



Cost-effective source tracing of hydrocarbon contamination - from compliance to insight

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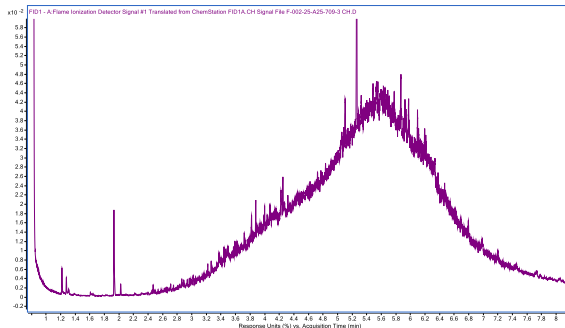


- Discuss different purposes of investigations
- Give examples of the tools that exist
- Motivate to an increased curiosity
- Start a conversation about the suitability of the tools being used



- ❖ **Analytical results vs. criteria**
- ❖ **Tools**
 - ❖ **Most important point!**
- ❖ **Soil package +**
 - ❖ **Case 1: New spill from the same oil tank**
 - ❖ **Case 2: Spill or leakage?**
 - ❖ **Data quality**
- ❖ **Questions?**

Analytical results vs. criteria



List of straight-chain alkanes - Wikipedia

Antall C-atomer	Molekylformel	Antall isomerer
6	C_6H_{14}	5
10	$C_{10}H_{22}$	75
15	$C_{15}H_{32}$	4347
20	$C_{20}H_{42}$	366319
25	$C_{25}H_{52}$	36797588
30	$C_{30}H_{62}$	4111846763
35	$C_{35}H_{72}$	493782952902

9 data points

> 25 000 data points

Theoretical?!

What is necessary depends on the purpose

Compliance assessment:

17(ish) data points

Substance (symbol)	Natural concentration ¹ mg/kg	Threshold value mg/kg	Lower guideline value mg/kg	Higher guideline value mg/kg
<i>Aromatic hydrocarbons</i>				
Benzene (p)		0,02	0.2 (t)	1 (t)
Toluene (p)			5 (t)	25 (t)
Ethylbenzene (p)			10 (t)	50 (t)
Xylenes ³ (p)			10 (t)	50 (t)
TEX ⁴		1		
<i>Polycyclic aromatic hydrocarbons</i>				
Anthracene		1	5 (e)	15 (e)
Benzo(a)anthracene		1	5 (e)	15 (e)
Benzo(a)pyrene		0,2	2 (t)	15 (e)
Benzo(k)fluoranthene		1	5 (e)	15 (e)
Phenanthrene		1	5 (e)	15 (e)
Fluoranthene		1	5 (e)	15 (e)
Naphthalene		1	5 (e)	15 (e)
PAH ⁵		15	30 (e)	100 (e)

Substance (symbol)	Threshold value mg/kg	Lower guideline value mg/kg	Higher guideline value mg/kg
<i>Petroleum hydrocarbon fractions and oxygenates</i>			
MTBE-TAME ¹¹	0,1	5 (t)	50 (t)
Petrol fractions (C5-C10 ¹²)		100	500
Middle distillates (>C10-C21 ¹²)		300	1000
Heavy petroleum fractions (>C21-C40 ¹²)		600	2000
Petroleum fractions (>C10-C40 ¹²)	300		

Site characterization

Are 17 data points
sufficient?

What is the conceptual
understanding?

