MINDeSEA

Seabed Mineral Deposits in European Seas: Metallogeny and Geological Potential for Strategic and Critical Raw Materials

Deliverable 2.4.: Dissemination Products

WP2 leader: Geological Survey of Spain (IGME) - Spain		
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Deliverable number	Short Title
2.4	Dissemination products
Long Title	
Deliverable 2.4 – Report summarizing the resources of the project partners to disseminate information	
Short Description	
This document presents the dissemination products and activities achieved during the project (websites, newsletters, journal articles, press releases, infographics, flyers and social media tools, annual reports etc) along with specific targeted dissemination at conferences and meetings.	
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D2.4 MINDeSEA Dissemination products report

Summary:

GeoERA is a Co-Fund ERA-NET action under Horizon 2020, towards "Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe". Its main objective is to contribute to the optimal use and management of the subsurface.

The project "Seabed Mineral Deposits in European Seas: Metallogeny and Geological Potential for Strategic and Critical Raw Materials" (MINDeSEA), materialized in the frame of the GeoERA Raw Materials Theme (Grant Agreement Nº 731166, project GeoE.171.001), resulted from the collaboration between eight GeoERA Partners and four Non-funded Organizations at various points of common interest for exploration and investigation on seafloor mineral deposits. This report analyses the dissemination and exploitation activities carried out throughout the project by all partners involved in the project.

This document aims to present the dissemination and exploitation activities of the MINDeSEA carried out over the life of the project (2018 – 2021). In this context, dissemination means sharing the research results with potential stakeholders: peers in the research field, industry and policymakers, among others. By sharing research results with the rest of the scientific community, the project contributes to the advancement of science overall. Potential stakeholders are researchers working on similar topics, policymakers (eg., DG MARE and DG GROW), the deep-sea science community and private companies involved in deep-sea mining. In addition, the term exploitation refers to the use of MINDeSEA project results in research activities in national or international projects or the innovation, development, creation, provision of services, products or processes derived from project results (e.g. to develop new public policies).

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

INDEX

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INTRODUCTION

Background and objectives

Background on the MINDeSEA project

The project MINDeSEA results from the collaboration between eight GeoERA Partners and four Non-funded Organisations at various points of common interest for exploration and investigation on seafloor mineral deposits. This project addresses an integrative metallogenetic study of principal types of seabed mineral resources (hydrothermal sulfides, ferromanganese crusts, phosphorites, marine placers and polymetallic nodules) in the European Seas. The MINDeSEA working group has both knowledge of and expertise in such types of mineralisation, providing exploration results, sample repositories and databases to produce innovative contributions. The importance of submarine mineralisation systems is related to the abundance and exploitation potential of many strategic metals and Critical Raw Materials (CRM) necessary for modern society development.

Therefore, this project proposal aims to establish the metallogenic context for different seabed mineral deposits with economic potential in the pan-European setting. To achieve this, the project has established a set of objectives.

The objectives include: **1**) Characterise deposit types; **2**) Characterise the trace element content of the deposit type including CRM; **3**) Identify the principal metallogenic provinces; **4**) Develop harmonised mineral maps and datasets of seabed deposits incorporating GSO datasets, along with mineral-potential and prospectivity maps; **5**) Demonstrate how the cases study results can be used in offshore mineral exploration; **6**) Analyse present-day exploration and exploitation status in terms of regulation, legislation, environmental impacts, exploitation and future directions. **7**) Demonstrate efficiency of a pan-European research approach to understanding seabed minerals and modes of exploration.

Specific objectives of deliverable D2.4: Dissemination products

This report aims to present the dissemination and exploitation activities of the MINDeSEA project from mid-2018 to October-2021. In this context, the document explains the activities developed to make the concepts, results, and deliverables available to stakeholders and the general public. Potential stakeholders are end-users, marine research centres, European and non-European national geological services, marine environmental policymakers, etc. In addition, different actions have been taken to promote the use of MINDeSEA project results in research activities in national or international projects with related study fields or the innovation, development and creation of services, products or processes derived from the project results.

This deliverable compile, informs and analyses both the dissemination and exploitation activities of the individual partners and those of the whole consortium carried out throughout the project.

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REPORT

Introduction

All the project partners of the MINDeSEA consortium have used multiple dissemination channels and approaches for reporting the concepts and results of the project beyond the project. This included oral presentations in various vital events, leveraging the web and social media channels for instant and more frequent dissemination, and sharing knowledge with the research community through contributions to scientific publishing and conference venues. All of these dissemination activities were designed to reach the greatest number of people possible.

The partners' extensive and high-impact dissemination initiatives have been carried out to reach as wide an audience as possible, primarily essential stakeholders. To this end, guidelines were established in the early stages of the project to identify and prioritise the key stakeholders targeted by the project's dissemination activities and thus reach out to them. Thus, the following groups of stakeholders were identified, classified and prioritised: Policymakers, industry and academia. A more detailed stakeholders list can be seen in table 1.

Table 1. Stakeholders are likely to be interested in the project's output and, therefore, targeted for communication and dissemination activities. *Industry: G-TEC (GSR NV) Belgium; Nautilus Minerals; DeepGreen Resources; FUGRO; UK Seabed Resources; Ocean Mineral Singapore.

Stakeholders	
Regulators & Policymakers	EU Commission and associated organisations
Consultancy	
Data providers	National Geological Surveys, International Seabed Authority (ISA), InterRidge, others
Civil Society	
International Agencies	EuroGeoSurveys, European Federation of Geologists, Euromines, ISA, IOC-UNESCO, United Nations, Secretariat of the Commonwealth, London
Research Centres /Training Centres/ Academia/ Private sector/ Industry	Universities, ISA, InterRidge, JRC, KIC Raw Materials, Marine mining enterprises*, Schools, Educators, others
Major Geoscience Data Infrastructures	EMODnet, EGDI
Nonprofit organisations	WWF; The Nature Conservancy; Conservation International
Investors	Marine mining enterprises*
EU & Global initiatives	i) Horizon 2020 strategy, ii) Innovation union & resource efficiency flagship initiatives, iii) A roadmap for moving to a low carbon economy in 2050, iv) Tackling the challenges in commodity markets and raw materials, and v) Commitment towards Green Economy worldwide (OECD, UNEP, etc.). Circular Economy, Critical Raw Materials List, Battery Initiative

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Dissemination channels

The MINDeSEA project consortium employed various distribution mechanisms to fulfill the dissemination objectives and reach the different stakeholder groups stated previously. Each target group has unique requirements and characteristics, which impact how project concepts and outcomes are presented. To that purpose, the distribution channels can be classified as follows:

- MINDeSEA webpages
- MINDeSEA social media. Including Twitter, Facebook and YouTube.
- MINDeSEA communication materials. Including newsletters and leaflets.
- Events: attended by MINDeSEA members or organised by MINDeSEA
- Meetings
- Scientific publications
- Media. Including radio, TV and newspaper

The project dissemination over these different channels is described in the rest of this report.

Webpage and social media

MINDeSEA webpages

There are two official websites where the MINDeSEA project stage can be seen. One is located inside the GeoERA project website (MINDeSEA-1) and the other is the own project webpage (MINDeSEA-2).

The first (**Fig.1**) includes a summary of the project, including the primary goals to be achieved and the most important information such as partners, budget, work packages, and the most relevant details (dedicated webpage and the Twitter account). It is also possible to download a set of key derivables where the main aspects of the project are explained. There is also a GIS viewer managed by GIP-P and forming part of EGDI (**Fig.2**), through which it is possible to see the dataset and seabed mineral cartographies obtained in the project.

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Figure 1. Screenshot of the MINDeSEA project located at GeoERA webpage.

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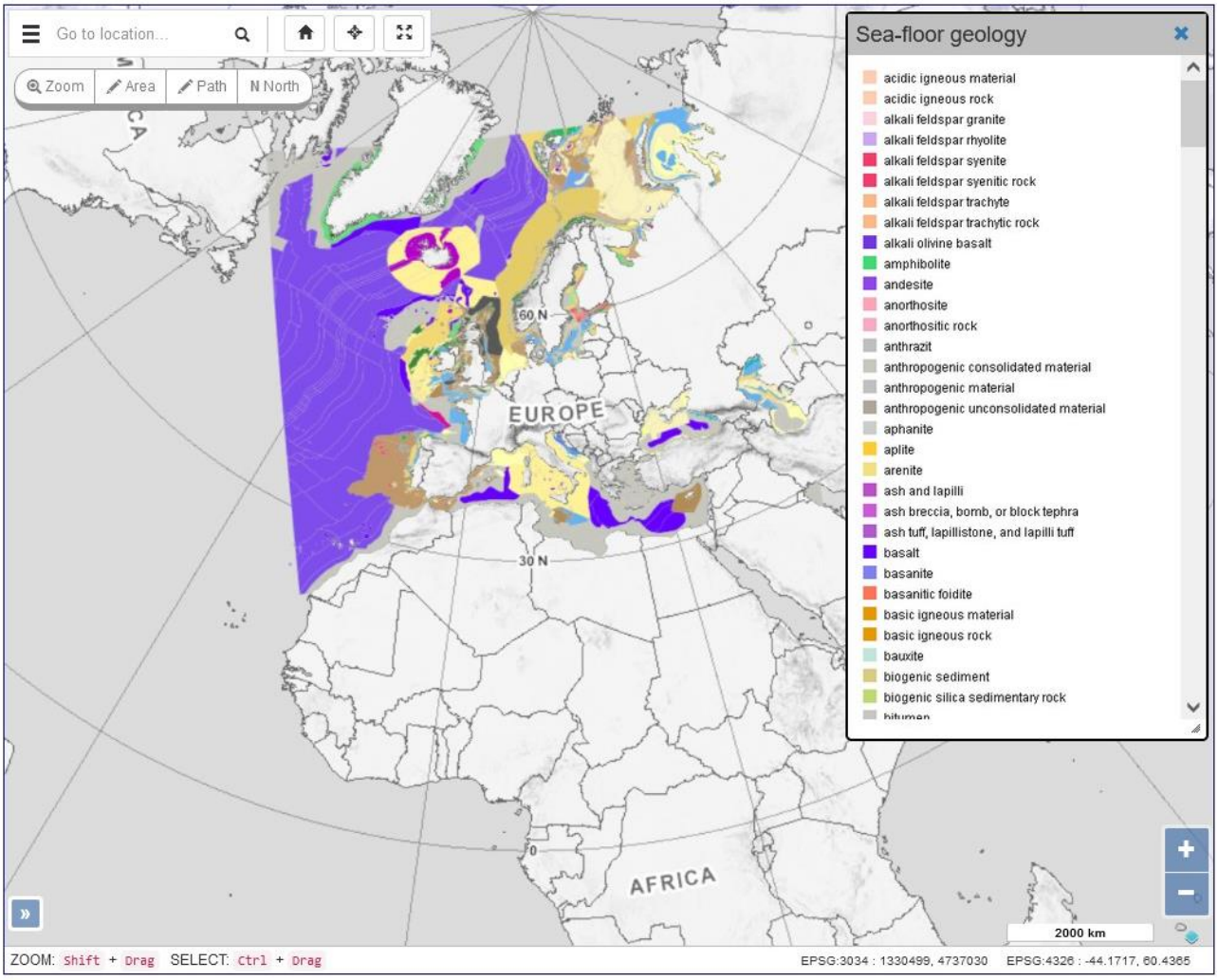

Figure 2. Screenshot of the GIS viewer where can be seen the project's results.

The MINDeSEA project's main website (**Fig.3**) is the primary channel to interact with and provide people from all stakeholder groups seeking information about the project. The website's home page includes a brief description and objectives to immediately convey the project's message to first-time visitors. In addition, the structure of the website is structured to make it easy for visitors to access all the information available:

Home: The MINDeSEA landing page includes the welcome message and the most recent news feeds.

Seabed mineral deposits: This section briefly describes the most relevant aspects of seabed mineral deposits like ubication and composition, including images on the deposit types. It is also possible to check a specific description of the principal seabed mineral deposits: Seafloor Massive Sulphides (SMS), Marine placer deposits, Ferromanganese Crusts (CFC), Phosphorites and Polymetallic Nodules (FMN).

Partners: Partners section includes a listing of the consortium members and links to respective organisations. The page also includes a collection of pictures of the project members. Also, the project contact info for direct inquiries.

News and Events: This section summarises the most relevant news related to the project. It also gives access to the newsletter registration.

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MINDeSEA Material: This section is used as the primary vehicle to disseminate public deliverables from the project, including pan-European seabed mineral maps and link to the EGDI platform. The page also includes a selection of downloadable slides, posters and publications produced by the consortium members.

Figure 3. Screenshot of the home page of the MINDeSEA project webpage.

Twitter

Twitter, which currently has approximately 300 million active users, is an ideal medium for sharing MINDeSEA project updates with all interested groups, targeting existing and new contacts. The Twitter profile was created in July 2018 and currently has approximately 530 followers, including research centres, universities, companies and relevant stakeholders linked to the field of DSM (**Fig. 4**). The network of contacts built has been constantly informed about all project progress, project-related news, multimedia content, upcoming events, news, etc. have been shared in a concise and accessible way the progress of the project as

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well as all the latest news and events that have taken place over the years and directly or indirectly involved with Deep Sea Mining (DSM). In addition, Twitter has allowed the project to interact with contacts through the messaging functions of the channels, monitor comments and reactions on each update and leverage the social connection of contacts to amplify the dissemination of updates (e.g. by retweeting the MINDeSEA update).

In addition, a GeoERA Did You Know Twitter (@GeoERA_DidUKnow) was created in May 2020 to disseminate news, events and actions in the framework of Raw Materials projects: MINDeSEA, FRAME, EuroLITHOS and Mintell4EU.

TWITTER ACCOUNT		
MINDeSEA	**Account:** **@MINDeSEA** **Followers:** **534** **Tweets:** **2164 (Oct. 27)**	The Twitter account focuses on broadcasting relevant MINDeSEA news, events, and partners activity in real-time if possible.

Figure 4. MINDeSEA Twitter account home page.

Facebook

Facebook is a huge social media and all published news is available worldwide. Since July 2018 the MINDeSEA account has posted all relevant information related to the project's progress and news related to the topics covered by the project, such as DSM or critical raw materials (**Fig.5**). The account has 206 followers (October 27), and the page has been updated practically weekly with fresh posts since its establishment.

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FACEBOOK ACCOUNT		
MINDeSEA	**Account:** **Mindesea Geoera** **Friends:** **206**	The Facebook account focuses on broadcasting relevant information related to MINDeSEA news and topics covered by the project.

Figure 5. MINDeSEA Facebook account homepage.

