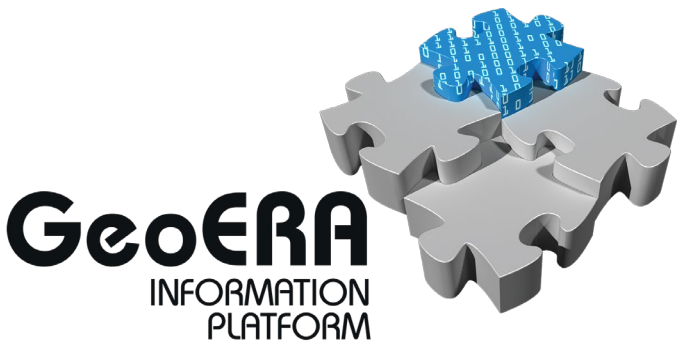

Deliverable 2.2.1

First report (M6) describing the requirements to the Information Platform by the GeoEnergy, Groundwater and Raw Materials themes.

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Approved (Coordinator)	30/01/2019	Jørgen Tulstrup

1 GENERAL INTRODUCTION

1.1 Background

The GIP-project is established to support the 14 scientific GeoERA projects in organising, disseminating to external users and safeguarding the results of their research in terms of geospatial data, reports and unstructured data.
This will be done by extending the current European Geological Data Infrastructure (EGDI) developed by member of EuroGeoSurveys.
EGDI already contains data and services from projects that are independent of GeoERA and this situation will remain. The development procedures that will be implemented in the GIP-project must take that into account.
In the GIP-project there will be several institutions involved in the development of components of software and these components will in many cases be interrelated. Furthermore, the development activities will take place under several Work Packages. A close coordination of these activities is therefore necessary.

1.2 Scope and purpose

The scope of this report consists in listing and describing whenever possible the requirements and expected functionalities of the webGIS platform made by the 14 GeoEnergy, Groundwater and Raw Materials projects. They were harvested using 2 questionnaires, a workshop and direct contacts with the projects. Despite the effort made by all the actors (liaison team, projects managers, IP projects leaders) this report should be considered as a preliminary one. Most of the thematic projects are at an early stage and are mainly working on the scientific contents. Therefore, they did not define yet their targets in terms of information technology.

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2 Definitions

Products: information that results of a project and will be delivered to the IP to make it available to end users. Several types of information:

- "GIS data": raster and vectors (ESRI shapefile, GRID, etc.).
- Web services: WMS, WFS and ATOM.
- Documents: PDF, text files, images, papers, etc.
- Other data: XLS, CSV, TXT, etc.

Flagship product: product identified as representative of the project.

Input data: information collected by the different WP in order to produce their products.

Georeferenced documents: documents which refer to a geographical location and which position can be displayed on a geographical viewer or used to make them discoverable through a spatial selection.

Basic EGDI Functionalities:

- Search: allows the user to search for spatial information and documents. It is intended that the search integrate the spatial and alphanumeric search (words and / or themes);
- zoom in/zoom out;
- pan;
- table of content: is a panel listing the different layers, used to turn on and off the display of each layer, as well as the display order;
- identify: allows the identification of each record (polygon, line, point or cell). Users can see corresponding attributes and attached files (pdf, png, jgp etc.) linked to a feature;
- measurement tool: allows to measure distances;
- show coordinates: is a panel showing the coordinates of the mouse pointer and the projection system;
- overview panel: allows user to locate themselves in the general view;
- download: allows the user to download once the export format is selected.

3 Groundwater projects

3.1 RESOURCE project

Aim data collection/generation: characterize Karst and Chalk aquifers and assess 3D structure of aquifers in terms of the water volumes, fluxes and quality

The information reflected below has being extracted from the following documents:

- Proposal;
- GIP WP2 Questionnaire (October workshop);
- Deliverable 6.1: "Template that can be used by all participating surveys to collect the required data ";
- Draft of Data Management Plan (03-12-2018);

3.1.1 Products

WPs	DATA TYPE	DELIVERY FORMAT to GIP-P
WP3 H3O-PLUS	Documents	Not yet defined
WP4 TRANSFLUX		
WP5 CHAKA		
WP6 PAN-EU GW RESOURCE MAP	***Pan European groundwater resources map***: multiple layers of information specifying lithology, depth and extent of Aquifers and Aquitards	ESRI shapefile + Excel file

3.1.2 Input data

3.1.2.1 WP input data

WPs	DATA TYPE	FORMAT	GEOMETRY
WP3: H3O-PLUS	Groundwater composition and age	Database and 3D Maps	No yet defined
	Cross-border Patterns of Groundwater depletion and recharge	Database and 3D Maps	
WP4: TRANSFLUX	Geological and hydrological data specifying delimitation of aquifer (thickness, depth, groundwater flow directions and flux)	No yet defined	
WP5: CHAKA	Hydrological dataset for numerical modelling		
WP6 PAN-EU GW RESOURCE MAP	Multiple layers of information specifying lithology, depth and extent of Aquifers and Aquitards. See table 1.2.2 for attributes	ESRI shapefile + Excel file	Polygon (each one 10X10 km)

Semantic and geometrical harmonization is expected for the Pan European groundwater resource map, nevertheless some of the following attributes are referred to national thresholds.

3.1.2.2 Collected attributes for the Pan European groundwater resources map

Main layer

Name of the attribute	Description	Unit	Data type
cell-id	**Unique identifier** for each grid cell.	NA	
Altitude_surface_level	**Average altitude** over the grid cell relative to the EU height reference level EVRF2007 (European Vertical Reference Frame).	meters	number
GW_level	**Average depth to the groundwater level** (depth of	meters	number

Name of the attribute	Description	Unit	Data type
	unsaturated zone) below the surface level.		
Label_dynamic	Label describing **dynamics of the groundwater level.** S=Static, K=Karst systems with seasonal groundwater level fluctuation, R=Recovery after mining, P=Groundwater depletion by pumping	NA	text
GW_level_amplitude	**If the groundwater level is dynamic, the amplitude**	meters	number
Unsat_lithology	Simplified **lithology** of the unsaturated zone	NA	text
Total_depth_active_layers	This indicates **the maximum depth of the layers** that are defined are of importance considering the fresh water volume**.**	meters	number
Label_maximum_depth_active_layers	In this column you can indicate **what is used as a label for the maximum depth of the active layers.** H=Hydrogeological boundary, C= Based on chloride concentration T=Based on TDS concentration E=Based on EC	NA	text

