

GeoERA



Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe

JOINT CALL DOCUMENT NO.9

CALL ANNOUNCEMENT AND SCIENTIFIC SCOPE

Stage Two - Project Proposals

Joint Call on applied geoscience in the fields of:

- Geo-energy
- Groundwater
- Raw materials
- Information platform

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1 Call Announcement

The GeoERA consortium announces the launch of the second stage of the GeoERA Joint Call for Transnational Research Projects. The GeoERA Call addresses research in Applied Geosciences and covers the following Themes:

- Geo-Energy
- Groundwater
- Raw Materials
- Information Platform

The Stage Two Call for Project Proposals should address Specific Research Topics addressed in this document. Only GeoERA partners are eligible for funding for projects awarded under this call. The Call opens on the 17th October 2017 and closes on 12th January 2018, 17:00 CET.

Details are provided in the supplementing Joint Call Documents available on the dedicated website geoera.eu/call.



2 Scientific Scope of Stage Two of the Joint Call

Within the course of Stage One, Call for Project Ideas, stakeholders have provided input to the Scientific Scope of the GeoERA Research Programme. This input has been used to identify the most important challenges and topics that the internal and external stakeholders prefer to obtain additional knowledge from in the coming years, delivered in a transnational setting. This document defines the Specific Research Topics (SRTs) based on the received Project Ideas in relation to the GeoERA Themes. The SRTs accomplish the general challenges, objectives and scope of the specific GeoERA Themes as outlined in chapter 3 of the GeoERA Call Document [No 4](#). In all SRTs submitting proposals on cross-thematic research is encouraged.

All GeoERA projects should reflect and support the aim of GeoERA in contributing to a sustainable use and management of the subsurface; maximising its added value, while minimising environmental impacts and footprints and the development of the establishment of a common European Geological Knowledge Base, and to the provision of a Geological Service for Europe. All GeoERA projects require a transnational to pan-European nature, in which research cooperation is encouraged between all GeoERA partners, to enhance the scientific and technical competence of the partners and improve the scientific cooperation, integration, the reduction of duplication of research effort and work beyond the state-of-the-art across Europe. Transnational research is defined in GeoERA Call Document No.3. It is strongly advised to prepare proposals that involves at least three, and preferably more, GeoERA partners from at least three different GeoERA partner countries, and preferably more. Any proposal should reflect the added value of cross border activities. It is expected from proposals to have the ambition of pan-European coverage, i.e. covering the whole of the European continent.

The projects are expected to interact closely with the GeoERA Information Platform. The maintenance, dissemination and sustainability of results are a joining and cross-cutting element and should be clearly addressed in all projects.

Every SRT has a table attached to it including an estimated budget for the SRT, and estimated budget per project and the maximum number of projects funded for this SRT. This serves as an indication of what kind of project sizes and number of projects the Executive Board is expecting and reflect indications to serve as guidelines for the submitters. These are indicative to be able to optimally use the EU funding provided to GeoERA. The final amount of funding for each project or SRT might changes depending of the outcome of the evaluation and ranking of the proposals, which is explained in Joint Call Document 8 Evaluation and selection.



3 Geo-Energy Specific Research Topics

GE1 - FOSSIL ENERGY, ENERGY SECURITY AND CLIMATE ACTION

Estimated total budget of this SRT	0.75 MEUR
Expected budget per proposal	0.75 MEUR
Number of projects to be funded within this SRT	1

Challenge

At present, conventional fossil fuels (coal, oil and gas) provide ca 85 % of the energy consumed worldwide. Despite the falling trends in production and consumption, fossil fuels are expected to play a major role in securing Europe’s energy supply over the coming decades. Natural gas can be an important resource during the transition towards a low-carbon energy system in Europe as it is a highly flexible and relatively clean (low-emission) fuel compared to other fossil fuels. Furthermore, hydrocarbon reservoirs can be used for subsurface storage (e.g. depleted reservoirs for CO₂- storage, enhanced oil recovery with CO₂, storage and buffering of gas and other types of energy carriers), this way contributing to emission reduction and secure energy supply. The continued importance of fossil fuels in Europe’s energy system forces us to look ahead to new frontier plays (e.g. gas hydrates, unconventional hydrocarbons) that have thus far received little interest in exploration. Conventional brown fields and mature fields may be revisited for remaining reserves that were deemed uneconomic or unrecoverable before. The understanding of on- and offshore hydrocarbon resources must be improved to avoid a too strong dependency on import from outside Europe. Consistent evaluation methods and data processing on newly-released and legacy data, will help rationalise the resource estimates across Europe, allowing for improved planning for new exploration, development and closure of hydrocarbon reservoirs.

Scope

- Consistent regional identification, characterisation and evaluation of hydrocarbon potential and exploration-risks in mature and underexplored plays in on- and offshore areas across Europe (source rock potential, brown and mature fields, frontier plays)
- Update and harmonisation of resources and reserves statistics for fossil energy sources according to international classification standards
- Evaluation of possible sequential and combined uses of fossil fuel reservoirs, including storage (CO₂, gas, other energy carriers), enhanced hydrocarbons recovery, and schemes for associated geothermal-hydrocarbon development
- Identification and categorisation of impacts and risks associated with fossil energy resources exploitation including possible mitigation measures by addressing critical knowledge gaps.

Expected impact

- Provision of consistent assessment, evaluation and data processing methods to help rationalise the resource estimates across Europe
- Improved knowledge which contributes to the security of supply of energy in the form of hydrocarbons
- Contribution to the climate action in exploring potential multiple uses within the subsurface
- Results should feed into planning and policy (e.g. licensing) activities in GeoERA partner countries, into commercial exploration strategies, and highlight remaining knowledge gaps.



GE2 - GEOTHERMAL ENERGY

Estimated total budget of this SRT	3.0 MEUR
Expected budget per proposal	1.0 MEUR
Number of projects to be funded within this SRT	Up to 3

Challenge

Despite their huge potential and wide occurrence, geothermal energy resources still represent a small share of the current total European energy spectrum (e.g. compared to fossil fuels). New and improved technologies are being developed to raise the share of this sustainable and non-intermittent resource in supplying power and heat for industry and residential buildings, and to increase its contribution to a reliable and low-carbon energy system. Currently, there is no comprehensive resource assessment methodology that provides a harmonized and comparable Europe-wide estimation of all prospective and identified geothermal energy resources with the inclusion of all relevant sources of uncertainty. New and emerging geothermal plays in Europe, such as deep bedrocks, provide promising yet challenging future targets. The limited exploration and often localized assessment of prospects hampers the establishment of an adequate knowledge and information base for de-risking, maturation and effective development of regional plays. More established forms of shallow geothermal uses based on closed- and open loop systems already play an important role in providing heating and cooling in Europe. Yet these systems face significant challenges with regards to conflicting subsurface uses, especially in dense urban settings.

