

UNFC work in Mintell4EU and UNFC on Norwegian Phosphate

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RESOURCE MANAGEMENT WEEK 2021 ENABLING SUSTAINABILITY PRINCIPLES IN RESOURCE MANAGEMENT



UNECE



- The European countries need a **common tool** to aggregate information for **continent wide** resource inventories
- In Mintell4EU we are testing if the United Nations Framework Classification is a tool that can be used by **geological surveys** to evaluate a country's known and potential resources.
- And we are also testing if the UNFC system can be used to provide better **harmonization** of mineral resource data nationally and across Europe.



22 case studies

National, regional and local level

UNFC application to aggregates (limestone; gravel and sand) resources in the Croatia, Koprivnica- Križevci County case study

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UNFC Case study – Slovenia

Introduction/Background

Define the resource
 What is your case study about, what kind of resource, location, situation, scale (project, local, regional or national) etc.
 It is about Slovenian national reserves classification mapping to UNFC classification.
 The case was for limestone (aggregate-cooked stone), but the methodology is the same for all kind of mineral resources (in this case overview)

Methodology

Did you use anything from ISO/IEC-compliant [data202](#)
 How have data been gathered? GeoS2 is a national mineral data manager authorized by [MRE](#), all concessionaires are obliged to report to Ministry, further all mineral data [go to data202](#).

What kind of data have been used?
 Availability of data sources: GeoS2 has the official permission [to manage and](#) has the access to all national mineral data

UNFC

Evaluation of data and areas, calculation of volumes, Slovenia specific [UNFC](#), we evaluate and calculate into mineral assessment within national reserves (exploration and exploitation areas)
 Defining the E, F and G [UNFC](#) prepared a "recipe" to transform national classification into UNFC (using E, F and G axes)

Challenges

Describe the challenges, harmonisation issues and uncertainties you may encounter in this kind of work. What is the quality of the data? What are the issues concerning availability of data?

Country	Gold	Copper	Cobalt	Manganese	REE	Phosphate	Limestone	Graphite	Aggregates	Natural stone	Peat	Gypsum	Perlite
Austria									X				
Belgium						X							
Croatia							X		X	X			
Denmark							X		X				
Finland	X	X	X					X			X		
Hungary				X								X	X
Norway						X		X	X	X			
Slovenia							X						
Sweden					X								

UNFC Case study – Danish chalk and limestone resources

Introduction/Background

Chalk and limestone have been mined for ages in Denmark, e.g. for improving agricultural soils but also as construction stone. Today, most chalk and limestone are used in cement production, for soil improvement, in paint, paper and plastic production, and in other chemical products.

In Denmark, raw materials can only be exploited in designated excavation areas laid out by the Danish Regions with an excavation license in hand. Licenses are based on a national Raw Materials Law and are issued and enforced by the Danish Regions. The licenses include environmental requirements, terms on access, noise, dust, groundwater protection etc. Besides, mining companies must provide an economic guaranty for reconstruction of the mined area when abandoned.

In Denmark, chalk and limestone are mined in open pits only.

Define the resource

What kind of resource, location, situation, scale (project, local, regional or national) etc.
 The following case study is national, covering Danish carbonates (see definition on the accessibility below).

The Danish carbonates are typically distinguished into two different types, depending on their age and lithology:

- Crataean chalk, a very fine grained (muddy) carbonate with a relatively low content of chert and variable but low clay content.
- Dniptro limestone, variable grain size from mud, silt to sand and with a higher content of chert. One exception is the local limestone, a very close limestone type, commonly found in the southeastern part of Zealand.

The main part of the Danish subsurface contains several hundred of meters of carbonates of different geological ages, but in most places too deep to be exploited. The first case, based on the resource evaluation conducted by Ditlevsen et al (2013), only includes resources down to 25 m below surface and with less than 20 m in overburden, see Figure 1.

Chalk and limestone are, in terms of proved/assessed resources, the third largest group of Danish raw materials, only surpassed by salt and sand & gravel. Chalk comprises with 95%, while limestone only stands for 5%. See table 1 for numbers on proved/assessed, installed and inferred resources. Green numbers (inferred resources) are model-based calculations, based on a maximum mining



UNFC Case study – A case study on Graphite

Introduction/Background

Define the resource

This case study was done on Tuba graphite deposits, and examines the Tuba deposit (active mine, Skander Graphite AS) and the Subakmøse deposit on large peninsula, in Trondheim in Northern Norway (Figure 2). In addition, UNFC classification was applied for 24 graphite deposits (Table 2). All of the graphite occurrences are found in supracrustal granitic gneiss rocks of Archaean to Proterozoic age, comprising quartzite, magnetite gneisses, iron formation, calc-silicate and graphite schist.

