Online GIS results

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Online GIS results

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GENERAL INTRODUCTION

The aim of the Geological Analysis and Resource Assessment of selected Hydrocarbon systems (GARAH) is to develop a harmonized, scientific based, geological analysis and assessment conventional and unconventional hydrocarbon resources that will help member states to continue the transition to lower Carbon energy sources.

The analysis and assessment of hydrocarbons focuses on two areas:

(i) in Europe's major petroleum province – the North Sea and include a "Geological analysis and resource assessment of North Sea petroleum systems",

(ii) with a pan-European view, "Hydrate assessment in the European continental margin and related risks".

The GARAH project uses the infrastructure that the GeoERA Information Platform Project (GIP-P) has developed for EU projects that deal with geology and GIS.

This paper describes how the GARAH project uses this infrastructure and what kind of information that is available.

EXECUTIVE REPORT SUMMARY

This document describes how the GARAH project uses the EGDI platform and web portal, what kind of data that is available for the users and how data will be presented.

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1 THE GIP-P INFRASTRUCTURE

GIP-P is the GeoERA Information Platform Project (https://geoera.eu/projects/gip-p/). The GIP-P infrastructure consists of a web portal, a project web page, web map services and web feature services, a metadata database, a digital archive for reports and unstructured data, multilingual keyword thesauri, and code list repositories. This central database ensures that the GARAH project data are stored and can be accessed in the future in EGDI by any end user.

The GARAH project uses all the other facilities that the GIP-P infrastructure provides. On top of that the GARAH project also has added functionality to deal with bibliographic references.

2 CODELISTS AND STANDARDIZATION

Many standards, for example the INSPIRE standard for geology, specifies complex xml structures, that are not supported by many GIS tools. To be able to support as many clients as possible the datasets in the GARAH project uses a flat data structure. Thus, the web feature services are not compatible with the INSPIRE standard.

For most of the datasets in the GARAH no obvious international standard exists. In theory one could use parts of other xml standards where the attributes resemble the attributes in GARAH. Unfortunately, picking of single attributes from a big selection of remotely related standards is not advisable either, since this makes the data definition very complicated and will deteriorate performance when data are parsed, reformatted, and validated against a multitude of XML schemas.

Thus, it is not possible to validate the web feature services provided by GARAH against external XML schemas. But this does not mean that the GARAH project has ignored any attempt to standardize data. The name of attributes follows the naming used in international standards when possible and the GARAH project also uses international codelists if these exist.

The work on the GARAH project has resulted in an extension of the INSPIRE codelist for lithology where the value mud-breccia has been added. The extension is found here: https://data.geoscience.earth/ncl/geoera/graph/lithology

Also a completely new code list for fluid flow indicators has been created: (https://data.geoscience.earth/ncl/geoera/graph/FluidFlowIndicator).

3 METADATA

Metadata are stored in MIcKA, The EGDI Metadata Catalogue (https://egdi.geology.cz/), that is the central access point to metadata concerning structured digital geological data sources and web services across Europe.

Before a dataset is uploaded to the EGDI web portal the metadata must be registered in MIcKA. For most datasets only one entry in the EGDI Metadata Catalogue (MIcKA) is needed but in some cases, the GARAH project also take advantage of that MIcKA is an implementation of ISO 19115 and thus supports a parent-child relationship between a dataset and a data subset. The user can navigate to the metadata description of the subset from the attribute table in the EGDI web portal Figure 1.

