassic-Early Cretaceous interval from the Dinaric platform interior we will: 1. document the facies within parasequences, and use parasequence stacking and disconformities to define depositional sequences and systems tracts, 2. use subsidence history plots, stacking patterns, Fischer plots, and published sea level curves to unravel tectonic effects versus 3rd and 4th order sea level changes 3. constrain ages of sections with benthic microfossils, 4. use the sedimentary facies (karst, microbialites, ooids) to define local climate controls on deposition (arid versus humid phases), and evolution of carbonate saturation state of platform seawater, that peaked in the Late Jurassic (Tithonian), 5. evaluate C-(and to a lesser extent, O) isotope curves across critical intervals to evaluate: degree of diagenetic resetting below subaerial surfaces, how C-isotope excursions might help correlate the sections, and see how oceanic anoxic events are manifested on the platform, and whether they occurred during warm high sea level phases; 6. compare the cyclostratigraphic data with that documented elsewhere for these time intervals, and compile global climate proxy data for the intervals to evaluate local versus global trends 7. analyze the measured section data using spectral analysis and spectral mapping for evidence of Milankovitch forcing, compare the results with radiometric ages of stages, and 8. use computer-modeling to simulate the stratigraphic successions with various sea level and subsidence scenarios, to define intervals with greenhouse versus transitional climate modes. We will be able to track the evolution of greenhouse and transitional climate states over the >50 m.y. Late Jurassic-Early Cretaceous "cool" mode, refine 3rd order sea level curves, and better constrain superimposed Milankovitch 4th order and perhaps 5th order frequencies and amplitudes.

Tracking global greenhouse and cooler, transitional climates through the Middle Jurassic-Early Cretaceous "cool" mode is important because presently used climate proxies and models conflict. Thus it will greatly refine our understanding of climate modes in this geologically important time in Earth history, and refine our understanding of the stratigraphic signature of these climate modes for the Mesozoic. The Virginia Tech group has been a leader in tying stacking patterns of carbonate platforms to global climate. The Tech group was one of the first to utilize and develop computer modeling to better understand stacking patterns on platforms and to recognize the significance of transitional climate modes intermediate between greenhouse and icehouse worlds in developing the distinctive stacking patterns of platforms

KATER II projekt

KATER II project

Glavni istraživač/Main researcher: Dr. sc. Ante PAVIČIĆ (ante.pavicic@hgi-cgs.hr)

Koncem 2006. godine završen je međunarodni projekt KATER II (KArst waTER research program), koji je nastavak međunacionalnog interdisciplinarnog projekta KATER. KATER II projekt je izведен u okviru Interreg III B CADSES programa. Vodeći partner je bio grad Beč i bečki vodovod, a u projektu su, osim Hrvatskog geološkog instituta – Zavoda za hidrogeologiju i inženjersku geologiju iz Hrvatske, sudjelovali Ministarstvo obrazovanja, znanosti i kulture – Austrija, Regionalna uprava Donje Austrije - Austrija, Regionalna uprava Štajerske - Austrija, Institut rудarstva, geotehnologije i okoliša - Slovenija, Regija Veneto - Italija i Regija Molise - Italija. Glavni cilj KATER II projekta bio je, u razvoju i procjeni na GIS-u temeljenog sustava potpore, donošenje odluka u području prostornog planiranja, zaštite podzemnih voda i okoliša. Projekt se izvodio na pilot područjima izabranim od strane svakog partnera s obzirom na njihovu specifičnu problematiku. Austrijski pilot projekt odnosio se na istraživanje utjecaja šumarstva i aktivnosti u turizmu i ispaši stoke na krške podzemne vode. Slovenski pilot projekt se odnosio na područje Krvavca i istraživanja utjecaja turizma i uzgoja stoke na podzemne vode. Pilot projekt Hrvatske obuhvaćao je sliv rijeke Gacke i istraživanje utjecaja prometne infrastrukture na krški vodonosnik. Predmet istraživanja Veneta bio je utjecaj intenzivne poljoprivrede i uzgoja stoke u ruralnim područjima, te komunalnih i industrijskih otpadnih voda u urbanim područjima na krški vodonosnik. Utjecaj poljoprivrednih i stočarskih aktivnosti na malteški krški masiv istraživan je na pilot području u Molise-u.

