

EMODnet



European Marine
Observation and
Data Network

EMODnet Thematic Lot n° 1 - Geology

EASME/EMFF/2016/1.3.1.2 - Lot 1/SI2.750862

Start date of the project: 12/04/2017 - (24 months)

EMODnet Phase III – Interim Report

Reporting Period: 12/04/2017 – 11/04/2018



Contents

Executive summary	3
1 Introduction.....	4
2 Highlights in this reporting period	6
3 Summary of the work done	7
4 Challenges encountered during the reporting period	8
5 Allocation of project resources.....	12
6 Work package updates	13
7 User Feedback	25
8 Meetings held/attended since last report.....	26
9 Outreach and communication activities.....	28
10 Updates on Progress Indicators	31
<i>Indicator 1 - Volume of data made available through the portal</i>	<i>31</i>
<i>Indicator 2 - Organisations supplying each type of data broken down into country and organisation type (e.g. government, industry, science)</i>	<i>31</i>
<i>Indicator 3 - Organisations that have been approached to supply data with no result.....</i>	<i>31</i>
<i>Indicator 4 - Volume of each type of data and of each data product downloaded from the portal.....</i>	<i>31</i>
<i>Indicator 5 - Organisations that have downloaded each data type.....</i>	<i>32</i>
<i>Indicator 6 - User statistics to determine the main pages utilised and identify user navigation routes</i>	<i>32</i>
<i>Indicator 7 - List of what the downloaded data has been used for.....</i>	<i>32</i>
<i>Indicator 8 - List of web-services made available and organisations connected through these.....</i>	<i>33</i>
11 Recommendations for follow-up actions by the EU	34
12 Annex: Tasks specified in Section 1.4.1.	35
13 List of abbreviations and acronyms.....	37

Disclaimer

The information and views set out in this report are those of the author(s) and do not necessarily reflect the official opinion of the EASME or of the European Commission. Neither the EASME, nor the European Commission, guarantee the accuracy of the data included in this study. Neither the EASME, the European Commission nor any person acting on the EASME's or on the European Commission's behalf may be held responsible for the use which may be made of the information.

Executive summary

The current EMODnet-Geology Project started in April 2017 and will run for 2 years, ending in April 2019. The group consists of 34 partners and 5 subcontractors who are able to provide geological information from all of the European seas. By including organisations from Iceland, Norway and Russia, it was possible to expand the information coverage into the North Atlantic Ocean and to the margins of the Arctic (Barents Sea and White Sea).

During the first three months efforts were put on partner data inventory on data which comply with the new requirements of 1:100 000 scale or finer where underlying data permit, as well as on launch of the new EMODnet Geology portal by partner and WP 9 lead GEUS in Copenhagen. Albeit very short deadline for this action the portal was up and running in the third project month.

All guidelines of the different workpackages were updated during the first 9 months, except for the new work package WP8 Submerged Landscapes, which started with a first workshop in late June in Copenhagen. The second WP8 workshop was held in Crete on January 31 – February 1 2018. The two focussed workshops organised during the first year were essential in the formulation of the guidelines, with the one held in Copenhagen resulting in the methodology to be followed and the timetable and the workshop in Crete defining the feature classes. Defining submerged landscape features had never been attempted before. The case study pilot areas agreed upon in Copenhagen were important in identifying the large variation of submerged landscape features that are present beneath European Seas. The chosen pilot areas were UK Shelf, Baltic, Aegean, and Tyrrhenian seas, as well as offshore Ireland and in the Sea of Marmara. One of the major realisations was just how large the subaerially exposed land area of Europe became when sea level was reduced by 120 metres. In this context, it was another challenge to identify those features which were formed when subaerially exposed from those that were formed latterly when sea level rose.

Except for WP8 which has just started in this phase of EMODnet Geology the other work packages have updated or are by the end of the first project year in the process of updating their map products according to the new resolution specifications set by our Service Contract.

1 Introduction

The EMODnet-Geology Project is one of eight that brings together information on the Geology, Chemistry, Biology, Physics, Bathymetry, Seabed Habitats, Coastal Mapping, and Human Activities in the European marine environment. During the second phase of EMODnet (2013-2016), 36 organisations from 30 countries demonstrated that geological information could be compiled and harmonised to map products at 1:250 000 scale from all of the European seas. In 2017, the group of mainly geological survey organisations from 30 countries was successful in being awarded the contract to deliver similar information for the entire European seas, but in a much finer scale, 1:100 000 or finer where the underlying data permit. (Figure 1).

The current EMODnet-Geology Project started in April 2017 and will run for 2 years, ending in April 2019. The group consists of 39 partners or subcontractors who are able to provide geological information from all of the European seas shown in Figure 1 and, by including organisations from Iceland, Norway and Russia, to expand the information coverage into the North Atlantic Ocean and to the margins of the Arctic (Barents Sea and White Sea). The information that will be included in the project is principally that held by the project partners, although other organisations contribute to the geological mapping objectives in many of the participating countries. The geology data that were compiled in the earlier phases and in the current project includes:

- Sea-bed substrate (sediment layer at the seafloor),
- Sediment accumulation rate ;
- Sea-floor geology - lithology (bedrock geology beneath the surficial sediment and Quaternary deposits);
- Sea-floor geology - stratigraphy ;
- Coastal behaviour;
- Mineral occurrences (e.g. oil and gas, aggregates, metallic minerals) ;
- Geological events and probabilities (e.g. earthquakes, submarine landslides, volcanic centres),

This phase includes also a new work package on Submerged landscapes (LGM landscape, palaeolandscapes across various postglacial timeframes).

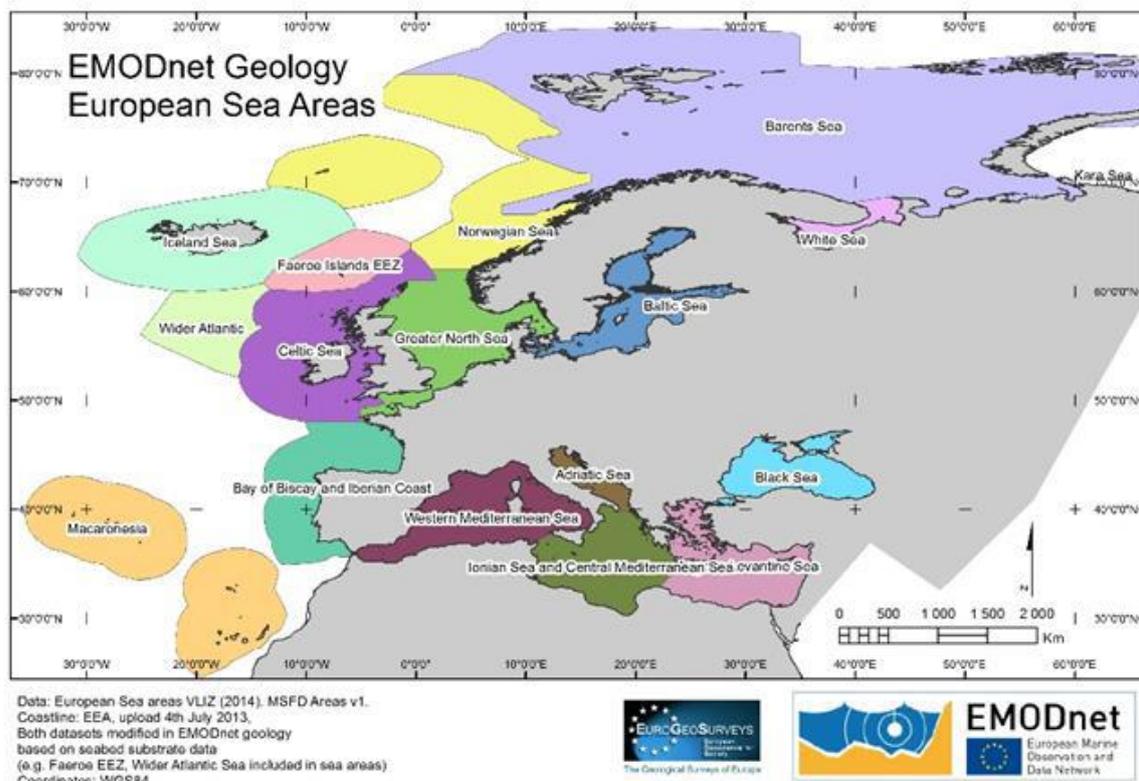


Figure 1. The European regional seas included in the EMODnet Programme. The EMODnet-Geology consortium includes partners who hold information from all regional seas.

The consortium includes the following organisations 1. Geological Survey of Finland (GTK); 2. Natural Environment Research Council – British Geological Survey (NERC-BGS United Kingdom) 3. Geological Survey of Sweden (SGU); 4. Geological Survey of Norway (NGU); 5. Geological Survey of Denmark and Greenland (GEUS); 6. Jarðfeingi (Faroe Islands); 7. Iceland GeoSurvey (ISOR); 8 Geological Survey of Estonia (EGT); 9. Latvijas Vides Geoloģijas un Meteoroloģijas Centr (LVGMC; Latvia); 10. Lithuanian Geological Survey (LGT); 11. Polish Geological Institute (PGI-NRI); 12. Geological Survey of the Netherlands (TNO); 13. Royal Belgian Institute of Natural Sciences (RBINS); 14. Bureau de Recherches Géologiques et Minières (BRGM, France); 15. IFREMER (France); 16. Geological Survey of Ireland (GSI); 17. Geological Survey of Spain (IGME); 18. Instituto Português do Mar e da Atmosfera (IPMA, Portugal); 19. Istituto Superiore per la Protezione e la Ricerca Ambientale. Servizio Geologico d'Italia (ISPRA); 20. Geological Survey of Slovenia (GeoZs); 21. Croatian Geological Survey (HGI); 22. Geological Survey of Montenegro (GEOZAVOD); 23. Geological Survey of Albania (GSA); 24. Institute of Geology and Mineral Exploration (IGME, Greece); 25. Hellenic Center for Marine Research, Greece (HCMR); 26. Institute of Oceanology – Bulgarian Academy of Science (IO-BAS); 27. National Research and Development Institute for Marine Geology and Geoecology (GeoEcoMar, Romania); 28. Geological Survey of Cyprus (GSC); 29. Continental Shelf Department of the Office of the Prime Minister (Malta); 30. Centre for Environment, Fisheries and Aquaculture Science (CEFAS, United Kingdom); 31. University of Sussex (United Kingdom); 32. Dipartimento Scienze della Terra Università La Sapienza, Roma (UNIROMA, Italy); 33. Department of Geology, University of Tartu (Estonia); 34 Foundation for Research and Technology Hellas – Institute of Computer Science (FORTH- ICS); 35. Prichornomorske State Regional Geological Enterprise (Ukraine); 36. Dokuz Eylul University (Turkey); 37. A.P Karpinsky Russian Geological Research Institute (VSEGEI); 38. Federal Institute for Geosciences and Natural Resources (BGR, Germany); 39. EMCOL Research Centre, Istanbul Technical University (ITU, EMCOL, Turkey).

The partnership consists of the geological survey organisations of the maritime countries of the European Union, added with expertise from five universities, mainly to fulfill the requirements of the new work package WP9 Submerged Landscapes. Twenty-five of the project partners are also members of the Geological Surveys of Europe (EuroGeoSurveys), which exists to promote the work of the geological surveys and therefore provides a long-term association under which the project partners collaborate.