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YouTube

MINDeSEA project doesn't have a YouTube channel to upload audiovisual content. Despite this, the project coordinator, Javier González, has participated in a TV documentary with a large audience analysing the potential of the DSM in the Canary Islands (**Fig.6-3:5**). This series of documentaries where broadcasted on Canary Islands TV and later uploaded to its YouTube channel (InformativosTcv), with 29,800 subscribers, where anyone interested in this field can access its content.

In addition, the project has also participated in other dissemination events in both Spanish and English. Audiovisual content has been added to high-impact channels such as the Spanish Geological Survey (1100 subscribers) (**Fig.6-1**) and the American Geosciences Institute (29000 subscribers) (**Fig.6-6**).

	YouTube			
1		**Date:** **28/06/19**	**Views:** 88 **Likes:** 4 **Comments:** 0	**Link:** https://www.youtube.com/watch?v=-RZMEd0Hngk
2		**Date:** **16/12/19**	**Views:** 178 **Likes:** 4 **Comments:** 0	**Link:** https://www.youtube.com/watch?v=JRGz_VcHWTY
3		**Date:** **30/09/20**	**Views:** 2531 **Likes:** 63 **Comments:** 6	**Link:** https://www.youtube.com/watch?v=l-PcUnGInOY

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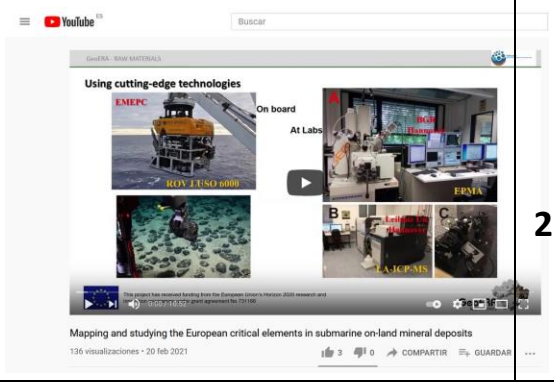
4		**Date:** **28/10/20**	**Views:** **2750** **Likes:** **61** **Comments:** **9**	**Link:** **https://www.youtube.com /watch?v=HDUG_mqDKLI**
5		**Date:** **02/12/20**	**Views:** **1972** **Likes:** **48** **Comments:** **6**	**Link:** **https://www.youtube.com /watch?v=4kDoxqf_fBE**
6		**Date:** **20/02/21**	**Views:** **136** **Likes:** **3** **Comments:** **0**	**Link:** **https://www.youtube.com /watch?v=D6IHPGHR2co**

Figure 6. MINDeSEA project appearance in YouTube.

Project communication media

Newsletter

The periodic MINDeSEA project newsletter was released twice a year, providing a brief description of the project progress, related events and news (**Fig. 7-1**). A PDF copy of the newsletter was published on the "News and Events" page of the main project website and a link to the newsletter was provided on the project's social media profiles. Furthermore, the newsletter was sent via email to the consortium partner organisations and other persons who have subscribed to it by registering online . The consortium members also had the responsibility of circulating the newsletter amongst their contacts.

In addition to the MINDeSEA newsletters, the project sometimes leveraged the GeoERA RAW MATERIALS newsletter with a larger audience than the project's stakeholder group profiles. This included the MINDeSEA-related news dissemination carried out by the project consortium (**Fig. 7-2**).

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AUGUST 2018 ISSUE 1

MINDeSEA

NEWSLETTER

MINDeSEA
Seabed Mineral Deposits in European Seas: Metallogeny and Geological Potential for Strategic and Critical Raw Materials

THE PROJECT MINDeSEA

The project MINDeSEA addresses an integrative metallogenetic study of principal types of seabed mineral resources (hydrothermal sulfides, ferromanganese crusts, phosphorites, marine placers and polymetallic nodules) in the European Seas. The MINDeSEA working group has both knowledge of and expertise in mineralisation, exploration results, sample repositories and databases to produce innovative contributions. The importance of submarine mineralisation systems is related to the abundance and exploitation-potential of many strategic metals and Critical Raw Materials (CRM), necessary for the modern society development.

IN THIS ISSUE

THE PROJECT MINDeSEA

GeoERA STARTS

NEWS AND EVENTS

1. MINDeSEA's newsletter. Released in August 2018, December 2018, August 2019 and November 2019. MINDeSEA newsletters link

Raw Materials Special

GeoERA RAW MATERIALS

November 2019

Raw Materials Week 2019

Highlights

Content:

- GeoERA at European Raw Materials Week
- Research and Innovation
- ORAMA hands over to GeoERA Raw Materials
- EUMICON and the EU Parliamentarians

The demand for mineral raw materials remains high while the challenges to produce in a social and environmental sound manner increase. This in short are the common findings expressed at the Raw Materials Week (RMW) 2019 that took place in Brussels from November 18 to November 22.

Sustainable and responsible sourcing from domestic and external resources, strategic and critical raw materials, exploration, data reliability, digitalisation as well as handling of big and harmonised data have been among the keywords of the week. These issues are addressed in the objectives of the GeoERA Raw Materials Projects EuroLithos, FRAME, MINDeSEA and MINTEL4EU and recognised by the European Commission (EC). The panellists in ORAMA's final event highlighted that the data need to be continuously updated in order to support fact based decision-making. A focus on data quality is important to reduce the signal to noise ratio.

Consequently, "Digitalisation in the Raw Materials Sector" is the topic of one of the next EIT Raw Materials Expert Fora.

The RMW 2020 is scheduled for 16 to 20 November 2020.

Policy officer Milan Grohol (DG GROW) referred to GeoERA Raw Materials as an important step forward to achieve Commissions goals.

GeoERA at Raw Materials Week 2019

tives will be driven by the

2. GeoERA RAW MATERIALS newsletter published in 2019, which included information about the MINDeSEA project.

FRAME
FORECASTING AND ASSESSING EUROPE'S STRATEGIC RAW MATERIALS NEEDS
Newsletter
JUNE 2021
www.frame.lneg.pt

Issue 8, June 2021

FRAME is coming to an end

FRAME started out with very definite objectives that built on previously available data developed in past EU projects (e.g., MAEU, EuRare, ProSUM, PROMINE and SCREEEN). As we fast approach the end of the GeoERA projects, in which FRAME is included, many are the achievements and substantial leaps forward in information gathering, data harmonisation and new understanding of the European mineral scenario.

At the end of October, FRAME will come to an end with the satisfaction that it has surpassed several milestones and offered new scientific products to earth scientists in general, but also to decision makers in local, regional, national and central government agencies.

This issue of the newsletter is yet another brief look at some of the more innovative achievements and results within the FRAME project.

Outlining the cobalt and phosphor exploration potential areas and mineralisation in Europe: a collaboration between FRAME and MINDeSEA projects

Authors: Martiya Sadeghi, Guillaume Bertrand, Francisco Javier González, Daniel de Oliveira

With contribution of the FRAME project: Aurete Pereira, Lidia Quental, Sophie Decree, Tuomo Törmänen, Håvard Gautneb

With contribution of the MINDeSEA project: Egidio Marino, Luis Somoza, Teresa Medialdea, Iker Blasco, Ana Belén Lobato

Introduction

One of the primary goals in FRAME project's WP3 (Critical and Strategic Raw Materials Map of Europe), in collaboration with other work packages of FRAME and other GeoERA projects, is to produce and present the mineralisation and potential areas for CRM in Europe. Identifying new resources of supply critical mineral potential on land and in the European seabed for CRM needed for energy transition, is crucial for the European Union. In this regard, identifying and mapping of the major metallogenic areas for different type of mineralisation is essential. The global demand for CRM and strategic minerals containing cobalt, phosphorous, rare earth elements, tellurium, manganese, nickel, lithium and copper, concurrent with the rapidly diminishing quality and quantity of land-based mined deposits, has placed the seafloor as a promising new frontier for the exploration of mineral resources.

To develop metallogenic research and models at regional and deposit scales, with special attention to strategic critical minerals, for which the EU's downstream industry is highly dependent in the mid- and long-term perspectives, one must go from the known to the unknown, or at least, less known. Collating this information into favourable terrains is absolutely necessary to be able to understand mineralisation at the various scales. The latter was one of FRAME's objectives as we will see developed below for phosphate and cobalt mineralisation.

The geological evolution of European terrains provided favourable conditions for the formation of a variety of

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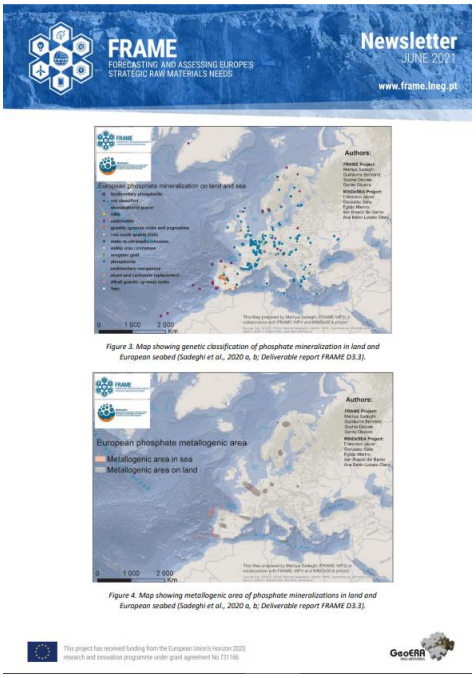
GeoERA

3. FRAME project newsletter. Released in June 2021. Available at FRAME



FRAME
FORECASTING AND ASSESSING EUROPE'S STRATEGIC RAW MATERIALS NEEDS
Newsletter
JUNE 2021
www.frame.lneg.pt

European phosphate mineralization on land and sea

Authors:

Figure 3. Map showing genetic classification of phosphate mineralization in land and European seabed (Sadeghi et al., 2020 a, b; Deliverable report FRAME D3.3).

European phosphate metallogenic area

Metallogenic area in sea

Metallogenic area on land

Authors:

Figure 4. Map showing metallogenic area of phosphate mineralizations in land and European seabed (Sadeghi et al., 2020 a, b; Deliverable report FRAME D3.3).

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GeoERA

4. MINDeSEA-FRAME cooperative compilation maps. Released in June 2021. Available at FRAME

Figure 7. 1) Newsletter available for MINDeSEA project. **2)** GeoERA Raw Materials Newsletter. In this issue, the MINDeSEA project is mentioned. **3)** Newsletter available for FRAME-MINDeSEA projects, cooperative metallogenic cobalt and phosphate onshore-offshore maps. **4)** Detail on the FRAME-MINdeSEA cooperative studies and newsletter.

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Project leaflet and poster

An electronic copy of a poster was developed describing the MINDeSEA project and made available on the "deliverables" area of the project website for people to access (**Fig.8-1**). It provides information on the project structure, main objectives, work packages and partners. Printed versions of the leaflet were presented at the Raw Materials Week 2018.

The GeoERA RAW MATERIALS projects, in which MINDeSEA included, made an electronic leaflet (**Fig.8-2**) describing the general lines of research that have been developed in the framework of the GeoERA RAW MATERIALS and in which MINDeSEA participates. It was published on the publicly accessible 'Promotional Material' area of the project's website. The hardcopy versions were printed and distributed at various events, including those organised by the project.

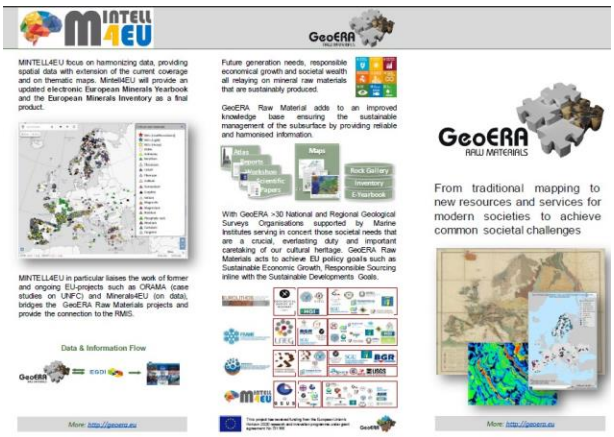
Project communications materials	
	**MINDeSEA project's poster** **Published at:** Kick-off conference at Brussels **Date:** July 2018 **Available on the web:** MINDeSEA Poster
	**GeoERA RAW MATERIALS leaflet** **Published at:** Raw Materials Week 2018, Brussels **Date:** November 2018 **Available on the web:** Leaflet

Figure 8. A) MINDeSEA project's poster where the most relevant information is summarised. **B**) Leaflet made by GeoERA RAW MATERIALS project, MINDeSEA project is present in it.

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Events

During the last 18 months the development of face to face events has been characterised by the negative impact of the COVID-19 pandemic in our normal progresses of GeoERA activities. The potential reach of the COVID-19 Coronavirus changed significantly in the beginning of March 2020. There had been an increasing incidence of infections in all the European countries and a growing number of employers and states were placing multiple limitations on works at office, laboratories, field trips and travels. All these circumstances delays and cancelations affecting multiple events.

Attendance and participation in events

The MINDeSEA project has been present, throughout the project, at a wide range of dissemination events organised by other organizations and scientific societies in the fields of geology, marine geology, DSM, mineral resources, climate change and a green transition, among others. Events included academic conferences, exhibitions, research dissemination events, seminars, congresses, webinars and workshops. The goal of attending these events was to promote awareness of the MINDeSEA project, improve networking possibilities within scientific groups, and share project findings. Throughout the project, MINDeSEA activities and results were presented at more than 70 dissemination events. This has demonstrated that MINDeSEA project members have focused on stakeholder engagement and dissemination of the knowledge generated. Presentations of the MINDeSEA project at these events took place in oral and poster presentations, both face-to-face and online. The activities were undertaken under a common dissemination strategy supported by tools such as the project brochure, social networks, etc. The project presentations were diverse in thematic areas and covered all the knowledge areas that the project has worked on (mineral resources, mineralogy, geochemistry, results of oceanographic campaigns, GIS...) under the project's multidisciplinary nature. The participants' response in the different events has been good, gathering more than 2500 people in two events where MINDeSEA members were integrating the proposal of sessions and chairman position (Goldschmidt Conference 2019, Barcelona; and EGU 2020, Vienna). The following table summarises all dissemination events where the MINDeSEA partners participated (**Table 2**).

Table 2. Summary of MINDeSEA project participation events.