U 2006. godini je posebna aktivnost na Kater II projektu posvećena završnoj konferenciji u Beču, na kojoj su svojim radovima aktivno sudjelovali brojni istraživači s projekta OHGK.

The close of the year 2006 saw the completion of the international project KATER II (KArst waTER research program), which is the extension of the earlier interdisciplinary international project KATER. KATER II is performed within the framework of Interreg III B CADSES program. The leading partner was the city of Vienna and the Vienna waterworks, whereas, the participants were the Croatian Geological Institute - Department for Hydrogeology and Engineering Geology - Croatia, Ministry of Education, Science, and Culture - Austria, Regional Department of Lower Austria - Austria, Regional Department of Stiermark - Austria, Institute of mining, geotechnology and environment - Slovenia, Region Veneto - Italia and Region Molise - Italia. The main scope of the KATER II project was to improve decision making in the area of space planning, groundwater, and environment protection, using development and evaluation of the system of support, based on GIS. The project exploited the pilot areas selected by each partner considering their specific questions and issues. The Austrian pilot project was focused on investigation of impacts of forestry, tourism activities, and cattle grazing on the karst groundwater. Slovenian pilot project highlighted the area of Krvavac and impacts of tourism and stockbreeding on groundwater. The Croatian pilot project embraced the drainage system of the river Gacka and investigation of the impact of the traffic infrastructure on the karst aquifer. Issues investigated by Veneto were associated with the influence of intensive farming and stockbreeding in rural areas, as well as, the influence of municipal and industrial waters on groundwater. Impact of crop and livestock activities on Maltese karst massif was explored in the pilot area of Molise.

In 2006, the special activity of the KATER II project was dedicated to the closing conference in Vienna, which included numerous researches from the project OHGK, who actively participated in the meeting by presenting their works.

BIBLIOGRAFIJA DJELATNIKA HGI-CGS 2006. – BIBLIOGRAPHY OF HGI-CGS STAFF IN 2006

DISERTACIJE I MAGISTARSKI RADOVI – *Ph.D. AND M.Sc. THESES*

Hajek-Tadesse, Valentina. Miocenski ostrakodi sjeverne Hrvatske / doktorska disertacija. Zagreb : Prirodoslovno-matematički fakultet, 10.02.2006., 179 str. Voditelj: Sokač, Ana ; Sremac, Jasenka.

KNJIGE - BOOKS

3rd Mid-European Clay Conference - Abstracts Book / **Vlahović, Igor**; Tibljaš, Darko; Durn, Goran; Biševac, Vanja (ur.). Zagreb : PMF ; RGNF, 2006.

3rd Mid-European Clay Conference - Field Trip Guidebook / **Vlahović, Igor**; Tibljaš, Darko; Durn, Goran (ur.). Zagreb : PMF ; RGNF, 2006.

De Vos, W., Tarvainen, T., Salminen, R., Reeder, S., De Vivo, B., Demetriades, A., Pirc, S., Batista, M.J., Marsina, K., Ottesen, R.T., O'Connor, P.J., Bidovec, M., Lima, A., Siewers, U., Smith, B., Taylor, H., Shaw, R., Salpeteur, I., Gregorauskiene, V., **Halamić, Josip**, Slaninka, I., Lax, K., Gravesen, P., Birke, M., Breward, N., Ander, E.L., Jordan, G., Duris, M., Klein, P., Locutura, J., Bel-lan, A., Pasieczna, A., Lis, J., Mazreku, A., Gilucis, A., Heitzmann, P., Klaver, G., Petersell, V. Geochemical Atlas of Europe, Part 2, Interpretation of Geochemical Maps, Additional Tables, Figures, Maps, and Related Publications. Espoo, Finland : Geological Survey of Finland, 2006.

POGLAVLJA U KNJIZI – *BOOK CHAPTERS*

Demetriades, A.; Pirc, S.; De Vos, W.; Ottesen, R.T.; Reeder, S.; O'Connor, P.J.; Bidovec, M.; De Vivo, B.; Lax, K.; **Halamić, Josip**; Pasieczna, A.; Slaninka, I.; Birke, M.; Siewers, U.; Breward, N.; Lima, A.; Duris, M.; Locutura, J.; Bel-lan, A.; Salpeteur, I.; Klein, P.; Jordan, G.; Mazreku, A.; Petersell, V. Distribution of elements in floodplain sediments // Geochemical Atlas of Europe, Part 2 / De Vos, Walter ; Tarvainen, Timo (ur.). Espoo : Geological Survey of Finland, 2006. Str. 41-44.