Rest of the layers

Name of the attribute	Description	Unit	Data type
cell-id	**Unique identifier** for each grid cell.		
LX_top	**The height of the top of the layer** in reference to surface level	meter	number
LX_bottom	**The height of the bottom of the layer** in meters below surface level.	meter	number
LX_aquifer	If layer **is an aquifer**	NA	text (Y/N)
LX_aquitard	if the layer is an **aquitard**	NA	text (Y/N)
LX_lithology	Description of the simplified lithology	NA	
LX_extent	**Percentage of the cell that is covered by the layer.**		number
LX_Confidence_label_delineation	Describes the **confidence level of which** about layer **depths and extent** EJ = Expert Judgement,	NA	Text

Name of the attribute	Description	Unit	Data type
	MOD = Based on subsurface model, BH = Based on boreholes		
LX_Porosity	Porosity indicated with two decimals		number
LX_kh	Horizontal conductivity in m/d	m/d	number
LX_KV	Vertical conductivity in m/d	m/d	number
LX_Confidence label_hydraulic_parameters	Indicates the c**onfidence level** of which the **hydraulic parameters.** EJ = Expert Judgement, MOD = Based on subsurface model, BH = Based on boreholes		
LX_Paleo	indicating if the **groundwater in the layer is Paleogenic**	NA	text (Y/N)
LX_Artesian	Label indicating if the **aquifer is confined/unconfined/Confined artesian** (C, U, CA).	NA	text
LX_Thermal	Label indicating if the **aquifer is (natural) thermal** or not	NA	text (Y/N)

3.1.3 Functionalities

1. Basic functionalities
2. Advance functionality requested: as the Pan European groundwater resources map is expected to be developed in 2.5D, possibility of making cross-sections in specific locations.

3.1.4 Issues and further clarification needed

Regarding the Pan European groundwater resources map some questions must be clarified in the coming months:

- How many of the attributes collected will be part of the product delivered to the IP.
- Define clearer 2.5D and cross-section visualization functionality. It is recommended that RESOURCE project joins the future conversations that is going to be held about 3D.

For the whole project

- Confirm that WP3, 4 and 5 are not going to deliver any “GIS Data” or web services product to the IP.
- Clarify if the documents delivered to the IP will be georeferenced documents, as some of them refer to specific cross-border locations.

3.2 VoGERA project

Aim data collection/generation: protecting the quantity and quality of groundwater resources against deep energy related activities.

The information reflected below has being extracted from the following documents:

- Proposal;
- Minutes from 30 November 2018 meeting held in Brussels, Belgium (03-12-2018);
- Draft of Data Management Plan (03-12-2018);

3.2.1 Products

During the meeting of the 30 November it was highlighted that VoGERA will use data (generally from pilot studies) for reports but the data will not be open. Therefore, no GIS data or web services will be delivered to the IP as products. **All products will be documents (reports, deliverables etc.)**

3.2.2 Input data

3.2.2.1 WP input data

WPs	DATA TYPE	FORMAT	GEOMETRY
WP3: Process understanding	- Fault zones - Boreholes - Physico-chemical data: stable isotopes, time indicators temperature - Geophysical methods - 3D models	Excel access databases, LAS files	Not yet defined
WP4: Conceptual framework for vulnerability characterization	- Models - Vulnerability maps	ESRI ArcGIS	

Semantic and geometrical harmonization is expected.

3.2.3 Functionalities

1. Basic functionalities
2. Advance functionality requested: possibility of developing a web tool based on a vulnerability methodology by the IP team.

3.2.4 Issues and further clarification needed

- Clarify if the documents delivered to the IP will be georeferenced documents as some of them refer to specific cross-border locations.
- A teleconference should be established between VoGERA and GIP-P (WP6) to learn more about the required functionality (input data types, output formats) and whether it is feasible to implement it.

3.3 HOVER project

Aim to link the geological settings and hydrogeological processes to the natural quality of groundwater and to the risk of transfer of anthropogenic dissolved elements to aquifers.

The information reflected below has being extracted from the following document:

- Proposal
- Draft of Data Management Plan (03-12-2018)

3.3.1 Products

For the time being, no flagship product has been identified. The project is carrying out a survey to know which type of data are available among the different partners. At this point, the only clear products are the deliverable documents included in the proposal.

3.3.2 Input data

3.3.2.1 WP input data

In the following table, proposal deliverables that are not documents are summarized. Since no flagship products have been identified, they are included in this section in order to provide an idea of the different outcomes that the project may lead to. Regarding semantic and geographical harmonization, a relative homogeneity of the data is expected.

WPs	DATA TYPE	FORMAT
WP3: Hydrogeochemistry and health	D3.1 Database for concentrations of dissolved elements and associated parameter to define thermal and mineral water Boreholes to define	Not specified
	D3.3: Database for concentrations of elements of natural origin per typologies	
	D3.5b: European exposure maps of selected elements (and indicators)	
WP5: Nitrate and pesticides transport from soil to groundwater receptors	D.5-1: Atlas of geological/hydrogeological settings Vulnerability maps	Not specified
	D.5-5: Maps of groundwater-N travel time	
WP6: Groundwater Age Distributions and residence times in European aquifers ("GADIS")	D.6-1a: Database for concentrations of groundwater age indicator sand vulnerability classes	Not specified
	D.6-1c: Maps and cross sections showing distribution of groundwater age and vulnerability classes in selected European aquifers.	Web service
WP7: Harmonized vulnerability to pollution mapping of the upper aquifer	D7-5: Maps and cross sections showing vulnerability of the upper aquifer to pollution.	WMS/WFS/atom feeds
WP 8: Effective monitoring of emerging contaminants (EC)	D.8-4. GIS-layers on the selected ECs (EGDI)	Web service

3.3.3 Functionalities

1. Basic functionalities

2. Project express the need that some parameters could be accessible.

3.3.4 Issues and further clarification needed

- Identify flagship product(s)
- Clearly set the delivery format to the IP.
- If the delivery format is a web service, please clearly establish what type of service: WMS, WFS or Atom. Also clarify if there is going to be a unique service collecting all the information from partners or if there is going to be several web services.
- Clarify if the databases will be delivered to EGDI central database.
- Clarify how the accessibility of the parameter information should be implemented (through the map viewer, through download…).
- Most of the Data Types listed in section 3.2.1 are going to be delivered along 2020 (Full development phase). Check with GIP-P is this may be a problem or not.

3.4 TACTIC project

Aim to collect data and tools for assessment of climate change impacts on groundwater and adaptation strategies.

All WPs have programmed a deliverable on M7, call "Inventory on data and results (specific requirements for the storage and visualisation in GIP)". It is advisable to review the current document and include, if needed it, modifications coming from the 4 TACTIC deliverables.

In parallel, a tool inventory is being carried out that will be available at M7. The aim is to build a toolbox to make tools readily available for all European Geological Survey Organisations (GSOs) in their task of undertaking Climate Change impact and adaptation assessments. The tools are currently not expected to be part of the EGDI infrastructure.

