# Report on the project:
Geophysical multilingual internet-driven information service (GeoMind)

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A b s t r a c t : The aim of the GeoMind project is to develop a multilingual informa-tion system, which will provide the access to geophysical data holdings, it will integrate national databases and make them available via Internet on a certain level, offering cross-border, European-wide, unified electronic service. The project was launched in September 2006 and is planned for 24 months. The results of the preparatory phase, the analysis of the present practice and the present infrastructure of national geophysical information systems, including payment functions have determined the functional requirements of the planned system. Because of heterogeneity of existing data systems new metadata (and data) models should be elaborated. Data models are going to be used as standards in the project for data transfer between national databases and the web server of GEOMIND system. The participants are going to use these standards in possible future data exchange between them, or with third party institutions as well.

1. Introduction
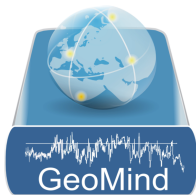
Environmental and geoscience problems are not respect-ing national frontiers. Therefore they demand providing trans-border geophysical information assembling and study. It is, however, commonly hard to perform even if the geophysical header data or measurement data are available on the national level, since their standards vary from one country

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to another. Different standards cause also problems with further data processing, needed to obtain valuable results. Another problem for establishing cross-border geoinformation services based on digital content is that all the national geodatabases use various languages and terminologies. Websites of geophysical data holders, if available, are provided only in national languages, or associated only with English additional linguistic versions of the services. So a user looking for geophysical information can very rarely work in his familiar linguistic environment.

The proposed solution addressing the problems and barriers, described above, is to develop an international, multilingual, Internet-driven easily extensible information system: GEOMIND. The system will provide cross-border, multilingual information services, offering access to geophysical data holdings, being at command of the participating data suppliers, in a consistent and seamless way, in the language chosen by the user.

2. What is GeoMind about?

– **GeoMind system** is developed to meet the needs of people who will potentially use geophysical data.
– **GeoMind** is a web-based information service (portal) to search and display geophysical metadata information across Europe. System gives a convenient way for online ordering and downloading (in selected cases) of geophysical data from providers as well, taking into consideration all nationally specific legal issues.
– **GeoMind Portal** is a multilingual public access platform to utilize geophysical data without a limitation of national boundaries.

3. Analysis of demand and user needs

The following groups of potential users of the new GEOMIND are envisaged:

- *Central and local authorities:* ministries, regional authorities, various governmental agencies etc.;

- *Exploration and mining companies,* especially of the energy sector (natural oil and gas, geothermal energy), looking for information essential for their prospecting, exploration, exploitation purposes;

- *Geophysical, geological, hydrogeological, engineering or environmental companies,* in large part SMEs, specialized in processing and/or interpretation of geophysical data for the services offered;

- *Researchers, students* and their groups, active in the field of geoscience, geophysics, geotechnics, environmental issues, involved in research projects and studies;

- *Insurance companies:* for geohazard risk estimations concerning human health or natural disasters;

- *Individual citizens:* requiring e.g. information on geohazards (radon risk, landslide risk, earthquake risk etc.) for decisions connected with small constructions (family houses etc.) and/or evaluation of lots, or for educational purposes.

The resulting multilingual character of the GEOMIND system will allow users from the participating data-providing countries and English-speaking users to take full advantage of the system and to find information needed by them for cross-border and abroad activities like:

- underground water (including geothermal) exploration, evaluation and exploitation;

- geological engineering studies for construction purposes, flood banks, slope and bank foundation, landslide protection, prediction and prevention, detection of tectonic zones;

- energy resources exploration and exploitation (geothermal energy, coal, oil, gas); prospecting and exploration of other mineral resources;

- detection and mitigation of radioactive hazards (natural or man-induced);

- environment protection and pollution risks management (e.g. due to exploitation of hydrocarbons); detection and monitoring of soil and groundwater pollution, land reclamation;

- spatial planning issues (industry zones, urban areas, traffic corridors, leisure and recreation areas), based on results of previous items;

- seismic hazard monitoring, together with recognition of active tectonics phenomena related to these hazards;
- geoscientific research activities, especially trans-border or large-scale scientific projects.

