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

Technical review report for project MINDeSEA

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:	Seabed Mineral Deposits in European Seas: Metallogeny and Geological Potential for Strategic and Critical Raw Materials
Project acronym:	MINDeSEA
Project reference number:	GeoE.171.001
Project topic:	Raw Materials
Project specific topic:	RM3-Metallogeny – Geological potential
Lead partner:	IGME-Sp Instituto Geológico y Minero de Espana (Geological Survey of Spain)
Project website:	https://geoera.eu/projects/mindesea2/

☐ Technical review report
☒ Final review report

Period covered	01/01/2020 – 31/10/2021
Review meeting date	23.11.2021; start at 13:30

Contributor:	Role:	Approved on:
Barbara Simić	Monitoring and reporting officer	25.11.2021
Aleksandra Trenchovska	Monitoring and reporting officer	26.11.2021
Ana Novak	Scientific reviewer	30.11.2021
Jasna Šinigoj	Scientific reviewer	30.11.2021
Matija Krivic	Scientific reviewer	30.11.2021
Antje Wittenberg	Theme coordinator	8.12.2021
Helena-Maria Cavaco-Viegas	GeoERA Stakeholder	7.1.2022
Christine Meyzen	GeoERA Stakeholder	28.12.2021

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?	☐		☒
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. 4	☐
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 minimizing 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 MINDeSEA project aimed to map and establish the metallogenic context for different seabed mineral deposits with economic potential in the pan-European setting and to address the potential supply shortage of strategic metals and critical raw materials (CRMs) critical for low-carbon energy production and new technologies. This project combined pan-European and national databases for the first time. The project expands knowledge on strategic metals and critical raw materials by compiling mineral potential and metallogenic studies on critical raw material resources in pan-European seas and provides recommendations for future target areas, studies and standards that can be used across Europe. At the start of the project, 7 objectives were set. Through the presentation of progress and discussion at the review meeting, the consortia have demonstrated that all objectives have been met.

The Covid 19 epidemic had an impact on the progress of the MINDeSEA 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. The latter 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 involvement in the project activities. To ensure the achievement of the set objectives, the partners increased their efforts, resulting in higher person-months and budget expenditures, mainly by the Lead partner. Overall, the project consortia spent 20% more budget than planned. The additional expenditure will be covered by the GeoERA project with the help of other projects where the funds were not used. The project did not identify any underperforming partners that could affect the quality of the project outputs. Only one partner, GEOINFORM, discontinued its activities in the second reporting period without any impact on the project work.

A communication and dissemination plan was adopted and a detailed description of the activities with timetable was provided. The project's communication and dissemination activities have adhered to the plan. Cooperation with other GeoERA projects, in particular FRAME, EuroLithos, Mintell4EU and GIP -P, was regular and contributed to a more complete database. In addition, the project collaborated with projects outside GeoERA, notably EMODnet, EXPLOSEA, AORA, Marine E-tech and the DG GROW and DG MARE programmes. The project maintained its communication and dissemination activities and adapted well to the pandemic situation.

Comment no. 1: The Final Project Progress Report was submitted on time in draft form. Partners still have the opportunity to recalculate their financials by the end of

the calendar year to include the final data, so minor variances can be expected. The changes will not affect the content of the project.

Comment no. 2: During the implementation of the project there were two changes in the partnership: partner 3 IGME-Gr Institute of Geology and Mineral Exploration was renamed to partner HSGME Hellenic Survey of Geology and Mineral Exploration. Later, Project lead IGME-Sp Geological Survey of Spain was integrated into the CSIC Agencia Estatal Consejo Superior de Investigaciones Científicas. At the end of reporting period 1, the project partner GEOINFORM State Research and Development Enterprise State Information Geological Fund of Ukraine ended its activities and did not participate in the second period. None of the above changes affected the ability of the project to achieve its objectives and outputs.