De Vivo, B.; Ander, E.L.; Bidovec, M.; Lima, A.; Pirc, S.; Reeder, S.; Siewers, U.; Smith, B.; Albanese, S.; Batista, M.J.; Bel-lan, A.; Birke, M.; Breward, N.; Demetriades, A.; De Vos, W.; Duris, M.; Gravesen, P.; Greogauskiene, V.; **Halamić, Josip**; Jordan, G.; Lax, K.; Locutura, J.; O'Connor, P.J.; Pasieczna, A.; Slaninka, I.; Tarvainen, T. Distribution of elements in stream water // Geochemical Atlas of Europe, Part 2 / De Vos, Walter ; Tarvainen, Timo (ur.). Espoo : Geological Survey of Finland, 2006. Str. 33-36.

De Vos, W.; Batista, M.J.; Pirc, S.; O'Connor, P.J.; Demetriades, A.; Tarvainen, T.; Salminen, R.; Reeder, S.; Salpeteur, I.; Gregorauskiene, V.; Lax, K.; **Halamić, Josip**; Pasieczna, A.; Slaninka, I.; Mazreku, A.; Siewers, U.; Birke, M.; Breward, N.; Bidovec, M.; De Vivo, B.; Lima, A.; Duris, M.; Locutura, J.; Bel-lan, A. Distribution of elements in stream sediments // Geochemical Atlas of Europe, Part 2 / De Vos, Walter ; Tarvainen, Timo (ur.). Espoo : Geological Survey of Finland, 2006. Str. 37-40.

De Vos, W.; Gregorauskiene, V.; Marsina, K.; Salminen, R.; Salseteur, I.; Tarvainen, T.; O'Connor, P.J.; Demetriades, A.; Pirc, S.; Batista, M.J.; Bidovec, M.; Bel-lan, A.; Birke, M.; Breward, N.; De Vivo, B.; Duris, M.; **Halamić, Josip**; Klein, P.; Lima, A.; Locutura, J.; Lis, J.; Mazreku, A.; Ottesen, R.T.; Pasieczna, A.; Petersell, V.; Reeder, S.; Siewers, U.; Slaninka, I. Distribution of elements in Subsoil and Topsoil // Geochemical Atlas of Europe, Part 2 / De Vos, Walter ; Tarvainen, Timo (ur.). Espoo : Geological Survey of Finland, 2006. Str. 21-30.

Durn, Goran; Mileusnić, Marta; **Miko, Slobodan**; Nakić, Zoran. Kategorije i parametri za motrenje onečišćenih tala Hrvatske // Priručnik za trajno motrenje tala Hrvatske / Dragičević Kučar, Savka (ur.). Zagreb : AZO-Agencija za zaštitu okoliša, 2006. Str. 83-182.

Fuček, Ladislav; Velić, Ivo. General Stratigraphic and Tectonic Characteristics of the Telašćica Nature Park and Kornati National Park // ADRIA 2006 Field trip Guide / Menichetti, Marco, Menucci, Daniela (ur.). Urbino : Universita degli Studi di Urbino, 2006. Str. 72-74.

Velić, Ivo. Basic Geology of the Krka National Park // ADRIA 2006 Field trip Guide / Menichetti, Marco, Menucci, Daniela (ur.). Urbino : Universita degli Studi di Urbino, 2006. Str. 60-60.

Velić, Ivo; Vlahović, Igor; Tišljarić, Josip; **Matićec, Dubravko**. Introduction to the Stratigraphy of the Karst (Outer) Dinarides // ADRIA 2006 Field trip Guide / Menichetti, Marco ; Menucci, Daniela (ur.). Urbino : Universita degli Studi di Urbino, 2006. Str. 15-17.

Velić, Ivo; Vlahović, Igor; Tišljarić, Josip; Sremac, Jasenka; **Matićec, Dubravko**. Middle Permian clastic deposits ; Carbonate succession Middle-Upper Permian ; Clastic-carbonate deposits of Middle-Upper Triassic (Ladinian-Norian) ; Lower Jurassic shallow-marine carbonates (Hettangian to Pliensbachian) ; Lower Jurassic bioturbated limestones (Toarcian) ; Oligocene-Miocene Jelar brechia // ADRIA 2006 Field trip Guide / Menichetti, Marco ; Menucci, Daniela (ur.). Urbino : Universita degli Studi di Urbino, 2006. Str. 51-58.