It should be emphasized, that the needs or requirements of the users of the GEOMIND system will be thoroughly studied in early phase of the project, to adapt the system and the scope of data offered as much appropriate to the needs as possible. As well, the contact with the users will be maintained and strengthened throughout the rest of the project duration, and after this, to collect feedback from the users and develop the system in the direction most requested.

4. GeoMind project consortium – List of participants

Most of the data sets are in hands of national geological surveys, although certain data sets are held by commercial companies, two of which are the project consortium partners. The project will take into account only data being already in digital format.

GeoMind project consortium consists of 12 considerable member organizations (10 of which are data provider) involving more than 100 professional specialists from 9 EU countries (see Fig. 1):

Polish Geological Institute – PGI (Państwowy Instytut Geologiczny) – Poland;

Czech Geological Survey – CGS (Česká geologická služba) – Czech republic;

Eötvös Loránd Geophysical Institute – ELGI (Magyar Állami Eötvös Lórand Geofizikai Intézet) – Hungary;

GEOCOMPLEX, a.s. – GCX (Geophysical Exploration Company) – Slovak Republic;

Geological Survey of Denmark and Greenland – GEUS (Danmarks og Grønlands Geologiske Undersøgelse) – Denmark;

Geological Survey of the Slovak Republic – GSSR (Štátny Geologický

ústav Dionýza Štúra) – Slovak Republic;

Geophysical Exploration Company – Miligal, s.r.o., Czech Republic;

Leibniz Institute for Applied Geosciences – GGA (Institut für Geowissenschaftliche Gemeinschaftsaufgaben) – Germany;

Golder Associates Srl. – Italy;

Institute of Geology and Mineral Exploration – IGME – Greece;

Institute of Engineering Seismology and Earthquake Engineering – ITSAK – Greece;

Information Technology co. – (Informacines Technologijos) – Lithuania.

5. Work packages description

WP1: Project Management – Leader: Polish Geological Institute (PL)
− co-ordination of project activities and work packages; ensuring provision of all deliverables on time and of reguied quality;
− maintaining communication EC–consortium, resolving problems encountered, financial and administrative issues.

WP2: User Needs Assessment and User Requirements – Leader: Golder Associates Srl (I)
− to identify specific needs in term of cross-border and international accessibility and usability of geophysical data among stakeholder and potential users;
− to elaborate interview/questionnaire templates;
− to study/analyse demand for geophysical data; to identify specific user needs/requirements.

WP3: Inventory of National Geophysical Data Resources – Leader GSSR Slovak Republic (Sk)
− to identify national geophysical data resources (digital);
− study/describe structure of meta-, header data. . . , study/review standards / data models in use, evaluate usability of given data resources, provide recommendations for further developments. . .

WP4: Legal Implications – Leader: Polish Geological Institute (PL)

− to prepare an overview of the national legal system with regard to distribution of geo-sciences data to the public in the participating countries;

− review national/international legal regulations concerning geodata dissemination; to analyse current practice of the dissemination, to detect possible legal/organisational difficulties for GEOMIND;

