

## CLAY TECTONICS PROJECT – DELIVERABLES

### ***D5.2 Report on the geophysical data system***

---

Jelle Rondelez<sup>1</sup>; Stijn Vermaere<sup>1</sup>; Thomas Mestdagh<sup>1</sup>; Hans Pirlet<sup>1</sup>

<sup>1</sup> Flanders Marine Institute (VLIZ), Jacobsenstraat 1, 8400 Oostende, Belgium

#### **1. Introduction**

The Clay Tectonics project (2023-2025) is a cSBO-project funded by Flanders Innovation and Entrepreneurship (VLAIO) through the Blue Cluster (DBC). The project aims to investigate the influence of clay tectonic features (CTFs) within the Kortrijk Formation on offshore wind foundation design and installation in the Belgian Part of the North Sea (BPNS). The project partners (VLIZ, UGent, VUB - OWI-Lab) will apply a multidisciplinary strategy, combining geophysical, geological and geotechnical methods.

The scope of the fifth work package (WP5 – Data management) is to support the research and valorization tasks by establishing a data system capable of capturing the collected geophysical datasets with the necessary metadata. This work package is supported by the data management plan (D5.1), which was created at the start of the project. FAIR principles will be applied as much as possible, in order to easily disclose the data to all potential end users. These principles, explained in the article '[FAIR Guiding Principles for scientific data management and stewardship](#)' published in 2016, provide guidance for the findability, accessibility, interoperability, and reusability of digital assets. More information on the FAIR principles can be found on the official [website](#).

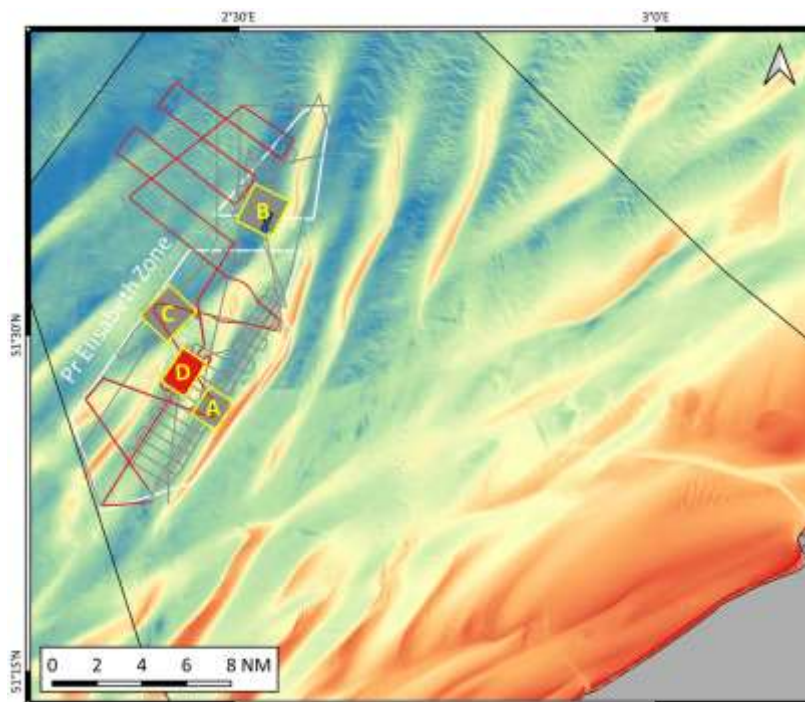
The goal of this deliverable (D5.2) is to describe how the geophysical datasets, generated within the context of this project, were stored within the data systems of VLIZ. Additionally the report also describes the future actions that will ensure that these datasets can be adequately and openly published for stakeholders.