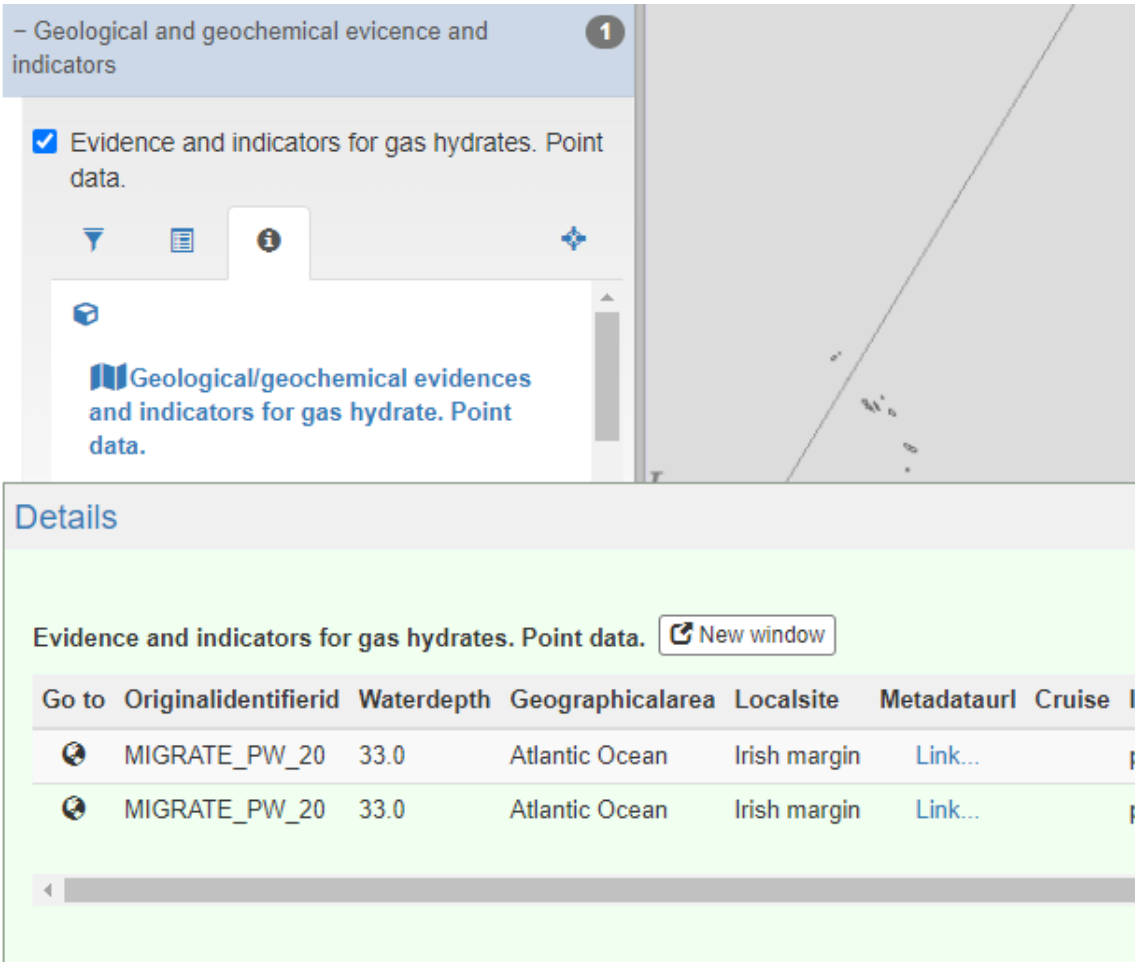

Figure 1 Metadata for Evidence and indicator for gas hydrates illustrated with a screenshot from the EGDI web portal. The dataset has both a metadata description for the whole dataset and metadata descriptions of subsets. The metadata for the subset are accessible via a link, Metadataurl, in the attribute table.

3.1 Keywords

Keywords, that the GARAH project intended to use, was reported to GIP-P in the early phase of the GARAH project (Deliverable 4.1. Preliminary Data Selection to Provide

Relevant Information in Assessing Hydrocarbon Resources in Subsurface). A keyword thesaurus is built upon the keywords reported by the GeoERA projects and this is used when metadata are entered into MIcKA.

4 THE WEB PORTAL

The URL for GARAH on the web portal is:

https://geusegdi01.geus.dk/egdi/?mapname=garah_preview#baslay=baseMapGEUS&extent=-6364260,-2140970,13510100,7002240.

The web portal supports the functionality one would normally expect from a GIS viewer. The screenshot below shows how the web portal typically appears. In the menu to the left on one has the possibility to click layers on and off, change transparency, etc. The general functionality of the web portal is described by the GIP project https://geoera.eu/projects/gip-p/.

