

SCIENCE CARVED  
IN THE STONES



**CLUSTER OF  
APPLIED EARTH  
SCIENCES**

BROCHURE'20



**Dear Readers,**

Welcome to the information brochure of the **Cluster of Applied Earth Sciences, CAPES!** Our cluster provides access to R&D&I capacity & state-of-the-art expertise in applied geoscience subjects, including hydrocarbon and geothermal research, as well as radioactive waste repository and environmental protection.

The **Cluster of Applied Earth Sciences** is a hub in Central Europe for high tech companies and earth science laboratories offering state of the art services and solutions in:

Mining, raw material, hydrocarbon exploration,  
Geothermal research,  
Research activity related to radwaste disposal projects,  
Environmental management,  
R&D&I projects.

**CAPES** uniquely delivers integrated expertise based on the knowledge pull of our member companies representing the highest standards of geoscience discipline and well established practice. Our organization is a client oriented and inspiring hub of innovation driven companies, laboratories, universities and R&D&I centers.

The overarching vision of the **Cluster of Applied Earth Sciences** is to provide comprehensive, fast and tailored services to our clients. We are committed to offering our clients quality, the best value on reasonable price.

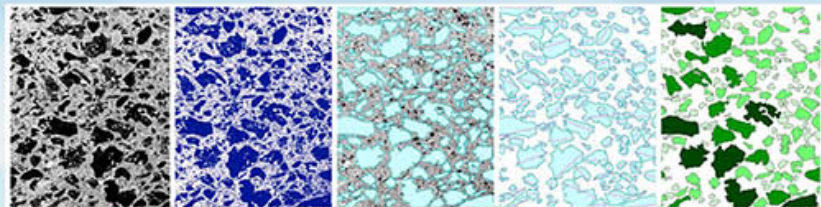
We are proud that **CAPES** and its members thrive. **CAPES** is also an active partner of the GeoEnergy Europe, a European Union metacluster partnership aiming to contribute to the industrial deployment and market uptake of sustainable geo-energy.

Please use this reference guide to source information on **CAPES** services, start business dialog and achieve success together.

Thank you and best wishes for much continued success!

**Dr. Ferenc Fedor**  
**President**  
**CAPES**



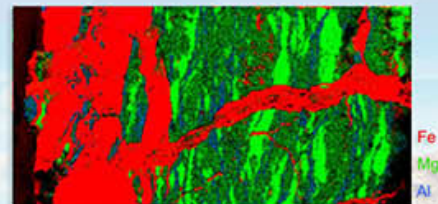


**Augen Consulting Ltd.** deals with data analysis and complex interpretation of materials of both geological (natural) and artificial origins. The main focus concerns evaluation of chemical and phase analysis data in bulk samples as well as in situ measurement in the  $\mu\text{m}^2$  up to  $\text{cm}^2$  range. As a routine, data of advanced microscopy and image analysis, X-ray diffraction and X-ray fluorescence, Raman spectroscopy, SEM, fluid inclusion microthermometry and organic geochemistry are involved. Complex laboratory data sets are evaluated for numerous reasons, like reservoir characterisation (both porous and fractured), ore body characterisation, solving environmental geological problems, qualification of building materials, archaeological artefacts among many others.

**Augen Consulting Ltd.** undertakes complex investigations in a wide spectrum of problems from sample preparation until data evaluation with international references.

**Selected projects, references and partners:**

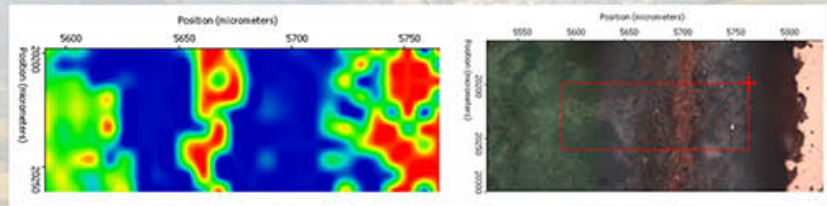
- Reuse possibilities of red mud bauxite waste ( Tatai Környezetvédelmi Zrt.)
- Inhomogeneity analysis on industrial plastic raw material (BV Hungária Kft.)
- Physicochemical characterization of artificial sea sediments (Norwegian Institute for Bioeconomy)
- Complex petrography, geochemistry and palaeofluid evolution studies on cores (Mecsekérc Zrt.)
- MOL Nyrt.
- O&G Development Kft.
- TXM Olajkutató és Gázkutató Kft.
- San Leon Services Sp. z o.o.
- Liesa Energy Sp. z o.o.
- Golder Associates (Magyarország) Kft.
- NaWest Koncessziós Kft.



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#### AURORA Energy Kft.

Our Company's main profile includes **consultancy services** in such sectors as **energetics and mining (and in particular oil mining)**, meeting your Company's existing needs and demands at the highest possible standards. We have decades of experiences in energetics and oil mining, and our Company was established with the **key goal to successfully and effectively deploy those experiences based on practical experiences and application, in favour of our clients.**

Relying on our practical experiences, our Company is prepared to take part, besides consultancy, in actual implementation efforts in areas like effective operation, company or asset acquisition or project management and implementation. If our Client requests so, which means that, we are prepared and skilled to find, in close cooperation with you, the successful form of investment and assets in the field of energetics as well as the effective and optimal way of operating the asset(s) (asset management). Our key objective is to provide you professional services so that, while always achieving greatest success, you can be satisfied with the quality of our services and the value for your money.

The consultants of **Aurora Energy** assume energy management and operational consultancy in all areas of energetics, such as operative organisational review and redesign, executive, crisis and change management and other fields of corporate management (project management, technical and financial planning and control, optimisation of procurement and CAPEX processes). You can keep on browsing our website as you like, and if you have any question in relation with our services, feel free to turn to us with confidence!

#### SERVICES:

"We know no impossibility, although it may take a while if you expect miracles."  
Our mission is to provide You such high quality and comprehensive services that will lead to a lasting long-term cooperation. You can always turn to us with confidence!  
• Energy and mining advising (Consultancy in energetics and mining)  
• Operational advising (Effective operational consultancy)

- Asset and company assessment (Consultancy on company and asset assessment (due diligence))
- Enterprise management (Business management consultancy)
- Trainings (Training and development)
- Hydrocarbon Upstream operation (US production and efficient operation and the seismic vibrator services)



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#### MOST IMPORTANT REFERENCES

- A Boston Consulting Kft.
- EU-Fire Kft.
- Rikopet Kft.
- MOL Nyrt.
- MFGK Austria GmbH.
- Geomega Kft.
- O&G Development Kft.
- OT Industries Zrt.
- KPMG Hungária Kft.
- TXM Olajkutató és Gázkutató Kft.
- Zerlux Kft.
- Magyar Bányászati és Földtani Szolgálat/Geofizika
- Kerui Group
- Magyar Horizont Energia Kft.
- GRID Zrt.
- Gashydrate Kft.
- FMBE Bank Cyprus
- Petrolgeorge Kft.
- Geoinform Kft.
- Dana Gas Plc.
- BTO Management Consulting GmbH.
- Bankers Petroleum Plc.
- Geophysik GGD mbH.
- Maximus Kft.
- Kerogoil Zrt.
- Folyópart Kft.

#### MR. ATTILA HOLODA – MANAGING DIRECTOR

Attila Holoda received his Master of Science Degree as a mining engineer from the Faculty of Petroleum Engineering at the Gubkin Russian State University of Oil and Gas in Moscow in 1989. He received his 'MBA in Finance' degree at the Budapest University of Economic Sciences in 2000. Completing the joint course by the Econovum Academy Association of Professors and the Newport University in 2012, he received an 'adult education PhD' degree in the field of Business administration. He started his career as a production engineer in 1989. Till 1999, he occupied a number of managerial positions at the mining plant, between 1999 and 2012, he managed the Domestic Production, Domestic Exploration and Production, and then the Central European and Eurasian Exploration and Production organisations.

In middle of 2012, leaving the MOL Hungarian Oil & Gas Company Plc., he fulfilled for a short period the position of the Deputy Secretary of State in charge of Energy at the Ministry of National Development of Hungary.

Former member in the Board of Directors of MMBF Zrt, the strategic underground gas storage Szőreg-I between 2007 to 2009.

Former member of the Board of Directors of the Croatian national oil and gas company INA d.d. between 2009 to 2011. He was the Chairman of the Supervisory Board of the Hungarian Hydrocarbon Stockpiling Association in 2012.

Member of the Hungarian Mining and Metallurgical Society since 1989, and its Vice President between 2007-2014 as the Chairman of its Crude Oil, Natural Gas and Water Mining Section. Member of the Hungarian Geological Society as the Chairman of its Mineral Geology Section since 2013.

Member of the International Society of Petroleum Engineers (SPE) since 2005.

Chairman of the Hungarian Mining Association between 2009 and 2012.





**Eco-Cortex Ltd** has been working for regional development since 1998. We are not doing scientific work, but we are preparing for the local university, the Economic Chamber of the county, the local authorities analyses, strategies and development materials which can be directly used for local politics, help developing the region's economy and society, and the preservation and economic exploitation of environmental, cultural values.

