



Geological Analysis and Resource Assessment of selected Hydrocarbon systems

Deliverable 4.1

PRELIMINARY DATA SELECTION
TO PROVIDE RELEVANT
INFORMATION IN ASSESSING
HYDROCARBON RESOURCES IN
SUBSURFACE

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GENERAL INTRODUCTION

This report D4.1 Preliminary data selection to provide relevant information in assessing hydrocarbon resources in subsurface i.e. IP-guidelines and QA procedures communicates the information relevant for harmonizing the produced GIS data between the GeoERA GARAH (Geological Analysis and Resource Assessment of selected Hydrocarbon systems) project and the GeoERA GIP-P (Geographic Information Platform Project) and consequently the European Geological Data Infrastructure (EGDI).

GARAH WP4 is responsible for communicating the requirements of the project to GIP-P and vice versa ensure that the guidelines and standards provided by GeoERA-IP are properly implemented in the GARAH WP2 and WP3 processes. At this stage the GARAH project all GIS data expected to be produced in the GARAH project is not fully described, but the GIS data description will follow the procedure outlined in the tables included in this report. As the GARAH project progress the tables in this report will continuously be updated.

This report summaries the information exchanged between GIP-P and GARAH projects at the GIP-P WP2 Interaction meeting 24th - 25th of October 2018 at the Royal Belgian Institute of Natural Sciences, Geological Survey of Belgium, and up to present.

EXECUTIVE REPORT SUMMARY

This report summaries the information exchanged between the GIP-P and the GARAH projects regarding the GIS data expected to be produced in GARAH and processed by the GIP-P project for publishing at EGDI WebGIS platform.

Following vector GIS data will be produced in GARAH: Basin outlines, formation outline, play outline, exploration wells, hydrocarbon fields, faults, geothermal gradients, seafloor temperature, seafloor T heat flow, gas hydrates below seafloor, gas stability map, seismic horizon interpretations and fishing activities. Following grid GIS data will be produced: Stratigraphic surfaces, bathymetry and sedimentation rates in 4D. Each GIS data layer is described with respect to expected attributes, suggested column name and unit.

Based on the present information exchanged between GIP-P and GARAH, basic GIS data information as coordinate system, metadata, expected WebGIS functionality and searchable keywords are given.





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1 INFORMATION FROM GIP-P

The GIP-P WP8 is dedicated to provide technical support for setting up the web-services. A wiki/cookbook solution is under development at https://github.com/GeoEra-GIP

GARAH WP4 will receive a questionnaire related to IPR issues from the GIP-P WP10 and GIP-P will provide a clear timeline including the interaction processes that we have with milestones and deadlines.

The GIP-P needs to be informed if a workshop within GARAH is organized and part of it concerns data, format and attributes.

1.1 GIS data

GIP-P need know what kind of data GARAH will produce and their attributes to be able to provide the best standards. GIP-P is aware that asking, "What you are producing including the attributes", is an iterative process. The liaison will contact each project to setup working plan in order to clarify those questions.

1.2 File formats

GIP-P encourages GARAH to provide produced data via web-services. In many cases, the structure of a shape file is too limited to respect standards such as the Inspire ones.

1.3 3D-models

GIP-P needs more information about 3D-models such as the software used and what kind of models (2.5D layers, complex features, voxel...). GIP-P are working on a short questionnaire, which will contain data examples mapped to the common standards and precise questions about 3D data.

2 GIS DATA EXPECTED PRODUCED IN THE GARAH PROJECT

The GARAH Project expect to produce both vector data and grids. The expected data layers are listed below. A more detailed description of the data layers are given in chapter 3 and 4.

2.1 Vector data

Basin outlines (polygons)

Formation outline (polygons)

Play outline (polygons)

Exploration wells (points)

Hydrocarbon fields (polygons)

Faults (lines, will be linked to fault data produced in GeoERA 3dGEO-EU)

Geothermal gradients (?)