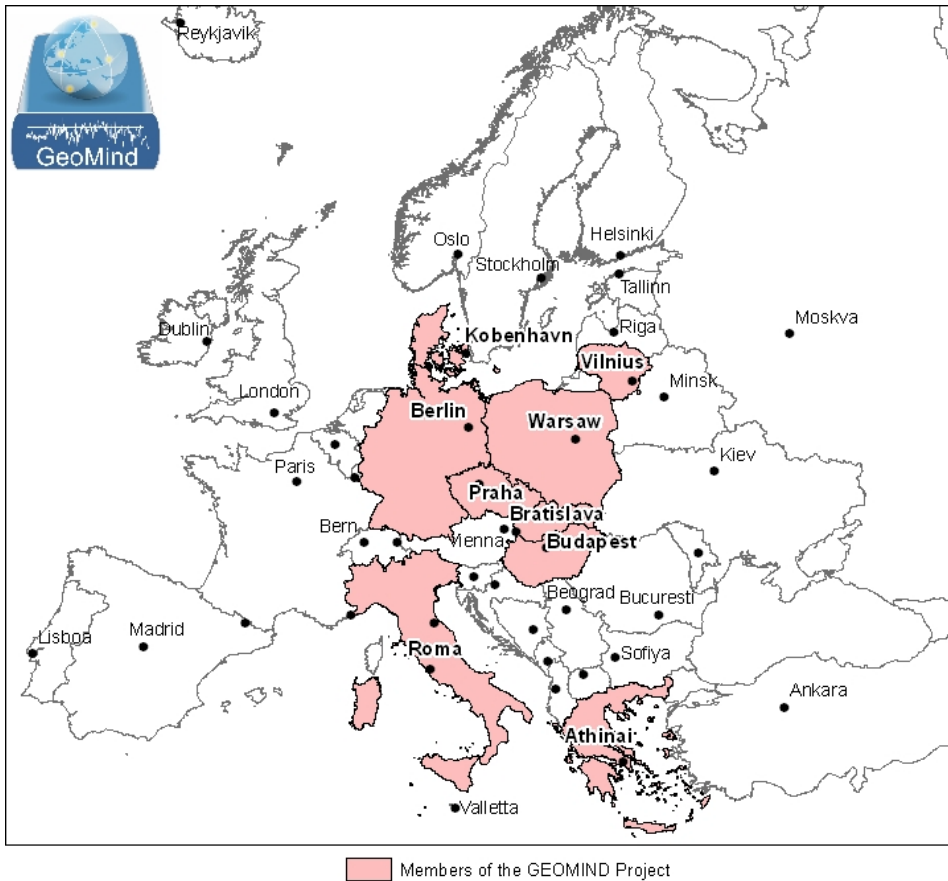− to give recommendations for new/changed organisational regulation.

Fig. 1. Member countries of the GeoMind project consortium.

WP5: System Concept and Functional requirements – Leader: Informacines Technologijos (LT)

– to analyse the collected requirements; to review architecture of existing geophysical information systems;
– to define the required system functionality provide the system functional concept; to design the system architecture.

WP6: Standards for Geophysical Digital Content – Leader: E. Loránd Geophysical Institute of Hungary (H)

– to analyse collected standards/ data models – to provide specifications for their extensions;
– define new standards for GEOMIND and the future. . . ; metadata /header/ measurement data, for data representation/transfer in GEOMIND, for data dissemination, for future data exchange: consortium, third parties.

WP7: Multilingual Dictionary and System Interface Content – Leader: E. Loránd geophysical Institute of Hungary (H)

– to develop mutlilingual content of the project website(s);
– to develop text multilingual content of the GEOMIND user interface, to develop multilingual content for the metadata /header/detailed geophysical data, to develop application for remote edition of the dictionary.

WP8: XML Exchange Standards for Geophysical Data – Leader: Geological Survey of Denmark and Greenland (DK)

– to develop XML exchange standards for geophysical metadata, for geophysical header data, for selected measurement/detailed data;
– to provide XML standards for data transfer – GEOMIND, . . . for data dissemination – GEOMIND,- . . . for future European (global?) data exchange.

WP9: Service Development and Implementation – Leader: Informacines Technologijos (LT)

– to design the GEOMIND information system according to concepts;

− to develop the system prototype; to provide testing of the prototype;
− to develop the final version of the system; to work out the system documentation;
− to deploy the system at the providers' sites; to provide training for system administrators

WP10: Awareness and Dissemination – Leader: Institute of Geology and Mineral Exploration (GR)

− to elaborate the dissemination plan; to disseminate information among potential users and new partners;
− to work out marketing strategy for the dissemination; to execute the marketing strategy;
− to provide web-based information services on GEOMIND; to produce/offer/distribute dissemination materials (www.geomind.eu).