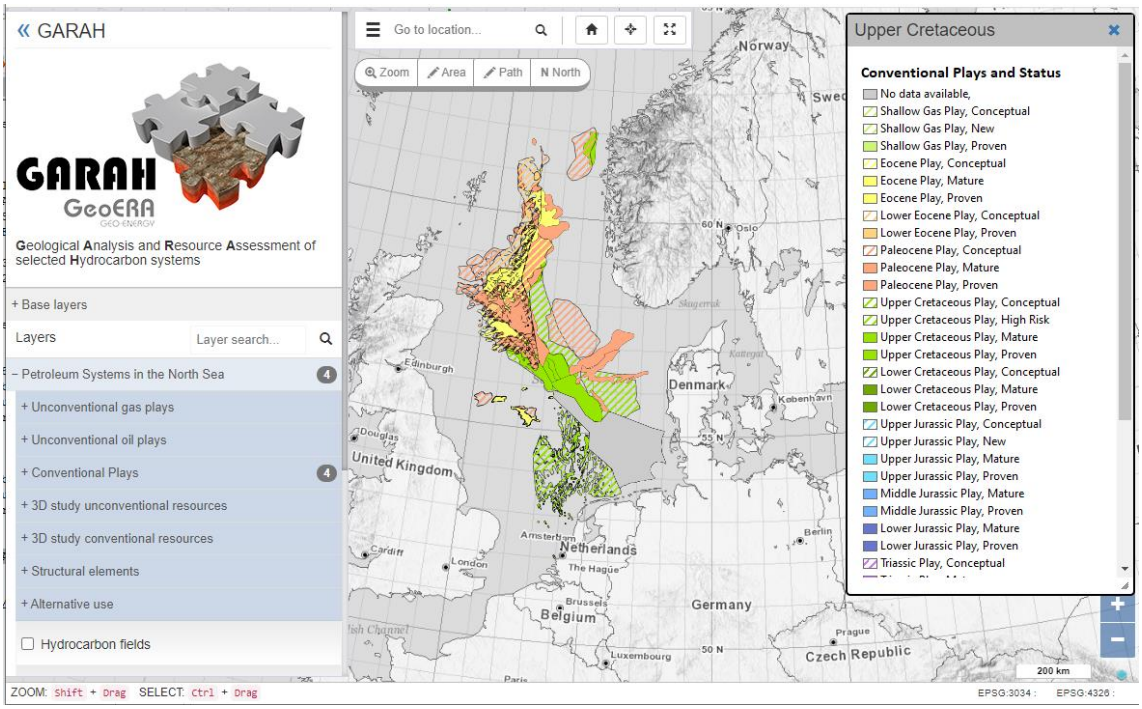

Figure 2 Screen shot from the GARAH web portal.

When the user selects a feature or more features in the map a table with the attributes of the feature appears Figure 3.