Seafloor temperature (points)

Seafloor T heat flow (points)

Gas hydrates below seafloor (polygons)





Gas stability map (polygons)

Horizon interpretations (lines)

Fishing activities (polygons)

2.2 Grids

Stratigraphic surfaces

Bathymetry

Sedimentation rates in 4D

3 VECTOR DATA ATTRIBUTES AND UNITS

In order to harmonize the data produced in GARAH the tables in the sub-chapters below have listed each data layer and suggestions for attribute names, column names, units and field type, supplemented with an example. Field types can be either short integer, long integer, double or text.

If possible or needed an attribute can be divided into an average value, minimum and maximum values, e.g. POR_avg, POR_min, POR_max (one column for each), this can illustrate uncertainties and range of variation.

3.1 Basin outline

Attributes: Basin outline (polygons)	Column name (max. 10 characters)	Units	Field type (GIS)	Example
Name	NAME		Text	Wessex

3.2 Formation outline

Attributes: Formation outline (polygons)	Column name (max. 10 characters)	Units	Field type (GIS)	Example
Name	NAME		Text	Gassum
Country	COUNTRY		Text	DK
Age	AGE		Text	U. Triassic – L. Jurassic
Lithology	LITHOLOGY		Text	Sandstone
Depth top max	DEP_TOP_MAX	Metre (m)	Numerical (Double)	-1200
Depth top min	DEP_TOP_MIN	Metre (m)	Numerical (Double)	-1500
Thickness	THICK_AGV	Metre (m)	Numerical (Double)	120
Volume?	VOLUME	Cubic kilo meter (km³)	Numerical (Double)	





Net/gross	NET_GROSS	ratio	Numerical (Double)	
Porosity	POR_AGV	%	Numerical (Double)	20
Permeability	PERMEA_AGV	milliDarcies (mD)	Numerical (Double)	1000

3.3 Play outline

Attributes: Play outline (polygons)	Column name (max. 10 characters)	Units	Field type (GIS)	Example
Name	NAME		Text	
Country	COUNTRY		Text	DK
Age	AGE		Text	U. Triassic - L. Jurassic
Lithology	LITHOLOGY		Text	Sandstone
Depth top max below sea level	DEP_TOP_MAX	Metre (m)	Numerical (Double)	-1450
Depth top min below sea level	DEP_TOP_MIN	Metre (m)	Numerical (Double)	-1800
Thickness average	THICK_AGV	Metre (m)	Numerical (Double)	120
Volume	VOLUME	Cubic kilo meter (km³)	Numerical (Double)	
Net/gross	NET_GROSS	ratio	Numerical (Double)	
Porosity	POR_AGV	%	Numerical (Double)	20
Permeability	PERMEA_AGV	milliDarcies (mD)	Numerical (Double)	1000
Salinity	SALINITY		Numerical (Double)	
TOC content	TOC	%	Numerical (Double)	3.2
TOC type	TOC_TYPE		Text	II marine
Thermal maturity	THERM_MAT		Text	>0.7% Ro, oil mature
Mineralogy	MINERALOGY		Text	Brittle
Pressure regime	PRESS_REG		Text	Normal
Structural complexity	STRUC_COMP		Text	Low to moderate
Hydrocarbon content	HC_TYPE		Text	Condensate
Play status	PLAY _STAT		Text	Drilled





3.4 Exploration wells

Attributes: Exploration wells (points)	Column name (max. 10 characters)	Units	Field type	Example
Name	NAME		Text	C1-X
Latitude	LAT		Coordinate	
Longitude	LONG		Coordinate	
x-utm	X_UTM		Coordinate	
y-utm	Y_UTM		Coordinate	
UTM zone	UTM_ZONE		Text	N31
Country	COUNTRY		Text	Denmark
Year	YEAR		Numerical (Short integer)	
Depth (below sea level)	DEPTH	Meter (m) Feet?	Numerical (Double)	2854
Hydrocarbon content*	HC_CONT	Oil, condensate, gas or mixed	Text	Oil and Gas tested
Operational status	OPR_STATUS		Text	Exploration

