Geological Analysis and Resource Assessment of selected Hydrocarbon systems

Deliverable 4.3

Assist in hydrocarbon resource planning

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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 will focus 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".

Even though there is a political agreement to cut the use of fossil fuels the study of hydrocarbon resources is still important for many reasons. Some of them are:

- The reservoirs and infrastructure used for hydrocarbon exploitation could find reuse for CO2- capture and storage.
- Gas hydrates reservoirs could also work as a CO2-storage using a process where the CO2-replaces methane.
- We do not know what the use of hydrocarbons might be in the far future. As the hydrocarbon industry scales down knowledge will disappear when people find other employment or occupation. It is important that their knowledge is kept for times to come.
- According to some theories breakdown of gas hydrates could cause a major greenhouse gas release if the temperature of the oceans increases. Even though this is debated it is still important to know the amounts and stability of the occurrences of gas hydrates to estimate the potential risk.

The GeoERA Information Platform Project (GIP-P) has developed an infrastructure for European projects that deal with geology. This paper describes how the GARAH project uses this infrastructure (the EGDI platform) to assist in hydrocarbon resource planning.

EXECUTIVE REPORT SUMMARY

This document describes how the GARAH project uses the EGDI platform and web portal and how data will be presented to planners of hydrocarbon resources.

TABLE OF CONTENTS

1 THE GIP-P INFRASTRUCTURE

The GIP-P infrastructure consists of a web portal, a metadatabase, and a digital archive for organizing reports and unstructured data, multilingual 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.

As the GIP-P infrastructure is still under development and the GARAH still data are developed, this paper cannot show the final result but it will describe the progress we have made so far and what we are planning for.

2 THE WEB PORTAL

The main purpose of the web portal is to visualize digital maps. In the GARAH project following layers are planned (Table 1). Changes to this plan will be anticipated as the project progresses.

Table 1. The layers on the portal and how they are grouped. The structure shown here might change as the work in the GARAH project progresses

Group	Subgroup	Title	Description
Gas hydrates	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.
		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 are 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.
	Base of hydrate stability zone	Base of hydrate stability zone for biogenic gas. NW Europe	Gas Hydrate Stability. Raster data

Group	Subgroup	Title	Description
		Base of hydrate stability zone for biogenic gas. SW Europe.	Gas Hydrate Stability. Raster data
		Base of hydrate stability zone for 100% CO2. Celtic Sea & French EEZ.	Gas Hydrate Stability. Raster data
		Base of hydrate stability zone for 96% CO2. 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% CO2. 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
	Base of negative buoyancy zone	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
	Oceanographic variables and geological constraints	Seafloor temperatures	Seafloor temperatures. Points.
		Heat flow	Heat flow. Points.
		Sediment thickness	Sediment thickness from https://gis.ngdc.noaa.gov/arcgis/services/web_mercator/sediment_thickness/MapServer/WMSServer
		Sedimentation rates	Sedimentation rates are from EMODNET
Petroleum Systems in the North Sea		Area of Interest	The outline of the study area of conventional resources in the North Sea
		Structural outlines	Outlines of structural highs and basins. Maybe two layers that show the situation in different stratigraphic levels
		Faults	Faults. Presented as lines.

Group	Subgroup	Title	Description
		Salt diapirs outlines	Outlines of salt structures
	Conventional resources	Exploration wells	Exploration wells. points.
		Hydrocarbon fields	Hydrocarbon fields.
		HC Plays	Hydrocarbon Plays. Polygons
	Unconventional resources	TOC maps (Total Organic Carbon)	The percentage of total organic carbon (TOC). Probably several layers (one for each stratigraphic unit) but this has not been decided yet
		Maturity maps	Maturity represented as vitrinite reflectance (%VR). Probably several layers (one for each stratigraphic unit) but this has not been decided yet
		Depth maps	Depth to the source rock
		Thickness maps	Thickness of the source rock
		3D models	3D Volumes. Same type of 3D volumes as used in 3DGEOEU
		2D Horizon interpretations	The format is not decided yet
		3D surfaces	2.5D Grids.
		Identified CO2 storage sites	Identified CO2 storage sites, CSS. Polygons.
Bathymetry		Bathymetry	Bathymetry from EMODNET.
Human activity		Active licenses	Licenses from EMODNET.
		Pipelines	Pipelines from EMODNET.
	Fishing activities		Fishing activities. From EMODNET.
	Windfarms		Areas with windmills. From EMODNET.

