A Geological Service for Europe

to deploy subsurface data, information, and knowledge for a sustainable, clean industrial future.

This paper is presented by EuroGeoSurveys, a not-for-profit member organisation representing the European Geological Survey Organisations, a >10,000 strong workforce collaborating through scientific expert groups, task forces, and EU-funded projects including our flagship Geological Service for Europe project (GSEU). EuroGeoSurveys' vision is to deliver a sustainable Geological Service for Europe – a data, information, and knowledge-based service drawing on the unique mandates of each National Geological Survey Organisation (NGSO) and their collaborative strength to support a sustainable future for Europe.

Main message

- The European GSEU project realises the foundation of a Geological Service for Europe grounded in pan-European integration and harmonisation of national subsurface data and collaborative research by NGSOs.
- Continued access to state-of-art European subsurface information and expert advisory services can only be secured with **structural, long-term implementation of a Geological Service for Europe**. This requires European-level funding aligned with strong national mandates for ongoing integration of NGSO data and programs with European policy and decision support platforms.

Call to Action

Through GSEU, we are exploring organisational, governance, and funding models to make the Geological Service for Europe a reality. To take the next steps, we need involvement of all NGSOs and from the EC. This requires endorsement of our ambitions at the highest possible national level to solicit EU-level commitment and resources. We request **national endorsement** for the establishment of a Geological Service for Europe to be directed to relevant representatives of the European Commission and European Members of Parliament.

The subsurface is essential for our societal needs

Geology comprises all natural processes and elements that occur in the Earth's interior (subsurface) and its surface. Human interactions take place between surface and 5 km depth. This upper part of the Earth is essential for extracting energy, mineral resources, and groundwater, storing heat, cold, natural gas, hydrogen, feedstock gases, and CO2. The upper 100 m pro-

vides the substrate for our living environment (nature, cities, infrastructure, agriculture), ecosystem services such as soils and groundwater, and is used for the construction of cables, pipelines, building foundations, and tunnels for transport and storage. Aside from human use of the surface and subsurface, many natural processes may impact society, e.g., landslides, flooding, drought, earthquakes, volcanic activity, environmental deterioration, for which geological knowledge is essential to mitigate risk.

A new perspective on subsurface use and protection

Until recently, extraction of fossil fuels and mineral resources, and groundwater pumping, have dominated geology's role in fulfilling societal needs in terms of supply security and economic benefits. However, climate, geopolitics, and economics are driving new subsurface uses and risks. Major interventions are needed to secure and protect subsurface capital for future use, e.g.:

- To meet massive demand for critical raw materials (CRM), mitigate the worst effects of climate change, and enable a clean energy transition, mining and fossil energy extraction is shifting towards innovative mining, renewable geo-energy, and underground storage technologies. This shift increasingly requires detailed information for new and underexplored parts of the subsurface and development of new types of geological information and knowledge.
- There are increasing spatial conflicts between different subsurface uses as well as between subsurface use and a combination of surface uses, vulnerable natural resources, ecosystems, and public concerns. As a result, land, marine, and subsurface planning increasingly rely on geological data and knowledge to secure efficient decision making and avoid future regrets.
- Changes in the mining and fossil energy market, including falling exploration investment, are resulting in departure of operators with historic knowledge bases, knowledge crucial for future sustainable subsurface use, e.g., exploration and maturation of prospects, drilling wells, operating and monitoring. NGSOs must secure, manage, and optimise future use of this data.

The importance of securing and re-using subsurface information

The Earth's interior is largely hidden from us: we can see only a small part at the surface. To understand what's beneath, we rely on drilling deep boreholes or using special tools (geochemical and geophysical) to measure its properties. This helps us understand the Earth's composition, structure, and processes and is crucial for finding resources e.g., minerals, energy, groundwater, and identifying suitable storage sites, e.g., for CO2. Collecting this data is expensive and time-consuming and is often done by companies exploring for resources or by NGSOs and some other government agencies. The availability of data depends on how much exploration has been done, whether it is considered economically viable and whether they are considered as strategic. NGSOs have key roles in collecting and analysing geological data, which is incredibly valuable (in the 10s of billions of euros), but with potential benefits many times greater than the cost of acquisition: it can help us find resources (e.g., geothermal energy, CRM, storage), reduce risks, and make better land use decisions. Unfortunately, this data can be lost or difficult to access. NGSOs, through their national mandates and legislation, are protecting data and making it available for future use, also using new technologies such as big data and AI to help us unlock its potential.

The need for and value of a Geological Service for Europe

A Geological Service for Europe is a pan-European data, information, and knowledge-based service drawing on the data and expertise of NGSOs to support a sustainable future for Europe.

Structural implementation of a Geological Service for Europe will deliver benefits at European and national level:

- Through **data acquisition, research, and access to legacy data**, secure and deploy pan-European geological information of Europe's surface and subsurface to support resolving future continental challenges e.g., clean energy, CRM, groundwater, natural hazards, and climate change,
- Ensure the European Commission and EU institutions, Member States, and other European countries have **access to transnational state-of-art knowledge** for their decision processes.
- Provide technical support to strategic international partnerships.
- Establish a **permanent body of geological experts** for advice on transnational strategic issues: resources, environmental protection, and geohazards, supporting national-level expert input and knowledge sharing, and levelling up geoscientific professional capacities across Europe.