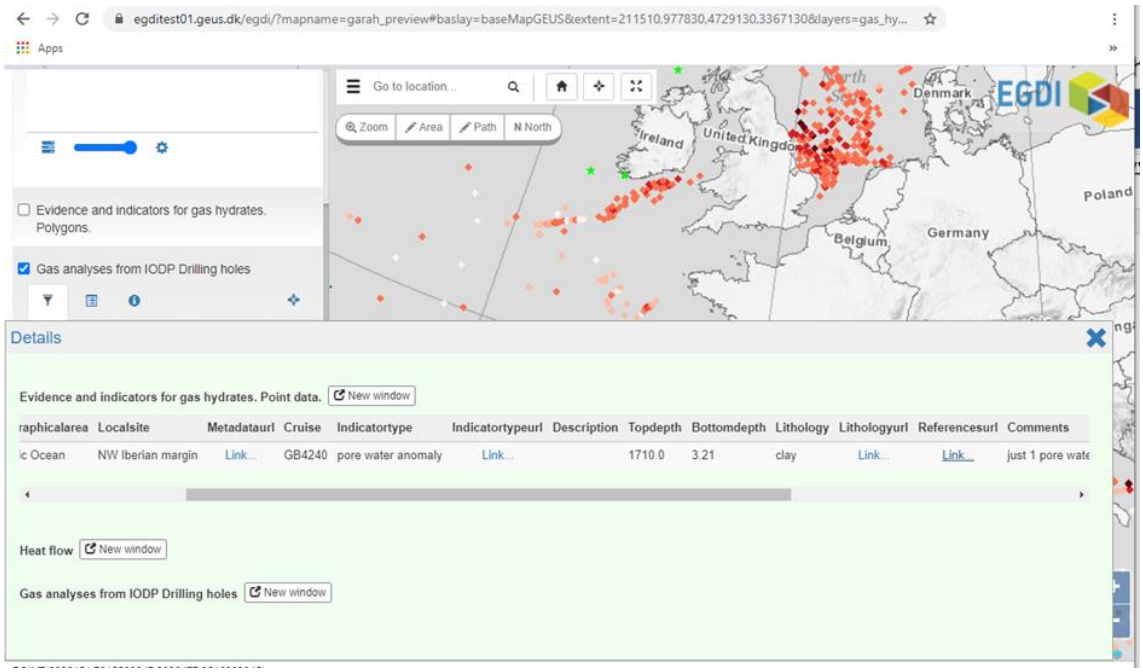

Figure 3 Example of the attribute table of a feature.

4.1 The menu in the web portal

The menu to the left of the web portal interface (Figure 3) has a three-level structure where the uppermost levels are the name of the group and subgroup, and the third level is the individual layer.

For each layer three tabbed pages exists

- A short description of the layer. Here are also opportunities for filtering if needed.
- The legend
- Metadata. In the GARAH project this is a link to the metadata database, MIcKA.

Like other GIS tools it is possible to turn layers on and off and change the transparency of the layer.

The functionality has in some cases been enhanced with JavaScript. For example, in the 3D study where a third level in the menu has been implemented with JavaScript (Figure 4).

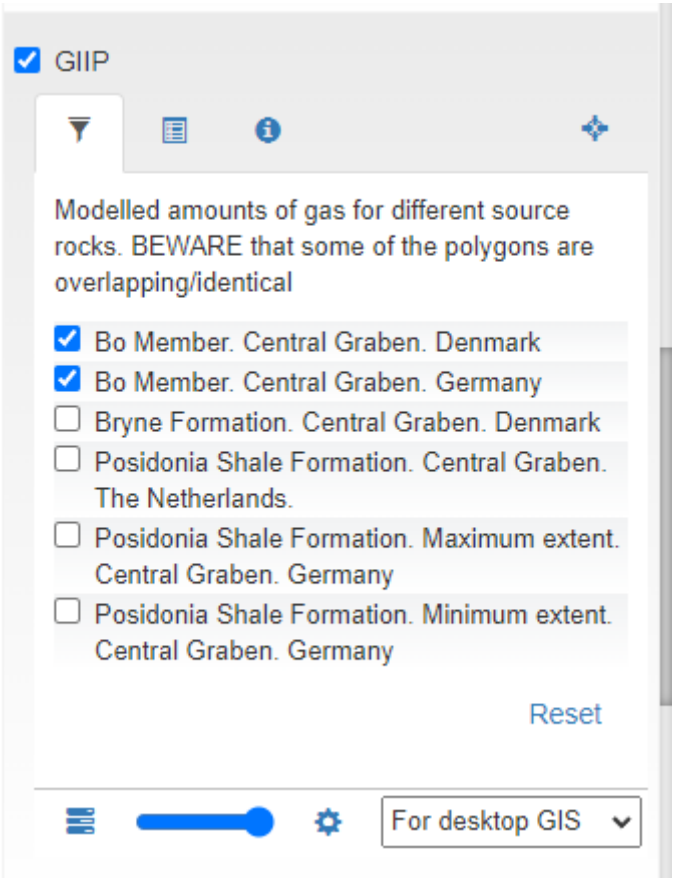

Figure 4 An example of customization with JavaScript. In this example a third menu level where layers can be clicked on and off is implemented with JavaScript.

Appendix 1 shows the layers on the portal and how they are grouped in the menu.

4.2 Attributes

When the user clicks on one or more features on the map a table with the attributes of the selected features becomes visible. As shown in the example Figure 3, the attributes not only contain plain text and numbers, but also link to further information. The types of information that a link can point to are

Links to metadata. These are used in the cases where a dataset is split into several subsets each with separate metadata.

Links to values in codelists. There are typically links to values in INSPIRE codelists or to values in the European geoscience registry.