We provide development assistance for the business sector through analysis, market research, the generation and development of projects to develop, the preparation of proposals for the expansion of financial resources and Project Management. We are currently developing a virtual incubator to increase the number of corporate relations in business development, especially in the field of innovation and e-commerce, and Economic development impact.

We also play an intermediary role in a number of international relations, primarily in the preparation and implementation of joint tenders and developments. We have a great experience in achieving a network of experts and coordinating its work, achieving professional outcomes reflecting integrated knowledge. This is particularly important for us, as we are able to achieve significant intellectual outputs in a wide range of professional and sectoral spectrum, despite our small numbers (capacity varying between 10-20 persons three 20 years). This is the role of our company's professional and business reliability, and the image that we can use to mobilise a wide and highly professional network of experts.

The majority of the company's employees are able to use English as a working language, and some people are high-level in German. International tenders and studies are made in English and the working language is also the English course of implementation.

Our characteristics are summarily: versatility, flexibility, High Professional need, complexity, Strategic system approach

#### CHARACTERISTICS OF THE MOST TYPICAL WORKSPACE

##### Territorial Development, urban development

- Urban development concepts and strategies
- Development of project plans and operational development documents
- Development of project funding proposals, studies and projects to win the European Union and Hungarian national and foreign development Funds
- Project management of projects



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#### Business Development, tourism development

- Project generation, project development
- Feasibility Study
- Site development, finding an optimal location for project implementation and infrastructure preparation
- Financing proposals, drawing up loan applications

#### Design, manufacture and distribution of creative wooden products "Woodspot":

We intend to increase the merits of the development consultancy activity for SMES by introducing and developing a new product group in the international e-commerce sphere on the European market.

#### CAPACITIES:

Human resources: 10 people, of which tertiary education: 10

Office: 150m<sup>2</sup>

#### SOME REFERENCES:

- Participation in the elaboration of a regional innovation strategy, developing an Regional education Strategy.
- Development of the Urban strategy papers of PECS, Regional Centre European Green Capital Award application.
- European Capital of Culture Award application - strategic base Elaboration (Székesfehérvár).
- Urban rehabilitation applications and project management of developments (Siklós, Villány, Szigetvár, Érd, Sarbogárd, etc.)

#### ECONOMIC DEVELOPMENT

- "REFRESH" – an international Creative Industry Project- Elaboration of a transnational strategy for the participating regions of 5 Countries
- Involvement in the creation of industrial parks, incubators (Siklós, Sarbogárd)
- Development of complex territorial tourism development and Management (Siklós – Mohács)
- Feasibility study of Resort hotel complex and other hotels (Siklós, Szigetvár)
- Wood Development Contest (MOHÁCS)
- Application and management of agricultural technological developments (Villány, Vajszló)





#### ABOUT THE COMPANY

**GEOCHEM Ltd.** is an innovation driven company having a high-technology equipped petrophysical laboratory, special knowledge and ideas, significant innovation and development potential.

Main performance of the company is research and development in the fields of geology, like hydrocarbon and raw material exploration, geothermal energy research, radioactive and hazardous waste disposal, water research and environmental protection. Its main objective is to integrate the results of basic research into industrial practice. The company focuses primarily on special instruments and continuous equipment improvements with the complex investigation of very tight and unconsolidated materials. Services are cost effective, internationally competitive and acknowledged Europe-wide for their high standards.

#### SERVICES

The measurement and development services of the company are especially demanded in the fields of geology, but the accumulated knowledge and measurement capability, supported by the available instrument park are also useful in material research and analysis, construction industry, archeological geology and automotive industry.

The basis of the services is the well-equipped laboratory - unique in Central-Europe - where a wide range of measurements and evaluations can be performed. The professional personnel offers reliable solutions in choosing the right equipment for work, in applying and managing tenders.

#### LABORATORY

GEOCHEM Ltd.'s laboratory is suitable for defining the physical parameters of various materials, primarily focusing on complex pore and reservoir characterization in case of porous and very tight (porosity < 10%) rocks and unconsolidated material. Porosity, saturation, permeability, sorption capacity and grain size distribution measurements provide essential information for industrial R&D in the fields of hydrocarbon exploration, radioactive and hazardous waste disposal, geothermal energy research, carbon-dioxide sequestration and coal bed methane extraction.

#### SOME OF THE SPECIALITIES

- Development of customized, case-specific solutions.
- SmartLab project: SmartLab can guarantee time-saving, cost effective solutions for clients by combining on-the-spot measurements made by local technicians in a portable container lab on the drilling site or anywhere where it is needed, and detailed analysis via internet connection in Hungary. In first phase a Smart Reservoir Laboratory (SRL) will be realized. More information on the HIFA website ([www.investhifa.hu](http://www.investhifa.hu), under „Green Industry”).
- Software development for enhanced interpretations (acoustic velocity, permeability, grain size analysis, electric properties, etc.)



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#### R&D ACTIVITY

- The further development of RS-PPD universal permeameter (SRL-P1000): methodological development (further real gas equations, estimation of parameters), automation (from 80% up to 100%), software development (programming pressure fall-off) – planned (instrument and software are available).
- SRL-A1000 for reservoir state (1000 bar and 150 oC) acoustic velocity measurements.
- SRL\_E1600 instrument: electric impedance tomography development.
- Low pressure, high resolution instrument for micromechanical experiments, prototype.
- Application of vapour sorption (polaric, apolaric) for estimating rock features on a nanoscale (surface energy, active binding sites).
- Methodological development of mercury porosimetry (compressibility, particle size analysis, fractal dimension, tortuosity).
- Development of helium pycnometry (high accuracy porosity determination on samples with irregular shape as well, porosity failure estimation).
- Investigations related to wetting angle measurement (contact angle, surface tension).
- Geological data processing program for particle size analysis, supporting the interpretation process (first working version of software available).
- Preparation of artificial core samples with natural cement and rock material (i.e. sand) and given petrophysical features (controlled porosity and permeability).
- Investigation of very tight rocks (radioactive waste disposal, unconventional CH exploration, geothermal research, coal exploration).
- Investigation of unconsolidated rocks (measurement of petrophysical parameters, gravel pack well completion, fracture conductivity) – prototypes owned by Mecsekérc Ltd. are available (designed by Fedor and Hlatki, prepared by MEAFK).
- Information systems development for Smartlab (cloud based system).

#### IDEAS FOR EU PROJECTS AND INVESTORS

- High pressure (500 bar), high temperature physisorption instrument working according to the volumetric principle – planned (low pressure instrument is available).
- Smart Reservoir Laboratory (SRL) – fully automated reservoir laboratory for HPHT reservoir characterization (thermo, acoustic, electric, porosity and permeability measurement – all in one).

**GEOCHEM Nonprofito Ltd.** is a subsidiary of GEOCHEM Ltd., which is responsible for participating in educational and research projects and participating in EU projects where the role of knowledge transfer is important and where profitable companies are disadvantaged. One such project was the RuGeol-Heat with Croatian and Slovenian partners in the field of shallow geothermal. In the future, the company will concentrate on postgraduate education in geosciences (preparation and holding of short courses, laboratory exercises).







The activities described above were used by the Company and its predecessor (among others) in the following research work:

- Site research on the disposal of low and intermediate level radioactive waste (Üveghuta)
- Geological survey of the radioactive "cemetery" environment for research purposes (Püspökszilágy)
- Geological foundation of high activity radioactive waste disposal research (Boda)
- Geological mapping of the planned nuclear power plant site (Paks)

**GeoEko Ltd.** (together with its legal predecessor) has been doing geological research for more than twenty years. We deal with all areas of classic geological mapping, after the preparation of the research plan, the preparation of the survey, the collection and systematization of archive data, the evaluation of the old maps and aerial images, we perform the field surveying to record their conditions. Rocks are sampled for laboratory testing. In order to clarify the underground spread of the formations and their relation to each other, artificial excavations, shafts, ditches, drills are planned, their materials processed and used to prepare complex documentation for the area.

**The result of the mapping is a geological map of a given scale, documentation containing basic data, and characterization of geological formations occurring in the mapped area.**

In the processing of artificial excavations, the examination of the core material of the deep boreholes has a special place. During the processing of these, GeoEko Ltd. supplements the separation and detailed macroscopic description of each layer with systematic sampling, and prepares documentation of drilling, including the results of the tests performed on the samples.

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#### SHALLOW ENGINEERING GEOPHYSICAL AND UPSTREAM PETROLEUM GEOSERVICES SINCE 1992

**Geomega Ltd** is a Budapest-based geological-geophysical service company, providing wide range of quality services in the field of shallow engineering geophysics as well as of subsurface- and hydrocarbon exploration. The largest value of our company is considered to be the intellectual capital of our highly qualified employees as well as our unmatched geophysical instrumentation.