The information reflected below has been extracted from de following document:

- Proposal;
- GIP WP2 Questionnaire (October workshop);
- Draft of Data Management Plan (03-12-2018);

3.4.1 Products

WPs	Data type	Format and other information
WP3 Integrated groundwater - surface water assessment	Documents	Not yet defined
WP4 Assessing groundwater recharge and vulnerability	Map displaying aquifer vulnerability to climate	
	Pan-European net-precipitation map multiple layers with mean, monthly, annual data etc.	
WP5 Assessment of salt-/sea water intrusion status and vulnerability	Documents	
WP6 Groundwater adaptation strategies	Documents	

3.4.2 Input data

Harmonization (semantic and geographical) among partners is not an objective in the project.

List of data types potentially collected by TACTIC

DATA TYPE	FORMAT	GEOMETRY
Hydrogeological parameters: (e.g. porosity, hydraulic conductivity, cation exchange capacity)	Georeferenced files ASCII files	Point
Hydrogeological time series: Water tables Head/River/concentrations Rainfall, temperature, Potential Evaporation Real time data	Georeferenced files ASCII files	Point
Borehole, hydrochemical and geophysicals logs (data and time series)	Standard log formats (staked)	Lines
Soil maps/soil properties Land use Specific model outputs (e.g. min, max, mean heads, or changes) Climate grid Satellite	vector or raster	Surface
3D data: Hydrogeological model – structures Hydrogeological parameters Model outputs	Volume/Stacked 2D? Rasters Unstructured grids	3D
Unstructured documents: Images, Tables	Not defines	NA

3.4.3 Functionalities

1. Basic functionalities;
2. Advance functionalities:
    a. 3D or Quasi -4D viewer;
    b. Geological, hydrochemical and geophysical log viewers.

3.4.4 Issues and further clarification needed

- Clarify if WP3, WP5 and WP6 will not deliver "GIS Data "or web services as products.
- Clearly set the delivery format to the IP of the two WP4 products.
- Clarify if input data will be stored in the under EGDI central database or not.
- Confirm that the toolbox will be not part of the EGDI infrastructure and clarify how tools will be access by the (GSOs) or thirds parties.
- Confirm if the two types of viewers listed in functionalities are a real need. If yes, set-up meeting with GIP-P (WP6) to define requirements.

3.5 Common needs expressed by the Groundwater projects

- Ensure that metadata are uploaded to the European Inventory of Groundwater Research (EIGR): GIP team may explore ways of linking GIP data with EIGR data and vice versa.
- Build on and further develop the thesaurus and groundwater research classification of the European Inventory of Groundwater Research (KINDRA/EIGR).

During the first semester of 2019 KINDRA project will update the content and explore the possibility to upgrade the inventory to Geonetwork 3.X. Therefore, in order to satisfy these two needs, conversations must take place between KINDRA project leader, Marco Petitta and GIP WP leaders 4 and 7 by the end of 2019 first semester.

Martin Schiegl, WP4 leader, has expressed that it is technically possible to incorporate the KINDRA thesaurus into the GeoERA thesaurus, under construction (first version planned for August 2019). It should be noted that once integrated, if new terms want to be added GeoERA thesaurus managers should be contacted. Task 4.3 "Governance Plan, Keyword Thesaurus Workflows", led by CGS, will start in July 2019. Thus, discussions on integration and maintenance of the KINDRA thesaurus can take place during the execution of Task 4.3. In the case of WP7 the task T7.2 Metadatabase (development of the EGDI metadata catalogue), lead again by CGS, is planned to start in January 2019. Conversations to clarify whether uploading of metadata generated by GeoERA projects to the EIGR metadata catalogue is possible and feasible can start from 2019.

4 Raw Materials projects

4.1 EuroLithos project

Aim to collect data on ornamental stones resources and their consumption. The two WPs that produce data have programmed a first task until M6 to contribute to the D6.1 on the IP requirements. The information reflected below has being extracted from the following documents:

- Proposal
- GIP WP2 Questionnaire (October workshop)

4.1.1 Products

WPs	Data type	Format and other information
WP3 Atlas of European Ornamental Stones	**Documents** Guidelines for the Atlas	
	Data Geology of the mining districts of ornamental stones	Polygon displaying the extent for a resource (i.e. geological unit) With one or several unique and denominated stone types (standard attributes: age/stratigraphic group or formation, lithology) Polygon or point

WPs	Data type	Format and other information
	Location of ornamental stones mining districts, mining sties or isolated quarries	With one or several unique and denominated stone types (standard attributes: age/stratigraphic group or formation, lithology)
	Location of building/construction	Point With one or several unique and denominated stone types Could be geographical coordinates, address or link to another database (there is an idea to use the building database from OpenStreetMap)
	List of unique and denominated stone types	Attributes: name, lithology, location (link to the above features)
	Other Photos necessary for entries (stones or building)	Approx. 5'000 photos
WP4 Directory of ornamental stone properties	**Data** Analyses and technical data	Linked to the unique and denominated stone types
	Document Guidelines for using the directory	
WP5 Ornamental stone heritage	**Document** Best practices and guideline	

4.1.2 Input data

Data type	Format	Geometry
Geology (geologic unit)	*Not précised* ***Note from GIP:*** *Shapefiles and WMS/WFS exist from OneGeology/OneGeology Europe*	Polygon
Location of current and relevant old/historic ornamental stones mining	*Not précised*	Point or Polygon

districts, mining sites or isolated quarries		
Land use planning constraints and threats	*Not précised*	Polygon

4.1.3 Expected functionalities

- Viewing and filtering data (based on location and/or attributes)
- Identifying data (view geological unit / area planner, decision maker, buildings, stones)
- Query stones used in a building
    - Which and from where are the stones used in this building?
- Query buildings using stones from a quarry
    - Which buildings use this type of stone and where are they located?