#	Date	Event	Presentation type	Place	Topics
1	Apr-18	Meetings	Oral presentation	Budapest (Hungary)	Presentation of MINDeSEA to the Mineral Resources Expert Group Eurogeosurveys (MREG)
	Jun-18	International conference	Oral presentation	Saint Petersburg (Russia)	Ferromanganese crusts from the Canary Island Seamount Province
	Jun-18		Exhibition		Presentation of MINDeSEA to the InterRIDGE Community
	Sep-18	International conference	Oral presentation	Bergen (Norway)	Communication at the "Underwater Mining Conference"

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Sep-18		Poster	Thessalonica (Greece)	Communication at the Thessalonica Conference
Sep-18		Oral presentation	Shëngjin (Albania)	Presentation of MINDeSEA to Marine Geology Expert Group-Eurogeosurveys (MGEG) and EMODnet-Geology consortium
Sep-18	Seminar	Oral presentation	Madrid (Spain)	Energy and Mineral Resources of the Oceans. Madrid Naval Week
Oct-18	Congress	Oral presentation	Madrid (Spain)	ESRI conference: Mapping underwater mineral deposits
Oct-18		Oral presentation		Dissemination "EuroGeoSurveys 45th General Meeting and Directors' Workshop"
Nov-18	Workshop	Oral presentation	London (UK.)	Critical raw materials exploration in the Atlantic Iberian and Macaronesian. Geological Society of London, Marine Minerals: A New Resource for the 21st Century margins
Nov-18	Workshop	Oral presentation	London (UK.)	Critical raw materials exploration in the Atlantic Iberian and Macaronesian margins. Geological Society of London, Marine Minerals: A New Resource for the 21st Century
Nov-18	Pitch event	Poster	Brussels (Belgium)	Earth observation systems and marine minerals
Nov-18	Pitch event	Oral presentation	Brussels (Belgium)	GeoERA's interest in earth observation data
Nov-18	Seminar	Seminar	Las Palmas (Spain)	(Egidio Marino PhD Student); Seminar on marine minerals
Nov-18	International conference	Poster	Brussels (Belgium)	Communication at the "Raw Materials Week"
Nov-18	International conference	Oral presentation	Brussels (Belgium)	Communication at the "Raw Materials Week"
Nov-18	Meetings	Oral presentation	Rome (Italy)	Presentation of MINDeSEA to the Mineral Resources Expert Group Eurogeosurveys (MREG)

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Nov-18	Meetings	Poster	Madrid (Spain)	PhDay, Univ. Complutense of Madrid. Mineral resources and strategic elements source
Dec-18		Poster		GeoERA InfoDay at the Greek Ministry of Environment and Energy
Dec-18		Oral presentation		Seabed mapping at the AGU Fall Meeting
Dec-18		Poster		Seabed mapping at the AGU Fall Meeting
Feb-19	International conference	Oral presentation	Toronto (Canada)	GeoERA-MINDeSEA project presentation at PDAC convention
Aug-19	International conference	Poster	Barcelona (Spain)	GeoERA-MINDeSEA project´s development. Goldschmidt 2019
Aug-19	International conference	Oral presentation	Barcelona (Spain)	Hydrothermal Input in Fe-Mn Crusts from Canary Islands Seamount Province. Goldschmidt 2019
Sep-19	International conference	Oral presentation	Münster (Germany)	Geological Survey Organisations contribution to Europe's raw materials sustainability. GeoMünster 2019
Oct-19	Workshop	Oral presentation	Las Palmas de Gran Canaria (Spain)	MINDeSEA presentation and cross-project activity. MarSP workshop.
Oct-19	Congress	Poster	Madrid (Spain)	Ferromanganese crusts of Spain's Atlantic margins: mineral resources and strategic element source. PhDay
Oct-19		Oral presentation		Dissemination "EuroGeoSurveys 46th General Meeting and Directors' Workshop."
Oct-19		Oral presentation	Athens (Greece)	Update of MINDeSEA to the Marine Geology Expert Group-Eurogeosurveys
Nov-19	Meetings	Oral presentation	Brussels (Belgium)	MINDeSEA was attending the Raw Materials Week participating in discussions and cooperative actions in the framework of GeoERA and ORAMA.
Nov-19		Oral presentation	Madrid (Spain)	Update of MINDeSEA to the Mineral Resources Expert Group at IGME EuroGeoSurveys members

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Nov-19	meeting	Oral presentation	Trondheim (Norway)	MINDeSEA consortium has celebrated the third internal meeting and Workshop on Deep-sea Geophysical Exploration at NGU
Nov-19	Workshop	Oral presentation	Ubatuba (Brazil)	Ferromanganese crusts from the Canary Island Seamount Province: High-resolution tools for critical metals determination
Nov-19	Meetings	Oral presentation	Brussels (Belgium)	SCRM occurrences from seafloor mineral deposits
Nov-19	ISA workshop	Oral presentation	Evora (Portugal)	Hydrothermal mineralisation and environmental issues in the Atlantic cross project's interactions
Nov-19	Internal project meeting	Workshop	Trondheim (Norway)	Workshop on Deep-sea Geophysical Exploration
Dec-19	Congress	Oral presentation	Madrid (Spain)	COP 25, Madrid International Climate Conference
Feb-20	Online webinar	Oral presentation	Castellón de la Plana (Spain)	XV JORNADES DE CIÈNCIES DE LA TERRA
Mar-20	International congress	Oral presentation	Delhi (India)	GeoERA-MINDeSEA project: evaluating ferromanganese crusts and their associated critical metals in European seas. IGC 2020
Mar-20	Online convention	Oral presentation	Toronto (Canada)	MINDeSEA project presentation. PDAC 2020
Apr-20	International conference	Oral presentation	Aachen (Germany).	GeoERA Raw Materials supporting Europe's mining future. AIMS 2020
Apr-20	Online congress	Oral presentation	Vienna (Austria)	Mineral resources - crucial components of a vital and wealthy society. EGU 2020
Apr-20	Online congress	Poster	Viena (Austria)	Hydrogenetic Fe-Mn crusts from European seas: source of potentially economic cobalt mining. EGU 2020
May-20	Webinar	Webinar	Barcelona (Spain)	Debate on "Mining of Future: Researching cobalt, tellurium and other strategic and critical metals from the deep-sea mineral deposits" (in Spanish)
Jun-20	International webinar	Webinar	Santiago de Chile (Chile)	"Seabed Mining" (in Spanish) addressed to Camara Minera de Chile with the participation of multiple mining

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				companies and stakeholders from Latin America
Sep-20	Workshop	Oral presentation		MINDeSEA-EMODnet cooperative works for mapping and studying European seabed minerals
Sep-20	Meeting			Bilateral meeting GeoERA-DG GROW
Aug-20	Online conference	Oral presentation	Utrecht (Holland)	Presentation of talks to GeoUtrech conferences. GeoUtrecht 2020
Oct-20	International webinar	Webinar	Buenos Aires (Argentina)	Webinar-Debate Seminarios de la Carrera de Especialización en Geología Minera. "Researching seabed mineral deposits: the last frontier"
Oct-20	International conference	Oral presentation	Florida (USA)	Presentation of talks to Underwater Mineral Conference. UMC 2020
Oct-20	Meeting	Oral presentation	Online	Update of MINDeSEA to the Mineral Resources Expert Group-Eurogeosurveys
Oct-20	Meeting	Oral presentation	Online	Update of MINDeSEA to the Marine Geology Expert Group-Eurogeosurveys
Nov-20	Meetings	Webinar	Online	MINDeSEA consortium was attending and presenting our principal findings and challenges in the GeoERA Webinar Series
Oct-20	Online conference	Oral presentation	Delphi (Greece)	REE contents in Fe-Mn crusts from Canary Island Seamount Province: High-resolution analysis to identify the metal-bearing minerals. ERES 2020
Feb-21	Webinar	Oral presentation	USA	Critical Minerals Forum: present and future directions of critical minerals research
Feb-21				MINDeSEA has reported to DG GROW an update on the dataset structure and results
Mar-21	Online convention	Oral presentation	Online	Project presentation. Prospectors & Developers Association of Canada (PDAC 2021)
Mar-21	Meetings	Meeting with other GeoERA project		GeoERA General Assembly

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Apr-21	International conference	Oral presentation	Online	EGU 2021, GeoERA Session: oral communications
Apr-21	International Webinar	Oral presentation	Santiago de Chile (Chile)	International Webinar "Seabed Mining" Cámara Minera de Chile
Apr-21	Meetings	Oral presentation		Presentation of MINDeSEA update to the Mineral Resources Expert Group Eurogeosurveys (MREG)
Apr-21	Online congress	Abstract	online	GeoERA-MINDeSEA Marine Data and Information Management Best Practices. International Conference on Marine Data and Information Systems (IMDIS 2021)
Apr-21			Geneva (Switzerland)	UNECE Resource Management Week 2021
Jun-21	Meeting			MINDeSEA has reported to DG GROW an update on the dataset structure and results
Jul-21	International Congress	Oral presentation		Occurrences of polymetallic nodules in European seas - preliminary results of the MINDeSEA project. Goldschmidt 2021
Jul-21	Congress	Oral presentation	Vitoria (Spain)	Two oral presentations at the 10th Geological Congress of Spain
Aug-21	International Congress		Digital edition	XV Congresso de Geoquímica do Países de Lingua Portuguesa (CGPLP)
Sep-21	Meetings	Oral presentation	Lisbon (Portugal)	Presentation of MINDeSEA update to the Mineral Resources Expert Group Eurogeosurveys (MREG)
Sep-21	International conference	Oral presentation	Brussels (Belgium)	Communication at the "Raw Materials Week"
Sep-21	International conference	Oral presentation	Karlsruhe (Germany)	Communication at "GEOKARLSRUHE 2021"
Sep-21	International conference	Oral presentation	Meggen (Switzerland)	Europe's Raw Materials Supply Chains Resilience and GeoERA's Contribution. 7th Meggen Raw material days
Oct-21	International conference	Oral presentation	Bergen (Norway)	Deep Sea Minerals Conference
Nov-21	International Conference	Poster presentation	Brussels (Belgium)	Raw Materials Week 2021

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Workshops and webinars

During the project, partners have participated and organised workshops to share information and knowledge related with project-related themes with other partners and stakeholders. The participants represented a mixed and interdisciplinary group drawn from national and international scientists, and government agencies in those events.

The goal of attending these events was to promote awareness of the MINDeSEA project, improve networking possibilities within scientific networks, and share project findings.

These events include the primary dissemination and exploitation events of the MINDeSEA project organised, such as the kick-off event in Brussels (2018) (**Fig.10**), MINDeSEA International Seminar on Deep-sea Mining and the 2nd meeting of project MINDeSEA in Madrid, Spain (2019) (**Fig.11**), the MINDeSEA International Workshop on Geophysical Tools applied to Marine Hydrothermal Minerals Exploration and the meeting of project MINDeSEA in Trondheim, Norway (2019) (**Fig. 12**) and the GeoERA Webinar Series (2020). More details about those are given in the following sections.

Table 3. Summary of workshops attended and organised by MINDeSEA partners

#	Event	Location	Date	Topic
	Kick-off meeting-Workshop	Brussels (Belgium)	Jul-18	Kick-off meeting of MINDeSEA project.
	Attendance to workshop		Oct-18	EuroGeoSurveys 45th General Meeting and Directors' Workshop.
	Attendance to workshop	Las Palmas (Spain)	Oct-18	Seminar on marine minerals organised by the University of Las Palmas.
	Workshop organised by the project	Madrid	May-19	Workshop "Seafloor Mineral Deposits for the Global Sustainable Development." The workshop speakers are internationally renowned senior scientists and members of MINDeSEA: James Hein (USGS), Georgy Cherkashov (VNII Okeangeologia), Thomas Kuhn (BGR), Fernando Tornos (IGEO) and Luis Somoza (IGME).
	Attendance to workshop		Oct-19	EuroGeoSurveys 46 General Meeting and Directors' Workshop.
	Attendance to workshop	Canary Islands (Spain)	Oct-19	Macaronesian Maritime Spatial Planning (MarSP) workshop, marine spatial planning in the Canary Islands (Tenerife and Gran Canaria). MINDeSEA presentation and cross-project activity
	Attendance to workshop	Ubatuba (Brazil)	Nov-19	Workshop "Marine E-Tech –Multidisciplinary Research on the Rio Grande Rise."

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Attendance to workshop	Brussels (Belgium)	Nov-19	Raw Materials Week participating in discussions and cooperative actions in the framework of GeoERA and ORAMA.
Workshop organised by the project	Trondheim (Norway)	Nov-19	MINDeSEA consortium has celebrated the workshop on "Geophysical Tools applied to Marine Hydrothermal Minerals Exploration" at NGU with the participation of all the project partners.
Attendance to workshop	Evora (Portugal)	Nov-19	ISA workshop: Hydrothermal mineralisation and environmental issues in the Atlantic.
Workshop organised by the project (Postponed by COVID)	Seville-Huelva (Spain)	Apr-20	MINDeSEA Workshop-Field Trip: "Iberian Pyrite Belt."
Webinar-Debate Invited speaker	Barcelona (Spain)	May-20	"Mining of Future: Researching cobalt, tellurium and other strategic and critical metals from the deep-sea mineral deposits" (in Spanish) addressed to the graduate, master and PhD students in Geology at the University of Barcelona and the Barcelona Student Chapter (25 attenders). (**Fig. 9-4**)
International webinar Invited speaker	Santiago de Chile (Chile)	Jun-20	International Webinar on "Seabed Mining" (in Spanish) addressed to Camara Minera de Chile with the participation of multiple mining companies and stakeholders from Latin America (more than 600 inscriptions, 100 attenders). (**Fig.9-1**)
Attendance to workshop	Online	Oct-20	MINTELL4EU had a digital workshop where eight case studies on United Nations Framework Classification for Resources (UNFC) were presented and discussed. Participation in MINDeSEA project.
International webinar Invited speaker	Buenos Aires (Argentina)	Oct-20	Webinar-Debate Seminarios de la Carrera de Especialización en Geología Minera. "Researching seabed mineral deposits: the last frontier"
Workshop with stakeholders	Online	Oct-20	Presentation and discussion of JRC Technical report: Background Study on the environmental impact assessment of non-energy minerals extraction projects concerning European Union Community requirements

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GeoERA Webinar	Online	Nov-20	GeoERA Webinar Series, Javier González Sanz (IGME) MINDeSEA project lead presenting results and key findings
International forum-workshop Invited speaker	Online	Feb-21	Daniel de Oliveira (LNEG), FRAME project lead, and Javier González Sanz (IGME) MINDeSEA project lead presenting "Mapping and studying the European critical elements in submarine and on-land mineral deposits for the sustainable future." **(Fig. 9-3)**
International webinar Invited speaker	Santiago de Chile (Chile)	Apr-21	International Webinar on "Seabed Mining" (in Spanish) addressed Camara Minera de Chile with the participation of multiple mining companies and stakeholders from Latin America. (**Fig. 9-2**)
Postponed workshop	-	-	MINDeSEA consortium planned a 3rd workshop-Field Trip to compare and discuss seafloor fossil hydrothermal mineralisation models and their application to the exploration of present-day seafloor hydrothermal systems. The workshop will be celebrated when the pandemic situation allows the reschedule of face-to-face MINDeSEA activities.
International conference-workshop Invited speaker	Onsite/ Online	Oct-21	Javier González Sanz (IGME) MINDeSEA project lead presenting "GeoERA-MINDeSEA project database and cartography of European seabed mineral deposits."