As the principal holders of marine geological information, the partnership also ensures that data from all of the European regional seas are provided to the project. The project will build on information primarily held by the project partners, but will also connect to other owners of information by offering data delivery to EMODnet either through the EMODnet Data Ingestion portal or straight to the EMODnet Geology portal. By doing so, the project will not recreate information that is held elsewhere. This is especially essential in case of the seismic surveys and borings which are mainly archived in external databases (such as the Geo-Seas portal). The EMODnet Geology portal (<http://www.emodnet-geology.eu/>) is from the beginning of this phase of EMODnet hosted by the Geological Survey of Denmark and Greenland (GEUS) in Copenhagen. To ensure the sustainability of the EMODnet Geology project, the EuroGeoSurveys' European Geological Data Infrastructure (EGDI) provides an appropriate platform for developing a long-term infrastructure for delivering the best available and up-to-date marine geological information held by the project partners.

2 Highlights in this reporting period

Provide a short summary of the key achievements and/or events of interest to a wider audience within this reporting period you wish to highlight. You can also consider the indicators or any other of the reporting sections.

- Migrating of the existing portal from BGS, UK, to facilities at GEUS, Denmark. The new portal at GEUS was up and running in mid-June 2017. The portal layout, styling and colors were aligned with new guidelines from the EMODnet Secretariat by end of 2017. EMODnet Geology portal also volunteered as a test case for the portal monitoring program and user activity is now logged to central database (Piwik/Matomo) hosted by EMODnet main portal.
- Datasets from previous phases of EMODnet Geology (in scales 1:1 000 000 & 1:250 000) were made available through the new and updated EMODnet 3 Geology portal during 2017.
- Update of the inventory of available data at 1:100,000 all over but finer where the underlying data permit was carried out by all workpackages during 2017.
- Guidelines of the work of the different work packages were updated to the criteria of the recent Service Contract and they were distributed to all partners by November 2017, except for the new work package 8 (Submerged landscapes), which had their guidelines finalized and distributed during the last quarter of the project year. Partners started to harmonise/treat their high resolution seafloor data and submit to the different workpackages.
- All work packages have been preparing their data and have updated or will soon update their products to cope with the new resolution criteria of the service contract. WP8 has worked with the new resolution criteria from the beginning and will publish their data products accordingly.
- The first version of the harmonised seabed substrate data on scale 1:100 000 with confidence estimates was made available at the EMODnet 3 Geology portal 23.03.2018
- WP5 (Coastal behaviour) generated a full-coverage pan-European satellite-based analysis of coastline migration, providing 10 years of coastline-position data for every 500 meters along the European coastline. This new data product will be published on the portal in the next three-month period.
- During the first year of the project a revised framework was created for reporting 11 different types of marine minerals. This and template shapefiles were disseminated to all partners. The first iteration of updated and new data have been delivered, a new service is being authored.
- Data and metadata on multibeam and seismic surveys and borings has been according to tender specifications (1.7.1.) made available on the web portal under "Lab" on the map viewer.
- Draft guidelines for Submerged landscapes (WP8) were successfully completed and provided for distribution to project partners by the end of the first year of EMODnet 3. This is the first time that submerged landscape features have been classified as the basis for a fully attributed GIS.



3 Summary of the work done

The first year of this third phase of the EMODnet-Geology Project has been focused on identifying the geological information that exist in each country and reconstructing the EMODnet-Geology portal. The portal was moved from BGS (UK) to GEUS (Denmark) and was by month 3 up and running. Initially the priority has been to assess information in the higher resolution requested in this phase of the project (1:100 000 scale or finer where the underlying data permit) held by each participating organisation, although as the year has progressed also external information, that is publicly available has been included. All workpackages (listed below) have updated their guidelines and distributed them to the project partners. After collection of all available geological data the different workpackages have worked on the construction of the products and portal services as outlined in the service contract and the GANNT chart presented in the project tender. The service contract described this phase continuing from month 1 (April 2017) to month 12 (April 2018). The main areas of progress have been in collating information for work packages 3 (sea-bed substrate), 4 (sea-floor geology), 5 (coastal behavior), 6 (geological events and probabilities), 7 (minerals), 8 (submerged landscapes), and 9 (data management, web portal and services). Since work package 8 (submerged landscapes) is a new work package and in practice started at the kick-off meeting in end of May 2017 it took almost the first project year to clarify the amount and extent of all possible data to be included this work will continue into the early months of the second year of the project. However, guidelines for this work package have been agreed upon, finalized and distributed to partners.

The second half of the project (April 2018 to April 2019) will concentrate on update of all web products produced by work packages 3 (sea-bed substrate), 4 (sea-floor geology), 5 (coastal behavior), 6 (geological events and probabilities), 7 (minerals), while work package 8 (submerged landscapes) will develop completely new information through offered web services. By the end of second project year all work packages will offer data products in scale 1:100.000 or finer where the underlying data permit.

The consortium has been aware of the earlier problems with the Geology portal and has put efforts on the recent implementation of the portal and its services. Access to data is improved by centralizing data products on the portal and adding Styled-layer-descriptions (opposed to ArcGIS, this is a non-proprietary styling format). Data products are available through all commonly used methods. To further improve accessibility of data, PostgreSQL is promoted as the preferred method of storing and accessing data products. By principal, all data products, vocabularies, harmonization, and contributions to the data entity indexes will be stored in the database.

Progress in each of the tasks specified in Section 1.4.1 of the Tender Specifications is listed in appendix 1 (page 40).

4 Challenges encountered during the reporting period

Main challenge	Measures taken
<p>WP1: Project management</p> <p>Subcontract of work package 4 leader Bundesanstalt für Geowissenschaften und Rohstoffe – the Federal Institute for Geosciences and Natural Resources, Germany (BGR) and A.P. Karpinsky Russian Geological Research Institute (VSEGEI) Federal State Budgetary Enterprise were in the beginning of the project delayed due to different reasons.</p>	<p>These problems were solved and agreements with these both subcontractors were signed during the second quarter, with BGR on 10th July and with VSEGEI on 16th August 2017. Due to the delay in agreement there was lack in staff at BGR, but the problem was solved during 3rd quarter: a GIS-engineer (1. December) and a marine geologist (1. January) were employed to BGR. VSEGEI didn't face such problems due to temporary budgetary funding for the project.</p>
<p>Status of partner Continental Shelf Department of the Ministry of Transport and Infrastructure of Malta was in June 2017 changed such that the department was moved to the Office of the Prime Minister.</p>	<p>All references in the Contract to partner "Continental Shelf Department of the Ministry of Transport and Infrastructure" of Malta are by EASME approval on December 21 2018 deemed to refer to "Continental Shelf Department, Office of the Prime Minister, Malta"</p>
<p>The 24 month time schedule of the project (in comparison with earlier 36 months) is in general rather challenging as the resources of the partners are limited and they have to provide data to many different work packages and even more data products.</p>	<p>Each partner has handled this in order of urgency, some deliveries of data have been scheduled for the second project year (months 13-24). This hasn't, however, affected the delivery of data products to the webpage. All work packages, except for the new work package Submerged Landscapes, have updated or are in the process of updating their data products from EMODnet phase II and the products will have final updates during the second year.</p>
<p>WP3: Seabed substrate</p> <p>The EEA coastline used in previous EMODnet projects was considered too general for the high resolution seabed substrate data by the project group.</p>	<p>It was agreed that the partners should use the national/original coastline of their data.</p>
<p>The EMODnet seabed substrate data product represent information using the Folk sediment classification scheme. However, the European sea-bed substrate information has been interpreted using more than 30 different national sediment classification schemes that are not necessarily directly compatible with the Folk scheme.</p>	<p>WP3 has provided guidelines to harmonise national data into the Folk scheme. The harmonisation includes evaluation of the different classification schemes used in each country, and classification or translation of the national data into the shared EMODnet classification system. To make the harmonisation process transparent the substrate attribute table includes columns for the Folk sediment classes as well as a column for the original seabed substrate class.</p>
<p>The first version of the 1:100 000 sea-bed substrate data product with confidence estimates was delivered to the data portal in March 2018, but the time schedule is challenging</p>	<p>As it is likely that some partners will provide new data into the data product and the product will be updated during the second year, certain update dates were agreed upon during the March workshop in Montenegro.</p>



<p>The seabed substrate data that is more detailed than 1:100 000 scale has been collected and harmonised simultaneously with 1:100 000 data, but it has not been included in the data product yet, due to lack of time.</p>	<p>The data processing and compilation of the more detailed seabed data will commence during the second year of the project, and it will be included into the data product.</p>
<p>Some partners have provided data at more general scales than 1:100 000. However, due to the time constraints, the previous WP3 outputs of 1:250 000 and 1:1 000 000 scale data products of earlier EMODnet phases I and II, will not be updated.</p>	<p>Update of the old EMODnet products is not possible due to the challenging time schedule of the recent EMODnet phase, at least not during the first two years, due to the time constraints, and the necessity of production of new products of the recent phase. Update of the old EMODnet products is not in conflict with the service contract, but it would of course, be better for the EMODnet Geology stakeholder community to have access to updates of all geology products.</p>
<p>The EMODnet Seabed habitats lot is interested in some additional features not represented in the Folk sediment classification.</p>	<p>To advance the collection of the additional information, WP3 has added a new column to the substrate attribute table on features not represented in the Folk classification. The field allows free text, but the guidelines suggested some features to include, e.g. bioclastic sediment, till, moving mud.</p>
<p>There is a risk of overlap of work between the work packages of our own lot as well as between our lot and other EMODnet lots, which emphasizes the necessity of co-operation within and between EMODnet lots.</p>	<p>WP3 has co-operated with other WP's and other EMODnet lots to ensure the data usability between WP's and to avoid double work among partners. WP3 representatives have participated in workshops held by other WP's (e.g. WP8 and WP4 workshops). WP3 Leader (GTK) participated in the Emomodnet Seabed Habitats – EMODnet Geology Lots workshop organized on 2 October 2017 at SHOM, Athens, Greece. EMODnet Geology and WP3 Leader have been active in EMODnet Technical Working Group and EMODnet Data Ingestion project and also participated in EMODnet Steering Committee meetings.</p>
<p>Case study 2 of the WP3: The second case study of the work package led by partner CEFAS aimed at spatially predict sedimentation rates for a sea-basin, provided that sufficient data exists. The Southern Baltic Sea was chosen as the sea basin to test the feasibility of this approach. As a first test it is challenging.</p>	<p>After investigations into the available data from Sweden, Denmark and Poland we unfortunately found that the sediment sample data was not suitable for interpretation. Data collected by these three countries is mostly recorded qualitatively in the field and not processed back in the lab using full particle size analysis.</p>
<p>Workpackage 4. Sea-floor geology</p> <p>The major challenge is the wide span of scales of the available data which reach from 1 : 25 000 to 1 : 1 Million and the aim is to investigate solutions to handle this continuing issue in relation to the set scales for this 3rd phase of EMODnet Geology.</p>	<p>The developed and agreed WP 4 Vocabulary serves as base for this work. The groups reconvened at the spring-EMODnet geology meeting in the second Harmonisation Workshop and presented their progress and results. A question was how to subdivide the Holocene stratigraphy and working group was founded to develop a common classification according to existing standards on the Holocene Epoch.</p>
<p>WP5: Coastal behavior</p> <p>Main original challenge was caused by unavailability of detailed (better than 1:250,000) data for many areas</p>	<p>This challenge is being overcome by the new satellite-based approach of determining decadal coastline change.</p>



