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

Technical review report for project GIP-P

This report is part of a project that has received funding by the European Union's Horizon 2020 research and innovation programme under grant agreement number 731166.

INTRODUCTION

Technical review report is part of GeoERA's Monitoring and evaluation process for co-funded projects (*hereinafter: project*). The aim of a technical review is to assess the work carried out under the project over a certain period and provide recommendations. Such technical review evaluates the project reports and deliverables, the proper use of resources, the management of the project and the expected impact.

Technical review report consists of four sections, each representing one level of monitoring and/or evaluation of the project:

Level	Monitor / Reviewer	Input	Aim
1 – Monitoring of progress indicators	Monitoring and reporting officer (GeoZS)	MPPR* FPPR**	Monitoring of the effectiveness of implementation of selected projects with respect to finance, time and administration.
2 – Scientific review	Reviewers (GeoZS)	Submitted deliverables MPPR FPPR	Quality review of the deliverables and review of achieving scientific and professional goals.
3 – Review of the theme progress	Theme coordinators	MPPR FPPR	Review of achieving theme objectives.
4 – GeoERA Progress evaluation	Stakeholder Council member(s)	Sections 1 and 2 of this report Review meetings	Overall project progress and general recommendations.

*MPPR = Midterm Project Progress Report (see PI doc no 2)
**FPPR = Final Project Progress Report (see PI doc no 2)

Monitoring and evaluation process:

M0 = End of reporting period
M1 = Submitted (Final) Project progress Report (MPPR / FPPR)
M2 = 1 – Monitoring & 2 – Evaluation
M3 = 3 – Evaluation of the theme progress
M3 = (Final) Review Meeting & 4 – Progress evaluation

Each project will be reviewed twice: for first project period M1-M18 – Technical review report, and second project period M19-M36 – Final review report.
Technical review report is based on Horizon 2020 templates but adopted to GeoERA needs. Technical reviews of projects shall be carried out on a confidential basis.

GENERAL INFORMATION

ERA-NET Cofund Grant Agreement:	731166
ERA-NET Cofund acronym:	GeoERA
Call identifier:	H2020-LCE-2016-2017/H2020-LCE-2016-ERA
Project full title:	GeoERA Information Platform project
Project acronym:	GIP-P
Project reference number:	GEoE.171.014
Project topic:	
Project specific topic:	
Lead partner:	GEUS Geological Survey of Denmark and Greenland
Project website:	https://geoera.eu/projects/gip-p/

☐ Technical review report

☒ Final review report

Period covered	01/01/2020 – 31/10/2021
Review meeting date	09.12.2021; start at 19:30

Contributor:	Role:	Approved on:
Barbara Simić	Monitoring and reporting officer	9.12.2021
Aleksandra Trenchovska	Monitoring and reporting officer	10.12.2021
Jasna Šinigoj	Scientific reviewer	13.12.2021
Matija Krivic	Scientific reviewer	17.12.2021
Antje Wittenberg	Theme coordinator RawMaterials	24.12.2021
Klaus Hinsby	Theme coordinator Groundwater	6.1.2022
Serge van Gessel	Theme coordinator Geothermal Energy	24.12.2021
Harvey Thorleifson	GeoERA Stakeholder	12.1.2022
Lesley Wyborn	GeoERA Stakeholder	7.1.2022

1 LEVEL 1 – MONITORING OF PROGRESS INDICATORS

In this section the project is monitored "remotely" on the basis of the respective reports. This part is filled in by Monitoring and reporting officer with aim to monitor the effectiveness of implementation of the selected projects with respect to finance, time and administration, based on submited MPPR and FPPR.

	Yes	Partially (comment needed)	No
PROJECT MANAGEMENT			
Has the MPPR / FPPR report been submitted on time?	☒	See comment no. 1	☐
Have there been any changes in project partnership?	☒	See comment no. 2	☐
Has the project management been performed as required?	☒		☐
Has the collaboration between partners been effective?	☒		☐
Do you identify evidence of underperforming partners, lack of commitment or change of interest of any partners?	☐ (see comment)		☒
DELIVERABLES and MILESTONES			
Have the planned deliverables for the period been submitted on time according to timeline in Project Agreement?	☐	See comment no. 3	☒
Have the planned deliverables for the period been completed (from MPPR / FPPR, sheet 4)	☒		☐
Have any changes to deliverables occurred (type/ dissemination level)? (from MPPR / FPPR, sheet 4 and 5)	☒		☐
Have planned milestones been achieved for the reporting period? (from MPPR / FPPR, sheet 4)	☒		☐
Have the project partnership identify any difficulties achieving any of the deliverables / milestones?	☒		☐
DEVIATIONS (from MPPR / FPPR, sheet 5)			
Has the project partnership identify any deviations that will not affect projects outputs?	☒		☐
Have any deviations occur on the project, with impact on project outputs?	☒	See comment no. 4	☐

In case of deviations, have the project adopted corrective measures?	☒		☐
DISSEMINATION, COMMUNICATION			
Has the project adopted its dissemination plan?	☒		☐
Have the planned dissemination activities been completed for the reporting period? (from MPPR / FPPR, sheet 6)	☒		☐
Have the partners' disseminated project results and information adequately?	☒		☐
Is the project following dissemination plan?	☒		☐
Is the project interacting in a satisfactory manner with other GeoERA projects?	☒		☐
Is the project interacting in a satisfactory manner with national/international bodies?	☒		☐

FINANCE			
To the best of your estimate, have the resources used been utilised for achieving the project? (according to MPPR / FPPR, sheet 9)	☒		☐
To the best of your estimate, have the resources used been in a manner consisted with the principle of economy, efficiency and effectiveness?*	☒		☐
Are there any major deviations in the budget consumptions from the financial plan? (zero consumption in M18; deviation from plan exceeding 20% in M36)	☒	See comment no. 5	☐
Are there any major deviations in the Person - Months consumptions from the plan? (zero consumption in M18; deviation from plan exceeding 20% in M36)	☒		☐
Are any budget modifications for the project needed? (from MPPR / FPPR, sheet 5)	☐		☒

***The principles of economy, efficiency and effectiveness**: refers to the standard of "good housekeeping" in spending public money effectively. Economy can be understood as minimising the costs of resources used for an activity (input), having regard to the appropriate quality and can be linked to efficiency, which is the relationship between the outputs and the resources used to produce them. Effectiveness is concerned with measuring the extent to which the objectives have been achieved and the relationship between the intended impact and the actual impact of an activity. Cost effectiveness means the relationship between project costs and outcomes, expressed as costs per unit of outcome achieved.