Examples of workshop-webinar events related to DSM and attended by MINDeSEA project can be seen below: Organised by Cámara Minera de Chile (**Fig. 9-1:2**), Student Chapter SGA-SEG Barcelona (**Fig:9-3**) and Critical Mineral Forum (**Fig. 9-4**).

MINDeSEA meetings

Project meetings have been held regularly to maintain track of the project's progress, discuss any project-related concerns, and make decisions as needed. The intern project meeting has been held regularly since its inception. In addition, project partners have participated in meetings with EGS (Marine Geology and Mineral Resources Expert Groups of EuroGeoSurvey)and stakeholders, such as DG-GROW.

Those activities and results have also been held remotely and in different locations with an agenda aimed explicitly at the project's progress. Regular videoconference sessions have been scheduled between project members and other GeoERA RAW MATERIALS projects (FRAME, MINTELL-4EU and Eurolithos) managed by our RM Coordinator, Antje Wittenberg. The main objective of these meetings was the presentation and discussion of the results and progress made.

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The most relevant meetings in which MINDeSEA project has participated are summarised in the following table (**Table 4**).

1		During this seminar, the participating experts approached the topic of underwater mining from different points of view.
2		During this event, experts discuss the environmental, legislative and production analysis and perspectives of DSM in Chile.
3		During the event, Dr. Gonzalez talked about the current state of exploration of seabed resources and the focus on this field in Spain, Europe and worldwide. Themes like the geopolitical aspect of the matter and explanations of the work of the ISA in regulating exploration) of the ocean floor were made.

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4	AGI american geosciences institute connecting earth, science, and people	During the event, they talk about "Mapping and studying the European critical elements in submarine and on-land mineral deposits for the sustainable future." MINDeSEA and FRAME projects cooperative work.

Figure 9. Some of the workshops-webinars attendance by the MINDeSEA project as invited speaker to talk about DSM and its current status.

Table 4. Summary of events organised and attendance by MINDeSEA project.

#	Event	Q	Date	Topic
	Internal project meeting	Q1-Q2 2018	May-18	IGME presented the first examples of compilation maps and tables in the Canary Islands and Iberian margins at the Madrid internal meeting
	Meeting	Q3-Q4 2018	Sep-18	One presentation on the MINDeSEA objectives and tasks have been presented by Teresa Medialdea (IGME-Spain) at the Marine Geology Expert Group-Eurogeosurveys in Shëngjin-Albania
	Meeting	Q3-Q4 2018	Nov-18	The coordinator has presented two talks on the activities and progresses of the MINDeSEA project to the Mineral Resources Expert Group-Eurogeosurveys in Budapest (April 2018) and Rome
	Internal project meeting	Q1-Q2 2019	Mar-19	The coordinator has presented one talk on the activities and progresses of the MINDeSEA project to the Mineral Resources Expert Group-Eurogeosurveys at NGU in Trondheim-Norway
	Internal project meeting	Q1-Q2 2019	May-19	MINDeSEA consortium has celebrated the second internal meeting at IGME in Madrid with the participation of all the project partners, including the non-funded partners (except GEOINFORM-Ukraine).
	Meeting	Q3-Q4 2019	Sep-19	Bilateral meeting GIP-P MINDeSEA
	Meeting with other projects	Q3-Q4 2019	Oct-19	One presentation on the MINDeSEA objectives and tasks have been presented by Teresa Medialdea (IGME-Spain) at the Marine Geology Expert Group-Eurogeosurveys in Athens-Greece

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Meeting with other GEOERA projects	Q3-Q4 2019	Nov-19	The coordinator has presented one talk on the activities and progresses of the MINDeSEA project to the Mineral Resources Expert Group-Eurogeosurveys at IGME in Madrid-Spain
Internal project meeting	Q1-Q2 2020	May-20	WP3 bilateral meeting was celebrated on 25 May 2020 to provide a digital version of the metallogenic map and related description (CRM), including on-land and seabed CRM.
Meeting with other projects	Q1-Q2 2020	May-20	MINDeSEA and GIP-P have celebrated a bilateral meeting. Data types and formats, standards, project vocabularies, data licensing models and data delivered plans were introduced and discussed.
Internal project meeting	Q3-Q4 2020	Jul-20	MINDeSEA consortium has celebrated several internal bilateral and trilateral meetings via teleconference in April, May and June 2020 with the participation of all the work packages leads or people in charge of specific tasks
Internal project meeting	Q3-Q4 2020	Sep-20	GeoERA project Leaders meeting 2020 to inform and analyse multiple issues related to the GeoERA developments (communication and dissemination, economic, pandemic, EGU, webinars, GeoERA final event, others).
Internal project meeting	Q3-Q4 2020	Sep-20	MINDeSEA consortium has celebrated several internal bilateral and trilateral meetings via teleconference with the participation of all the WP leads or people in charge of specific tasks
Internal project meeting	Q3-Q4 2020	Sep-20	MINDeSEA-FRAME WP3 bilateral meetings were celebrated on September-October 2020 to produce cooperative works on metallogenic maps and reports of CRM
Internal project meeting	Q3-Q4 2020	Oct-20	MINDeSEA consortium has celebrated several internal bilateral and trilateral meetings via teleconference with the participation of all the WP leads or people in charge of specific tasks
Online Meeting	Q3-Q4 2020	Oct-20	Update of MINDeSEA to the Mineral Resources Expert Group-Eurogeosurveys
Online Meeting	Q3-Q4 2020	Oct-20	Update of MINDeSEA to the Marine Geology Expert Group-Eurogeosurveys

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Internal project meeting	Q3-Q4 2020	Nov-20	MINDeSEA consortium has celebrated several internal bilateral and trilateral meetings via teleconference with the participation of all the WP leads or people in charge of specific tasks
Internal project meeting	Q3-Q4 2020	Dec-20	GeoERA project Leaders meeting 2020 to inform and analyse multiple issues related to the GeoERA developments (communication and dissemination, economic, pandemic, EGU, webinars, GeoERA final event, others).
Internal project meeting	Q1-Q2 2021	May-21	MINDeSEA and GIP-P have celebrated bilateral meeting
Meeting with other GeoERA projects	Q1-Q2 2019		Regular WebEx teleconferences on coordination have been celebrated with all the Raw Materials projects and our RM Coordinator, Antje Wittenberg
Meeting with other GeoERA projects	Q3-Q4 2019		Regular WebEx teleconferences on coordination have been celebrated with all the Raw Materials projects and our RM Coordinator, Antje Wittenberg
Internal project meeting	Q3-Q4 2019		MINDeSEA consortium plans the next internal meeting to coincide with the GeoERA Midterm review meeting in Ljubljana (Slovenia), 19 March 2020.
Internal project meeting	Q1-Q2 2020		Weekly Skype teleconferences on coordination have been celebrated with all the Raw Materials projects and our RM Coordinator, Antje Wittenberg
Internal project meeting	Q1-Q2 2020		MINDeSEA consortium has celebrated several internal bilateral and trilateral meetings via teleconference in April, May and June 2020, with the participation of all the WP leads
Internal project meeting	Q1-Q2 2020		MINDeSEA consortium is celebrating continuous meetings to discuss and validate the data structure for each WP 3-7. Vocabularies, the GeoPackage and a QGIS Project.
Meeting	Q1-Q2 2020		GSI and MINDeSEA consortium cooperate with GIP-P and the other RM projects to propose new project vocabularies.
Meeting with other projects	Q3-Q4 2020		MINDeSEA is forming part of the Research & Innovation Working Group in the preparation of the CSA-GSE proposal attending the meetings and requirements
Internal project meeting	Q3-Q4 2020		Weekly Skype teleconferences on coordination have been celebrated with all the Raw Materials projects and our RM Coordinator, Antje Wittenberg.

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Internal project meeting	Q3-Q4 2020	MINDeSEA consortium is celebrating continuous meetings to discuss and validate the data structure for each WP 3-7 and the GeoPackage and a QGIS Project.
Internal project meeting	Q3-Q4 2020	MINDeSEA and GIP-P have celebrated bilateral meetings. Data types and formats, standards, project vocabularies, data licensing models and data delivered plans were introduced and discussed.
Meeting	Q3-Q4 2020	GSI and MINDeSEA consortium cooperate with GIP-P on the website, EGDI platform design, formats of products and new project vocabulary.
Internal project meeting	Q1-Q2 2021	Weekly Skype teleconferences on coordination have been celebrated with all the Raw Materials projects and our Raw Materials Coordinator, Antje Wittenberg.
Internal project meeting	Q1-Q2 2021	MINDeSEA consortium has celebrated internal bilateral and trilateral meetings via teleconference along the semester based on different issues (reports, datasets and maps, GIP-P interactions) with the participation of all the WP leads and expertise technicians
Internal project meeting	Q1-Q2 2021	MINDeSEA consortium is celebrating continuous meetings to discuss and validate the data structure for each WP 3-7.
Internal project meeting	Q3-Q4 2021	Weekly Skype teleconferences on coordination have been celebrated with all the Raw Materials projects and our Raw Materials Coordinator, Antje Wittenberg.

As mentioned above, the most relevant events organised by the MINDeSEA project partners were the Kick-off meeting, the 2nd meeting of the project carried out in Madrid and the 3rd meeting carried out in Trondheim.

Kick-off meeting of project MINDeSEA

Brussels (Belgium), July 2018

Organisation

The kick-off meeting of project MINDeSEA was organised by the GeoERA Coordinator and Secretariat with the assistance of each funded project and hosted by EGS on 3-5th July 2018. A total of 300 people attendance from EGS members and stakeholders. The key goal of this meeting was to present the awarded projects. GeoERA got acquainted with all the international project partners and interested society. Expectations were discussed and recommendations from the European Commission and GeoERA's Stakeholder Council received. Also, tasks, milestones, synergies and impact of GeoERA projects were discussed.

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Agenda and Outcomes

The event consisted in different parts: 1) Introduction GeoERA "Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe"; 2) Relevance of GeoERA for EC Policy and expectations; 3) Projects introduction; 4) Communication, Dissemination and Exploitation of GeoERA; 5) Impact Assessment and Monitoring Indicators.

Photo story

Up: GeoERA Raw Materials poster and MINDeSEA cover presentation; Work package Leaders of the project MINDeSEA during the Kick-off Meeting.

Right: Kick-off venue.

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Right: MINDeSEA meeting	

Figure 10. Pictures were taken Kick-off event of the MINDeSEA project.

2nd meeting of project MINDeSEA and workshop "Seafloor mineral deposits for the global sustainable development."

Madrid (Spain), May 2019

Organisation

The 2nd meeting of project MINDeSEA was organised and hosted by the Spanish Geological Survey (IGME), lead partner, on 6 May 2019. The participants to the meeting were a total of 50 people, all of the international experts in DSM-related fields, assisted from 12 partner institutions of the members. The key goals were to talk about the advances in the project status for all the working packages and discuss them.

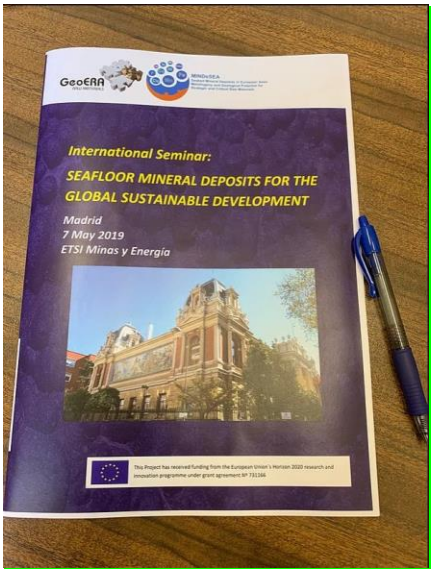
Agenda and Outcomes

This meeting consisted of two parts, divided into one day each. On the first day, an introductory statement was delivered, followed by a presentation from each of the working packages to provide insight into their development. On the second day, a workshop titled "SEAFLOOR MINERAL DEPOSITS FOR GLOBAL SUSTAINABLE DEVELOPMENT" was held, in which important topics in the deep sea mineral sector were discussed.

Photo story

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

2nd MINDeSEA project meeting opening at the Mining School (UPM).



Proceedings of the International Seminar on "Seafloor mineral deposits for the global sustainable development"

MINDeSEA members attending to 2nd MINDeSEA project meeting at the Geominero Museum (IGME).

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Presenting: Director of the Mining School (UPM)

Presenting : Javier González (IGME)

Presenting: Georgy Cherkashov (VNII)

Presenting: James Hein (USGS)

Presenting: Fernando Tornos (IGEO)

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Presenting: Luis Somoza (IGME)

Presenting: Thomas Kuhn (BGR)

Figure 11. Pictures from the 2nd meeting of MINDeSEA project and workshop "Seafloor Mineral Deposits for the Global Sustainable Development" carried out in Madrid.

3rd meeting of project MINDeSEA and MINDeSEA International Workshop on Geophysical Tools applied to Marine Hydrothermal Minerals Exploration.

Trondheim (Norway), November 2019

Organisation

The 3rd meeting of project MINDeSEA and MINDeSEA International Workshop on Geophysical Tools applied to Marine Hydrothermal Minerals Exploration was organised and hosted by the Norwegian Geological Survey (NGU) on 26-27 November 2019. The participants to the meeting were a total of 50 people, all of the international experts in DSM-related fields, assisted from 8 partner institutions of the members. The key goals were to talk about the advances in the project status for all the working packages and discuss them.

Agenda and Outcomes

As the meeting carried out in Madrid, this meeting consisted of two parts, divided into one day each. On the first day, an introductory statement was delivered, followed by a presentation from each of the working packages to provide insight into their development. On the second day, a workshop about "Geophysical Tools applied to Marine Hydrothermal Minerals Exploration" was celebrated. Here, the project partners and some DSM-related organisations and companies' representatives treated topics related to the workshop theme.

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Photo story

Attendance from partners to 3rd MINDeSEA project workshop in Trondheim (Norway).

Presenting: Javier González (IGME)

Presenting: Henrik Schiellerup (NGU)

Figure 12. Pictures from the 2nd meeting of MINDeSEA project and MINDeSEA International Workshop on Geophysical Tools applied to Marine Hydrothermal Minerals Exploration. Both were carried out in Trondheim.