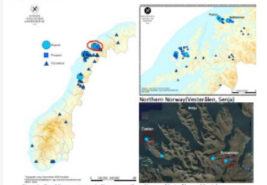


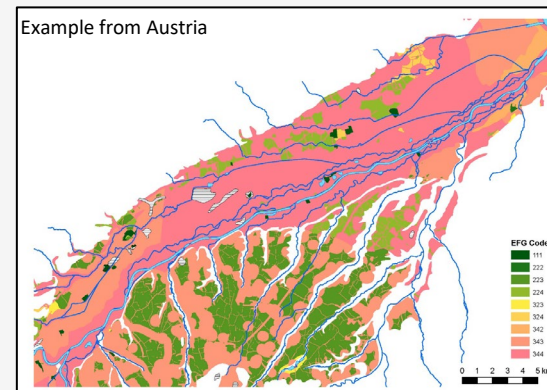
Figure 1. Graphite occurrences in Norway, northern Norway (Trondheim and Tuba)



- Case studies shows that geological surveys can do UNFC on Raw Materials
- The partners in MINTELL4EU have different levels of experience in UNFC and the **approach and methods** on UNFC varies between the countries. Stricter **guidelines** are required.
- **Data availability** is an issue as non-accessible data can result in less precision. In addition, not all geological surveys have the **responsibility** or data availability to be able to classify the E- and F-axis in UNFC.
- There is a need to compare the case studies and the surveys approach to identify **obstacles, data gaps** and **harmonization issues**.
- There is a need to work on the visualisation of UNFC

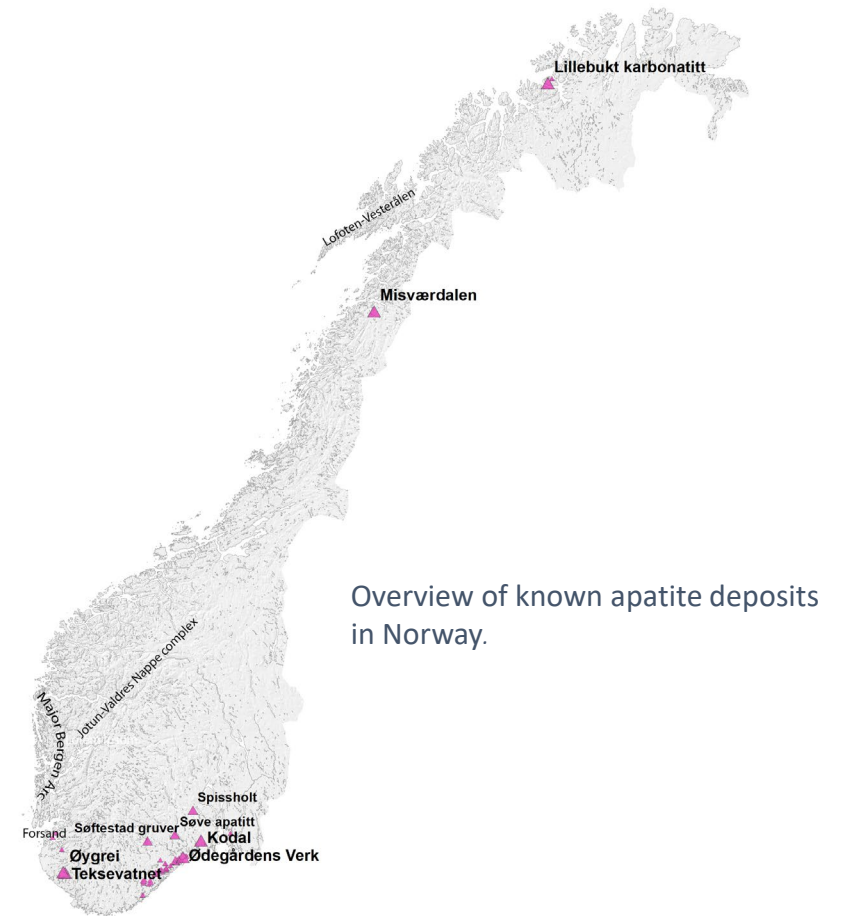
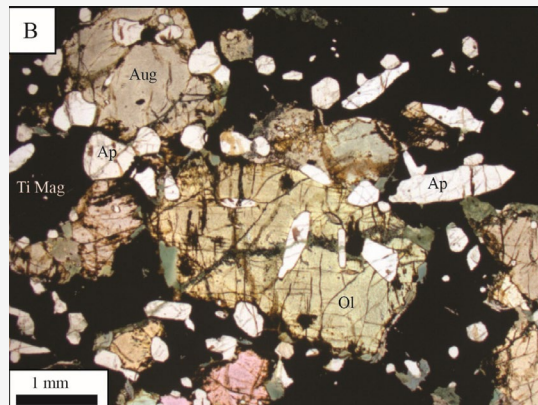