#### UNMATCHED COMBINATION OF GEOPHYSICAL INSTRUMENTS

- Electromagnetic equipments at various frequencies for fast near-surface anomaly detection
- Land and unique submersible GPR technology
- Multielectrode geoelectric instrument for land and shallow fresh water applications
- Magnetic instrument for archeological applications and buried object detection
- Wireless seismic acquisition system
- Proprietary 3-component land-streamer technology for effective seismic acquisition
- Pand S-wave mini vibro seismic source
- Ultrahigh resolution single-channel water seismic instrument
- Software solutions for geophysical data inversion, seismic reflection-, refraction- and tomographic as well as state-of-the-art seismic surface wave processing

#### FOR MORE THAN 25 YEARS ...

... we have been present in the Hungarian and international geophysical market. During our hundreds of domestic and foreign projects we have solved many geological problems being key to the engineering design. For example, determination of the tunnel path of Metroline 4 below the River Danube, geological investigations of the Paks Nuclear Power Plant, surveying of shipping routes on major European rivers and investigation of sedimentation of a mine pit in the Dominican Republic.



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#### WIDE RANGE OF SERVICES, INTEGRATED METHODS

Our main services include the implementation of engineering and shallow geophysical measurements as well as various subsurface geological exploration activities. With the help of our instrument park we can offer effective solution for many engineering-geophysical and geological problems:

- surveying of pipeline crossings below rivers
- river bed and wreck surveying
- mud thickness and other river bed anomalies
- detection of buried objects (i.e. hazardous waste)
- flood protection and embankment surveying
- archeological-geophysical investigations
- agrogeophysical surveyings, water-table detection
- surveying and condition of concrete structures
- geological investigation and interpretation below special constructions (power plants, dams)
- geotechnical surveying
- determination of soil mechanical parameters
- cavity, -drain-, pipeline and cable investigations
- surveying of road condition
- delineation of soil contaminations
- geothermal exploration
- drilling of shallow boreholes
- environmental and geological exploration supporting remediation works
- water reserve exploration

#### OUR PHILOSOPHY

... persuade yourself before persuading the Client!







**INNOTEQ - THE EXCITEMENT OF DISCOVERY  
INNOVATIVE - TECHNOLOGY - EXCELLENT - QUALITY**

We give you more than just an IT solution!

Our visualization solutions make the discovery of digital collections, museum exhibitions, archive documents and maps a thrilling adventure. With the possibilities of GIS and Augmented Reality new dimensions are opened in content presentation. The company has many years of experience in innovation. Not only do our customers expect solutions to their problems, but they want to enjoy every moment of their work. Not only do they want to see the final result, but also the way to it. When we start a new task, we always keep this in mind. We are not afraid of new ways either, but we are also trying to find the place of old values as well. We enhance our applications with innovative solutions, a routine solution is never enough. We offer you excitement, the excitement of discovery.

**OUR SOLUTIONS:**

**AUGMENTED REALITY**

With our mobile phone and tablet solutions, multimedia and 3D contents are added to real-world objects. (Exhibition guides, textbooks, advertisements, user manuals, etc.)

**INNOVATIVE MULTIMEDIA SOLUTIONS**

Our Divit System provides a spectacular display of exhibit content on multimedia terminals or mobile devices.

**GIS AND 3D DEVELOPMENT**

Autodesk, Esri, Mapinfo, MAPserver. We adapt our GIS solutions to the needs of our customers. Our applications open up new possibilities for discovering digital maps.



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**VIRTUAL REALITY**  
We offer a wide range of spectacular solutions for creating a themed website, presenting collections on the web, and web 2 community solutions.

**MOBILE APPLICATIONS**  
Pocket our solutions! Take and use our applications optimized for mobile environments anywhere you go!

**CUSTOM SOFTWARE DEVELOPMENT**  
Mapping and analyzing business processes, building new systems, optimizing and upgrading existing IT systems to meet the specific needs of our customers.

**MAIN PARTNERS:**





#### ABOUT THE COMPANY

During the last 25 years, **KAROTÁZS Ltd.** has achieved an important role in the practice of Hungarian borehole and well-logging metrology. Beside the daily routine work we have developed new measuring equipments and techniques. The R&D activity is a still running program in the life of our Ltd. Our developed products can be purchased from the Ltd. In case of special needs, we undertake them to modify our technologies for able to be applied in solving various problems.

Since the establishment, we have been taking part in several well-logging, geophysical and well testing works, like projekt preparing the disposal of high level radioactive waste at Boda Claystone formation, projects in the disposal of low- and intermediate-level radioactive waste in Bataapáti, works involving mine closure well testing, water and environmental protection measurements in Hungary and in the neighbouring countries.

#### SERVICES

- Our field of activity is mainly well-logging, drilling geophysics and well testing.
- Our services: Well-logging for well construction, condition assessments, dynamic well testing
- Borehole logging for mineralogical purposes, geological prospecting, water and environmental protection measurements.

#### PRODUCTS

- Complex installation of well-logging equipment!
- Surface Unit: PCKarotáz - Complete well logging data acquisition system.
- PCKarotáz equipment is a universal, PC-based surface recording unit, which was constructed using exclusively own developments. The measuring and processing software is also self-created.
- Karotáz winches: Electric motor driven winch with 300-600-1100-2100 m 3/16" (4.76mm) diameter 4 core armoured cable. Cable speed 0-40m/minute. Winch is supplied with collector, depth decoder for depth measuring and well site wheel too.

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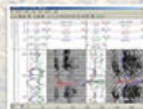
- Karotáz probe: Well - logging for well construction, condition assessments, dynamic well testing, Borehole logging for mineralogical purposes, geological prospecting, water research, environmental protection measurements.
- EITS: The potential applications of the system: FFT spectrum measurement, impedance measurement (EIT), impedance spectrum measurement (EIS). With the measurement system it is possible to measure in two points with multiple frequencies or at a constant frequency in many points.

#### MEASUREMENT

We undertake to equip our partners with the required equipment on demand, to train the measurements, to service them, to repair them, and to carry out joint research and development on demand.

#### INNOVATION RESEARCH DEVELOPMENT (GINOP PROJECT)

- PCKarotáz (deep drilling-geophysical) surface unit development for different types of measurements, probes, in IP64 design also.
- For measuring electrical impedance (EI, EIT, EIS) in time and frequency range.
- For time-critical and non-time critical measurements, flexible addressable multiplexer enhancements.
- Development of EI spectrum and tomography units in the frequency domain for different types of application development.
- Prototype development for high frequency porosity measurements.
- Marketing activity.





#### ABOUT THE COMPANY

**KVA Consulting Ltd.** is a management consulting firm providing services for companies starting or developing geoscience related businesses in Hungary and abroad.

#### DELIVERING THE BEST PERFORMANCE

Having expert knowledge of the Hungarian business environment, investment market and the ability to supply our clients with market intelligence give our clients competitive edge. KVA Consulting Ltd is a member of the Cluster of Applied Earth Sciences (CAPES) and offers the cluster's scientific and entrepreneurial knowledge to its clients. Time to time we team up with International experts to deliver the best performance in special fields too. KVA Consulting Ltd participates in the GeoEnergy Europe metacluster led by Pole Avenia.

#### KVA CONSULTING LTD. OFFERS THE FOLLOWING SERVICES:

- Project management consultancy
- Location consultancy
- Trade representation
- Marketing consultancy



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#### OUR APPROACH

To fulfill our mission we offer trusted sources of information, motivated professional experts, extensive network of business and administrative contacts.

#### PARTNERS

**KVA Consulting Ltd** is a founder member of **CAPES (Cluster of Applied Earth Sciences)** and an active team member of **GeoEnergy Europe** project, partnership and metacluster.

#### CONTACT US

For more information please contact us.





#### LOGFRAME CONSULTING OFFICE

Project development and project management – from idea to implementation

#### ABOUT US

**Logframe Consulting Office** was founded in 2007. The company has outstanding international experience, its main field of activity is project development and full-scale project management.

Our colleagues are all university graduates who have been involved in regional development for two decades, while becoming familiar with both sides of the funding system. This experience is a great advantage when it comes to thinking with the head of the funding authorities and of goals at macro level. In addition, through previous work experience, we have built up a wide network of contacts, both among municipalities and businesses as well as policy makers.

#### PHILOSOPHY

Philosophy of the company is to provide our clients with full-scale services, our activities reach well beyond elaboration of project applications. On one hand we actively contribute to preparation of development programmes and projects, on the other hand we strive to assist our clients in common thinking about project elaboration and elaboration.

Based on our two-decade experience, we can find the appropriate answers to unexpected situations and problems raised during project implementation. Other main cornerstone of our philosophy is based upon the Logframe matrix indicated in the name of our company; we seek for defining logically structured project elements both in terms of contents and time schedule, and we also put high emphasis on defining project outputs contributing to expected immediate results and long-term impacts. This is very a important aspect for the success of project applications as grantors always search for the fulfilment of their pre-defined objectives in the submitted project proposals – these programme-level objectives should be brought in line with the interests of the applicants.



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#### QUALITY MANAGEMENT

**Logframe Consulting Office** has MSZ EN ISO 9001:2009 and MSZ EN ISO 14001:2005 certificates dated from 2013, ensuring the quality-based and environmental-conscious operation.

We pay high emphasis on complying with the rules of sustainable development and environmental protection regulations. Our employees all have strong environmental consciousness contributing to our efficient operation which provides our clients with further advantages.