#### **2. Geophysical dataset generated in Clay Tectonics**

Geophysical data used within the Clay Tectonics project was acquired during multiple survey campaigns on the Belgian Part of the North Sea. Most of these were campaigns conducted fully within the scope of the project, although some relevant datasets were also obtained during surveys financed by other projects. Overall, the following geophysical surveys generated data for the Clay Tectonics project:

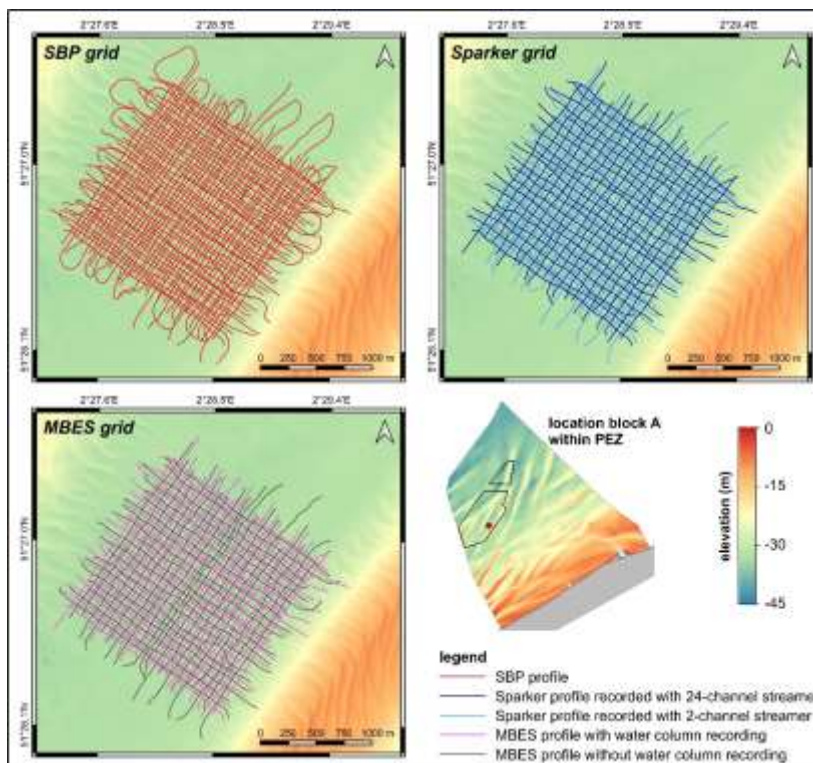
- RV Simon Stevin Cruise 23-120 (<https://www.vliz.be/vmdcdata/midas/cruises/2329>)
- RV Simon Stevin Cruise 23-300 (<https://www.vliz.be/vmdcdata/midas/cruises/2351>)
- RV Simon Stevin Cruise 24-270 (<https://www.vliz.be/vmdcdata/midas/cruises/2448>)
- RV Belgica Cruise 2023-23 (<https://odnature.naturalsciences.be/belgica/nl/campaign/1996>)
- RV Belgica Cruise 2022-30 (<https://odnature.naturalsciences.be/belgica/nl/campaign/1947>)

The majority of the obtained geophysical data is combined into four densely spaced survey grids, situated within four distinct study areas in the Pr. Elisabeth Zone, designated A to D:



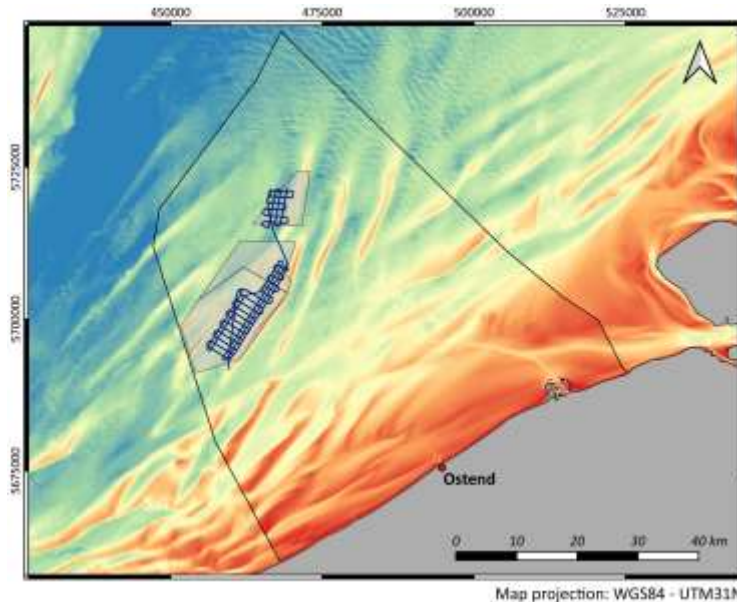
**Figure 1.** The regions of the Pr. Elisabeth Zone where geophysical campaigns were conducted.