RADOVI U CURRENT CONTENTS ČASOPISIMA – *PAPERS IN JOURNALS INDEXED BY THOMSON SCIENTIFIC CURRENT CONTENTS*

Biondić, Božidar; **Biondić, Ranko**; Kapelj, Sanja. Karst groundwater protection of the Kupa River catchment area and sustainable development. // Environmental Geology. 49 (2006) ; 6, 828-839.

Čelebić, Asja; Baučić, Maja; Stipetić, Jasmina; Baučić, Ivo; **Miko, Slobodan**; Momčilović, Berislav. Ion release from gold/platinum dental alloy: could release of other elements be accountable in the contact allergy attributed to the gold? // Journal of Materials Science: Materials in Medicine. 17 (2006) , 4; 301-305.

Galović, Ines; Bajraktarević, Zlatan. Sarmatian biostratigraphy of the Mountain Medvednica at Zagreb based on siliceous microfossils (North Croatia, Central Paratethys). // Geologica Carpathica. 57 (2006) , 3; 199-210.

Husinec, Antun; Jelaska, Vladimir. Relative Sea-Level Changes Recorded on an Isolated Carbonate Platform: Tithonian to Cenomanian Succession, Southern Croatia. // Journal of Sedimentary Research. 76 (2006) , 10; 1120-1136.

Husinec, Antun; Read, J. Fred. Transgressive oversized radial ooid facies in the Late Jurassic Adriatic platform interior: Low energy precipitates from highly supersaturated hypersaline waters. // Geological Society of America Bulletin. 118 (2006) , 5/6; 550-556.

Husinec, Antun; Sokač, Branko. Early Cretaceous benthic associations (foraminifera and calcareous algae) of a shallow tropical-water platform environment (Mljet Island, southern Croatia). // Cretaceous Research. 27 (2006) , 3; 418-441.

Kollarits, Stefan; Kuschnig, Gerhard; Veselič, Miran; **Pavičić, Ante**; Soccorso, Corrado; Aurighi, Marina. Decision-support systems for groundwater protection: innovative tools for resource management. // Environmental Geology. 49 (2006) , 6; 840-848.

Kovačić, Marijan; Grizelj, Anita. Provenance of the Upper Miocene clastic material in the southwestern part of Pannonian Basin. // Geologica Carpathica. 57 (2006) , 6; 495-510.

Marković, Tamara; Miko, Slobodan; Kapelj, Sanja; **Buljan, Renato; Larva, Ozren; Peh, Zoran.** Behaviour of metals and nutrients in soils and groundwater of a karst polje. // Journal of Geochemical Exploration. 88 (2006) ; 124-129.

Peh, Zoran; Miko, Slobodan; Mileusnić, Marta. Areal versus linear evaluation of relationship between drainage basin lithology and geochemistry of stream and overbank sediments in low-order mountainous drainage basins. // Environmental geology. 49 (2006) , 8; 1102-1115.

RADOVI U ČASOPISU GEOLOGIA CROATICA – PAPERS IN GEOLOGIA CROATICA

Vrsaljko, Davor; Pavelić, Davor; Miknić, Mirjana; Brkić, Mato; Kovačić, Marijan; Hećimović, Ivan; Hajek-Tadesse, Valentina; Avanić, Radovan; Kurtanjek, Nenad. Middle Miocene (Upper Badenian/Sarmatian) Palaeoecology and Evolution of the Environments in the Area of Medvednica Mt., (North Croatia). // Geologija Croatica. 59 (2006) , 1; 51-63.

RADOVI U OSTALIM MEĐUNARODNIM ČASOPISIMA – PAPERS IN OTHER INTERNATIONAL JOURNALS

Brozović, Ivan; **Kruk, Boris; Kastmuller, Željko;** Zajc, Josip. Tehnologija proizvodnje opeke u pogonu Wienerberger Ilovac d.d.. // Mineral - stručni časopis za područje rудarstva i graditeljstva. 5 (2006) ; 30-32 (članak, stručni rad).

Buljan, Renato; Marković, Tamara; Zelenika, Mladen. Vodonosnik zapadnog dijela Prgovog polja na otoku Lastovu. // Rudarsko-geološko-naftni zbornik. 18 (2006) ; 15-27.