Scope

Research Projects should address one or more of the following bold topics:

Innovative and comparative estimation of geothermal energy resources across Europe

- Development of a uniformly applicable methodology for estimation, comparison and prospect-ranking of geothermal resources across Europe at various scale, covering all stages of exploration and incorporating different sources of uncertainty
- Classification of assessed geothermal resources according to international standards
- Improvement and demonstration of methodologies and approaches in representative transnational case studies
- Integration of geological-economic estimation techniques to facilitate realistic estimates of the future market impact of geothermal energy use in Europe.

Geological evaluation of new deep geothermal plays in Europe

- Improved understanding of geological conditions that determine the distribution and technical extractability of geothermal resources in deep bedrocks, that are characterised by complex fluid flow mechanisms
- Consistent mapping and assessment of the 3D distribution and geothermal reservoir properties of these reservoirs at European scales
- Incorporation of these results within a common assessment and classification framework for all deep geothermal reservoirs
- Improving the understanding of possible exploitation impacts and operational issues related to geological aspects.



Geothermal energy and groundwater in urban areas

- Quantification of geothermal energy resources in urban conglomerations across Europe
- Identification and evaluation of specific challenges related to geothermal exploitation and spatial planning issues in urban areas, such as interfering neighbouring geothermal installations, extractions of groundwater, subsurface infrastructure (tunnels, sewage), pollution of soil/groundwater or linked surface waters/ecosystems
- Development of interoperable quality standards for assessing and monitoring the efficiency of geothermal based heat supply and storage, and developing and sharing innovative concepts for increasing the efficiency of heating and cooling supply.

Expected impact

- Improved and better harmonized European overview of prospective and identified geothermal energy resources
- Provision of a consistent and data-driven knowledge base to aid in the formulation of policy tools and strategies aiming for large-scale geothermal energy developments across Europe
- A further stimulus for green thermal energy uptake in European urban regions
- Increased confidence in the prospectivity and potential contribution of geothermal resources across Europe
- Increase awareness of its economic viability, due to increased understanding and knowledge transfer
- More effective and extended information support of the public-private-policy dialogue on geothermal energy resources in relation to the license to operate and the European Union's energy and climate targets.



GE3 - ENERGY STORAGE

Estimated total budget of this SRT	0.75 MEUR
Expected budget per proposal	0.75 MEUR
Number of projects to be funded within this SRT	Up to 1

Challenge

The transition towards a clean and low-carbon energy system can have substantial impacts for many citizens and industries in Europe in terms of interrupted energy supply or high costs for energy consumption. Subsurface storage of energy can play a pivotal role in mitigating these impacts, for example by providing flexible bulk power management services for electricity, gas and heat. The subsurface can host strategic energy reserves and balancing solutions for unavoidable seasonal variations in supply and demand. The technical assessment of the potential capacity and overall performance of subsurface energy storage is still immature, with large contrasts between fore-runner and follower countries. A lack of common performance evaluation methodologies and geological criteria to map out and assess the potential sites hampers the establishment of comprehensive and comparable national portfolios and those of the European Union, which are key to the strategic selection of optimal sites for development of subsurface energy storage from a technical, geographical and investor point of view.

Scope

- Extend and enhance the European knowledge base for subsurface energy storage, including the identification, 3D-mapping, parameterisation and characterisation of suitable geological storage formations and spaces
- Establishment and application of common criteria and methodologies for assessing subsurface energy storage capacities, performances and safety aspects in different geological settings across Europe
- Compilation of assessment results in a comprehensive, uniform, updateable and end-user oriented storage portfolio including potential capacities, technical performance indicators and geological risk aspects
- Identification and characterisation of various efficiency and subsurface safety aspects related to energy storage deployment
- Evaluation of potential synergies between energy storage and other subsurface activities.

Expected impact

- Deliver technical support for analysing future national and European energy systems scenarios and potential impacts/benefits from subsurface energy storage
- Support strategic decisions towards an effective implementation of future national and European energy storage systems by improved understanding on the critical techno-economic challenges and potential impacts/benefits from subsurface energy storage
- Deliver results for a better Policy-Public-Private dialogue and support planning of subsurface land use in relation to energy generation, transportation, storage and distribution
- Results should aid in improved knowledge sharing with stakeholders and public, including the awareness raising of the potential of subsurface energy storage and the distribution of capacities for storing energy carriers in the subsurface.



GE4 – INDUCED IMPACTS AND HAZARDS

Estimated total budget of this SRT	1.0 MEUR
Expected budget per proposal	0.5 MEUR
Number of projects to be funded within this SRT	2

Challenge

Many countries within Europe deal with increasing social concerns related to the impacts and hazards of subsurface uses. On the one hand, a poor understanding of these issues can provoke public resistance, which may lead to a delay or even cancellation of developments that are needed to fulfil future societal demands. Such delays have a consequence in increasing exploitation costs. On the other hand, impacts from subsurface exploitation are already a reality and the occasionally unexpected scale at which they occur, have occasionally led to high societal costs. Every accident that is associated with a given exploitation activity jeopardises the future development for the entire line of related activities. In order to support a responsible use of subsurface space and resources, and to help minimising and mitigating unintended impacts, such as induced seismicity, subsidence or impact on groundwater, it is crucial to improve the essential geological knowledge base for predicting and preventing adverse consequences of exploitation.

Scope

- Inventory and evaluation of recommended, state of art practices, methods and information sources used in impact and induced hazards assessment
- Collation of these practices into a shared European knowledge base and research area, categorised by different subsurface uses and geological settings
- Identification and demonstration of improvements that advance the state of art for impact and induced hazards assessments in different parts of Europe, e.g. by advancing novel 3D/4D modelling approaches enabling a more reliable earthquake localisation, or a better assessment of faults prone to induce/trigger seismic events. These improvements are preferably demonstrated in realistic case studies and key problem areas
- Filling-in of critical knowledge and information gaps that hamper an adequate assessment of impacts and induced hazards in Europe, among others, by generating, processing and integrating existing and new data into a robust and updatable European Information Platform
- Establishment of high standard information services that support policy making and facilitate societal awareness to minimize and mitigate impact an hazards.