4.1.4 Overall principle

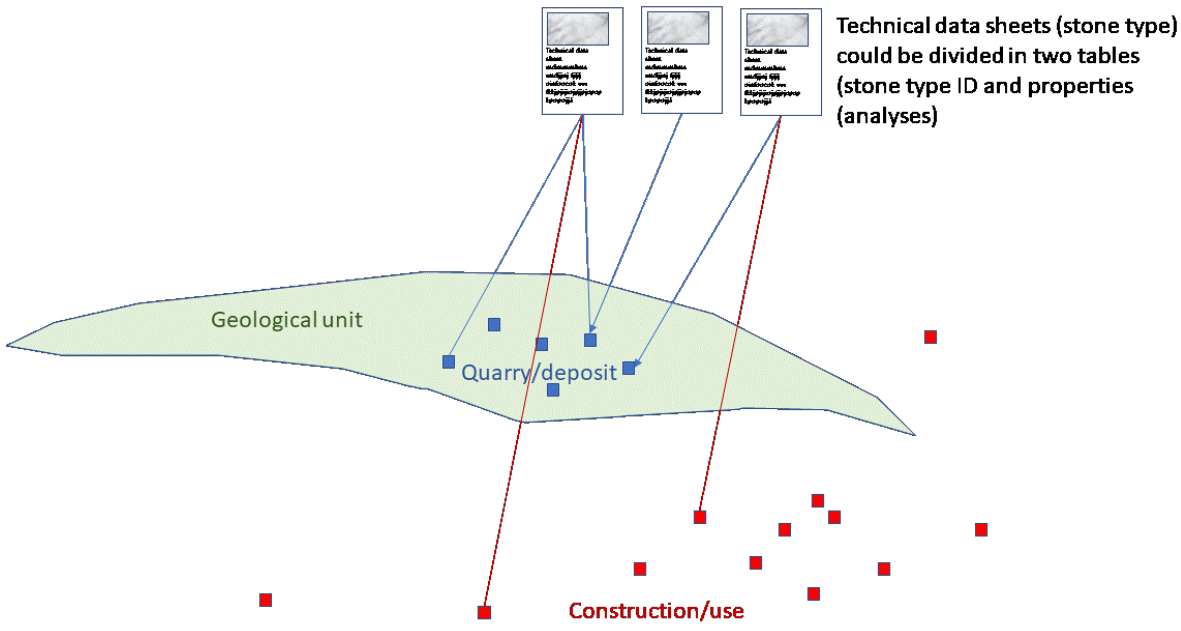

Figure 1 - Relations between objects in EuroLithos

4.2 FRAME project

Aim to complete data on critical and strategic raw materials.

The information reflected below has been extracted from the following documents:

- Proposal
- GIP WP2 Questionnaire (October workshop)
- Bilateral workshop (online) between FRAME project and the GIP-P

4.2.1 Products

WPs	Data type	Format and other information
WP3 Critical and Strategic Raw Materials Map of Europe	**Documents** Methodology used	
	Data Metallogenic map Predectivity map Prospectivity maps Mineral Occurrences and Mines update for CRM	 Raster/Grid Raster/Grid Raster/Grid Point or Polygon On land and marine: Link with MINDeSEA project Potential CRM resource estimates: Link with Mintell4EU project Data stored in ArcGIS geodatabase (according to the Minerals4EU database format –relational) Update of services used to deliver data to the EU-MKDP (for national provider) Need to add new features in the Mineral resources data model of EGDI: 1. site status 2. Feature type: Methods List of geochemical analytical techniques List of mineralogical techniques List of applied geophysical techniques
WP4 CRM in phosphate deposits and associated black shales	**Data** Mineral Occurrences and Mines update for phosphate deposits and associated New geological, chemical-mineralogical and geochronological data for some deposits	 *Cf. WP3* Will be used to update the Mineral Occurrences

WPs	Data type	Format and other information
		Analytical data in text and spreadsheet format (e.g. CSV, MS Excel or equivalent)
	Document Metallogenic studies	
WP5 Energy Critical Elements	**Data** Potential and prospectivity maps Mineral Occurrences and Mines update for natural graphite, lithium and cobalt	Raster/Grid *Cf. WP3*
WP6 Conflict free Nb-Ta for the EU	**Data** Mineral Occurrences and Mines update for Nb-Ta mineralisation	*Cf. WP3*
	Document Report on the distribution and systematics of NB-Ta mineralisation in Europe Report outlining recommendations for future exploration in Europe for Nb-Ta	
WP7 Historical mining sites revisited	**Document** Reports: Potential target areas identified; Case studies; Final report	
	Data Mineral Occurrences and Mines update for historical mines	*Cf. WP3*

4.2.2 Input data

Data type	Format	Geometry
Mineralisation and deposits on land and the marine environment	*Not précised* ***Note from GIP:*** *Data from Minerals4EU, ProMine and OneGeology Europe exists as WMS/WFS (for some)*	Polygons and points
Secondary resources (mining waste)	*Not précised* ***Note from GIP:*** *Data from ProSUM Mining Waste (to be delivered) will be*	Points

	provided as WMS/WFS (for countries participating to ProSUM project)	

4.2.3 Expected functionalities

- Web portal
  - Metadata catalogue service
  - interactive GIS maps
    - with online calculator
    - visualizing filter
  - direct access to data (download)
  - new functionalities related to 3D-geomodelling (to be determined)
- Harvesting system to exchange data from National Geological Survey Databases to EGDI
- Might be interesting to have online analysis, at European level or at country level
- Tool to archive and search in the reports, visualization of reports in HTML would be a plus

4.2.4 Other points

FRAME project has raised the problem of ***data augmentation***. As the content created in the FRAME project will be refinement of some commodities in Europe, made by some countries on behalf of other EU countries, the question of how this data will be stored and presented to the users is raised.

4.3 MINDeSEA project

Aim to characterize deposit types, the trace element content of the deposit type; develop harmonized mineral maps and datasets of seabed deposits.

The information reflected below has being extracted from the following documents:

- Proposal
- GIP WP2 Questionnaire (October workshop)

4.3.1 Products

WPs	Data type	Format and other information
WP3 Seafloor Massive Sulphide Deposits	**Data** Seafloor Massive Sulphide (SMS) deposits (Point) (data on metallogeny, chemistry and economic)	Point, Shapefile (attributes well defined) To be integrated into the European resource databases and information systems.
	Document Models for the formation of European SMS deposits Potential for SMS mineral deposits	
WP4 Ferro-manganese Crusts, Phosphorites and Critical Raw Materials	**Data** Phosphorites & Crusts Mineral-potential and prospectivity maps	Polygon and point, Shapefile (attributes well defined) Plan to be INSPIRE-compliant harmonized datasets and maps *Not précised*
	Document Report highlighting the endowment and exploration potential of CRM associated with submarine ferromanganese crusts and phosphorites in Europe Literature review report on regulation, legislation and exploitation of ferromanganese crusts and phosphorites… Project report	

