DIGITAL GEOLOGICAL ATLAS OF THE LITTLE HUNGARIAN PLAIN (KISALFÖLD)

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Abstract

A short introduction is devoted to feature the objectives and the principal aspects of the complex geological mapping of the Little Hungarian Plain with major emphasis on its multidisciplinary approach. It is followed by a detailed list of thematic maps included into the atlases published according to 1:100.000-scale quadrangles. The fist four of them were produced using traditional techniques of preparation for printing. A number of reasons including the introduction of GIS technology and the growing need for generating derived, applied geological maps upon established databases gave us the impetus to adopt computer-assisted production methods for map generation. The final goal of the project is thus to set up the geology-related database of the region allowing us to produce custom-specific maps facilitating decision-making procedures as well as to have a cartographic database illustrating fundamental features of its geological setting. The paper is closed by addressing applied geological projects in the frame of outside contracts awarded, using data of the related database. This final section serves to illustrate how the data of a fundamental research of initially mainly scientific aspect can produce results for the solution of up-to-date, practical issues.

1. Objective of the geological mapping in the Little Hungarian Plain

The complex regional geological mapping aimed at providing fundamental data on the Little Hungarian Plain's geological setting was launched in 1982. Initially, the project was supported fully from state budget. The targeted area is approximately 10.000 km^2 large and is situated in the NW part of Hungary. As a matter of fact, it is an alluvial plain filled with comparatively thick Quaternary sediments of the Danube river and its tributaries. Consequently, it has a substantial agricultural potential being simultaneously rich in subsurface and thermal water resources of high quality. One of its sub regions called Szigetköz has recently become the subject of international debate focused on the establishment of a water dam on the Hungarian - Slovak border and its eventual impact on subsurface water regime. The thickness of Quaternary sediments, 50-100 m on the average in this specific sub region, achieves occasionally values as high as 400-600 m. They are underlain by several-thousands-m-thick fine-grained Neogene formations. Due to this geological setting, the area can be regarded as one of the most important subsurface water reservoir in Central Europe. Simultaneously, it is highly vulnerable to pollution whose eventual effects are extremely difficult to remediate.

The need for gathering fundamental geological data as well as for addressing effectively the above specified problems was the reason for initiating a multidisciplinary project. The simultaneous study of the same area from several aspects of geosciences was a cost-effective method of investigation saving time and money, i.e. collecting as much data as possible with the least expenses. The mapping involved thus the intervention of experts engaged in different fields of geology. Related *thematic groups of maps* included in the atlases are as follows:

- geology
- geomorphology
- hydrogeology
- engineering-geology
- pedology

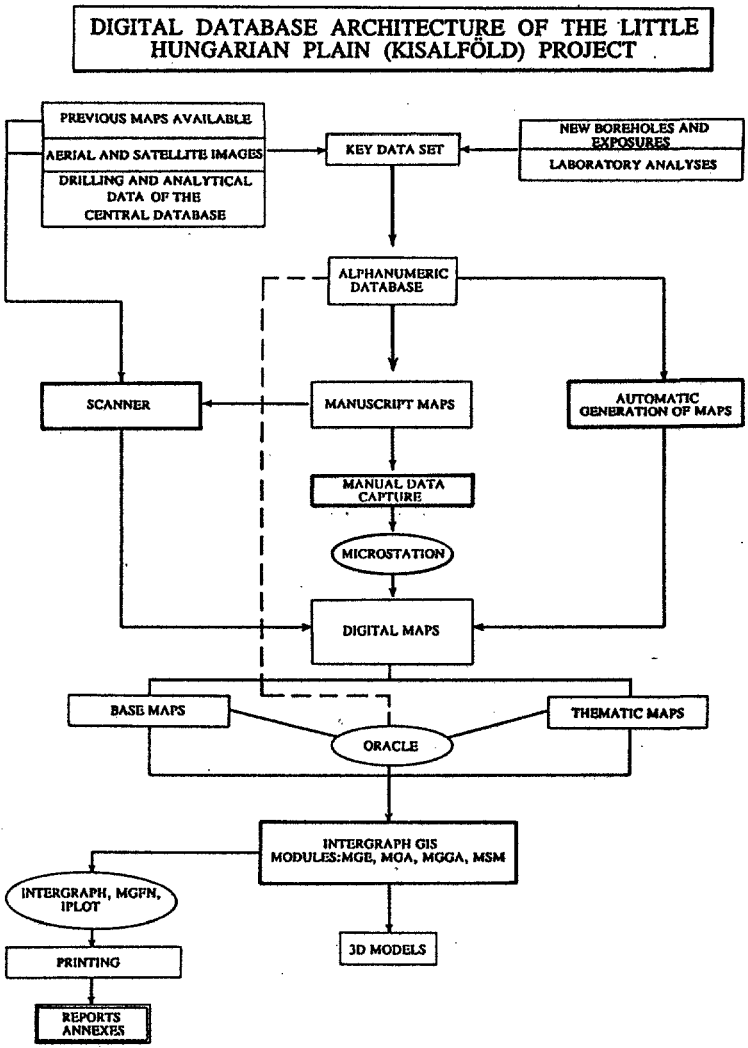
DIGITAL DATABASE ARCHITECTURE OF THE LITTLE HUNGARIAN PLAIN (KISALFÖLD) PROJECT
PREVIOUS MAPS AVAILABLE
AERIAL AND SATELLITE IMAGES
DRILLING AND ANALYTICAL DATA OF THE CENTRAL DATABASE
KEY DATA SET
NEW BOREHOLES AND EXPOSURES
LABORATORY ANALYSES
ALPHANUMERIC DATABASE
SCANNER
MANUSCRIPT MAPS
AUTOMATIC GENERATION OF MAPS
MANUAL DATA CAPTURE
MICROSTATION
DIGITAL MAPS
BASE MAPS
THEMATIC MAPS
ORACLE
INTERGRAPH GIS MODULES:MGE, MGA, MGGA, MSM
INTERGRAPH, MGFN, IPLOT
PRINTING
REPORTS ANNEXES
3D MODELS

Fig. 1.

