

## **GEOPHYSICAL MULTILINGUAL INTERNET-DRIVEN INFORMATION SERVICE (GEOMIND)**

**Artemios ATZEMOGLOU<sup>1</sup>, Alexandros SAVVAIDIS<sup>2</sup>, Efstathios TSIRAS<sup>2</sup>, Eleni ZARGLI<sup>2</sup>  
and GEOMIND Team<sup>3</sup>**

### **ABSTRACT**

Different geophysical databases exist in European countries, both in public and private organisations. They are dispersed and have various standards and languages applied. Thus their usefulness and availability are limited, although geophysical information may be very effectively applied, processed and interpreted for a wide variety of purposes: exploration for mineral resources and groundwater, studying environmental features for spatial planning, construction works or detection of potential geo-hazards, fresh water exploration and protection, research studies etc. Processing will be enhanced if these databases are integrated in a certain level and accessed via the Internet, offering cross-border, European-wide, unified electronic services, making geophysical data much more available. Therefore an Internet-driven multilingual information system (GEOMIND), integrating geophysical data coming from national data holdings, is being proposed to be designed, developed and set up, developing also metadata and data representation standards. The system will be addressed to local and central authorities, prospecting companies, research and education institutions and citizens.

Keywords: geophysical data, geophysical database, national data holders, Internet

### **INTRODUCTION**

To determine the scope of datasets it seems to be reasonable to identify specific needs in term of cross-border and international accessibility and usability of geophysical data among stakeholders and potential users. An essential preparatory phase of the project is to make an inventory of national geophysical data resources, availability of their content, together with detailed description of geophysical metadata, header data and detailed measurement data models or national standards. To make the system really usable, we have to take the legal implication in consideration, which determines the practice of dataflow. For this reason an overview of each national legal system with regard to geo-scientific data is prepared in order to analyse the current practice of data dissemination in the participating countries. The results of the preparatory phase, the analysis of the present practice and the present infrastructure of national geophysical information systems, including payment functions will determine 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. To

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<sup>1</sup> Institute of Geology and Mineral Exploration (IGME), Branch of Thessaloniki, Greece [matzem@thes.igme.gr]

<sup>2</sup> Institute of Engin. Seismology and Earthquake Engin.(ITSAK), PO Box 53, GR-55102, Thessaloniki, Greece [alekos@itsak.gr]

<sup>3</sup> PGI(PL), CGS(CZ), ELGI(HU), GCX(SK), GEUS(DK), GGA(DE), GLD(IT), GSSR(SK), ITG(LT) and MGL(CZ).

ensure a real publicity in a cross-border sense the GEOMIND information system will be multilingual. The languages will be English and the national languages of the members.

Exchange formats will be mostly based on standards. However wherever necessary exchange formats will be developed for the geophysical metadata (of datasets), header data (of measurements) 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.

## METHODOLOGY

In order to supply the GEOMIND consortium partners with information to understand geophysical data needs of potential of the GEOMIND portal a web survey was introduced. This survey identified the specific needs in terms of cross-border international accessibility and usability of geophysical data resources and also if those needs could be fulfilled by the establishment of a service providing accessibility via the Internet to a seamless multilingual information system that integrates geophysical data. Additionally gathered valuable input to be taken into consideration in developing the data service, in order to fulfil the highlighted user needs.

A list of 200 potential users was created in over 150 different companies and organizations and was further contacted. A total of 63 users replied and completed the survey. Among other obstacles on geophysical data availability users noted:

(a) A big delay is caused because government agencies require a written request for a particular data set. The agency will then review the request and decide whether they will release the data to the purchaser. Additional to that, some data the government agencies possess are still private even though the data had been collected several years ago.

(b) A lot of time is being spent from users to convert data or metadata information from one format to another. A standard format of every type of data, wherever is that possible, should be adopted and will eliminate this problem.

(c) In many cases incompleteness of the data is remarked. Extra-geophysical information, like petrophysical properties of rocks or accurate geographical locations of geophysical data sets, is some time incomplete or missing.

The GEOMIND portal should try to streamline the procedure of providing data and particularly in the areas of authorizing data dissemination, data format and extra-geophysical data.