<p>New key challenge is validating these data in terms of coastal erosion and accretion, and translating this validated data product to coastal resilience and vulnerability, which have far more applied societal value.</p>	<p>Validation of satellite-based determination of coastal change is in progress and both literature and field checks will be performed in test areas during the second project year.</p>
<p>WP6: Geological events and probabilities Identification of a <u>univocal</u> definition of "geological events probabilities".</p>	<p>Among several definitions considered, INSPIRE data specification on Natural Risk Zone defines probabilities either as a quantitative or a qualitative likelihood of occurrence.</p>
<p>Assessment of a quantitative likelihood of occurrence requires very detailed data.</p>	<p>Research is in progress to model a qualitative likelihood of occurrence (aka susceptibility) based on data collected within EMODnet Geology.</p>
<p>Many models have been applied to sub-aerial landslides but very few to submarine landslides, also because of lesser information available on the events in submerged areas. Moreover, these elaborations are time consuming.</p>	<p>Models are being examined and tested in order to verify their applicability in submerged areas and identify relevant parameters to be considered.</p>
<p>WP7: Minerals Not all partners have been able to make the submission deadline. Much pressure is put on all partners to deliver data by the end of the first project year, for most Work Packages. This is to ensure that WP leaders subsequently have new material to publish ahead of midterm report. This timeline is short and demand of partners may be too much.</p>	<p>We have encouraged partners to submit updates to data. We have indicating the importance of an update before publishing of a renewed WP service. If this is done prior to the receipt of all updates the result will be create an incorrect, unfinished map. A new service will not be published until all partners update data submitted during Phase 2</p>
<p>The GSI (WP7 lead) has undergone structural and staff changes. This has resulted in the transfer of two key data managers and GIS specialists from the marine section. These staff enabled the transfer of merged WP7 data to WMS, the assignment of CC's and DOI's for data and management of the services. Their roles have yet to be filled.</p>	<p>Recruitment of substitute contractors is in progress. It has been decided that the publication of a service, and the addition of DOI and CC licences for all WP's will now be taken on by GEUS as data administrator. This project decision reduces the issues caused by the challenge.</p>
<p>WP8: Submerged landscapes In general there were no demanding challenges but setting out the general outline of how to meet the criteria set in the Service Contract was a minor challenge for WP coordination and participating partners.</p>	<p>After data identification and compilation for the pilot areas UK Shelf, Baltic, Aegean, and Tyrrhenian seas, as well as offshore Ireland and in the Sea of Marmara, draft guidelines for the Submerged landscapes WP were set in the first quarter of 2018. Partners have delivered data according to the guidelines and products are being prepared for GIS.</p>
<p>WP9: Data management – web portal Data owners found it difficult to comprehend the entity index concept. In addition, the drafted exchange format (WFS) raised concern if data owners would be able to setup</p>	<p>To make sure we are gaining access to as much content as possible, we are now working on a "maturity ladder" for data owners allowing them to initially share entity indexes with simpler techniques and requirements. Then later, they can improve the setup with the assistance from other partners</p>



online services complying with both OGC standards and INSPIRE directives.	
Data management in EMODnet Geology involves a wide variety of technologies and components. The complexity puts high demand on all participants.	To decrease the workload, we are joining forces with EGDI (functionality), EPOS (schema definitions and data harvesting), and the EMODnet main portal (social platforms and user experience/statistics).



5 Allocation of project resources

In this section, please provide information about the efforts spent during the reporting period on the achieving the main objectives and tasks of the project. Provide an overview of resource usage (percentage of project resources) divided into the following categories (if no precise information is available, provide estimate indication instead).

Categories	Resource usage (%)
Making data and metadata interoperable and available	20
Preparing data products	70
Preparing web-pages, viewing or search facilities	70
Managing user feedback	30
Project management	60
Outreach and communication activities	50
Others	50

6 Work package updates

WP1 – Project Management (led by the Geological Survey of Finland - GTK)

Objectives: To manage the overall project, ensure delivery of the outputs and outcomes as agreed with the European Commission. To assess and evaluate the project and its results.

The EMODnet-Geology Project contract was signed on April 12th 2017. Work on the project commenced immediately with partners starting the exercise of compiling inventories of available data for each work package (Workpackage 2). The project kick-off meeting was held in Espoo, Finland on 30-31 May 2017 hosted by the Geological Survey of Finland (GTK) at which all but 3 partner organisations were able to participate. The objectives of the project were described by the Project Co-ordinator and the timescale for achieving the objectives according to the project workplan were presented along with financial information and other project management procedures. A second project meeting was held in Rome, Italy on 26-28 September 2017, hosted by the University of Sapienza. 37 of the 39 partner organisations were represented (including subcontractors). In the end of the first project year a third project meeting was held in Budva, Montenegro on 26-28 March, hosted by the Geological Survey of Montenegro. 34 partner organizations were able to participate in this meeting. The Project Co-ordinator has provided trimonthly progress reports to the EASME, the EMODnet Secretariat and the European Commission according to schedule and has attended all of the EMODnet Steering Committee meetings throughout the year.

During the reporting period two cases have appeared where the status of a partner has changed such that new documentation and amendment of contract has been requested by the EASME. The case of the Maltese partner (Continental Shelf Department – CSD) was approved by EASME in late December 2017 and the other case (Estonia) is still pending as documents are being prepared in Estonia.

WP – 2. Geological data specification and sourcing (led by the Geological Survey of Finland - GTK)

Objectives: To prepare and provide access to the information required to deliver in 1:100,000 scale or finer, if such data exists, maps of the sea-bed substrate (improving where possible the current resolution of the classes and data), the rate of accumulation and/or sedimentation on the sea-floor; sea-floor (bedrock) lithology and sea-floor (bedrock) stratigraphy; geological events and event probabilities and minerals occurrences. For the coast, information will be provided on its behaviour (migration direction, rate and volume) as well as resilience. Information and expertise will also be provided for reconstructions of the submerged landscapes of the European continental shelf at various time-frames, such as information on shorelines and coastal environments and deposits; valleys and riverbeds, terraces and associated deposits; river-deltas and delta-clinoforms; submerged water points, e.g. submarine groundwater discharges, and freshwater lakes; thickness of Holocene deposits above the Last Glacial Maximum (LGM) landscape; flora and fauna on the submerged landscapes. The data products (maps) will use the standards developed in the EMODnet-Geology Project.

During the initial months of the project each partner was asked to compile inventories of the information that would be used to construct the outputs for work packages 3 to 8. These assessments were presented according to schedule at the 2nd project meeting held in Rome on the 26-28 September. Information was subsequently delivered to the work package leaders according to the guidelines that they distributed to the project group during the 'Construction of the products/maps' phase of the project, which started in month 4 (July 2017). The sourcing of further information is an ongoing objective throughout the project, especially regarding the new work package 8 Submerged Landscapes. Progress during the first year is reported in the following sections describing workpackages 3-8.



WP – 3. Seabed substrate (led by the Geological Survey of Finland - GTK)

Objectives: To compile all available seabed substrate information at a scale of 1:100,000 or finer, to support the delivery of the seabed substrate component of Section 1.7.2. of the tender specifications, and all available information on the rate of accumulation and sedimentation on the sea floor. Additional seabed information not included in the seabed substrate datasets will be further discussed and described for the future work towards more detailed/informative geological products designed for different purposes, such as maritime spatial planning. To optimise co-operation with WP4, especially on issues requiring the integration of information, such as geomorphology and Quaternary geology. WP3 will also continue and deepen the communication and co-operation with other relevant Lots such as Seabed Habitats, to ensure that geological information is used in these Lots to its fullest extent and capabilities

During the first year, Work package WP3 has focused on identifying the available high resolution seabed substrate data as well as creating sea-bed substrate data attribute table, adjusting available data into the scheme, and combining the first version of the sea-bed substrate map at 1:100 000 scale for the study area. During the second year, WP3 aims to produce seabed substrate data at more detailed scales and to update sedimentation rate data collected in the previous phases. WP3 includes two case studies, which are led and reported by CEFAS. Case study 1 “*Quantitative seabed sediment composition of the north-western European continental shelf*” is executed successfully and will be reported in the final report of the project, whilst case study 2 “*Spatial prediction of sedimentation rates*” failed due to the fact that sediment sample data from southern Baltic Sea was not suitable for interpretation of the case study, due to lack of coherent and overlapping datasets of particle size analyses.

WP3 leader, Geological Survey of Finland (GTK), provided guidelines for national seabed substrate harmonisation and confidence evaluation in September 2017 (Kotilainen et al., 2017), which partners have then implemented individually. Harmonisation included the evaluation of the different classification schemes used in each country, classification or translation of the national seabed substrate data into a shared EMODnet classification scheme, fitting the data into a WP3 geodatabase and compilation of maps into a seabed substrate map of the European sea areas. The harmonisation process was slightly adjusted from the previous phases to make it faster and ease the data processing. During the third phase, WP3 the index information and confidence estimates were included in the actual seabed substrate attribute table and not done separately as previously. The partners were expected to provide their seabed substrate data/map in an ArcGIS/ESRI format for WP3 leader. GTK did not do any interpolation on the basis of samples or other raw data as national partners are the best experts to interpret data from their marine areas.

The aim was to deliver GIS layers of information compiled on a scale of 1: 100 000 or more detailed wherever possible. In principal, WP3 follows the guidelines for the smallest cartographic unit (SCU) set up by the MESH project (Foster-Smith, R. & al., 2007). Based on this the SCU in the printed map should be about 4 - 9 mm², meaning that within e.g., 1:100 000 data product SCU should be about 0.05 km² (5 hectares). Nevertheless, the 1:100 000 data product includes all seabed substrate data that was received from the partners at this scale. If the partners have different principles for SCU's they have not been changed. Thus, the 0.05 km² rule does not necessarily apply to all data.

During this 3rd phase the data was not adjusted into a shared coastline as previously, because the EEA coastline used in previous EMODnet projects was considered too rough for the high resolution seabed substrate data. It was agreed by all partners at the 2nd workshop of EMODnet 3 Geology in Rome on 26-28. September 2017 to use their original national coastline (of the data).

The partners were requested to deliver their high resolution seabed substrate data to WP leader by November 2017. In some cases, the data processing took longer than expected (e.g. due to digitizing) and not all data was received by the preferred date. Up-to-date 20 countries have submitted high-resolution data, 10 countries have not submitted data yet and 2 of them have informed that they do not have high-resolution data (high resolution = 1: 100 000 or more detailed). After receiving the data, WP leader, GTK, checked that it meets the criteria and combined it with other datasets.

The sediment accumulation maps of WP3 will be updated during the second year of the project.

Harmonization and combining individual maps

During the first year of EMODnet 3 Geology GTK has according to EMODnet principles harmonized all available spatial datasets that were submitted at a scale of 1:100 000 and combined them into seabed substrate maps of the seafloor (Figure 2). The EMODnet 3 Geology seabed substrate map was made available for use through the project portal on 23rd March 2018. Most likely the current version will be updated and so should not be regarded as the final output.