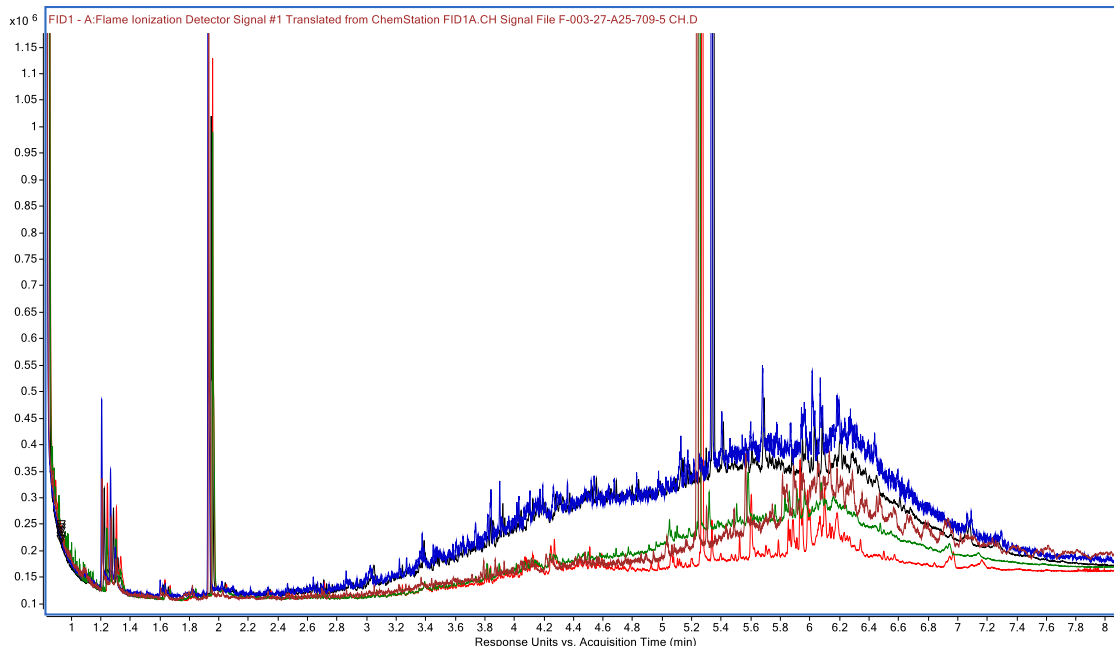
Is the conceptual
understanding
challenged?

What is/are the
source(s)?

Is it the same source for
all the contamination you
are observing?

How was the area
contaminated?