Links to bibliographic references. A many-to-many relation exists between features and bibliographic references. That is, a feature can be described in many publications and a publication can describe many features. The infrastructure provided by GIP-P does not support this relation. For this reason, the GARAH project has developed a webservice that returns the bibliographic references for a given feature. The bibliographic

data are maintained directly in EGDI's PostgreSQL database using SQL or a general database editor. No special editing tool for bibliographic data has been developed.

Figure 5 Example of bibliographic references for a specific feature.

Links to pdf documents and figures. PDF documents and figures in PNG format can be uploaded to a repository hosted by EGDI. The GARAH project stores descriptions of unconventional plays (c.f Deliverable 2.2. Petroleum system report and GIS maps) and images of profiles from the 3D studies in the repository (c.f. Deliverable 2.4. 3D Pilot Study - Unconventionals and Deliverable 2.5. 3D Pilot Study - Conventionals).

4.3 WFS and WMS

The data shown on the web portal will also be available as web feature services (WFS) and web map services (WMS).

These services give the user the opportunity to combine her or his own data with the data displayed in the GARAH project. Also layers from other projects that use the EGDI infrastructure can be easily combined. All common GIS tools as for example QGIS shown in the screenshot below, support this.

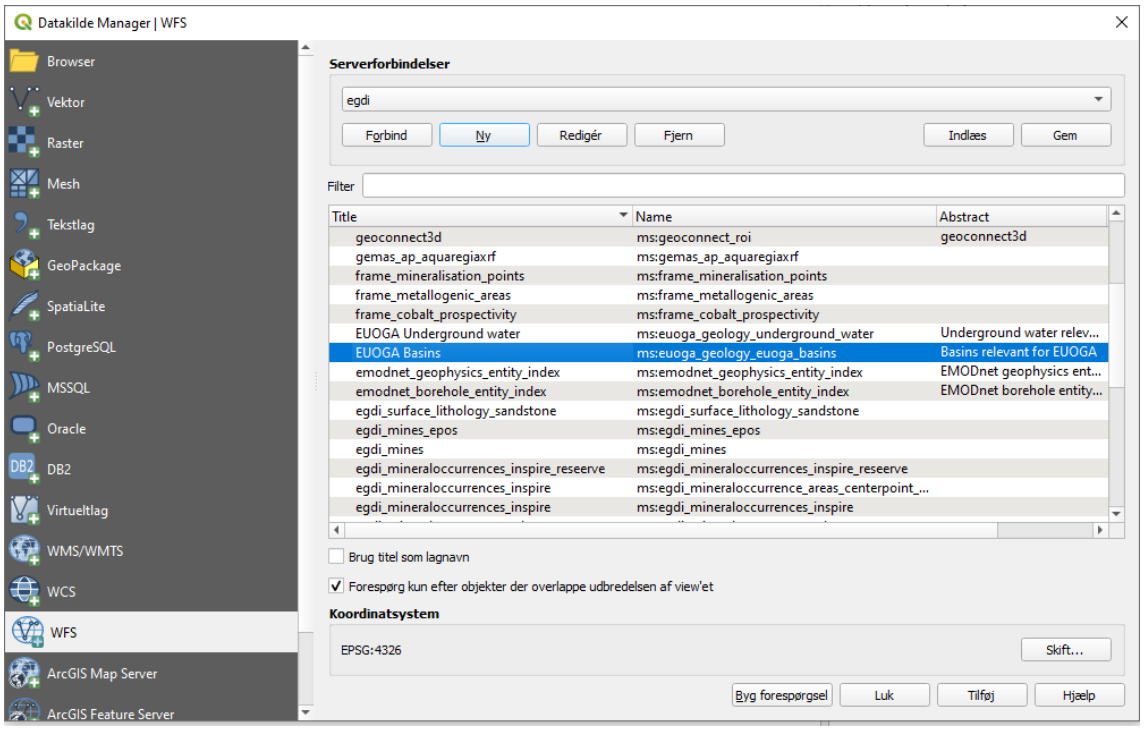

Figure 6 Screenshot from QGIS showing the list of layers available as WFS from the EGDI web portal.

5 THE DOCUMENT REPOSITORY

Data without spatial information such as documents (in PDF format), images, datafiles (in CSV format) and DOIs can also be uploaded to the portal. As mentioned before this functionality is used by GARAH to store PDF documents with description of plays, and images of profiles. The report deliverables are also stored in the repository so that these can be referred to from the web portal and the GARAH project page, https://geoera.eu/projects/garah4/.