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

The deliverable changes in the project implementation period are:

Reporting period 1:
D2.3 postponed from M8 (28.2.2019) to M11 (31.5.2019)
D1.1 postponed from M15 (30.9.2019) to M17 (30.11.2019)

Reporting period2:
D6.2 postponed from M24 (30.6.2020) to M32 (28.2.2021)
D2.3 postponed from M28 (31.10.2020) to M30 (31.12.2020)
D3.3 postponed from M28 (31.10.2020) to M34 (30.4.2021)
D4.4 postponed from M28 (31.10.2020) to M34 (30.4.2021)
D5.4 is renamed to Placers metallogenic models and postponed from M28 (31.10.2020) to M38 (31.8.2021)
D4.5 postponed from M30 (31.12.2020) to M36 (30.6.2021)
D1.3 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D2.2 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D2.3 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D2.4 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D3.2 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D3.4 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D4.2 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D4.3 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D4.6 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D4.7 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D5.2 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D5.3 postponed from M36 (30.6.2021) to M40 (31.10.2021)

D5.5 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D6.3 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D6.4 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D6.5 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D7.2 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D7.3 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D7.4 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D8.2 postponed from M36 (30.6.2021) to M40 (31.10.2021)
D8.4 postponed from M36 (30.6.2021) to M40 (31.10.2021)

Comment no. 4: Some project partners spent 20% more than their planned budget, others spent less than 80%. The partners that have exceeded their budget are BGR and IGME-Sp. Partner that spent less than their planned budget is SGU. The consumption of man-months followed the EUR consumption.

The project has coped well with the negative external factors and has overcome its challenges in such a way that it has achieved its planned objectives and project results. For this reason, the project is rated as "excellent" at level 1 and thus receives a rating of 4 - Objectives and targets fully achieved.

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 audience reach
EVENTS	60.270		138	119	181	67	148		97		**61.020**
MEETINGS	1.960		14	22	12		3				**2.011**
ONLINE_MEDIA	6.141	32.662	61	79	21		16	11	77		**39.068**
PUBLICATIONS	31.770		80	140	116		60		79		**32.245**
Total	**100.141**	**32.662**	**293**	**360**	**330**	**67**	**227**	**11**	**253**		**134.344**

	CONGRESS	FACEBOOK	INTERNAL PROJECT MEETING	MEETING WITH OTHER GEOERA PROJECTS	MEETING WITH OTHER PROJECTS	NEWSLETTER	OTHER	SCIENTIFIC PUBLICATION	THESIS	TWITER	WEBINAR	WEBSITE	WORKSHOP	YOUTUBE	Total
EVENTS	22						3				7		1		33
MEETINGS			1	4	1										6
ONLINE_MEDIA		240								708		2		4	954
PUBLICATIONS						2	12	15	1						30
Total	22	240	1	4	1	2	15	15	1	708	7	2	1	4	1023

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	**96,57**	**791.156,25**	29,7%	**234.973,43**	**556.182,83**
1st period consumption	43,64	381.165,29	29,7%	113.206,09	267.959,20
2nd period consumtion	82,54	595.433,25	29,7%	176.843,67	418.589,57
TOTAL	**126,18**	**976.598,54**		**290.049,76**	**686.548,77**

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):

Responses from the Impact Assessment questionnaire:

QC2. The extent to which your co-funded Project contributed to each of the Expected Impacts.
Scale for assessing impacts: 1-unsatisfactory, up to 60% implementation of expectations; 2-poor implementation, from 60-80%; 3-medium implementation, from 80-90%; 4-good implementation, 90-100% of expectations; 5-Excellent implementation, surpassing expectations.

QC2M1 Reinforcing synergy at international level and reduced fragmentation of raw materials research and innovation across Europe facilitating a more efficient use of natural resources, minimizing waste and improving recycling. 4
QC2M2 Providing technical solutions that enhance the exploration phase, making it more efficient and less invasive, and optimising deposit exploration. 4
QC2M3 Providing innovative solutions for mineral exploration and development, helping to optimise their investment. 4
QC2M4 Providing data and tools to facilitate the re-use and recycling of mineral based waste. 2
Comment: MINDeSEA is providing datasets on seafloor minerals but in Europe seabed mining is not active yet. Therefore, mineral based waste recycling data, tools and assessment will be available when the mining operations are generating wastes.
QC2M5 Reduction of the import dependency of Europe’s industries for critical raw materials. 4

QC3 The extent to which your co-funded Project contributed to:
Scale for assessing impacts: 1 — No Impact. 2 — Weak Impact. The Project broadly addresses the criterion, but there are significant weaknesses. 3 — Good Impact. The Project addresses the criterion well, but a number of shortcomings are present. 4 — Very Good Impact. The Project addresses the criterion very well, but a small number of shortcomings are present. 5 — Excellent Impact. The Project successfully addresses all relevant aspects of the criterion. Any shortcomings are minor.