Expected impact

- The alignment of national research on geo-energy related (induced) impacts and hazards and increased European collaboration
- Provision of a framework for project specific environmental impact studies and risk assessments applicable at pan-European level
- Support policy decisions through better standards and beyond state-of-art subsurface knowledge and information on induced impacts and hazards
- Development of a scientific basis to support responsible exploitation of subsurface uses that society will benefit from, including the contribution to increased awareness related to potential risks towards geo-energy promoters and local administration



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- Contribution to the reduction of societal costs and losses on investments by improved identification and anticipation of adverse consequences from exploitation of geo-energy resources.



GE5 - ADVANCEMENTS IN DEVELOPING AND USING 3D TRANSNATIONAL GEOMODELS

Estimated total budget of this SRT	3.8 MEUR
Expected budget per proposal	2.0 MEUR
Number of projects to be funded within this SRT	Up to 2

Challenge

The assessment of subsurface resources and impacts must be consistent with subsurface parameters and the 3-dimensional arrangement of geological strata, rock and fault properties in order to adequately inform stakeholders and decision makers. For this reason GSOs, academic institutions and industry commonly underpin their assessments with 3D geo-models. GSOs usually select approaches and definitions that are most suitable for the given geological setting (e.g. structural complexity), source data coverage (e.g. wells, seismic) and application-specific requirements of the models (e.g. scale, attributes). Consequently, many different tools, architectures, standards and dissemination platforms are used. This reduces the effectiveness and applicability of 3D geo-model information in transnational settings.

Scope

- Advance the state-of-art towards an integrated and applied 3D modelling within the pan-European dimension, including the establishment and demonstration of common solutions for building, integrating and applying 3D structural and parameter models and databases for resource/impact assessments in transnational geological settings and building a platform for managing, disseminating and querying geo-models and servicing the end-user needs in (cross) thematic areas
- Prioritisation of research on technical solutions that are applicable to multiple countries and needed for the development and application of regional to transnational geo-models in practical multinational case studies (e.g. multi-scale architectures, standards correlation, integrating different levels of geological complexity and exploration)
- Advance the state of art for 3D mapping solutions and the development of a suite of holistic 3D model information for true interlacing/merger at European -scale. They should enable the efficient and consistent uptake and embedding of 3D model information into the GeoERA Information Platform safeguarding interoperability and future-proof web availability.

Expected Impact

- Enhancement of the reliability of the knowledge and models by the convergence of 3D geo-modelling approaches at the European scale, through the establishment of a comprehensive suite of 3D models or databases at European scale
- Provision of a common and objective knowledge base to support cross-border discussions, decisions and policy-making, regarding subsurface resource management, exploitation and associated impacts
- Enable a more integrated approach towards realising national and European societal challenges that are linked with the exploration, exploitation, protection and regulation of subsurface resources and capacities (e.g. resource security vs climate targets vs environmental protection) across borders.



GE6 - ENABLING SUBSURFACE MANAGEMENT AND DECISION SUPPORT

Estimated total budget of this SRT	1.0 MEUR
Expected budget per proposal	1.0 MEUR
Number of projects to be funded within this SRT	Up to 1

Challenge

Human activity in the subsurface is increasing, and the number and variety of actors and stakeholders is growing, both in rural and urban areas. Geo-thermal energy production, unconventional oil and gas exploitation, mining, on- and offshore exploitation of construction materials such as sand and gravel (aggregates) subsurface storage of heat, water, gases, and the disposal of waste are examples of this increase in subsurface activities which may potentially interact and represent competing demands on the subsurface. Reliable 3D geological models, e.g. connecting deep and shallow parts of the subsurface, are necessary for better understanding and management of risks from multiple uses to support stakeholders and policy makers in evidence-based decision-making for sustainable subsurface management. For reaching agreed energy and climate goals, access to tailored information on geo-energy resources and storage capacities is needed in order to provide unambiguous and unbiased information to support the regulation of energy policies and the design of effective measures. One part of this challenge focuses on the integration and preparation of various information sources for different subsurface activities, with the aim to allow for an integral evaluation of potentially concurrent or interfering uses. Another part of this challenge focuses on the development and demonstration of how such information can be established and optimally applied for the support of subsurface management and regulation in cross-border areas of Europe.

Scope

Research Projects should address several (not necessarily all) of the following topics:

- Systematic organisation and harmonisation of geo-energy capacities (e.g. geothermal, hydrocarbons, coal, CCS, energy storage) and associated non-geodata to develop a state-of-art overview for Europe
- Provide a framework and novel workflows for an efficient and continued incorporation of new assessment results established at national level for an European overview
- To extend the functionality towards subsurface spatial planning services by analysing the spatial and physical links between assessed uses and resources, and determining potential synergies and competitive relationships
- Demonstrate the applicability and added value of developed standards/approaches for private/public stakeholders and decision makers aimed at realistic cases in an interregional or European setting. Soliciting proposals are encouraged to evaluate cross-thematic/-disciplinary relationships (e.g. impacts on groundwater, hazards, etc.)
- Provide recommendations on lifting the case-study based results to a generic level and evaluate the relevance of a wider/systematic application of developed standards, practices and principles;
- Accomplish the translation of geo-data into end-user decision parameters using novel approaches that take into account 3D subsurface and temporal relationships
- Disseminate and secure the outcomes and inform stakeholders/end-users on key required data and information through the web-based Information Platform.



Expected Impact

- Actual and updatable overview of exploited, explored and prospective geo-energy resources, capacities and/or other relevant subsurface activities to facilitate development and evaluation of national energy policies and those of the European Union
- Demonstrated approaches that help to paved the way for a more consistent and scientifically based national and European planning of the subsurface beneficial for an efficiently and sustainably used subsurface providing to the society
- Improved interaction schemes between various National and European information repositories to support the decision processes for optimised use of the subsurface and enhancing, economising and speeding up the transition towards a sustainable society.