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Publications

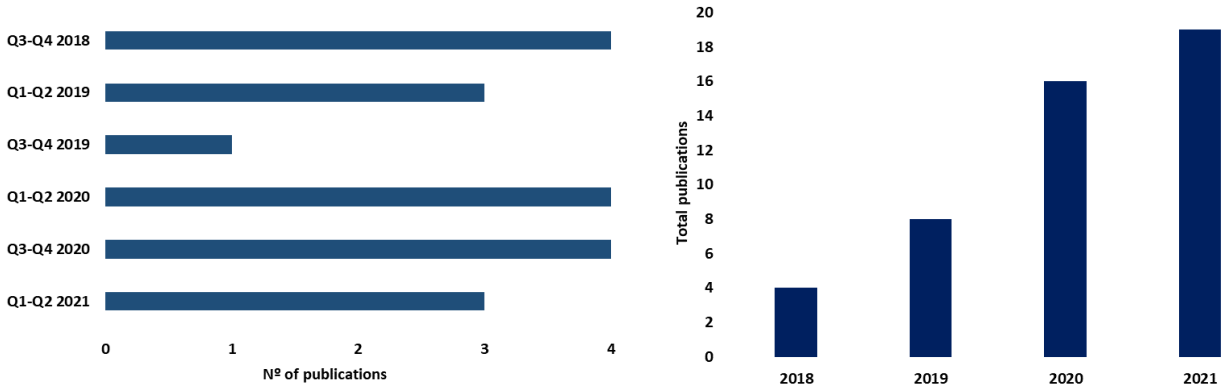
Scientific publications

The MINDeSEA project consortium comprises academic organisations and research centres that have sought to combine applied research with scientific excellence at an international level. To meet these objectives, emphasis has been placed on sharing the results obtained throughout the project with the scientific community by presenting research papers at conferences, reports and publications in reputable scientific journals in the areas relevant to the project. The topics covered during the project period have been very varied, covering exploration and mapping, mineralogy, geochemistry, microbiology and biomineralisation and processing of submarine mineral deposits, principally.

Between the project's start in 2018 and its conclusion in 2021, the project partners published 29 papers and 46 abstracts at conferences (**Graph 1,2; Apendix II**). These publications have also been published in high-impact journals:

- Journal of Maps (Q1): 1 paper
- Minerals (Q2): 3 papers
- World Journal of Engineering (Q4): 1 paper
- Geological Society, London, Special Publications (Q2): 1 paper
- Frontiers in Marine Sciences (Q1): 1 paper
- Marine Geology (Q1): 3 papers
- Microorganisms (Q2): 1 paper
- Quaternary Science Reviews (Q1): 1 paper
- Biogeosciences (Q1): 1 paper
- Deep Sea Research Part I (Q1): 1 paper
- European Geologist 1 paper
- Okeanos 1 paper
- Oceans 1 paper
- Bolletino di Geofisica teorica et applicate: 1 paper
- Society of Geology Applied to Mineral Deposits (SGA) News: 1
- Boletin informative de la Sociedad Española de Cartografía, Fotogrametría y teledetección (SECF) : 1

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).



Graph 1. Left: Nº of scientific paper publications made by MINDeSEA project. **Right**: Total of scientific paper publications made during the project timeline.

During the project, a special issue named "**Marine Geology and Minerals**" has been published in **Minerals Journal** with the participation of two members of the MINDeSEA project **Dr. Luis Somoza** (IGME) and **Dr. Javier González** (IGME), WP and project lead respectively, as guest editors. This special issue relates to the "Mineral Deposits" area, and the deadline was closed on 31 August, 2020. The threated subjects were the investigation of deep - sea minerals, including seabed mapping and other exploration techniques in various tectonic settings such as mid-ocean ridges, seamounts, abyssal plains, convergent edges and submerged volcanoes. Also, publications outline seabed and sub-seafloor research strategies for characterising mineral resources globally (**Fig.13**).

The special issue has had a great participation rate within the international community. A total of 18 papers were published for different topics such as "exploration of massive sulphides deposits", "genesis and evolution of ferromanganese crust" or "ferromanganese nodules" and management and development of exploration contracts in international waters under ISA regulations. All articles are available on the **webpage**.

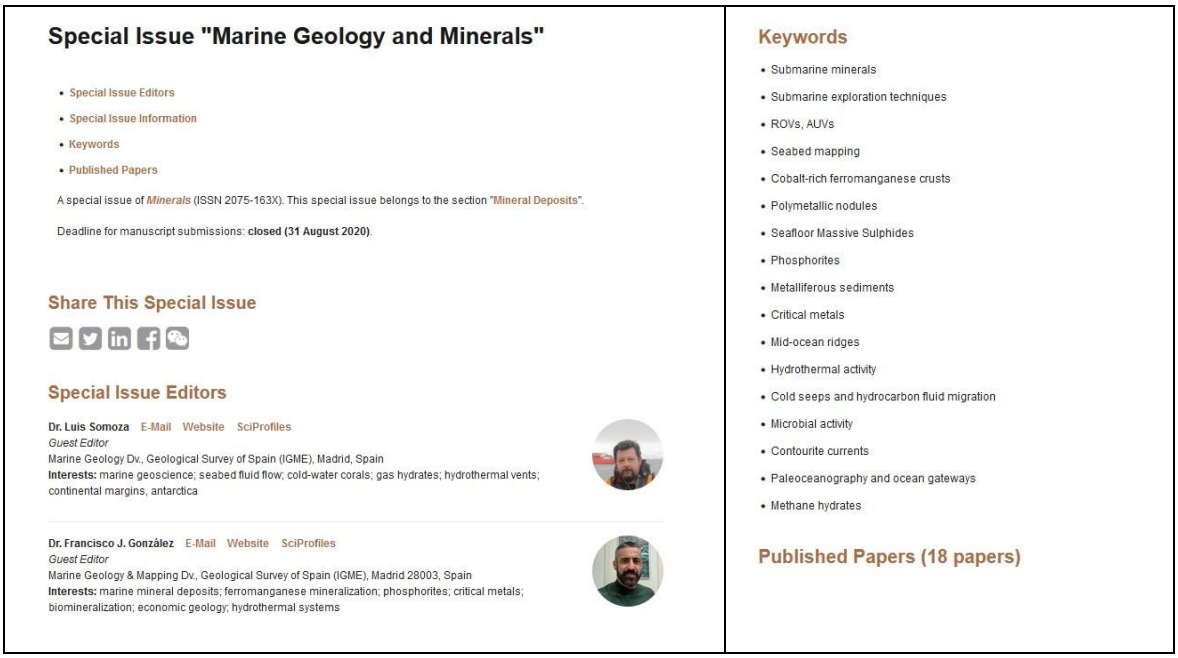
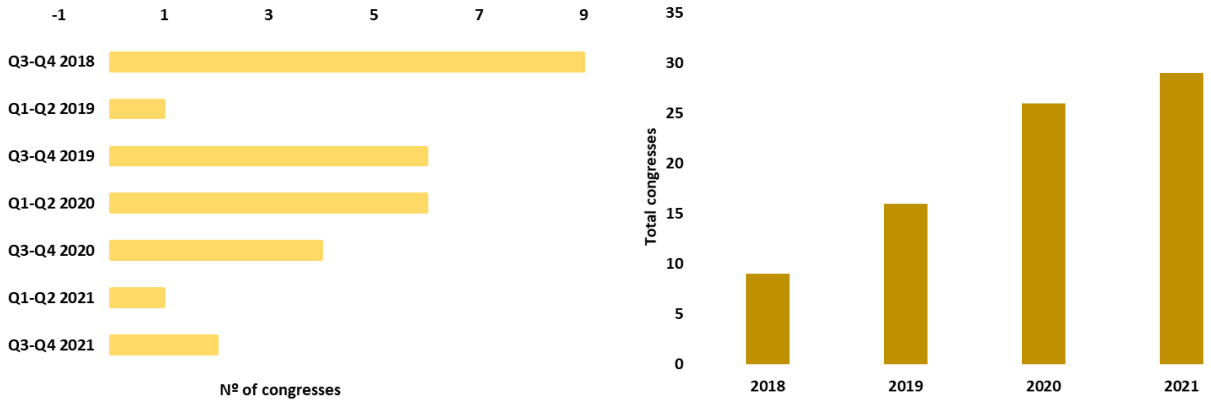


Figure 13. Marine Geology and Minerals special issue available information.

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Attendance to conferences

Regarding the project results presented at congresses, numerous communications have been made by the partners. It should be noted that results have been presented at some of the most important international congresses in the field of geosciences, such as Goldschmit (**Fig.15**), in the field of seabed mineral resources, such as the Underwater Minerals Conference (UMC) (**Fig. 13**) and the field of raw materials, such as Raw Materials Week or PDAC (**Fig. 14**) among others.



Graph 2. Nº of national and international, multidisciplinary congresses and conferences where has been MINDeSEA project's attendance. **Right**: Total of congresses and conferences attendance during the project timeline.

The publications produced or submitted to date are shown in *Appendix* I*: Scientific papers*. Also, the attendance to national and international congresses and conferences is given in more detail in *Appendix II:* Abstracts in *National and international, multidisciplinary congresses and conferences*.

Underwater Mining Conference, Bergen (2018)

Figure 14. Pictures were taken during Underwater Mining Conference 2018 (Bergen, Norway). The left picture was taken during MINDeSEA project presentation.

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Raw Materials Week, Brussels (2018)

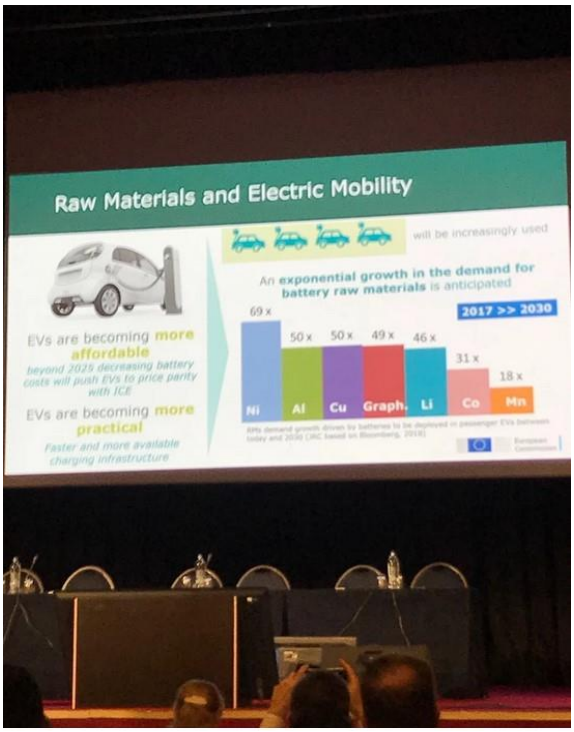


Figure 15. Pictures were taken during Raw Materials Week, Brussels (Belgium) oral sessions and from the poster session.

Goldschmidt 2019

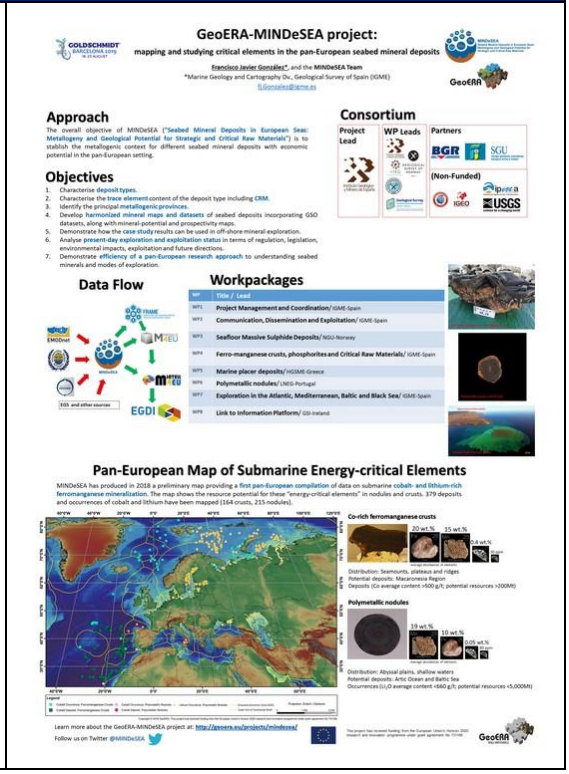


Figure 16. Pictures were taken during the Goldschmidt conference 2019 deep sea mineral oral and a poster session.

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Technical reports

A wide variety of reports has been published since the project started. The objective of them was to summarise the information obtained in different related activities. A list of the published or project participated reports can be seen below (**Table 5**).

Table 5. Summary of the workshop reports

Date	Publisher	Report	
2018	GeoERA	Report of the Kick-off	
2019	INTERRIDGE	Report from Egidio's stay at BGR (Germany). Iron isotopes on Fe-Mn crusts from Canary Islands Seamount Province as records of genetic processes in their growth history.	
2019	MINDeSEA	Workshop report 2.3-1: Seafloor Mineral Deposits for the Global Sustainable Development	
2019	MINDeSEA	Workshop report 2.3-2: Geophysical Tools applied to Marine Hydrothermal Minerals Exploration	
2020	MINDeSEA	Workshop report 2.3-3: MINDeSEA Workshop-Field Trip: "Iberian Pyrite Belt."	
2020	MINDeSEA	Workshop report 2.3-4: MINDeSEA Workshop-Series: "Seabed Mining"	
2021	MINDeSEA	Workshop report 2.3-5: "Deep Sea Minerals- Critical Minerals" MINDeSEA invited talk and panel discussion	

The MINDeSEA consortium has interacted with the EU multiple times as an advisor on seabed mineral resources during the project's lifetime. To this end, all the knowledge and data obtained have been transferred to the EU. As a result of this cooperation, the "MARINE MINERALS" section of the "EU Blue Economy Report" (**Fig. 17**) has been developed with the advice of the MINDeSEA project since 2019. It is important to mention that this report's function is to analyses the scope and dimension of the Blue Economy in the European Union and provide support to policymakers and stakeholders in the quest for sustainable development of the oceans and marine resources.

Blue Economy Report 2019	Blue Economy Report 2020	Blue Economy Report 2021

Figure 17. EU Blue Economy reports were published in 2019, 2020 and 2021.