6. Data levels included in GeoMind

− ISO19115 Metadata (General metadata: general description, distribution, quality and data processing information, spatial and temporal extent of underlayed detailed geophysical data);
− Geophysical metadata (Metadata depending on the given geophysical method: header parameters, instrumentation, measuring conditions, etc.);
− Detailed geophysical data (in GeoMind xml format and in supported international standard formats).

Exchange formats will be mostly based on standards. However wherever necessary exchange formats will be developed for the geophysical metadata, and to some degree for detail data (of measurements). These formats shall be used for transmitting data from the national systems and for downloading data, to and from the GEOMIND information system, respectively. The exchange-formats will be implemented using XML (Extensible Markup Language), which is widely accepted as the standard for data exchange on the Internet. The XML standard of metadata will follow the ISO-19115 standard for metadata. XML standards for header data and detail data will correspond to the underlying geophysical methods and thus the basic data model.

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Recently available data types (approved by inventory of national databases in the project) are the following:

Vertical Electrical Sounding (VES); Time Domain ElectroMagnetics (TDEM); Magnetotellurics & Tellurics (MT & T); Gravimetry; Airborne and land Magnetometry, Radiometry & gammaspectrometry data; Seismic exploration data & seismologic monitoring; Well logging; Petrophysical measurements.

7. GeoMind system concept

Function and architecture

System architecture has been built for reliable managing along the aimed functionality of the involved geophysical information in the form defined by GeoMind metadata Profile and General Geophysical Model.

In the usual dataflow (Fig. 2), several organizations will provide their geophysical data through the GeoMind portal. An individual interested in geophysical data will be able to search (textually or graphically) the GeoMind system for types of data available from data providers. Once the user
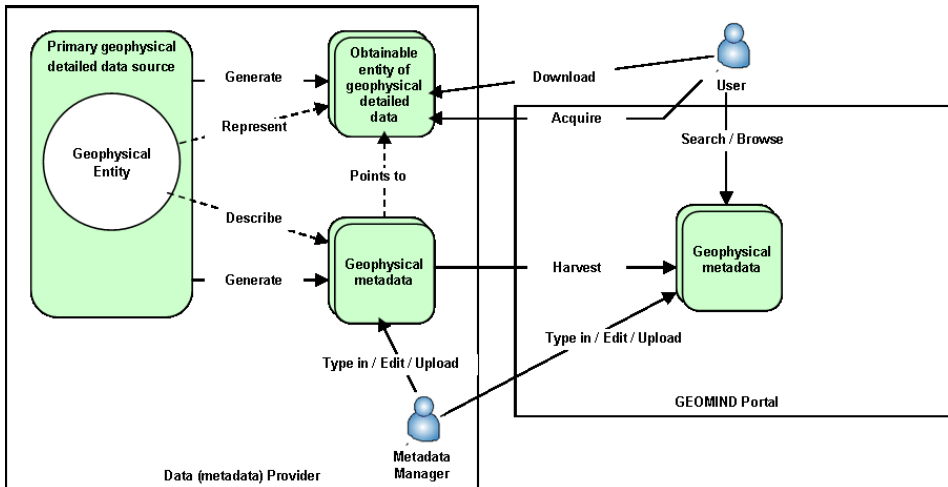

Fig. 2. Dataflow diagram of the GeoMind system.

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has found data he/she will be able to order them by the data provider using the GeoMind portal online tools.

Portal – Data query environment

Internet portal (www.geomind.eu) provides spatial and thematic search against unified metadata repositories, gives information on the availability, the way of distribution and on the quality of the geophysical datasets. The website is an opened WMS/WFS based GIS portal of geophysical datasets from the data provider partner institutions, and from all those, who are willing to join to the system in the future. The developed system architecture allows future extensions by adding new languages to the GeoMind's multilingual facility, defining new data models for data types to be additionally distributed by the system, and new geographic areas, like countries included into the current data supplier community.