Galović, Lidija. Geološka radionica Ice Age Earth. // Vijesti Hrvatskog geološkog društva. 43 (2006) , 1; 16-19.

Halamić, Josip. Geokemijski atlas Europe. // Vijesti Hrvatskog geološkog društva. 43 (2006) , 1; 44-45.

Kruk, Boris; Brozović, Ivan; **Kastmuller, Željko;** Zajc, Josip; Tibljaš, Darko. Ležište ciglarske gline Rečica kod Karlovca. // Mineral - stručni časopis za područje rudarstva i graditeljstva. 3 (2006) ; 22-24.

Marković, Stjepan; Kovačić, Miron. Izvorište geotermalne vode u Stubičkim Toplicama. // Hrvatske vode. 55 (2006) ; 173-181.

Roetzel, Reinhard; Čorić, Stjepan; **Galović, Ines;** Fred Rögl. Early Miocene (Ottangian) coastal upwelling conditions along the southeastern scarp of the Bohemian Massif (Parisdorf, Lower Austria, Central Paratethys). // Beiträge zur Paläontologie. 30 (2006) ; 387-413.

RADOVI U ZBORNICIMA SKUPOVA S MEĐUNARODNOM RECENZIJOM– PAPERS IN PROCEEDINGS WITH INTERNATIONAL REVIEW

Buljan, Renato; Pollak, Davor; Pešt, Damir. Engineering geological properties of the rock mass along the Kastela Bay sewage system // IAEG2006 ; Engineering geology for tomorrow's cities ; Pre-Congress Proceedings / Culshaw, Martin ; Reeves, Helen ; Spink, Tim ; Jefferson, Ian (ur.). London : The Geological Society of London, 2006. 1-8.

Krsnik, Marijan; **Pavičić, Ante;** Grgec, Damir; **Terzić, Josip.** Hydrogeological and geophysical research for urban planning purpose in Zadar, Croatia // All About Karst & Water – Decision Making in a Sensitive Environment. Beč :Vienna Waterworks, City of Vienna, 2006. Dostupno na: www.kater.at.

Miko, Slobodan; Pavičić, Ante; Marković, Tamara; Kuhta, Mladen. Impact of highway stormwater runoff on the chemical status of karst waters of the gacka spring, croatia // All About Karst & Water – Decision Making in a Sensitive Environment. Beč :Vienna Waterworks, City of Vienna, 2006. 277-282.

Miko, Slobodan; Peh, Zoran; Ozren, Hasan; Šparica Miko, Martina; Mesić, Saša; Bukovec, Dragan. Geochemical Mapping of Topsoil in Croatian Karst: Provenance Implications and Pollution Signatures // Proceedings of the 5th European Congress on Regional Geoscientific Cartography and Information Systems - Earth and Water / Artioli, G.P. ; Berastegui, X. ; Schmidt, H. (ur.). Barcelona : Institut Cartografic de Catalunya ; Institut Geologic de Catalunya, 2006. 169-171.

Mlinar, Željko; Jamičić, Domagoj. Dependence of geotechnical and engineering geological modeling on structural forms in karst area of Croatia // 2006 7th International Symposium of Structures, Geotechnics and Construction Materials. Santa Clara, Cuba, 2006.

Pavičić, Ante; Miko, Slobodan; Dolić, Mario; Marković, Tamara; Kuhta, Mladen. Impact of Transport Infrastructure (Motorways) on the Environment and Water Resources in Karstic Areas:Croatian Contribution to Kater II // All About Karst & Water – Decision Making in a Sensitive Environment. Beč :Vienna Waterworks, City of Vienna, 2006. 245-251.

Terzić, Josip; Pavičić, Ante; Marković, Tamara. Hydrogeological investigations with water quality and quantity monitoring on loskun spring in croatia // All About Karst & Water – Decision Making in a Sensitive Environment. Beč : Vienna Waterworks, City of Vienna, 2006. 259-265.

OSTALI RADOVI U ZBORNICIMA SKUPOVA– PAPERS IN OTHER PROCEEDINGS

Avanić, Radovan; Bakrač, Koraljka; Grizelj, Anita; Wacha, Lara; Šimić-Stanković, Mirjana; Hećimović, Ljerka; Tibljaš, Darko; Kruk, Boris. Ivšević Gaj ceramic clay deposit in the vicinity of Vojnić // Field Trip Guidebook : Ceramic and brick clays deposits and excessive flysch erosion / Vlahović, Igor ; Tibljaš, Darko ; Durn, Goran (ur.). Zagreb : PagiGraf, Zagreb, 2006. 39-47.