The main goal of the GEOMIND project is to increase the availability, use and distribution of the European geophysical data by offering cross-border, European-wide, unified electronic services, making geophysical data much more available. Therefore an Internet-driven multilingual information system, integrating geophysical data coming from national data holdings, will be designed, developed and set up. Metadata and data representation standards, will also be developed wherever is considered necessary to support further integration and dissemination of European or global geo-information holdings.

### **Brief inventory of national geophysical digital data resources.**

The objective of the brief inventory of national geophysical digital data resources, supplied by geological surveys, research institutions, private companies and other data providers, is to describe available data for GEOMIND project in these partner institutions.

An overview of geophysical digital data resources with list of methods and data quantity was made. In the first phase institutions from Czech Republic, Denmark, Germany, Greece, Hungary, Poland and Slovakia were contacted via questionnaire.

More precisely, among GEOMIND partners there are 10 data providers from Germany, 2 data providers from Denmark, Poland and Slovakia and 1 data provider from Czech Republic, Greece and Hungary.

The system will be addressed to local and central authorities, prospecting companies, research and education institutions and citizens. So the system will demonstrate research capabilities of the partners and will increase public awareness of the usefulness of geophysical research methods for various needs of the society.

The GEOMIND system is planned as open-system:

- other institutions and datasets can be added in the future.
- other institutions and datasets can be added in the future and will be also included into next steps of the project, especially to specialize standards for geophysical digital content.

Preliminary results of geophysical methods in the inventory are those which include among else gravimetry, airborne magnetometry, airborne radiometry, DC soundings, 2D seismics, Borehole logs, Seismologic monitoring data etc.

Further step could be a next version of inventory questionnaire based on ISO-19115 standard for metadata about geophysical datasets together with header data form for each method.

### **Brief inventory of national and international legal regulations.**

The aim of this inventory was the analysis of national and international legal regulations in order to detect possible legal barriers for international geophysical data dissemination through an Internet-driven Information System GEOMIND. However, there are a number of national-level privileges, giving special rights to information access for bodies like state institutions or local authorities. Such privileged access to geoscience information will need to be dealt with on a national level rather than on an international one.

The objectives of the brief inventory of the legal implications were:

- a) to prepare an overview of the national legal systems with regard to distribution of geo-scientific data to the public in the participating countries;
- b) to analyze the current practice of geophysical data dissemination in the participating countries;
- c) to provide a brief review of international legal regulations concerning dissemination of geophysical data;
- d) to detect legal or organizational difficulties existing in the cross-border distribution of geophysical data;
- e) to provide specifications, based on existing legal regulations and organizational procedures, for the information system to be developed and for the scope of data to be addressed by the new services.

The synthesis of national legal regulations, based on the national reports, has two components added:

- a) Extended description of Intellectual Property Rights legal issues, in the context of geophysical data;
- b) Review of international legal acts concerning public dissemination of environmental and/or geoscience information.

### **National regulations and procedures of geoscience data dissemination**

The geological and/or mining law, called briefly Law on Underground, Geological and Mining Law, Mining Act, Geological Law etc. defines the scope of activity of a national geological survey, specifies rules and requirements for geological works, states rules of ownership of geological information, sets obligation to supply geological information to geological survey, defines general rights to access geo-scientific information. It also specifies detailed procedures of storage and dissemination of geoscience data.

Law on environmental information states the public access to environmental information. Definitions are not always precise and are subject to various interpretations; exclusions are also made to obligations to make the environmental information public.

Law on public access to information is intended to provide for the transparency in the activities of public institutions.

National laws on protection of databases allowing the database producer to extract and use the database content.

National laws on intellectual property rights (IPR). They protect results of creative activities like artistic creations, articles, trademarks, patents, designs and software. Particular national regulations on IPR would differ very widely from each other. Among the issues related to the GEOMIND system, the following may be regarded as compositions protected by IPR: a) interpreted geophysical measurements; b) oil and gas-related data of professional secrecy; c) environmental data if someone has the intellectual rights to the data. In all participating countries in the GEOMIND project, geophysical data (e.g. metadata) which is not interpreted, published, confidential and their rights do not belong to private investors can be disseminated and obtained.