WPs	Data type	Format and other information
	Other Models of formation	*Not précised*
WP5 Marine Placer Deposits	**Data** Compilation of placer deposits Mineral potential and prospectivity maps	Polygon and Point, Shapefile (attributes well defined) Plan to be INSPIRE compliant harmonized datasets and maps *Not précised*
	Document Literature review report on regulation, legislation and exploitation of placer deposits	
WP6 Polymetallic Nodules	**Data** Polymetallic Nodules	Polygon and Point, Shapefile (attributes well defined) Plan to be INSPIRE compliant
	Document Report of the polymetallic nodules prospect evaluation parameters… Report of the polymetallic nodules prospect evaluation for European waters	
WP7 Exploration in the Atlantic, Mediterranean, Baltic and Black Sea	**Data** Exploration Mineral-potential and prospectivity maps	Polygon, Shapefile (attributes well defined) Plan to be INSPIRE compliant *Not précised*
	Document Literature review report of exploration for submarine mineral deposits around Europe	

4.3.2 Input data

Data type	Format	Geometry
Marine geology	*Not précised* *it is précised that it will reuse part of EMODnet, Interridge programs and Geo-Seas*	Polygon
All other Marine information about SMS, Placers, Nodules…	*Not précised* *It is précised that it will reuse part of EMODnet, ISA, Interridge programs and Geo-Seas*	*Not précised*

4.3.3 Expected functionalities

- Visualization of map and object information

4.4 Mintell4EU project

Aim to update the European Minerals Yearbook (e-MYB), improve quality and spatial coverage of the Minerals Inventory…

The information reflected below has being extracted from the following documents:

- Proposal
- GIP WP2 Questionnaire (October workshop)

4.4.1 Products

WPs	Data type	Format and other information
WP2 Update to Electronic European Minerals Yearbook	**Data** e-Minerals Yearbook, including (statistical data at country level) • Production data for 2004 to 2019 • Trade (Import/Export) data for 2004 to 2018 • Resource data (ref. year 2019) • Reserve data (ref. year 2019) • Exploration data (ref. year 2019)	
	Document Report describing the processes developed for updating the electronic European Minerals Yearbook	

WP3 Minerals inventory	**Data** (Update of) Minerals Inventory, including - Mineral occurrences (points or polygons) - Mines (points)	Points or polygons Served as WFS by national provider Harvested to a central database (used by EGDI) Follow INSPIRE MR/ERML 2/Minerals4EU data model

4.4.2 Expected functionalities

- Web GIS
- Visualization of objects (Mineral occurrences and Mines)
- Search for mineral occurrences and mine (both in the map and in search – Google search like)
- Integration of the e-Minerals Yearbook
- Generation of pdf reports for individual commodities on demand

4.5 Common needs expressed by the Raw Materials projects

- Viewing, identifying, filtering and querying data (based on location and/or attributes)
- direct access to data (download)
- 3D-geomodelling capabilities, creation of virtual boreholes

5 GeoEnergy projects

5.1 Geoconnect³d project

The project will develop and test a new methodological approach to prepare and disclose geological information for policy support and subsurface management.

The information reflected below has being extracted from the following documents:

- Proposal
- GIP WP2 Questionnaire (October workshop)
- Bilateral workshop (online) between GeoConnect³d project and the GIP-P

5.1.1 Products

WPs	Data type	Format and other information
WP2 Interface package & Methodology	**Documents** Intra- and inter-thematic exchange logbook Report on fault property requirements Report and publication(s) on the two-step framework-geomanifestation methodology	
WP3 Roer-to-Rhine Build a cross-border structural framework for the entire study area based on existing information on faults and determinant features (e.g. folds and unconformities); Link existing models at different scales and resolution (voxel (cf. RM2), 3D, resource models…) to this framework;	**Data** Structural Framework	Fault database of Hike (see Hike) Geological Limits Geological Units Polygon, Polyline mainly shapefiles. PostgreSQL/PostGIS Existing 3D Geological models or 2D (proprietary format) and/or shapefiles. PostgreSQL/PostGIS

WPs	Data type	Format and other information
Making an inventory of cross-border data on selected geomanifestations (seismicity, those indicative of channelled or blocked fluid and heat flow…) and harmonising these data; Tying the data on geomanifestations to the structural framework; 21 Improving the structural framework based on new insights gained from the geomanifestations; Using the augmented structural framework to evaluate the impact of deep geothermal exploitation on other subsurface activities and to propose a concept for inclusive subsurface management and planning; Making the geological information readily accessible, understandable and tailored to the needs of multiple stakeholders and end-users (cf. EGDI).	Geomanifestation **Documents** Scientific publication on annotated R2R models Report on ways to disclose essential subsurface data and information to different stakeholders	Geological Units Polygon, Polyline mainly shapefiles. PostgreSQL/PostGIS +Time component
WP4 Pannonian Basin To build a beyond the state-of-the-art cross-border and cross-thematic geological and structural model of the Pannonian Basin covering territories from eight countries; Challenge this model by means of an annotated structural framework model with the goal to increase the geological understanding,	**Data** 3D structural geological models 3D fault plane surfaces Voxel models, derived traffic light maps from a propriety of the model Seismic data	*See WP3*
	Document	

WPs	Data type	Format and other information
including transport of fluids and heat for geothermal purposes; Provide methods and recommendations regarding subsurface planning and management.	A joint report on geomanifestations with their physical, spatial- and temporal (4D) analysis Scientific publication on geomanifestation	
WP5 Sharing the case studies	**Data** See WP3	See WP3
	Document Report on lessons learnt from the Pilots areas Generic evaluation scheme for subsurface activities	

5.1.2 Input data

Data type	Format	Geometry
Geology (geologic unit)	*Shp ,grid, 3D models*	Polygon
Faults, Fault systems	*Shp or PostgreSQL, 3D models*	Point or Polygon
Chemical analyses of springs water	*Excel*	
Wells measurements	*Excel, CSV*	

5.1.3 Expected functionalities

- Web portal
  - Metadata catalog service;
  - interactive GIS maps;
    - visualizing filter and SQL query (directly to the DB);
    - Transparency;
  - direct access to data (download);

- new functionalities related to 3D-geomodelling (to be determined);
- handling transparency for the 3D models;
- Capable of Multiscaling, data resolution refining while zooming in conjunction with the display of a selection of new layers
- system is capable of showing time component (time series data).