QC3a Science impacts: research results have an effect on the subsequent progress and contribution to the body of knowledge. They affect the formation and development of disciplines as well as training and can also affect the development of a research field itself, generating interdisciplinary and international projects. 4

QC3b Innovation impacts: product, process and service innovations as well as know-how partly result from research activities. There are few indicators for assessing this dimension, other than patents, which have generated some debate regarding their utility. 4
QC3c Economic impacts: these refer to the impact on an organisation's budgetary situation, operating costs, revenues, profits, the sale price of products; on the sources of finance, investments and production activities; and on the development of new markets. At the aggregate level, they can also refer to economic returns, either through growth or increased productivity, of a given geographical unit. 4
QC3d Cultural impacts: these relate to an individual's knowledge and understanding of ideas and reality, as well as intellectual and practical skills, attitudes, interests, values and beliefs. 4
QC3e Societal impacts: research affects the welfare, behaviour, practices and activities of people and groups, including their well-being and quality of life. 4
QC3f Policy impacts: research influences how policy makers and policies act. It can provide evidence that influences policy decisions and can enhance citizens' participation in scientific and technological decisions. 4
QC3g Organisational impacts: these refer to the effects on the activities of institutions and organisations: planning, organisation of work, administration, human resources, etc.
QC3h Health impacts: these relate to impacts on public health, e.g. life expectancy, prevention of illnesses, quality of life, and the health-care system. 4
QC3i Environmental impacts: these concern management of the environment, notably natural resources and environmental pollution, as well as the impacts of research on climate and meteorology. 4
QC3j Symbolic impacts: these are the gains in areas such as credibility due to undertaking R&D or linked to universities or research institutions that offer gains in terms of potential clients, etc. 4
QC3k Training impacts: these are impacts of research on curricula, pedagogical tools, qualifications, entry into the workforce, etc.4

QC4 The extent to which your co-funded Project contributed to European Impact: *Scale for assessing impacts: 1 — No Impact. 2 — Weak Impact. The Project broadly addresses the criterion, but there are significant weaknesses. 3 — Good Impact. The Project addresses the criterion well, but a number of shortcomings are present. 4 — Very Good Impact. The Project addresses the criterion very well, but a small number of shortcomings are present. 5 — Excellent Impact. The Project successfully addresses all relevant aspects of the criterion. Any shortcomings are minor*

QC4a Establishing interoperable, pan-European data and information services. 4
QC4b Developing European common assessment frameworks and methodologies. 4
QC4c To Knowledge and services aimed at European policy makers and stakeholders. 4
QC4d To more competitive research, such as the reduction of fragmentation and

duplication of effort of both policy initiatives and research activities, providing increased coordination 4
QC4e To Removing obstacles for undertaking transnational coordination:
QC4e1 The misalignment of national thematic programme priorities. 4
QC4e2 National administrative procedures and legal conditions. 4
QC4e3 EC administrative procedures or legal requirements. 4
QC4e4 Other (specify)
QC4f Contribution of GeoERA Co-founded projects to ERA NET. The overall objectives of the ERA-NET scheme:
QC4f1 Achieving critical mass, to ensure better use of scarce resources. 4
QC4f2 Influencing the national focus of research policies and instruments (GeoERA funding programmes match with national programmes) 4
QC4f3 Join forces to provide common answers to common problems. 4
QC4f4 Addressing global issues. 4
QC4f5 Developing common approaches. 4
QC4f6 Addressing specific geographical issues internationally. 4
QC4f7 Speaking with "one voice". 4
QC4f8 Avoiding overlap and build up expertise. 4
QC4f9 Exchange of good practice. 4
QC4f10 Access to expertise from other countries. 4
QC4g To selected priorities of Horizon 2020 and its Focus areas in The 2018-2020 Work Programme
QC4g1 Excellent science (World class science, able to develop, attract and retain research talent, with the best access to infrastructures) 4
QC4g2 Industrial leadership (Strategic investments in key technologies underpin innovation across existing and emerging sectors, attracting more private investment, innovative small and medium-sized enterprises) 4
QC4g3 Societal challenges (answering to concerns of citizens and society; breakthrough solutions from multi-disciplinary collaborations) 4
QC4g4 Digitising and transforming European industry and services 4
Comment: To perform more excellent science in Raw Materials at European level is necessary more invesment in geological exploration of CRM (geophysical, seafloor mapping, labs). New high-resolution technologies and results are necessary at the field-work and laboratory levels.

