

2. NATURAL AND ANTHROPOGENIC PROCESSES OF THE LITHOSPHERE AND HYDROSPHERE PROGRAM

Program leader: **Dr. Szilárd Szabó**, DSc

General aims of the program

Our aim is to preserve the intellectual heritage of the outstanding scientists and to support the application of recent research trends and methods in the departments of the University of Debrecen, namely the Department of Mineralogy and Geology and the Department of Physical Geography and Geoinformatics. Another aim is to meet the social requirements of recent years, the EU directives and to transfer modern, internationally high standard knowledge.

Research fields in the program: physical geography, geology, hydrogeology, geophysics, geoinformatics.

Key-points of the program in geology

- On the basis of its specific views, diverse analysis methods and close relationships with a wide range of natural sciences, geology is suitable for modelling the long-term and short-term processes, exposing the development trends, protecting the values of our planet and environment that increasingly lose their equilibrium regarding.
- It is a basic task to apply and integrate the results achieved in plate tectonics, palaeoecology, geochemistry, geothermics and environmental geology into education with the help of up-to-date theoretical and analytical apparatus. The program can be divided into several topic groups that are based on each other.
- Up-to-date informatics and geoinformatic methods are essential for the solution of the above tasks that are fundamental for both database construction and modelling.
- National and international and also institutional co-operation possibilities are important for focusing on interdisciplinary fields (morphotectonics, energetic, protection of environmental values, avoidance and prevention of damage to values) just as reviving the methods of exploring essential raw-material.

Key-points of the program in Geomorphology

- On the one hand, recent processes may cause concrete risk or damage to the society and on the other hand, their thorough knowledge may help exposing their utilizable characteristics.

- It has been revealed in recent decades that the surface is formed to an increasing extent by the society to create a new environment for itself (nature – society interaction). The activity of the society triggers new processes forming the surface and at the same time it can modify significantly the effects of active natural processes (action – reaction). As a result, recent surface forming processes become more and more anthropogenic and their study gets the studying science even closer to the society. As a result, in changing geomorphology the basic characteristics of the traditional duality of geography strengthen (studying the spatial processes of nature on the one hand and the society on the other hand and thus expose their interaction in detail).
- Today, geomorphologic research must not remain at studying the shaping effects of natural and social processes but it has to be completed with evaluating the positive (advantageous) and negative (exposing threat) effects of these processes with exposing feedback mechanisms and modelling.
- New aspects and tasks in geomorphology today include the exact measurement of processes and landforms as conditions apart from the detailed genetic and qualitative mapping of the surface. Their successful utilization and even (justified) preservation is only possible based on the above results. Co-operation with engineering sciences in the field of applied geomorphology: creating useful information for sciences helpful for regional planning.

Key-points of the program in geoinformatics

The spreading of personal computers in Hungary and professional software packages in earth sciences over the last two decades enabled new possibilities in almost all fields of research considering data storage, processing and interpretation.

- Geoinformatic and geostatistical processing of geological and geomorphological taking utilization aims into account.
- Applying and developing geoinformatic modelling in research fields associated with our doctoral program.
- Remote sensing possibilities in geological, geomorphological, hydrological and hydrographical research based on aerial (satellite, airplane, drone) and land (GPS, measurement station, land photogrammetry) survey data.
- Development of geoinformatic methods, and the study of the accuracy of measurements, data and methods.
- Analysis of digital elevation models using geomorphometric methods for object identification.
- Solving urban geomorphological research tasks with the joint application of geomorphology and geoinformatics.

Recommended and highly supported topics in the doctoral program

- Studying rapid climate change and associated changes in the environment and the biosphere in the Mesozoic.
- Studying the noble gas isotope ratio (He, Ne, Ar, Kr, Xe) of rocks and fluid inclusions in minerals in order to determine the origin of the rock or that of fluid movements in rocks (crust or mantle).
- Hydrodynamic and contamination flow modelling of subsurface waters. Interaction of subsurface waters. Studying filtration in the three phase zone of soils.
- Up-to-date geodynamic, micro-tectonic and morphotectonic studies and sequence stratigraphy based basin analysis supported with geophysics and geoinformatics, characterization of raw material resources (water, coal, geothermal energy), resource calculation, optimization of mining methods and effective exploitation of resources.
- Volcanological research integrated with regional tectonics and mega-structural reconstructions covering areas that lacking data (e.g. Tardona Hills, Mecsek) and also regions over the border (e.g. Transcarpathia, Northern Transylvania).
- Complex geological, technological, environmental geological, etc. research of mineral raw materials and their environmental friendly utilization.
- Research of the material and origin of archaeological tools, archaeometric study of the material and technology of building material and ceramics, palaeoenvironmental reconstruction of archaeological expositions.
- Research of the morphological issues of natural landscape evolution present in today's natural environment, especially in the lowlands, hills and mountains of NE Hungary. Special focus is directed on fluvial, aeolian processes and mass movements.
- Characteristics and modifications of landscape development due to anthropogenic activities. Geomorphological risk and hazard analyses, equilibrium problems in river floodplains, wind-blown sand areas and in valley systems in hills and mountains.
- Geomorphological natural value survey and protection especially in landscape types sensitive to natural equilibrium. Development of the theoretical basis and practical system of geomorphological value protection in Hungary.
- Geomorphological modelling – modelling experiments, theoretical models.
- Exposing the geomorphological characteristics of highly dangerous – either directly or in their long-term effects – anthropogenic activities (mining, industry, infrastructure development, intensive agriculture), prognosticating their consequences and reduction of their threat.
- Analysing the geomorphological relations of landscape planning and reclaim of mined areas, integration of the role of geomorphology in landscape protection. Analysis of the natural bases of regional development.
- Quantitative study of the characteristics of the earth surface (relief), integration of the results in geographical information systems (GIS), theoretical-methodological issues

of the application of informatics in geological, geomorphological, hydrological, etc. research, geomorphological possibilities and tasks in digital thematic mapping.

- Application of remote sensing methods in analysing and interpreting surface changes.

Program courses

- Clay minerals and the environment (István Viczián)
- Applied and environmental geology (Árpád Csámer)
- Applied and environmental geochemistry (József Posta, Dávid Nagy)
- Petrology of formations (István Viczián)
- Hydrodynamic modelling (János Szanyi, Tamás Buday)
- Radiometric age determination (Zsolt Benkó, Zoltán Pécskay)
- Environmental geophysical applications (Tamás Buday)
- Igneous petrogenesis (Gábor Dobosi)
- Basin analysis in raw-material exploration (Zoltán Püspöki)
- Facies reconstruction of carbonates (Olga Piros)
- Palaeontology (Árpád Dávid)
- Interpretation of geochemical data (Gábor Dobosi)
- Structural geology and morphotectonics (Richard William McIntosh)
- Applications of thermal analysis (Árpád Csámer)
- Building stones in history (Péter Rózsa)
- Planetology and meteoritics (Arnold Gucsik)
- Geomorphological problems of landscapes in the Alföld (József Lóki)
- Society as a geomorphological factor (Csaba Tóth)
- Static and dynamic surface analysis and evaluation (József Szabó)
- Research planning and publication (Szilárd Szabó)
- Statistics (Szilárd Szabó)
- Landscape metrics (Szilárd Szabó)