5.2 HIKE project

Aims to support research and assessments of induced hazards and impacts that are related to the exploitation of subsurface resources and capacities throughout Europe. It will also create a Fault database

5.2.1 Products

WPs	Data type	Format and other information
WP2 Fault database development To establish uniform and widely applicable specifications and novel methods for fault characterization across Europe. The collect, process, harmonize and centrally store publicly available national and transnational fault information repositories into the established FDB architecture.	**Data** - Faults as spatial objects (in order of significance) o Lines (2d and 3d) o 3d surface (3d triangulated surface) o Polygons (2d and 3d) o Pointsets (3d pointcloud) (rarely) o Gridded / contoured surfaces (rarely) - Attributes, related to the spatial objects - Project vocabularies - Metadata	Web services hosted per provider built on a PostGIS PostgreSQL databases, to be harvested by central server (geometries and related attributes) HIKE will define the webservice content (exchange format) and produce a suggestion for partner database implementation.
	Document	
WP3 Hazard and Impacts Method Development Establish novel techniques that will serve of basis for hazard and impact assessment and test these techniques in practical	**Data** See WP2	See WP2

WPs	Data type	Format and other information
use cases across Europe. These cases involve different geological settings and subsurface utilizations. • Evaluate the added-value of fault information collected in WP-2 for improving or validating novel and existing hazard and impact assessment approaches • Exchange and compare assessment approaches and information uses between different case studies in HIKE and in other GeoERA projects, which focus on the investigation of induced hazards and impacts.	**Document** Hazard and impact assessment methodologies reports	Reports / case studies (documents)
WP4 Hazards and Impacts Knowledge Improve the exchange of information and knowledge used in hazard and impact research, based on a synthesis of methods and sources applied on WP2 and WP3 • Implement a data management strategy to identify, store and integrate data resulting from case studies carried out at the geological surveys of Europe • To provide recommendations for improving the implementation of hazard and impacts research results at various stakeholders	**Data** See WP2	See WP2
	Document Hazard and impact knowledge base (not related to spatial objects)	

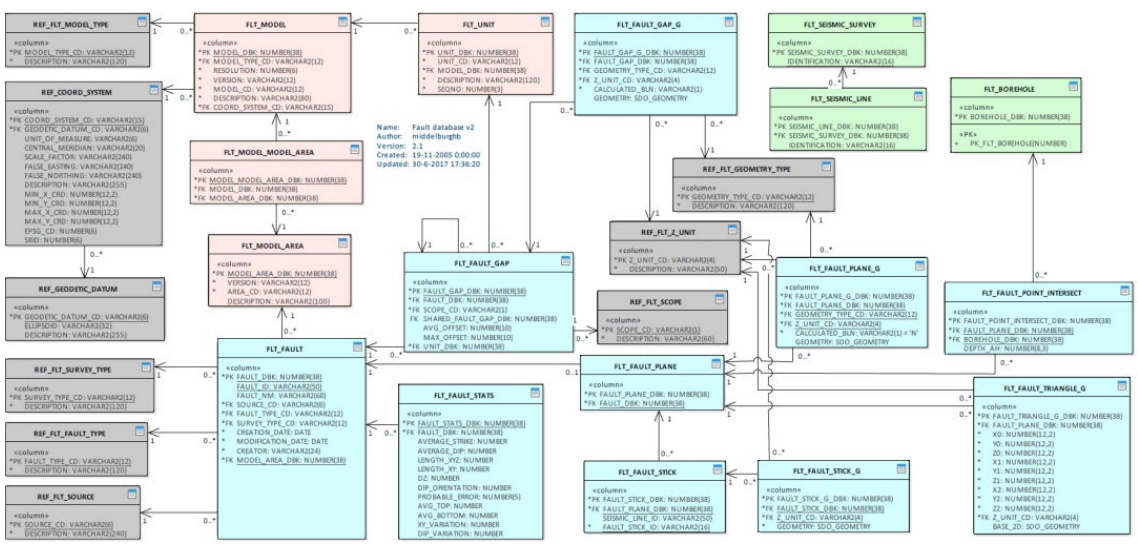

Figure 2: Data structure prototype of the Hike database

5.2.2 Input data

Data type	Format	Geometry
Geology (geologic unit)	*SHP, spatial databases, grid, 3D models*	Polygon
Faults	*SHP, spatial databases, grid, 3D models*	Polylines or 3d polylines (XML)

5.2.3 Expected functionalities

- Viewing and filtering data (based on location and / or attributes)
- Identifying data
- Downloading full data (3D geometries of faults and related tables – Petrel, GOCAD, move format)
- Generation of statistics that can be derived from the geometry of individual faults, like strike and dip for visualization in rose diagrams, histograms and scatter plots in the portal
- Possibility to upload data for partners (backup method for cases where webservice harvesting is not possible)
- Interface to knowledge base and related documents, including links to regions (e.g. case study areas) or other spatial objects (e.g. faults or groups of faults)

5.2.4 Issues and further clarification needed

Special functionality is needed for conversion of geometries (specific: sticks to 3d triangulated surfaces). This functionality could be implemented in the project infrastructure or in the central database or in the GIP-P.

5.3 3DGEO-EU project

Aims to improve, develop and test methods for the harmonization of cross-border 3D geomodels in different geological situations and source data coverage, thus providing

significant keystones to increase the effectiveness and applicability of 3D geomodel information in transnational settings towards the future goal of having coherently harmonized 3D geomodels across Europe.

5.3.1 Products

WPs	Data type	Format and other information
WP1 Pilot area: onshore Dutch-German cross-border region WP2 Pilot area: onshore German-Polish cross-border area WP3 Pilot area: offshore cross-border North Sea area between the Netherlands, Germany and Denmark	**Data** - - 2.5D Time model (xyz) - 2.5D Velocity maps (xyz) - 3D Structural model - 3D Harmonized model of lithostratigraphic layers - Geothermal properties related to wells (porosity & permeability) + 2D Geothermal property maps - Example datasets and models containing uncertainty information - 2D Maps of Cenozoic reservoirs (extent + depth) - 2D Map of extent & depth of salt/fresh groundwater barrier - Uncertainty in geomodels - Metadata	- Gocad ASCII format - VTK ASCII and binary format (Visualization Toolkit, see www.vtk.org, open source) - 2D grids in CPS3 format - Properties in Excel format Specific format and/or representation for uncertainty in 2d and 3d.
	Document Reports	Doc, PDF
WP4 Method development – WP5 Method development – Faults WP6 Method development – Optimizing reconstructions of the subsurface to reduce	**Data** See WP1,2,3 Fault database (see Hike project)	See WP1,2,3

WPs	Data type	Format and other information
structural uncertainty in 3D models	**Document** Reports on studied cases, harmonization procedure	Doc,PDF

5.3.2 Input data

Data type	Format	Geometry
Geology (geologic unit)	*SHP, spatial databases, grid, 3D models*	Polygon
Wells observations	*Not précised, but varies from excel sheets to shp*	Point
Reservoirs proprieties	*Grid/ 3d models (Voxel)*	Polygon