Kruk, Boris; Brozović, Ivan; **Kastmuller, Željko;** Zajc, Josip; Tibljaš, Darko; **Kruk, Ljiljana.** Deposit of brick clays Rečica // Field Trip Guidebook / Vlahović, Igor ; Tibljaš, Darko ; Durn, Goran (ur.). Zagreb : PagiGraf, 2006. 33-38.

SAŽETCI U ZBORNICIMA SKUPOVA I NEOBJAVLJENI RADOVI – ABSTRACTS IN PROCEEDINGS AND UNPUBLISHED PAPERS

Boris Lukšić; Željko Dedić; Željko Kastmüller. Mineralne sirovine Primorsko-goranske županije // Prirodoslovna istraživanja riječkog područja / Milvana Arko-Pijevac, Borut Kružić, Marcelo Kovačić (ur.). Rijeka : Prirodoslovni muzej Rijeka, 2006. 59-60.

Bukovec, Dragan; **Miko, Slobodan**; Kušan, Vlado; Antonić, Oleg; **Peh, Zoran; Mesić, Saša**; Pernar, Renata; **Šparica Miko, Martina**. Procjena rizika zakiseljavanja atmosferskim putem u Primorsko- goranskoj županiji na temelju geokemijskog kartiranja // II. znanstveni skup s međunarodnim sudjelovanjem "Prirodoslovna istraživanja Riječkog područja", Knjiga sažetaka / Arko-Pijevac, Milvana ; Kružić, Borut ; Kovačić, Marcelo (ur.). Rijeka : Prirodoslovni muzej Rijeka, 2006. 54-55.

Galović, Lidija. Paleotla u pleistocenskim praporima Baranje i Srijema - geokemijske značajke // Uloge tla u okolišu: sažeci / Kisić, Ivica (ur.). Zagreb : Hrvatsko tloznanstveno društvo, 2006. 53.

Galović, Lidija; Mileusnić, Marta; **Peh, Zoran;** Durn, Goran; **Halamić, Josip.** Mineralogical and geochemical characteristics of loess/paleosol section in Šarengrad, Srijem, Croatia // 3rd Mid-European Clay Conference - MECC06, Abstract book / **Vlahović, Igor** ; Tibljaš, Darko ; Durn, Goran ; Biševac, Vanja (ur.). Zagreb : Faculty of Science ; Faculty of Mining, Geology and Petroleum Engeneering, 2006. 46.

Hajek-Tadesse, Valentina; Mesić, Saša; Sremac, Jasenka; Sokač, Ana; **Miko, Slobodan.** The Holocene Ostracods from Vrana Lake (Cres Island-Croatia) // Zbornik povzetkov / Režun, Bojan ; Eržen, Uroš ; Petrič, Metka ; Gantar, Ivan (ur.). Idrija : Rudnik živega srebra v zapiranju d.o.o., 2006. 52-53.

Hajek-Tadesse, Valentina; Sremac, Jasenka; Belak, Mirko; Bermanec, Vladimir; Sokač, Ana. Preservation, abundance and architectural variations of Ostracods in different Miocene Paleoenvironments of Northern Croatia // Zbornik povzetkov / Režun, Bojan ; Eržen, Uroš ; Petrič, Metka ; Gantar, Ivan (ur.). Idrija : Rudnik živega srebra v zapiranju d.o.o., 2006. 52.

Halamić, Josip; Peh, Zoran; Miko, Slobodan; Galović, Lidija; Hasan, Ozren; Šparica Miko, Martina; Mesić, Saša; Šorša, Ajka. Geochemical Atlas of the Republic of Croatia - State of the Art // Uloge tla u okolišu / Kisić, Ivica (ur.). Šibenik : Hrvatsko tloznanstveno društvo, 2006. 35.

Halamić, Josip; Šajn, Robert; **Peh, Zoran; Galović, Lidija.** Težke kovine u aluvialnih sedimentih reke Drave // Zbornik povzetkov / Režun, Bojan ; Eržen, Uroš ; Petrič, Metka ; Gantar, Ivan (ur.). Idrija : Rudnik živega srebra v zapiranju d.o.o., 2006. 95.