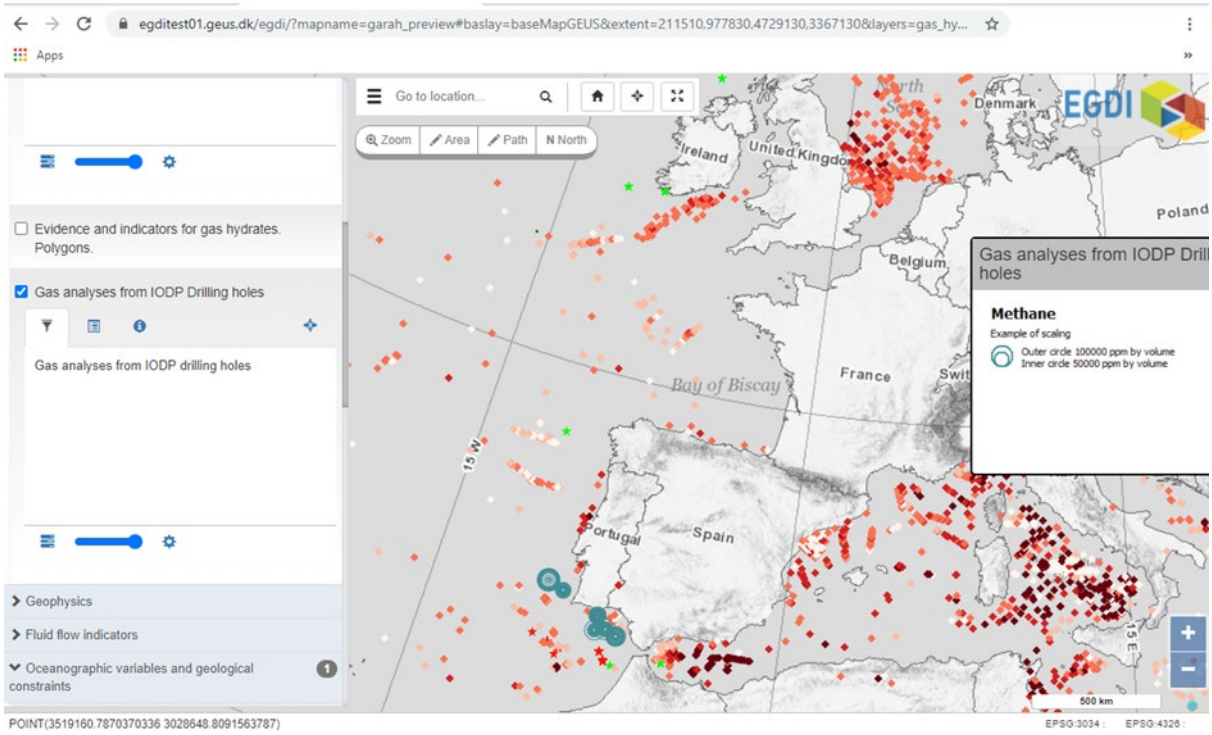

Figure 1 Screen dump showing the main features on the web portal.

At this stage of the project, the web portal only exists in a test version. The screen dump (Figure 1) shows the main features of the web portal.

2.1 The menu

The menu to the left 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. This corresponds to the grouping described in Table 1.

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 metadatabase, Micka.