In each of these regions, geophysical exploration was conducted with both a GSO360 multi-tip sparker source, using both single- and multi-channel streamers, and an Innomar Quattro parametric sub-bottom profiler (SBP). Additionally, a multibeam grid was acquired for each of the survey areas using a hull-mounted Kongsberg EM2040 installation.



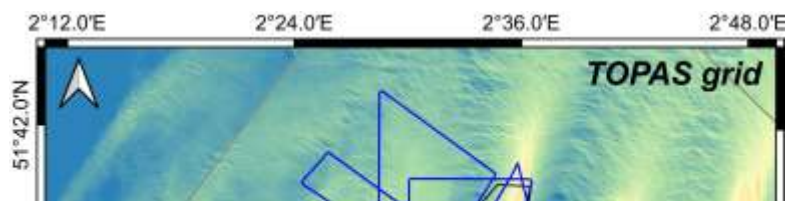
**Figure 2.** Example of region A where sub-bottom profiler (SBP), sparker and multibeam (MBES) grids were acquired over the course of the project.

Aside from these densely spaced grids, regional datasets were also obtained to explore and correlate the findings on a larger regional scale. During the RV Belgica survey 2022-30, TOPAS data was acquired to explore the larger area of the Pr. Elisabeth zone:

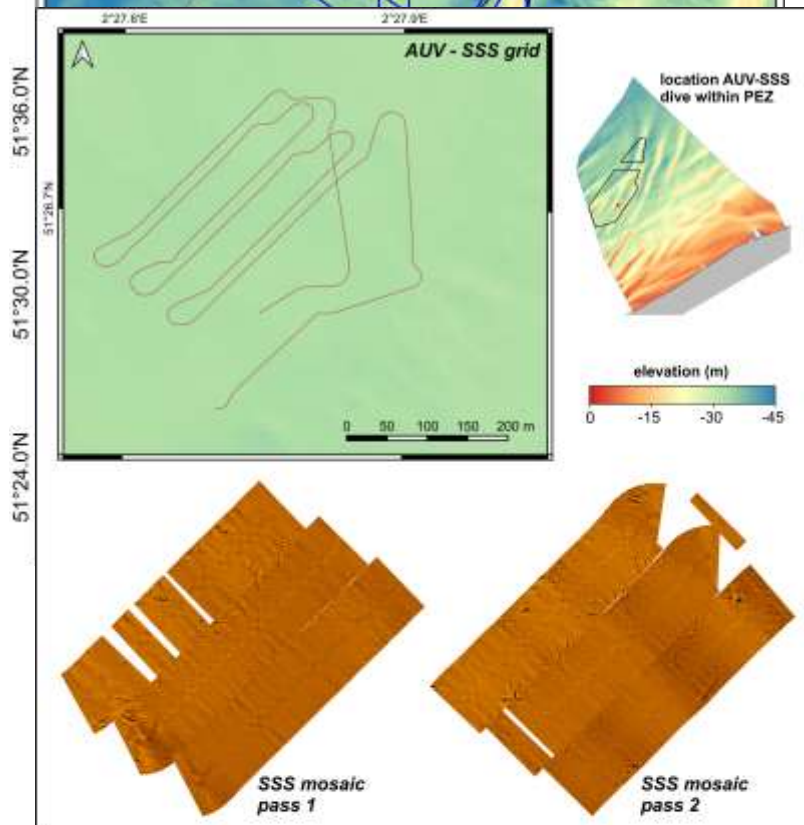


**Figure 3.** Map of the TOPAS survey lines, obtained during the RV Belgica survey 2022-30.

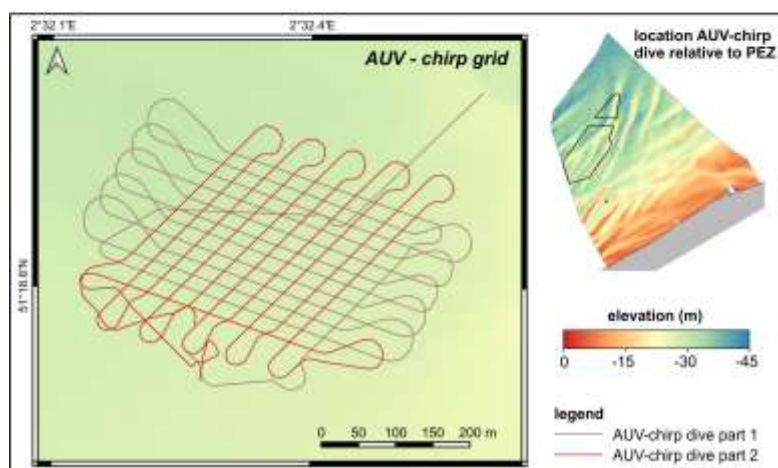
In the RV Belgica survey 2023-23, TOPAS data was again acquired for the larger Pr. Elisabeth area, along with a pilot study for the collection of SBP and side scan sonar data using an autonomous underwater vehicle (AUV):



**Figure 4.** Map of the TOPAS survey lines, obtained during the RV Belgica survey 2023-23.

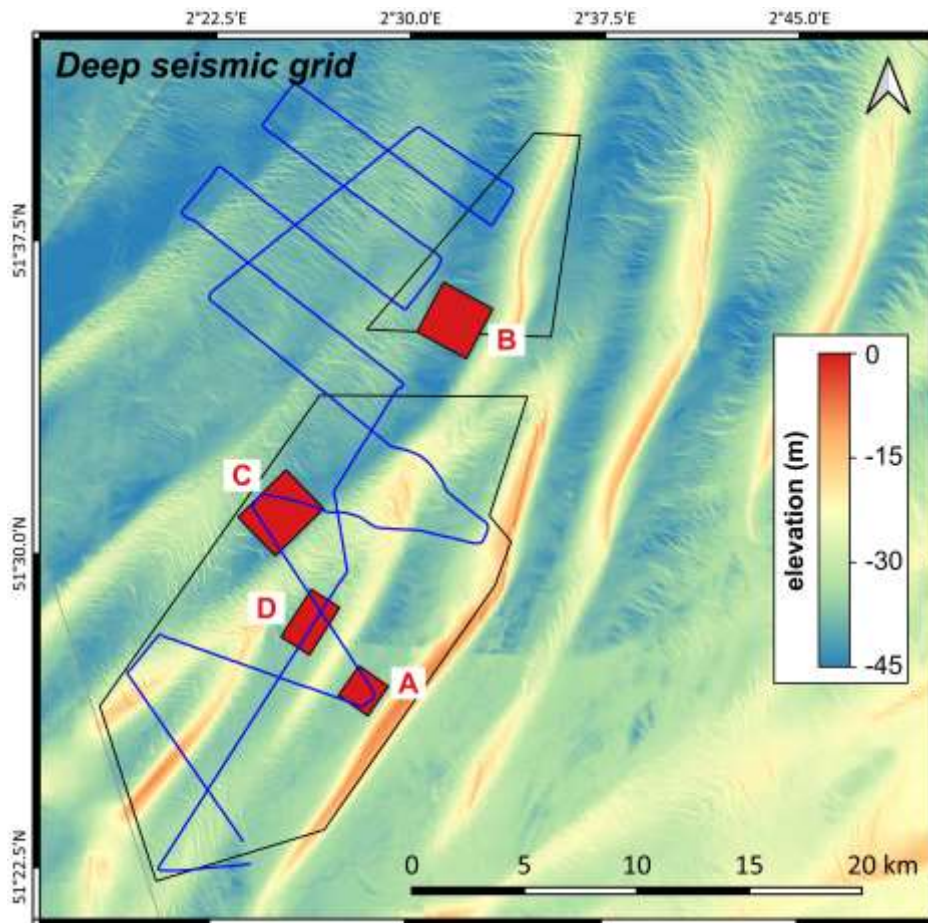


**Figure 5.** Map of the side scan sonar (SSS) and sparker (chirp) survey grids, obtained using an AUV in the RV Belgica survey 2023-23.