#### SERVICES

- Project development: definition and detailing of project elements, elaboration of efficient project management structure, professional cash-flow planning;
- Elaboration of project applications: elaboration of applications for co-financing of the European Union and domestic funding resources, free initial project eligibility check;
- Project management: full-scale project management, administrative and financial assistance of project implementation;
- Project crisis management: making success out of projects in hopeless situation endangered by irregularity procedure;
- Obligatory publicity and communication: carrying out tasks of obligatory publicity and communication according to pre-defined rules;
- Programming: two-decade experience in elaboration of regional development concepts, strategic and operational programmes;
- International project development: professional preparation and implementation of EU co-financed projects based on international cooperation, experience in cross-border and transnational project development and management co-financed by EU Interreg programmes.

#### MAIN REFERENCES

##### Projects:

- Development of technology of sustainable and cost-effective thermal water reinjection wells\*, co-financed by ERDF funds of European Union with a total budget exceeding EUR 8 million, preparation of project proposal in collaboration with project experts, full-scale management of the project;
- Mitigation of structural uncertainty of geological research projects with energy exploitation purpose on the basis of validating geological model of Southern slope of Mecsek hills\*, co-financed by ERDF funds of European Union with a total budget exceeding EUR 5.5 million, preparation of project proposal in collaboration with project experts, full-scale management of the project;
- Preparation and management of various energy efficient and renewable energy-oriented EU projects in South Transdanubian region of Hungary.

##### Programmes:

- Active participation in conceiving South Transdanubian Operation Programme co-financed by the European Union, elaboration of regional and sub-regional strategic documents;
- Key expert participation in elaboration of Interreg V-A Hungary-Croatia Cooperation Programme.





#### THE SURVEY'S MISSION AND PROFILE

The mission of the Mining and Geological Survey of Hungary to become a modern, client-driven mining and geological survey relying on traditions of mining administration and geological-geophysical research; serving all social needs of the 21st century, and to strengthen its position as a nationally recognized geoscientific knowledge and competence centre.

#### MAIN RESEARCH AREAS

- Geology
- Geodesy
- Geophysics

- Geochemistry
- Engineering geology
- Mining
- Hydrogeology

- Geoinformatics
- Climate research

#### MINING AUTHORITY TASKS

- Various authority (technical safety, occupational health and safety, fire control, construction, etc.)
- Mineral resource management, keeping and updating records of national raw material resources and reserves
- Tasks and duties concerning tariffs, royalty management
- Tasks and duties related to concession tender procedure
- Complex vulnerability and impact assessment studies prior to tendering (impacts of co-use, geo-fluids)

Concession: hydrocarbon, geothermal energy (below -2500 m), coal, ores.



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#### Basic geological research

- Complex geological evaluation of the Pannon basin
- Geological Mapping
- Tectonics
- Basin analysis, sequence stratigraphy
- 3D modelling

#### GEOPHYSICAL RESEARCH

Study of the subsurface by different geophysical methods, understanding the physical processes of the deep subsurface

#### Study of various fields of forces

- Planning and execution of various geophysical explorations (seismics, VSP, electric methods)
- Data processing and interpretation
- Establishment and continuous update of national databases

#### GROUNDWATER RESEARCH

Support for national groundwater management, study of climate impacts on groundwater resources

#### Basic operational tasks

- Well documentation and cadastre, National Hydrogeological Archive
- National groundwater monitoring network (part of the WFD monitoring)
- Accredited groundwater sampling

#### Geoscientific collections

- Memories of geological exploration from the past 150 years
- Geological museum

#### Geophysical model of Hungary

- Model establishment
- Geophysical basic infrastructure

#### Hydrogeological research

- Hydrochemistry
- Geothermal energy
- 3D Numerical modelling
- Karst hydrogeology

#### Applied geological research

- Interference of human activities and the geological environment
- Engineering geology
- Geochemistry
- Geological risks

#### Observation and monitoring networks

- Geophysical Observatory (Tihany)
- Paleomagnetic laboratory
- Gravimetric Observatory (Mátyáshegy)
- National gravimetric and magnetic

#### Policy, support, expert opinion

- River Basin Management Plans (WFD)
- Transboundary, bilateral and ICPDR level
- Local studies





#### **ÖETVOES AND CO. ENVIRONMENTAL LTD.**

##### **FIELDS OF ACTIVITY**

- environmental expertise in the protection of geological formation, water protection, waste management, environmental remediation,
- water management expertise, planing primarily in the field of water protection, water quality damage prevention,
- environmental impact assesments, reviews, audits, performance evaluations involving qualified external experts as needed.

##### **ENGINEERING DESIGNER CHIEF SPECIALIST IN THE ENGINEERING CHAMBER LIST:**

- Planning of municipal water utility,
- Planning of water management structures,
- Planning of water resources management structures.

##### **FIELD OF EXPERTISE IN THE ENGINEERING CHAMBER LIST:**

- Expertise in water management structures,
- Environmental expert eligibility,
- Water and geological media protection,
- waste management.

##### **REFERENCES:**

- Environmental Impact Assessment of Baja-Bácsalmás-Csikéria (Co untry Border) Rail Line Renovation Development of Groundwater and Soil Chapters,
- Review of the steps to close the coal mines in Mecsek,
- Dermal waste landfill environmental review in Garé, from 2002 in every 5 years,
- Environmental impact assessment, development of groundwater and soil chapters in the southern section of north-south regional high speed railway in Budapest,
- Geological status assessment of communal solid landfill at Szombathely operated by SZOVA Zrt.

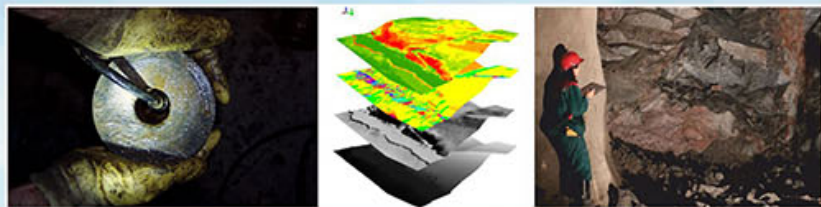


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#### ROCKSTUDY Ltd.: Science of Depth, Depth of Science

„Our working method is to deeply understand the clients' needs and solve their most critical engineering, economic, safety or authorization problems. Our mission is to perform our job on the highest available scientific level applying up-to-date technologies.“

- László Kovács, Director

**ROCKSTUDY Ltd.** is specialized in performing laboratory and in situ measurements, design work and providing technical expertise related to geotechnics and rock mechanics. The company was established in 2008 with the aim of performing the geotechnical tasks arising during the construction of National Radioactive Waste Repository (L/ILW, at Bataapáti). ROCKSTUDY Ltd. carried out wide range of laboratory and in situ measurements and monitoring, geotechnical surveying and evaluation tasks at Bataapáti. Utilizing the special knowledge and experiences the scope of services has expanded: rock mechanical tasks of siting of new Hungarian NPP and HLW repository have been also successfully fulfilled as well as UCG, geothermal, civil engineering, oil & gas industrial and R&D projects.

**ROCKSTUDY Ltd.** is committed to the highest attainable working quality and using sustainable and environmentally friendly technologies and solutions. It is also demonstrated by establishing and implementing the integrated quality and environmental management system in accordance with ISO 9001:2015 and ISO 14001:2015 standards. The economic stability of our firm is proven by AAA (triple A) credit rating issued by Bisnode, a leading European Data & Analytics company. That indicates the financial risk of establishing business relations with us is very low, since only 0.63% of the companies are entitled to similar rating at the Hungarian market.

**The number of employees** varies between 10 and 15, depending on the ongoing projects. The core group consists of highly educated and trained experts (e.g. mining engineer, civil and geotechnical engineers, environmental protection scientists, hydrogeological engineer, physicist, geologist, geographer, GIS specialists and mechanical technicians). The company operates three sites: head office is located in Pécs (Southwestern part of Hungary). Our well-equipped rock mechanical laboratory operates near the city and we have a special R&D site in Budapest.

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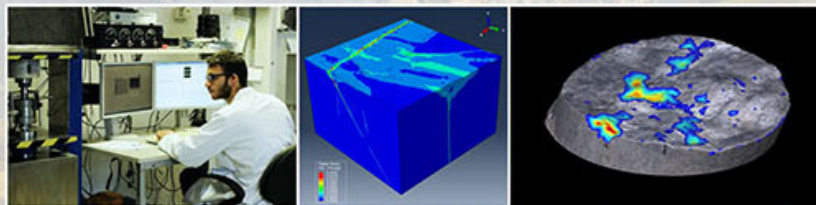


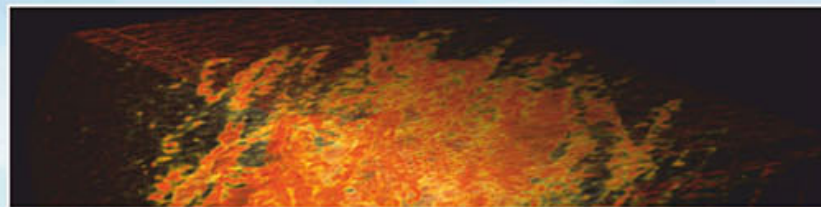
#### Most important references:

- Geological research project for the new Hungarian nuclear power plant (Paks II)
- Rock mechanical investigations of the UCG-research project in the Eastern-Mecsek Mts.
- Rock mechanical and geotechnical investigations of NRWR at Bataapáti.
- The characterization project preparing the final disposal of Hungarian HLW and spent fuels.
- Geothermal R&D projects: development of a sustainable reinjection technology of used hot water.
- Rock mechanical investigations and development of methodologies regarding the operation of the former deep uranium and copper mines in Hungary and the possible reopening of them.

