



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

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MINDeSEA Consortium











PDAC 2021 THE WORLD'S PREMIER MINERAL EXPLORATION & MINING CONVENTION

Challenge

Seafloor deposits:

the most important yet least explored resource of CRM

ICELAND

By 2030, 10% of the world's minerals, including cobalt, copper and zinc could come from the ocean floors.

Global annual turnover of marine mineral mining can be expected to grow from virtually nothing to **€10 billion by 2030**.





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2020 CRMs (30)			
Antimony	Fluorspar	Magnesium	Scandium
Baryte	Gallium	Natural graphite	Silicon metal
Beryllium	Germanium	Natural rubber	Tantalum
Bismuth	Hafnium	Niobium	Tungsten
Borate	HREEs	PGMs	Vanadium
Cobalt	Indium	Phosphate rock	Bauxite
Coking coal	Titanium	Strontium	
Lithium	LREEs	Phosphorus	
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~			Source: EC







### Characterising the European deposit types and their CRM

- **1- Hydrothermal mineralizations**
- 2- Co-rich Ferromanganese Crusts
- **3- Phosphorites**
- **4- Polymetallic Nodules**
- **5- Marine Placer deposits**











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#### Identifying the principal metallogenic provinces

Mineral assemblages Areas of distribution Epochs of formation Genetic models







González et al., 2020



#### **Developing harmonized mineral maps and datasets**

**Geological Survey Organizations datasets Mineral potential and prospectivity maps** 



ISO/TS 19139:2007 Geographic information — Metadata — XML schema implementation

	ATTRIBUTE	FIELDNAME	FORMAT	COMMENT
	OBJECTID	FID	Unique Identifier	Unique Shapefile identifier
	Shape	SHAPE	Geometry	Point
	Longitude	LONGITUDE	Number	reorder as longitude is X, Decimal (5) Degree format
	Latitude	LATITUDE	Number	reorder as latitude is Y, Decimal (5) Degree format
General Data	Country Code	COUNTRY	Text (2)	rename field. ISO 3166 Two Letter Country Code e.g. IE, NO, ES
	Administration	MARITIME ZONE	Text (24)	Controlled vocabulary
	Geographical Area	SEA AREA	Text (32)	Controlled vocabulary
	Sector	SECTOR	Text (40)	What is the purpose of this geographical name description?
	Importance	IMPORTANCE	Text (20)	Controlled Vocabulary (Importance)
	Deposit Group	MINERAL DEPOSIT GROUP	Text (53)	Controlled Vocabulary (Mineral Deposit Group)
	Deposit Type	MINERAL DEPOSIT TYPE	Text (84)	Controlled Vocabulary (Mineral Deposit Type)
	Hydrothermal activity	HYDROTHERMAL ACTIVITY	Text (8)	Controlled Vocabulary (MINDeSEA)
	Distance from rift or active vent sites	RIFT DISTANCE	Number	Distance in km
	Age	AGE	Text (250)	Age of the mineral deposit and host rock
	Host rock	HOST ROCK	Text (250)	Substrate rock or sediment surrounding the ore deposit
	Metallic Commodity	METALLIC COMMODITY	Text (250)	Controlled Vocabulary (Commodity Code)
Metallogeny	Other metals	OTHER METALS	Text (250)	
	Commodity Group	COMMIDITY GROUP	Text (250)	Controlled Vocabulary (Commodity Code) duplicate?
	Ore Minerals	ORE MINERALS	Text (250)	Metal-hosting minerals (see INSPIRE)
	Gangue Minerals	GANGUE MINERALS	Text (250)	Non-economic minerals (see INSPIRE)
			T-++ (4.6)	
	Mineral Occurrence Type	MINERAL_OCCORRENCE_ITPE	Text (10)	Controlled Vocabulary (Mineral Occurrence Type)
	Mine Status		Text (28)	Controlled Vocabulary (Minies Activity Type)
	Mining Activity Type	MINING_ACTIVITY_TYPE	Text (36)	Controlled Vocabulary (Mining Activity Type)
	Deposit Size	DEPOSIT_SIZE	Text (40)	Deposit size calculated according to Provine (small, medium)
	Grade	GRADE	Text (40)	Deserves a la MA
	Resources (total)	RESOURCE	Number	Resources in Mt
	Reserves (total)	RESERVE	Number	Reserve in Mt
Economic Data	Mined tonnage	MINED_TONNAGE	Number	Ionnage in Mt
	Total tonnage	TOTAL_TONNAGE	Number	Tonnage in Mt
	Remaining tonnage	REMAINING_TONNAGE	Number	Tonnage in Mt
	Resource reporting standard / compliancy	STANDARD	Text (58)	Controlled Vocabulary (Minventory)
	Reference for tonnage assessment	REFERENCE	Text (40)	Company ordering the assessment
	Data Scale	SCALE	Text (9)	1:250,000
	Exploration Activity Type	EXPLORATION_ACTIVITY_TYPE	Text (50)	Controlled Vocabulary (Exploration Activity Type)
	Operator	OPERATOR	Text (250)	Research, exploration or operating agency/company
	Cruises	CRUISES	Text (250)	Cruises identification
	Sampling Methods	SAMPLING_METHODS	Text (250)	Sample recovery method controlled vocabulary?
	Data Provider	DATA_PROVIDER	Text (250)	Name of organisation providing the data
	Data Provider Contact	CONTACT_EMAIL	Text (250)	GDPR compliance contact email
	Deposit extent (km2)	DEPOSIT_KM2	Number (Double) (11,4)	Area of deposit
	Depth to Deposit (m)	DEPTH_TO_DEPOSIT	Number (Double) (11,4)	Depth to deposit from sea surface
invironment	Fauna	FAUNA	Text (100)	Controlled vocabulary?
	Description	DESCRIPTION	Text (500)	
Other Data	Gallery	GALLERY	Image	Images of the mineralization (geophysical, sampling, textural features, paragenesis, etc)
	References	REFERENCES	Text (250)	Link to bibliographic references (DOI and/or Author, Year & Title if you wish)
	Comments	COMMENTS	Text (250)	Any additional comments or observations







## Demonstrating the efficiency of the case study results

#### Offshore minerals exploration Critical metals assessment



Baltic Sea (all 3 sub-regions)







#### pan-European research approach for seabed mineral deposits



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#### Analysing present-day exploration and exploitation status

Regulation, legislation, environmental impacts, exploitation and future directions





United Nations Convention on the Law of the Sea of 10 December 1982 Overview and full text

> **Developing a Regulatory** Framework for Mineral **Exploitation in the Area**



A Discussion Paper on the development and drafting of **Regulations on Exploitation** for **Mineral Resources** in the Area

> (Environmental Aatters









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