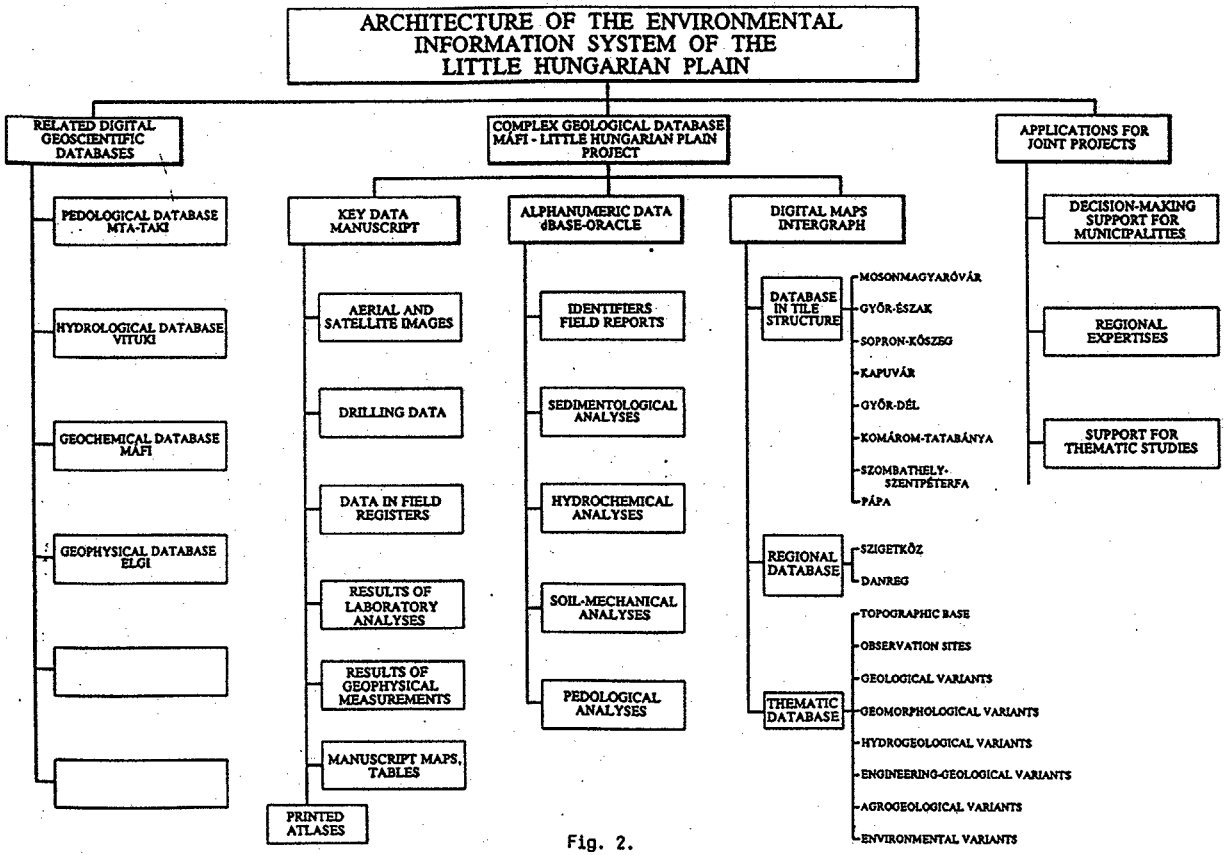
ARCHITECTURE OF THE ENVIRONMENTAL INFORMATION SYSTEM OF THE LITTLE HUNGARIAN PLAIN
RELATED DIGITAL GEOSCIENTIFIC DATABASES
PEDOLOGICAL DATABASE MTA-TAKI
HYDROLOGICAL DATABASE VITUKI
GEOCHEMICAL DATABASE MÁFI
GEOPHYSICAL DATABASE ELGI
COMPLEX GEOLOGICAL DATABASE MÁFI - LITTLE HUNGARIAN PLAIN PROJECT
KEY DATA MANUSCRIPT
AERIAL AND SATELLITE IMAGES
DRILLING DATA
DATA IN FIELD REGISTERS
RESULTS OF LABORATORY ANALYSES
RESULTS OF GEOPHYSICAL MEASUREMENTS
MANUSCRIPT MAPS, TABLES
PRINTED ATLASES
ALPHANUMERIC DATA dBASE-ORACLE
IDENTIFIERS FIELD REPORTS
SEDIMENTOLOGICAL ANALYSES
HYDROCHEMICAL ANALYSES
SOIL-MECHANICAL ANALYSES
PEDOLOGICAL ANALYSES
DIGITAL MAPS INTERGRAPH
DATABASE IN TILE STRUCTURE
MOSONMAGYARÓVÁR
GYŐR-ÉSZAK
SOPRON-KŐSZEG
KAPUVÁR
GYŐR-DÉL
KOMÁROM-TATABÁNYA
SZOMBATHELY-SZENTPÉTERFA
PÁPA
REGIONAL DATABASE
SZIGETKÖZ
DANREG
THEMATIC DATABASE
TOPOGRAPHIC BASE
OBSERVATION SITES
GEOLOGICAL VARIANTS
GEOMORPHOLOGICAL VARIANTS
HYDROGEOLOGICAL VARIANTS
ENGINEERING-GEOLOGICAL VARIANTS
AGROGEOLOGICAL VARIANTS
ENVIRONMENTAL VARIANTS
APPLICATIONS FOR JOINT PROJECTS
DECISION-MAKING SUPPORT FOR MUNICIPALITIES
REGIONAL EXPERTISES
SUPPORT FOR THEMATIC STUDIES

Fig. 2.