Multilingual functionality

The multilingual (cross-border) approach of the GeoMind project and its outcomes is emphasized. The launched Geomid portal prototype recently could be reached in 10 different languages of current participants and in English. Multilingual support covers system interface, GeoMind metadata profile, and hierarchical geophysical thesaurus with independent usability. Thesaurus supports interactive translation of any textual geophysical content out of the system too. An interactive tool, the WRTranslator (see Fig. 3 bottom and Fig. 4) is developed for online preparation and maintenance of the multilingual textual system elements. This utility allows easy future extension by adding any other languages (as well as other data providers) from new countries.

Metadata Editor – Data preparation tool

MetadataEditor (see Fig. 3 top) is the core tool for providers to manage geophysical metadata & detailed data of their own repositories for standardized transfer to the central metadata catalog system in the background of GeoMind portal. MDEditor manipulates on the geophysical contents hold in GeoMind standard XML structures. It provides functions for interactive data editing at the client side and bulk data uploading as well. The user interface of the MDEditor is also multilingual and can be extended with new languages at any time by using WRTranslator.

Internal data representation – GeoMind XML exchange standards

Data models have been developed for the geophysical metadata, header data and detailed data as internal standards using XML (Extensible Markup Language) which is widely accepted as the standard format for data exchange on the Internet. GeoMind internal metadata standard established by removing optional elements and including general mandatory part of the ISO-19115 with extension by special components describing geophysical issues (see Fig. 4). These standards are used for transmitting the geophysical data from the national systems to the GeoMind information system and for downloading data from the system. These standards are planned to use in possible future data exchange between the participants, or third party institutions as well.

8. Geomind Portal Prototype

The following is the complete list of the major functional modules of the Geomind Portal (and their current state):

- User Management Module (CRM) including Administration: Complete;
- Multilingual Thesaurus Module: Complete;
- Metadata Management Module: Beta Version;
- Metadata Ordering and Delivery Module: Pending;
- Automated Metadata Harvesting Module: Alpha, Pending.

Previously created CS-W module of Metadata Editor will be integrated in Portal as Metadata Harvesting module. Fig. 5 displays the screenshot of the Geomind Portal front page.

