



Geological Analysis and Resource Assessment of selected Hydrocarbon systems

Deliverable 1.5

Annual progress report 2020

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GENERAL INTRODUCTION

The aim of the Geological Analysis and Resource Assessment of selected Hydrocarbon systems (GARA) 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. This will contribute to climate commitments and the planning to secure sources of affordable energy. The analysis and assessment of hydrocarbons will focus on two objectives:

(i) in Europe's major petroleum province – the North Sea a comprehensive cross-border “Geological analysis and resource assessment of North Sea petroleum systems” is conducted. This research includes the assessment of conventional and unconventional oil and gas resources in the most important hydrocarbon basin in Europe. Integrative cross-border analysis will accomplish a comprehensive knowledge and management of the remaining resources in this hydrocarbon province and identify options for multiple and alternative uses of the subsurface as producing fields come off-line.

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

The assessment of gas-hydrates resources in the European continental margin represents an information gap of pan-European interest. This will improve the understanding of the potential role that gas-hydrates may play in the future EU energy mix, as it will constitute a baseline for future projects pertaining the improvement of the European model of the Gas-Hydrate-Stability-Zone (GHSZ), related hazards and potential for geological storage of CO₂.

A catalogue evaluating the multiple use of hydrocarbon reservoirs, as integrated or alternative use of the subsurface, together with an appraisal on hazards and safety, will be produced.



EXECUTIVE REPORT SUMMARY

This report is a project progress report describing the results achieved in the GARAH project in 2020.

The geological survey of Ukraine, GEOINFORM, has unfortunately left the GARAH project in 2020, as the institution has altogether withdrawn from participation from the GeoERA project consortium.

In general, all work packages are in full progress. However, the Covid-19 pandemic has delayed the GARAH-project, as well as the overarching GeoERA project. Some deliverables have been protracted and the deadline for the overall project has been postponed to ultimo October 2021.

As a part of the GeoERA midterm technical review the GeoERA “Geological Analysis and Resource Assessment of selected Hydrocarbon systems” (the GARAH Project) was reviewed overall as excellent.

Based on existing data and knowledge from the WP-partners WP2 will give a harmonized cross-border overview of the North Sea petroleum systems and assess their resource potential. In 2020 work on the GIS database continued and the first unified cross-border maps were produced. The screening of the North Sea areas for unconventional plays have been completed and shale play with adequate data material for resource has been identified. After the preliminary 3D basin and petroleum system setup at the end of 2019, a detailed 3D basin and petroleum systems model for a case study area across Germany, Denmark and the Netherlands has been constructed to assess unconventional HC resources in a first step.

During 2020, the data model structure of the GIS hydrate-related database has been specified and implemented within the GIIP WP. The data base is structured in four information categories: (i) geological and geochemical evidence and indicators, (ii) geophysical indicators, (iii) fluid flow structures, (iv) oceanographic variables. Four types of descriptive items are implemented: location, property metadata, geo-descriptors and references-comments.

A complete set of twenty thematic datasets so far have been deployed and configured on the test EGDI geoportal.



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1 PROJECT PROGRESS

An important purpose of this GARAH project is to generate a catalogue evaluating the multiple use of hydrocarbon reservoirs, as integrated or alternative use of the subsurface, together with an appraisal on risks and safety. This catalogue will be uploaded to an EGDI platform by the GIP- project.

As a part of the GeoERA midterm technical review the GeoERA “Geological Analysis and Resource Assessment of selected Hydrocarbon systems” (the GARAH Project) was reviewed in February 2020. A scale of one to five, where

5 - **Overachiever** (the project has achieved all objectives and goals for the period and has even exceeded expectations)

4 - **Excellent progress** (the project has fully achieved its objectives and goals for the period)

3 - **Good progress** (the project has achieved most of its objectives and goals for the period with relatively minor deviations)

2 - **Acceptable progress** (the project has achieved some of its objectives; however corrective action will be required)

1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or is not at all on schedule),

the project was evaluated in five categories:

- an overall assessment of 4 “Excellent progress”,
- the dissemination activities were assessed to be 3 “Good”,
- the quality as a whole been achieved according to the objectives was assessed as 4 “Excellent progress”, while
- the expected impact of the theme was assessed as 3 “Good progress”,
- and the project progress according to your own understanding and expectations of the GeoERA project was evaluated to be 4 “Excellent progress”.