Lastly, the RV Simon Stevin survey 24-270 resulted in regional sparker data, specifically obtained to focus on the deeper regions of subsurface:



**Figure 6.** Map of the sparker survey lines obtained in the RV Simon Stevin survey 24-270.

### 3. Storage in geophysical data collection of VLIZ

#### 3.1. Raw data

All raw data that was obtained, as described in the chapter above, was immediately stored on the internal servers of VLIZ. This storage is structured similarly for each campaign, ensuring that sparker, MBES and PES data is accompanied by the necessary logsheets, navigation and tide data to be able to process the raw data over time:

- 01 PES data
- 02 Sparker data
- 03 MBES data
- 04 Navigation and tide data
- SiSt24-270\_CruiseReport\_Final.pdf
- SiSt24-270\_LogsheetsSeismics.pdf
- SiSt24-270\_LogsheetsVibrocoring.pdf

**Figure 7.** Example of the folder structure of the RV Simon Stevin Cruise 24-270, in the internal VLIZ storage.

VLIZ ensures backups of this internal server and that the raw data will remain available as long as possible beyond the duration of the project, with a minimum of five years beyond the project, in conformity with the agreements made in the data management plan (DMP, D5.1).

### 3.2. Marine Data Archive

As the internal servers of VLIZ are not open for external users and consortium partners, the geophysical data was subsequently stored in the Marine Data Archive. The Marine Data Archive (MDA; [mda.vliz.be](http://mda.vliz.be)) is an online repository specifically developed to independently archive data files in a fully documented manner. The MDA can serve individuals, consortia, working groups and institutes 1) to manage data files and file versions for a specific context (project, report, analysis, monitoring campaign, 2) as a personal or institutional archive or back-up system and 3) as an open repository for data publication.

Access to MDA is restricted by an authentication process, where users gain clearance for specific folders or 'contexts' within the archive based on their given purpose within the registration process. This process is regulated by the helpdesk of the VLIZ Data Center.

**MDA registration**

Please register by filling out the form below. Once you have submitted your registration, you will receive a confirmation email.

☐ my details are listed in [IMIS](#)

First name\*

Last name\*

Password\*

Confirm password\*

E-mail\*

Purpose\*

☐ I agree that my personal data is processed in accordance with the General Data Protection Regulation ([GDPR](#))

**Figure 8.** Registration form used to gain access to the Marine Data Archive.

The geophysical data from the Clay Tectonics' campaigns were stored in the 'SeismicData' context of MDA. This context was created to archive geophysical campaigns conducted by VLIZ, or campaigns provided to



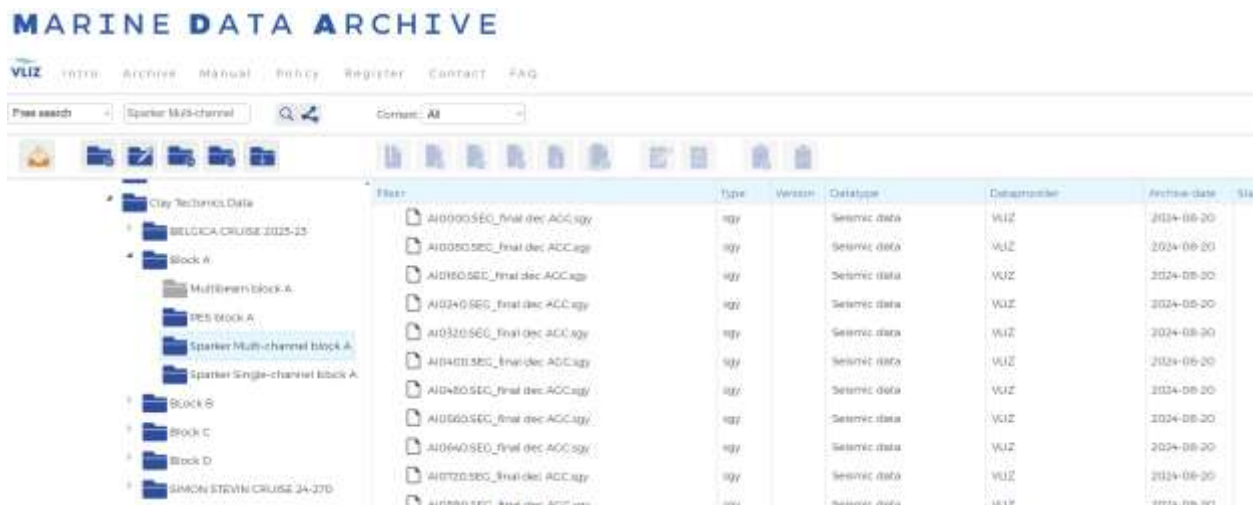
VLIZ by third parties (e.g. consortium partners, partner institutes, etc.). In total, this context currently contains 181 geophysical campaigns, with 37 additional campaigns still awaiting archiving.