6 CONCLUSION

The GIP-P web portal was developed in parallel with the GARAH project. This meant on the one hand, that extra functionality could be added when needed, but on the other hand, that the GIP-P web portal was not always bug free and ready for use. Future projects that use the GIP-P web portal will profit from the added functionality and testing done in projects like GARAH, as well as the collaboration that these projects had with the GIP-P project.

The objective of Work Package 4 in GARAH was to lead the interactions with the GIP-P project and to ensure that the guidelines and standards provided by GIP-P are properly implemented for WP2 and WP3 in the GARAH project. As described above, WP4 has extensively used the tools provided by GIP-P (the metadata database, web portal, repository) and has thus been forced to use the standards set by GIP-P. The result is that the data and the way of presenting data provided by GARAH can easily be used by external partners, particularly by other projects that use the EGDI platform. The only special customization that must be done – the webservice that returns bibliographic references for a feature – could with a few changes also be used by other projects.

7 APPENDIX 1

The layers on the portal and how they are grouped in the menu.

First level	Second Level	Title	Description
Petroleum Systems in the North Sea	Unconventional gas plays	Bo member	Estimates of absorbed gas, free gas and GIIP (Gas Initially In Place) for the percentiles P10, P50 and P90 for the Bo member. GIIP at P50 is used for symbolization
		100 m Kimmeridge Clay and equivalents	Estimates for 100 m Kimmeridge Clay and its equivalents. A 100 m thick slice of Kimmeridge clay and its equivalents is assumed to be more realistic with respect to development and exploitation than the whole unit thickness.
		Kimmeridge Clay and equivalents	Estimates for Kimmeridge Clay and equivalents (For the whole stratigraphic unit)
		Posidonia and equivalents	Estimates for Posidonia and equivalents
		Sleen Formation	Estimates for the Sleen Formation
		Bowland and equivalents	Estimates for Bowland and equivalents
	Unconventional oil plays	Bo Member and equivalents	Estimates of free oil in 10^6 m^3 or in 10^6 barrels are shown for the percentiles P10, P50 and P90 for the Bo Member and equivalents. Symbolization is based the content of free oil at P50.
		100 m Kimmeridge Clay and equivalents	Estimates for 100 m of Kimmeridge Clay and equivalents
		Kimmeridge Clay and equivalents	Estimates for Kimmeridge Clay and equivalents (For the whole stratigraphic unit)
		Posidonia and equivalents	Estimates for Posidonia and equivalents
		Sleen Formation	Estimates for Sleen Formation

First level	Second Level	Title	Description
	Conventional Plays	Shallow Gas	A detailed description of lithology, structures, ages for Shallow Gas plays
		Eocene	Descriptions of conventional Eocene plays
		Lower Eocene	Descriptions of conventional Lower Eocene plays
		Paleocene	Descriptions of conventional Paleocene plays
		Upper Cretaceous	Descriptions of conventional Lower Cretaceous plays
		Lower Cretaceous	Descriptions of conventional Upper Jurassic plays
		Upper Jurassic	Descriptions of conventional Middle Jurassic plays
		Middle Jurassic	Descriptions of conventional Lower Jurassic plays
		Lower Jurassic	Descriptions of conventional Triassic plays
		Triassic	Descriptions of conventional Zechstein plays
		Zechstein	Descriptions of conventional Permian Rotliegend plays
		Permian Rotliegend	Descriptions of conventional Carboniferous plays
		Carboniferous	Descriptions of conventional Devonian plays
		Devonian	Descriptions of conventional Profile line plays
	3D study unconventional resources	Profile line	Cross section through the 3D model. The attribute table contains links to profiles that show stratigraphy and content of generated petroleum
		GIIP	Modelled amounts of gas initially in place for different source rocks
		OIIP	Modelled amounts of oil initially in place for different source rocks.