4 Groundwater Specific Research Topics

GW1 - DRINKING WATER, HUMAN HEALTH AND ECOSYSTEM

Estimated total budget of this SRT	2.7 MEUR
Expected budget per proposal	1.0-2.7 MEUR
Number of projects to be funded within this SRT	Up to 2

Challenge

Groundwater quantity and quality is under significant pressure from a wide range of human activities on and below the surface and groundwater protection is of increasing importance. Groundwater is the most important resource for fresh water for human consumption, irrigation and industrial and other uses in Europe and it delivers base flow to river systems and other associated ecosystems. . Hence, improved and sustainable groundwater management and protection in relation to human, agricultural and industrial uses is a significant challenge to prevent further deterioration of the *quality* of the resource. EU Member States are required to deliver information about their “groundwater bodies” “natural backgrounds” , “threshold values” and chemical trends for chemical status assessment according to the Water Framework Directive and Groundwater Directive. However, EU Member States have considerable problems with this and often state that the existing knowledge and data are insufficient. GeoERA can provide significant contributions to establish the required fundament of knowledge and data.

Scope

Research Projects should address one or more of the following bold topics:

Geogenic diversity, exposure to hydrogeotoxic elements and hydrochemical base line

Projects will develop tools and databases for a common approach to assessment and interpretation of special groundwater, including thermal waters, mineral waters, medical springs and artesian wells to eventually enable harmonized Pan-European and regional mapping of these resources. Finally, projects should create a European overview of natural background concentrations of geogenic trace elements and radionuclides, where human exposure may result in health risks or benefits as well as the spatial distribution of groundwater containing these, including geological formations causing elevated values.

Anthropogenic impacts:

Projects must develop a consistent design (including analytical techniques) for monitoring of emerging contaminants in groundwater, in time and space to provide early warning and ensure effectiveness and comparable data across the range of European geological and environmental settings. Projects should also evaluate and improve approaches for vulnerability assessment, characterize the vulnerability of groundwater resources at a Pan-European scale, and create EU wide maps on aquifer vulnerability to groundwater pollution (nitrate, pesticides, emerging contaminants) that account for the different hydrogeological conditions in Europe, including travel times in saturated and unsaturated zones, hydrogeochemical (redox) processes and groundwater, surface water interaction. Besides, projects must address the development of common standards, databases and maps illustrating the distribution of groundwater ages in Europe by the use of tracers and numerical models for improved understanding of groundwater recharge rates and groundwater quality evolution in time and space. This will result in a better understanding of the time lags for trend reversal, following programmes of measures to reduce nutrient or pesticide applications to take effect in groundwater and associated surface water. Finally, projects can aim at developing tools to monitor, describe and model



contaminant (incl. emerging contaminants) transformation processes in the groundwater-surface water transition zones (both groundwater fed rivers and riverbank infiltration situations). Projects will select pilot areas for demonstration of the developed methodology and indicators at local to regional scale in different hydrogeological settings.

Expected Impacts

- Increased political and public awareness of health issues related to groundwater quality issues through easy access to relevant data and maps on the information platform
- Improved tools and support for the implementation of the European water policies as the Water Framework and Groundwater Directives to sustain Europe's groundwater resources for drinking water supply and other human uses and ecosystems
- Better groundwater protection strategies through easy access to information, visualizations and maps of groundwater quality stratification, natural background values and hydrogeochemical processes, travel times from infiltration to recharge and discharge zones, and time lag between measures and recovery of water quality
- Improved databases and visualization tools required to produce EU scale maps on e.g. groundwater quality issues supporting assessments of health issues related to the quality of drinking water produced from groundwater
- Best practice guidance from demonstration projects on monitoring of different contaminant (emerging etc.) in different hydrogeological settings to support harmonized monitoring strategies across Europe.



GW2 - TOOLS FOR CLIMATE CHANGE IMPACT ASSESSMENT AND ADAPTATION

Estimated total budget of this SRT	1.7 MEUR
Expected budget per proposal	1.7 MEUR
Number of projects to be funded within this SRT	Up to 1

Challenge

Climate change may alter the natural hydrological system and have a severe impact on the quantity, quality and accessibility of water for consumption, agriculture, industry, and the support of ecosystems. Expected primary impacts include frequencies and magnitudes of geohazards such as flooding and droughts, increased saltwater intrusion, and stresses on groundwater dependent ecosystems; secondary impacts - which in some cases or regions may have even higher impacts on groundwater quantity and quality - include the human responses to climate change such as land use changes or climate change mitigation measures. A prerequisite for the selection and design of optimal and sustainable solutions to climate or global change (incl. primary and secondary climate change impacts, population changes etc.) is a thorough understanding of the system, and detailed assessments of current and future impacts and its associated uncertainties. Furthermore, management of such complex systems, subject to multiple user interests and various policies, requires coherent, harmonized and transparent approaches, databases and methodologies relying on up-to-date databases, modelling tools and/or decision support systems. It is essential to establish best practices and develop improved integrated groundwater-surface water assessment tools for prioritizing alternative management strategies sustained by and utilizing easily accessible data on subsurface structures and hydrogeological properties.

Scope

The aim is to develop a research infrastructure among the European Geological Surveys to advance and harmonize the assessments of present and future primary and secondary impacts of climate change, and develop tools needed for the design of optimal adaptation strategies in water resources systems across relevant scales. To achieve this, guidelines based on best practice protocols and state-of-the-art should be developed which acknowledge the current tools/approaches used as well as data availability and accessibility, and provide directions for advancement. Hydrogeological data readily available e.g. for modelling purposes should be harmonized and prepared for the Information Platform so that new tools for data analysis, visualization and download can be developed by the Information Platform. The project should further analyse the utilization of satellite data (earth observed satellite data products) to enhance European-wide data acquisition and/or assessments, e.g. of overexploitation of groundwater, water table decline and land subsidence. The developed approaches and methodologies will be demonstrated by assessments and analysis of sustainable management strategies in pilot areas covering various hydrogeological conditions and management structures at different scales focusing on regional and cross-border scales, which are subject to different challenges, such as sea/saltwater intrusion, drought and floods.

Expected Impacts

- Improved support to EU policy making by contributing to the development of coherent and transparent assessments of climate change impacts on groundwater and surface water using



common and integrated approaches, methodologies and tools consistent across the different European countries

- Improved decision support and data access for stakeholders and decision makers dealing with climate change impact assessment and adaptation by:
 - Achieving a better knowledge and understanding of climate change impact on natural hydrological systems in Europe from pilot studies and integration of regional, national and transnational research resources
 - Easy access to maps, data and model results via the Information Platform
 - A roadmap for further development of advanced and strong GSO research on climate change impacts on groundwater and surface water in Europe.