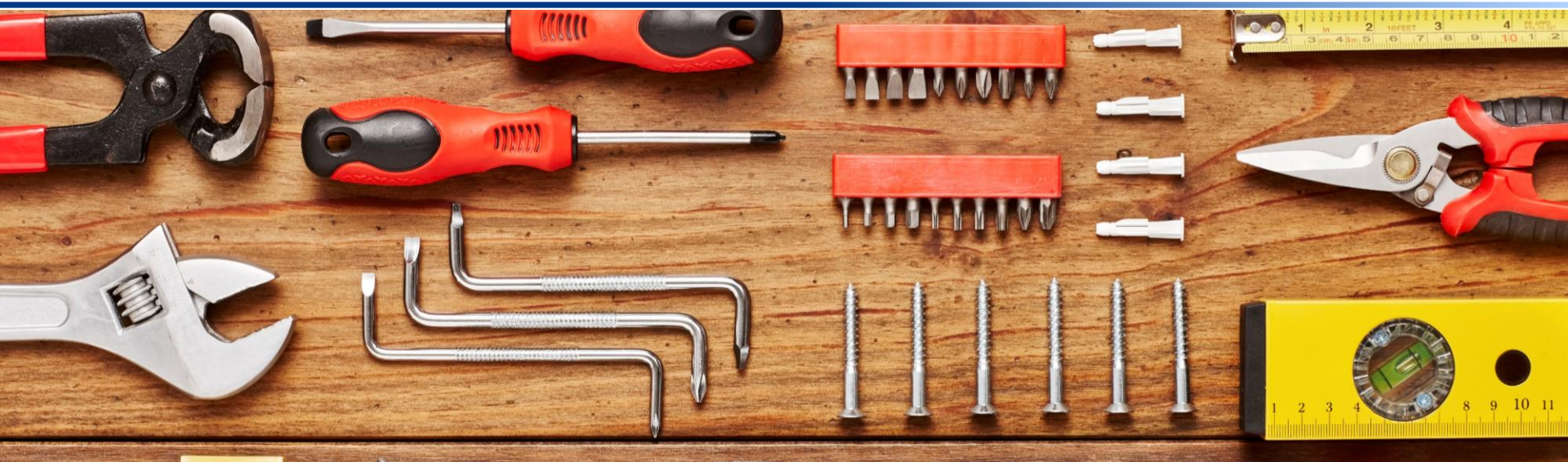
Site characterization



Much can be done
with the data we
already have

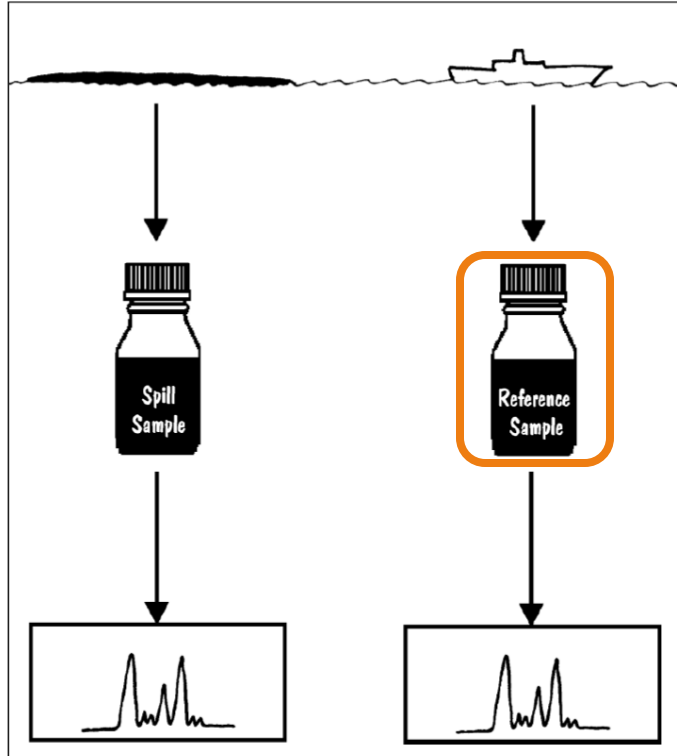
Correct data quality

Future proof –
What if there are
additional questions
in the future?



Tools

THE MOST IMPORTANT POINT!



- The main challenge is always the interpretation of the data
- It is much easier to conclude if you have a source sample!

1. Secure a sample of the source(s)

2. Analyse

3. Store

Chemfing Soil / - Air



Expanded indicator compounds

Parameter	Enhet	Prove 1	Prove 2	Parameter
17a(H)-diahopane	ug/kg	D	12.00	C3-Fluorenes
A1-C20TAS	ug/kg	Nd	D	C3-Naphthalenes
A2-C21TAS	ug/kg	Nd	D	C3-Naphthobenzothiophenes
A3-C26TAS(20S)	ug/kg	Nd	D	C3-Phenanthrenes/anthracene
A4-C26/C27TAS	ug/kg	Nd	24.00	C4-Benzanthrene/chrysenes
A5-C27TAS(20R)	ug/kg	Nd	18.00	C4-Dibenzothiophene
A6-TAS(20S)	ug/kg	Nd	19.00	C4-Fluoranthrenes/pyrenes
A7-TAS(20R)	ug/kg	Nd	16.00	C4-Naphthalenes
Acenaphthene	ug/kg	340.00	Nd	C4-Phenanthrenes/anthracene
Acenaphthylene	ug/kg	Nd	Nd	Cholestane
Anthracene	ug/kg	55.00	Nd	Chrysene
Benzo(a)anthracene	ug/kg	Nd	Nd	cis/trans Decalin
Benzo(a)pyrene	ug/kg	Nd	Nd	Dibenz(a,h)anthracene
Benzo(b)fluoranthene	ug/kg	Nd	D	Dibenzofuran
Benzo(e)pyrene	ug/kg	Nd	9.90	Dibenzothiophene
Benzo(g,h,i)perylene	ug/kg	Nd	9.90	Fluoranthene
Benzo(k)fluoranthene	ug/kg	Nd	Nd	Fluorene
Biphenyl	ug/kg	18.00	18.00	Indeno(1,2,3-cd)pyrene
C1-Benzanthrene/chrysenes	ug/kg	Nd	21.00	1-Methylnaphthalene
C1-Dibenzothiophene	ug/kg	220.00	Nd	2-Methylnaphthalene
C1-Fluoranthrenes/pyrenes	ug/kg	85.00	Nd	Naphthalene
C1-Fluorenes	ug/kg	620.00	Nd	Naphthobenzothiophene
C1-Naphthalenes	ug/kg	97.00	23.00	Perylene
C1-Naphthobenzothiophenes	ug/kg	Nd	25.00	Phenanthrene
C1-Phenanthrenes/anthracenes	ug/kg	1.10	18.00	Pyrene
C2-Benzanthrene/chrysenes	ug/kg	Nd	27.00	Refene
C2-Dibenzothiophene	ug/kg	160.00	Nd	S14-Cholestane(20R)
C2-Fluoranthrenes/pyrenes	ug/kg	33.00	Nd	S15-Cholestane(20S)
C2-Fluorenes	ug/kg	480.00	Nd	S18-Ethylidicholestane
C2-Naphthalenes	ug/kg	130.00	53.00	S19-Ethylidicholestane
C2-Naphthobenzothiophenes	ug/kg	Nd	48.00	S20-Methylcholestane
C2-Phenanthrenes/anthracenes	ug/kg	680.00	34.00	S22-Methylcholestane(20R)
C3-Benzanthrene/chrysenes	ug/kg	Nd	22.00	S23-Methylcholestane(20S)
C3-Dibenzothiophene	ug/kg	60.00	Nd	S24-Methylcholestane
C3-Fluoranthrenes/pyrenes	ug/kg	nd	nd	S25-Ethylcholestane