Comments (highlighting the project progress) / deviations / recommendations:

The main objective of the GIP -P project was to support all three scientific themes and to link the results of all 14 scientific GeoERA projects in one information system in order to organize, standardize, disseminate and secure their results (background data, digital maps, geological models, reports, etc.) according to the guidelines of FAIR, while ensuring high quality and cost-effectiveness. The project had 3 purposes: 1) to support the 14 projects in achieving their specific objectives, 2) to ensure that the outputs of the overall GeoERA programme are more accessible and standardized across the 14 projects, supporting GeoERA's overall objective of providing solutions to cross-thematic issues, and 3) to ensure the sustainability and accessibility of GeoERA's digital outputs in the long term. To ensure that the objective and purpose were achieved, the project consortium was in constant contact with the liaison officers of each scientific project, guiding them through the data requirements and translating the scientific view into IT technical requirements. The results of the 14 projects are published in the European Geological Data Infrastructure (EGDI) database, which presents their results in maps, systematizes their metadata, provides a document repository, project vocabularies and multilingual keyword thesauri to ensure maximum interoperability and documentation of scientific terms and concepts. The decision to use the EGDI database was based on its stability and sustainability, which ensures that the maps and data remain available after the projects have been completed. The platform was already in place before GeoERA and contained the data from previous projects. With the data from GeoERA, the database doubled in size and was expanded to include 3D data and document repository. The consortium is aware there is a room for improvement and will consider possibilities to make the databases better. In 40 months, during which all projects were affected by the pandemic, the project consortium succeeded in fulfilling its purpose and achieving its objective.

The EGDI platform will remain active and updated after the end of GeoERA. The platform will be integrated into the upcoming CSA project for the next 5 years. In the long term, the EGDI will be maintained as one of the main pillars of the planned Geological Service for Europe even after the CSA project.

The Covid 19 epidemic had an impact on the progress of the GIP -P project. In December 2020, the project was extended by 4 months, from 30.6.2021 until 31.10.2021. The postponed project activities were appropriately communicated to the GeoERA Executive board, which has reviewed and approved the changes in terms of achieving the project outcomes. A detailed list of changes is part of the project documentation in the Project plan History of changes.

The project management structure was well defined and efficient. The pandemic situation required a high degree of flexibility of the partnership and adaptability of its activities and management of the 14 scientific projects. With the exception of one

scientific project, 13 projects were extended until the end of October, the same number of months as the GIP -P project. The delays in the projects gave the project consortium less time to sort and publish the data, which increased efforts towards the end of the project and afterwards to ensure that the results were published even if the other projects were late in submitting their data. To ensure the achievement of the set targets, the partners increased their efforts, which translated into higher expenditure on person-months and personnel budget, mainly due to unused travel costs. Overall, the project consortia spent 95% of the planned budget. The project did not identify any underperforming partners that could affect the quality of the project outputs.

A detailed and targeted communication and dissemination plan was adopted and a description of the activities with timetable was provided. The project's communication and dissemination activities followed this plan.

Comment no. 1: The Final Project Progress Report was submitted on time in draft form. Partners still have a chance to recalculate their financials until the end of calendar year to include the final data, so minor deviations can be expected. The changes will not affect the projects content.

Comment no. 2: During the implementation of the project, one partnership changes occurred: partner IGME-Sp Geological Survey of Spain has been integrated into CSIC Agencia Estatal Consejo Superior de Investigaciones Científicas. The change has not impacted project's ability to reach its goals and results.

Comment no. 3: Due to the pandemic situation, some activities were delayed, and deliverables had to be submitted later than planned. The changes in the deliverable dates were communicated with the Monitoring team and the GeoERA Secretariat by amending the project plan.

The deliverable changes in the project implementation period are:

Reporting period 1:
D10.1 postponed from M4 (31.10.2018) → M7 (31.1.2019)
D3.1 postponed from M9 (31.3.2019) → M11 (31.5.2019)
D3.2.1 postponed from M12 (30.6.2019) → M14 (31.8.2019)
D3.2.2 postponed from M15 (30.9.2019) → M18 (31.12.2019)
D5.1 moved from M18 (31.12.2019) → M16 (31.10.2019)

Reporting period 2:
D8.3.2 postponed from M24 (30.6.2020) → M28 (31.10.2020)
D5.1 is deleted → new deliverable D5.3
D5.2 is deleted→ new deliverable D5.3
D7.3 postponed from M30 (31.12.2020) → M33 (31.3.2021)

D1.2 postponed from M31 (31.1.2021) → M33 (31.3.2021)
D1.3 postponed from M32 (28.2.2021) → M36 (30.6.2021)
D8.4 postponed from M32 (28.2.2021) → M40 (31.10.2021)
D4.4 postponed from M34 (30.4.2021) → M38 (31.8.2021)
D6.5 postponed from M35 (31.5.2021) → M39 (30.9.2021)
D7.4 postponed from M35 (31.5.2021) → M39 (30.9.2021)
D7.5 postponed from M35 (31.5.2021) → M39 (30.9.2021)
D9.2 postponed from M35 (31.5.2021) → M39 (30.9.2021)
D9.3 postponed from M35 (31.5.2021) → M39 (30.9.2021)
D10.4 postponed from M35 (31.5.2021) → M39 (30.9.2021)
D11.3 postponed from M35 (31.5.2021) → M39 (30.9.2021)
D11.4 postponed from M35 (31.5.2021) → M39 (30.9.2021)
D1.4 postponed from M36 (30.6.2021) → M40 (31.10.2021)
D1.2_6 is added M40 (31.10.2021)
D1.3_7 is added M40 (31.10.2021)
D5.3 is added M40 (31.10.2021)

Comment no. 4: Some deviations affected the project outcomes, all with positive effects. Early in the project it was decided to introduce a free text search, based on a system previously developed by partner IGME, to allow users to find information on all the different types of products that the scientific projects had delivered. IGME, together with other partners, has developed an EGDI version of the system, which was not foreseen in the proposal.