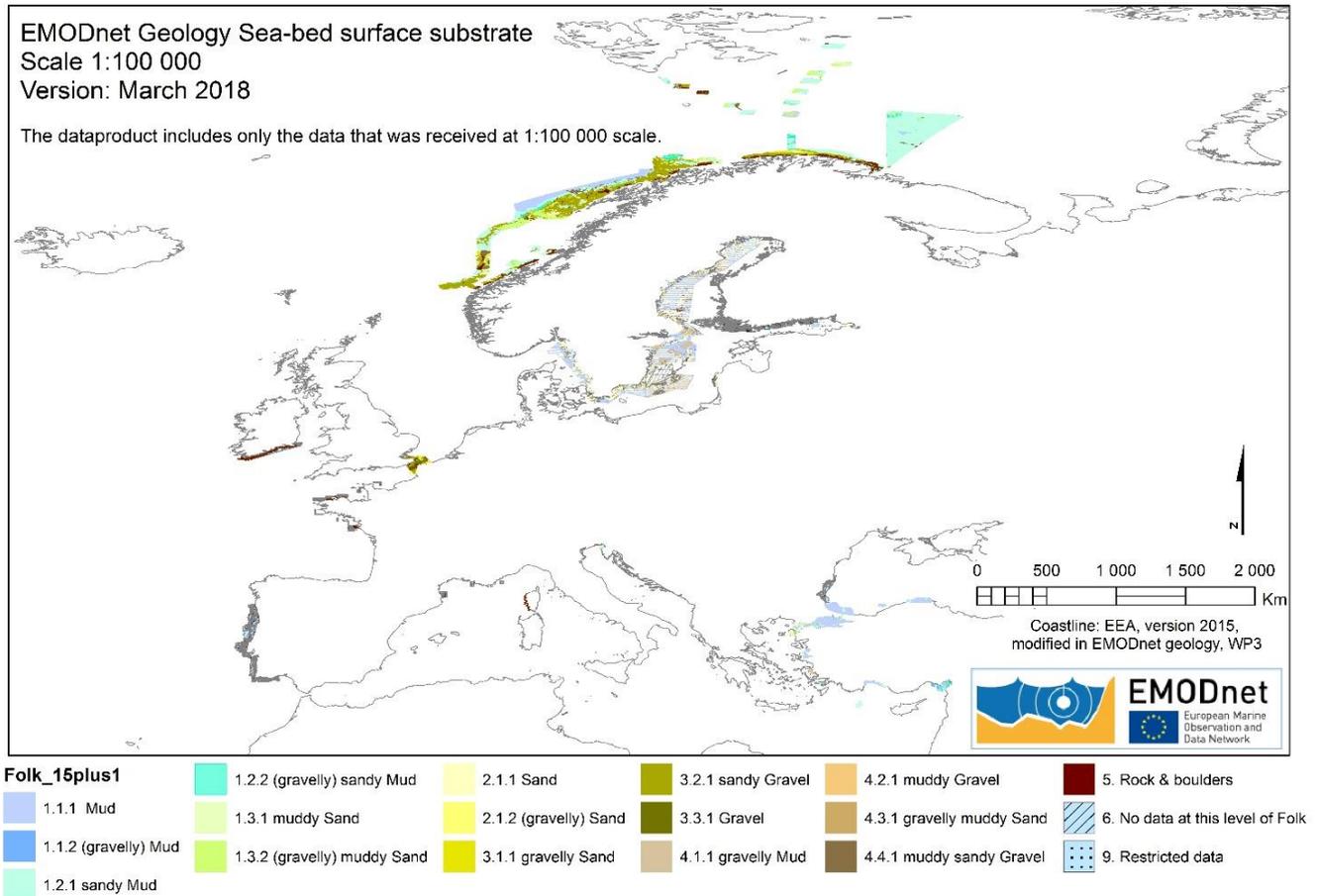


Figure 2. The EMODnet Geology sea-bed substrate information at 1:100 000 scale for the European Seas; hierarchy of 16 classes.

WP – 4. Sea-floor geology (led by Bundesanstalt für Geowissenschaften und Rohstoffe – the Federal Institute for Geosciences and Natural Resources, Germany - BGR)

Objective: To compile and harmonise all available sea-bed geology (Quaternary and sub-Quaternary) and geomorphology information at a scale of 1:100,000 or as detailed as available data allows

During the reporting period a new edition of the WP 4 Data specifications and Technical Guidelines for the project participants has been created and distributed to all participants. This includes the description of a procedure to collect, compile and harmonize in parts data according to INSPIRE standards (data model and geology classifications). The workpackage guidelines include additional vocabularies for the Quaternary geology which was developed further and new vocabularies specifically for geomorphology, the new theme for WP 4. This was developed together with the CGMW/INQUA/BGR project of the Quaternary map of Europe IQUAME2500 and contains ca. 90 terms including mud volcanos, cold seeps (an area of the ocean floor where hydrogen sulfide,

methane and other hydrocarbon-rich fluid seepage occurs, pockmarks (concave crater-like depression of the type that occurs in profusion on muddy seafloors), glacial scour marks, submarine landslides etc.. While using the new vocabulary on geomorphology in reality several suggestions for modifications have been made by the partners and are in discussion for inclusion.

The WP 4 guidelines were distributed in Summer 2017 and datasets of the pre-Quaternary, Quaternary and the new WP 4 theme Geomorphology are being collected and as far as possible semantically harmonized.

Work within three pilot areas on the three WP 4 themes Pre-Quaternary, Quaternary and Geomorphology started at a kick-off workshop which took place just before the autumn EMODnet geology meeting in Rome 2017. Within these Pilot areas a complete harmonization both semantically and geometrically is being pursued.

- Adriatic Sea (by the Adriatic Sea Group: Italy, Slovenia, Croatia, Montenegro, Albania, Greece)
- Western Baltic Sea (Denmark, Poland, Germany, Sweden)
- South-West Europe (Spain, Portugal, France)

WP – 5. Coastal behaviour (led by Geological Survey of the Netherlands - TNO)

Objective: To classify the coastal behaviour and resilience of each country represented in the project partnership at the finest scale available, using a common legend, and to provide European and transnational decision makers with harmonised geological background information. Areas of erosion, stability and accretion will be distinguished, as well as high-, moderate- and low-resilience coastal sections, with a further distinction between cliffs/bluffs, soft natural coasts and artificial coastal-protection structures. Fine-scale information (1:100,000 or higher resolution where data permit) adds relevance in areas where 1:250,000 products of the current EMODnet phase are not being used in decision making because better information is available nationally. In a corresponding pilot project by selected partners, the value of other coastal-geological parameters with potential value for decision makers, such as erodibility, geomechanical stability and sensitivity to subsidence of rock and sediment, will be tested. The primary aim is to make geoscience more visible in the Coastal Zone Management (CZM) decision-making process, from the EU to local level, and to generate ideas for the next phase of EMODnet.

In a game changer for WP5, a full-coverage analysis was produced on decadal coastline change for the period 2007-2017, using publicly available satellite data. For every 500 m along the European coastline, the position of the waterline was determined from each suitable (non-cloudy) satellite image using automated scripting. Plotted on a graph, these positions may (Figure 3) or may not show a change in time for individual profiles.

This new technique is associated with inherent limitations. The most important sources of uncertainty are a) the limited – though improving – resolution associated with the large pixel size of the images, and b) the effect of the tide, which changes the shoreline by up to hundreds of meters each day. Because many data points are available for each profile, these uncertainties commonly fall within the range of change observed over a ten-year interval.

Still, validation is required with field studies available to the consortium. To facilitate and stimulate this validation, the partners have been creating national inventories of available studies published both in English and in their national languages, provided in Excel format. Thus far, about 400 studies have been provided. In addition, an inventory of peer-reviewed scientific papers of relevance was made for all European countries. To provide a graphical, queryable overview, WP5 produces an ArcGIS shapefile and associated WMS showing the location boxes and metadata of the reported studies (Figure 3 inset (left)). About 200 studies were entered in the present reporting period.

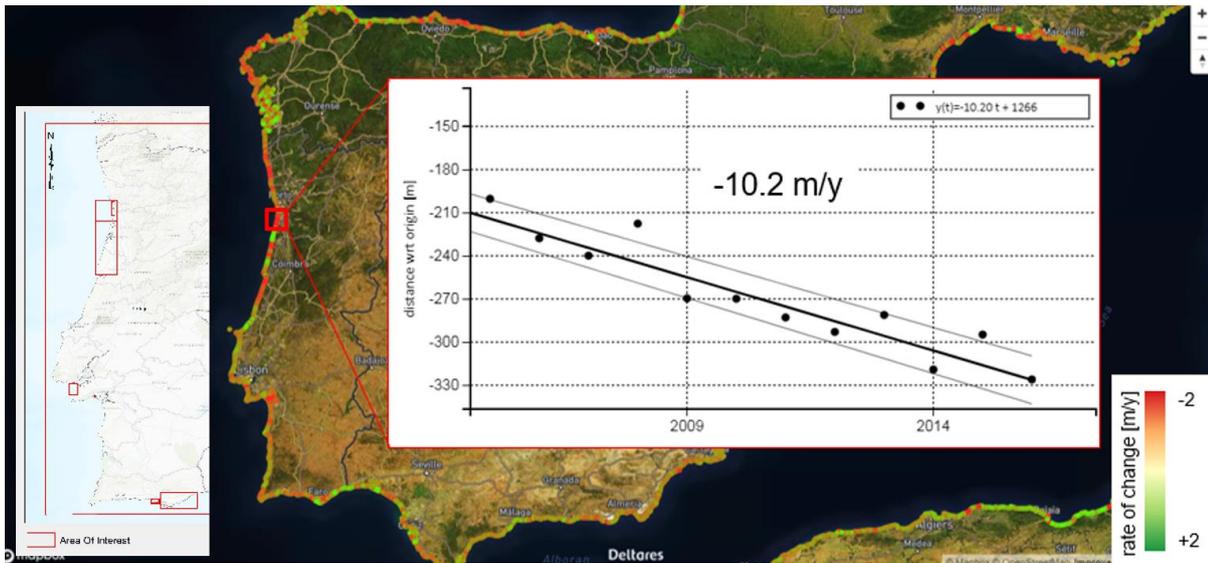


Figure 3. Satellite-based analysis of coastline change, shown for Spain, Portugal and southern France. The central inset plots this change for a location along the northern Portuguese coast. It illustrates that the inherent uncertainty due to pixel size and tidal phase does not preclude a calculation of mean annual coastline migration. The left inset, showing the availability of coastal geological studies (red rectangles) as provided by Portuguese partner IPMA, indicates that there are field studies for validating the satellite data shown in the central inset.

To add detail to the EMODnet 2 WP5 deliverable, Lithuania and France provided fine-scaled updates of their coastline-migration data products.

WP – 6. Geological events and probabilities (led by Istituto Superiore per la Protezione e la Ricerca Ambientale - ISPRA)

Objective: To identify and map the locations of all significant geological events and provide information on probabilities of occurrence where available. In order to complement comprehensive information, considering the connection of tectonics with volcanic, earthquake and tsunami hazards, the outputs will consider all faults, folds, antiforms, synforms, morphological and volcanic lineaments.

Feedback and updated data have been provided to the new Portal Manager by the WP6 lead.

Starting from the results of the previous phase, new WP6 guidelines have been adjusted to suit the needs of the higher resolution required in this phase, after testing a pilot area in Italy.

Following contacts with the EMSC (European Mediterranean Seismological Centre), it was decided to create an additional earthquakes layer within WP6, differently from what had been done during the previous phases of the Project. A shapefile format regarding earthquakes has been included in WP6 guidelines, in order to allow Partners to provide harmonized information as well as additional data, which are not reported on the EMSC website.