The review report affirmed that the GARAH project as a whole achieved the objectives and expected impact:

1.1 WP1: Coordination

This work package is concerned with the overall financial, administrative and operational management of the project as well as coordinating activities across the work packages. WP1 is coordinated by GEUS, and 6 person months are budgeted for the WP.

WP1 has organized the GARAH response and presentations with regard to the GeoERA mid term technical evaluation.

WP1 has organized combined technical and regular project board meetings by teleconference using Skype on a monthly basis. At all meetings so far, enough partners have participated to reach quorum.



A face-to-face board meeting was held on the 21st November 2018 in Madrid, and a second meeting was held in Edinburgh 24 October 2019. Due to the Covid-19 pandemic, no face-to-face meeting was held in 2020. Depending on the Covid-19 situation, we hope to have a last face-to-face meeting by end of June 2021.

Regarding deliverables, WP1 has in 2020 produced D1.4: GARAH PI doc no 2B_Midterm Project Progress Report

1.2 WP2: North Sea Petroleum Systems

WP2 is coordinated by GEUS and further 5 partners have reserved time and budget to participate in the tasks. In total, 62.54 person months are budgeted for the WP.

The assessment of the North Sea Petroleum Systems is divided into two parts; a general assessment part utilizing the “EUOGA” methodology, and a pilot study area using a 3D basin and petroleum system modelling (3D BPSM) assessment.

General assessment EUOGA method

Based on existing data and knowledge from the project partners WP2 will give a harmonized cross-border overview of the North Sea petroleum systems and assess their hydrocarbon resource potential. The main focus for the conventional assessment is on harmonizing published national resource assessments and combining the hydrocarbon play maps across borders. This process allows to identify potential underexplored play systems or define new play concepts which will be included in the assessment. The unconventional assessment aims at identifying potential shale gas/oil plays in the North Sea Basin and will apply the EUOGA assessment method to the identified plays.

Conventional

In 2020 work on the GIS database of the North Sea Basin continued and the first unified cross-border maps were accomplished. Layers to be included in the final database were specified and a delivery schedule to the GIP program was set up. New play maps for the Dutch offshore were compiled according to the approved workflow used in Denmark and Norway to ensure cross-border compatibility. Specifications for the UK maps are underway, with a focus cross-border compatibility, especially concerning differences in play concepts. It was decided that a number of GIS layers would be compiled to also focus on alternative energy resources such as wind power and geothermal potential (where possible).

Unconventional

The screening of the North Sea areas for unconventional plays have been completed and several shale plays with adequate data material for resource assessments have been identified. About ten shale assessment units have been distinguished, from three main stratigraphic intervals: the Carboniferous and the Lower and Upper Jurassic units. Monte-Carlo simulations of unconventional resources following the EUOGA assessment method are underway. Parameter distributions for EUOGA assessments are fine-tuned with sensitivity analysis results from 3D BPSM in the pilot study area.

3D pilot study petroleum modelling assessment



In WP 2D a detailed 3D basin and petroleum systems model (3D BPSM) for a case study area across Germany, Denmark and the Netherlands has been setup to assess unconventional HC resources in a first step.

After the preliminary 3D basin and petroleum system setup at the end of 2019, systematic model testing and verification procedures have been conducted. Additional key parameter distributions, provided by the project partners, have successively been incorporated into the model. Sensitivity analysis for key parameters in regard to petroleum generation were carried out. A final high-resolution model has been developed and utilized for in-place, unconventional HC resource assessments of the cross-border source rocks.

Submittal of deliverable Report D2.4 – “3D Pilot Study – Unconventionals” has been rescheduled to end of February 2021. It is timely on track, probably, submitted concurrently to this annual report.