During the project implementation it was decided to include a 3D model viewer developed at GBA to work with the 3D database supplied by GEUS to the project. GBA developed this viewer as a modification of a viewer developed earlier.

The GIP -P project wanted all scientific projects to associate license models with their data. They placed more emphasis on explaining and making recommendations about Create Commons (CC) models, which resulted in an additional report for the GIP -P.

Comment no. 5: Some project partners have spent more than their planned budgets, others have spent less. The partner that has exceeded its budget is GTK. Partners that spent less than budgeted are: HGI-CGS , LfU, LNEG, NGU, SGU and TNO, all due to constraints from the pandemic situation. The unused project budget is transferred to partners that spend more than planned.

The project consortium not only achieved its goal on time, but also added to the already extensive list of deliverables, achieving more than was expected at the beginning. For this reason, the project is rated "overachieving" at level 1 and thus receives a rating of 5 - objectives and targets fully achieved and expectations exceeded.

Overall assessment of the project:

☒ 5 - **Overachiever** (the project has achieved all objectives and goals for the period and has even exceeded expectations)

☐ 4 - **Excellent progress** (the project has fully achieved its objectives and goals for the period)

☐ 3 - **Good progress** (the project has achieved most of its objectives and goals for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has achieved some of its objectives)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives)

Summary of dissemination activities:

	SCIENTIFIC COMMUNITY	GENERAL PUBLIC	POLICY MAKERS	EUROPEAN INSTITUTION	NATIONAL INSTITUTION	REGIONAL INSTITUTION	INTERNATIONAL INSTITUTION	LOCAL INSTITUTION	PRIVATE COMPANIES	OTHER	Total Target Group reach
EVENTS	260	449		375	80		20			40	1224
MEDIA	5	100									105
MEETINGS	3748			263	472					198	4681
ONLINE_MEDIA	1626	84798								193	86617
PUBLICATIONS	620	2470	5	5							3100
Total	**6259**	**87817**	**5**	**643**	**552**		**20**			**431**	**95727**

	BLOG	CONGRESS	FACEBOOK	INTERNAL PROJECT MEETING	LEAFLET	LINKEDIN	MEETING	MEETING WITH OTHER GEOERA PROJECTS	NEWSLETTER	OTHER	PINTEREST	PITCH EVENT	POSTER	SCIENTIFIC PUBLICATION	SEMINAR	TECHNICAL REPORT	TWITER	WEBINAR	WEBSITE	WORKSHOP	YOUTUBE	Total
EVENTS		2								3		3			2			7		8		25
MEDIA										2												2
MEETINGS				44			11	55		3												113
ONLINE_MEDIA	12		14			53				2	1						13		1		14	110
PUBLICATIONS					2				6				2	1		2						13
Total	**12**	**2**	**14**	**44**	**2**	**53**	**11**	**55**	**6**	**10**	**1**	**3**	**2**	**1**	**2**	**2**	**13**	**7**	**1**	**8**	**14**	**263**

Are the dissemination activities adequate?

☒ 5 - **Overachieved** (the projects dissemination activities have exceeded expectations)

☐ 4 - **Excellent** (the projects dissemination activities have fully achieved its expectations)

☐ 3 - **Good** (the projects dissemination activities are adequate)

☐ 2 - **Acceptable** (the projects dissemination activities are acceptable)

☐ 1 - **Unsatisfactory** (the project has failed to disseminate)

Cummulative financial statement:

	Person months	Total eligible costs	Reimbursement rate	GeoERA contribution	In-kind contribution
Plan	**538,15**	**3.693.304,59**	**29,7 %**	**1.109.384,70**	**2.583.919,89**
1st period consumption	191,32	1.371.882,27	29,7 %	407.449,03	964.433,24
2nd period consumption	370,78	2.123.645,47	29,7 %	630.722,70	1.492.922,77
TOTAL	**562,10**	**3.495.527,74**	**29,7 %**	**1.038.171,73**	**2.457.356,01**

2 LEVEL 2 – SCIENTIFIC REVIEW

In this section the project is reviewed ”remotely” on the basis of the respective reports. This part is filled in by reviewer with aim to review the quality of the deliverables and review of achieving scientific and professional goals. Scientific review is based on submitted deliverables and reported Impact statement in MPPR/FPPR.

Impact statement (from MPPR / FPPR, sheet 8):

According to the GeoERA Programme Specific Research Topic “IP1 - DEVELOPMENT OF AN INFORMATION PLATFORM TO SUPPORT MANAGEMENT AND PROVISION OF DATA FOR THE THREE OTHER THEMES” the GIP-P should “first of all add value by supporting the GSPs 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”. This has had the highest priority during the GIP-project through the strong focus on mapping and harmonising the requirements of the GSPs and by the selection and extension of the EGDI for the user access and we are confident that our work has had that effect.