**Figure 9.** Folder structure of the 'SeismicData' context in MDA. The processed data from ClayTectonics is stored in the 'North Sea' folder.

### 3.3. Processed Data

In consultation with the researchers who generated the data, the choice was made to only archive the processed data on the MDA. The reasoning behind this was that 1) there is little relevance for external users to acquire the raw, not-preprocessed data and 2) the needed memory to store both versions of data would put too much of a strain on the data system's capacity. A reference to the possibility of requesting the raw data will be included in the final metadata of the published datasets.

A new folder was created for the Clay Tectonics project, called 'Clay Tectonics Data'. For each of the four densely spaced survey grids, a separate folder was created labelled block A to D. These were then further divided between PES, multi-channel and single-channel sparker. For the regional datasets that are situated beyond the dense grids, a separate folder has been created per cruise. For the RV Belgica Cruise 2022-30, this folder was placed outside the 'Clay Tectonics Data' context as this data was acquired within the scope of multiple different projects, and should therefore be accessible separately. On publishing however, all metadata records will be clearly linked to the Clay Tectonics project.



**Figure 10.** Folder structure of the 'Clay Tectonics Campaign' context in MDA, with an example of the data files stored for the multi-channel sparker grid of Block A.

A metadata template, specifically designed for this type of geophysical data in cooperation with researchers and leading international standards, has described each of the data files stored within in the several folders. The VLIZ data managers using the tools of the MDA system, after the leading researchers of the geophysical campaigns provided the necessary information completed this task. The template contains the following fields:

- Filename
- Downloadlink
- Data type
- Template author
- Dataprovider
- Email dataprovider
- Condition of use
- Creationdate
- Submitter
- Submit date
- Archiver
- Archive date
- Start year
- End year
- Project
- Ship/Platform
- Number of lines
- Chief scientist
- Data owner
- Additional data
- Seismic source
- Seismic receiver
- File type
- Data storage
- Data form
- Geodetic model
- Coordinate system
- Coordinate format
- Positioning device
- Positions
- Tide correction
- Logbook
- Cruise report
- Linked files
- Summary
- Description
- Changes

#### 4. Public disclosure of datasets

Using the metadata templates from the MDA storage, VLIZ will publish the data as metadata records in the Integrated Marine Information system of VLIZ (IMIS, <https://www.vliz.be/nl/imis?module=dataset>), which is an extensive online metadata catalogue made and maintained by VLIZ. The catalogue connects



datasets, publications, institutes, projects and persons together through the addition of well-described metadata and clear references to the storage locations of the (data)files.

A metadata record for the whole Clay Tectonics project is already available in IMIS: <https://www.vliz.be/nl/imis?module=project&proid=5379>. The primary goal of this WP5 is that this record includes a list of all datasets generated or used by the project, where a user can be redirected to an individual metadata record for each of the datasets. These dataset records will contain much more extensive metadata, as well as clear links to retrieve the data or be redirected to related publications.

To ensure this, additional discussions will be held with the researchers to 1) make sure the metadata is enriched with information relevant for this type of research, and 2) agree on the level on which metadata records will be created, being either on project, campaign, region or equipment level. The latter will have implications on the amount of metadata records published, the size of the published data files, as well as on the capacity of the system to provide a direct download link in comparison to a request form that triggers a manual transfer by the VLIZ Data Center helpdesk.

Lastly, the VLIZ data center will explore other thematic data portals to which the metadata can be published, such as the EMODNet ([European Marine Observation and Data Network](#)) and Coastal Portal thematic portals. Publishing of the data would preferably be done using a spatial format, enabling the user to see the location of the data within a GIS viewer before being redirected to the metadata records in IMIS mentioned above. An example of such a spatial layer is available on the Coastal Portal [website](#), named 'Contouren Bathymetrische metingen VLIZ (2012-2022)'.