GW3 - HARMONIZATION OF GROUNDWATER RESOURCES INFORMATION AT CROSS-BORDER TO PAN-EUROPEAN SCALE

Estimated total budget of this SRT	2.5 MEUR
Expected budget per proposal	2.5 MEUR
Number of projects to be funded within this SRT	Up to 1

Challenge

Sustainably balancing the needs of different types of human and ecological uses of groundwater in relation to the good status objectives of groundwater and surface water resources is key in European Union's legislation on water (WFD and GWD). However, good practices in providing harmonized data and information across borders for proper assessments of water volumes, fluxes and water quality at a cross-border scale are nearly absent and are needed for successful water planning and management in Europe. Although EU Member States deliver information about their "groundwater bodies" to the European Union for the Water Framework Directive, this does not yet lead to a harmonized pan-European assessment of the 3D structure of aquifers, the volumes of water involved and its quality. Harmonization of hydrogeological information and harmonized 3D characterization of aquitards and aquifers is a prerequisite for any transboundary groundwater management.

Scope

Proposals should address the following elements:

- Demonstrating harmonized methodologies and data on hydrostratigraphy, groundwater quantity, groundwater quality and age, and groundwater fluxes in a number of transboundary demonstration projects as a first step towards harmonization at European scale. The set of demonstration projects should put a new standard for harmonization across borders, not only for geological structures but also for hydrological characteristics such as heads and water quality
- Demonstrating how harmonized synchronized cross-border groundwater data, information, and 3D geological models can be used for cross-border aquifer management and sustainable prioritization of shallow and deep groundwater and subsurface uses in areas where many activities strive for prioritization, preferably involving regional stakeholders
- Creating the first harmonized pan-European maps that present the spatial overview of the volume and depth of Europe's fresh groundwater resources – yielding the total volume of fresh water available for humans and other uses and a first estimate of total abstraction - and the location of deep, paleo-waters that might need tailored protection regimes and might function as strategic reserves
- Developing a common methodological framework for characterization of karst systems aiming at general recommendation on management and protection strategies for various karst aquifer types.

Expected impacts

- Considerable progress beyond the current state-of-the-art in demonstrating the merits of 3D cross-border geologic and hydraulic and chemical characterization that enable groundwater managers of cross-border regions to manage their resources with a good understanding of



geological structure, groundwater flow and age patterns in order to prioritize competing uses of the subsurface and effectively protect their resources

- Easy access to tools and information for regional authorities responsible for groundwater management in the greater cross-border area, drinking water suppliers and member state governments that perform groundwater management at national and supranational level
- Better support for subsurface management in European transboundary regions in initiating the development of Pan-European products that visualize and disseminate key characteristics of Europe's groundwater resources, helping in implementing European Union's water policies such as the Water Framework and Groundwater Directives
- Better access to information for 3D subsurface spatial management of transboundary groundwater and translated raw data for useful information for decision makers, and stakeholders such as the CIS working groups of the European Union.



GW4 - CONTRIBUTE TO GROUNDWATER MANAGEMENT AND INTERACTIONS WITH ENERGY AND MINING IN RURAL AND URBAN AREAS

Estimated total budget of this SRT	0.8 MEUR
Expected budget per proposal	0.4-0.8 MEUR
Number of projects to be funded within this SRT	Up to 3

Challenge

Traditionally, groundwater protection focused on safeguarding water resources from threats associated with land use functions at the surface. However, human activity in the subsurface is increasing, and the number and variety of actors and stakeholders is growing. Geo-thermal energy production, unconventional oil and gas exploitation, mining, subsurface storage, and disposal of wastes are examples of this increase in subsurface activities which may potentially interact and represent competing demands on the sub-surface. A better understanding and management of risks from multiple uses towards groundwater resources is needed to support stakeholders and governments in evidence-based decision making. Future research and harmonized assessment can profit from an integrated approach to protect groundwater for the next generations whilst recognizing the need for economic development.

Scope

Projects should focus on different aspects of energy, mining, and urban activities in relation to groundwater protection to ensure that the risk associated with these activities are properly characterized to enable protection of groundwater used for drinking water and industrial water supply or for supporting surface water aquatic and terrestrial ecosystems. Projects are expected to explore the application of advanced 3D geological models when working with more but not necessarily all of the following:

- Developing tools for assessing the potentials of shallow aquifer thermal energy systems and its associated risk for other groundwater uses
- Substantiating the relation between deep industrial activities (e.g. geothermal energy and unconventional hydrocarbon exploitation) and shallow groundwater resources by identifying pathways (fault zones, permeable shortcuts) in pilot areas and evaluate the effects of these pathways on flow, recharge and water quality using chemical, isotopic and intercalibrated (geo)physical methods and equipment applied by the GSOs
- Elaborating an interoperable inventory of mining exploitations and a common assessment methodology to estimate potential impacts on groundwater quantity and quality for dissemination through the GeoERA Information Platform
- Demonstrating the tools mentioned above in a series of effective demonstration pilots in a variety of hydrogeological settings over Europe and translate them into useful information for decision makers and the public
- Develop connected on- and offshore 3D geological models of the land-sea continuum for improved integrated onshore/offshore understanding and assessment of contaminant loadings to marine ecosystems via submarine groundwater discharge, sea water intrusion and availability of aggregates (sand and gravel resources) near the coast e.g. for coastal protection.



Expected impacts

- Consolidated cooperation and communication between national/regional subsurface research institutes and European stakeholders that deal with groundwater resource management in relation to Energy, Mining and Urban Areas, focusing on issues relevant to the implementation of the Water Framework Directive, Groundwater Directive, the CCS Directive and the common EU Energy Policy Initiatives
- Improved knowledge-sharing across Europe and common approaches including intercalibration procedures and standards for geophysical equipment used for subsurface characterization and identification and assessment of risks to groundwater from known and new emerging pressures
- Improved coastal planning and protection by the use of integrated 3D geological models of the land sea continuum facilitated by geophysical mapping and parameterization of the narrow unknown zone “the white ribbon” between land and sea where typical no data exist
- Better planning of subsurface uses enhancing the possibilities for geothermal energy and storage of heat, gases and/or waste products thereby significantly helping Member States in reducing reliance on (imported) fossil fuels for energy supply, and helping countries to meet their CO₂ targets.