The new WP6 Guidelines were distributed at the end of November 2017. Since the beginning of 2018, Partners started to deliver new shapefiles. Deliveries are being examined in order to test their correspondence with the Guidelines.

The possibility to represent "geological events probabilities" is being explored. An enquiry was carried out regarding definitions of "geological events probabilities" in the literature. Partners were asked to seek for them within their mother tongue publications. The discussion led to the definition of "Probability" as "Susceptibility" in agreement with INSPIRE data specification on Natural Risk Zone. The probability of a natural hazard is defined by the concept "likelihood of occurrence" which can be expressed either quantitatively or qualitatively. In order to

model the quantitative likelihood “which is either a probability of occurrence or a return period” very detailed and complete data are needed. The qualitative likelihood (also known as susceptibility) is defined as a descriptive assessment of the likelihood of occurrence of a hazard event.

According to data available within EMODnet Geology, it was decided to adopt the definition of "Probability" as "Susceptibility". Susceptibility could be elaborated modeling the possible link among geological events occurrences and geo-morphological elements of the surrounding area. A bibliographical review of the models used to elaborate susceptibility maps has been conducted, and the MAXENT model was chosen to be tested. As a first step of the process a set of multiscale morphometric maps were elaborated starting from the DEM produced by EMODNET-Bathymetry. At present the processed morphometric maps are: slope, morphometric features (peaks, ridges, passes, channels, pits and planes), plan curvature and profile curvature. All the maps have been calculated in 6 different spatial scales. These, and other maps that are still being processed, will be used to possibly identify which morphometric characteristics might influence probability of occurrence of events, and to use such characteristics together with events occurrence locations to model susceptibility.

Connections among different WPs have been highlighted. An issue concerning events occurring along the coastline involves WP5 “Coastal behaviour”. Regarding Geomorphology, a subject which crisscrosses WP3, WP4, WP5, WP6 and WP8, it was decided to establish a working group to tackle this specific issue; the first step undertaken was to identify a vocabulary in agreement with INSPIRE and fulfilling the needs of each Partner and each WP. The approach is aimed at preventing duplication of terms and/or features across WPs.

WP – 7. Minerals (led by Geological Survey of Ireland - GSI)

Objectives:

- *gather identified marine minerals data sets;*
- *create a multi-resolution map of marine minerals with common standards and formats;*
- *distribute the data through the EMODnet-Geology portal, allowing users to find, visualise and download data; - expand on data products produced during the current phase of EMODnet-Geology representing the spatial distribution of known marine mineral occurrences of: aggregate deposits, hydrocarbon reservoirs, gas hydrate deposits, marine placer deposits, phosphorite deposits, evaporate deposits, polymetallic sulphides, polymetallic nodules and cobalt-rich ferromanganese crusts, by adding additional marine mineral types including pegmatite, deep-sea metal-rich sediment and coal;*
- *use information available to the project partners, including publicly available national reports and published scientific papers;*
- *incorporate WMS from other mineral resource data providers where necessary;*
- *report new metadata from each project partner, detailing information on the origin of data delivered;*
- *expand on the key attribution available for each mineral type and formalise subcategories where appropriate;*
- *represent each mineral type using a suitable visualisation style, adhering to the INSPIRE Directive for mineral and energy resources to allow these data to be comparable to other marine and terrestrial EC-funded projects and international data portals;*
- *aim to provide geo-located data products at a scale of 1:100,000 and associated metadata in accordance with EMODnet standards and INSPIRE Directive. Make these available as a downloadable service that incorporate a Digital Object Identifier System (DOI), to facilitate the tracking of data usage, and a Creative Commons (CC) notification that will inform end users of how data can be used and cited;*
- *aim for complete interoperability with services developed by other EMODnet thematic groups, the INSPIRE Directive and other non-EU organisations;*
- *ensure all marine mineral data downloads prepared for EMODnet-Geology will be interoperable with data distributed by non-EU organisations;*
- *produce peer-review publications and provide informative dissemination material for non-restricted download via the website, which explains: the project, the minerals workpackage, methods for the standardisation of data, established symbologies and download services, instructions for reaching the help desk and directions for users wishing to leave feedback. The material will be available for distribution and use at relevant conferences and regional seas conventions;*

- maintain close collaboration with the EMODnet Human Activities Lot regarding the crossover in subject matter that is pertinent to mineral extraction planning, policy, marine spatial planning and the coast;
- establish connection with the EMODnet Seabed Habitats and Chemistry Lots in order to develop overlap with both and establish interoperability with services;
- Develop a process to deal with user feedback. Solicit and monitor feedback.

The target for EMODnet Phase III Geology, Work Package (WP) 7 is to further develop the mapping of marine minerals, raw materials and hydrocarbons across all European seas.

For this purpose the remit of the minerals WP was expanded and now includes all 11 mineral types that occur in the marine area. A focused effort to standardise sub classifications of aggregate deposits and hydrocarbons has been made and is included in a guidance document that has been produced and disseminated to all project partners.

Following presentation of WP7, including the comprehensive framework and timeline, at the second EMODnet Geology meeting at the Sapienza University, Rome 26-28th Sept, the GSI team have been available to guide partners through submission of their data. Some partners have been in touch to query information or alert us of the usefulness of these data to third parties.

It is our understanding that the framework has been well received by all partners, questions and concerns have been minor.

The deadline for submitting partners' first iteration of data has surpassed. Data has been submitted for 10 of the 11 mineral types so far. These data are under QC and merge; they will be published as a service with new text and metadata to describe the WP, once we have received an update from all partners. This service is to be created by GEUS who are the Data Management WP leader and responsible for data administration. GEUS will add a DOI and CC license to the service.

A poster presentation of the project and the WP has been created and is available for use by all partners. It currently resides on the FTP site, with all WP7 meeting presentations, the guidance document and template shape files.

WP 7 continues to communicate EMODnet, Marine Geology, and WP7 Minerals nationally and internationally at relevant geology and marine events, meetings and conferences.

The ongoing plan for disseminating information includes: online and published news articles; a poster and peer-reviewed publication; sessions, exhibitions and presentation at national and international Earth and Ocean science fora.

WP – 8. Submerged landscapes (led by British Geological Survey - GSI)

Objective: To compile and harmonise all available information on submerged landscape features by integrating existing records of palaeoenvironmental indicators with interpretations of geomorphology, stratigraphy and type of sediment. This information will be used to reconstruct palaeogeography at various time-frames.

During the reporting year the focus has been on producing the first guidelines for the features which will be used in compiling the submerged landscape GIS. Submerged landscape features have been mapped previously, but never before has an attempt been made to characterise these as feature classes and compile these into a harmonised GIS. The submerged landscape work package is based on previous EU projects including the COST action SPLASHCOS and the FP-7 SASMAP project, and the lead WP8 team includes partners who contributed to these projects as well as to the European Marine Board SUBLAND group which produced position paper 21: "Land beneath the Waves - Submerged landscapes and sea level change" (Flemming et al., 2014).

The submerged landscape features identified as forming the GIS include landforms and deposits and palaeoenvironmental indicators developed through an appraisal of existing records such as maps, geophysical data, databases, reports, and literature. Submerged landscape features incorporated included: i) coastal (shorelines, lagoons, beaches, estuaries etc.), ii) riverine (valleys, channels, deltas, terraces etc.), iii) subaerial (aeolian, rough or flat terrains, karst, volcanic etc.) and iv) water points (groundwater discharge points, freshwater lakes etc.). Palaeoenvironmental information comprises records of flora and fauna and indicators of former sea level. Chronological information (e.g. C14) will be included as an attribute, and used to assign features to a specific palaeogeographic reconstruction. The submerged landscape and palaeoenvironmental indicators, including estimated age, will be compiled as point-source information and delivered as a fully attributed GIS layer. The varied nature of the features which form the classes provided challenges which included their various scales which ranged upward from point source to polylines and polygons. All features had to underpin the palaeogeographic reconstructions across various timeframes.

The two focussed workshops organised during the year essential in the formulation of the guidelines, with the one held in Copenhagen resulting in the methodology to be followed and the timetable and the workshop in Crete defining the feature classes.

At the Copenhagen workshop priorities in the first year (2017-2018) were considered to be:

- Identify and input archaeological data (e.g. SPLASHCOS),
- Identify what features are already in the EMODnet database (Work Package 3 – rocky areas, sediment rate, glacial features; Work Package 4 – Pre-Quaternary rocky o/c, ?Holocene, limestone karstified features; Work Package 6 – Geological events; Work Package 7 - Aggregate data),
- Countries – identify and collate data bases (as per contract),
- Identify relevant data evidencing submerged landscapes (drainage channels polygons, lines, coastlines, isoanomalies),
- Identify key areas (available data to test guidelines for landscape mapping),
- Determine GIS feature representation (point, polyline, polygon),
- Draft/test guidelines.

All were achieved.

As noted above defining submerged landscape features had never been attempted before. The case study pilot areas agreed upon in Copenhagen were important in identifying the large variation of submerged landscape features that are present beneath European Seas. One of the major realisations was just how large the subaerially exposed land area of Europe became when sea level was reduced by 120 metres. In this context, it was another challenge to identify those features which were formed when subaerially exposed from those that were formed latterly when sea level rose.

The range of evidences on which the feature classes were based, was also a challenge in defining the confidence analysis. Confidence estimates are as follows:

1. High: Sampled feature with good age and palaeoenvironmental control.
2. Sampled feature with poor or none age and palaeoenvironmental control.
3. Constructed by remote sensing data only.
4. Low: Reasonable without any direct evidence.

The feature classes agreed and defined at the Crete workshop and included in the guide with their representations, is included below.

Point Features	Cores
	Samples (other than cores)
	Age dates (e.g. C14)
	Sea level index points



	Coastal and submarine springs
	Sea level curve
	Caves
	Archaeological features: Cave site, Open air site, Settlement, Other
Polygon Features	Submerged forests
	Lakes
	Deltas
	Lagoons
	Estuaries
	Bedrock exposed at seabed (from WP3)
	Valleys and channels
	Beach deposits
	Terraces
	Wetlands
	LGM landscape/ base of the post LGM deposit
Polyline Features	Palaeocoastline/shoreline (mapped or assumed according to the confidence level) at this stage mapped, focus on LGM, but others can be submitted
	Linear Channel features: thalweg, channel margins
	Coastal Landform: Beachrock, Littoral deposit, Coastal dunes, Cliff, Sand bars, Beach ridges, Other
	Terrace edge

The next actions during the second year of EMODnet 3 are to agree the feature style guides and test the validity of the guidelines, and how representative the pilot areas actually are. These actions include:

- Confirm results of first year,
- Holocene thickness,
- Modelled inputs – coastlines,
- Confidences,
- Workshop (Istanbul) to discuss results of first phase uploads onto website,
- Finalise data input,
- Finalise harmonisation.

WP – 9. Data management, web portal and services (led by Geological Survey of Denmark and Greenland - GEUS)

Objectives:

-To maintain and further develop the EMODnet-geology portal and to make sure that all data, data products and metadata are made available in a user-friendly web environment and that the data are furthermore interoperable with other EU and well as non-EU organisations. The key components of the web portal will be;

-An interactive map with standard zooming and panning facilities on which the various data and data products can be viewed and the associated metadata can be accessed.