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

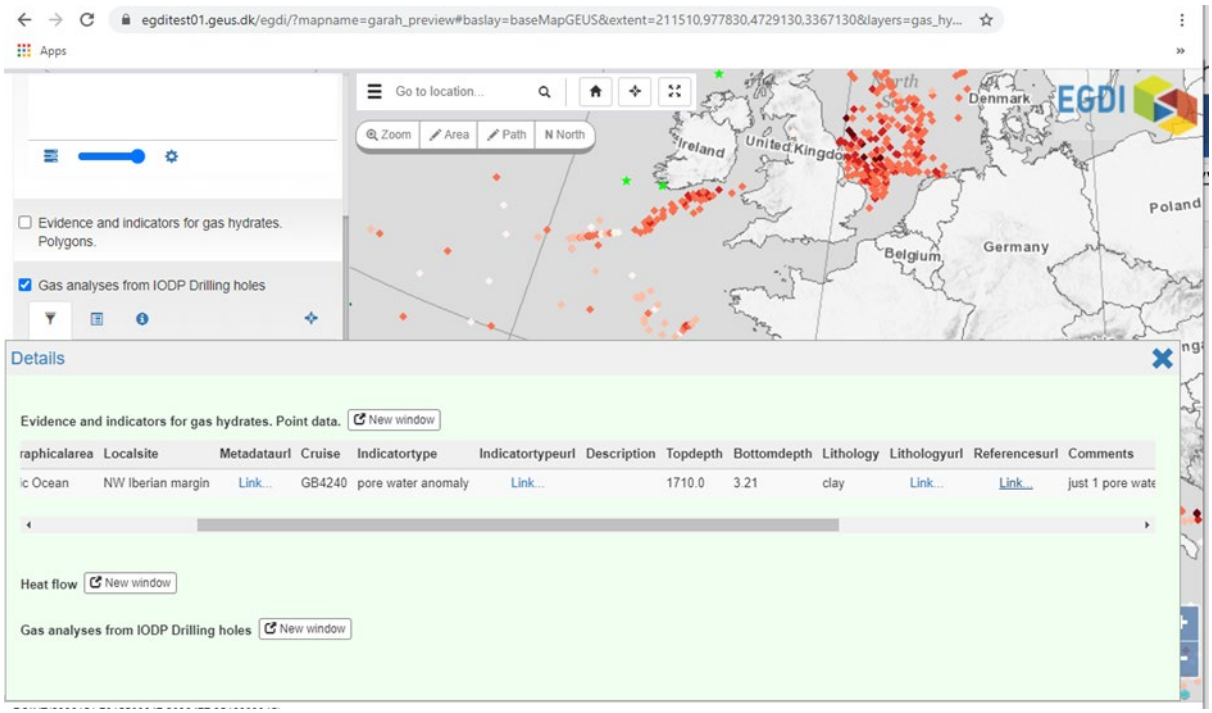

Figure 2 Feature attributes

2.2 Attributes

If the user clicks on one or more features on the map then a table with the attributes of the selected features becomes visible. In the example shown in Figure 2 many of the attributes are links.

The link, Metadataurl, points to a record in Micka – (a metadata management software). Usually, only one link exists for each dataset but in this case the dataset consists of several subdatasets that are described with different metadata. Micka supports this hierarchical structure. Figure 3 shows a screen shot from Micka.

The type of indicator is shown both as a name - the column Indicatortype - and as link – the column Indicatortypeurl. Indicatortypeurl points to the European geoscience registry where new codelists (and extensions to old codelists), which are created during the work in the GARAH project, are stored. Figure 4 shows how the European geoscience registry presents data.

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 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 result is show in Figure 5.