QC5 The extent to which your co-funded Project contributed to any other European Impact
Scale for assessing impacts: 1 — No Impact. 2 — Weak Impact. The Project broadly addresses the criterion, but there are significant weaknesses. 3 — Good Impact. The Project addresses the criterion well, but a number of shortcomings are present. 4 — Very Good Impact. The Project addresses the criterion very well, but a small number of shortcomings are present. 5 — Excellent Impact. The Project successfully addresses all relevant aspects of the criterion. Any shortcomings are minor.

QC5a Enhancing innovation capacity. 4
QC5b Synergies with businesses: Creating new market opportunities. 3
QC5c Strengthen competitiveness and growth of companies. 3
QC5d Improving potentials for climate and environmental policy. 4
QC5e Employment. 3
QC5f Synergies with science education. 4
QC5g Engaging of researchers with civil society. 4
QC5h Other (specify):.

QC6 Assess the quality of Measures to maximise impact. Strategy for knowledge management and protection. The extent to which your co-funded Project:
Scale for assessing impacts: 1 — No Impact. 2 — Weak Impact. The Project broadly addresses the criterion, but there are significant weaknesses. 3 — Good Impact. The Project addresses the criterion well, but a number of shortcomings are present. 4 — Very Good Impact. The Project addresses the criterion very well, but a small number of shortcomings are present. 5 — Excellent Impact. The Project successfully addresses all relevant aspects of the criterion. Any shortcomings are minor

QC6a Integrated obtained Results into knowledge base 4
QC6b Secured Open access to results by other project partners 4
QC6c Identified project Results that may qualify for Intellectual property protection 4
QC6d Secured Open access of data to general public 4
QC6e Other (specify):

QC7 Assess the quality of Measures to maximise impact. How many of listed activities enabling knowledge transfer and dissemination have you accomplished, Yes/No:

QC7a Knowledge transfer workshops with relevant stakeholders. yes
QC7b Knowledge sharing networks / workshops with other EU and international stakeholders, yes
QC7c Working structures to coordinate collaboration with other ERA-NETS. no
QC7d Joint events with other relevant initiatives — mutual learning, development of common strategic agenda, yes
QC7e Knowledge exchange / clustering workshops of funded projects. yes
QC7f Knowledge hubs. yes
QC7g Promotion of data sharing and publication via open access journals. yes
QC7h Production of webinars and website content available to large public. yes
QC7i Training activities and seminars. yes
QC7j Appointment of special groups (e.g. Knowledge exchange strategy group). yes
QC7k Other (specify):

QC8 What do you consider the most important longer-term impacts of your involvement in GeoERA?
Scale for assessing impacts: 1 — No Impact. 2 — Weak Impact. The Project broadly addresses the criterion, but there are significant weaknesses. 3 — Good Impact. The Project addresses the criterion well, but a number of shortcomings are present. 4 — Very Good Impact. The Project addresses the criterion very well, but a small number of shortcomings are present. 5 — Excellent Impact. The Project successfully addresses all relevant aspects of the criterion. Any shortcomings are minor.

QC8a An increase of strategic cooperation among EU Member States 4
QC8b An increase of the amount of research funding in the domain of GeoERA? 4
QC8c A reduction of duplication and fragmentation of research activities 4
QC8d An increase of knowledge exchange 4
QC8e A better integration of basic and applicative research 4
QC8f More effective transdisciplinary approach 4
QC8g New methodologies, tools, knowledge 4
QC8h Other (specify):

QC9 Assessment of the success factors: which activities/factors were the most important for the success of the project outcomes regarding your part of the project and your institution, respectively?
Scale for assessing impacts (Source: D2.2): 1 — Not important. 2 — Weakly Important. 3 —Medium Important. 4 — Very Important, but not necessarily crucial. 5 — The key to success, indispensable.