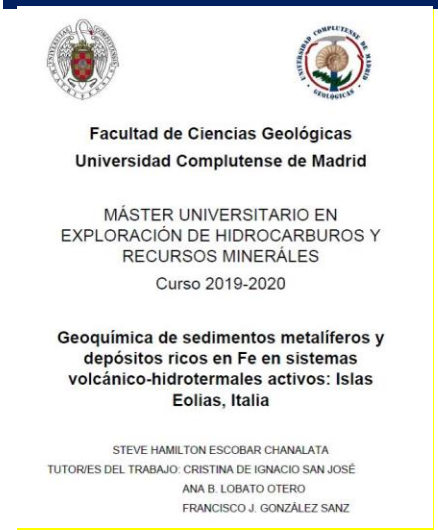
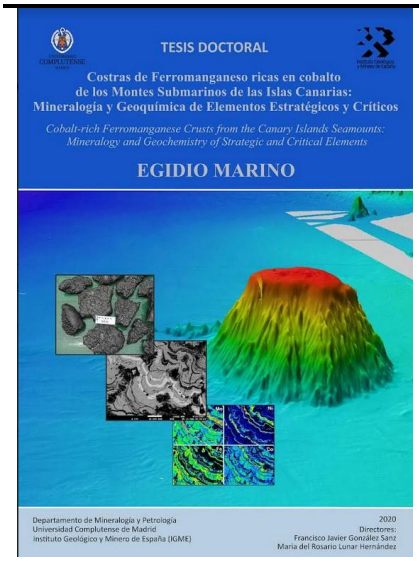
This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Thesis

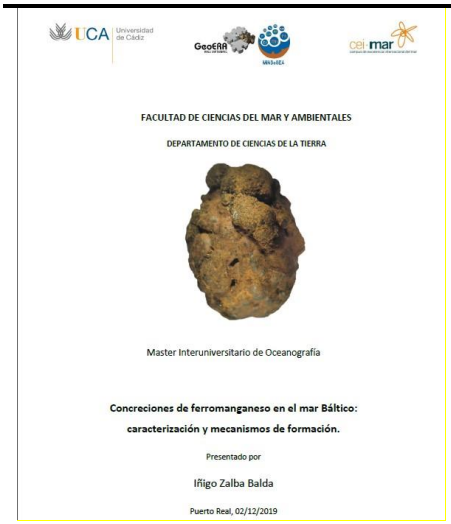
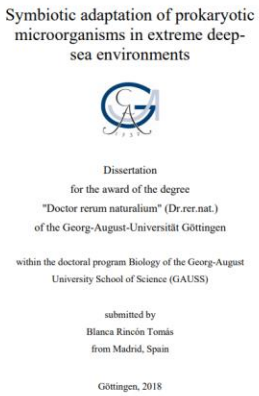
Many findings have been created from information supplied by MINDeSEA participants during the years that the project has been active. Numerous sample analyses have been made, and databases have been reviewed, literature has been compiled, etc., generating the data for scientific publications, attendance to congresses, seminars and everything mentioned in the report. Furthermore, the project has provided clear exploitation actions based on the knowledge and results generated from the beginning. These exploitation actions include, among others, master and doctoral theses.

A total of three master theses and two doctoral theses have been carried out in the framework of the MINDeSEA project (**Table 6**). The topics covered were diverse and involved six different organisations, both from within the project and external collaborators such us Geological Survey of Spain (IGME), Swedish Geological Survey (SGU), University of Göttingen, Germany (GAUSS); the University of Cádiz, Spain (UCA); Geoscience Institute from Spain (IGEO) and Complutense University of Madrid (UCM).

Table 6. Summary of the master/PhD thesis made within the MINDeSEA project.

	Author	Year	Partners	Title
	Steve Hamilton Escobar (Master thesis)	2021	IGME-IGEO-UCM	Geochemistry of metalliferous sediments and iron-rich deposits in active volcanic-hydrothermal systems from the Aeolian Islands (Italy)
	Egidio Marino (PhD thesis)	2020	IGME-IGEO-UCM	Cobalt-rich ferromanganese crusts from the SW Canary Island seamounts: mineralogy and geochemistry of strategic and critical elements "Cum Laude".

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

	Janine Wegner (Master Thesis)	2019	BGR-Hannover U.	Mineralogy and geochemistry of manganese nodules
 FACULTAD DE CIENCIAS DEL MAR Y AMBIENTALES DEPARTAMENTO DE CIENCIAS DE LA TIERRA Master Interuniversitario de Oceanografía **Concreciones de ferromanganeso en el mar Báltico: caracterización y mecanismos de formación.** Presentado por Iñigo Zalba Balda Puerto Real, 02/12/2019	Iñigo Zalba (Master Thesis)	2019	IGME-SGU-UCA	Ferromanganese concretions from the Baltic Sea: characterisation and genetic models
 Symbiotic adaptation of prokaryotic microorganisms in extreme deep-sea environments Dissertation for the award of the degree "Doctor rerum naturalium" (Dr.rer.nat.) of the Georg-August-Universität Göttingen within the doctoral program Biology of the Georg-August University School of Science (GAUSS) submitted by Blanca Rincón Tomás from Madrid, Spain Göttingen, 2018	Blanca Rincón Tomás (PhD Thesis)	2019	IGME-GAUG	Symbiotic adaptation of prokaryotic microorganisms in extreme deep-sea environments. "Cum Laude."

Derivables from project´s work packages

The project program is divided into eight different work packages developed by the partners during the timeline. Each one covers a specific knowledge area and covers well-defined objectives to achieve. As stated in the project plan, all the results obtained in those work packages are referred to in reports and maps available for stakeholders (**Table 7**).

In the following list are summarised the different work packages and the number of deliverables linked to them. A list with all the specific deliverables can be seen in *appendix IV*

Table 7. Summary of the work packages and the deliverables included in each

Work Package	Nº of derivable
WP1. Project Management and Coordination	12
WP2. Communication, Dissemination and Exploitation	7
WP3. Seafloor Massive Sulphide Deposits	4

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WP4. Ferro-manganese crusts, phosphorites and Critical Raw Materials	7
WP5. Marine placer deposits	5
WP6. Polymetallic nodules	5
WP7. Exploration in the Atlantic, Mediterranean, Baltic and Black Sea	4
WP8. Link to Information Platform	4

EGDI database

EGDI is EuroGeoSurveys' European Geological Data Infrastructure. It provides access to Pan-European and national geological datasets and services from the Geological Survey Organizations of Europe. Through EGDI, data from many European data harmonization projects are accessible. This website forms the basis for an information platform that is being developed under the GeoERA programme and will host all the databases and maps created during the project. In this framework, all the data obtained from the MINDeSEA project will be available through this platform (**Fig.18**).

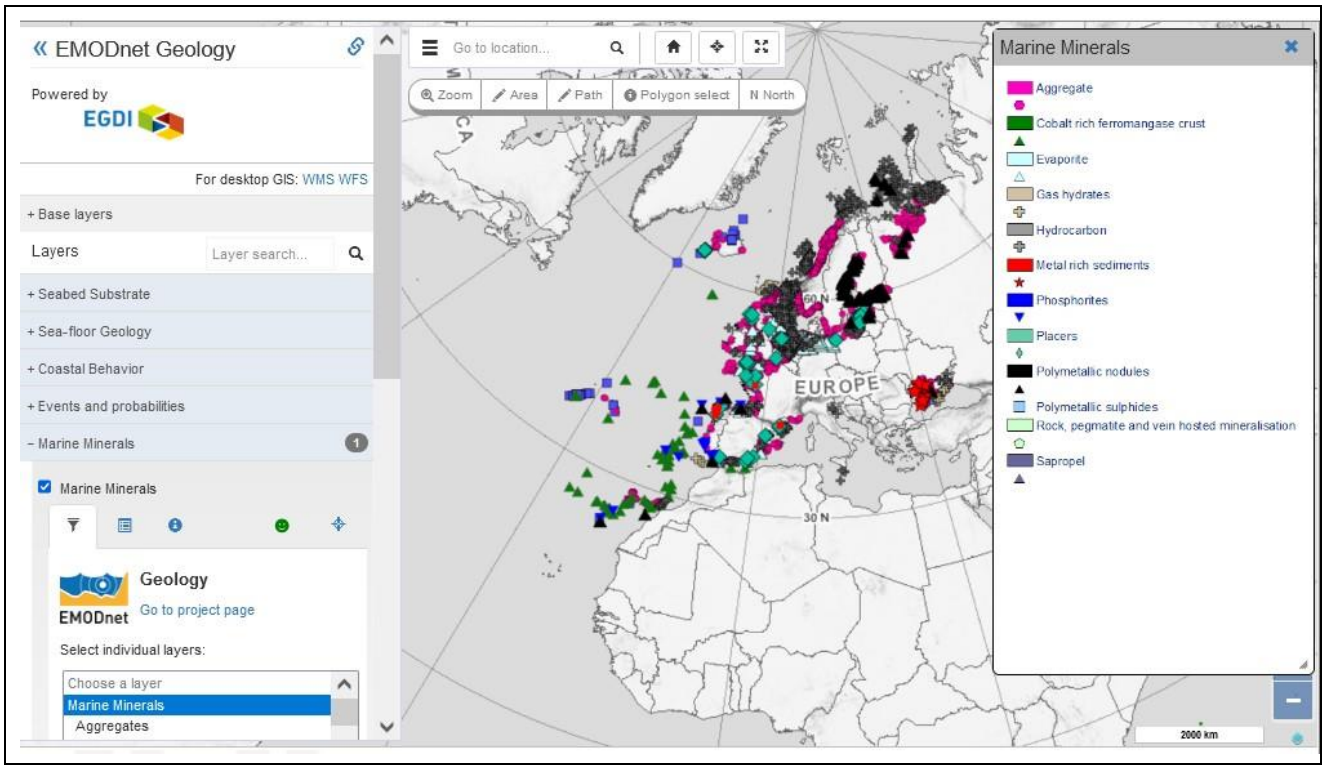

Figure 18. EGDI website GIS. Available at: **EGDI**

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Cooperation support activities

Project partners

During the project, members have supported numerous research-related activities. During 2018-2019 the coordinator of MINDeSEA and partner members (BGR, USGS, VNIIOkeangeologia) have supported with letters different projects in competitive tenders for the procurement of new equipment in Research Labs at IGME-Sp and the Complutense University of Madrid.

International cooperation

As part of our international networking and cooperative actions, MINDeSEA and IGME will support a cooperative short-visit at IGME (prevision February-August 2021 postponed by COVID-19 incidence) as part of the PhD formation of Mariana Benites (Univ. Sao Paulo-Brazil) to perform specific studies on Fe-Mn crusts and phosphorites related to her Thesis: "Genesis and evolution of ferromanganese crusts from the summit of Rio Grande Rise, Southwest Atlantic Ocean."

Project support

During the MINDeSEA project, all the organisations involved have collaborated with each other in order to develop the proposed objectives in the most suitable way. In addition to these partners, other projects and organisations not included in the framework of the project have collaborated. These collaborative relationships have enabled access to samples, data collection in oceanographic surveys, laboratory analysis, and collaboration in many publications, among other issues.

In cooperation with other research centres, universities, several organisations and projects from many countries have participated in different types of partnerships. These are listed below (**Table 8**).

Table 8. Summary of the research centres, universities and projects with which it has collaborated.

Name	Country	Colaboration activity	Link
Research centres and Universities			
Geological Survey of Norway (NGU)	Norway	Data contribution	
Hellenic Survey of Geology & Mineral Exploration (HSGME)	Greece	Data contribution	
Laboratorio Nacional de Energia e Geologia I.P.	Portugal	Data contribution	
The Instituto Hidrográfico de la Marina (IHM)	Spain	Cooperation in the processing of multibeam bathymetry data and technical assistance during cruises.	
Natural Environment Research Council (NERC)	United Kingdom, UK.	Collaboration in research	
Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP)	Brazil	Collaboration in research	

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Instituto Oceanográfico da Universidade de São Paulo	Brazil	PSD analyses	
Raman Spectroscopy Laboratory of the Department of Science of Roma Tre University	Italy	Technical assistance	
Fundação para a Ciência e a Tecnologia	Portugal	Collaboration with fellowship program	
Unidad de Tecnología Marina (UTM)	Spain	Data adquisition in expedition EXPLOSEA 2 (Mid-Atlantic Ridge)	
Estrutura de Missão para a Extensão da Plataforma Continental (EMEPC)	Portugal	Samples and data recovery in expedition EXPLOSEA 2 (Mid-Atlantic Ridge)	
National Key R&D Program of China	China	Collaboration in research activities	
National Natural Science Foundation of China	China	Collaboration in research activities	
Key Laboratory of Marine Geology and Environment, Chinese Academy of Sciences	China	Collaboration in research activities	
Laboratory for Marine Geology, Qingdao National Laboratory for Marine Science and Technology	China	Collaboration in research activities and sample share.	
Mineralogy & Petrology Department of the Complutense University of Madrid (UCM)	Spain	Research activities and collaboration	
Geological Survey of Spain (IGME)	Spain	Research activities and collaboration	
Federal Institute for Geosciences and Natural Resources (BGR)	Germany	Research activities and collaboration. Also, supply of raw nodules, financial and additional support	
Leibniz Universität Hannover Institut für Mineralogie	Germany	Research activities and collaboration	
Projects			
EXPLOSEA project	Spain	Collaboration with the project and participation in oceanographic surveys: EXPLOSEA-1, EXPLOSEA-2	
Russian Science Foundation project	Russia	Chemical-analytical study of samples and samples collection in this research is a contribution to the project.	
EMODNET-Geology	EU	Funding and interaction with its large European community	

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EMODNET-Geology	EU	EMODnet Geology has released new datasets of recorded marine minerals in seas surrounding European waters	
MINEPLAT project	Portugal	Provide data for the project	
Spanish projects for the Extension of the Continental Shelf of Spain	Spain	Research support	
SUBVENT project	Spain	Research support	
Atlantic Ocean Research Alliance Coordination and Support Action (AORA-CSA)		Cooperation with Atlantic Seabed Mapping International Working Group (ASMIWG)	
MarineE-Tech project	United Kingdom, UK.	Collaborative studies and	
US Extended Continental Shelf program	United States of America (USA)	Providing the samples collected during the Healey cruises	
REMIMARES project	Spain	Provide data for the project	

Media

Due to the importance of disseminating the MINDeSEA project and its results within the people and the stakeholders, the partners made several activities with the media, primarily in Spain. Overall, over 60 appearances in Spanish media between 2018-2021, including press releases, TV and radio.

Press releases

During the project, many press releases have been published at the national level to reach a massive audience. To achieve this, news and short communications concerning the project's subjects have been made. A list of the most relevant news is available below and a complete list is in appendix III.

Some news concerning the project has been published on websites and magazines with a wide audience and a focus on the marine and offshore mineral resources sector such as The European Marine Observation and Data Network (**EMODnet**) (**Fig. 19**). This is a network of organisations supported by the EU which works together to observe the sea, process the data according to international standards and make that information freely available as interoperable data layers and data products. In addition, specialized deep sea mining online magazines, such as **Ocean Mining Intel**, have published news related to the MINDeSEA project. (**Fig. 20**)

Radio/TV

Over the years, radio and TV programs have contacted the project to ask questions related to the project or on which its members could give their expert opinion. In addition, interviews, reports and press news have been published (**Table 9**).