## 5. Future outlook

The actions conducted within WP5 of this project fit within a larger ambition of VLIZ to set-up a pilot (meta)data system for geophysical, bathymetric and core sampling datasets. These datatypes, although relevant for a large number of scientific and economic activities in the marine realm, have typically not been made available in an open and tailor-made way, especially when considering the FAIR principles. VLIZ intends to address this issue for the Belgian Part of the North sea, by creating a system that allows exploration both of the large data collections of VLIZ and any collections from third parties that are currently closed and archived in partner institutes and can be disclosed.

The envisioned system will focus primarily on the first acronym of the FAIR principles, being 'findability'. Users should be able to explore a centralized catalogue of metadata, which redirects them to the specific location of a dataset, being either in one of the VLIZ storage systems or at an external archive or repository. This catalogue would ideally be situated in an already existing platform, such as the EMODNet and Coastal Portal thematic portals. Metadata would be fed to the catalogue using different webservices, scripts and workflows, custom built for each of the data types combined within this system.

Through different projects, short-term initiatives and summer interns, VLIZ has steadily constructed the building blocks to create workflows for its internal data collections:

- **For geophysical data:** The geophysical datasets of the Clay Tectonics project will be the first geophysical datasets of VLIZ that have a complete metadata description in MDA and will receive a completely 'FAIR' metadata record in VLIZ. Additionally, the template created to import the metadata in MDA and IMIS has also been used to describe the other geophysical datasets within the 'SeismicData' context of MDA, with 117 of the 179 datasets now being ready to be published

through IMIS. In the future, all metadata should be able to flow to a centralized catalogue using the already established tools of IMIS.

- **For bathymetric data:** Some bathymetric data that was already stored on MDA within earlier projects was published on the Coastal Portal thematic [website](#), as a spatial layer named 'Contouren Bathymetrische metingen VLIZ (2012-2022)'. VLIZ will look into using this workflow for the geophysical data of Clay Tectonics, as well as the other geophysical datasets on MDA, to be able to provide metadata to a centralized catalogue.
- **For core sampling data:** Within the DISSCO project, VLIZ has created a POSTGRES database to hold all metadata for sediment cores stored in the (physical) core storage of VLIZ. This database has been given an interface to allow easy exploration and editing of all metadata and has a library of API's that can be used to both insert and export metadata to relevant systems and catalogue. Annually, summer interns further complete the database with new or corrected data.

As for the other acronyms of 'FAIR' - i.e. accessible, interoperable and reusable - VLIZ will initially provide a range of options for formats and licenses to be used. This strategy will be adopted in order not to hamper the findability and inclusion of data collections, and to maximize the willingness of researchers and partners to share their metadata, which is the primary objective of this pilot project. Once this pilot project, and the resulting (meta)data system, have been established, VLIZ will identify new actions to adhere to all FAIR principles.

## 6. Conclusion

In this deliverable of the Clay Tectonics project, information is provided on the storage of the data coming from the several geophysical campaigns that were conducted. Where raw data is stored on internal servers of VLIZ, due to performance considerations, the processed data is stored in a specific context of the Marine Data Archive (MDA). Here, data are described with metadata with a standardized template.

This context is currently only accessible by the project partners. Once metadata records are created within the Integrated Marine Information System (IMIS), the data files of the Clay Tectonics project will be made available directly to stakeholders and interested parties. This will be made possible by either a direct download link, or through a request button and a transfer by the VLIZ Data helpdesk in cases where the size of the dataset prohibits a direct link.

VLIZ will use the metadata in the MDA system to create the corresponding metadata records in IMIS, in the coming month. To do so, a number of considerations still need to be made, in accordance with the data owners, to maximize the findability and reusability of the project's geophysical data. This concerns the best workflow of providing the actual data files to a user and the regional, temporal or other parameters according to which the metadata records will be classified.

Once the datasets are available through IMIS, VLIZ will investigate how to make the data findable through relevant thematic portals. After the project, VLIZ will continue developments to work towards a full-fledged geo-dataportal centralizing geophysical, bathymetrical and core sampling data on the Belgian Part of the North Sea in a FAIR way.