#### Main Services

- In-situ measurements and monitoring (high-precision rock deformation measurements, virgin rock stress measurements - overcoring techniques, measuring both of loads of supporting structures and stress changes caused by tunnelling, complex THM monitoring systems, optical televiewer surveys).
- Geotechnical assessment and classification (geotechnical core logging, geotechnical classification of underground cavities and open-pit walls applying standard empirical methods - e.g.: RMR, SMR, Q, GSI, RMI -, supporting by the creation of georeferenced photogrammetric 3D models, home-developed Advanced Survey software for the simultaneous geotechnical and geological, tectonical and hydrogeological mapping).
- Rock mechanical laboratory services (sampling, sample preparation, non-destructive tests by DRF method, standard uniaxial and triaxial strength and deformation tests on intact samples, acoustic emission measurements, shear box test, determination of failure envelope applying Multiple Failure State method, short- and long-term rheological tests).
- Consulting and engineering (slope, tunnel and borehole stability analyses, design of underground openings and supporting systems applying coupled finite element modelling, data-processing, evaluation and integrated interpretation with complex geostatistical methodology, complex R & D tasks and software development, professional training programmes). Analysis of rock mechanical issues related to loose sediments in a hydrocarbon or geothermal reservoir during the lifetime of an injection/production well.
- GIS database building, data processing and developing (field mapping, close-range photogrammetry, 3D geometry editing, automating workflow and GIS analysis with Python scripts, designing and building spatial databases and GIS-based expert systems with uniquely developed WebGIS applications).





**TOMOGEO Ltd** and Geosoft Partnership Ltd independent private Hungarian companies were founded by Tamás Földes geologist who has 40 years professional experience in the oil and gas business and 20 years experience in development and evaluation of X-ray Computer Tomography measurements on inorganic materials.

#### KEY PERSON:

Tamás Földes graduated from the Geological Section of Natural Sciences Branch of Study of the University of Sciences „Eötvös Loránd” in 1979. He has ten years of well site, two years of exploration, four years of geological interpretation of well log analysis and eight years of reservoir modeling and production geologist experience in Hungarian Oil and Gas Company. He worked as a head of department of geological interpretation of well information including interpretation, operations, computing technology and consulting for four years. He was an award winner (co-author) of the Application of Innovation of Hungarian Academy of Sciences for the development of 3D geological visualization software in 1994. He was the winner (co-author) Norman Falcon Award (Best Poster Award of the Petroleum Division of EAGE) in Leipzig, 1998. (Csato, L. and T. Földes, Halo-kinetic structures and hydrocarbon plays – Examples from the Middle East.) He has been working on the 3D reservoir geological modeling, salt modeling, production operation and horizontal well planning of numerous oil and gas fields of Hungarian and foreign areas (Qatar, Yemen, Pakistan, Tunisia). He has an experience in geological modeling of underground gas storage for ten years. He has had a special development and has carried out scientific activity since 1998. It is the integrated interpretation and application of X-ray computer tomography measurement of reservoir geological modeling. He has been invited as a speaker in the several Hungarian universities (University of Sciences „Eötvös Loránd” University of Kaposvár and University of Pécs) several times. He has published numerous technical papers for several EAGE and AAPG conferences. He is a member of EAGE, Hungarian Geological Society and Hungarian Geophysical Society.

#### MAIN RESEARCH INTERESTS:

Using and evaluation of X-ray computer tomography, positron emission tomography, neutron magnetic resonance measurement in rock and inorganic materials. Characterization of oil and gas fields and modeling of well surroundings and reservoir characterization.



Tamás Földes

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#### PRESENT RESEARCH PROJECT ACTIVITIES:

- Evaluation and characterization of core sample material based on CT measurements by displacement test with reservoir condition.
- Characterization of rock material based on CT and microCT measurements
- Development of displacement test equipment for microCT measurement with reservoir condition
- Development of PET measurement for reservoir rock evaluation.
- Characterization of wood material based on saturation test during CT measurement
- Determination of concrete parameters based on CT and microCT measurement
- Monitoring of high pressure rotary rubber hose by CT measurement
- Analysis of P-S wavelet and velocity based on displacement test combined CT measurement
- Quality control developments in car business based on X-ray computer tomography measurement
- Quality control developments in concrete material based on X-ray computer tomography measurement

#### REFERENCES:

- Main signed contracts (TOMOGEO and Geosoft Companies):
- MOL group: Core analysis by CT measurement contract (8 km measured core since 1999)
- Mecsekerc Hungary Plc Core analysis by CT measurement contract for modeling of nuclear waste deposit
- LMK resources (Halliburton-Landmark Co Islamabad Pakistan) Core analysis by CT measurement contract
- Falcon Oil and Gas (USA) – TXM Ltd Core analysis by CT measurement contract
- Torredor Co Core analysis by CT measurement contract
- Continental Co Monitoring of high pressure rotary rubber hose by CT measurement contract
- Ural and Gas Co (Kazakhstan) Core measurement contract in Uralsk
- RAG Co (Austria) Core measurement contract
- Nuclear power plant projects and contracts in Hungary (Paks I, II)

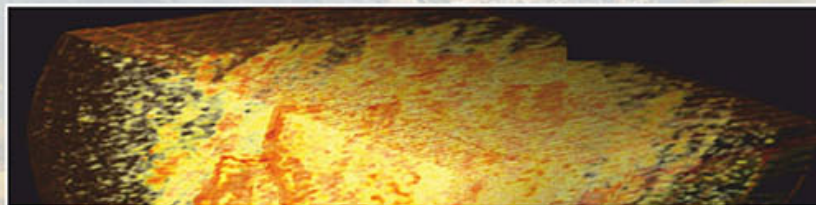
#### AWARDS AND HONORS:

- 1994 Hungarian Association For Innovation Award
- 1997 Oil and Gas Conference for MOL Plc organized Award

- 1998–EAGE - Best Poster Award European Association of Geoscientists and Engineers, 6th Conference and Technical Exhibition, Leipzig, Germany
- 2006 Hungarian Association For Innovation Award

#### HOME PAGE AND PUBLICATIONS:

[https://www.researchgate.net/profile/Tamas\\_Foeldes](https://www.researchgate.net/profile/Tamas_Foeldes)










#### VALIDALTD. FIELDS OF ACTIVITY

- Radiometric survey and monitoring (baseline survey, impact assessment, planning, execution, evaluation, reporting)
- Field Uranium exploration using complex geophysical, geochemical and radiometric methods
- Hydrocarbon exploration using field radiometric (emanation, gamma spectrometric) methods, geochemical sampling and analyses, integrated interpretation of results
- Uranium mine remediation (environmental impact assessment, monitoring, radioprotection, dosimetry)
- High grade education and training in radiological impact assessment, field radiometric methods, monitoring, radioprotection, Uranium mine remediation topics.

#### VALIDALTD. – REFERENCES

- Uranium exploration reports carried out in W-Mecsek mountains (Hungary), using and developing complex radiometric methods
- Development and operation of portable radon monitors
- Hydrocarbon exploration reports carried out in South-Transdanubia basin using complex field radiometric and geochemical methods (on behalf of MOL Co.)
- Baseline radiometric survey reports for decommissioning and remediation of abandoned Uranium mining and ore processing sites
- Environmental impact reporting of long-term monitoring system operated in abandoned and remediated Uranium mining area
- Radiological impact assessment for environmental licensing of new Uranium mine
- Professional training in nuclear environment protection specialization in Pécs University and in IAEA training courses.

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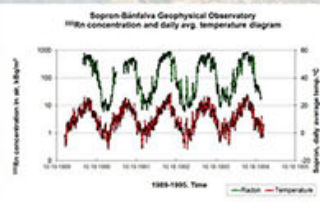


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BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS  
Faculty of Civil Engineering - founded in 1782

Department of Engineering Geology and Geotechnics  
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#### DEPARTMENT OF ENGINEERING GEOLOGY AND GEOTECHNICS

Budapest University of Technology and Economics, which was founded in 1782, has been the top higher education institution of Hungary and it has a well-established international reputation. As a member of the oldest faculty of the university the Department of Engineering Geology and Geotechnics has a great past in education, research and testing materials. With the expertise that we gain in the field of engineering geological and geotechnical investigations, design, numerical modelling and research, we are usually requested to accomplish more complex industrial assignments. Our accredited laboratory is working on the fields of Soil and Rock mechanics, which provides a great spectrum of investigations. We actively take part in education (BSc, MSc, and PhD courses in English) and in research, and industrial development. With our background and experiences, we can offer solution for a wide range of geotechnical and engineering geological problems from the material testing till the design of a project. We have broad links and intense research activities at national and international level (radioactive waste disposal, slope stability, natural stone and historic monuments, renders with CO<sub>2</sub> storage potential, etc.)