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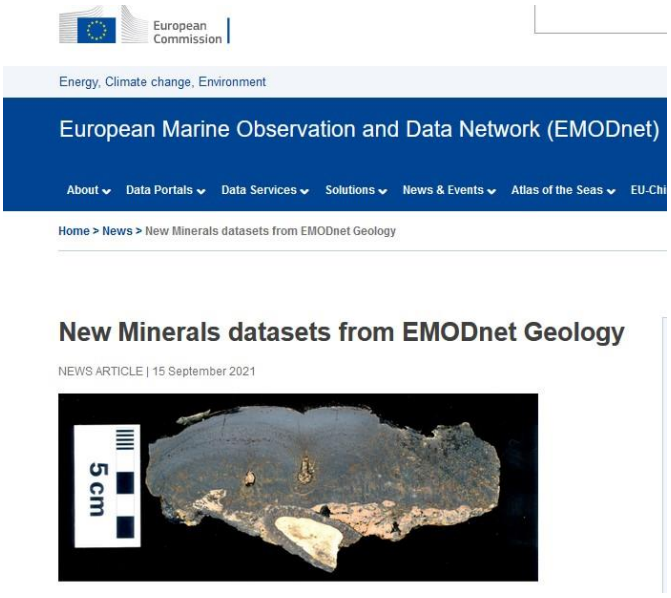

Figure 19. Screenshot of a new published in the news section of the EMODnet project.

Date:

15 September 2021

Source:

https://emodnet.ec.europa.eu/en/new-minerals-datasets-emodnet-geology-update

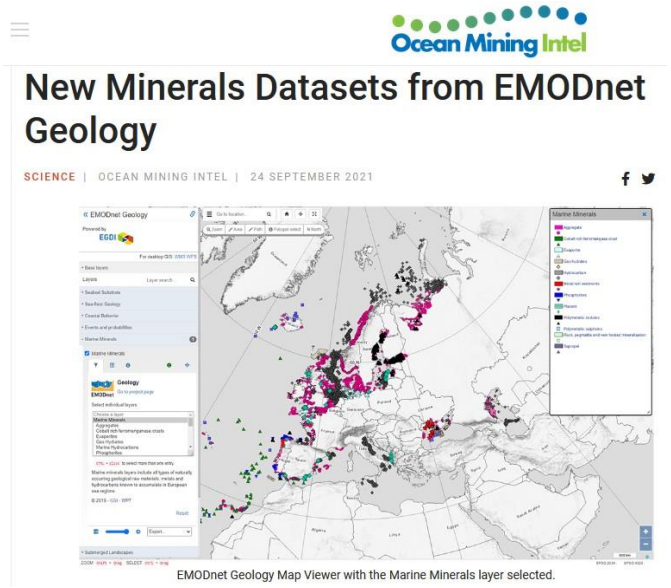

Figure 20. Screenshot of a new published in the deep sea mining specialized online magazine.

Date:

24 September 2021

Source:

https://oceanminingintel.com/news/science/new-minerals-datasets-from-emodnet-geology

Table 9. Summary of the appearance of the MINDeSEA project on radio and TV.

#	Category	Date	Source	Link
1	Radio	Nov-18	Cadena SER	
2	Radio	Sep-18	Cope	
3	Radio	Oct-19	Cadena SER	
4	Radio	Oct-19	Cope	
5	Radio	Jul-19	Cope	
6	Radio	Jul-19	Cope	

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7	TV	Dec-20	RTVC	
8	TV	Oct-20	RTVC	
9	TV	Oct-20	RTVC	

Other

As the MINDeSEA project is led by the Spanish Geological Survey (IGME), some press releases were published on its website. The IGME is a research centre and the website is available to everyone, but it is mainly focused on the scientific community. This factor has made this medium ideal for publishing information on the project. Press releases are available in the table below (**Table 10**).

Table 10. Summary of press releases published on the IGME webpage.

#	Category	Date	Source	Link
1	Press release	Jul-19	IGME	
2	Press release	Jul-19	IGME	
3	Press release	Jul-19	IGME	

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7. APPENDIXES

APPENDIX I-A: PROJECT SCIENTIFIC PAPERS (in bold are marked GeoERA consortium members)

1. **Wittenberg, A., Oliveira, P., Jørgensen, L., González, J. & Heldal, T.** (2021). GeoERA Raw Materials to support Europe's resilience on raw materials. *Society of Geology Applied to Mineral Deposits (SGA) News, 48*.

2. **Alcorn, T., Monteys, X., Blasco, I., Lobato, A., & González, J.** (2021). Are the pan-European seas a promising source for critical metals supply? GeoERA-MINDeSEA Marine Data and Information Management Best Practices. *Bollettino di Geofisica Teorica ed Applicata, 62*.

3. **Somoza, L.**, Rueda, J. L., Sánchez-Guillamón, O., **Medialdea, T.**, Rincón-Tomás, B., **González, F. J.**, ... & Vázquez, J. T. (2021). The Interactive Role of Hydrocarbon Seeps, Hydrothermal Vents and Intermediate Antarctic/Mediterranean Water Masses on the Distribution of Some Vulnerable Deep-Sea Habitats in Mid Latitude NE Atlantic Ocean. In *Oceans* (Vol. 2, No. 2, pp. 351-385). Multidisciplinary Digital Publishing Institute. https://doi.org/10.3390/oceans2020021

4. Kfouri, L. O., Millo, C., de Lima, A. E., Silveira, C. S., Sant'Anna, L. G., **Marino, E.**, ... & Murton, B. J. (2021). Growth of ferromanganese crusts on bioturbated soft substrate, Tropic Seamount, northeast Atlantic Ocean. *Deep Sea Research Part I: Oceanographic Research Papers*, *175*, 103586. https://doi.org/10.1016/j.dsr.2021.103586

5. **Somoza, L., Medialdea, T., González F.J.,** Machancoses, S., Candón, J.A., Cid, C., Calado, A., Afonso, A., Pinto, L., **Blasco, I.**, Albuquerque, M., Asensio-Ramos, M., Bettencourt, R., De Ignacio, C., **López-Pamo, E.**, Ramos, B., Rincón-Tomás, B., **Santofimia, E.,** Souto, M., Tojeira, I., Viegas, C. and Madureira, P. (2021). High-resolution multibeam bathymetry of the northern Mid-Atlantic Ridge at45–46° N: the Moytirra hydrothermal field. *Journal of Maps*. https://doi.org/10.1080/17445647.2021.1898485

6. **Somoza, L., González F.J.** (2020). Marine Geology and Minerals. Special Issue Editors. *Minerals* 10. https://www.mdpi.com/journal/minerals/special_issues/marine_geology_minerals

7. Blokhin, M., Zarubina, N., Mikhailik, P., Elovskiy, E., Ivanova, Y., **González, F. J., & Somoza, L.** (2020). Discriminating formation and accumulation processes of some strategic metals in Fe-Mn deposits of the Atlantic Ocean. *World Journal of Engineering*. https://doi.org/10.1108/WJE-10-2020-0526

8. **Terrinha, P., Medialdea, T.,** Batista, L., **Somoza, L., Magalhães, V., González, F.J.,** Noiva, J., **Lobato, A.,** Rosa, M., **Marino, E.,** Brito, P., Neres, M., Ribeiro, C. (2020). Integrated thematic geological mapping of the Atlantic Margin of Iberia. In: Asch, K., Kitazato, H. and Vallius, H. (eds) From Continental Shelf to Slope: Mapping the Oceanic Realm. *Geological Society, London, Special Publications*, 505. https://doi.org/10.1144/SP505-2019-90

9. **Somoza, L., Medialdea, T., González F.J.,** Calado, A., Afonso, A., Albuquerque, M., Asensio-Ramos, M., Bettencourt, R., **Blasco I.,** Candón, J.A., Carreiro-Silva, M., Cid C., De Ignacio, C., **López-Pamo, E.**, Machancoses, S., Ramos, B, Ribeiro, L.P., Rincón-Tomás, B., **Santofimia, E.**, Souto, M., Tojeira, I., Viegas, C. and Madureira, P. (2020). Multidisciplinary Scientific Cruise to the Northern Mid-Atlantic

This project has been supported by the European Union's Horizon 2020 research and innovation programme, GeoERA (Grant Agreement Nº 731166, project GeoE.171.001).

Ridge and Azores Archipelago. *Frontiers in Marine Sciences* 7: 568035. https://doi.org/10.3389/fmars.2020.568035

10. **González, F.J.,** Rincón-Tomás, B., **Somoza, L.,** Santofimia, E**., Medialdea, T.,** Madureira, P., López-Pamo, E., **Hein, J.R., Marino, E.,** de Ignacio, C., **Reyes, J.,** Hoppert, M., Reitner, J. (2020). Low-temperature, shallow-water hydrothermal vent mineralization following the recent submarine eruption of Tagoro volcano (El Hierro, Canary Islands). *Marine Geology* 430. https://doi.org/10.1016/j.margeo.2020.106333
11. Rincón-Tomás, B., **González, F.J., Somoza, L.,** Sauter, K., Madureira, P., **Medialdea, T.,** Carlsson, J., Reitner, J., Hoppert, M. (2020). Siboglinidae Tubes as an Additional Niche for Microbial Communities in the Gulf of Cádiz—A Microscopical Appraisal. *Microorganisms* 8 (3), 367. https://doi.org/10.3390/microorganisms8030367
12. **González, F.J., Medialdea, T., Schiellerup, H., Zananiri, I., Ferreira, P., Somoza, L., Monteys, X. and the MINDeSEA Team**. (2020). Are the pan-European seas a promising source for critical metals supply? The project GeoERA-MINDeSEA. *European Geologist Journal 49*, 37-41.
13. Zhong, Y., Chen, Z., **Hein, J.R., González, F.J.**, Jiang, Z., Yang, X., Zhang, J., Wang, W., Shi, X., Liu, Z., Liu, Q. (2020). Evolution of a deep-water ferromanganese nodule in the South China Sea in response to Pacific deep-water circulation and continental weathering during the Plio-Pleistocene. *Quaternary Science Reviews* 229, 106106, https://doi.org/10.1016/j.quascirev.2019.106106
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APPENDIX I-B: INTERNATIONAL PROJECTS NETWORK & COOPERATIVE SCIENTIFIC PAPERS

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APPENDIX I-C: PROJECT "OPEN ACCESS" DATABASE AND MAPS

1. **González, F.J., Medialdea, T., Schiellerup, H., Zananiri, I., Ferreira, P., Somoza, L., Monteys, X. and the MINDeSEA Team.** (2021). GeoERA-MINDeSEA Database and Cartographies. https://geoera.eu/projects/mindesea2/

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APPENDIX II: ABSTRACTS IN NATIONAL AND INTERNATIONAL, MULTIDISCIPLINARY CONGRESSES AND CONFERENCES

1. **González, F.J., Medialdea, T., Schiellerup, H., Zananiri, I., Ferreira, P., Somoza, L., Monteys, X., Alcorn, T., Marino, E., Lobato, A., Kuhn, T., Nyberg, J., Magalhaes, V., Lunar, R., Maliuk, B., Hein, J.R., Cherkashov, G., and the MINDeSEA Team.** 2021. GeoERA-MINDeSEA project database and cartography of European seabed mineral deposits. *Deep Sea Minerals Conference*, October 2021. Bergen (Norway).

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5. **Marino, E., González, F.J., Somoza, L., Medialdea, T., Ferreira, P., Kuhn, T., Lobato, A., Magalhaes, V., Moniz, C.** 2021. Discovering the high potential for critical raw materials of submarine Fe-Mn deposits in European seas: GIS multi criteria analysis on MINDeSEA database. *RawMat2021*. 05-09 September 2021. Athens (Greece)

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10. **Lobato, A., Marino, E., González, F.J., Medialdea, T., Somoza, L.** 2021. Predicting potential areas for the formation of Co-rich ferromanganese crusts in the Canary Islands Seamount Province using multi-criteria GIS analysis. *EGU General Assembly 2021.* 19-30 April 2021, online conference.

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13. **González, F.J., & the MINDeSEA Team**. 2021. GeoERA-MINDeSEA project. *Prospectors & Developers Association of Canada (PDAC 2021)*, Virtual Convention, March 2021. Toronto (Canada).

14. **Oliveira, D.P.S., González Sanz, F.J.** 2021. Mapping and studying the European critical elements in submarine and on-land deposits for the sustainable development. *Critical Mineral Forum*, February 2021. Organized by the Geological Survey of Canada, Geoscience Australia, and the United States Geological Survey,online conference.

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16. **Marino, E., González, F.J., Somoza, L., Kuhn, T., Medialdea, T.**, Oeser, M., **Lunar, R.** REE contents in Fe-Mn crusts from Canary Island Seamount Province: High-resolution analysis to identify the metal-bearing minerals. *ERES2020, virtual conference*, 6-9 October 2020. Delphi (Greece).

17. **González, F.J., Medialdea, T., Schiellerup, H., Zananiri, I., Ferreira, P., Somoza, L., Monteys, X., Alcorn, T., Blasco, I., Lobato, A., Kuhn, T., Nyberg, J., Melnyk, I., Magalhaes, V., Lunar, R., Martínez-Frías, J., Marino, E., Hein, J.R., Cherkashov, G., and the MINDeSEA Team**. 2020. An integrative metallogenetic study of seabed mineral deposits in the pan-European seas: The project GeoERA-MINDeSEA. *Underwater Minerals Conference (UMC 2020)*, Virtual conferences, September, 2020. Florida (USA).

18. **Marino, E., González, F.J., Somoza, L., Kuhn, T., Medialdea, T., Madureira, P., Lunar, R.** 2020. Cobalt-rich Ferromanganese Crusts from the Canary Islands Seamounts: Mineralogy and Geochemistry of Strategic and Critical Elements. *Underwater Minerals Conference (UMC 2020)*, Virtual conferences, September, 2020. Florida (USA).

19. **Wittenberg, A., Oliveira, D.P.S., Flindt Jørgensen, L., González, F.J., Sievers, H., Quental, L., Pereira, A., Heldal, T., Whitehead, D.,** 2020. Raw materials - you can't do well without them. *GeoUtrech 2020*, Virtual conferences, August 2020. Utrecht (Holland).

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21. **Zalba, I., González, F.J.**, Fernández-Puga, M.C., **Nyberg, J.** 2020. Ferromanganese concretions in the Baltic Sea: characterization and forming processes. *10th Geological Congress of Spain*. Postponed by COVID-19 to July 2021.