Husinec, Antun; Read, J. Fred. Late Jurassic Tithonian greenhouse climate inferred from facies stacking: Adriatic cyclic platform interior, Croatia // Geological Society of America Abstracts with Programs, Vol. 38, No. 7. Philadelphia, PA : Geological Society of America, 2006. 74.

Husinec, Antun; Velić, Ivo. Biostratigraphy and diversity of mid-Cretaceous benthic foraminifers of Adriatic Platform, S Croatia // Anuario do Instituto de Geociencias / Koutsoukos, E.A.M. (ur.). Rio de Janeiro : Universidade Federal do Rio de Janeiro, 2006. 652-653.

Jamičić Domagoj, Ptoljan Božo, Markulin, Ž. & Takač D. The correlation between the stress field in the Pannonian and Dinaridic-Adriatic part of Croatia // 5th European Congress on Regional Geoscientific Cartography and Information Systems. Barcelona, 2006. 130-131.

Kovačić, Miron; Rajver, Dušan. Geothermal Resources in the Border Regions of Croatia And Slovenia - State of the Art // Book of Abstracts / Režun, Bojan ; Eržen, Uroš ; Petrič, Metka ; Gantar, Ivan (ur.). Idrija : Rudnik živega srebra v zapiranju, 2006. 110-111.

Miko, Slobodan; Mesić, Saša; Šparica Miko, Martina; Prohić, Esad. Teški metali i elementi u tragovima u tlima i jezerskim sedimentima područja Kvarnera i Gorskog kotara // II. znanstveni skup s međunarodnim sudjelovanjem "Prirodoslovna istraživanja Riječkog područja", Knjiga sažetaka / Arko-Pijevac, Milvana ; Kružić, Borut ; Kovačić, Marcelo (ur.). Rijeka : Prirodoslovni muzej Rijeka, 2006. 53-54.

Miko, Slobodan; Šparica, Marko; Koch, Georg; Šparica Miko, Martina; Bergant, Stanislav. Influence of land use in small karst catchments on the chemical status of peloid sediments on the eastern Adriatic coast // Sediment key-issues between the river and the sea / Besten, Piet ; Brils, Jos (ur.). Venecija : TNO:SedNet Secretariat, 2006. A-02.

Pavelić, Davor; **Kovačić, Marijan; Vlahović, Igor.** Periglacial aeolian – alluvial interaction: Pleistocene of the Island of Hvar (Eastern Adriatic, Croatia) // Frome the Highest to the Deepest. Abstracts. Volume A / Hoyanagi, K. ; Takano, O. ; Kano, K. (ur.). Fukuoka : ISC 2006, Organising Committee, 2006. 218.

Terzić, Josip; Dolić, Mario; Vlahović, Tatjana; **Marković, Tamara.** Sanitary protection zones on karstified island of Kočula in Croatia // 5th European Congress on Regional Geoscientific Cartography and Information Systems. Barcelona, 2006. 553-554.

Tibljaš, Darko; **Avanić, Radovan;** Hanžel, Darko. Glauconitic materials from Lower Miocene Macelj Formation (NW Croatia) – new data // MECC'06 Abstracts Book / Vlahović, Igor ; Tibljaš, Darko ; Durn, Goran ; Biševac, Vanja (ur.). Zagreb : PMF ; RGNF, 2006. 113.

Tibljaš, Darko; Balen, Dražen; Mahečić, Smiljan; **Kovačić, Marijan;** Jozić, Dražan; Španić, Darko; Judik, Katalin; Árkai Peter. Clay minerals as indicators of thermal history of Palaeozoic rocks from Marija Hills, NW Croatia // MECC'06 Abstracts Book / **Vlahović, Igor** ; Tibljaš, Darko ; Durn, Goran ; Biševac, Vanja (ur.). Zagreb : PMF ; RGNF, 2006. 114.

Veseli, Vladimir; **Velić, Ivo; Vlahović, Igor;** Tišljarić, Josip; Stanković, Damir. Biozonation of Sinemurian and Pliensbachian larger benthic foraminifera (Velebit Mt., Croatia) // Anuario do Instituto de Geociencias- UFRJ, Vol. 20-1 / Carvalho, Ismar de Souza (ur.). Rio de Janeiro : Universidade Federal do Rio de Janeiro, Centro de Ciencias Matem. a da Natureza, Instituto de Geociencias, 2006. 368-369.