In the longer perspective it is a requirement that the GIP-P shall “pave the way for the establishment of a single access point to the combined European geological knowledge base that links the harmonised national information systems at Europe’s GSOs”. The strong focus in the GIP-P on standards and the fact that all GeoERA results are accessible through the EGDI platform ensures this. A dedicated GeoERA instance of an EGDI map (https://data.geus.dk/egdi/?mapname=geoera) has been developed on which approx. 600 layers documenting the GSPs geospatial results is available for easy inspection, download and combination with other data. Comprehensive metadata (http://www.europe-geology.eu/metadata/) document the datasets so that the users are well-informed about the background, quality, etc. of the data of their interest and the free text system at https://geusegdi01.geus.dk/searchsystem/en/GeoERA and the document repository systems at https://search.europe-geology.eu/ makes it easy for the different user categories to find relevant results in the whole complex of data types produced by GeoERA.

The extension of the EGDI “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.” This again has been ensured by the emphasis on standard, FAIR data principles and the easy and user-friendly access via the EGDI.

Finally, it was required that the GIP-P “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”. The GIP-P has not only been

promoting and using the established standards it has also worked on extending those primarily through the implementation of Project Vocabularies where the GSPs' needs have required that.

Expected impact (from Project Agreement):

The primary impact of the GIP-P will be indirect as the project's primary goal is to support the GSPs and thereby the scientific and sociatal impacts that will result from those. The GSPs' impacts are expected to be considerably higher than they would have been without the GIP-P because the GIP will ensure a common access point to the GeoERA results and a much higher degree of harmonisation of the data and information making this much more useful for users working cross thematic and cross border or even pan-European. In the past, user-friendly access to geological data and information from across Europe has been very limited. A number of European data harmonisation projects successfully developed web portals, but these were never maintained after the end of the project. With the establishment of version 1 of the EGDI in 2016 by the EuroGeoSurveys members, the foundation for a long-term sustainable infrastructure was made. The first version was basic, but well-functioning, and basing the GIP-P on the EGDI will be an valuable and cost efficient instrument for advancing the developments and ensure that a number of different stakeholders in Europe will not only get user-friendly access to the results of the GSPs through a common access point, but that they will also be able to combine these results with data from numerous previous European and regional projects. By building on EGDI the GIP will furthermore bring additional value for scientists, decision makers and other stakeholders by giving access to the GeoERA results through the same portal as a wide range of other data and information about geology and related topics from the European Geological Surveys, including geohazards, geochemistry, geophysics and basic geology. This will significantly increase the value of the GeoERA results for the mentioned stakeholders. As EGDI, and the extensions to this through the GIP, adheres to established European and international standards, the GeoERA results will also be interoperable with data and information from other domains than geology like biology, land use, physical infrastructure and others. This will greatly increase the impact of the GSPs' results for a broad range of stakeholders. In addition to the support of the GSPs, the GIP/EGDI will however also in itself have great impact by enabling SMEs like software companies, consultants and similar to develop advanced services on top of the platform as the project will establish new or extend existing standards for data exchange of geoscientific data. An important example of this will be 3D/4D geological models where no standard exists today miking it difficult to build sustainable software for this kind of information. As EGDI originates from the EGS and is backed by this organisation, the platform can be considered sustainable also beyond the lifetime of the GeoERA programme itself. This will make it much more valuable for the SMEs as they can develop their services with a long-time frame.

Evaluation of deliverables

No.	Title	Status (Approve/ Reject)	Comments
D1.2	Internal progress report (4)	Approve	/
D1.3	Project progress meeting minutes (7)	Approve	/
D2.1.2	Data delivery plan	Approve	See below
This deliverable provides an overview of the final datatypes (formats, way of delivery, etc.) that each GSP will submit to EGDI, indicating when each dataset will be ready for testing and the date of their final submission.			
D2.1.3	Wrapping-up the synergies and overlaps highlighted between the projects in terms of geoinformation.	Approve	See below
This deliverable provides an overview of the synergies in terms of geoinformation that have been established among the GeoERA GSPs. It shows correlations among the data formats chosen by the different projects and among the different functionalities needed and synergies among different projects to create joint datasets, vocabularies, etc.			
D2.3.2	Fill-out of the gap between the first extensions to EGDI and the actual geoinformation produce by the projects.	Approve	See below
This deliverable describes the extension of EGDI needed to meet the requirements described in D2.3.1 and D2.2.2.			
D3.2.2	Technical requirements	Approve	See below
This report highlights the possible overlaps and potential synergies that could be established between different GeoERA projects. For architecture they recommended a mixed approach. Data providers are encouraged to try the distributed approach and set and configure tools to transform and expose their data in standard formats yet datasets that will not be reused in the future, a (semi-)central system will be available. In order to reduce the cost of tool setup learning, WP3 propose the data providers to capitalize on the use of specific software's/tools to transform and expose their data.			
D3.3	Validation service specification and requirements	Approve	See below
This report presents the existing procedures to validate network services and data models that can be implemented in the platform or used by data providers in different GSPs.			
D4.4	Final Report on semantic harmonisation	Approve	See below
The present report presents the results of work package 4 "Semantic Harmonisation Issues". The main goals were creating a geoscientific keyword thesaurus and the processing of terminological project knowledge as 'knowledge representation' and			

publishing both as RDF Linked Data. These goals were achieved. The results are good basis for the entry of the geosciences into Linked Data and Semantic Web in the future.			
D5.3	GIP Blueprint & GeoERA Central system specification (D5.1 and 5.2 ver2 merged into new D5.3)	Approve	See below
This document reviews the state of the EGDI platform with regards to the recommendation and gives a potential path for improvements of the EGDI platform following GIP-P.			
D6.4	Portal version 2	Approve	/
D6.5	Demonstrator portals, version 2	Approve	See below
This report describes the functionalities in the EGDI portal at the end of the GeoERA.			
D7.2	Report on testing	Approve	/
D7.3	Final version of Central database / harvesting	Approve	See below
This document focuses on the backend part, especially on the central databases and harvesting system of the EGDI and gives a basic overview of the whole system.			
D7.4	Final version of system management tools	Approve	See below
This document gives an overview of the EGDI management tools and the procedures that must be followed to deliver data to EGDI. They also contain links to extensive online documentations including recorded webinars and training videos.			
D7.5	Final version of metadata catalogue and populated metadatabase	Approve	See below
This deliverable describes the final version of the EGDI Metadata Catalogue. The integration of central codelists, connection to the EGDI Portal and the definition of certain rules have improved the degree of FAIRness achieved.			
D8.1	A series of cookbooks	Approve	See below
This report describes the cookbooks that were provided for EGDI Data and Metadata Delivery Guidance (about the types of data that can be delivered, about the pros and cons of delivering data by upload or by data services). Information is provided on creating spatial data sets and how to create your data sets in a way that make them most usable for the users. Instructions are provided on how to upload data sets or register data services in EGDI.			
D8.2	A series of e-Learning resources	Approve	See below
This report describes a series of e-Learning resources providing interactive delivery of the content created in deliverable D8.1. A series of e-Learning resources have been developed to make it easier for data providers to understand the guidance provided by the cookbooks.			