First level	Second Level	Title	Description
		Vitrinite reflectance at the Base Cretaceous Unconformity subcrop	Calculated vitrinite reflectance (EASY%Ro) at the Base Cretaceous Unconformity subcrop. The subcrop covers the Top Upper Jurassic, Top Lower Jurassic and Triassic
		Average vitrinite reflectance for the Upper Jurassic	Calculated average vitrinite reflectance (EASY%Ro) for the Upper Jurassic interval
		Average transformation ratio for the Upper Jurassic	Calculated average transformation ratio (TR all) for the Upper Jurassic interval. The transformation ratio (TR) as defined by Tissot and Welte (1984) is the ratio of the petroleum (oil and gas) actually formed by the kerogen to the total amount of petroleum that the kerogen is capable of generating.
		Average vitrinite reflectance for the Lower Jurassic	Calculated average vitrinite reflectance (EASY%Ro) for the Lower Jurassic interval.
		Vitrinite reflectance at the Top Lower Jurassic	Calculated vitrinite reflectance (EASY%Ro) at the Top Lower Jurassic
		Average transformation ratio for the Lower Jurassic	Calculated average transformation ratio (TR all) for the Lower Jurassic interval. The transformation ratio (TR) as defined by Tissot and Welte (1984) is the ratio of the petroleum (oil and gas) actually formed by the kerogen to the total amount of petroleum that the kerogen is capable of generating.
		Wells used for calibration	Wells used for calibration of the model
		Study area	3D Study area for both conventional and unconventional resources

First level	Second Level	Title	Description
	3D study conventional resources	Profile line	Cross section through the 3D model with link to profile that shows hydrocarbon migration and accumulations.
		Source rocks	The extent of the four source rocks in the 3D model study area
		Modelled accumulation of hydrocarbons	Example showing the distribution of accumulations after introducing more reservoir layers and tighter shaly lithologies in the overburden to force pressure built-up in the upper part of the Cenozoic section. The areas marked by coloured circles represent areas where majority of HCs are accumulated in the individual reservoir layer shown in the upper right corner. Remaining accumulations not encircled are areas where HCs accumulate in Upper Cretaceous reservoir.
		Study area	3D Study area
	Structural elements	Salt Structures	Salt diapirs and salt pillows in the North Sea Area
		Basins and highs (from NAG-TEC)	Basins and highs from NAG-TEC
		Ages of structural elements (from NAG-TEC)	Basins and highs from NAG-TEC: Northeast Atlantic Geoscience Tectonostratigraphic Atlas. The symbolization is based on the age of the structural element
		Regions of structural elements (from NAG-TEC)	Structural regions from NAG-TEC
	Alternative use	CO_2 Storage	Assessment of CO_2 Storage Potential in Europe

First level	Second Level	Title	Description
	Hydrocarbon fields		Hydrocarbon fields in the North Sea. This dataset contains information about the types of hydrocarbon, status, start year and operator. The dataset is compiled by the GARAH project and is based on data from the National Data Repositories from Norway, Denmark, Germany, The Netherlands and the UK.
	Area of interest		Area of interest of the GARAH project work package 2. The GARAH project focuses on the petroleum systems of both conventional and unconventional resources in the North Sea.
Gas hydrates	Assessment	Susceptibility	Likelihood of occurrence (below seafloor) of marine hydrates in the sediment column, and subsequently the likelihood of them being affected by dissociation processes resulting from natural or human-induced activities (liquefaction, explosions, collapse, crater-like depressions or submarine landslides).
		Susceptibility Reliability	Reliability of the susceptibility assessment to the presence of marine hydrate deposits. It based on the density of geographical data taken into account in the susceptibility assessment.

First level	Second Level	Title	Description
	Knowledge Gap	Knowledge gap assessment of hydrate evidence and indicators	Density map of hydrate evidence (samples of hydrates in gravity cores or wells) and indicators (seismic anomalies or geochemical indicators). It has been developed with the "point density" algorithm of ArcGIS®. Pixel value, number of data per 100,000 km^2. Parameters: population field, none; cell size, 5000; radius, 178,415 metres; areal units, square kilometres; method, geodesic. Knowledge gap, raster value < 1.
		Knowledge gap analysis of geothermal gradient data.	Density map of geothermal gradient developed with the "point density" algorithm of ArcGIS®. Pixel value, number of data per 100,000 km^2. Parameters: population field, none; cell size, 5000; radius, 178,415 metres; areal units, square kilometres; method, geodesic. Knowledge gap, raster value < 1.
		Knowledge gap analysis of seafloor temperature data	Density map of seafloor temperature developed with the "point density" algorithm of ArcGIS®. Pixel value, number of data per 100,000 km^2. Parameters: population field, none; cell size, 5000; radius, 178,415 metres; areal units, square kilometres; method, geodesic. Knowledge gap, raster value < 1.
	Geological and geochemical evidence and indicators	Evidence and indicators for gas hydrates. Point data.	Samples of gas hydrate is an example of evidence. Indicators are degassing structures or pore water anomalies
		Evidence for gas hydrates. Polygons.	Occurrences of gas hydrates presented as polygons.