QC9a Networking activities like events, conferences, meetings. 4
QC9b Consortium: the fact of having a consortium of partners with different expertise and skills. 5
QC9c Strategy: the well-defined research questions and aims of the project. 4
QC9d Internal communication. 4
QC9e External communication. 4
QC9f Trainings or other forms of education. 4
QC9g Quality of results. 4
QC9h Research approach: the innovative methods/tools/techniques used. 4
QC9i Exogenous factors: legal environment, market conditions, coincidence etc. 5

QC10 The extent to which your Project directly contributed with its results to benefits of different groups of users/beneficiaries
Scale for assessing impacts: 1 — Not important. 2 — Weakly Important. 3 —Medium Important. 4 — Very Important, but not necessarily crucial. 5 — The key contribution, which is 'game changer'

QC10a Contribution to you personally 5

QC10b Contribution to your research team 4
QC10c Contribution to your organization 4
QC10d Contribution to Geosciences 4
QC10e Contribution to research sector, 4
QC10f Contribution to government sector, 4
QC10g Contribution to business sector, 4
QC10h Contribution to broader community 4
QC10i Other (specify):

QC11 Maturity Score: Asses how much has GeoERA contributed to geoscience, before this project and after its completion
Scale for assessing impacts (Source: Own): 1 — No contribution. 2 — Weak contribution. 3 —Medium contribution. 4 — Very Important, but not necessarily crucial contribution. 5 — Crucial contribution for geoscience.

QC11a Systematic exchange of information and good practices on existing research programmes. 4
QC11b Identification and analysis of common strategic issues. 5
QC11c Development of joint activities between national or regional research programmes. 5
QC11d Implementation of joint transnational research activities:
QC11d1 Defining common priorities and joint research agendas. 5
QC11d2 Implementing joint research agendas. 5
QC11d3 Jointly implementing and financing calls and projects. 5
QC11d4 Engaging in transnational R&D cooperation beyond the GeoERA. 5
QC11d5 Mutual learning. 5
QC11e Achieving self sustained network - P2P networks that can operate without EU funding.

Expected impact (from Project Agreement):

The implementation of this Project Proposal will contribute to achieving the following scientific or societal impacts:
• Provide integrated reliable data and information of the off-shore resources, useful for economic and social agents for the selection of viable mine sites and the design of environmentally sound and efficient seabed mining systems for the future.
• Support exploration and development of marine mineral raw materials by improving our knowledge and understanding of the occurrence of critical raw materials and base metals on submarine mineral deposits. As a consequence, the cost of exploration will be reduced.
• Future marine-based mining of critical raw materials, especially cobalt (Co), tellurium (Te), niobium (Nb), rare earth elements (REEs) and platinum group elements (PGEs), will contribute to reducing Europe's import dependency for these metals. This will support both the maintenance and creation of jobs within Europe.

• Develop cooperation and collaboration ties between researchers in the different partner
organisations and countries participating in the project, contributing towards reducing duplication of research – both in terms of data acquisition as well as resource potential modelling.
• Additionally, the identification of data gaps and target areas will facilitate more directed and transnational future projects.

To do this, MINDeSEA will, though a series of key work packages, develop research that will:
• Give a comprehensive overview of seafloor mineral deposits in European Seas. This will be novel as a metallogenic-geological potential study of the different types has never been achieved for European seas. Therefore, the accomplishment of this research will represent a substantial advance in the state of knowledge relating to the genesis and importance of European seafloor metallogenic mineralisation
• Extend our knowledge and understanding for the geological characteristics of seabed
mineralisations, their origin and evolution, relations with the tectonic activity and the sedimentary systems as well as the water masses composition and distribution.
• Improve the information available on the role exerted by the different local and regional factors on the deposits formation and the location of metals of economic interest.
• Understand the key processes for critical raw material concentration on submarine minerals, using modern laboratory technics and experimental models.
• Establish reference zones used as potential areas for increasing the knowledge on the processes of the different types of seafloor mineral deposits and their economic potential for critical and strategic metals.
• Determine the interest of the metallogenic studies on seafloor mineralisation to the development of technical, legal and environmental regulations for their future exploitation in the European Seas.
• To increase the existing information on the seabed mineralisations and their importance in local and global biodiversity, and to evaluate their vulnerability to processes derived from the anthropic activity.
• To improve the knowledge of natural processes by means of mathematical-GIS modelling and the accomplishment of simulations.