- environmental-geology
- geophysics

2. Methods of investigation and map publishing applied

Basic methods of investigation included:

- interpretation of satellite and aerial images
- penetration of shallow, medium deep and deep boreholes
- shallow and deep-ranging geophysical investigations
- in-situ investigations and field trips
- laboratory analyses
- construction of the related alphanumeric database
- capturing digital maps and setting up the GIS database

In compliance with the subdivision of this geographic region into thirteen 1:100.000-scale quadrangles, *13 atlases including 28 thematic map variants each* were defined for publishing. Four of them have finally been prepared using traditional techniques of preparation for printing. They communicate relevant information for local and regional authorities concerning the state of the environment of the area and its potentialities.

3. Constructing the GIS database architecture

A number of reasons including a severe budget cut prevented us from going on with the publication of the atlases in the traditional way. This event regarded initially as handicap turned out, however, to be an advantage with the simultaneous introduction of *GIS technology* into the Institute. Computer-assisted processing methods, literally revolutionising traditional cartographic techniques furnished us the necessary tool for generating the database of the related area. It consists of remote sensing-, borehole- and laboratory data items as well as a considerable number of manuscript maps (Fig. 1). As a result of the multidisciplinary approach of this project and the large amount of maps, some of them prepared through the integration of single-theme basic variants, this mapping program was selected as the pilot project for implementing GIS in the Geological Institute of Hungary. This choice had a twofold advantage as providing excellent data for testing the GIS as well as to set up the digital GIS database of the Little Hungarian Plain facilitating to publish thematic maps of the project through computer-assisted processing.

Four digital geological atlases covering approximately a 3000 km^2-large area have already been printed. The powerful capabilities of the system based on two industry standard GIS products - *Intergraph MGE* and *Arc/Info* - allows us to perform sophisticated queries and data integration procedures through logical overlay upon the multidisciplinary database.

As far as the *cartographic composition* of the maps is concerned, 1:100.000-scale topographic maps in Gauss-Krueger projection system serve as their background. Their simplified version appears in the digital database. Symbology of map elements corresponds to the uniform legend of geological maps that is being worked out within the framework of an individual project in Geological Institute of Hungary. The symbology used in the Little Hungarian Plain served in fact as the basis for elaborating the uniform symbology of geological cartographic elements in alluvial plains and related lowland areas in Hungary. For the time being, boreholes and point features of other observation sites appear as digitally captured vector data on the maps. The next step will consist of filling all borehole data into our GIS' *Oracle* database allowing us to generate borehole symbols from the database with selected label information.