- Report with a **case study review** with practical **guidelines/work flow** and examples of applying UNFC to European Mineral Resources (not necessarily best practice....)
- Report on **harmonization issues, data gaps and challenges**, reviewing also the quality of the Pan-European aggregated inventories of selected commodities
- Doing a pilot on visualization of UNFC





- The most prominent phosphate bearing mineral in Norway is apatite of igneous origin.
- There are several known deposits and occurrences. Some have been well-known for several years, other are less known.



Overview of known apatite deposits in Norway.



- Only two of the deposits have JORC compliant resource estimates enabling bridging to UNFC: Kodal and Øygrei.
- Other deposits have resource estimates that are non-compliant and not done according to known classification standards. Hence, bridging is not an option for most phosphate deposits in Norway.
- Both published and unpublished data (geological reports and articles, company reports and more) have been compiled, mainly focusing on the quality, and performed activities at the various deposits.

Numbers and classification for the Kodal deposit.

Category	Gross			Net			UNFC bridging		
	Mt	Grade	Mt	Mt	Grade	Mt	E	F	G
	P ₂ O ₅ + Fe	P ₂ O ₅	P ₂ O ₅	P ₂ O ₅ + Fe	P ₂ O ₅	P ₂ O ₅			
Indicated	14,6	5,18	0,76	14,6	5,18	0,76	E2	F2.2	G2
Inferred	34,3	4,59	1,58	34,3	4,59	1,58	E2	F2.2	G3
Sub.									
Total	48,9	4,77	2,34	48,9	4,77	2,34	E2	F2.2	G2+G3

Detail for the most promising area of the Misværdal deposit

Locality	Area	Apatite	P ₂ O ₅	E	F	G	Comment
Coarse-grained zone at Skaråslia	200mx650m	9.6wt%	4.1wt%	E3	F3	G3	Volume estimated down to 100 m depth.



Deposit	Location		Mt in total	Grade		UNFC			
				Apatite [wt%]	P ₂ O ₅ [wt%]	E	F	G	
Bjerkreim-Sokndal	Zone A/MCI Ibe		43.1	8.30%	3.50% ^E	E2	F2.1	G3	
	Zone B/MCU IIIe		95.7	7.8%	3.29% ^E	E2	F2.1	G3	
	Zone C/MCU IV		216.9	10.2%	4.31% ^E	E2	F2.1	G3	
	Øygrei (Constrained area containing mineralised rocks in MCU III and IV)	Ind. res.		800	4.36% ^E	1.84%	E2	F2.1	G2
		Inf. res.		750	3.86% ^E	1.63%	E2	F2.1	G3
	Total		1550	4.12% ^E	1.74%	E2	F2.1	G2+G3	
Kodal		Ind. res.	14.6	12.27% ^E	5.18%	E2	F2.2	G2	
		Inf. res.	34.3	10.87% ^E	4.59%	E2	F2.2	G3	
		Total	48.9	11.30% ^E	4.77%	E2	F2.2	G2+G3	
Misværdal	Skaråslia		41.47	9.60%	4.05% ^E	E3	F3	G3	
Ødegården	Ødegården		38.28	2.37% ^E	1.00%	E3	F3	G3	
Lillebukt	Lillebukt		28.71	7.11% ^E	3.00%	E3	F3	G3	

E) Estimated using this formula:
 wt% apatite = wt%P2O5
 * 2.3695 to convert between wt%
 apatite and wt% P2O5.

- **UNFC** is a tool that **can be used by geological surveys** to evaluate a country's known and potential resources.
- The UNFC system can be used to **provide better harmonization** of mineral resource data nationally and across Europe.
- We are at a **starting point** at establishing a more harmonised system and **stricter guidelines** are required

“As a geologist, assessing the G axis was assumed to be the “easy” part compared to the E axis and the F axis. However, following previously developed decision flow tools such as the ones developed in the ORAMA project, such as by Brown et al 2019, make the job much easier for all the three axes when in doubt. “

(Quotation from one of the case studies)

Thank you!



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