### **Ownership of geoscience information**

Slovakia (SK). The owner of geological information is the Ministry of Environment and the Geological Survey of the Slovak Republic (GSSR) is responsible for geological and geophysical data collection and dissemination.

Lithuania (LT). Geological information belongs to the state and each geological data, including private one, must be delivered to the Geological Survey of Lithuania (LGT)

Czech Republic (CZ). The state-paid geophysical databases belong to the Czech Geological Survey (CGS) and Geofond. CGS and Geofond are allowed to extract or re-use the whole content of the databases, for their own use or for other persons or authorities.

Denmark (DK). Data collected by the Geological Survey of Denmark and Greenland (GEUS) is owned by the survey.

Germany (D) and Hungary (HU). Information ownership belongs to the person or company that has paid for the survey.

Greece (GR). Ownership of the data is subject to aforementioned copyright rules, especially should such data be created or collected by private bodies or on behalf of them. Also public authorities may provide for copyright claimers and make the access to geoscientific information subject to prior permission. In general, however, access and further dissemination of public information is subject to aforementioned Laws on access to public or environmental information and re-use of public information in case such data is created or held by public authorities

Italy (I). Ownership to geophysical data is permitted by public agencies that acquire geophysical data free of charge, with the condition that the data cannot be sold for profit.

Poland (PL). The State is always the owner of the information, unless the data provider, who financed the geological works, is the owner of the data.

### **Data confidentiality**

A typical case is that a data supplier (to a geological survey) is allowed to make a restriction to forbid dissemination of those data outside the geological survey, even if the data are becoming a state property once supplied. Such a restriction is typically limited in time (CZ, DK, HU, PL, and SK). In Germany, the access to data may be restricted being in accordance with international legal regulations. Metadata are free. Detailed data are only open with acceptance by the owner.

### **Responsibility for data quality and completeness**

No specific legal regulations concerning quality of geoscience data being disseminated by national geological surveys. A data supplier is responsible for the source data quality.

### **Legal rules and data dissemination**

No legal obstacles suppressing international dissemination of geophysical data have been found in participating countries. The geophysical data can be disseminated after a written request (DK, HU, SK, GR) or via the internet (CZ, D, HU, PL). In Poland, however, the geophysical data dissemination is restricted to the metadata itself. In the Czech Republic the access via the Internet enables finding only basic information on geophysical data (location on the map) but not the data itself.

### **Current data dissemination procedures**

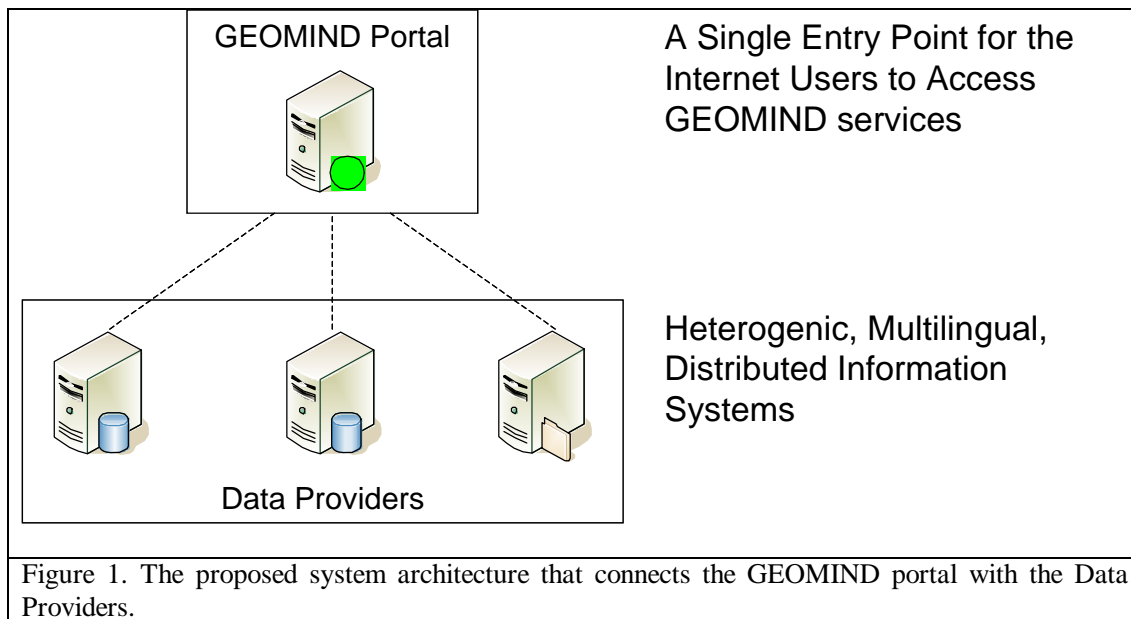
In all the countries involved, there are public Internet services providing geophysical index data free of charge.