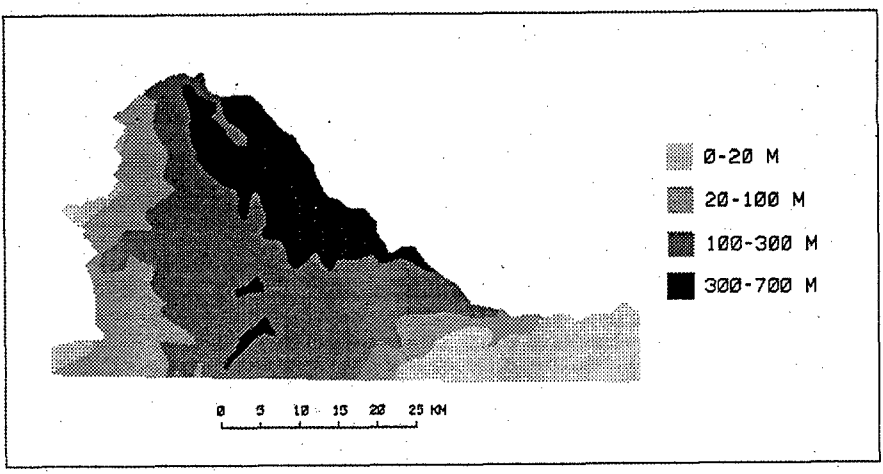

Figure 3: Thickness of the Quaternary sediments in the Szigetköz area

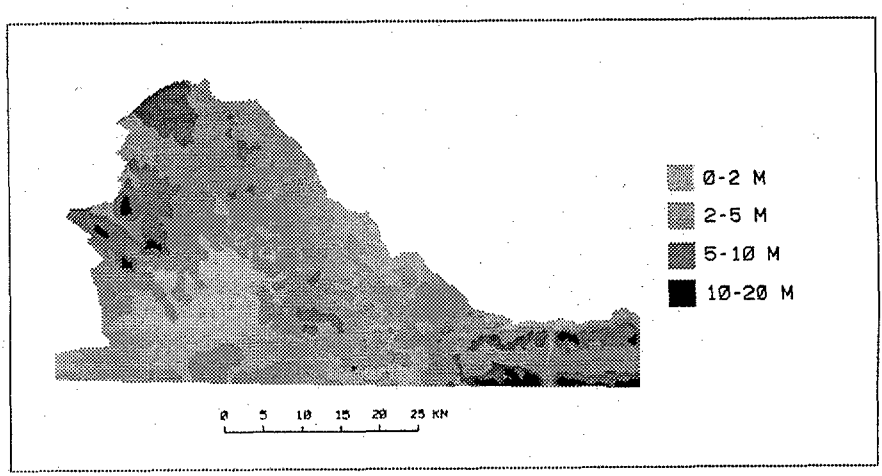

Figure 4: Hydrostatic level of the ground-water below the surface in the Szigetköz area

In order to arrive at map products of cartographic quality using exceptionally computer-assisted methods we are in the process of studying possible ways of generating colour-separated PostScript files using our GIS softwares available. Our ultimate goal is to set up a digital geological map production system for publishing maps of fundamental geological data as well as applied variants with legend and symbology corresponding to our customers' requirements.

4. Related projects

One of our chief customer, the *Ministry for Environment and Regional Policy* contracted us on several occasions to study and assess different aspects of the state of environment in the so-called Szigetköz region extremely vulnerable to pollution. Data gathered in the frame of the Little Hungarian Plain project with incorporation of the results of other, more detailed studies including hydrogeological, hydrological and hydrochemical investigations allowed us to set up the environmental information system of the related area extended later to the whole Little Hungarian Plain (Fig. 2). It provides the Ministry with information on the pollution susceptibility of this region supporting thus to take measures for mitigating eventual effects of pollution sources. Figure 3 and 4 illustrate two individual thematic maps of the related information system.

The growing amount of *communal, industrial and radioactive wastes* imposes an ever growing burden on regional and local authorities to cope with them. Geological as well as hydrogeological data are indispensable for addressing this issue together with a number of other factors to be considered including protection zones around rivers, roads and settlements defined by health authorities. The integration of the high number of themes involved into the analysis can largely be facilitated through the use of GIS provided that the necessary data is available in digital form. This is effectively the case in the already processed segment of the Little Hungarian Plain simplifying thus considerably eventual site selection procedures for waste depositories.

Multinational projects: Experience accumulated during mapping the Little Hungarian Plain and constructing the related GIS database allowed us to launch large-scale co-operation projects with other European geological institutions. The *DANREG* (DANube REGion) *project* is aimed at producing a multidisciplinary geological database and related thematic maps along a 40-km-wide belt of the common border between Austria, Hungary and Slovakia. Another program focused on elaborating principal methodological features of *investigating alluvial plains* envisaged to be carried out jointly by the geological surveys of Catalonia, Emilia-Romagna (Italy), Holland and Hungary is about to be launched later this year.

References

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