^{*}Hydrocarbon content: write the primary content first

3.5 Hydrocarbon fields

Attributes: Hydrocarbon fields	Column name (max. 10	Units	Field type (GIS)	Example
(polygons)	characters)		(/	
Name	NAME		Text	South Arne
Country	COUNTRY		Text	Denmark
On or offshore	ON_OFFSHOR		Text	Offshore
Age	AGE		Text	U. Cretaceous - Paleogene
Formation	FM		Text	Ekofisk
Lithology	LITHOLOGY		Text	Chalk
Discovery year	DISCOV_Y		Numerical (Double)	1969
Hydrocarbon content*	HC_CONT	Oil, condensate, gas or mixed	Text	Oil and Gas
Status	STATUS	Pending production, Producing, depleted, abandon	Text	Producing
Operator	OPERATOR		Text	Hess
Operational status	OPR_STATUS		Text	Producing

^{*}Hydrocarbon content: write the primary content first





3.6 Faults

Attributes: Faults (lines)	Column name (max. 10 characters)	Units	Field type	Example
Name	NAME		Text	Fjerritslev

Remark: Faults (lines) will be linked to 3dGEO-EU project.

3.7 Geothermal gradients / Heat flow

Attributes: Geothermal gradients	Column name (max. 10 characters)	Units	Field type (GIS)	Example
ID name	ID		text	987B
Data source	SOURCE		text	OceanicHeatFlo w_Pollacketal19 93
Latitude	LAT	DD	Double	53.7262
Longitude	LONG	DD	Double	-14.389
Water depth	DEPTH	Meters	Long integer signed	-1993
Heat flow	HEATFLOW	mW m-2	Double	78.5
Thermal Conductivity	T_CONDUC	W m-1 K-1	Double	1.24
Geothermal Gradient	GEO_GRAD	mK m-1	Double	28.8
Geothermal Gradient - 2	GEO_GRAD2	Celsius/ 100 m	Double	33.1

3.8 Seafloor temperature

Attributes: Seafloor temperature (points)	Column name (max. 10 characters)	Units	Field type (GIS)	Example
ID name	ID		text	06MT18_1- A01E-558
Data source	SOURCE		text	WOCE_CTD_ar tic_v2
Latitude	LAT	DD	Double	53.7262
Longitude	LONG	DD	Double	-14.389
Water depth	DEPTH	Meters	Long integer signed	-1993
Seafloor temperature	TEMP_SF	Celsius	Double	3.3705
Comments	COMMENTS		text	Internal document

3.9 Underwater masses

Attributes: Seafloor T heat flow (polygons)	Column name (max. 10 characters)	Units	Field type (GIS)	Example
Name	MASS_NAME		text	MOW
Source	SOURCE		text	Llave et al 2008
Description	DESCRPT		text	Mediterranean outflow water





3.10 Gas hydrates direct evidences (points)

Attributes: Gas hydrates below seafloor (points)	Column name (max. 10 characters)	Units	Field type (GIS)	Example
ID name	ID		text	Scg_87B
Cruise	CRUISE		text	TTR-14
Method	METHOD		text	Gravity core
Latitude	LAT	DD	Double	53.7262
Longitude	LONG	DD	Double	-14.389
Water depth	DEPTH	Meter	Long integer signed	-1993
Depth below seafloor	DEPTH_BSF	Meter	Long integer signed	-0.43
Data source	SOURCE		text	Kenyon et al 2002
Institution	INSTITUT		text	GEOMAR
Contact name	CONTACT_N		text	Jaco Pastorius
E_mail	EMAIL		text	Pastorius.king@ ip.pt
References	REFS		text	10.1029/2000G L012141
Comments	COMMENTS		text	Internal document

3.11 Seismic Anomalies (polygons)

Attributes: Gas hydrates below seafloor (polygons)	Column name (max. 10 characters)	max. 10		Example
ID name	ID		text	Scg_87B
Cruise	CRUISE		text	TTR-14
Method	METHOD		text	Gravity core
Area	AREA	km ²	Double	45
Seismic anomaly type	ANOMAL_TYP		text	BSR
Data source	SOURCE		text	Kenyon et al 2002
Institution	INSTITUT		text	GEOMAR
Contact name	CONTACT_N		text	Jaco Pastorius
E_mail	EMAIL		text	Pastorius.king@ ip.pt
References	REFS		text	10.1029/2000G L012141
Comments	COMMENTS		text	Internal document