#### REFERENCES:

- site investigation and design of major construction projects (highways, railways and tunnels)
- geotechnical investigations of Nuclear Power Plant (Paks)
- testing of petrophysical properties of Radioactive Waste Repository (Bátaapáti)

- exploring of the geological conditions and reserve calculations of stone quarries
- qualification of dimensions stones and aggregates
- diagnostics of monuments (House of Parliament, Matthias Church)
- design and stabilisation of subsurface openings
- landslide monitoring and slope stabilisation
- geological hazard assessment



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#### EXPERIENCES AND FACILITIES

- **engineering geological site and laboratory investigation**
- **geotechnical testing and design**
- **numerical modelling of geotechnical and engineering geological problems** (tunnels, deep foundations, slopes) using FEM codes
- **fully equipped and accredited (EN, ASTM) soil and rock testing laboratory**

#### INTERNATIONAL PROJECTS AND CO-OPERATION WITH MAJOR UNIVERSITIES AND RESEARCH INSTITUTES:

Charles University Prague (CZ), Complutense University (ES), EPFL Lausanne (CH), ETH Zürich (CH), Geosciences University China (CH), Oxford University (UK), Purdue University (USA), Saitama University (JP), San Diego State University (USA), University of Cyprus (CYP), Technical University of Darmstadt (D), Technical University of Graz (A), Université Orleans (FR), University of Ghent (B), University of Göttingen (D), University of Hawaii (USA), University of Maribor (SLO), University of Munich (D), University of Newcastle (AUS), University of Split (CRO), National Technical University of Athens (GR), University of Malta (MT), University of Babes-Bolyai (RO), University of Zagreb (CRO)

#### QUALIFICATIONS FOR TESTING MATERIALS (EN AND ASTM ACCREDITED TEST)

- **in situ and laboratory testing of soils** (classification of soils, compressibility, shrinkage, organic compounds, compactibility, consolidation, triaxial test, shear strength, bulk density, porosity, Atterberg limits, etc.)
- **in situ and laboratory testing of natural stone** (petrographic examination, tensile strength, point load strength, compressive strength, elastic modulus, Poisson ratio, triaxial test, shear test along discontinuities, ultrasonic velocity (V<sub>p</sub>, V<sub>s</sub>), bulk density, porosity, etc.)
- **durability and non-destructive testing of stones** (surface hardness tests, salt crystallisation, frost resistance, water absorption, slip resistance, abrasion resistance, etc.)
- **testing of aggregates** (determination of particle shape and size distribution, methylene blue test, resistance to freezing and thawing, magnesium sulfate test, Los Angeles, micro-Deval test, etc.)
- **compositional and textural testing of mineral phases and micro-fabric characteristics of stone, mortar and cement** (mineralogical and phase composition testing with XRD, DTA, petrographic microscopy)





Eötvös Loránd University  
Department of Geology



**Partners** include

- MOL;
- Oil and Gas Development, RAG Oil Company;
- Vermilion Energy, Geogold Kárpátia Kft;
- Smaragd Kft;
- Golder Associates Zrt;
- General Directorate of Water Management;
- Hungarian Natural History Museum, Mining and Geological Survey of Hungary.

The **Department of Geology** is the largest geology department of the country at the prestigious Loránd Eötvös University (ELTE) Science Faculty in Budapest. We participate in training future geologists, earth scientists, geography teachers and environmental scientists at BSc, MSc, PhD levels. We are proud of our diverse profile ranging from classical geology subjects like

- physical geology,
  - geohistory,
  - sedimentology,
  - tectonics,
  - stratigraphy,
  - speleology,
- to a wide range of applied geology subjects in
- hydrogeology
  - oil geology
  - geomathematics
  - modelling.

The **hydrogeology group** focuses on researches related to the understanding of groundwater flow systems of siliciclastic and carbonate areas and contribute to solve water management, geothermal, hydrocarbon and environmental problems.

Our **large laboratories** are ready for analysing water, sediment, soil or solid rock samples. The **microscope laboratory** has both stereo and transmittent light microscopes for research and education.

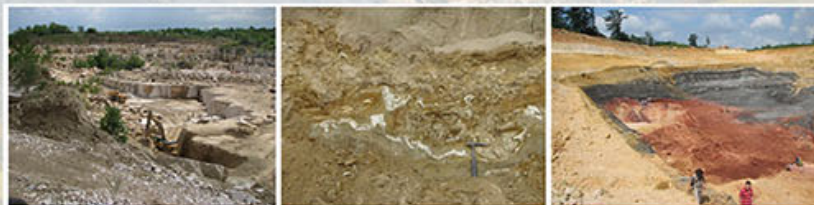


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**Institute for Geological and  
Geochemical Research  
Research Centre for Astronomy  
and Earth Sciences**



#### Main fields

The main duty of the institute is to carry out fundamental research for better understanding the formation of materials of the lithosphere and related processes through the study of mineral and rock formation, isotope geochemistry and environmental geochemistry.

The institutes' major activity focus on environmental research with increasing importance, due to recent developments in geochemistry, and the claim to recognize and restore natural environmental conditions, and to improve the quality of life. Within this research field, activities related to the processes in the geospheres and their boundaries are dominant. Primarily, the conditions and changes of the past and recent environment in the Carpathian Basin and its wider environment are studied. Statistical analysis of large databases is also included in the research activities and appear in scientific publications.

In the frame of the wider environmental geochemical research, mineralogical and geochemical properties of soils, geochemistry of surface and groundwater, and the role of microbial processes in mineral formation are studied.

Archeometry is one of the major research activity field of the institute. Coordination of the archeometry sub-project of the Seuso Research Project played a major role in the research related to the study of the cultural heritage.

Due to the formation of the Research Centre for Astronomy and Earth Sciences, interdisciplinary research activities were also continued on the boundary of earth sciences and astronomy. Studies on laboratory astrophysics are carried out through the cooperation of several institutes of the research centre.


#### Facilities

##### Stable isotope mass spectrometry


The laboratory was established in 1990. It has three mass spectrometers: a Finnigan MAT delta S isotope ratio mass spectrometer; a Finnigan delta plus XP mass spectrometer equipped with a GASBENCH II unit used for carbonate analyses; a Thermo Finnigan delta V mass spectrometer equipped with TC/EA and elemental analyzer units to measure H-C-N-O isotopes in organic matter and hydrous minerals. H-O isotope compositions of water samples are measured using three laser spectrometers (Los Gatos Instruments), one of them dedicated to fluid inclusion research.



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#### Laboratory for mineral and rock analyses

The major profile of the laboratory is the analysis of geological materials for their chemical and phase composition; however, significant experiences are possessed on the analysis of (industrial) ceramics, metals, glasses, and materials of the cultural heritage. Its special areas of analysis are the clay mineral identification and structure analyses, the archeometric analysis, as well as the integrated phase and chemical micro-analysis. A Fourier Transformation Infrared Spectroscopy (Bruker Vertex 70) equipped with a Hyperion 2000 IR microscope, a Rigaku DMax RapidII X-Ray micro-diffractometer, two X-Ray diffractometers (Rigaku Miniflex 600 and Philips PW1729), a handheld X-Ray fluorescent spectrometer (Spectro XSort Comb), an electron microprobe (Jeol Superprobe JXA733), an atomic absorption spectrophotometer (Perkin-Elmer Analyst 300) and an automatic titrator are operated in the laboratory.

#### Sample preparation laboratory for in-situ produced cosmogenic nuclide

The setup of a sample preparation laboratory for in-situ produced cosmogenic nuclides in our Institute begun in 2013 and has been set for processing quartz-containing sediment and rock samples for the determination of their in-situ produced cosmogenic <sup>10</sup>Be and <sup>26</sup>Al concentrations. Main research topics: exposure age and denudation rate determination of fluvial terraces using <sup>10</sup>Be depth profiles, burial age determination using the <sup>26</sup>Al/<sup>10</sup>Be nuclide-pair and <sup>10</sup>Be exposure age determination of glacial landforms.

**References:** Most of the results achieved by the institute appear in publications mainly in leading international journals.

#### Examples from 2018:

Bajnóczi B et al. (2018) Material analysis and TL dating of a Renaissance glazed terracotta. JOURNAL OF CULTURAL HERITAGE 33: pp. 60-70.

Hatvani IG et al. (2018) Speleothem stable isotope records for east-central Europe. EARTH SYSTEM SCIENCE DATA 10: 1 pp. 139-149.

Ruszkiczay-Rüdiger Zs et al. (2018) Integration of new and revised chronological data. QUATERNARY GEOCHRONOLOGY 48: pp. 148-170.

Sipos P et al. (2018) Contribution of individual pure or mixed-phase mineral particles to metal sorption in soils. GEODERMA 324: pp. 1-8.

Stevens T et al. (2018) Ice-volume-forced erosion of the Chinese Loess Plateau global Quaternary stratotype site. NATURE COMMUNICATIONS 9: 1 Paper: 983





#### MAIN FIELDS OF ACTIVITY

Research and development activity of the Institute is manifold thanks to the excellent teaching and research staff. Fields of activities associate with topographic mineralogy, mineral resource exploration (ore, industrial and hydrocarbon as well), equipment development for exploration, environmental geochemistry, archeometry, applied mineralogy research. One indicator of excellence is the seven new mineral species discovered under the leadership of specialists of the Institute. In the last years, another important achievement of the Institute was the rare element potential assessment of Hungarian primary and secondary raw materials. Research achievements are supported by the high-quality laboratory facilities.