5 Raw Materials Specific Research Topics

RM1 – IMPROVING AND SUSTAINING THE RAW MATERIALS KNOWLEDGE BASE BY PERIODICALLY DELIVERING A MINERALS YEARBOOK AND INVENTORY INFORMATION SYSTEM

Estimated total budget of this SRT	2.0 MEUR
Expected budget per proposal	2.0 MEUR
Number of projects to be funded within this SRT	1

Challenge

The European Union has identified security of supply, improvement in environmental management and resource efficiency as key challenges for the raw materials sector. Hence, there is a need to have access to up-to-date, comprehensive, reliable and harmonized information across borders on primary and secondary raw materials. Data on location and spatial distribution, production, trade, resources and exploration activity underpin decision making in government and industry. Delivering a minerals yearbook and inventory information system on a periodic bases must support policy development and the monitoring of the effectiveness of policies, such as the Raw Materials Initiative, the European Innovation Partnership on Raw Materials and here in particular the establishment of the EU Raw Materials Knowledge Base (EURMKB), the Circular Economy Action Plan and the various directives related to waste.

Scope

Previous and ongoing projects such as Minventory, Minerals4EU, ProSUM and MICA have developed intelligent systems for the collection, storage and dissemination of data and information on Europe's raw materials (on-shore and off-shore). The CIP-ICT funded project EuroGeoSource provided a first approach on how to harmonise and disseminate information on resources and be INSPIRE compliant. Although a significant contribution to the EURMKB is made the systems need to be maintained, updated and current information added. The enhancement should include in particular production data on a regular and time stamped basis. In addition, data gaps in the spatial coverage (e.g. Germany, Poland and SE Europe) have to be addressed and recommendations on how to complete the coverage need to be made. The project description needs to outline how data harmonization (data coherence for a given raw material and among GeoERA partners countries will be achieved from the various data sources and the format by which the data will be portrayed. An inventory and statistical information on a wide range of raw materials including Critical Raw Materials (CRM) and Industrial Minerals. Harvesting, harmonizing and presenting raw materials data needs to be easy accessible and well represented, taken into account data ownership and other legal constrains where relevant. In addition, information on the geological potential for the discovery of mineral deposits in Europe should be included.

In particular the project should provide:

- Periodic updating of reliable mineral production data, resource and reserve data and exploration information for the Minerals Yearbook
- Merging of the current database for the Minerals Yearbook into the current Minerals4EU database and application of the current Minerals4EU harvesting system to the Minerals Yearbook information (production, etc.)
- Updated mineral resource assessment information for the Minerals Inventory
- Case studies are invited to demonstrate the general adaptability and interoperability of typical classification, standards and code systems that might support the harmonization process.



And should facilitate:

- Interoperability between relevant systems, i.e. RMIS and the GeoERA Information Platform
- Electronic data input from the individual partners
- Provide easy digital access to processed data
- Periodic maintenance in order to facilitate technological developments.

Expected Impact

The following are the impacts expected of the project

- The establishment of an EURMKB portal
- Improved level of data harmonization and reliability
- Presence of coherent and comprehensive information that supports spatial planning and the management of competing land-uses
- Improved competitiveness and functioning of the EU economy and societal well-being by e.g. helping to sustain raw material supply and by reducing Europe's import dependency for a range of raw materials
- Contribution to the sourcing of raw materials within Europe in order to realize green economy goals
- Improved connection between society and raw materials by improving awareness, confidence and knowledge of the need for raw materials production within Europe by providing evidence-based and accessible information.



RM2 – CONSTRUCTION MATERIAL

Estimated total budget of this SRT	1.25 MEUR
Expected budget per proposal	0.5-0.75 MEUR
Number of projects to be funded within this SRT	Up to 2

Challenge

This SRT addresses challenges concerning the wide group of construction materials regardless of their occurrence (on shore or off shore), size and use. These materials differ in respect of their economic value per cubic meter and transport or haulage (trading) distance. The vast bulk of mineral construction materials are sourced within Europe. Expected infrastructure projects (e.g. housing, transport, and off-shore constructions) will continue to ensure high demand. In addition, Europe also has a rich heritage of monuments and buildings of world and national importance, which require maintenance. Yet, the level of information on occurrence, distribution, quality and quantity of the original building material is variable and scattered throughout Europe. At the same time information on general demands at a larger scale and details on qualities and applications, provide an important management and policy support in e.g. land-use planning, resource management, environmental protection, heritage protection, jobs and growth. Typically, bulky materials are highly transport sensitive and therefore are managed at the local level. However, information on the general distribution, type and quality is often lacking and this can jeopardize addressing grand societal challenges or overarching policies when they compete with other land-use, e.g. forestry or sites of scientific importance or planning needs. In addition, an increasing interest in cultural heritage preservation and stone for building purposes may produce an increasing requirement for specific raw materials with particular properties (physical, mechanical and chemical). Information needs to be added to the European Union Raw Materials Knowledge Base (EURMKB) and made generally available through the GeoERA Information Platform.

Scope

This SRT addresses different aspects of bulk materials (e.g. aggregates, sand and gravel) and of dimension stones (e.g. natural stones, ornamental stones). The Project(s) are invited to identify and map the type and quality of construction materials. Tools and protocols for the assessment and comparison of deposits using standard criteria (e.g. geological, physical, mechanical, chemical, historical and aesthetic) should be developed and established while classification and standard codes for the classification of resources need to be considered. Results should be summarized, harmonized and accessible so that planning and environmental regulations are met (i.e. land-use planning requirements).

The Project(s) will have to take existing and ongoing projects into account including EMODNet for offshore construction materials. Information on the quality of the deposit is requested to take into account additional information such as cultural heritage and building preservation aspects and any other information concerning its technical application, e.g. for cladding, roadworks, insulating or super-refractory. It is expected that this (these) Project(s) will develop databases on the occurrences of these materials and will therefore require close interaction with SRT RM1 and the Information Platform.

Projects may focus either on bulk materials and/or dimension stones, and will have to:

- Develop inventories in conjunction with the Information Platform
- Case studies shall provide information of Europe's prospective areas of construction raw material deposits and provide a visualization which can be used for land-use planning



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- Explore the applicability and interoperability of standard codes among partners (e.g. UNFC to solid mineral resources in Europe) for harmonised reporting of resources
 - Ensure data coherence within a given raw material and among GeoERA partner countries. Case studies and/ or demonstration projects could assist the harmonization process
 - Provide appropriate input to SRT RM1
 - Provide advice on how forecasting for the demand of these materials can be improved so that policy formulation and government resource management can be enhanced and capital investment by industry can be prioritised
 - Provide readily accessible information and easy to use decision making tools for the public and local authorities, respectively.