D8.3.1	A functioning support network (2)	Approve	See below
This deliverable describes a support network incorporating buddy system, email-based helpdesk and issue triage system.			
D8.3.2	Webinar training workshops (2)	Approve	See below
This report describes the webinars and videos that were provided (documentation for delivering data to the EGDI; using the GitHub issue tracker; series of metadata webinars; configuring maps & presenting data in the EGDI)			
D8.4	A series of example Docker containers	Approve	See below
This report describes the potential benefits for data providers who do want to set up their own services of using container technology and the results of experiments done with containerising some example OGC web services. Data providers who want to set up their own services are given guidance on how to install Docker and Git on their own local development computers			
D9.1	Report on the analysis of possible funding sources	Approve	See below
This deliverable describes potential funding options for sustaining the information platform (EGDI) after GeoERA. A long-term sustainable funding model for EGDI is the key to sustaining the results from the GeoERA scientific projects however such a model is currently not in place.			
D9.2	Report on financial models	Approve	See below
This report describes the funding possibilities that have been identified with main focus on the future Coordination and Support Action for a Geological Services for Europe which is expected to be granted under Horizon Europe in 2022.			
D9.3	Report on governance models	Approve	See below
This report describes the suggestions for governance. Main focus is on the future Coordination and Support Action for a Geological Services for Europe which is expected to be granted under Horizon Europe in 2022, but it will also be taken into account that EGDI is serving other projects than the ones from GeoERA and the CSA			
D10.2	A report covering limitations on free movement of geodata	Approve	See below
This report addresses the limitations on free movement of geological data and advocates the use of particular types of basic user/supplier forms. There are many factors that affect the free movement of data and within this report: consent, embargoes, data protection, user/ supplier licence agreements and acknowledgements/DOIs are analysed as to their potential effect on the GeoERA programme.			
D10.3	Report on new legislation covering access/open access, etc	Approve	See below

This document looks at data archiving and storage with a particular emphasis on legislation and how it affects the processes. Guidance for geospatial data preservation is discussed, as well as International Standards which apply to the area.			
D10.4	A study of the risks associated with geodata delivery in Europe	Approve	See below
This document looks at right to use and publish data with a particular emphasis on new initiatives and legislation and how it affects the processes. From initial observation of data and software by scientists at an early stage of the research process, it looks at the key considerations to enable either open access to output data or the required licenses to make the dissemination legal.			
D11.3	Information content material	Approve	See below
This deliverable contains the list of information material generated in the project in various formats (leaflets, posters, videos, newsletters, press releases and blog posts). This material has been focused on different target audiences to be distributed through various communication channels.			
D11.4	Report on Performance Audit	Approve	See below
This deliverable aims to review all communication and dissemination activities carried out, taking into account the project objectives and including, where possible, impact measurement as proposed in the GeoERA and GIP-P Communication Manuals. It shows the communication activities in relation to the different target audience, as well as the communication and dissemination channels used.			

Has the quality as a whole been achieved according to the objectives? Has the project as a whole been making satisfactory progress?

☒ 5 - **Overachiever** (the project has achieved all objectives and goals for the period and has even exceeded expectations)

☐ 4 - **Excellent progress** (the project has fully achieved its objectives and goals for the period)

☐ 3 - **Good progress** (the project has achieved most of its objectives and goals for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has achieved some of its objectives)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives)

Comments (highlighting the project progress) / deviations / recommendations:

The overall aim of the GIP-P is to support the GeoERA Geoscientific Projects (GSPs) in organising, disseminating and sustaining their results in terms of digital data, interpretations, reports and services and reviewer acknowledge that.

Digital geological data and information play a vital role in responding to the key social and economic European challenges and the need for uniform access to multi-domain data is drastically increasing. GIP-P has ensured that the results from all GeoERA projects are accessible on one single, user-friendly platform through the web-GIS interface and the search systems. It also gives access to the results in machine-readable forms using OGC services which also allows connection with other European e-infrastructure. With this, the GIP-P has contributed to the ambition of the GSPs to reach their target groups.

The project consists from 24 partners and it is organised in 11 Work Packages. The reviewer recognises the complexity.

The architecture of EGDI was customized to implement results for each of the GSPs to be shown on their individual project pages on geoera.eu. It has also been used to make a combined GeoERA map (https://geoera.eu/projects/gip-p/overall-geoera-map/) in addition to the thematic maps on the EGDI website itself. The GSPs have added close to 300 new layers to EGDI.

Regarding functionality the following major new modules have been implemented by GIP-P:

- A generic 3D geological model database.
- Two connected 3D model viewers.
- Project Vocabularies implemented in a triple store.
- A Multilingual Keyword Thesaurus
- A Document Repository for unstructured data (reports, images, spreadsheets, ...).
- Integration between the EGDI metadata catalogue and the web-GIS.
- An Administration module for upload geospatial or unstructured data to the EGDI.
- A general free-text search system which enables end-users to find information in all the modules of EGDI and display the results according to a ranking algorithm based on the relevance of the result.
- Extensions to the web GIS.
- Extensions to the central database.
- Making data available through services and for download.
- Extensions to the harvesting system.