In the Czech Republic, the CGS and Geofond are responsible for developing a common Internet portal as a single user access point to geo-scientific data. In Greece, ITSAK provides data and metadata through the web. In Denmark, there are two main databases containing geophysical data: GERDA and SAMBA. The former is a system for management of environmental geophysical data and the latter is GEUS' central database for oil and gas exploration, production and research-data. GERDA is the Danish national database for shallow geophysical data. In Germany, there are different federal and state activities for dissemination of geo-referenced data owned by the federal and state authorities. Exploration data of the oil and gas industry are stored in a hydrocarbon information system (FIS KW) at the Hydrocarbon Information and Data Exchange Center. Geophysical measurements conducted by the GGA institute and other project partners are stored in GGA's geophysics information system (FIS GP). In Hungary, the client, after a preliminary inquiry, orders the data in written form from the Geological Survey of Hungary. At the Polish Geological Institute (PL) access to detailed geoscience data, being a state property, requires a written application to the Head of the PGI. Metadata concerning geoscience information are disseminated for free, using Internet whenever possible, which is in fact being currently made by the PGI to some extent. Geological Survey of the Slovak Republic is authorized to execute the state geological service and design the geological information system. In most countries all state-owned data are available free of charge. In Poland an applicant is requested to supply a proof of payment for the data. The Polish Geological Institute is allowed to charge only for extra services required for data supply, if they are not funded otherwise. In Germany access to data of public ownership is available free of charge for all state bodies or authorities. In all other cases, users have to pay for the service. In the Geofond (CZ) the service charges are based on the official Price List for Works and Services, being publicly available on the Internet (the unit price for geophysical data is usually price per 1Mb of data). The price does not include the price of information, only cost of the service (selection of relevant data from database etc.). In Denmark, payment is made according to the invoice. In Germany costs depend on the individual case of the data request. In Slovakia, service charges are specified in the list of prices of the Geological Survey. Finally, in Hungary, the service fee is calculated on the base of laid down list of unit prices. The sum depends on the working hours and quantity of data.

## **SYSTEM CONCEPT**

The proposed system will be composed of two main components as described in Figure 1:

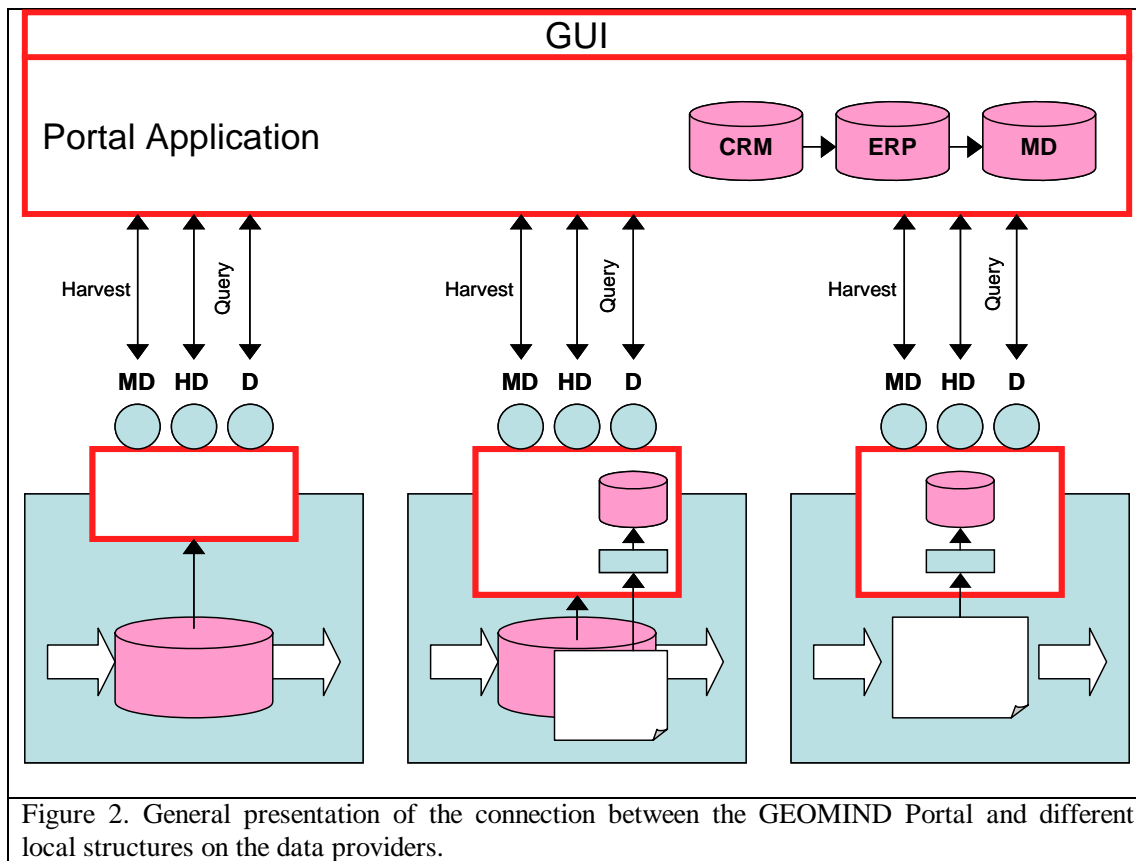
- The major central component, containing the multilingual portal with the GIS facility, geophysical metadata and header data base, multilingual thesaurus with its database, textual system website with descriptive information on the GEOMIND project and the system;
- The minor local components, providing communication (including geophysical data transfer) between the central component and geophysical databases, located at the data supplying institutions.



Each of selected data sets will be made available through the GEOMIND system on one of three levels of availability:

- Metadata level, allowing a user to detect and locate the data set, and to get acquainted with its general content and spatial extent; the user will be informed on the procedures required to obtain the measurement data from this data set; the metadata will be available through GEOMIND;
- Header data level, showing spatial locality (by means of GIS) of each geophysical survey recorded in the data set, and offering basic information of those surveys, their technology, year of provision etc.;
- Detailed (measurement or processed) data level, offering results of the geophysical measurements themselves; those detailed data will be charged and be available according to national regulations concerning the data set given.

Depending on the structure of the data available to each data provider one of the models presented in Figure 2 will be applied. The portal will have access to already established data base structures or structures that are partially based on database but also to simple files, or to simple file structures.



The system will offer a wide variety of procedures of online data ordering, supporting nationally set structure of charges. Whenever appropriate, an online data supply will be offered, providing online payments of the supply charges. The data exported from the system on the user's request will be standardized, with translatable content provided in the language selected by a user.

The developed system architecture will allow future extensions by adding new languages to the GEOMIND's multilingual facility, new thematic groups of data distributed by the system, and new geographic areas, like additional countries, to the current data suppliers.

The structured abilities of users of the GEOMIND portal are presented below and a diagram of the order procedure is presented in Figure 3:

1. All users will have the ability to Search for Geophysical Data through:
    - a. Alphanumerical Search
      - i. Simple
      - ii. Advanced
    - b. Spatial search
  2. Further to that to browsing meta- and header data :
    - i. List search results
    - ii. Detailed meta- and header data view
    - iii. Display meta- and header data location
    - iv. Drill up/down to related meta- and header data in hierarchy
  3. Directly Download Data if they are Freely Available
- Or
4. Order Geophysical Data (ONLY for Registered Users)
    - a. Select Data for Ordering
    - b. Review, Refine & Place Order
    - c. Respond to Ordering Workflow Requests

- d. Download Data
- 5. Process Orders (Organization User)
  - a. Respond to Ordering Workflow Requests
  - b. Prepare & Place Data (Optionally)
  - c. Confirm/Reject Orders