22. **González, F.J., Somoza, L., Medialdea, T., Marino, E., Blasco, I., Lobato, A.** 2020. GeoERA-MINDeSEA Project: Establishing the metallogenic context for seabed mineral deposits in the pan-European seas. *10th Geological Congress of Spain*. Postponed by COVID-19 to July 2021.

23. **Wittenberg, A., Oliveira, D.P.S., González Sanz, F.J., Heldal, T., Whitehead, D., Flindt Jørgensen, L.** 2020. GeoERA Raw Materials supporting Europe's mining future. *Mineral Resources for Future Generations. AIMS 2020*. April 2020. Aachen (Germany).

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24. **González, J., Medialdea, T., Schiellerup, H., Zananiri, I., Ferreira, P., Somoza, L., ... & MINDeSEA Team.** 2020. Critical minerals in the European seas: The project GeoERA-MINDeSEA. In EGU General Assembly Conference Abstracts (p. 13271). *EGU General Assembly, Virtual conference*, April 2020. Vienna (Austria).

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27. **González, F.J., & the MINDeSEA team**. 2020. GeoERA-MINDeSEA project. *Prospectors & Developers Association of Canada (PDAC 2020)*, Virtual Convention, March 2020. Toronto (Canada).

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29. **Blasco, I., and the MINDeSEA Team.** 2019. Oceania. Expedicion Mar Azúl. *COP 25*, December 2019, Madrid (Spain).

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31. **Marino, E., González, F.J., Lunar, R., Somoza, L., Medialdea, T.**, Reyes, J., **Kuhn, T.**, Wegorzewski, A.V., Madureira, P., Mirao, J., Miguel, C., Oeser, M. 2019. Ferromanganese crusts from the Canary Island Seamount Province: High-resolution tools for critical metals determination, *Workshop "Marine E-Tech –Multidisciplinary Research on the Rio Grande Rise"*, 19-22 de November 2019. Ubatuba (Brazil).

32. **Marino E.** Las costras de hierro-manganeso con alto contenido en cobalto de los márgenes atlánticos de España: recursos minerales y fuente de elementos estratégicos. *3º PhDay Complutense (Ciencias Geológicas)*. Universidad Complutense de Madrid, 5 noviembre 2019. Madrid (Spain).

33. **Wittenberg, A., Oliveira, D.P.S., Heldal, T., González Sanz, J., Flindt Jørgensen, L.** 2019. Geological Survey Organisations contribution to Europe's raw materials sustainability. *Geomünster 2019*, 22-25 September 2019. Münster (Germany).

34. **González, F.J. & MINDeSEA Scientic Party**. 2019. GeoERA-MINDeSEA project: mapping and studying critical elements in the pan-European seabed mineral deposits. *Goldschmidt 2019*, August 2019. Barcelona (Spain).

35. **Marino, E., González, F.J., Lunar, R., Somoza, L., Medialdea, T., Kuhn, T.**, Wegorzewski, A., Oeser, M. 2019. Hydrothermal Input in Fe-Mn Crusts from Canary Islands Seamount Province: LA-ICP-MS Analyses and Fe Isotopes. *Goldschmidt 2019*, August 2019. Barcelona (Spain).

36. **González, F.J., & the MINDeSEA Team**. 2019. GeoERA-MINDeSEA project. *Prospectors & Developers Association of Canada (PDAC 2019),* March 2019. Toronto (Canada).

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37. **Marino E.** Las costras de hierro-manganeso con alto contenido en cobalto de los márgenes atlánticos de España: recursos minerales y fuente de elementos estratégicos. *2º PhDay Complutense (Ciencias Geológicas). Universidad Complutense de Madrid*, 28 noviembre 2018. Madrid (Spain).

38. **Wittenberg, A., González, F.J., Oliveira, D., Tulstrup, J., Hedal, T., and the GeoERA RM Party**. 2018. GeoERA's interest in earth observation data. *Raw Materials Week 2018*, 12-16 Nov 2018. Brussels (Belgium).

39. **González, F.J.**, **Somoza, L.**, **Medialdea, T.**, **Zananiri, I.**, **Schiellerup, H.** and the **MINDeSEA Scientific Party**. 2018. Earth observation systems and marine minerals: *Copernicus and MINDeSEA links. Raw Materials Week 2018*, 12-16 Nov 2018. Brussels (Belgium).

40. **Marino, E., González F. J., Lunar,R., Somoza,L., Reyes, J., Medialdea, T., Bellido, E**., **Kuhn, T.**, Anna Wegorzewsky, A., Oeser-Rabe, M. 2018. Mineralogy and geochemistry of critical metals in Fe-Mn crusts from the Canary Islands Seamount Province. *Geological Society of London, Marine Minerals: A New Resource for the 21st Century*, 30 Oct-1 Nov 2018. London (UK).

41. **González, F.J.**, **Somoza, L.**, **Terrinha, P.**, **Medialdea, T.**, **Magalhaes, V.**, Madureira, P., **Ferreira, P.**, **Marino, E.** 2018. The Atlantic Iberian and Macaronesian margins: A promising context in critical raw materials exploration. *Geological Society of London, Marine Minerals: A New Resource for the 21st Century*, 30 Oct-1 Nov 2018. London (UK).

42. **Blasco, I., Blanco, L.** 2018. MINDeSEA: Un Proyecto Europeo para cartografiar los depósitos minerales submarinos. *ESRI Spain Conference. Annual ESRI Meeting 2018.* 24-25 October 2018. Madrid (Spain).

43. **Somoza, L.** 2018. El interés (la lucha) por los Recursos Energéticos y Minerales de los Océanos: desde el Ártico a la Antártida". *Madrid Navy Week*, 20-30 September 2018. Madrid (Spain).

44. **Zananiri, I., and the MINDeSEA Team**. 2018. Η ΣΥΜΜΕΤΟΧΗ ΤΟΥ ΙΓΜΕ ΣΤΟ ΕΥΡΩΠΑΙΚΟ ΠΡΟΓΡΑΜΜΑ GeoERA: Θεματικό πεδίο ΠΡΩΤΕΣ ΥΛΕΣ. *TIF 2018*.Thessalonica (Greece).

45. **González, F.J., Somoza, L., Medialdea, T., Kuhn, T., Zananiri, I., Judge, M., Stanley, G., Schiellerup, H., Ferreira, P., Nyberg, J., Malyuk, B., Terrinha, P., Magalhaes, V., Lunar, R., Martínez-Frías, J., Hein, J.R., Cherkashov, G., and the MINDeSEA Scientific Party.** 2018. Seabed Mineral Deposits in European Seas: Metallogeny and Geological Potential for Strategic and Critical Raw Materials (MINDeSEA Project), *Deep-Sea Mining: Challenges of Going Further and Deeper Advances in Marine Research and Subsea Technology Beyond Oil & Gas UMC 2018 · 47th Underwater Mining Conference*, 10-14 September 2018. Bergen (Norway).

46. **González F. J., Somoza L., Marino E., Reyes J., Castillo-Carrión M., Medialdea T., Blasco I.** 2018. Cobalt, tellurium and other critical elements distribution in ferromanganese crusts from the Canary Island Seamount Province (NE Central Atlantic). *Joint International Conference, Minerals of the Ocean- 9*, 5-7 June 2018. Saint Petersburg (Russia).

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APPENDIX III: PRESS RELEASES

1. GeoERA Raw Materials (08-2018) https://geoeramindesea.wixsite.com/mindesea/press-release
2. La minería submarina es la nueva frontera (10-2018) https://geoeramindesea.wixsite.com/mindesea/press-release
3. Raw Materials Week 2018 (11-2018) https://geoeramindesea.wixsite.com/mindesea/press-release
4. Científicos europeos buscan los metales de los coches y la energía del futuro en los mares de toda Europa (12-2018) https://geoeramindesea.wixsite.com/mindesea/press-release
5. Descubrimiento de nuevos campos de chimeneas y hábitats profundos en la dorsal del Atlántico Norte (07-2019) https://geoeramindesea.wixsite.com/mindesea/press-release
6. GeoERA Raw Materials to support Europe's resilience on raw materials (06-2021) https://geoeramindesea.wixsite.com/mindesea/press-release

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APPENDIX IV: PROJECT WORK PACKAGE DELIVERABLES

Work package description

Work package 1: Management and Coordination

Deliverables:

- **D1.1:** Biannual Internal Progress Reports will be compiled and submitted to the Raw Materials Theme Coordinator outlining: meetings held, difficulties encountered, inventories of data starting at Month 6 of the project and continuing throughout the 36 months. M6, M12, M18, M24, M30, M36
- **D1.2:** A first interim Project Progress Report will be delivered in month 18 (M18) according the timetable indicated in the GeoERA Project Implementation Document Nº1. The interim report will include Project Progress Report template (Reporting Template Document 2B) with a summary of work completed and what remains to be done; the challenges faced; the effort (percentage of project resources) spent on the preparation of and access to data in each country, the access to data from international sources'. providing the data infrastructure to give access and make data accessible across countries, and developing standards.
- **D1.3:** A Final Project Progress Report will be delivered at the end of the project in month 40 (M40) according the timetable indicated in the GeoERA Project Implementation Document Nº1. The Final Report will include the Final Project Progress Report template (Reporting Template Document 2C) with a description of the work that was done during the project; the challenges faced; an analysis of performance and lessons learned; an analysis of sustainability of the project; a 15-page executive summary that can be read by a non-specialist.
- **D1.4:** Cumulative expenditure reports gathering information of all partners regarding costs incurred in each calendar year according the timetable indicated in the GeoERA Project Implementation Document Nº1. M6, M18, M30

Work Package 2: Communications, Dissemination & Exploitation

Deliverables:

- **D2.1:** WP2 Communications, Dissemination & Exploitation Task Guide, to outline the work schedule, specific deliverables and provide detailed instructions to project partners. M4
- **D2.2:** Digital dissemination will be based particularly on the Information Platform. Others include digital products, such as newsletters, journal articles, press releases, infographics, flyers and social media tools. M1-40
- **D2.3:** Workshops dedicated to the main themes of the work packages (jointly with other SRTs?). M11, M17, M21, M30, M40
- **D2.4:** Report summarising the resources of the project partners to disseminate information (websites, newsletters, flyers and social media tools, annual reports etc) along with specific targeted dissemination at conferences and meetings. M40

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Work package 3: Seafloor Massive Sulphide Deposits

Deliverables:

- **D3.1:** WP3 Seafloor Massive Sulphide Deposits Task Guide, to outline the work schedule, specific deliverables and provide detailed instructions to project partners. M3
- **D3.2:** Provide harmonised data for European SMS deposits, including their classification and potential for critical elements. Data to be integrated into the European resource databases and information systems, including the EURMKB (RM1) and EGDI. M1-40
- **D3.3:** Develop and/or review the models for the formation of European SMS deposits (report). M34
- **D3.4:** Assess the potential for SMS mineral deposits within the European territory based on data generated by this study (report). M40

Work package 4: Ferro-manganese Crusts, Phosphorites and Critical Raw Materials

Deliverables:

- **D4.1:** WP4 Ferromanganese crusts, phosphorites and critical raw materials Task Guide, to outline the work schedule, specific deliverables and provide detailed instructions to project partners. M3
- **D4.2:** INSPIRE-compliant harmonised datasets and maps of marine ferromanganese crusts and phosphorites and their associated CRM for the European sea basins. M1-40
- **D4.3:** Mineral-potential and prospectivity maps, where such information is available. M40
- **D4.4:** Models of formation for the main provinces of ferromanganese crusts and phosphorites occurrence, as defined through this study. M34
- **D4.5**: Report highlighting the endowment and exploration potential of CRM associated with submarine ferromanganese crusts and phosphorites in Europe. M36
- **D4.6:** Literature review report on present-day status of regulation, legislation and exploitation of ferromanganese crusts and phosphorites, with emphasis on the impact of a pan-European research approach. M40
- **D4.7:** The results of the case study will be presented in a separate project report. M40

Work package 5: **Marine Placer Deposits**

Deliverables

- **D5.1**: WP5 Marine Placer Deposits Task Guide, to outline the work schedule, specific deliverables and provide detailed instructions to project partners. M3
- **D5.2:** INSPIRE-compliant harmonised datasets and maps of marine placer deposits for the European sea basins. M1-40
- **D5.3:** Mineral-potential and prospectivity maps, where such information is available. M40
- **D5.4**: Models of formation for the main provinces of placer occurrence, as defined through this study. M38

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- **D5.5:** Literature review report on present-day status of regulation, legislation and exploitation of placer deposits, with emphasis on the impact of a pan-European research approach. M36

Work package 6: **Polymetallic Nodules**

Deliverables:

- **D6.1:** WP6 Polymetallic Nodules Task Guide, to outline the work schedule, specific deliverables and provide detailed instructions to project partners. M3
- **D6.2:** Report of the polymetallic nodules prospect evaluation parameters that will be employed as a road map for the creation of the polymetallic nodules occurrence database. M32
- **D6.3:** INSPIRE-compliant harmonised data for polymetallic nodules occurrences database, including their classification and potential for critical elements prospect evaluation. Data to be integrated into the European resource databases and information systems, including the EURMKB (RM1), EmMODnet Geology and EGDI. M1-40
- **D6.4:** Identification of areas of high likelihood occurrence of polymetallic nodules. M40
- **D6.5:** Report of the polymetallic nodules prospect evaluation for European waters based on data generated by this study. M40

Work package 7: Exploration in the Atlantic, Mediterranean, Baltic and Black Sea

Deliverables:

- **D7.1:** WP7 Exploration in the Atlantic, Mediterranean, Baltic and Black Sea Task Guide, to outline the work schedule, specific deliverables and provide detailed instructions to project partners. M3
- **D7.2:** INSPIRE-compliant harmonised datasets and maps of marine areas explored for different mineral resources and unexplored regions in the European seas. M1-40
- **D7.3:** Mineral-potential and prospectivity maps, where such information is available. Proposal of pilot areas for discovery of new resources. M40
- **D7.4:** Literature review report on present-day status of exploration for submarine mineral deposits around Europe. M40

Work package 8: Link to Information Platform

Deliverables:

- **D8.1**: Concise overview report with explanatory notes relating to the standards for databases, data, information and communication that will be created by the WPs (see each WP for detailed information). This will be agreed with the GeoERA IP and will adhere to European standards such as those devised by INSPIRE, EMODnet Geology and EGDI, where relevant. M3
- **D8.2:** Project metrics will be reported on the accessibility and use of data, data products and outreach material, for the IP and general public. M1-40
- **D8.3:** Best practice manual with practical guidelines and workflows for data, to include examples of mapping and resource assessment tools and procedures of offshore CRM, base and strategic minerals. M18

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- **D8.4:** Completion of project databases & fully functional portal with published maps relating to each of the WP deliverables. These will adhere to INSPIRE principles and formats according to the EGDI standards. M1-40

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