3.12 Seismic Anomalies (lines)

Attributes: Gas hydrates below seafloor (lines)	Column name (max. 10 characters)	Units	Field type (GIS)	Example
ID name	ID		text	Line_87B
Cruise	CRUISE		text	TTR-14
Method	METHOD		text	airgun
Data source	SOURCE		text	Kenyon et al 2002
Seismic anomaly type	ANOMAL_TYP		text	BSR
Institution	INSTITUT		text	GEOMAR
Contact name	CONTACT_N		text	Jaco Pastorius
E-mail	EMAIL		text	Pastorius.king@ ip.pt
References	REFS		text	10.1029/2000G L012141
Comments	COMMENTS		text	Internal document

3.13 Seismic Anomalies (points)

Attributes: Gas hydrates below seafloor (points)	Column name (max. 10 characters)	Units	Field type (GIS)	Example
ID name	ID		text	Scg_87B
Cruise	CRUISE		text	TTR-14
Method	METHOD		text	airgun
Latitude	LAT	DD	Double	53.7262
Longitude	LONG	DD	Double	-14.389
Data source	SOURCE		text	Jaco Pastorius
Seafloor depth	DEPTH_S_M	Meter	Double	525
Depth of anomaly TWT bsl	D_BSI_TWT	Second	Double	0.5
Depth of anomaly TWT bsf	D_BSF_TWT	Second	Double	0.65
Seismic anomaly type	ANOMAL_TYP		text	Gas flare / BSR
Institution	INSTITUT		text	GEOMAR
Contact name	CONTACT_N		text	Jaco Pastorius
E-mail	EMAIL		text	Pastorius.king@ ip.pt
References	REFS		text	10.1029/2000G L012141
Comments	COMMENTS		text	Internal document





3.14 Thickness of the base of the gas hydrate stability zone

Attributes: Gas stability map (lines	Column name (max. 10 characters)	Units	Field type (GIS)	Example
Thickness of the Base of Gas Hydrate Stability Zone	BGHSZ	Meter	Double	120.6

3.15 Horizon interpretations

Attributes: Horizon interpretations (lines)	Column name (max. 10 characters)	Units	Field type GIS)	Example
ID			Text	
Name			Text	

3.16 Fishing activities

Attributes: Fishing activities (polygons)	Column name (max. 10 characters)	Units	Field type (GIS)	Example
Name	NAME		Text	Doggerbanke
Activity type	TYPE		Text	Hooks

4 GRID DATA

Tree thematic layers have been identified: Stratigraphic surface, bathymetry and sedimentation rates in 3D.

4.1 Stratigraphic surfaces

Stratigraphic surfaces with grid cells values as meters below sea level. The stratigraphic surfaces (horizons) expected to be included in GARAH are shown with red in figure 1.

4.2 Bathymetry

Bathymetry with grid cells values as meters below sea level.

4.3 Sedimentation rates in 4D

At present it's not clear how this data will be presents as grid data.

4.4 Thickness of the base of the gas hydrate stability zone

At present it's not clear how this data will be presented as grid data.