-A user friendly search facility to allow users to query the underlying metadata catalogue as well as a number of "data entity indices". The architecture underlying this facility will provide a fast and efficient interface to access and download data in the underlying repositories in a uniform way according to the requirements of the tender specifications.

- Procedures for machine-to-machine connections as e.g. readily available guides to the end points of the underlying web service architecture.
- Processes to monitor performance and receive user feedback.
- Access to a help desk offering user support.

The work package is focusing on streamlining existing and future data products by centralization and harmonization. To this effort, WP9 lead (GEUS) host and manage services for database (storage), CMS (web portal), Web-GIS/WFS/WMS (interactive map and services), CSW (metadata), FTP (file share). All data products from phase II are migrated to this system. Data and vocabularies are migrated to the database which in turn is made available online for direct access. All portal components access contents from the database directly. To make data products available in as many formats and environments as possible, open standard style definition (SLD) is adopted and used in the GIS engine. Vocabularies from INSPIRE and GeoSciML have been cross-checked with existing style definitions from phase II for WP4 data products and optimal results used for styling.

Another important part of WP9 is gathering borehole locations, geophysical survey tracks, and backscatter outlines to promote the availability of national data products through so-called data entity indexes. As per today, more than half the partners have delivered some kind of index contributions. These contributions are being harmonized and stored in the database to create a pan-European entity index per data type. When this work is done, a download manager will be created, where users can select their area of interest via the interactive web-map and have a custom data product download containing all available locations, tracks and outlines.

WP – 10. Dissemination (led by Geological Survey of Finland - GTK)

Objective: To ensure effective and widespread dissemination and two-way communication of the activities and outcomes achieved within the project, during and also after the EMODnet-Geology Phase 3. Dissemination will especially highlight the benefits that the project will bring to target groups cross the European Union and beyond. As EMODnet-Geology will now also cover submerged landscapes, as well as geomorphology, it will be an important new aspect in dissemination. The project and especially this work package will co-operate with the EMODnet Secretariat in its efforts to disseminate the results to stakeholders.

The outreach activities are listed in table in chapter 9.

In order to give more visibility for EMODnet in general and especially EMODnet geology we have ordered EMODnet Geology shirts with EMODnet logos and the general payoff in front of the shirt as well as on the short sleeve and with our own payoff "Discover Europe's Seafloor Geology" and the web address on the back of the shirt, see pictures below. As our outreach activities are often connected with large conference, fairs, and scientific meetings we see that the shirt is good for marketing – EMODnet, both in general and EMODnet Geology specifically.



We are planning a press-release of the outcomes of the first project year and the coordination has asked partners for highlights to be added to the text. The text will be edited at the GTK and it will be distributed to partners in May. The partners will have to translate the text and if necessary edit it according to local needs.

WP – 11. EMODnet Collaboration (led by Geological Survey of Finland - GTK)

Objective: To ensure that the EMODnet-Geology Project is fully aware and complementary to the objectives of other marine science initiatives within European waters. To prepare for better and linked marine data that will have an immediate impact on the planning of environmental policy and mitigation measures within the European Union and to facilitate impact assessments and scientific work.

The EMODnet Geology lot has actively communicated with other EMODnet lots, especially the Seabed Habitats lot, the Human Activities lot as well as the High Resolution Seabed mapping Project.

- WP 3 meeting with the Seabed Habitats lot in Athens 2 October 2018.

The regional sea conventions (RSC's) have been officially invited to all our project meetings. The RSC's had not responded to any of the invitations by end of September 2017.

A visit to HELCOM was suggested in a promotional letter "Introduction to the EMODnet geology project" - Unfortunately, this offer did not succeed. The coordination of EMODnet geology is now planning similar offers to the other RSC's.

The Barcelona Convention responded positively to the last invitation to attend our project meeting "*Even though we are very interested to participate to this event, our tight schedule does not allow it.*" We will be in contact with them, and hope that they will attend in the future. Once we have contact with them we will see what they need from us.

An analysis on interoperability with data (standards and protocols) distributed by non-EU organisations is in progress.

For the moment we are co-operating with Geoscience Australia. This issue will be discussed and further co-operation planned during the Resources for Future Generations conference (Vancouver, June 2018), where EMODnet Geology is together with Geoscience Australia sharing a session called "From Continental Shelf to Slope - Mapping the Oceanic Realm "

The main driver for this action is international collaboration between various sea-floor mapping programmes and brainstorming on a road map for future global seafloor mapping initiatives.

We see that the European approach is best tested and well running, a single standard for one continent. Thus, co-operation with similar global initiatives is important at this moment, such that global standards and protocols in acquisition and processing of seafloor data into user-friendly products can be assured.

We will also approach the ambitious Seabed 2030 project by GEBCO and Nippon Foundation in order try to add a geological component to their agenda.

WP – 12. Project analysis and sustainability (led by Geological Survey of Finland – GTK and Geological Survey of Denmark and Greenland - GEUS)

Objective: To analyse each phase of the project and to provide a report on the lessons learned.

During the kick-off meeting it was agreed upon that the objective of WP12 is to analyse each phase of the project and to provide a report of the lessons learned. This includes the analysis of the main barriers to the provision of data by data holders, the challenges related to rendering the interoperable data and the challenges related to producing contiguous data over the maritime basins. A plan to overcome these barriers and proposals of steps that can be improved will be provided in co-operation with other WPs.

This workpackage is scheduled for months 22-24, at this moment we record important issues of concern and they will be collected by month 22.

To ensure the sustainability of the EMODnet Geology project, EGDI provides an appropriate platform for developing a long-term infrastructure. Full assessment of project implementation and recommendations for future steps provide an outcome that can assist the EC in developing its maritime strategy.

7 User Feedback

Date	Name	Organization	Type of user feedback (e.g. technical, case study etc.)	Response time
11.07.2017	*****	*****	Support: "Problems with access to seabed substrate data"	Resolved by GTK immediately
23.08.2017	*****	*****	Question: "Acknowledgement/citation of EMODnet geology project"	GTK answered immediately
31.08.2017	*****	*****	Question: "EUNIS sensitivity"	Forwarded to EMODnet Biology
29.9.2017	*****	*****	WP 4 EMODnet Habitat lot : Interest in WP 4 Geology Lot, geomorphology – Offer to provide list of attributes of interest	A week-end
31.10.2017	*****	*****	Support: Problems with access to seabed substrate data	Corrected within 24 hrs
14.11.2017	*****	*****	Typo error on the portal	Corrected within 7 min
12.12.2017	*****	*****	Support: Problem accessing seabed substrate data via WMS in QGIS	Corrected within 25 hrs
26.01.2018	*****	*****	Problem opening Substrate map in ArcGIS (version info missing in the zip)	Solved within 72h/GTK
31.01.2018	*****	*****	Requesting Substrate Classification info	Solved within 24h/GTK
01.02.2018	*****	*****	Found problems with legends and metadata descriptions	Solved within 48h GTK+GEUS+ISPRA
05.02.2018	*****	*****	Looking for download link to sediment acc. rates	GEUS missed this in the mailbox. Solved on 10.04.2018
13.02.2018	*****	*****	Requesting Substrate Classification info	Solved within 24h/GTK
01.03.2018	*****	*****	How to open Substrate map in non-ArcGIS software	Answered within 48h. /GTK

Following presentation at the international AGU Fall Meeting 2017, researchers from China, Korea, Australia and America expressed interest in the EMODnet Geology project and specifically the WP7 Minerals framework. They are to investigate the associated web links further.



8 Meetings held/attended since last report

List here the internal and external meetings held/participated by the contractor since the last report. Please add short description on the meeting as well as the nature and volume of the audience.

Date	Location	Title	Internal/External + Short Description
29. May 2017	EMODnet geology Steering Group meeting in Espoo, Finland	Project kick-off	All WP leaders were present at the kick-off meeting in planning the project kick-off
30-31. May 2017	EMODnet geology project kick-off meeting in Espoo, Finland	Project kick-off	Project coordination and all WP leaders introduced all consortium partners to the Service contract and project actions
26-28. June 2017	EMODnet Geology III WP8 Submerged landscape meeting in Copenhagen, Denmark	Discussion of the features to be included in the new WP and interactions with other WPs. This is a new topic which needs proper planning.	Participation by WP8 partners and WP3,4,6, and 8 leads. EMODnet geology coordination was represented by WP3 member ***** (GTK)
4-7. July 2017	EMODnet Technical Working group meeting in Genoa, Italy	Technical issues	The EMODnet geology coordination was represented by ***** (GTK) and EMODnet geology lot by technical coordinator *****
10-12. April 2017	EMODnet Data Ingestion Workshop in Limassol, Cyprus	Workshop	Participation in the meeting both as EMODnet Data Ingestion partner and as member in EMODnet 3 Geology lot
13-15. September 2017	Spazio Europa, Rome	EMODnet 8th Steering Committee meeting	Steering Committee meeting
25. September 2017	Sapienza University, Rome	WP4 workshop	Geomorphology harmonization issues and plans for next 6 months
26-28. September 2017	Sapienza University, Rome	EMODnet Geology, second project meeting	Project meeting discussing progress and future actions
27. September	Sapienza University, Rome	WP8 workshop	Workshop on submerged landscapes issues and plans for next 6 months
27. September	Sapienza University, Rome	Adriatic subgroup meeting	Editing of a harmonized map of solid geology for the Adriatic Sea

2 October 2017	SHOM, Athens	EMODnet Seabed Habitats – EMODnet Geology, co-operation between lots	EMODnet Geology coordinator and WP3 Leaders (GTK) participated in this co-operation workshop
27 October 2017	Rome	Meeting of the Italian Research Group contributing to EMODnet Geology (ISPRA, ENEA, ISMAR, OGS, Universities of Palermo, RomaTRE and Trieste)	Discussion on the next steps to be undertaken in order to provide data at the resolution required by the new phase of the Project, particularly regarding WP6.
06 November 2017	Skype	WP9 strategy and coordination, between partners GEUS and GeoZS.	Strategy and coordination of WP9 activities.
23 November 2017	SYKE, Helsinki	EMODnet Broad scale habitats.	Finnish/National meeting discussing EMODnet Broad scale habitats and HELCOM Hub classification
11-15. December 2017	AGU 2017 Fall Meeting, New Orleans, LA, USA	Geological events in submerged areas: attributes and standards in the EMODnet Geology Project Marine minerals	Presentation of the criteria and methods applied in the compilation of WP6 Information on EMODnet Geology & WP7 marine minerals
31. January - 1st February 2018	Iraklion, Crete	Meeting of WP8	Successful completion and agreement of the draft guidelines for WP8
12-16. February 2018	Ocean Science Meeting, Portland, Oregon, USA.	Seabed Mapping Data Translated into Standardised Marine Minerals Maps for Europe.	Poster on the WP7 Marine Minerals Maps of Europe. Available via the EMODnet Geology web FTP
22-23. February 2018	External meeting attended: CGMW General Assembly, Paris (UNESCO)	Cross-boundary Geological Mapping	The General Assembly of the Commission of the Geological Map of the world takes place bi-annually. Crossboundary mapping projects worldwide are being introduced and discussed. WP 4 leader gave a presentation and displayed a poster of the cross-boundary marine mapping of EMODnet.
26 March 2018	Budva, Montenegro	Meeting of the Adriatic Group of EMODnet	Discussion on the data available for the Adriatic pre-Pliocene geological map



9 Outreach and communication activities

Please list all the relevant communications activities or products you have developed/executed during this period (including presentations, lectures, trainings, demonstrations and development of communication materials such as brochures, videos, etc.).