Expected Impact

- Improved knowledge-sharing across Europe through a common understanding of Europe's raw material sources and an increased understanding of Europe's construction raw material deposits as a prerequisite to supplying Europe's construction raw material needs
- Contribution to environmental friendly raw materials production
- Provision of relevant information for the construction sector (including architectural and cultural heritage preservation) facilitating the conservation of Europe's national monuments, protected structures and the built environment in general
- Stimulation of the consolidation of the cooperation and communication between national/regional subsurface organizations and European stakeholders that deal with spatial planning in relation to Energy, Mining and Urban Areas.



RM3 – METALLOGENY – GEOLOGICAL POTENTIAL

Estimated total budget of this SRT	1.5 MEUR
Expected budget per proposal	0.5 MEUR
Number of projects to be funded within this SRT	Up to 3

Challenge

The formation of mineral deposits is complex and is influenced by a number of factors including deposit type, tectonic setting, age and local structure. This complexity provides an opportunity for developing advanced exploration methods. However, the significance of the different geological processes involved is often relatively poorly understood thus hampering efficient exploration strategies and reliable mineral resource assessment. Metallogenic studies are a support, and in some cases a prerequisite, for many exploration approaches for mineral deposits. Yet, the level of expertise is scattered and the application of modern metallogenic studies unevenly applied throughout Europe. The need to prospect and evaluate deposits is increasing as Europe seeks to implement Action Area II.2 (Access to Mineral Potential in the EU) of the Strategic Implementation Plan of the European Innovation Partnership on Raw Materials. Moreover, further development and application of modern exploration technologies and management tools require advanced metallogenic understanding.

Scope

This SRT addresses the specific requirements related to the various deposit types and their geological domains, their petrology, mineralogy and geochemistry regardless of whether they occur on-shore or off-shore. Findings of former and ongoing projects such as ProMine, Blue Mining and EMODNET could be integrated and updated where appropriate to add to the European Union Raw Materials Knowledge Base (EURMKB). For improvement of the EURMKB and capacity building, the participation of as many partners as who wish to participate in metallogenic studies, is requested. Projects need to closely collaborate with SRT RM1 and the Information Platform, respectively. The scope of the projects should contain the following aspects:

- Characterize the different deposit types, identifying metallogenic provinces, spatial and temporal attributes (metallotects)
- Develop improved tectonic and metallogenic models for Europe's most promising geological domains by e.g. using a mineral-systems approach and focus on the ore forming systems; the mechanisms and the geodynamic systems that drive them
- Provide systematic characterization of the trace element content of the ores/deposits and identify controlling factors on the occurrence of critical raw materials (e.g. Ga, Ge, In). Characterize the setting and location of minerals on the EU's Critical Raw Materials list (e.g. graphite and fluorite)
- Develop harmonised databases and maps of ore deposit types, along with mineral-potential maps and prospectivity maps
- Case studies should be developed to demonstrate the usefulness of the findings of studies, especially with regard to their efficacy with respect to mineral exploration. This may include the use of government datasets for exploration targeting or the application of a mineral-systems approach to the understanding of mineral deposits.



Expected Impact

- Facilitation of more directed and economic exploration with an enhanced probability for the discovery of mineral deposits and the development of improved data quality acquisition methods and tools for mineral exploration
- Contribution to reducing Europe' import dependency for mineral raw materials by providing common views on resources and enhancing the EURMKB
- Obtained a better understanding of Europe's mineral endowment and the attractiveness of Europe for mineral exploration and development
- Improved scientific cooperation and integration, reducing duplication of research effort across Europe.



RM4 – FORECASTING AND ASSESSING EUROPE’S STRATEGIC RAW MATERIALS NEEDS

Estimated total budget of this SRT	2.5 MEUR
Expected budget per proposal	1.0-1.5 MEUR
Number of projects to be funded within this SRT	Up to 2

Challenge

The high importance of some strategic raw materials to Europe’s society and economy, their sustainable and reliable supply and accountability (within Europe’s territory as well as abroad) has found wide reflection by the European Union’s policies over the past number of years. Strategic raw materials includes the Critical Raw Material (CRM) and other raw materials that have a specific strategic value to European Union. Periodical reports on CRM are published by the European Commission. Monitoring and forecasting of developments on primary raw materials and dynamics in the related sectors are a permanent challenge. Often this task is given to National and Regional Geological Surveys and their national partners to provide national input to the CRM Report. However, generating a holistic and common view for Europe is a challenge on its own. Moreover, unlike base metals many CRMs are not mined directly, but are instead recovered as by-products or co-products of primary ores at some stage during processing. In some cases CRM may be discarded as mine waste. Despite the efforts of previous projects (e.g. Minerals4EU), there is still a requirement for the identification, compilation and documentation of the strategic raw materials potential (incl. CRM), their metallogenesis and prospectivity across Europe.

Scope

The scope limits itself to raw materials which are listed as critical by the European Union as well as those which are of strategic interest (specific economic, social or environmental importance) to European society. The CRM list of the EU and raw materials of strategic importance for any partner country need to serve as a guide to the identification of particular commodities for study within this. Only in case the strategic importance is well reflected and justified, any other commodity may be considered.

Characterization of deposits (including mine waste) and identification of occurrences, i.e. petrological, mineralogical, geochemical and structural features of the occurrence, is requested. Findings should be summarized and provided to SRT-RM1. While the concept of critical or strategic raw materials is dynamic the project proposal should investigate prospective and undiscovered resource regions and demonstrate them by specific case studies. The areas identified as having potential should be disseminated to the relevant stakeholders, e.g. to authorities responsible for planning and managing competing land uses. Attention should be given to those industries likely to require CRM or strategic minerals or element such as the energy, transport or information communications technology (ICT) sectors. Information on strategic raw materials forecasts, also in relation to e.g. environmental (e.g. footprint), social (e.g. competing land uses, acceptance) and economic (e.g. jobs and growth, key enabling technologies) aspects are welcome.