Assessment report

Ambiental			
Concentração	Unidade	NC30	n-Tetralacetonas
39.331	6.36005	NC34	n-Tetralacetonas
42.457	7.23336	NC35	n-Pentilacetonas
41.338	17.87212	NC36	n-Hexilacetonas
42.248	363.83332	NC37	n-Heptilacetonas
43.145	12.00244	NC38	n-Octilacetonas
44.209	35.22923	NC39	n-Nonilacetonas
45.199	12.81160	NC40	n-Decilacetonas
46.261	46.13631		

Figura 3. Tabela com as razões dos principais biomarcadores indicativos de origem Petrogénica.

Composto	Valor
Flu/Flu	0.033
Flu/Flu	0.046
Flu/Flu	57.692
Flu/Flu	0.644
Flu/Flu	0.731

Figura 4. Espectro de massas das Parafinas (m/z 74).

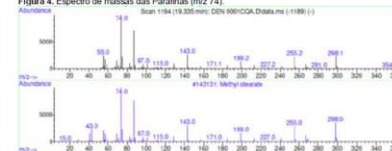


Figura 5. Espectro de massas do composto Saturado (m/z 57).

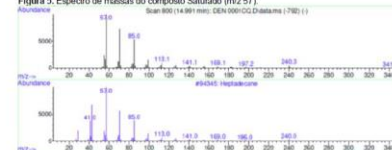


Figura 6. Espectro de massas do composto aromático (m/z 149).

Reference sample
(oil)

“Screening” (standard
parameters incl.
markers)

Can be archived until
the project is
completed

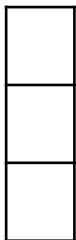
Soil package+
(soil)

(markers + weathering
+ PAH(16))

Minimises uncertainty
between samples
within the same project

Case 1: New spill from same oil tank

3 depths per sampling point

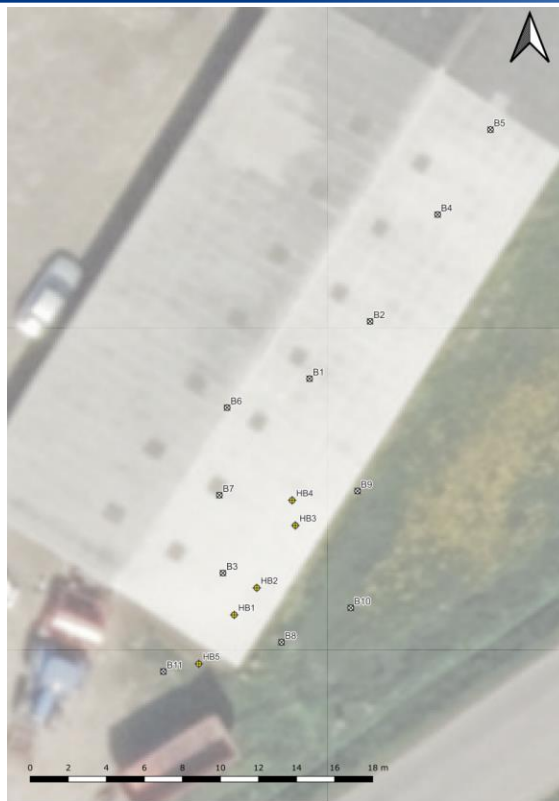


Degree of degradation
(weathering) in three levels:

Strongly degraded

Moderately degraded

«Fresh»



Case 1: New spill from same oil tank

3 depths per sampling point



Degree of degradation
(weathering) in three levels:

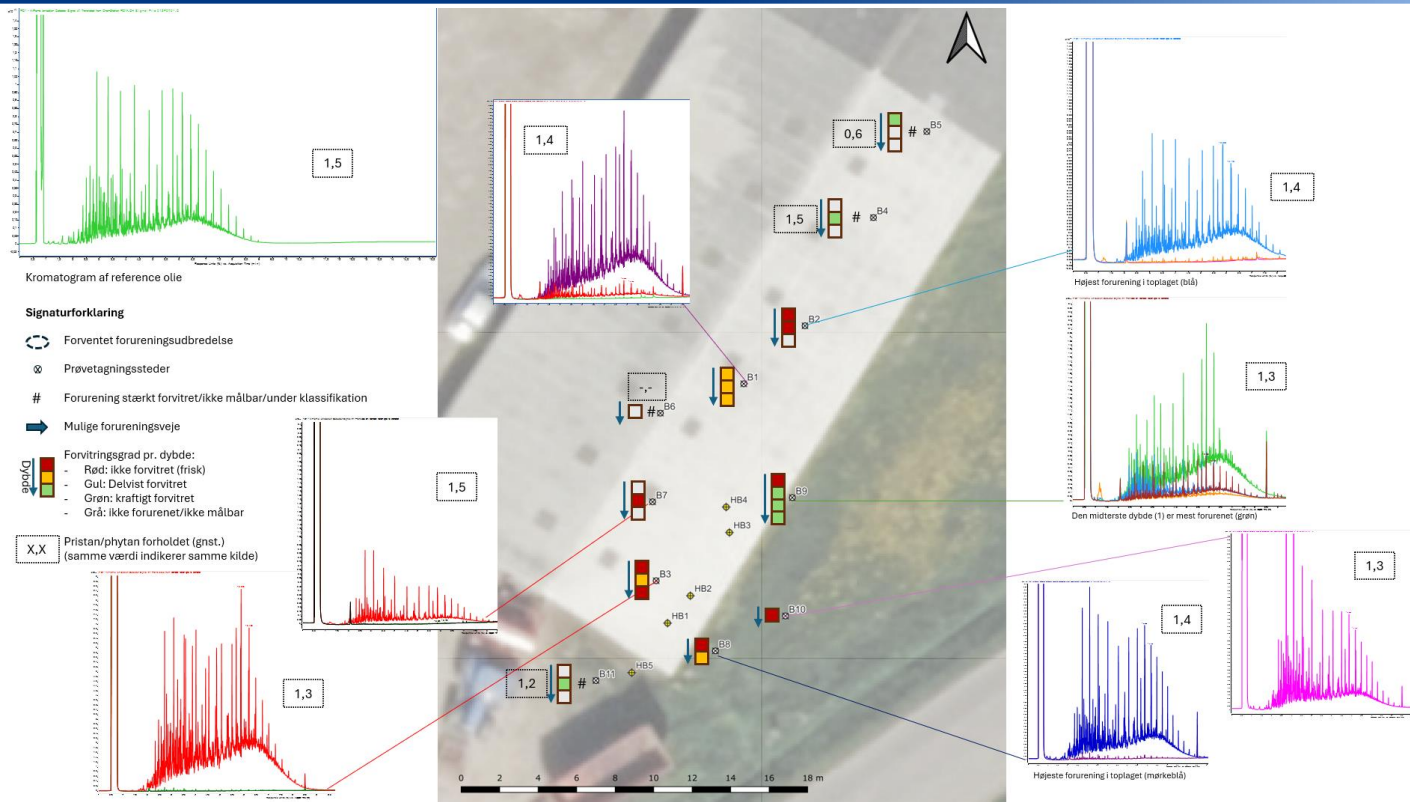
Strongly degraded

Moderately degraded

«Fresh»



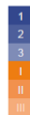
Case 1: New spill from same oil tank



Case 2: Spill or leakage



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Rapportdato: 07.10.2025
Sagsnr.:
Sagsnavn:

07.10.2025
Rapport version: 1

Vurderingsrapport - Jordpakke+

Bestemmelse af nedbrydningsgraden af jordforurening
Sagsidentifikation:

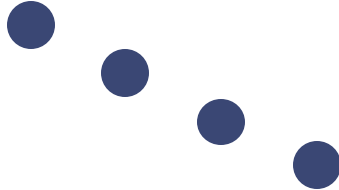
Case 2: Spill or leakage



What does the degree of weathering in the source mean?