Relevant scientific and/or popular articles you know have been published using/referring to EMODnet must also be reported here.

Date	Media	Title	Short description and/or link to the activity
Date	<i>Media</i>	<i>Title</i>	<i>Short description and/or link to the activity</i>
20-21. April 2017	<i>GEO, Workshop, Florence, Italy</i>	<i>GEO (Group on Earth Observations) data providers</i>	<i>Opportunity for EMODnet Geology to contribute marine geology data to GEO</i>
04. May 2017	<i>GeoHab 2017, Halifax, Canada</i>	<i>Henry Vallius and EMODnet Geology partners: Multi-scale harmonized geological maps of the European seas–3rd phase of the EMODNET-geology project</i>	<i>Presentation of the new phase of the EMODnet geology project to the GeoHab community</i>
03. May 2017	<i>GeoHab 2017, Halifax, Canada</i>	<i>Anu Kaskela and Aarno Kotilainen: Seabed geodiversity of the Baltic Sea</i>	<i>Case study from a regional sea (the Baltic Sea) on seabed geodiversity</i>
14. June 2017	<i>Baltic Sea Science Congress 2017, Rostock, Germany</i>	<i>Anu Kaskela and Aarno Kotilainen: Quantifying seabed geodiversity of the Baltic Sea</i>	<i>Case study from a regional sea (the Baltic Sea) on quantification of seabed geodiversity. Plenary lecture</i>
10-12. May 2017	<i>Congress of the Italian Association of Cartography (AIC), Genoa, Italy</i>	<i>Italian Geological Mapping of submerged areas and its contribution to EMODnet - European Marine Observation and Data Network</i>	<i>Presentation of the Italian Geological Mapping Project (CARG) and the products obtained from its elaboration and delivered within EMODnet Geology</i>
22-23. May 2017	<i>6th Annual Deep Sea Mining Summit, London, UK</i>	<i>WP7 at ADSMS</i>	<i>EMODnet, marine geology and minerals specifically.</i>
29. June 2017	<i>Digital Ocean, Galway, Ireland</i>		<i>Publicising EMODnet, EMODnet Geology and the Minerals WP through brochures, pull-up banners and discussion.</i>
30. June 2017	<i>Harnessing Our Ocean Wealth, Galway, Ireland</i>		<i>"</i>



29. September 2017	<i>EuroGeoSurveys , Marine Geology Expert Group Annual Meeting</i>	<i>A. Kotilainen: EMODnet Geology</i>	<i>Presentation of EMODnet geology to the network</i>
29. September 2017	<i>A short article in the BGR Newsletter (4/2017) announcing that BGR is participating in the EMODnet project</i>	<i>Geoinformationen: Teilnehmer Arbeitspaket EU-Projekt zu Meeresdaten</i>	<i>https://www.bgr.bund.de/SharedDocs/Newsletter/DE/2017/newsletter-2017-04.html?view=renderNewsletterHtml&nn=1544598</i>
4-6. September 2017	<i>Italian Volcanology Association Congress Pisa, Italy.</i>	<i>Geosciences: a tool in a changing world.</i>	<i>Map of submerged volcanic structures in Italy Presentation of EMODnet Geology products at the Italian Volcanology Association Congress</i>
29. September 2017	<i>European Researchers Night</i>	<i>Relief model of submerged volcanic structures in Italy</i>	<i>European dissemination project: research meets society</i>
12-15. September 2017	<i>RAO/CIS Offshore 2017, St. Petersburg</i>	<i>"Role of EMODnet"</i>	<i>Round table in the frame of 13-th International Conference and Exhibition on Oil and Gas Recourses Exploration in Russian Arctic and continental Shelf of CIS</i>
24-29. September 2017	<i>46th Underwater Mining Conference, Berlin, Germany</i>	<i>First map and catalogue of submarine mineral deposits from Spain: EMODnet-Geology project</i>	<i>Economical, Technological and Environmental Aspects: Cooperative Solutions for Future Deep-sea Mining UMC 2017 · Federation of German Industries (BDI)</i>
8-17. September 2017	<i>82nd Thessaloniki International Fair</i>	<i>"IGME: The Hellenic state's advisor on geoscientific issues"</i>	<i>Presentation of EMODnet as a part of a slideshow in Greek at the International exhibition</i>
09 October 2017	<i>Gulf of Finland Trilateral Forum, Tallinn, Estonia</i>	<i>EMODnet Geology - geological data from the European marine areas</i>	<i>Presentation by Kaskela, A. et. al.</i>
30. November 2017	<i>Gulf of Finland Trilateral (Russia – Estonia – Finland) Expert Group Meeting, Helsinki, Finland</i>	<i>Experiences of data harmonization and seabed substrate data harmonization process in the EMODnet Geology project</i>	<i>Presentation by Kotilainen, A. et. al.</i>
07. November 2017	<i>Geoscience 2017, Dublin, Ireland</i>	<i>'What geoscience is worth to you'</i>	<i>Information on the EMODnet Geology project & WP7 minerals</i>

15-16. November 2017	<i>INFOMAR Seminar, Cork, Ireland</i>	<i>The Irish National Seabed Mapping Programme</i>	<i>Information on the EMODnet Geology project & WP7 minerals</i>
16. November 2017	<i>EMSAGG Workshop, Cork, Ireland</i>	<i>European Marine Sand and Gravel Group (EMSAGG) Work Shop</i>	<i>Presentation of the EMODnet Geology project & WP7 minerals</i>
30 November 2017	<i>Gulf of Finland Trilateral (Russia – Estonia – Finland) Expert Group Meeting, Helsinki, Finland</i>	<i>Need for data harmonization in multinational marine areas. Experiences from the harmonization within geology (EMODnet, TOPCONS, Balance)</i>	<i>Presentation by Kotilainen, A., Kaskela, A., and Alanen, U.</i>
8-9. December 2017	<i>USGS-ISPRA bilateral meeting, Lafayette, LA - USA</i>	<i>Coastal change and events probabilities</i>	<i>Activities carried out by ISPRA concerning coastal changes within WP5 and WP6</i>
11-15. December 2017	<i>AGU 2017 Fall Meeting, New Orleans, LA, USA</i>	<i>Geological events in submerged areas: attributes and standards in the EMODnet Geology Project Marine minerals</i>	<i>Presentation of the criteria and methods applied in the compilation of WP6 Information on EMODnet Geology & WP7 marine minerals</i>
12-16. February 2018	<i>Ocean Science Meeting, Portland, Oregon, USA.</i>	<i>Seabed Mapping Data Translated into Standardised Marine Minerals Maps for Europe.</i>	<i>Poster on the WP7 Marine Minerals Maps of Europe. Available via the EMODnet Geology web FTP</i>
22.-23. February 2018	<i>External meeting attended: CGMW General Assembly, Paris (UNESCO)</i>	<i>Cross-boundary Geological Mapping</i>	<i>The General Assembly of the Commission of the Geological Map of the world takes place bi-annually. Crossboundary mapping projects worldwide are being introduced and discussed. WP 4 leader gave a presentation and displayed a poster of the cross-boundary marine mapping of EMODnet.</i>
21. March 2018	<i>NCK Days 2018, Haarlem, Netherlands</i>	<i>DINOloket, EMODnet and OpenEarth</i>	<i>Sprint session led by YY and XX (***) and WW (*****)</i>
21. March 2018	<i>NCK Days 2018, Haarlem, Netherlands</i>	<i>A new generation of marine geological maps in the Netherlands</i>	<i>Poster by XX et al.</i>

Scientific dissemination: Kaskela, Anu. 2017. Seabed landscapes of the Baltic Sea: Geological characterization of the seabed environment with spatial analysis techniques. PhD thesis, University of Helsinki.

EMODnet 3 Geology WP3 product, seabed substrate map/data product was used in a scientific study that was published online in Geomorphology Journal in July 2017, and in a research report that was published online in March 2018:

Kaskela & Kotilainen, 2017. Seabed geodiversity in a glaciated shelf area, the Baltic Sea. Geomorphology 295, 419–435.

Kaskela, A. & Rinne, H. 2018. Vedenalaisten Natura-luontotyypin mallinnus Suomen merialueella (In Finnish). Geologian tutkimuskeskus, Tutkimustyöraportti 6/2018.



10 Updates on Progress Indicators

Using the indicator as a header list the metrics collated and the time interval. If there was no activity to report leave the section under the indicator header blank. Please note that this list can be subject to revision.

Indicator 1 - Volume of data made available through the portal

- Seabed Substrates: Four layers totalling 106.499 features.
Seabed substrate datasets (1 m & 250 k) from previous phases of EMODnet Geology are available through new/updated EMODnet II Geology portal
- Sea-floor Geology: One layer (four variations) totalling 7.754 features
- Coastal behaviour: Two layers totalling 137.679 features
- Events & Probabilities: 12 layers totalling 10.155 features
- Mineral occurrences: 14 layers totalling 12.199 features

No change since Sept 2017

Indicator 2 - Organisations supplying each type of data broken down into country and organisation type (e.g. government, industry, science)

In the EMODnet Geology technical tender (chapter 5) members of the consortium have listed all the primary data, which is been made available for the EMODnet project according to the signed contract. The table was, updated during the three first months of the project. Additionally one of the six members of the consortium, that are not data suppliers to the EMODnet project, but will work on interpretations of coastal and marine data, mainly the submerged landscapes topic, has made available marine data for EMODnet - geology. In practice the European geological survey organisations (project partners) are in most cases administrators of the national geo data centres, so very few data are to be found outside the consortium. Those external sources, which might have additional data, are encouraged to submit their data through the EMODnet Data Ingestion portal or straight to EMODnet geology lot. Additionally the EMODnet Geology consortium has now drafted a stakeholder questionnaire on possible data delivery to EMODnet geology as well as possible usage of EMODnet geology data products on web. This questionnaire will be distributed by consortium partners to all participating countries. Stakeholders are asked to respond to the coordinator who (GTK, Finland) who collects and analyses the obtained information.

Indicator 3 - Organisations that have been approached to supply data with no result

- SeaDataNet has expressed willingness to give WFS access to their borehole and geophysics indexes but until now has only granted point search access via WMS requests. Reason unknown. Pending.
- In June talks, EMODnet Human Activities expressed willingness to harvest more attributes for their hydrocarbon boreholes (e.g. link to contact/download). A new harvesting is pending.

Indicator 4 - Volume of each type of data and of each data product downloaded from the portal

Download since early September when the portal started download registration.

- Seabed Substrates: 15,168 MB

- Sea-floor Geology: 1,547 MB
- Coastal behaviour: 1,195 MB
- Events & Probabilities: 1,254 MB
- Mineral occurrences: 266 MB

Indicator 5 - Organisations that have downloaded each data type

We have had altogether 219 downloads from different users (listed below). We started distinguishing between Academia/Research-Government/Public-Business and Privat Company-Others after the 9th EMODnet Steering Committee meeting. After that we have had; 10 Academia/Research, 7 Business and Private company, 4 Government/Public administration and 7 Others.

No specified data is possible to show due to the GDPR directive.