The developed metadatabase was populated with metadata from GeoERA scientific projects, it contained 439 records describing data sets and services and in total 50 metadata editors from GSPs were involved. 7 models generated in different 3D

modelling tools are stored in a generic 3D geological model database. 15 Project Vocabularies created for 6 different projects altogether contains 8386 scientific concepts including 1286 bibliographic references and a Multilingual Keyword Thesaurus with 2596 terms. Terms were translated into a total of 21 languages. A Document Repository for "unstructured" data contains currently 694 PDFs, 231 Images and 59 DOIs.

Gip-P has focused also on achieving FAIRness. Comprehensive metadata descriptions for all uploaded data and the INSPIRE compliant metadata system itself ensures a high degree of FAIRness and also use of CC-BY licence model has been recommended.

In the first half of the project the main focus was on identification of the requirement from GSPs. Many meetings were held between the GSPs and the GIP-P and mapping and harmonisation of these requirements was done and that this task is very complex and demanding and the projects has done an impressive job.

GIP-P also extended the Mineral inventory data harvesting system which collects the minerals inventory data from 30 data providers local databases into one common harvested database.

A centralised GeoERA data provider support hub was established as well as a buddying system where GIP user support staff assist the GSPs in managing and preparing their spatial datasets and in providing spatial data services for inclusion in the information platform. A number of cookbooks have been made as well as five videos. Also a series of e-Learning resources have been made available on a specific platform at http://elearning.europe-geology.eu/.

The reviewer recognises that project has achieved all objectives and goals and has even exceeded expectations by establishing a free text search system, 3D model viewer, SOLR based repository and the extension for download copies of the uploaded GeoPackages.

EGDI (with GIP-P extensions) is now composed of many components hosted by at least 8 teams and they are maintained by different organisations and also GSPs were aploaded a lot of datasets and documents. It is therefore important to find a sustainable solution both in terms of funding and governance of the platform (operation, maintenance and further development). A long term sustainable funding model for EGDI is the key to sustaining the results from the GeoERA scientific projects.

3 LEVEL 3 – REVIEW OF THE THEME PROGRESS

In this section the project is reviewed ”remotely” on the basis of the respective reports. This part is filled in by Theme coordinator with aim to review the achieved scientific goals in accordance with theme objectives, on the basis of Sheet 3 in MPPR / FPPR – Project contribution to GeoERA project.

Project contribution to GeoERA project (from MPPR / FPPR, sheet 3):

The overall aim of GeoERA – to integrate European Geological Surveys’ information and knowledge on subsurface energy, water and raw material resources to contribute to sustainable use and management of the subsurface – has to a very high degree been supported by the GIP-P. Not only has the information and knowledge generated in the other GeoERA projects been made useful for all relevant stakeholders like national and regional policy makers, industry, science, SMEs and consultants by making it standardised and interoperable at a pan-European level. It has also been made easily accessible through a single point of access – the user friendly EGDI platform – and through the fact that for instance all data shown on the maps are also accessible through web map services (INSPIRE compliant in many cases). In this way the GIP-P has substantially contributed to the overall ambition of making the GeoERA results FAIR.

The scope described for projects under the GeoERA Programme Specific Research Topic “IP1 - DEVELOPMENT OF AN INFORMATION PLATFORM TO SUPPORT MANAGEMENT AND PROVISION OF DATA FOR THE THREE OTHER THEMES” has to a high degree been fulfilled in the GIP-P. The platform contains the following elements to support the other GeoERA projects:

- a central database to store geospatial data as GeoPackages (or similar GIS formats), tabular data as well as 3D geological models,
- a web-portal giving end users easy access to all results,
- an archive for other digital products like reports, images, spreadsheets,
- a project vocabulary based on Linked Data technologies for organisation of new terms, and for supporting specialised functionalities like the HIKE knowledge sharepoint,
- a metadatabase with ISO and INSPIRE compliant metadata information coupled to a multilingual Keyword Thesaurus about all geospatial results,
- a free text search system giving the user the possibility to find information across all GeoERA projects and all result types, and
- extensive user support facilities and content including an eLearning Platform.

The content and the functionalities have to a very high degree been based on the requirements from the other GeoERA projects. An organisational structure was implemented to facilitate the day-to-day exchange of information and views between the GIP-P and geoscientific projects and three rounds of bilateral meetings with the other projects have been carried out to ensure that their needs were sufficiently understood and implemented in the EGDI platform.

Theme objectives:

GeoEnergy Theme (Excellent/Overachieving)
The GIP-P project has successfully supported the development and integration of novel and challenging information services for the GeoEnergy projects in EGDI. GIP-P dealt with a very complex challenge to serve 14 different projects. The products developed in the GeoEnergy projects are diverse with different scopes, objectives, types of information, services, functionalities and targeted user groups. GIP-P has been able to align these developments in projects and to present these together in a single access point. Many common and re-usable elements were identified that are shared by projects such as for example Metadata catalogues, LinkedData concepts, Vocabularies, functionalities to view, browse, inspect and retrieve project data, Libraries and Share Points for unstructured data, 3D data, etc. The joint development of these elements via GIP-P has saved a lot of time and effort and strongly contributed to a more homogeneous and interoperable representation in EGDI. Many of these accomplishments have come to realization through intensive collaboration between GIP-P and the research projects from geo-energy and other themes. This also contributed to new ideas and better products. The resulting extensions and new contents to EGDI are established according to FAIR data principles and provide a strong basis for future developments (new data, new services and functionalities, further harmonization and integration of geoscience data and information). The joint achievements in GeoERA are an important stepping stone for the expected follow-up in CSA – Geological Services for Europe.