#### FACILITIES

##### X-ray diffractometry

Crystal structure based mineralogical investigations are carried out on the Bruker D8 Advance powder diffractometer (Cu K $\alpha$  source) with parallel beam produced by Göbel mirror or parafocusing Bragg-Brentano geometry options, in transmission or reflection geometry. In parallel beam geometry samples down to 0.5 mg can be measured for quantitative analysis or crystal structure refinement. In addition, block samples of 10x10x10 cm can be investigated in non-destructive ways. Quantitative calculations are made by Rietveld refinement in TOPAS4 software.

##### Laboratory for mineral and rock analyses

Chemical analysis is performed by X-ray fluorescence spectrometry on Rigaku SuperMini benchtop WDS-XRF system (F to U detection) with Pd source. The instrument operates under vacuum of noble gas flushing environment, with Cerrox cemented powder pellet or Li-metaborate fused glass pellets. Analysis from major to trace elements is provided with resolution down to 10 ppm.

##### Optical and electron-optical laboratories

The optical microscopy lab enables magnifications up to 150x for stereo- and up to 500x for polarizing microscopy. Beyond fast and adequate texture and phase characterization, is a basic tool for speeding up electron micro-beam investigations also. The stereomicroscope has motorized focus and in-depth morphology imaging software (Z-stack solution at 0.001 mm lowest step).



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Scanning electron microscopy and chemical analysis is resolved on a Jeol JXA 8600 Superprobe with W-filament. The instrument is equipped with state-of-the-art Si-drift EDS detector (C to U detection range) and 5 WDS detectors, with the necessary calibration standards. High precision (1  $\mu$ m resolution) X-ray element mapping is available in both element distribution and quantitative distribution maps.

#### Sample preparation

The Institute is equipped with the full scale of instruments to cover basic and highly specialized geological research. Thin section and polished slabs are produced with the high through put semi-automated Struers RotoPol 35. Loose material, from soils to flotation fractions, is cemented under vacuum with epoxy resin to obtain solid specimens. Powder sample preparation is powered by a Retsch MM 400 tungsten-carbide high frequency vibrating mill, average rock sample is milled from 2 mm to < 0.02 mm in 10 minutes. Fine fraction (e.g. clay minerals) separation is helped by Hettich Rotina high speed centrifuge, with the possibility of heavy mineral separation by Na-polytungstate safe and secure method.

#### 3D laboratory

A new, integrated 3D laboratory at the University of Miskolc with cutting edge analytical equipments partly belongs to the Institute. It brings new dimensions in materials testing and R&D, including four equipments: Stresstech XStress Robot for measuring non-destructive residual stress, a Bruker D8 Discover XRD, SAXS, XRR x-ray diffractometer, an Xylon FF35 Computer Tomograph with dual beam and a Thermo Scientific Helios G4 PFIB SEM equipped with a correlative laser ablation tool. This set of instruments allow the 3D investigation of almost any materials in a wide dimension range down to the nanometre scale.

#### REFERENCES:

##### Research and development projects:

- UNEXMIN: a H2020 project led by the University of Miskolc, which develops an autonomous underwater robotic explorer capable to 3D map and deliver geo-scientific information by non-invasive methods from flooded underground mines. (<https://www.unexmin.eu/>)
- REEBAUX: an EIT RawMaterials KAWA project for prospecting of REE recovery from bauxite and bauxite residue in the ESEE region.
- Basic research on critical raw materials in Hungary within international cooperation framework. (TÁMOP-4.2.2/A-11/1/KONV-2012-0005) (<http://kritikuselemek.uni-miskolc.hu/>)
- Sustainable raw-material management network „RING 2017”. (EFOP-3.6.2-16-201700010)
- 3D LAB Infrastructure development for research of special materials. (GINOP-2.3.3-15-2016-00024)

##### R&D for industrial partners:

- Stockwork Ltd. (Romania): Mineralogical investigation of ore samples (2015).
- RAG-Hungary Ltd. (Hungary): Petrographical and sedimentological analysis of the Kihá-003 well (2015).
- Bollden Mineral AB (Sweden): Analysis of ore samples from Aitik North, XRPD phase identification with Rietveld refinement (2017).
- PT J Resources Nusantara (Indonesia): Quantitative mineralogical investigation by Rietveld-refinement on X-ray Powder Diffraction data (2017).





**University of Miskolc  
Research Institute of  
Applied Earth Sciences**



#### CONTINUOUS INNOVATION

As a major factor in world economy and in the energy sector today, the oil and gas industry requires continuous optimization of petroleum exploration, and there is also a constant need for keeping level with the recent methods and developing new, better solutions. The currently achievable technologies gave us the opportunity to be able to interpret new techniques and to improve the older ones to a higher, new level.

As a sustainable and conventional energy source, petroleum itself has always been a key factor in the energy sector, but for the perfect exploitation, our research system requires a thorough and complex research view. In order to make safe, long-lasting and valuable decisions, a very well examined and established base knowledge is the undoubtedly needed.

To develop and maintain such a unique and important data, instrument and knowledge base, in order to examine and gather information about the petroleum reservoirs, the Research Institute of Applied Earth Sciences, was founded to become the main support of the Hungarian oil and gas industry.

#### HISTORY AND RECENT GOALS

The Petroleum Industry Research Laboratory of the Hungarian Academy of Sciences was founded in 1957 on the recommendation of Zoltán Gyula, the first head of the Department of Oil Production of the University of Miskolc and Elemér Szádeczky-Kardoss academic professor. The Memorandum declared that the main objective of the establishment of the Institute was to "fulfill the research needs of the Hungarian oil and gas industry". In the past approximately sixty years, the Research Institute of Applied Earth Sciences and its predecessors functioned accordingly to the original aims, but the range of research fields have become wider, we operate successfully by maintaining an innovation system.

#### RESEARCH AREAS

The primary goal of the Institute is to solve tasks in the following areas of sciences:

- general chemistry
- chemical engineering
- reservoir mechanics.

We also develop and improve IOR/EOR (improved oil recovery/enhanced oil recovery) technologies, plan and perform industrial experiments and analyze them afterwards. We also deal with production technology and well stimulation of injection and production wells.



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#### R&D IN WELL-AND PRODUCTION SYSTEMS

We also improve hydraulic profiles, having special experiences in:

- decreasing water influx and coning
- mitigating formation damage
- bottom hole cleaning
- mobilization of the pinched-off oil/gas (residual reserve)

In our Institute there is a complex basic and applied research work on partially depleted (brown) fields in order to improve the recovery factor with the goal-oriented connection of flooding and reservoir conformance control technologies. The primary aim of this complex research is to lengthen the lifetime of the oil and gas fields.

#### SPECIAL CORE ANALYSIS (SCAL)

Understanding a reservoir starts with knowing petrophysical properties of rock samples. We also undertake service tasks. These include the determination of petrophysical properties like

- pore structure, pore size distribution (with mercury injection)
- porosity (with helium, brine or petroleum)
- absolute and relative permeability (with helium, brine or petroleum)
- rock compressibility
- capillary pressure and relative permeability

of sandstone and carbonate type reservoir rocks at atmospheric and reservoir conditions. Core preparation and photography also take place here. Determination of complex rheologic and interfacial chemistry properties in multi-phase systems can also be performed.

#### ENHANCED OIL RECOVERY (EOR) TECHNOLOGY

To contribute to the production technology improvement, modeling of displacement processes takes place in our Institute on small (~7 cm), medium size (~21 cm) and long (~100 cm) core sample assemblies in multi-phase systems at atmospheric and reservoir conditions. This also includes the optimization of the IOR/EOR (improved/enhanced oil recovery) technologies, developing injection protocols and optimized flooding technologies. The recovery factor, the mobility ratio and the alteration of the differential pressure are also investigated in this type of measurements.

#### PLANNING AND IMPLEMENTATION OF RESEARCH DEVICES

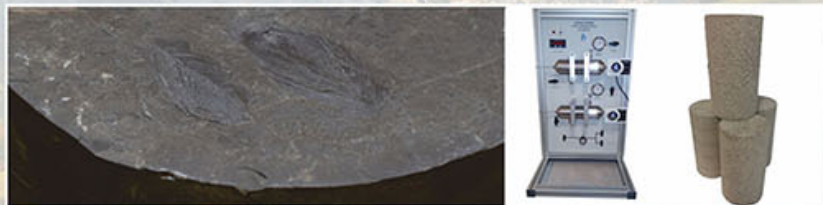
Our researchers and technicians can plan and construct special HPHT (high pressure and high temperature) laboratory tools, devices, equipments.

These include:

#### RESEARCH AND DEVELOPMENT WORKS

We also deal with R&D works associated with non-conventional hydrocarbons (shale gas, high and low viscosity petroleum stored in extreme low permeability rock, methane stored in coal fields) in the areas mentioned in the previous lines.