Proposals might focus either on the assessment of undiscovered resources or on individual raw materials (topic or material). In both cases there may be separate work packages addressing different raw materials. In particular, the projects should:



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- Identify areas with potential for critical raw materials or strategic minerals (e.g. prospective mineral deposits, past and active mines)
 - Identify processes leading to CRMs enrichment (e.g. systematic mineralogical, geochemical and/or geophysical characterization), and ascertain the different types of deposit hosting CRMs or strategic minerals or elements
 - The undiscovered resources of Europe should be estimated using either established methods or techniques to be developed as part of the project proposal. Resources in this context may be any mineral raw material
 - Case studies should be developed which demonstrate the usefulness of the findings of the work.
 - Information generated by the project shall be provided to the EURMKB, SRT RM1 and the GeoERA Information Platform.

Expected Impact

- Increase the reliability of data and information to the EURMKB as a basis to improving trust and acceptance by society of minerals development and as a basis for economic and social planning, to enhance Europe's attractiveness for mineral investment
- Contribute to self-sufficiency of raw materials within Europe
- Contribute to achieve common European goals such as the circular economy; sustainable development; a Resource Efficient Europe; and the Investment Plan for Europe (Juncker Plan)
- Assist in raw materials planning at a national and international level
- Improve access to raw materials resources by providing information to relevant authorities involved in assessing the use of both the surface and subsurface
- Improve accountability of Europe's actions in the context of raw materials extraction.



RM5 - RAW MATERIALS MODELLING AND INTERACTIONS WITH ENERGY AND GROUNDWATER

Estimated total budget of this SRT	1.15 MEUR
Expected budget per proposal	1.15 MEUR
Number of projects to be funded within this SRT	1

Challenge

Mining activities, such as the on- and offshore exploitation of minerals, and the disposal of waste are examples where interaction with geo-energy or groundwater resources takes place. Reliable 3D geological models e.g. connecting deep and shallow parts of the subsurface, are necessary for better understanding and management of risks from multiple uses to support stakeholders and policy makers in evidence-based decision-making for sustainable subsurface management. Mineral resources are intrinsically defined in 3 dimensions. GSOs across Europe have their own approach for collecting, inventorying and analysing subsurface data. Consequently, different 3D geological models and dissemination platforms are used. Harmonizing and combining data should lead to a better understanding of the underlying processes and help to evaluate interactions.

Scope

Modelling of the subsurface is a complex issue requiring the design and development of systems and protocols to assist both the practitioner and the user. Modelling systems include regular layer, voxels or blocks, triangulation, and irregular 3D polyhedral shapes. Modelling protocols need to address INSPIRE issues. Demonstration projects need to be developed which illustrate the applications of these systems and protocols to geological, planning and subsurface use issues. Proposals should address as many of the following issues as possible:

- Demonstrate the application of selected geo-models for cross-border and cross-thematic resource assessment applications
- Structural modelling to depths of up to 5km to aid exploration for deep-seated mineral raw materials deposits (the distribution of known mineral deposits should be illustrated) and gain an understanding of the interaction of different earth resources, such as groundwater and geo-energy
- Describe how linear (e.g. borehole), surface (e.g. fault surface) and volume (e.g. lithological unit) elements are to be incorporated into 3D models and describe the geological evidence that may be used to define them
- Developing a common protocol, that takes into account differences in data quality and quantity, and develop a “guidebook” documenting the protocol that can be applied to other regions and resources
- Build on the outcome of previous projects (e.g. ProMINE) and expand its application to the whole of Europe
- Provide case studies on structural modelling of raw materials for policy support.

Expected Impact

- Improved knowledge base of the spatial distribution of resources; integration of data - methodology and procedures of different partners
- Data, information and knowledge that supports mineral exploration through the development of reliable, feasible and economic viable modelling systems



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- Reduced fragmentation of information between various authority levels (local, regional, European). Contribution to subsurface management, improved integrated spatial planning and policy support.



6 Information Platform Specific Research Topic

IP1 - DEVELOPMENT OF AN INFORMATION PLATFORM TO SUPPORT MANAGEMENT AND PROVISION OF DATA FOR THE THREE OTHER THEMES

Estimated total budget of this SRT	3.9 MEUR
Expected budget per proposal	3.9 MEUR
Number of projects to be funded within this SRT	1

Specific challenge

The overall aim of GeoERA – to integrate European GSOs’ information and knowledge on subsurface energy, water and raw material resources to contribute to sustainable use and management of the subsurface – requires a coordinated effort in order to make the results interoperable at a European Level. This is in particular the case because the other GeoERA projects will produce large amounts of complex geological information. Data, services and requirements will have many similarities across the GeoERA themes. The project results will be of much higher value being available according to agreed standards through a common platform. This is relevant for pan-European, cross-border as well as cross-domain information. Therefore, a common Information Platform (IP), where European, national and regional policy makers as well as industry, science and other stakeholders will have user-friendly access to the GeoERA results, must be established. Previously a large number of geological data harmonisation projects have been completed, but in almost all cases, the results are not sustained.

Scope

The IP must include a central database, a web-portal and a digital archive. The content and functionality of the IP must be based on the requirements from the other GeoERA projects. Therefore, the proposal should clearly describe principles and structures for the exchange of information and collaboration between the project and the projects of the other GeoERA themes. The IP must include cross-domain integration and facilities for making information available in a user-friendly way for the stakeholders. This includes metadata systems for discovering data and data access services. The IP must exploit results from previous EU funded projects regarding harmonisation, organisation, exchange and dissemination of geoscientific data and must be based on the European Geological Data Infrastructure (EGDI). A mechanism for sustaining the platform after the end of GeoERA must be proposed. The IP must to the highest degree possible use European and international standards for the exchange of data including those from INSPIRE, OGC and CGI.

Expected impact

The IP must first of all add value by supporting the other projects in structuring and disseminating their results in an up-to-date, user-friendly and harmonised form thereby strengthening the scientific and societal impact of those. In the longer perspective, the project must pave the way for the establishment of a single access point to the combined European geological knowledge base that links the harmonized national information systems at Europe’s GSO’s. In addition to that, the establishment of the IP is in itself expected to have huge scientific and societal impacts in that it must enable scientists, public and private decision makers as well as industries to get a vastly improved access to the geological information to better solve their needs regarding geological issues but also in combining the geology with information from other domains like land use, physical infrastructure, transportation,



environment, biology, etc. Finally, the IP must contribute to the general Spatial Data Infrastructure of Europe by establishing or extending standards for data exchange of 3D/4D geology, etc. This is expected to enable stakeholders, like SMEs or consultants, to be able to develop services based on the GeoERA data and information results to thereby creating economic growth for Europe.