Evaluation of deliverables

No.	Title	Status (Approve / Reject)	Comments
D1.3	Final Project Progress Report	Approved	/
D2.4	Report WP2	Approved	See comment below
Compliments to the project team for the large amount of dissemination products.			
D3.3	SMS metallogenic models	Approved	/
D3.4	SMS potential assessment	Approved	/
D4.3	Mineral-potential and prospectivity maps	Approved	See comment below
As the “distance to coast” factor greatly reduces the probability index near volcanic islands, it would be worth considering if this factor should be used only for continental margins.			
D4.4	Fe-Mn crusts and phosphorites metallogenic models	Approved	See comment below
p. 40, last line: "2017Post" should be "2017; Post"; p. 41, Sect. 5.1.3, first sentence: a word is missing somewhere - sentence is unclear; p. 42, line 7 & p. 43, Sect. 5.3.2: "Km" should be "km"; p. 44, line 4: probably "increased" instead of "interesting"; p. 58-61: offset indentation from reference 100 onwards; English could be improved in Sect. 5.3.1, 5.3.2, 5.3.4, 5.4			
D4.5	Exploration potential of CRM	Approved	See comment below
Sect. 3.1: (abyssal) "planes" should be "plains"; p. 22, Fig. 10: figure could include a colour bar or a figure caption that would explain the colours (for example: red = high contents, blue = low contents; p. 23 4.1.2.2: "Zealand" instead of "Zeeland"; English could be improved in Sect. 3.1, 3.2, 4.4.2, 4.4.4.			
D4.6	Status of regulation, legislation and exploitation	Approved	/
D4.7	Case study	Approved	See comment below
p. 6, line 30: "truthing" should be "trothing"; Sect. 3.1.3: "predectivity" should be "predictivity"; Section 3.1.3, Fig. 8: The colour bar for the bathymetry (blue-green-yellow-red) is very similar to the blue-yellow-red colour bar for the potential mining site, therefore the figure can be a bit confusing for the reader; Similar to comment for D4.3: is proximity to coast reasonable for predictivity maps in the case of islands related to hotspots or ridges?			
D5.3	Mineral-potential and prospectivity maps	Approved	/
D5.4	Placers metallogenic models	Approved	/
D5.5	Status of regulation, legislation and exploitation	Approved	/

D6.2	Polymetallic nodules prospect evaluation parameters	Approved	See comment below
p. 27 l.2: “truly” should probably be “true			
D6.4	Mineral-potential and prospectivity maps	Approved	/
D6.5	Polymetallic nodules prospect evaluation	Approved	/
D7.3	Mineral-potential and prospectivity maps	Approved	/
D7.4	Present-day status of exploration	Approved	See comment below
p. 11 row 1: probably missing source link for Trans-Tasman Resources			

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 GeoERA MINDeSEA is a project focused on seabed mineral deposits of European seas. The project was especially dedicated to the characterisation, compilation, and mapping of different types of seabed deposits, however several other objectives were also included in the project Work Packages. Despite a delay due to the pandemic, the project was successful in achieving all the set objectives and provided all the planned deliverables. The project members were very active in dissemination activities, especially within the scientific community. A lot of effort was also put into outreach activities, for example via local news outlets. The scientific output of the project team was commendable with several publications in high-ranking journals and also with a Special Issue. The submitted deliverables extensively covered their topics and the produced maps provide an important resource for future studies of European seabed deposits.

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):

MINDeSEA is the flagship project of GeoERA on seabed mineral deposits in the European Seas, and one of the cornerstones of the GeoERA Raw Materials theme. The Earth provides mineral resources that are vital for human life. As global demand grows, especially for strategic metals and critical raw materials (CRM) crucial for low-carbon energy production and new technologies, there is a proportionate risk of increasing supply shortage for resources that are identified as critical to Europe's economy. In addition, the COVID-19 pandemic has posed significant challenges for supply chains globally. This project handles the Critical Raw Materials in a follow up of the EU Commission’s concerns regarding the sustainable sourcing of strategic and critical raw materials to Europe's industry, the contribution to the Blue Growth strategy, the Battery Alliance and the transition from a carbon-based to green-energy-based world.

MINDeSEA aims to assess the quantity and quality of marine CRM’s, and a more comprehensive pan-European identification and compilation of mineral potential and classification of metallogenic seafloor mineral deposits, including predictive areas. MINDeSEA also aims to provide guidance for the management of impacts resulting from deep sea resource exploitation, minimising environmental impacts and footprints. Marine spatial planning to ensure conservation of oceans as well as prevent conflict with other ocean users is in its core action.

This overall philosophy of research within MINDeSEA fulfills the main objective of GeoERA, which is to contribute to the sustainable use and responsible management of the subsurface. GeoERA will aim to support:
1) a more integrated and efficient management, maximising its added value and
2) a more responsible and publicly accepted, exploitation and use of the subsurface, minimising environmental impacts and footprints.