Time (Ma)	Era	Period	Series	Stage/Age Menning (2012)	Strat. Marker	Depth maps	SPBA Doornenbal & Stevenson (2010)	NL TNO Kombrink <i>et al.</i> (2012)	Tectonic phase	Но	orizons of GARAH
			Holocene	Holocene			` '			(0)	Sea bottom
2.6 Ma		a	Pleistocene	Pleistocene	q					0	oca bottom
			Pliocene	Piacenzian Zanclean	tpl						
		ne		Messinian Tortonian	tmio						
	ပ	Neogene		Serravallian Langhian	tmiR	~~~~		200			
240407407700	Cenozoic	Ne	Miocene	Burdigalian				Upper			
24 Ma	enc			Aquitanian Chattian	tmiu tolo			North Sea Group		(1)	MMU
	ပ	a	Oligocene	Rupelian Priabonian	toIR						
		gen		Bartonian	teom						
		Palaeog	Eocene	Lutetian		ľ	Near base				
		Pal		Ypresian	teou		Tertiary	Lower and Middle			
			Paleocene	Thanetian Selandian	tpao		(Top Chalk Group; Top Danian)	North Sea Groups		(2)	Base Tertiary
65 Ma			r aicocomo	Danian	td		Domany				
				Maastrichtian Campanian	krma krca				Sub- Hercynian		
			Upper	Santonian	krsa	J	(100 m)		nercyman		
		Sno	ų	Coniacian Turonian	krcc krt		Base Cretaceous (Base Chalk Group;				
99 Ma		cec		Cenomanian	krc		Base Cenomanian)	Chalk Group		(3)	Doga Upper Cretegogue
		Cretaceous		Albian Aptian	krl krp					9	Base Upper Cretaceous
		Ü	Lower	Barremian	krb		Near base				
			ر د	Hauterivian Valanginian	krh krv		Lower Cretaceous (approximately near base	Rijnland Group			
142 Ma				Berriasian	Wd		Ryazanian)	, injinana oroap		(4)	Base Lower Cretaceous
	П			Tithonian	joPO				Late Cimmerian		
			III)		10.000		Near base		Ommonan		
			Upper (Malm)	Kimmeridgian	joki		Upper Jurassic				
		sic		Oxfordian	joox		(varying from the Callovian to	Schieland, Scruff		(5)	Daga Unnar Juragaia
157 Ma	oic	Jurassic		Callovian	jmcl	~~~	the base of the Oxfordian)	Niedersachsen Groups	Mid-	0	Base Upper Jurassic
	Mesozoic	극	Middle (Dogger)	Bathonian	jmbt		Near base		Cimmerian	_	
178 Ma	Me		Mic Do	Bajocian Aalenian	jmbj jmal		Middle Jurassic (Top Lias Group)			(6)	Base Middle Jurassic
			F (2)	Toarcian	jutc		Near base			(71)	Desidenia Chala/Tearsian
			Lower (Lias)	Pliensbachian Sinemurian	jupl jusi		Lower Jurassic			(7.1)	Posidonia Shale/Toarcian
200 Ma				Hettangian	juhe		(Base Lias Group)	Altena Group		(7)	Base Lower Jurassic
			-	Rhaetian	ko			7 illeria Group			
			Keuper	Norian	km			Upper Germanic			
			Ž,	Carnian			Near base	Trias			
235 Ma					ku		Upper Triassic	Keuper FM Group			
243 Ma		Triassic	Muschel- kalk	Ladinian Anisian	mo mm mu		Near base	Muschelkalk			
245 Ma		rias	Upper	Röt	soT soS		Middle Triassic (Base of the Röt evaporites)	Wadonoman			
			nie		smSWF			Lower			
			andste	Olenekian	smHWF smH			Germanic			
			San		smDWF smD smVWF		Near base	Trias			
			Buntsandstein		smV suB		Lower Triassic	Group		_	
251 Ma			Lower	Induan	suC		(Base Buntsandstein)	Buntsandstein		(8)	Base Triassic
			Ë	Changhsing	z5-7						
255 Ma			Zechstein (Lopingian)		z4						
		_	ech (Lopir	Wuchiaping	z3						
258 Ma		mian	N		z2Na z2 z1		Base Zechstein	Zechstein		(9)	Base Zechstein
		Perr	_		roH roD roSL ro			Upper Rotliegend			2000 20011010111
		_	Rotliegend	Upper	roSL ro		Upper Rotliegend	Group			
			tlieg		ru			Lower Rotliegend			
300 Ma	ċ		Rol	Lower			Lower Rotliegend	Group			
Jov Ma	OZC	SI	Cileri	Stephanian	cst		Stephanian		Saalian		
326.5 Ma	Palaeozoic	Carboniferous	Silesian	Westphalian	cw		Westphalian	Limburg Group			
220.0 1.10	ď	ul	an	Namurian	cn		Namurian	Carboniferous			
		arbe	Dinantian	Viséan			Vinéan	Limestone			
358 Ma		Ö	Dị.	Tournaisian			Viséan Tournaisian	Group			
					d						
				Devon	u u						
417.5 Ma											
417.5 Ma											

Figure 1. Provisional, non-harmonized nomination of model horizons (Subsequent, possible integration of further Jurassic to Tertiary horizons)





5 GEOGRAPHIC PROJECTIONS

It is recommend to use the projections listed by Inspire. At present, the WebGIS portals support two projections, WGS 84 and ETRS 89 LCC. GIP-P consider adding ETRS 89 LAEA (Lambert Azimuthal Equal Area) to the system for true area representation purposes.

