

# Towards a common geological data infrastructure for Europe

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Geology does not respect national borders. Hence, in order to get geological overviews of Europe, input from geological surveys in more than 35 countries is required. European policy makers have several times been forced to rely on the US Geological Survey to provide e.g. resource estimates from the European continent, but for obvious reasons there is a wish to base European decision making on European knowledge. Consequently, the European Commission and the European Parliament have formulated a request for the establishment of a ‘Geological Service for Europe’. In its strategy towards 2020, EuroGeoSurveys (EGS) addresses the creation of such a service through three pillars. EGS is an umbrella organisation through which national geological survey organisations of 36 European countries cooperate, referred to below as national surveys. The three pillars are designed to integrate input from all national surveys into a system that can swiftly act on urgent needs for knowledge-based decision support. The three pillars relate to joint research, data integration and sharing of facilities (Fig. 1). Whilst the third pillar has only recently been dealt with, the two first have already advanced through a number of recent initiatives. Having been a key player in numerous EU projects for many years, the Geological Survey of Denmark and Greenland (GEUS) has attained a central role in the implementation of these two pillars of the strategy, both as coordinator of the European Geological Data Infrastructure (EGDI, [www.europe-geology.eu](http://www.europe-geology.eu)) and as one of the biggest players in the so-called GeoERA programme. GEUS participates in ten projects and is a partner in the secretariat and the coordinator of the GeoERA Information Platform. The present paper outlines the main steps towards the current situation and provides a background for GEUS’ role in this.

## Towards a EU geological knowledge base

The European Commission has contributed financially through several framework programmes to increase knowledge sharing, capacity building as well as cross-border and pan-European research within different geoscience domains. In most cases, data play a central role, and EGS members have many years of experience in working together with the purpose of making geological data FAIR (Findable, Accessible, Interoperable and Reusable). In many cases, Euro-

pean projects have historically only had the participation of a limited number of national surveys, but in 2008 a flagship project funded by the EU was launched with the participation of 20 national surveys as a logical follow-up of the global OneGeology initiative ([www.onegeology.org](http://www.onegeology.org)). OneGeology aimed at assembling a geological map of the world on a scale of 1:1 000 000 by piecing together national contributions in whatever format they had, using distributed web services. The OneGeologyEurope project went a step further. GEUS and the 19 other European national surveys worked together for two years to produce a distributed, web-based surface geological map of Europe on a scale of c. 1:1 000 000 that was harmonised with a common data structure and agreed geological classifications. At that time, the project represented a leading edge activity, as it demonstrated the power of national organisations working together around a common data structure and nomenclature for geological units (geochronology and lithology). Importantly, the project built on principles and rules from the INSPIRE directive from 2007 and was thus not only a step on the way for the national sur-

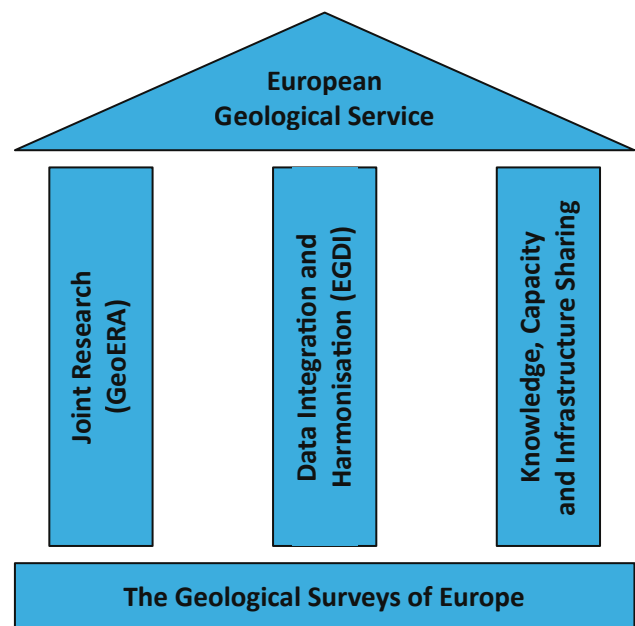


Fig. 1. The three pillars of the EGS strategy for the establishment of a European Geological Service.

veys to fulfil their obligations towards the directive, but also served to demonstrate the feasibility of making geological data interoperable for Europe and beyond. The results of the project were fed into the legal process to define the EU-wide INSPIRE geological data specification, which since 2014 constitutes the implementing rules.