Theme objectives:

GeoERA RawMaterials Theme objectives are defined by the Grant Societal Challenges acknowledged by the European Union and the UNSDG. They are descript on a topic-specific basis in the Raw Materials Initiative and policies derived from it (i.e. COM(2008) 699 final; COM(2011) 25 final), in particular:

• the security and sustainability of mineral raw materials supply from EU domestic sources and other sources (primary and secondary) and
• the management of competing uses of the European surface and subsurface.

The overarching goal "*Improvement of EU raw material resilience*" is key to all GeoERA RawMaterials projects, whilst the scientific projects are focussing on specific facets of the challenge. The EC gives focus to the CRM GeoERA Raw Materials followed a wider approach considering the high importance of mineral raw materials for our society. All four scientific projects of GeoERA RawMaterials worked closely together to achieve the overall goals and to meet the needs of the stakeholders as much as possible under the given conditions. MINDeSEA provides fundamental knowledge and information that allows future activities to be focused on the most promising and priority areas, be they raw material-specific aspects, logistical challenges related to technological or spatial issues, and even legal aspects.

MINDeSEA responds to the predefined main goals of GeoERA RM "*Extending, deepening, upgrading the quality of the pan-European primary and secondary continental and marine resources inventory*" particularly by providing e.g. the first pan-European map of marine mineral resources, information on their occurrences and predictivity, the likelihood to be of economic interest and more (e.g. D 1.1, D 3.3, D 4.3, D 4.5, D 5.3). The close cooperation with FRAME allowed to link the information on CRM to those of the landlocked CRM for the first time in Europe.

The goal "*Implementation of innovative and efficient approaches throughout the mineral raw materials value chain, with the aim of optimizing the use and management of the resources, while minimizing negative environmental, health and societal impacts*" is approached from several perspectives. The compilation on MS level concerning marine legislation (D 4.6) combined with information on activities, experiences (such as on technologies and on observations in the biosphere) and derived recommendations are important information to optimise the resource management for example. Despite the enormous effort of every scientific cruise, D 7.2. points out that the previous exploration cruises only equated to pinpricks and much more is needed to lift the full potential of Europe's seabed resources. The work on potentiality and predictively are of great importance in order to further optimize future exploratory trips in terms of their scientific knowledge gain with a high ecological and economic efficiency (e.g. D 3.4, D 4.3, D 5.3; D 6.4; D 6.5).

The provided show cases and the reflection on existing exploration licences and their outcome so fare respond well to the goal of "*Performing pilot studies supporting exploration and development of mineral raw materials*". N.B.: The goal "*Updating contributions to and augmenting the coverage of the Annual Minerals Yearbook published by the Minerals4EU project*" is addressed specifically by MINTELL4EU. However, MINDeSEA provided significant input on new data and information that is been taken up by MINTELL4EU. The strong cooperation with MINTELL4EU, which forms the central raw material database, and with GIP-P

which connects the information with the EGDI platform and with EMODNet, shows the interoperability of the data, the exchange of knowledge and the interdisciplinary in its application.

MINDeSEA has meet the designated objectives of GeoERA RawMaterials and those defined within the project. The enormous dissemination and communication output by MINDeSEA is a strong surplus for the entire GeoERA Team.

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 data and information collected are based on scientific cruises, whose work is inherently limited (e.g., spatially, temporally, financially). Consequently, there are limits to general transferability to a larger scale. Further work is needed to fully exploit the potential of marine resources. Recommendations on management and legislation would benefit from joint interdisciplinary, transnational research projects. Mastered technical and logistical challenges encountered on marine exploration cruises can also help in the development of complex deposits on land. The enormous dissemination and communication campaign of a rather small team is impressive. It is due to the exceptionally strong commitment of the partners and benefits from the involvement of a professional communication team. The European Commission has already welcomed the work of MINDeSEA and took advantage (e.g. Blue Economy Report, presentation at the EU stand at PDAC at the invitation of the EC).

On an actor-specific basis a brief summary of the recommendations should be broken down and disseminated, To improve impact and further deepen knowledge.