5.3.3 Expected functionalities

- WP4 “Uncertainty in Geomodels” will produce a requirements document how uncertain 3D geomodels could be visualized and produce corresponding example models.
- Legend with short descriptions in tree-view
- Switching on/off of objects following hierarchy.
- Color- and alpha- mapping functions to render attributes
- Extraction and visualization of virtual cross sections using corresponding color codes
- Extraction and visualization of virtual boreholes using corresponding color codes
- Extraction and visualization of virtual horizontal slices using corresponding color codes
- Download of whole model or parts in a common format (zipped)
- Glyphs for data representation
- Visualize objects from different models at the same time in the same viewer
- Render view to image
- 3D visualization and interaction functionalities:
    - Pan
    - Zoom
    - Rotate
    - Zig-zag profile
    - Fly through (recordable)
    - Drill-down visualization (apple bore)
    - Steering of camera via geolocation services like postcodes
    - Predefined general viewpoints
    - Predefined viewpoints for objects upon selection in tree of 3D
    - Zoom level dependent visualization of data and level of detail
    - Possibility to display objects

    - 3D text to name objects
    - Option to blend in a topographic map for orientation
    - Optional grid lines to show scale
    - Compass to show viewer orientation / direction
- Possibility to link data and reports
- API to the EGDI visualization tools, so that it can be used as a basis for future implementations

5.4 MUSE

MUSE investigates resources and possible conflicts of use associated with the use of shallow geothermal energy (SGE) in European urban areas and delivers key geoscientific subsurface data to stakeholders

5.4.1 Products

WPs	Data type	Format and other information
WP2 Technical aspects of shallow geothermal energy use in urban areas WP3 Management strategies and action plans for a sustainable and efficient use of shallow geothermal energy	**Data** -Unknown (but in principle no spatial data)	-
	Document 4 Reports, factsheet	Doc, PDF,XLS
WP4 Testing and implementation of developed methods and workflows in urban pilot areas across Europestructural uncertainty in 3D models	**Data** • Potential (resources) linked to the use of closed loop systems (see also figure 3) • Potential (resources) linked to the use of open loop systems (see also figure 4) • Conflict layers: see figure 5 • General topics, Topographic-, infrastructural maps: e.g. anthropogenic lines, traffic lines etc.; data represented as vector polygons rather than lines. This will enable the anthropogenic lines to have a buffer width. Each object has an attached description and possibly classification e.g. Fill polluted, cable trench, fill not polluted; locations of boreholes; • Geological data: most partners plan maps, some would like to present 3D based data (e.g. extraction of virtual borehole profiles); • Traffic light maps indicating the suitability for SGE installations (green, yellow, red): Vector polygons or raster files	Vector, Grid, 3D models

WPs	Data type	Format and other information
	Document 13 factsheets of pilot areas 1 report	DOC,PDF,XLS

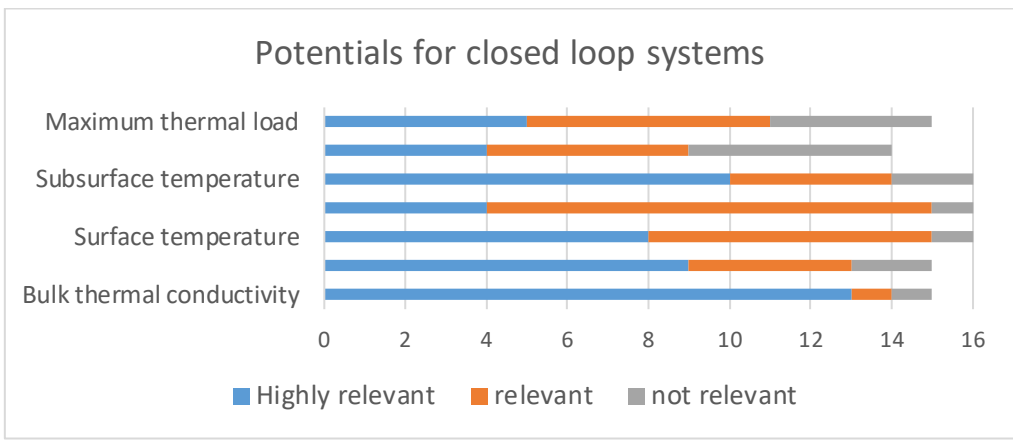

Figure 3: Potential for closed loop systems

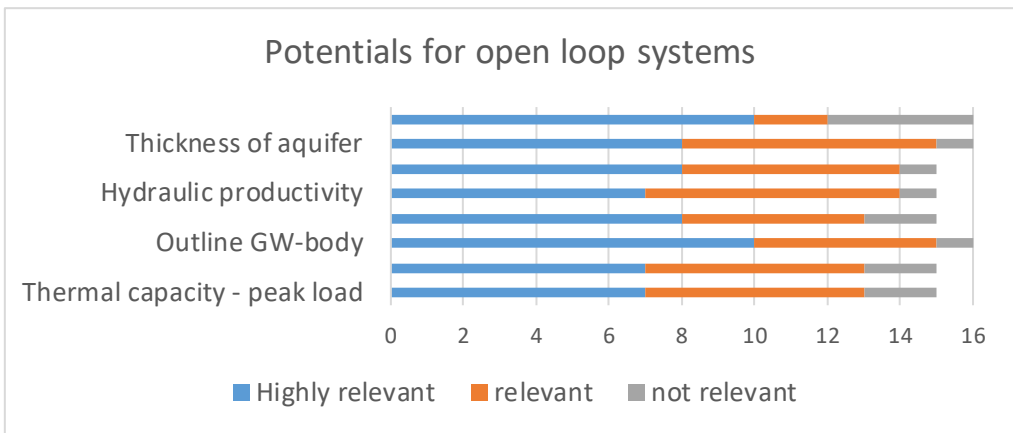

Figure 4: Potential for open loop systems

Figure 5: Conflict layers

5.4.2 Input data

Data type	Format	Geometry
Geology (geologic unit)	*SHP or 3D models (2.5D grids)*	Polygon
Conflicting layers (see figure 4)	*Many but most will be shp*	Point or Polygon
Wells, boreholes observations, samples measurements	*Excel, shp*	Point

5.4.3 Expected functionalities

- Viewing and filtering data (based on location and / or attributes)
- Identifying data
- Extract of virtual boreholes from 3D models
- Location specific data query: selection of a location by entering addresses, coordinates or by clicking on a location on a default map on the web information; afterwards, all geodata available on the selected site will be extracted and displayed in an automatized report (PDF);

5.5 HotLime project

HotLime aims to explore and evaluate the potential of carbonate basins for deep geothermal energy. 10 test cases are selected across Europe.