6 METADATA

Metadata is literally "data about data". It is a description of the content, quality, lineage, contact, condition, and other characteristics of data. Pertaining to spatial data, metadata can help provide answers to such questions as:

- Who created the data?
- When was the data created?
- When was the data updated?
- Why was the data created / what does it represent?
- What kind of data is it?
- How accurate is the data?

Metadata is a critical and mandatory component of a dataset and should comply with the ISO standards. Metadata preserve the usefulness of all types of environmental data over time by detailing methods for data collection and dataset creation.

The ISO metadata standard must be: ISO 19115-1:2014 for Geographic Information Metadata

Further details and information about metadata will be described in a follow-up notice.

7 WEBGIS FUNCTIONALITY

The GIP-P has requested information on how the GARAH project expect users to work with the data in the WebGIS platform. At present one functionality has been communicated to GIP-P and that is the option for users to make queries (Query builder).

8 KEYWORDS TO SEARCH CATEGORIES

WP4 have submitted the keywords listed in the table below to GIP-P 9/11-2018. The list can be extended.

Terms extracted	Search Categories
3D models: geological, deep, fault plane surfaces,	GEOTHERMAL RESOURCES
structural-geological model, petroleum system,	GEOLOGICAL PROCESSES
seismic interpretation, t, Fracture, facies	STRUCTURAL GEOLOGY





	APPLIED GEOPHYSICS			
	FOSSIL RESOURCES			
	LITHOLOGY			
	GEOLOGICAL PROCESSES			
Assessment of the conventional and unconventional	APPLIED GEOPHYSICS			
resources	LITHOLOGY			
	GEOCHEMISTRY			
	APPLIED GEOPHYSICS			
Gas Hydrate	FOSSIL RESOURCES			
	GEOCHEMISTRY			
	GEOLOGICAL PROCESSES			
Geological storage of CO2	STRUCTURAL GEOLOGY			
	APPLIED GEOPHYSICS			
GIS layers	INFORMATION SYSTEM			
Olo layolo	FOSSIL RESOURCES			
	GEOLOGICAL PROCESSES			
Hazards: geological hazards	LITHOLOGY			
	NATURAL HAZARD			
	GEOLOGICAL PROCESSES			
	APPLIED GEOPHYSICS			
HC resources	FOSSIL RESOURCES			
	LITHOLOGY			
	GEOCHEMISTRY			
	GEOLOGICAL PROCESSES			
GIIP: Gas Initially in place	APPLIED GEOPHYSICS			
	FOSSIL RESOURCES			
	GEOLOGICAL PROCESSES			
OIIP: Oil Initially in place	APPLIED GEOPHYSICS			
	FOSSIL RESOURCES			





	APPLIED GEOPHYSICS		
Reservoir rock parameters	PETROPHYSICS		
reservoir rook parameters	LITHOLOGY		
	FOSSIL RESOURCES		
	GEOCHRONOLOGY		
Shale formations	CHRONOSTRATIGRAPHY		
Graic formations	GEOLOGICAL PROCESSES		
	INFORMATION SYSTEM		
	GEOLOGICAL PROCESSES		
Source rocks	APPLIED GEOPHYSICS		
Source rocks	LITHOLOGY		
	GEOCHEMISTRY		
Tectonostratigraphic models; geochemical and	STRUCTURAL GEOLOGY		
geological	MODELLING		
Geological 3D models	MODELLING		
Unconventionals	FOSSIL RESOURCES		
Conventionals	FOSSIL RESOURCES		