Upon the success of OneGeologyEurope, a natural extension came with the increased attention on securing the supply of critical raw materials for European industry. This was partly based on the rare-earth element trade dispute that began in 2010 when China imposed strict export quotas for rare-earth elements. Such elements are used in a number of high-technology industries, and since China accounts for 97% of the world production, the situation was considered critical (Kalvig & Machacek 2018, this volume). Consequently, the European Commission urgently needed an overview of raw materials resources in Europe. This led to a number of EU projects. Especially one of them had strategic importance for the EGS, namely the Minerals4EU project. GEUS cooperated with 27 other national surveys and other EU organisations to build the foundation for a European raw materials knowledge base, by extending the OneGeologyEurope philosophy and by complying with and contributing to INSPIRE. Subsequently, other EU projects like EURare, ProSUM, MICA and the recently launched ORAMA project have extended and/or improved this common knowledge base. At the same time GEUS also participates in the Knowledge and Innovation Community (KIC) for Raw Materials, through which a number of complementary projects are run in cooperation with universities and industrial partners.

Simultaneously with these raw materials projects, a number of other European data harmonisation projects were

carried out within other EGS research areas such as groundwater, energy, geohazards and soil. However, it became increasingly clear along the way that there was a need for co-ordination in order to increase the efficiency, reusability and sustainability – not only to meet European expectation, but also for the sake of geoscientists. This was addressed in the EGS strategy that was published in 2014 and laid the foundation for the European Geological Data Infrastructure.

## The European Geological Data Infrastructure

In 2012, EGS' members were granted a two-year EU project called EGDI-Scope, aiming to assess the possibilities of setting up a long-term sustainable European geological data infrastructure in line with the second pillar of the EGS strategy. The initiative addressed the fact that almost all previous common European geoscience projects had succeeded in producing good European datasets and commonly also web-based dissemination platforms, but that such systems would typically disappear after a certain period because of lack of financial support for basic operation and maintenance. The EGDI-Scope project revealed that data from more than 80 past European projects, worth 400–700 million Euro, could potentially be 'saved' and made available through a common data infrastructure which should also be the natural dissemination platform for future projects. GEUS was part of the EGDI-Scope core team and was in charge of stakeholder consultation, thereby analysing both end-user needs and interfaces to other large European earth science projects and initiatives.

An important goal of EGDI-Scope was to pave the way for a larger EU project, whereby EGDI could be implemented.