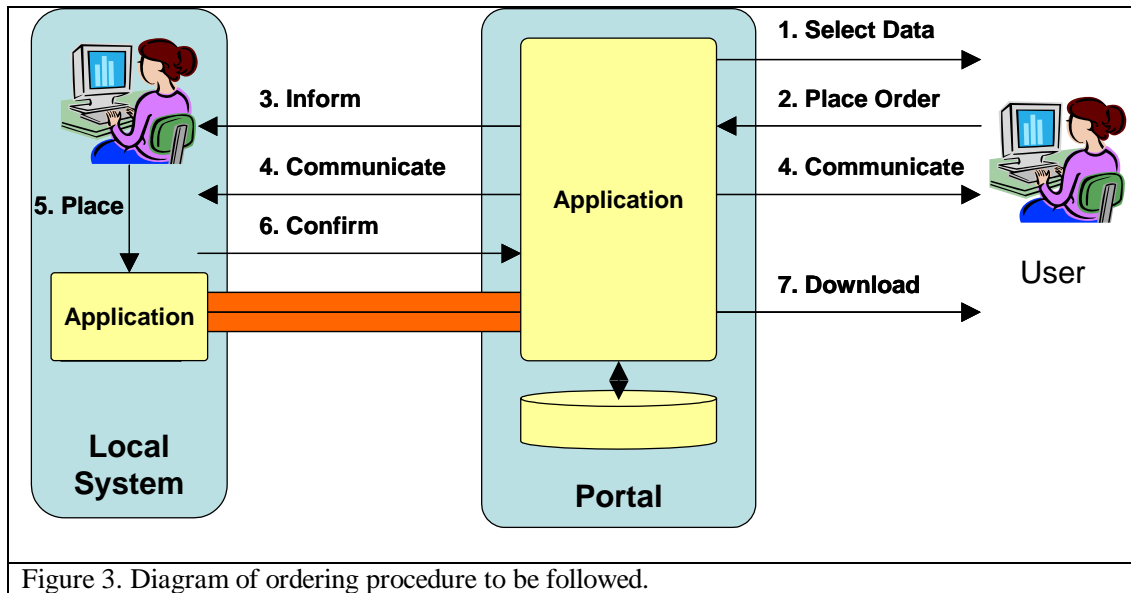


Figure 3. Diagram of ordering procedure to be followed.

## DATA SOURCES

The data sources or geophysical data sets, to be supported by the project throughout its duration, are at command of the project consortium members. In some cases, additional national data resources may be taken into account, if easily available at the national level. Thus, the geophysical data sets addressed by the project will come from 7 European countries, namely: Czech Republic, Denmark, Germany, Greece, Hungary, Poland and Slovakia. Most of the data holdings referred is 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.

The geophysical data addressed are stored mostly in separated databases, which structure may vary from country to country. However, the core part of the data structure, composed of attributes like numerical results of measurements or locality information, is expected to be rather consistent. The quality of information stored may be diminished mostly by using various, national or local coordinate systems. This fact will require to apply on-the-fly conversion facilities, included in the system.

### Analysis of Local Data Structures and Data types

A questionnaire to investigate local database structure and data formats was created. The forms were distributed to all GEOMIND members. The resulted reports are under consideration. Structural reports are used to selected data types to be supported and find the common solutions for the GEOMIND data model.

To be able to provide geophysical information in a relatively uniform way the classification of local data types is required. To establish a common practice in terms of parameter usage, structures and data content local data type must be analyzed. The focus of the analysis is on the header and metadata



content of different data types. Analysis of local data types will be based on three different data type categories and are presented in Table 1.

Table 1. Analysis of local data types

<b>Data Type Category</b>	<b>Hierarchy Level</b>	<b>Metadata Level</b>
Measurement <sup>1</sup>	GraphObject	Feature
Model <sup>2</sup>	GraphObject	Feature
Geophysical Object <sup>3</sup>	GraphObjectSet	Dataset

<sup>1</sup>ves, tdem, seismic profile, seismic field data, gravity, magnetometry ...