- Designing of different laboratory cells for unique requirements
- Complex measurement systems for oil- and gas industry
- Design and implementation of high pressure hydraulic pumps
- Long term laboratory measurements on different fields
- Investigation equipment to understand three water reinjection mechanisms
- Automatic remote monitoring systems for water quality tests





#### DEPARTMENT OF ENVIRONMENTAL ENGINEERING

##### University of Pécs - Faculty of Engineering and Information Technology

The University of Pécs, the oldest university in Hungary, was founded in 1367. Today our university, with its 10 faculties, nearly 20,000 students, 1400 teachers and researchers is one of the largest higher education institutions in Hungary and the centre of knowledge within the Transdanubian region. The Faculty of Engineering and Information Technology, with its 3,000 students and several decades of experience, is one of the most colourful institutions of Hungary's tertiary technical education and one of the prominent centres of the country's engineering life. The 8 basic training programmes cover technical, artistic and information technology related fields of study in the following branches: architecture, civil engineering, environmental engineering, electrical engineering, information technology, mechanical engineering and architectural design.

#### RELEVANT STUDY AND RESEARCH OPPORTUNITIES

The topics of applied earth sciences appear in the training and research programs of the Department of Environmental Engineering. Among the trainings, the BSc in Environmental Engineering should be highlighted, aiming at the training of environmental engineers with up-to-date technical, scientific and management knowledge, who are able to prevent, reduce and eliminate environmental harms and damages, to implement near zero-waste and resource-efficient technologies, to use professional databases, design and simulation software, as well as to manage the social transition to the use of renewable resources and the implementation of GHG emission reduction. The major research areas of the Smart City Technologies research group include non-destructive material testing, alternative raw material management, waste management, water management and city management.

Our main research topic is the enhancement of special electrical, non-destructive material testing methods, with special focus on the development of instrumentation, measurement methods and evaluation algorithms. The research focuses primarily on tomography methods, whose applications include geophysical measurements (contaminated soils, landfill exploration, hydrogeology), laboratory tests (e.g. chemical reactor monitoring), and biological and medical applications.



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#### SERVICES

- Development of tomography instruments and measurement methods; solution of measurement technology related technical problems
- Sample preparation (contaminated industrial soils, sediments, wastewater, sewage sludge, waste, ash, biological samples, unknown materials)
- Analysis of water, soil, sludge and waste
- Elemental analysis, trace element analysis
- Determination of carbon, hydrogen, sulfur, nitrogen and chlorine content of samples
- Particle size distribution of dusts and soils (0.02 µm to 2,000 µm range)
- Examination of biogas and landfill gases
- Physical and chemical testing of fuels; determination of the heat of combustion of liquid and solid samples
- Quality control of secondary raw materials, biomass and residue derived fuels (calorific value, moisture content, particle size distribution, ash content, etc.)
- Investigation of thermal conversion of solids (inorganic compounds [ceramics, glass-ceramics, cement, composite materials, metals, minerals, nano-products, solid mixtures, melt, gypsum], food [food ingredients, starch, sugars, fats, proteins], organic materials [polymers, drugs, biomass, tires], pesticides, waste, catalysts, adsorbents and raw material samples).

#### RELEVANT LABORATORY INFRASTRUCTURE

The Environmental Measurement Technology laboratories are equipped with the following main tools and instruments in addition to basic chemical laboratory equipment: digital balance scales and analytical scales; positive pressure filtration device with membrane filter and compressor; water purifier with UV preparation; ultrasonic cleaner; microwave destruction unit; calcining furnace; lab ovens; automatic titrator; laboratory and in-situ multimeters (pH / temperature / conductivity / dissolved oxygen); COD meter with destruction unit; BOD meter; photometers; UV-VIS spectrophotometers; water analysis rapid tests; TOC meter; portable micro-GC; shaker screen; compact laser particle counter; stereomicroscope with camera; portable multi-gas meter (CH<sub>4</sub>, O<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, CO); cutting mill; ultra-centrifugal mill; AAS device; ICP-OES device; DSC thermal analyzer; bomb calorimeter; C-H-S-N-Cl elemental analyzer; Electrical Impedance Based Material Analysers.

#### REFERENCES

- International patent: Borbás Károly, Kiss Tibor, Kincsik Mihály, Kvasznicza Zoltán, Máthé Kálmán, Vér Csaba, Vizvári Zoltán, Odry Péter: PROCESS AND MEASURING SYSTEM FOR DATA ACQUISITION AND PROCESSING IN SOFT - TOMOGRAPHY STUDIES (US 2018 / 0374244 A1; PCT / HU2016 / 050062)
- 2 prototype impedance measurement units (low / high voltage)
- Vizvári Z. – Kiss T. – Máthé K. – Odry P. – Vér Cs. – Divos F.: Multi-Frequency Electrical Impedance Measurement on a Wooden Disc Sample, Acta Silv. Lign. Hung., Vol. 11, Nr. 1 (2015) 67–75.





University of Szeged  
Department of Mineralogy,  
Geochemistry and Petrology



#### Facilities

Hitachi S-4700 FE-SEM Field-Emission Electron Microscope  
L2130 High Performance Liquid Chromatography  
Horiba Jobin Yvon XGT 5000 X-Ray Fluorescence (XRF) system  
Olympus BX-41 Polarizing, epi-fluorescent microscope  
OceanOptics QE PRO VIS-NIR spectrometer  
Rigaku Ultima IV X-ray diffractometer  
THERMO DXR Raman microscope  
Linkam THMSG-600 and MDS-600 heating-freezing stages  
Mass spectrometer-based gas analyser with on-line, low-pressure crushing unit

**The University of Szeged** is one of the leading universities in Hungary. It has twelve faculties among which Faculty of Science and Informatics is the largest and has the highest-level international reputation. In collaboration with the Department of Geology and Palaeontology and Department of Meteorology, our department coordinates education of Earth Sciences at BSc, MSc and PhD levels. The major topics of research activity at the department concern geological interpretation, modelling and estimation of different resources, like fluids (hydrocarbon and geothermal), primary and secondary ores (rare earth element, lithium, scandium, microdiamond, etc.) and soils. In addition, we deal with petrological, structural and hydrodynamic modelling of fractured waste repositories.

The department possesses a well-developed analytical laboratory with rock, soil and fluid sample preparation lab, as well as numerous types of equipment for chemical analysis (XRF, micro-XRF, EDS, LA-ICP-MS), solid-phase analysis (XRD, Raman spectrometer, SEM), fluid analysis (microthermometry, mass spectrometer-based chemostratigraphy) among others.

**The most important partners** of the department in applied mineralogy, geochemistry and geology are the followings: MOL Nyrt., Smaragd-GSH Kft., Envirotis Holding Zrt., Mecsekérc Zrt., Coca-Cola HBC Magyarország Kft., Golder Associates Magyarország Zrt., Contitech Rubber Industrial Kft., Zeolitos SRL, Balla Géza Winery, Árpád Agrár Zrt., Geotermikus Szolgáltató Kft., Móra Ferenc Múzeum.



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### CAPES goes international with Enterprise Europe Network

**The Enterprise Europe Network helps small and medium-sized businesses, clusters and other actors innovate and grow internationally. The Network's achievements are best shown through the positive results of the many businesses having been helped already. This success story is about how Cluster of Applied Earth Sciences (CAPES) got into an international metacluster with the assistance of Network partner Chamber of Commerce and Industry of Pécs-Baranya.**

#### CAPES goes international

The high performance French **POLE AVENIA** cluster started to prepare for a **COSME** Call for proposal "Cluster Go International" in 2017. The topic was "Support the establishment of **European Strategic Cluster Partnership - Going International**".

The overall goal was to create a European Strategic Cluster Partnership with a focus on the sustainable use of the **subsurface energy** and to develop a joint internationalisation strategy as well as an implementation roadmap.

**Enterprise Europe Network South West France** provided information, support and assistance to **POLE AVENIA** in the preparation of their proposal. A **partner search** was conducted and a research profile was published on the Enterprise Europe Network's **Partnership Opportunity Database**.

In response to the partner search profile **Cluster of Applied Earth Sciences (CAPES)** – client of Enterprise Europe Network **South West Hungary** – made an expression of interest for joining the project. CAPES has a **deep knowledge and expertise in geothermal energy, environmental engineering, management and renewable energy** thus, it was readily integrated by **POLE AVENIA** in the proposal with the title **GEO-ENERGY Europe**.

The project comprising **Belgian, French, German, Hungarian, Irish, Spanish and Turkish clusters** started in 2018 with a budget of **€ 267 000** (75% financing rate).

The partnership also submitted a second proposal on 30 October, 2019.

Check for more: <https://www.geoenergyeurope.com/>

#### Enterprise Europe Network

The Network – present in more than 60 countries – provides support for **SMEs, clusters, universities and other actors** to build international partnerships.

#### Going international

Competent partners are needed to expand businesses in other countries. The Enterprise Europe Network helps find them. Database of cooperation profiles and matchmaking events assist potential business or technology partners in getting in touch.

Check for more: <http://een.ec.europa.eu>

#### Chamber of Commerce and Industry of Pécs-Baranya (CCIPB)

CCIPB – responsible for South West Hungary – is one of the 600 partners of Enterprise Europe Network. The chamber (Est. in 1881) has the ability to help get in contact with innovative SMEs, large companies, research institutions, universities, incubators, innovation agencies, regional development agencies (etc.) at national and international level. In addition CCIPB supports realisation of their goals with advisory services.

Check for more: <http://pecseconomy.eu/>



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