1.3 WP3: Knowledge Gaps Gas Hydrates

WP3 is coordinated by IGME and further 3 partners have reserved time and budget to participate in the tasks. In total, 39.02 person months are budgeted for the WP.

The database is a comprehensive collection of gas hydrate related Pan-European data, incorporating a multitude of different data sources. Hydrate related information is grouped in two sets of data (geological-geophysical and oceanographic data) and assessed on public and free access data in two scopes: (i) data of pan-European scope coming from public and free databases such as EMODnet Geology and Bathymetry, PERGAMON and MIGRATE COST actions, WOD (World Ocean Database), global heat flow database, NOAA and NPP data base; and (ii) data of regional scope coming from scientific organizations such as GEUS, IGME, BGS and BRGM.

GIS hydrate-related database.

During 2020, the data model structure of the GIS hydrate-related database has been specified. The data base is structured in four categories: (i) geological and geochemical evidence and indicators, (ii) geophysical indicators, (iii) fluid flow structures, (iv) oceanographic variables. Four types of items describe the information: location items, property metadata, geo-descriptors and references-comments. Location items describe the geographical location (coordinates, geological setting, etc.). Property-reference metadata store the owner of data and contact information. Geo-descriptors describe the geological, geochemical and geophysical characteristics of the evidence of indicator. Finally, references-comments store bibliographic references and other comments of interest of the hydrate evidence or indicator.

Geological and geochemical evidence and indicators store gas hydrate evidence and indicators (eg. degassing structures and pore water anomalies) acquired by direct sampling. Geophysical Indicators resemble characteristic reflection seismic or electric features of the gas hydrate presence in the sediment column such as high resistivity, bottom simulating reflector (BSR) level, bright spots, blanking acoustic facies or gas chimneys among other. Seabed fluid flow structures store structures related with the fluid migration in areas where hydrates evidence or indicators have been noticed. Finally, oceanographic variables store information about seafloor temperature, geothermal gradient and bathymetry.



Regarding hydrate samples, seismic indicators and seabed fluid flow structures, more than 136,000 records have been stored so far.

In the oceanographic variable group, seafloor temperature data (5,896 records), geothermal gradients (4,332 records) and bathymetry raster datasets with a cell size ~100x100 m) have been incorporated into the database .

Regarding deliverables, WP3 has in 2020 produced “GARAH.D.3.2: Hydrates GIS-dataset” (M27), giving details on the hydrate database structure and incorporated datasets.

1.4 WP4: Knowledge Data Base

WP4 is coordinated by GEUS and further 3 partners have reserved time and budget to participate in the tasks. In total, 11.08 person months are budgeted for the WP.

Most of the data from WP3 (gas hydrates) are uploaded to the EGDI test geoportal. The possibility to upload raster data was only implemented at the end of December 2020, thus uploading of raster datasets is not yet completed and ongoing.. Twenty datasets from WP3 are so far uploaded to and configured on the geoportal. A dedicated webservice returning a list of related publications for any given gas hydrate feature has been developed and implemented in the geoportal.

All datasets for WP3 are registered in the EGDI metadata catalogue, “Micka”. The metadata still need to be finalized (e.g. lineage and copyright information still needs to be added to some of the datasets).

The data from WP2 are not ready yet, but some associated datasets like fishing activities, license areas and pipelines are added to the geoportal.

WP4 has made two reports during 2020:

- Deliverable 4.2 Description of the work done on EGDI, guidelines for uploading, updating and consulting information
- Deliverable 4.3 Assist in hydrocarbon resource planning has been submitted at the end of 2020.



2 DISSEMINATION ACTIVITIES

The GARAH dissemination activities are given in the table below.