<sup>2</sup>ves-tdem 1D models, stacking velocity data

<sup>3</sup>Airborne radiometry grids, shapefiles (digitized), tomographic velocity grids (generated), printed maps

## **DISSEMINATION OF INFORMATION**

IGME (Greece) is the work package leader and coordinates the dissemination and marketing activities. All other partners take and will take part in actions in order to disseminate the results to regional authorities, institutions, universities, professionals, engineering and environmental companies. Activities are: (1) Web-based activities (website) aiming at disseminating the knowledge and technology produced. The project web page ([www.geomind.eu](http://www.geomind.eu)) has been established in month 3 and contains detailed information on project, have links to related networks and projects. Through the website the partners can easily share files but also opinions as well in the electronic forum. The website provides also public files and information to the visitor (Presentation of the project, Deliverables etc.); (2) Participation in conferences organized within the framework of similar projects (already presentations are being prepared for EAGE Conference in London, ICEGE in Thessaloniki and other geophysical associations are being prepared); (3) Scientific publications in journals and conference papers; (4) Workshops and seminars that will aim to introduce GEOMIND to potential users, will be conducted by all the project partners of GEOMIND in nine countries all over Europe.

In the context of dissemination and awareness, a Business Plan and a Marketing Strategy will also be outlined.

The characteristics of the market, pricing issues, the characteristics of the project and the actions that the participants of the consortium have to undertake in order to promote the dissemination of information regarding the project (Marketing Strategy), are the subjects that the Business Plan is dealing with. This will also help the partners of GEOMIND that are willing to sell their data, to take decisions on crucial matters such as pricing and competition. In order to do so we can use the potential user analysis to deduct the needed assumptions.

Overall we can state that the GEOMIND Project is designed and composed of two main components: the major central component (deployed at one site) and the minor local components (set up at the data suppliers' sites). The maintenance of the local components, and their possible development to support new data sets, will be up to the data suppliers, interested to disseminate the data at their command. As for the maintenance of the central component it is agreed that it will be maintained by one of the project's participants, Geological Survey of Denmark and Greenland, for 5 years after the project's completion. This covers up the greatest portion of the arising costs and in the long run guarantees the viability of the project for the next 5 years after the completion of GEOMIND. Any remaining cost will be met with the resources of the members of the consortium.

## RESULTS

The up to now final results deal with the inventory of the national legal implications and could be presented as followed:

- No legal obstacles for international dissemination of geoscience data have been detected.
- The planned system functionality is in line with overall EC policy regarding dissemination of environmental data and providing access to public data holdings, using electronic means of data distribution.
- National regulations, concerning geoscience data dissemination, have many similarities, although specific differences have been also detected, regarding mostly data access restrictions or special access for privileged groups of users.
- The data access restrictions, based on national legal regulations, have to be respected by the GEOMIND system; to provide on-line data delivery, the restricted data have to be digitally identified on the level of national databases.
- The privileged access to data for specific groups of users is of a national nature, and should not be supported by the GEOMIND system.
- The system should provide as much geophysical data as possible.
- Whenever access to geophysical data requires special formal procedures, the system users have to be informed of the procedures and contact points.
- The system should be transparent, providing data quality information, information on data producers and suppliers, as well as description of the procedures applied to produce the digital data being offered.
- Names of authors of source geoscience information should be provided by the system.
- The current national procedures of geoscience data dissemination are different; electronic on-line data ordering and supply procedures are well developed in certain countries only.
- The possibility to support off-line data ordering by the system should be considered, if reasonable in case of a given country.
- The decision of making particular parts of national data holdings available through the GEOMIND system should be up to national geological surveys.
- The pricing policies for data and supply services should be defined on the national level and agreed with legal bodies being supervisors of national geological surveys; the proposed scope of geophysical data, provided by the system, should be accepted by those bodies.
- The decisions and specifications of procedures of data electronic ordering and supply should be up to national geological surveys.
- In case of uncertainties regarding Intellectual Property Rights associated with geoscience data to be disseminated, an additional legal expertise on the national level is recommended. Each participating survey should guarantee that the data supplied for dissemination are legally flawless.
- An international agreement for the GEOMIND system maintenance is strongly recommended.

Intermediate results of the project will be the application or newly elaborated (extended) standards of geophysical metadata, including XML exchange standards of those data.

The main 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.

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