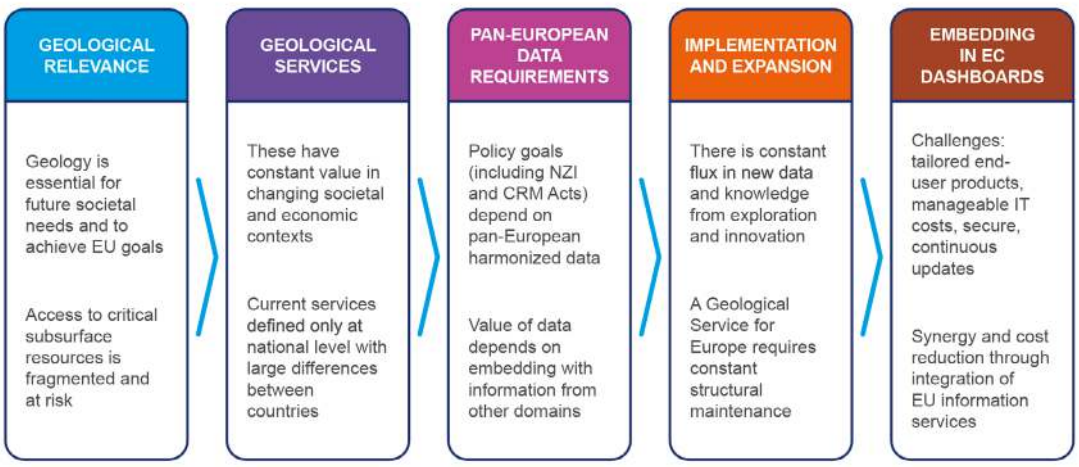
The GSEU project is establishing the core elements of a Geological Service for Europe. Now the challenge is to secure a permanent service and implement it as a formal European-scale instrument.

What is needed to develop a permanent Geological Service for Europe?

The ambition for a sustainable and up-to-date integrated Geological Service for Europe will only be possible with strong commitments, mandates, and resourcing. Firstly, a national mandate for NGSOs to participate is a key prerequisite to benefit from the Geological Service for Europe. Secondly, European-level structural funding must be allocated and aligned with strong national programs, with resourcing appropriate to the information, research, and advisory capacities required for a successful Service. European funding will enable both national and European impacts that are not otherwise possible including European-scale levelling-up of geoscientific capacity and expertise for policy implementation, common implementation actions, and cost-saving through coordination of research, information, and expert advisory services.

To integrate geological information repositories and ensure such information is fit-for-purpose for Europe's policy goals, a Geological Service requires collaboration with the European Commission and organisations maintaining information infrastructures and policy dashboards. This should be achieved through collaboration agreements delivering an actionable joint European agenda, including alignment with national programmes and mandates, e.g., national exploration programmes mandated under the CRM Act and national geological data required under the Net Zero Industry Act. Fit-for-purpose services, delivering state-of-art geological knowledge for high-priority policy areas should be supported by tailored European service contracts. Resourcing should also include European-level resourced R&I to deliver state-of-art geoscience to support needed subsurface knowledge and management. Long-term success requires a robust financial and operational framework with sustained European investment and adaptive governance to meet evolving scientific, societal, and policy needs.

From geological data to services for policy implementation



Our progress to date toward a Geological Service for Europe

In recent years, NGSOs, notably through EU projects and programmes including GeoERA, GSEU, and Minerals4EU, have made significant progress through, e.g.:

- Developing **data and information services** on raw materials, geo-energy, groundwater, marine geology, geochemistry, geo-hazards, geoheritage etc.,
- Developing the **European Geological Data Infrastructure** that provides access to these services as well as links to other infrastructures, e.g., RMIS, EMODnet, EPOS, EGMS.
- Fostering **structural collaboration** between Europe's NGSOs,
- Fostering **international partnerships** through NGSOs, geological survey associations, and technical support to EU bi-lateral strategic partnerships.

However, delivering on EU targets for CRM, renewable energy, CO2 storage, groundwater preservation, soil health, and more, require a major shift from project-based operations to secure, long-term implementation through a sustainable Geological Service for Europe. **The following requirements are critical** for such a Service beyond the 2022–2027 GSEU project:

- **A mandate** from EU Member States and other European countries to establish and participate in the Geological Service for Europe
- **An ongoing commitment** from EU Member States and other European countries to deliver relevant harmonised national data at European level, with European-level support
- **Alignment and collaboration** with the European Commission and organisations responsible for maintaining information infrastructures and policy dashboards to integrate geological information repositories and ensure information is fit-for-purpose.
- Enable **tailored European service contracts** to guarantee the latest state-of-art geological information and knowledge for high-priority policy areas.

Geological services are needed at European scale

NGSOs are public national and regional institutes with mandates to gather and preserve subsurface information, advance geological knowledge, and advise national stakeholders and society on subsurface use and protection. Geological information and research are mostly governed nationally with varying degrees of detail and quality. Investment in harmonised trans-boundary geological information of appropriate scale and quality has been limited and mostly results from finite projects. Recent legislation increasingly recognises the importance of integrating national information at pan-European level, e.g., the Net Zero Industry Act and the CRM Act, both supported by outputs of GSEU. Such knowledge-sharing is also crucial for protection of soils and groundwater, and managing and mitigating geohazards and climate impacts. Without such trans-boundary and European-scale information, there is no European overview of our collective resource potential or risks. Nor is there a framework for European-level support to building the required geoscientific expert knowledge for decision-making, resource management, and EU-level reporting – expertise and best practices that may not be otherwise available at national level. Currently, there are no incentives for ongoing, sustainable structural maintenance and updates of geological information at European scale (beyond a project-based system), nor is there a framework to ensure ongoing integration, harmonisation, and dissemination of geological information and research for all European countries. Crucial information is still lacking for many European regions, hampering a comprehensive overview of resources and subsurface environments and geohazards critical for cross-border and pan-European decision making. These are the roles of a sustainably EU-resourced Geological Service for Europe.