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:

With a sea areal extent of 15,000,000 km^2, Europe is remarkably well-endowed with seabed metalliferous mineral resources, but its seabed mineral wealth and potential are still largely underestimated. The European interest revival for seafloor mining has been recently boosted by the European need to guarantee enough supply in strategic metals for ensuring the growing development of clean-energies. Deep-sea mining is now beginning to be considered as a viable alternative to land-based mining. Within this framework, the MINDeSEA project fostered concerted European efforts of services of major research institutes and Geological Surveys, from 12 coastal states bordering the European seas to build a first inventory of strategic mineral deposits within European seas and elucidate their economic potential.
One major strength of the project is to have gathered together a wide spectrum of data (bathymetric, structural, mineralogical, geochemical ect..) from a diversity of seabed deposit-types ranging from massive sulfide deposits, though polymetallic nodules to phosphorites and marine placer deposits to build friendly-user databases. Within the time limit (and with the added complexities of the COVID pandemic), the investigators have hence achieved a large amount of work for meaningfully collecting all available data from different sources not always easily accessible. This project demonstrates the European capability to establish facilities for storing seabed deposit data and guarantying their long-term stewardship and distribution. The database

outcomes lead to critical refinements of our current understanding and knowledge of European deposits. These databases are a key factor to develop metallogenesis 3-dimensional models and for establishing a first European budget of the metal resources. The insights will allow to set up some of these deposits as natural laboratories for sustained time series observations needed to monitor the complex interplay between magmatic, tectonic, hydrothermal, and biological processes to gain understanding into their processes of formation and economic potential. This work is also laying the foundation for targeting in the near future the most accessible resources to be mined with a minimum environmental impact. In addition, this project defines a new volume of the European digital scientific library for managing, indexing and providing access to ocean and marine derived data sets, acquired during cruises and by European institutions in European marine waters.
Regarding future developments, establishing a similar inventory for on-land Volcanogenic Massive Sulfide deposits would be of interest. At least for massive sulfide deposits associated to active vents already present in the database, if not yet available, it might become soon critical that biologists conduct a systematic inventory of their associated fauna. Gaining more knowledge on inactive hydrothermal deposits is of crucial importance for lowering the environmental impact of future deep-sea mining.
Overall, the investigators of this project have ensured to achieve and deliver the objectives of the original proposal in a timely manner. The coordinated approach led in this project to future seabed deposit monitoring in European waters is remarkable and will support sustainable exploitation while maintaining a good environmental status of the European seas.

Stakeholder two evaluation:

It is proved that the project was capable to deliver successfully its objectives.
The achievements of the MINDeSEA project represent a remarkable milestone in terms of the pan European seabed mineral deposits knowledge base.
The work developed by this project is impressive, in particular if we consider that the resources were somehow limited.
The project had good interactions with other research projects and with policy oriented organizations. The project provided an important contribution to three editions of the EU Blue Economy Report.
Not being one of the central subjects of the project, the environmental dimension, including the impacts of a potential future exploitation of seabed mineral deposits, is nevertheless summarized in deliverable 4.6. We consider that in any future follow-up project, the environmental aspects should be described/studied more in depth, including by integrating in the team the required expertise to address it. Equality important for the future is to identify the main bottlenecks to use these mineral resources, suggest solutions to tackle it and ensure fruitful interactions with NGOs.

Annex 1: Review meeting list of participants

Name	Role	Organisation
Joop Hasselman	GeoERA coordinator	Netherlands Organisation for Applied Scientific Research
Helena-Maria Cavaco-Viegas	GeoERA Stakeholder	DG GROW, EC
Christine Meyzen	GeoERA Stakeholder	Unipd, Italy
Barbara Simić	Monitoring and Reporting Officer	Geological Survey of Slovenia
Aleksandra Trenchovska	Monitoring and Reporting Officer	Geological Survey of Slovenia
Ana Novak	Scientific Officer	Geological Survey of Slovenia
Jasna Šinigoj	Scientific Officer	Geological Survey of Slovenia
Matija Krivic	Scientific Officer	Geological Survey of Slovenia
Antje Wittenberg	Raw Materials Theme Coordinator	Federal Institute for Geosciences and Natural Resources, Germany
Francisco Javier González Sanz	MINDeSEA Project manager	Geological Survey of Spain
Teresa Medialdea Ceia	Project member	Geological Survey of Spain
Henrik Schiellerup	Project member	Geological Survey of Norway
Irene Zananiri	Project member	Hellenic Survey of Geology and Mineral Exploration
Pedro Ferreira	Project member	The National Laboratory of Energy and Geology, Portugal
Xavier Monteys	Project member	Geological Survey Ireland
Trevor Alcorn	Project member	Geological Survey Ireland