The mostly downloaded product is the Substrate 250k (71 downloads)

Indicator 6 - User statistics to determine the main pages utilised and identify user navigation routes

Period: 2017.09.27 – 2018.04.10

- 3,046 visits
- 3min 37s average visit duration
- 32% left the website after one page
- 3.8 actions (page views, downloads, outlinks and internal site searches) per visit
- 9,871 pageviews 7,231 unique pageviews
- Referrer types: 1,080 websites, 651 search engines

From above we can conclude that users on average click 4 times on the portal before leaving again. We can assume they find the relevant content within four clicks, but to know for sure we would have to do user interviews.

Indicator 7 - List of what the downloaded data has been used for

We activated a comment possibility to the download form mid-November. Since then, about 30% leave the field blank. 40% state academic/educational or research, about 10% from the private sector and the final 20% are stated word-by-word in Indicator 5. Data has been reported to be used for instance for:

- Substrate info for Finnish navigational charts
- Off-shore wind farm development by several different users
- Commercial use (chart plotter)
- Habitat mapping
- Cetacean study, fisheries studies
- Academic Research
- Publication
- Academic dissertations, PhD studies
- Studies for MSFP, MPA

Indicator 8 - List of web-services made available and organisations connected through these

We extended capabilities with WFS access. These services are yet not published to the broader public but were used for an educational “hackathon” with success.

Indicator 11 - Relevant scientific and/or popular articles using /referring to EMODnet

Kaskela, A., 2017. Seabed Landscapes of the Baltic Sea: Geological characterization of the seabed environment with spatial analysis techniques. Academic dissertation, Department of Geosciences and Geography, University of Helsinki. Geological Survey of Finland. 42 p.

EMODnet 3 Geology WP3 product, seabed substrate map/data product was used in a scientific study that was published online in *Geomorphology Journal* in July 2017, and in a research report that was published online in March 2018:

Kaskela & Kotilainen, 2017. Seabed geodiversity in a glaciated shelf area, the Baltic Sea. *Geomorphology* 295, 419–435.

Kaskela, A. & Rinne, H. 2018. Vedenalaisten Natura-luontotyyppien mallinnus Suomen

merialueella (In Finnish). Geologian tutkimuskeskus, Tutkimustyöraportti 6/2018.



11 Recommendations for follow-up actions by the EU

Please, give a list of recommendations and suggestions for the EU to consider and take action.

[Max 1 page]

The EMODnet Geology consortium has earlier submitted the recommendation below, we wish to resubmit the same recommendation.

Sediment dynamics and seabed sediment geochemistry

Sediment dynamics are an important driver of many physical, chemical and biological processes, and the distributing agent of chemical substances and biological organisms. Key to understanding the associated environmental effects is to understand sediment sources, transfer and storage. Pan-European mapping of large-scale sediment transport pathways and regional sediment fluxes requires the combination of geological, sediment and geomorphological data with hydrodynamics and hydrology. Data products from EMODnet-Geology, EMODnet-Bathymetry and EMODnet-Physics, produced in the current phase, are highly useful to map source and sink areas. Seabed-sediment patterns and gradients (Geology) reflect the major erosional and depositional sedimentary systems resulting from the current-derived (Physics) regional sediment transport pathways. Where quantitative grain-size data are available they can be combined with current data to provide estimates of seabed mobility. In areas with abundant sand, net sand transport can also be derived from the asymmetries and dynamics of bedforms (Bathymetry). Finally, sediment fluxes and budgets are available from the literature. A pan-European source-to-sink approach is important to understand the sediment budgets in a supraregional framework, and thus to predict transnational sedimentation and erosion patterns affecting habitats and food chains.

The EMODnet-Geology partners have for several decades gathered a considerable amount of sea-floor sediment chemistry data. For example, in the UK more than 9,000 seabed samples have been analysed for up to 38 metals and have been published on the BGS website (see <http://www.bgs.ac.uk/discoverymetadata/13605645.html>). Although the EMODnet-Chemistry Lot has been made aware of the data, there is a need to provide sea-floor sediment geochemistry interpreted information to the EMODnet portal. The EMODnet-Geology consortium proposes that such data and interpretations could be the subject of a joint Case Study between the Geology and Chemistry lots. This data has traditionally been produced by geologists and the EMODnet-Geology partners therefore have a good understanding of what is required to prepare this data for EMODnet. Such data is of high value in many marine activities and in marine spatial planning, which is also important when considering implementation of the Maritime Spatial Planning Directive (2014/89/EU).

12 Annex: Tasks specified in Section 1.4.1.

Progress of each of the tasks specified in Section 1.4.1., of the Tender Specifications

Task 1: Develop a common method of access to data held in repositories:

In corporation with other EU projects (EGDI, EPOS, ProSUM), we develop and implement a common method of access to data held in locally distributed repositories. In EMODnet Geology, we are in the data discovery phase, where 28 partners have been asked to share descriptions (metadata) and spatial location of true ground samples and geophysical surveys. We now have 12 of 19 borehole indexes delivered, harvested and merged into a first simple pan-European entity index viewable on the portal web map. We are currently creating similar indexes for geophysics (13 of 24 partners delivered) and backscatter (one or two partners can deliver). We are in dialogue with data managers in the EGDI, EPOS, and ProSUM to decide the best approach to have these data sets harmonized and make them seamlessly downloadable to users on request.

Task 2: Construct products from one or more data sources that provide users with information about the distribution of parameters in time and space:

To allow users access more geological relevant data sets from within the portal, we added new external data sources to the map viewer under paragraph "Other Portals"; EMODnet Bathymetry, Geo-Seas, and Seismic Portal. Now, users can select between all free data layers available in these data sources.

Task 3: Develop procedures for machine-to-machine connections to data and data products:

All data products are listed on the "Products" page with links and examples to web services, data download and online Web-GIS. These options are by identified use-cases selected to be the most efficient way in helping users access our products and services, whether it is desktop GIS software, handheld devices, large-scale data projects or casual data browsing.

We are making our data products cover even more use-cases by allowing registered users online access to a read-only database (PostgreSQL). This approach is to our knowledge without precedent but could for some users prove to be a highly efficient way to access and integrate EMODnet Geology data into their existing environment.

Regarding metadata, we have a running service (GeoNetwork) enrolled into nightly harvesting by EMODnet main portal and EGDI MICKA. This way, users browsing both EMODnet main portal and EGDI will easily discover our data products.

Task 4: Develop a web portal allowing users to find, visualise and download data:

The web portal was constructed and up and running during the first three months of the project. We are continuously extending the functionality and usability of the portal. Data products are now well described and made easily available for both download, online map view, and as web services. On request, we can even offer users access to a PostgreSQL database where all data are available for SQL analysis. Most recently, we upgraded the layout and styling to align with the other EMODnet portals.

Task 5: Ensure the involvement of regional sea conventions:

The three regional sea conventions (RSC's) have been officially invited to our three project meetings. The RSC's had not responded to the invitations by end of October 2017, and the EMODnet geology decided to pay a visit to HELCOM. Thus, a promotional letter "Introduction to the EMODnet geology project" was sent to HELCOM secretariat on November 27th with an offer of visit such that EMODnet Geology could be presented to the HELCOM secretariat at their office. Unfortunately, this offer did not succeed. The coordination of EMODnet geology is now considering similar offers to the other RSC's. A visit to any interested RSC will be on the list for the first quarter of the second year. Finally the Barcelona Convention responded positively to the last invitation to attend our project meeting in Budva in the end of March "*Even though we are very interested to participate to this event, our tight schedule does not allow it.*" The coordination of EMODnet Geology will now be in contact with them, and hope that they will attend in the future, or we will pay a visit to their secretariat. Once we have contact with them we will see what they need from us.

Task 6: Facilitate interoperability with data distributed by non-EU organisations:

An analysis on interoperability with data (standards and protocols) distributed by non-EU organisations is in progress. Now, we are co-operating with Geoscience Australia, and this issue will be discussed and further co-operation planned during the Resources for Future Generations conference, which will be held in Vancouver in June 2018. EMODnet Geology Consortium is together with Geoscience Australia having a session called "Marine Geoscience and Geospatial Data Crossing Borders" The main driver for this action is international collaboration between various sea-floor mapping programmes and brainstorming on a road map for future global seafloor mapping initiatives. We see that the European approach is best tested and well running, a single standard for one continent. Thus, co-operation with similar global initiatives is important at this moment, such that global standards and protocols in acquisition and processing of seafloor data into user-friendly products can be assured. For the same reason we will also approach the ambitious Seabed 2030 project by GEBCO and Nippon Foundation in order try to add a geological component to their agenda.

Partners of the EMODnet Geology consortium are participating in the Atlantic Seabed Mapping pilot, initiated by the Atlantic Seabed Mapping International Working Group (ASMIWG), which was established by the Trilateral Galway Statement Implementation Committee.

EMODnet Geology initiatives, methods and products have been presented at various international fora, such as the American Geophysical Union Fall Meeting (for a comprehensive list see paragraph 6. Outreach and communication activities), where good acceptance was gained from researchers from China, Korea, Australia and America, and future cooperation was discussed.

Task 7: Install a process to monitor performance and deal with user feedback:

We are now linked to a monitoring system hosted by the main portal (Piwik). Here we can login and extract performance and user statistics. The portal offer users the possibility to write feedback. We receive a few each month and answer within 1-2 working days in case of questions. We participate in all statistical initiatives put forward by the EMODnet Secretariat and Steering Committee.

Task 8: Operate a help desk offering support to users:

We continuously run our help desk according to rules set in the Tender Specifications. We receive on average four support questions per month which are handled within 1-2 working days.

13 List of abbreviations and acronyms

AGU – American Geophysical Union

CGMW – Commission for the Geological Map of the World

CC – Creative Commons

CSW – Catalog Service for Web, allows CSW clients to retrieve service metadata from a server

DOI – Digital Object Identifier

EEA – European Environment Agency

EGDI – European Geological Data Infrastructure

EGDI MICKA – European Geological Data Infrastructure MICKA metadata catalogue

EMSC – European-Mediterranean Seismological Centre

EPOS – The European Plate Observing System, EMODnet Geology adopts the methodology used in EPOS for sharing and serving borehole entity indexes

EuroGeoSurveys – The Geological Surveys of Europe

FTP – File transfer protocol

GeoSciML – Geoscience Markup Language

GIS – Geographical Information System

INQUA – International Union for Quaternary Research

IQUAME2500 – Internationale Quartärkarte von Europa 1:2.500.000 - International Quaternary Map of Europe 1:2,500,000

MAXENT – Maximum Entropy Modelling

MESH – Mapping European Seabed Habitats

MeshAtlantic – Mapping European Seabed Habitats of the Atlantic Ocean

OGC – Open Geospatial Consortium

Piwik (now Matomo) – tracks online visits to one or more websites and displays reports on these visits for analysis.

PostgreSQL – object-relational database management system with an emphasis on extensibility and standards compliance

ProSUM – Prospecting Secondary raw materials from the Urban Mine and Mining waste - ProSUM project

RSC's – Regional Sea Conventions (HELCOM, OSPAR...)

SASMAP – Survey, Assess, Stabilise, Monitor And Preserve underwater archaeological sites (SASMAP) was a three year project (2012-2015) funded by the EU FP7 framework and involved 11 partners from seven European countries.

SCU – Smallest cartographic unit

SLD – Styled Layer Descriptor

SPLASHCOS – COST action Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf

SQL – Structured Query Language

SUBLAND – WG SUBLAND of the European Marine Board

Web-GIS – a pattern, or architectural approach, for implementing a modern GIS. It's powered by web services—standard services that deliver data and capabilities, and connect components.

WFS – Web Feature Service

WMS – Web Map Service