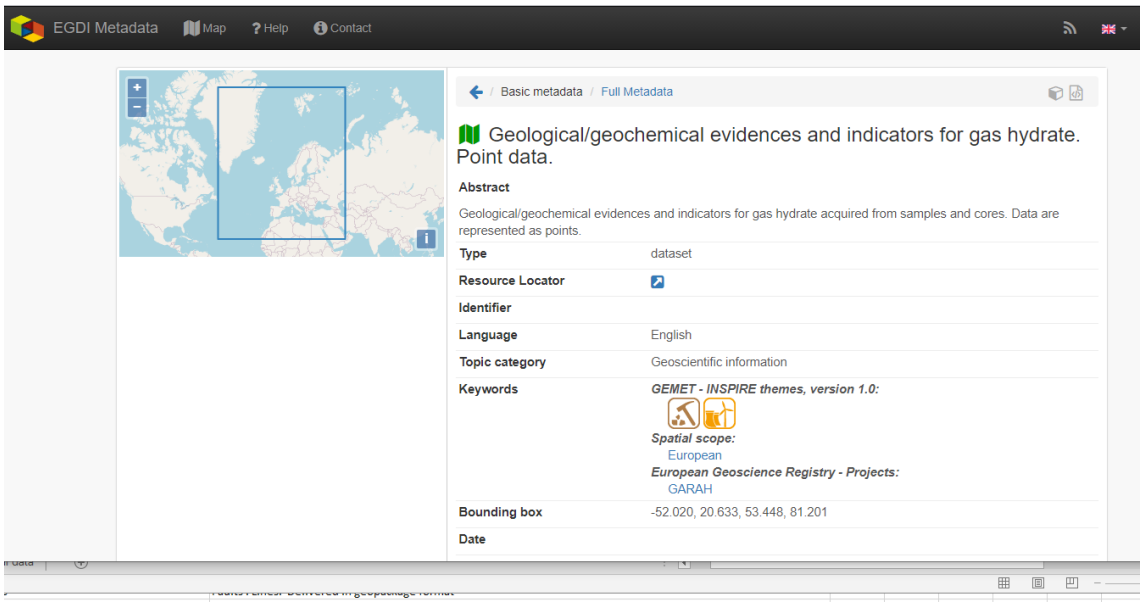

Figure 3 Example of a metadata record in Micka

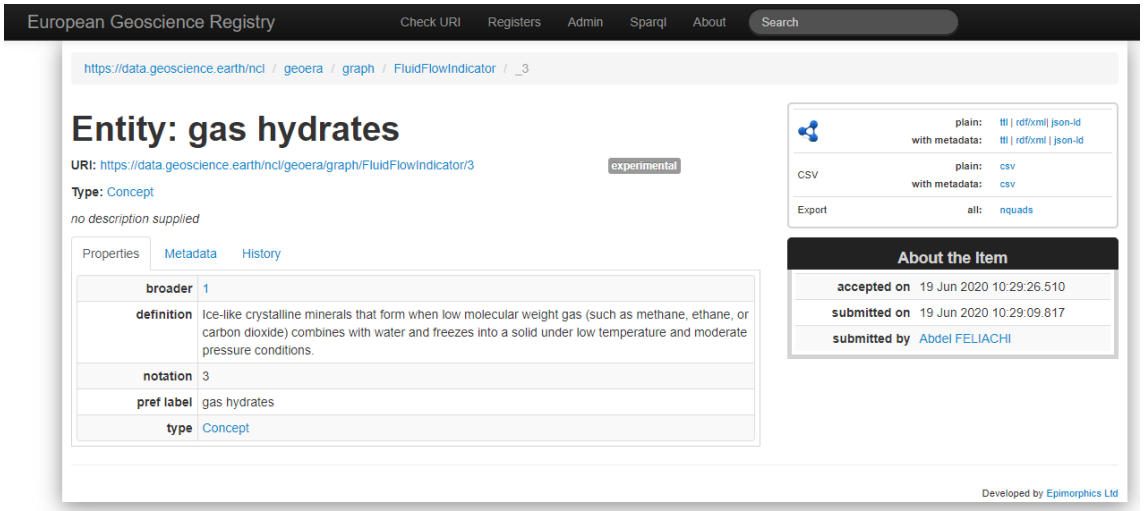

Figure 4 Example of a record in the codelist, fluidflowindicators, in the European Geoscience Registry

Figure 5 Example of bibliographic references for a specific feature.