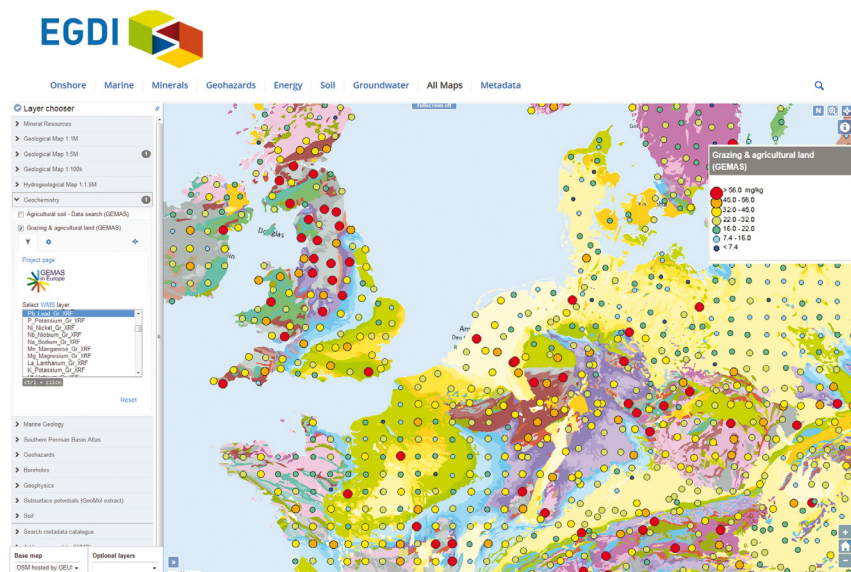


Fig. 2. The interactive map viewer of the European Geological Data Infrastructure (EGDI) portal through which hundreds of different data themes can be viewed in combination. The map shown here illustrates the concentration of lead in grazing land (coloured dots) on top of a geological map of Europe.

Unfortunately no appropriate Horizon 2020 (EU's framework programme) calls were launched, and two proposals targeting some generic electronic infrastructure calls were rejected. However, the concept of EGDI was widely used in strategic communication, and eventually the situation became critical: everybody talked about EGDI, but it did not exist. Consequently, GEUS mobilised the so-called 'Spatial Information Expert Group' of the EGS, and after a long process of argumentation and communication the EGS General Assembly accepted to provide in-kind resources from the national surveys to establish a first basic implementation of the EGDI.

### EGDI version 1

On 14 June 2016, the first version of EGDI was launched at the premises of the EGS secretariat in Brussels. Besides directors and other EGS key persons, the audience comprised a number of distinguished EU commissioners representing different parts of the commission, including DG GROW (raw materials), DG MARE (maritime affairs), DG ENER (geoenergy), DG RTD (research) and DG JRC (joint research and INSPIRE). The participants were very happy with what they saw. Even though it is not fully-fledged, EGDI V.1 contains most parts of the system that was identified under the EGDI-Scope project. A number of datasets from past European projects are included and made available through a common web portal ([www.europe-geology.eu](http://www.europe-geology.eu); Fig. 2), which was to a large extent developed by GEUS. However, the portal is only a small part of EGDI. The infrastructure itself consists of a complex of central databases, a metadata catalogue and distributed web services that all conform to the same standards. Roles and responsibilities are agreed internally in EGS, and work is in progress to establish a more permanent governance structure.

### EGDI in the European landscape of electronic infrastructure

EGDI is not alone! There are many other related European initiatives (Fig. 3) and a few will be mentioned here. The European Plate Observing System (EPOS) is a research infrastructure for solid-earth sciences in Europe and is of strategic importance to the EU. It aims to facilitate research into natural disasters such as earthquakes and volcanic eruptions through the integration of geoscience data from a number of different research communities. Geological data represent one of the domains that EPOS will integrate; the EGS community is the main provider of such data. GEUS has a role in the implementation project EPOS-IP and actively uses this position together with other participating national surveys to ensure the complementarity between EGDI and EPOS through various coordination activities.

The European Marine Observation and Data Network (EMODnet) is a large programme aiming at providing uniform access to marine data from Europe's coastal states. EMODnet is divided into seven discipline-based themes, one of which deals with geological data. The EMODnet-geology project has been running in several phases since it started in 2008. In the current third phase, GEUS has leading role in the work package dealing with data management and web portal development – again a strong position that GEUS uses to strengthen the coherence of the European e-Infrastructure landscape through technical coordination with EGDI, EPOS and other large initiatives.

The role of EGDI as a central data-bearing component in European geoscience research is continuously being strengthened through coordination with other European projects and programmes. One of these is GeoERA.