RawMaterials (Excellent)
GIP-P was designed to the purpose of the Key objective to support the three GeoERA themes and to link the results of all 14 scientific GeoERA projects in one information system in order to organize, standardize, disseminate and secure their results (background data, digital maps, geological models, reports, etc.) according to the guidelines of FAIR, while ensuring high quality and cost-effectiveness. This objective was well meet from GeoERA RawMaterials perspective. The solutions provided enable the sustainability and accessibility of GeoERA digital results in the long term, while relying on continuous input from expert scientific teams.
The projects (GIP-P and the scientific projects) have benefited greatly from the strong interaction between the respective projects ensured by the responsible persons on both sides - the GIP-P team and the scientific project team. Though this close cooperation experiences successfully exchanged, standards and outcomes improved and validated.
GIP-P has performed its role of supporting the scientific projects very well. Thanks to the IT specialists in GIP-P and especially in collaboration with MINTELL4EU, a viable solution was found to allow the integration of the results into the Raw Materials Information System of the JRC Science Hub (requirement of the European Commission). This allows for accessibility of the results beyond EGDI also.

Groundwater Theme (Overachieving)

The original call text for the ERA-NET LCE-26-2016: Cross-thematic ERA-NET on Applied Geosciences did not contain or request a specific theme for developing a common subsurface information platform. This was though indicated as an important activity within the described ERA-NET **Scope**:

"GIS-based databases shall be developed with a view to, in the longer term, the operation and maintenance of an integrated database and map of the European underground, its resources (geo-energy, groundwater and raw materials) and its potential uses. Where appropriate, synergies and compatibility with the EPOS research infrastructure is required and will ensure that developed databases, tools and models can serve the largest communities. The database shall be INSPIRE compliant and be compatible with energy minerals data and marine maps (EMODnet) for the proper land planning and use of both surface and sub-surface. Furthermore, databases should have the technical specifications so that they can be potentially hosted by the European Commission."

And again in the **Expected Impact**:
"Improved interoperability of data and information, thus allowing a uniform, unbiased and independent insight in the distribution of identified and prospective geo-energy, groundwater and raw materials resources. Better understanding and management of the water-energy-raw materials nexus through a more integrated and efficient management and exploitation (and more responsible and publicly-accepted use) of subsurface resources for the various uses, while reducing any associated potential impacts and risks."

At an early stage the chairs of Spatial Information Expert Group of the EuroGeoSurveys suggested to add a specific theme for developing a common information platform on the subsurface in order to be able to better coordinate information platform activities within the geoenergy, groundwater and raw materials themes and enable synergies, and this was agreed with the other themes and described in the final proposal submitted to the Commission.

In the groundwater theme we believe this was the right decision and supported this all the way, and we believe the outcome clearly demonstrates that all the three other GeoERA themes benefitted from that through more efficient information platform services.

During GeoERA we have had much support from the GIP-P contact / liaison person, who enabled a final outcome and number of on-line information products from the four GeoERA groundwater projects beyond our expectations. The GeoERA project / program was the first time the European geological surveys had a chance to collaborate not only between hydrogeologists / groundwater scientists across Europe, but also with data scientists of the data departments of the surveys. Despite missing previous experiences and very different competences within the surveys and the different scientific disciplines we have managed to provide more than 250 map views on groundwater quantity and quality at different scales (local / well to pan European), and in addition to that enable downloads of data, reports, scientific papers, plots,

maps and metadata for all of these. The process of providing the data (incl. metadata) and visualizing them on maps, has been so efficient that valuable time was also allowed for publication of data and results in peer reviewed journals, and the four groundwater projects is expected to ultimately publish nearly 30 peer reviewed papers related to the compiled data and developed information products for the information platform (23 is already published). The information platform / EGDI and the developed information products will no doubt be a strong selling point in future EU proposals. All in all the achievements and the final outcome of our common efforts are beyond our expectations for the groundwater projects hence the rating as "overachieving".

The current version of the GeoERA information platform / "EGDI" is now probably *the* most comprehensive and advanced subsurface information platform, globally – not the least when talking about cross-thematic common digital multi-national harmonized subsurface data platforms.

Has the project as a whole achieved the objectives and expected impact of the theme?

☒ 5 - **Overachiever** (the project has achieved greater impact on project theme and/or other themes than expected)

☐ 4 - **Excellent progress** (the project has fully achieved its objectives and goals towards the theme as expected)

☐ 3 - **Good progress** (the project has achieved most of its impact towards the theme for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has minor impact)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or has no impact on the theme)

Comments / deviations / recommendations:

The GIP-P has further developed the necessary infrastructure (EGDI) that provides access to a standardized representation. The data quality, interoperability and targeted linking for solving cross-thematic issues depends on the input of the specialized projects and will have to evolve over the years. GIP-P has laid the foundations for presenting interactive thematic maps, enabling their interconnection (e.g. transparency mode), and thus provides an important milestone for addressing cross-thematic issues in a next step.

GeoERA as such, however, would have benefited from a sequential set-up of the interlocking requirements (e.g. (a) provision of coordinated and largely standardized cross-thematic specialized information (b) visualization (c) proposed solutions for societal challenges). The coordination between the topics has come too short (the

necessary foundations are only now available) and should be increasingly addressed in follow-up projects.

The GeoERA RawMaterials TEAM like to express their thanks for the excellent support by the GIP-P TEAM. The cooperation and support actions are a proved milestone towards a *Geological Service for Europe.*

4 LEVEL 4 – GEOERA PROGRESS EVALUATION

In this section the project is reviewed on the Review meetings, where projects present their overall progress and achievements. This section relates to particular project, broader impact of GeoERA as a whole on policies will be covered at the Final Review meeting with questionnaire and interview with Evaluator.

Based on technical review summaries provided by Sections 1 – 3 of this report, and project presentation on the (Final) Review meeting:

Has the project as a whole been making satisfactory progress according to your own understanding and expectations of the GeoERA project?