5.5.1 Products

WPs	Data type	Format and other information
WP2 Characterization and Mapping WP3 Play and Prospect Evaluation WP4 Deep Carbonate Play Development WP6 Project-Project Interface	**Data** Boreholes, wells, outlines of formations, temperature maps, basin outlines, geothermal gradients, horizon interpretations, 4D faults, linked to HIKE Synthesis maps (50% 3D models, rest maps(series)). GW chemistry type, bulk permeability. Results like what is currently shown for GeoMOL on the HIKE portal but extended in area. - Metadata	-Shapefiles -Grids -3d models, proprietary formats Specific format and/or representation for uncertainty in 2d and 3d.
	Document Reports	Doc, PDF
WP5 Knowledge Transfer	**Data**	
	Document Reports on subsurface planning, technical recommendations…	Doc, PDF

5.5.2 Input data

Data type	Format	Geometry
Geology (geologic unit)	*SHP or 3D models (2.5D grids)*	Polygon
Conflicting layers (see figure 4)	*Many but most will be shp*	Point or Polygon
Wells, boreholes observations, samples measurements	*Excel, shp*	Point
Faults	*Shp, Hike spatial DB*	Polylines or 3d polylines (XML)

5.5.3 Expected functionalities

- Viewing and filtering data (based on location and / or attributes)
- Identifying data
- Downloading full data (3D geometries of faults and related tables – Petrel, GOCAD, move format)
- query functions
- crossections, slicing, virtual boreholes,
- exploded views of a detailed part of the 3d model
- documents repository

5.6 GARAH project

Aims to make a scientifically based, geological analysis and assessment conventional and unconventional hydrocarbon resources in Europe.

WPs	Data type	Format and other information
	Main product, a static 2d harmonized map of the oil and gas resource	ESRI GeoDatabase, shapefiles, grids A link to descriptive excel sheet will be present Excel sheets describing in detail the resource.
	Side data/products: Boreholes, wells, outlines of formations, temperature maps, basin outlines, bathymetry, geothermal gradients, seafloor temperature, horizon interpretations, seafloor T heat flow, sedimentation rates in 4D, fishing activities, gas hydrates below seafloor, gas stability map, faults	ESRI GeoDatabase, shapefiles, grids

	Document Reports	Doc, PDF

5.6.1 Expected functionalities

- Filtering on attributes
- Identifying data, including attribute data linked from the Excel sheets
- The 3d model that is used as a data source for the 2d maps should be downloadable

5.7 Common needs expressed by the GeoEnergy projects

- Viewing, identifying, filtering and querying data (based on location and/or attributes)
- direct access to data (download)
- 3D-geomodelling capabilities, creation of virtual boreholes
- Creation of crosssections
- Link data to report

6 Data types and formats summary mentioned by all the thematic projects.

Data Types									
Projects	Point	Line	Polygon	Grids	Volumes (Block model)	Time-Series Data	Downhole Logs	Documents	Photos
3DGEO-EU	Y	Y	Y	Y	Y	TBC	Y	Y	
GARAH	Y	Y	Y			Y		Y	
GeoConnect³d	Y	Y	Y	Y	Y	Y	Y	Y	
HIKE	Y	Y	Y	Y				Y	Y
HotLime	Y	Y	Y	Y	Y			Y	
MUSE	Y	Y	Y	Y			Y	Y	
HOVER								Y (may be georeferenced)	
RESOURCE			Y					Y (may be georeferenced)	
TACTIC						Y		Y	
VoGERA								Y	
EuroLithos	Y		Y					Y	Y
FRAME	Y	Y	Y	Y				Y	
MINDeSEA	Y	Y	Y					Y	
Mintell4EU	Y	Y	Y					Y	

Data Formats									
Projects	Geodatabase	Postgres/ PostGIS	Shapefiles	XLSX	ASCII Grids/ Volumes	JPEG	PDF	DOC	Proprietary 3D file
3DGEO-EU		TBC			Y		Y	Y	Y
GARAH	Y						Y	Y	
GeoConnect³d		Y	Y	Y	Y				Y
HIKE	Y	Y	Y	Y		Y	Y	Y	Y
HotLime		Y		Y	Y		Y	Y	Y
MUSE		Y	Y	Y	Y	Y	Y	Y	
HOVER									
RESOURCE			Y (2.5 D 10X10km Grid)	Y		Y	Y	Y	
TACTIC									
VoGERA						Y (or PNG)	Y		
EuroLithos		TBC	Y			Y	Y	Y	
FRAME	Y		Y	Y	Y	Y	Y	Y	
MINDeSEA		TBC	Y				Y	Y	
Mintell4EU		Y					Y	Y	

7 Summary of the expressed functionalities by all the thematic projects

7.1 Basic EGDI Functionalities:

- Search: allows the user to search for spatial information and documents. It is intended that the search integrate the spatial and alphanumeric search (words and / or themes). A searchable documents repository linked with the metadata catalog;
- A web-page showing all the data/services accessible/downloadable (including the 3D models) classified by projects/themes
- Search location based on an address;
- Zoom in/zoom out; Pan;
- Table of content: is a panel listing the different layers, used to turn on and off the display of each layer, as well as the display order;
- Identify: allows the identification of each record (polygon, line, point or cell). Users can see corresponding attributes and attached files (pdf, png, jgp etc.) linked to a feature;
- Measurement tool: allows to measure distances;
- Show coordinates: is a panel showing the coordinates of the mouse pointer and the projection system;
- Overview panel: allows user to locate themselves in the general view;
- Export the displayed map to a pdf/image, reporting and download the file.

7.2 Advanced and/or to be developed functionalities:

- Handling and displaying time component, time series data;
- Multiscaling, data resolution refining while zooming in conjunction with the display of a selection of new layers
- Displaying geological, geophysical, hydrochemical predefined logs. Creation of logs based on the data displayed on the interface and/or from table values. Virtual boreholes creation from 2.5D layers.;
- Displaying pre-defined georeferenced cross-sections. Live modelling of a virtual cross-section based on trace drew by the user in the interface. The trace could be a simple line or a “zigzag” ;
- A web-page application solving vulnerability model stored in an Excel document;
- Creation of statistical diagrams such as rose diagrams, histograms, scatter plots based on a selection of values of attributes.

- Ensure that the metadata stored in the catalog are exportable to other EU Inventories and vice-versa;
- Build on and further develop the thesaurus and groundwater research classification of the European Inventory of Groundwater Research (KINDRA/EIGR);
- Into the webGIS interface create simple query to filter/extract/display specific information from a layer. Possibility to realise SQL query directly to the database;
- An upload system for the projects that will deliver static data;
- From a getfeatureinfo, creation of an automatic pdf report querying a selection of layers;

7.3 3D modelling functionalities:

- Handling and displaying of 3D models by the interface and the metadata catalogue;
- Transparency as well as for the 3D models;
- Quasi-4D viewer;
- Virtual borehole, virtual cross section, virtual horizontal slice, drill-down apple bore;
- Visualisation of objects from different models in the same interface;
- Handling uncertainty in Geomodels;
- Compass to show the direction of view.