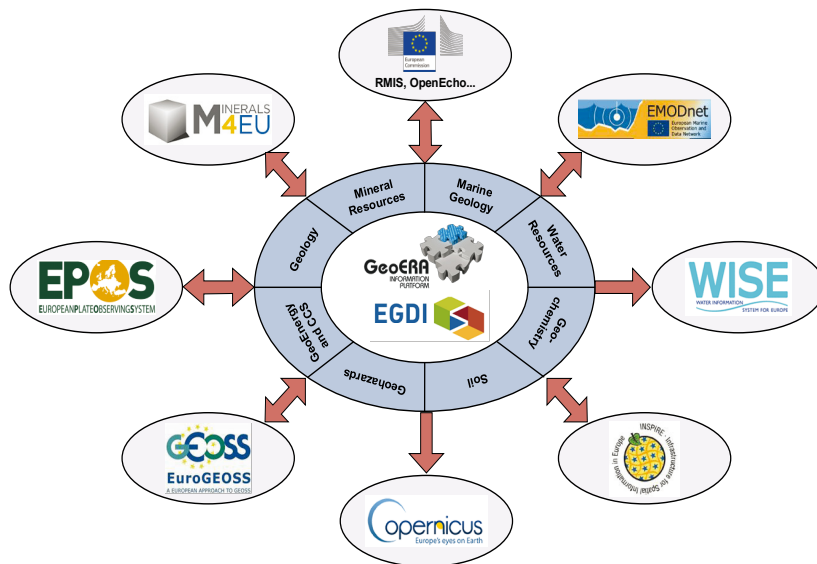


Fig. 3. The central position of the EGDI in the European e-Infrastructure landscape. EGDI serves geological data from a lot of different geological research areas and thereby contributes geological data to numerous European information systems through interoperable web services.

## GeoERA

The first pillar of the EGS strategy, the joint research pillar, is on its way to be implemented through an ERA-NET on 'Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe (GeoERA)'. The main objective of GeoERA (<http://geoera.eu>) is to contribute to the optimal use and management of the subsurface. Forty-eight national surveys from 33 European countries will participate in research projects under GeoERA with the purpose of supporting a more integrated and efficient management as well as a more responsible and publicly acceptable exploitation and use of the subsurface. GeoERA covers the three geoscientific themes of geo-energy, groundwater and raw materials; the projects will run for three years starting in July 2018.

The three geoscientific themes share the objective of organising and disseminating a large amount of results in the form of digital maps and other data. Furthermore, cross-thematic integration of information is an important aspect of GeoERA. It has therefore been decided to establish a common 'Information Platform' for the efficient integration of all IT-related and technical issues (database and dissemination) from all GeoERA projects. The platform will be capable of integrating up-to-date data, interpretations and models from different and distributed sources, both within and across the three main geoscientific themes of GeoERA.

The platform will be based on EGDI which contains some of the functionality foreseen to be required by the GeoERA projects. EGDI will, however, have to be extended in order to handle and disseminate for instance 3D/4D geological models.

In addition to organising the geoscientific projects, GeoERA also carries out 'foresight activities' with the purpose of assessing how longer-term funding of the activities can be obtained and eventually lead to a 'Geological Service for Europe'. The safeguarding of the GeoERA results through the information platform and the long-term operation and maintenance of the entire EGDI should be seen in this context.

## The future

One of the main challenges for all these European initiatives, including EGDI, is to make them sustainable. All EU projects are run for a limited period after which the funding

ends, and due to budget mechanisms, the European Commission is not in a position to fund permanent maintenance of any system. EGS has therefore continuously tried to find sustainable funding models to keep EGDI alive in a technical and organisational sense. Currently the EGS members are able to finance the very basic operation of EGDI. From 2018–2021 work within the GeoERA projects will ensure that EGDI will be significantly upgraded with much more data and functionality. With EGDI becoming a continuously bigger and more integrated piece in the European puzzle, the chances of finding a long-term solution are on the increase, but a sustainable solution will probably have to be connected to the establishment of the 'Geological Service for Europe' at least partly funded by EU.

Other challenges facing the generation of truly pan-European harmonised geological datasets are that some of the most relevant data are considered confidential in some countries. This is for instance the case for some data about mineral occurrences in certain East European countries. In other countries the organisation and provision of data are the responsibility of regional authorities instead of national surveys, who are less committed to the European viewpoint on data than EGS.

Finally, it has turned out that it is difficult to convert national geological databases and make them interoperable according to the requirements in the INSPIRE implementing rules. Many of these rules are very complicated, and many resources have been allocated to the database administrators at the national surveys in order to make their data compliant with the standards.

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