☒ 5 - **Overachiever** (the project has exceeded expectations)
☐ 4 - **Excellent progress** (as expected)
☐ 3 - **Good progress** (minor recommendations given below)
☐ 2 - **Acceptable progress** (below expectations)
☐ 1 - **Unsatisfactory progress** (the project did not meet expectations)

Overall comments for the project (overall recommendations, modifications, corrective actions, or re-tuning the objectives to optimize the impact or keep up with the State of the Art, re-focusing, or a simple praise)

Stakeholder one evaluation:

This project has exceeded expectations in being able to deliver more complex forms of geoscience data related to three themes: GeoEnergy, Raw Materials and Groundwater from multiple agencies, through a central portal.

GIP-P has ensured that the results from all the GeoERA projects are accessible on one single, user-friendly platform through a web-GIS interface and related search systems which provide access to the search results in machine-readable forms using OGC services. It also allows advanced free text search, as well as multilingual search: the free text search system gives the user the possibility to find information across all GeoERA projects and all result types. Its standards-based approach also allows connection with other European e-infrastructure using similar standards and methodologies.

This project has helped align national thematic priorities of numerous European Geological Surveys and has done an incredible job in bringing similar geological data types together, and in making geological data products such as maps, images, 3-D models, grids, documents etc accessible. I know of no other such successful undertaking with as many different agencies and different data types in the Geosciences internationally.

In particular, I would like call out the work on multilingual thesauri : this is outstanding and groundbreaking. I know of no other equivalent effort in internationally in multilingual vocabularies and ontologies in the Earth and environmental sciences. I so hope that this work will be more widely publicised and published, not just to the Earth science community, but also to the international semantic vocabulary/ontology community in multiple domains.

I also feel that how this project brought so many national efforts together into the one portal is worth documenting in a published paper, so that other groups that are trying to do similar efforts could learn from the GIP-P project. It is not easy to bring this many countries together in a single initiative over such a short period of time.

The question is where to next? and how sustainable is what has been developed?

I see GIP-P as laying the foundation for making other Geoscience datasets such as geophysics and geochemistry accessible through GIP-P. It currently is biased towards making geological data products accessible in a GIS-based portal. I think it would not be too hard to use the infrastructure developed to make rawer, less processed versions of the data accessible so that users could develop their own data products. I did note that the goals said "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". This will suit some consultants and SME's, but the research sector and some industries are more likely to want access to the rawer forms of the data. Access to the rawer forms of data would also enable more innovation in Europe with new methods and processing algorithms being able to be applied that are more targeted towards the user's specific needs.

I have two main concerns (but these are not meant to detract from the high-quality product that has been developed – they are merely suggestions).

1) In its current form it appears that the GIP-P that it has been built through interactions between the geological surveys only – I could not see interactions with the industry or research sectors and before going much further it would be good to have a workshop with members from industry and research and gather feedback on whether the way the data and information is being disseminated is compatible with systems/standards that they are using. Likewise, there are equivalent efforts in North America, Australia and elsewhere in building similar systems: it would be good to have an externally-focussed international workshop where the international geoscience community (across all three sectors – industry, government and research) compared notes on what each is currently building and/or plans to build to ensure global harmonisation and minimise reinventing of wheels. If

Geoscience is to contribute to global challenges such as the UN sustainability goals, climate change and global management of the diminishing resources of our planet, then it would be good to see if this excellent European platform can integrate with other globally distributed geoscience data and information resources. And then there is the question of transdisciplinary research and whether this GIP-P platform can integrate with other disciplines, in particular data from the social science community.

2) I worry that some of packages such as MapServer, GeoServer, Rasdaman, GeoNetwork, etc., although currently widely used, have been around for a long time and question whether in moving forward, a review should be undertaken as to whether these tools are going to continue to be as widely used as they currently are, particularly given their dependencies on current versions of the OGC WMS, WFS and WCS standards.

My final words are congratulations on this effort, it has been a pleasure to be part of the review team and be able to hear first-hand about GIP-P.

Stakeholder two evaluation:

Excellent work, from which I have learned a great deal.

Annex 1: Review meeting list of participants

Name	Role	Organisation
Tessa Witteman	GeoERA coordinator	Netherlands Organisation for Applied Scientific Research
Harvey Thorleifson	GeoERA Stakeholder	Minnesota Geological Survey
Lesley Wyborn	GeoERA Stakeholder	Australian National University
Barbara Simić	Monitoring and Reporting Officer	Geological Survey of Slovenia
Aleksandra Trenchovska	Monitoring and Reporting Officer	Geological Survey of Slovenia
Jasna Šinigoj	Scientific Reviewer	Geological Survey of Slovenia
Matija Krivic	Scientific Reviewer	Geological Survey of Slovenia
Antje Wittenberg	Raw Materials Theme coordinator	Federal Institute for Geosciences and Natural Resources, Germany
Klaus Hinsby	Groundwater Theme coordinator	Geological Survey of Denmark and Greenland
Serge van Gessel	GeoEnergy Theme coordinator	Netherlands Organisation for Applied Scientific Research
Jørgen Tulstrup	GIP-P Project manager	Geological Survey of Denmark and Greenland
Pierre-Yves Declercq	GIP-P Project member	Geological Survey of Belgium
Carlo Cipolloni	GIP-P Project member	Italian Institute for Environmental Protection and Research
Martin Schiegl	GIP-P Project member	Geological Survey of Austria
Jean-Baptiste Roquencourt	GIP-P Project member	French Geological Survey
Lisbeth Flindt Jørgensen	GIP-P Project member	Geological Survey of Denmark and Greenland

David Garcia	GIP-P Project member	Royal Belgian Institute of Natural Sciences
Bjarni Pjetursson	GIP-P Project member	Geological Survey of Denmark and Greenland
Andrej Vihtelič	GIP-P Project member	Geological Survey of Slovenia
Patrick Bell	GIP-P Project member	British Geological Survey
Diana Ponce de Leon gil	GIP-P Project member	Spanish Geological Survey
Chris Luton	GIP-P Project member	British Geological Survey