2.3 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.

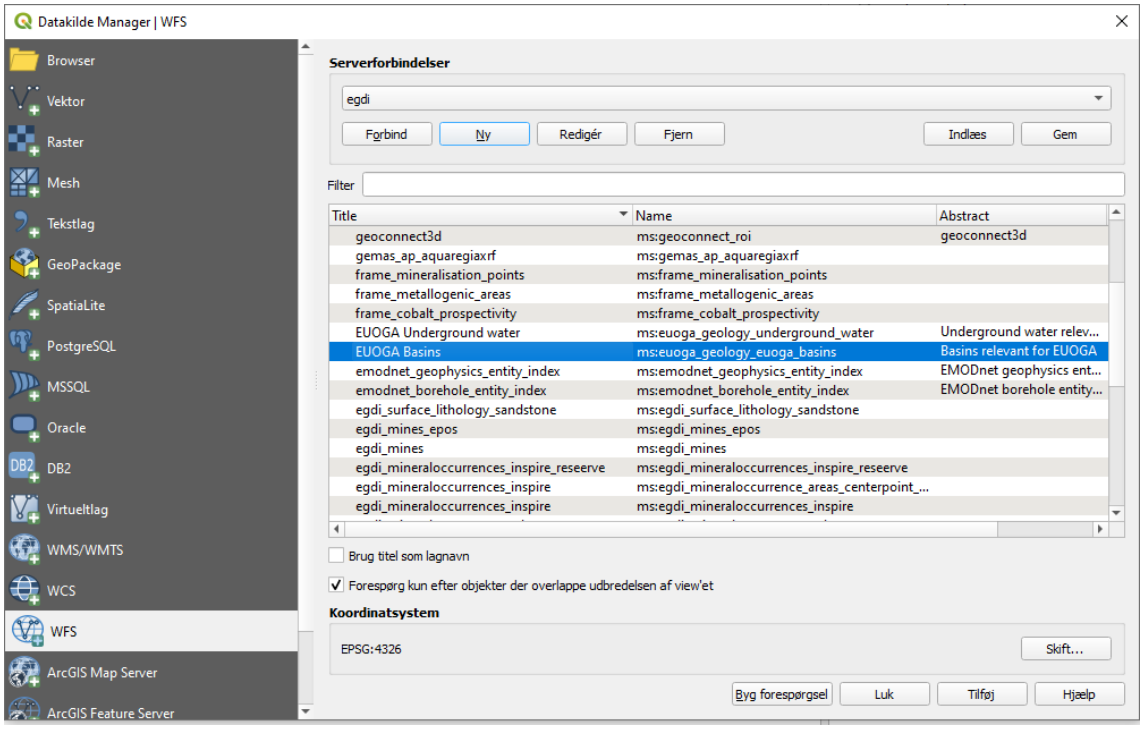

Figure 6 Screenshot from QGIS showing the list of layers available as WFS from the EGDI web portal. The GARAH layers will also automatically appear on the list when the testing is finished and the GARAH data are deployed on the EGDI web portal.

3 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. In the GARAH project group it has been suggested to make documents for each hydrocarbon play. These documents, which summarize information like the chance for success and source rock parameters, will be uploaded to the document repository and linked to from the map.

4 CONCLUSION

The EGDI infrastructure developed by the GIP project gives users who are involved in the planning of hydrocarbon resources, CO2 storage and risk management both an overview of relevant data and the possibility to go into details. As layers are available as WFS and WMS, data can easily be combined with data from other source by means of the user's GIS tool of choice.
One of the main purposes of the EGDI infrastructure is to store and disseminate data after the related projects finish. The data produced by the GARAH project will thus be available for many years to come.