9. Expected results

- The final result of the project will be the new GEOMIND *information system*, offering public access to various geophysical metadata, header data and detailed data sets in a multilingual, cross-border and unified way.
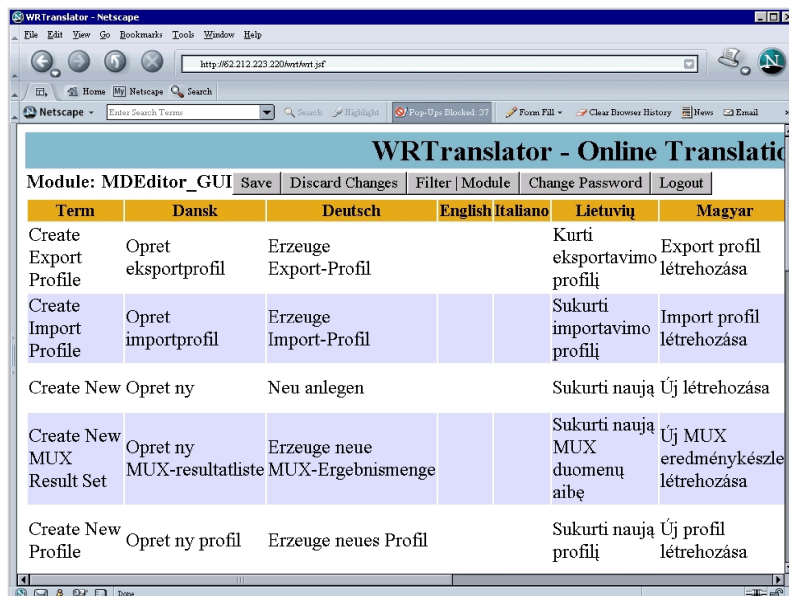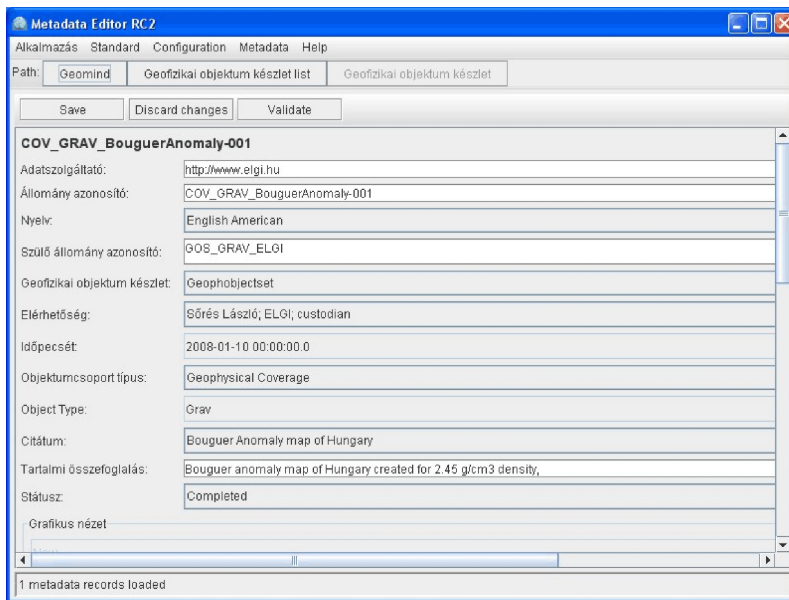
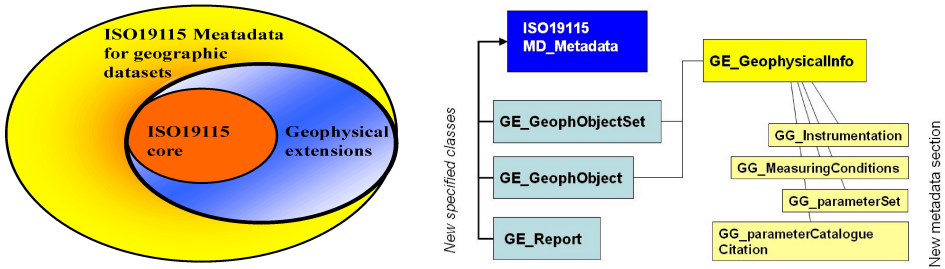Fig. 3. MetadataEditor and WRTranslator (with Hungarian UI).

Fig. 4. ISO-19115 metadata standard extension concept and Geophysical MetaData Model.

Fig. 5. Screenshot of the Geomind Portal front page.

- Other final results of the project will be newly elaborated (or extended) standards of representation of geophysical metadata, header data and detailed (measurement) data, including XML exchange standards of those data.

- A remarkable part of the intermediate project results, may be utilized

within other initiatives of development and integration of national data at the international level, especially within the EU.

- It is expected that the GEOMIND project, with its results, will essentially contribute to cross-border, multinational use of underlying geophysical data resources, providing modern and universal infrastructure of their electronic dissemination.

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10. Conclusion

The final implementation of GeoMind system and the public dissemination of the service are the main current activities in the project. It is expected that the results of the GeoMind project will essentially enhance the cross-border, multinational use of geophysical data resources. The project will contribute to the development of the European Spatial Data Infrastructure (INSPIRE) and is supposed to assist communication and collaboration of different European countries.

The portal (www.geomind.eu) will be maintained after the completion of the implementation of the project. The first organization taking care of it will be the Geological Survey of Denmark and Greenland (GEUS). Thus European geophysical data will be effectively applied, processed and interpreted for a wide variety of such purposes as exploration for mineral resources and groundwater, studying environmental features for spatial planning, construction works or detection of potential geohazards, various research projects as well.

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