First level	Second Level	Title	Description
		Gas analyses from IODP Drilling holes	Chemical analyses of gases from IODP drilling holes. Point Data
	Geophysics	Geophysical indicators for gas hydrates. Point data	geophysical indicators. Examples are Bottom Simulating Reflectors (BSR) or gas chimneys
		Geophysical indicators for gas hydrates. Lines	Indicators interpreted from seismic lines. Examples are pockmarks or collapses
		Geophysical indicators for gas hydrates. Polygons	Indicators interpreted from seismics. Typical gas chimneys. The area with indicators is shown as polygons
	Fluid flow indicators	Seafloor features that indicate fluid flow. Point data	FluidFlow seafloor features. Examples are mud volcanoes and pockmarks.
		Seafloor features that indicate fluid flow. Polygons	FluidFlow seafloor areal features. Typically pockmark fields.
	GHSZ	Base of negative buoyancy zone for 100% C02. Celtic Sea & French EEZ	Gas Hydrate Stability. Raster data
		Base of negative buoyancy zone for 96% C02. Celtic Sea & French EEZ	Gas Hydrate Stability. Raster data
		Base of negative buoyancy zone for 96% C02. Extended 200M in the FISU Area, Celtic Sea.	Gas Hydrate Stability. Raster data
		Base of negative buoyancy zone for 96% C02. South of Biscay Bay, Galicia Area	Gas Hydrate Stability. Raster data
		Base of hydrate stability zone for biogenic gas. NW Europe	Gas Hydrate Stability. Raster data
		Base of hydrate stability zone for biogenic gas. SW Europe.	Gas Hydrate Stability. Raster data

First level	Second Level	Title	Description
		Base of hydrate stability zone for 100% CO_2. Celtic Sea & French EEZ.	Gas Hydrate Stability. Raster data
		Base of hydrate stability zone for 96% CO_2. Celtic Sea & French EEZ.	Gas Hydrate Stability. Raster data
		Base of hydrate stability zone for biogenic gas. From Piñero et al. (2013).	Gas Hydrate Stability. Raster data
		Base of hydrate stability zone for 96% CO_2. Extended 200M in the FISU Area, Celtic Sea.	Gas Hydrate Stability. Raster data
		Base of hydrate stability zone for 96% CO2. South of Biscay Bay, Galicia Area.	Gas Hydrate Stability. Raster data
	Oceanographic variables and geological constraints	Seafloor temperatures	HeatFlow Global. Points.
		Heat flow	Seafloor Temperature: Points.
Bathymetry	Bathymetry	Bathymetry from EMODnet.	Bathymetry from EMODnet.
Other	Europa offshore faults (IGME 5000)		International Geological Map of Europe 1:5 Million and Adjacent Areas (IGME5000).
	Sediment accumulation rate cm/year		Sedimentation rates per year. Part of the European Marine Observation and Data network (EMODnet) Geology.
	Sediment thickness, m		Total Sediment Thickness of the World's Oceans and Marginal Seas. From NOOA.
Human activity	Fishing activities	Average Surface Swept Area Ratio 2015-2018	Fishing activities. From EMODNET.
	Windfarms	Windfarms from EMODnet (polygons)	Windfarms from EMODnet presented as polygons

First level	Second Level	Title	Description
		Windfarms from EMODnet (points)	Windfarms from EMODnet presented as polygons
	Wells		Wells from EMODnet
	Active licences		Active licences from EMODnet
	Pipelines		Pipelines in the North Sea region. Data originate from the national repositories of UK, Norway, Germany, The Netherlands and Denmark
	Infrastructures		Infrastructures in the North Sea region. Data originate from the national repositories of UK, Norway, Germany, The Netherlands and Denmark