Activity	Subcategory	Date	Target audience	Number of people reached	Short name of project participant	Author(s)	Title
PUBLICATIONS	SCIENTIFIC PUBLICATION	17-06-2019	SCIENTIFIC COMMUNITY		npa	Schovsbo	See bibliography below
MEETINGS	Meeting with international body	03-07-2018	EU INSTITUTION	200	many		
MEETINGS	Meeting with other GeoERA projects	01-09-2018	SCIENTIFIC COMMUNITY	15	TNO, BGR, GEUS, PGI		
MEETINGS	Meeting with other GeoERA projects	01-03-2019	SCIENTIFIC COMMUNITY	75	many		
MEETINGS	Meeting with other GeoERA projects	01-09-2019	SCIENTIFIC COMMUNITY	15	TNO, BGR, GEUS, PGI		
MEETINGS	Internal project meeting	oct-2018	SCIENTIFIC COMMUNITY	20	TNO, IGME, BRGM, BGR, BGS, GEOINFORM, GEUS		
MEETINGS	Internal project meeting	oct-2019	SCIENTIFIC COMMUNITY	20	TNO, IGME, BRGM, BGR, BGS, GEOINFORM, GEUS		
MEDIA	ONLINE MEDIA		GENERAL PUBLIC		many		
EVENTS	CONGRESS	sep-19	SCIENTIFIC COMMUNITY	100+	BGR, TNO, GEUS	Arfai, Ja	See bibliography below
MEDIA	ONLINE MEDIA	mar-19	GENERAL PUBLIC				GeoERA Newsletter #7
MEDIA	ONLINE MEDIA	jun-19	GENERAL PUBLIC				GeoERA Newsletter #8
MEDIA	ONLINE MEDIA	nov-19	GENERAL PUBLIC				GeoERA Newsletter #9
MEDIA	ONLINE MEDIA	jun-20	GENERAL PUBLIC				GeoERA Newsletter #13
EVENTS	CONFERENCE (tele-conference)	maj-20	SCIENTIFIC COMMUNITY	500		Leon, R. et	See bibliography below
EVENTS	CONFERENCE (tele-conference)	maj-20	SCIENTIFIC COMMUNITY	500		Lutz, R. et	See bibliography below
EVENTS	CONFERENCE (tele-conference)	maj-20	SCIENTIFIC COMMUNITY	500		Nelskamp	See bibliography below
EVENTS	CONFERENCE (tele-conference)	maj-20	SCIENTIFIC COMMUNITY	500		Schovsbo	See bibliography below
PUBLICATIONS	SCIENTIFIC PUBLICATION	06-06-2020	SCIENTIFIC COMMUNITY			Schovsbo	See bibliography below
EVENTS	CONFERENCE (tele-conference)	nov-20	POLICY MAKERS	110	GeoERA Webinar		GeoERA-Geol. Serv. EU
MEDIA	ONLINE MEDIA	nov-20	SCIENTIFIC COMMUNITY		researchgate.net		GARAH research link
MEETINGS	Meeting with international body	nov-18	SCIENTIFIC COMMUNITY	50	MIGRATE COST	R. León	
MEETINGS	Meeting with international body	29-01-2019	SCIENTIFIC COMMUNITY	20	MIGRATE COST	R. León	
EVENTS	WORKSHOP	sep-19	SCIENTIFIC COMMUNITY	50	GDR Hydrates, Bres	A. Burnol	
EVENTS	CONGRESS	sep-19	SCIENTIFIC COMMUNITY	100	IAS 2019, Rome	R. León	



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Journals

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Schovsbo, N.H., Ladage, S., Mathiesen, A., Nelskamp, S., Stewart, M.A., Britze, P., 2020a. Unconventional hydrocarbon resource plays in the



North Sea Basin, Northwestern Europe, EGU General Assembly 2020,
Vienna, Austria.



3 CUMULATIVE EXPENDITURE GARAH PROJECT

The cumulative expenditure for 2020 is given in the table below.

No.	Beneficiary	Project	Cumulative Expenditure 2020 reported by Beneficiaries
1	TNO	GARAH	€ 19.494
11	GEUS	GARAH	€ 159.894
13	BRGM	GARAH	€ 11.426
14	BGR	GARAH	€ 31.306
41	IGME-Sp	GARAH	€ 52.544
44	GEOINFORM	GARAH	-€ 198
45	NERC_UKRI_BGS	GARAH	€ 6.281
SUM GARAH € 280.747			