Some checks
have to be made

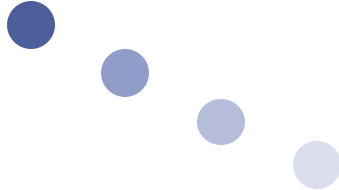
Case 2: Spill or leakage



What does it mean if it have a stable degree of weathering?

Some checks
have to be made

Case 2: Spill or leakage



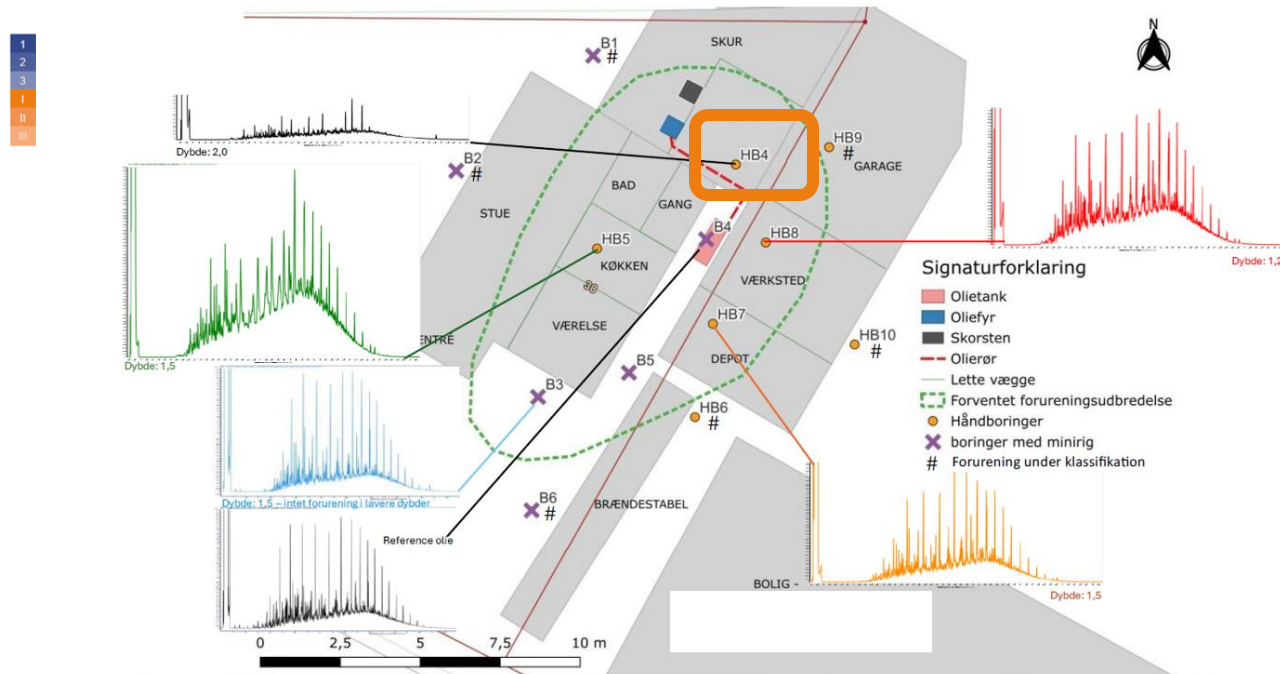
What does it mean if it have an increasing degree of weathering?

Some checks
have to be made

Case 2: Spill or leakage

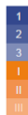
Vurderingsrapport - Jordpakke+

Bestemmelse af nedbrydningsgraden af jordforurening
Sagsidentifikation:



Figur 3.1: Opsummering af sagen, kromatogrammer vist for den mest forurenede dybde. Prøver hvor ingen af dybderne har påvist olieforurening er markeret med #. Kromatogram af referenceolie nederst til venstre.

Case 2: Spill or leakage



Vurderingsrapport - Jordpakke+

Bestemmelse af nedbrydningsgraden af jordforurening
Sagsidentifikation:

- Ikke forvitret (frisk): n-C17/pristan > 1 (1,0-1,5 empirisk).
- Delvist forvitret: n-C17/pristan < 1.
- Stærkt forvitret: n-C17 er helt nedbrudt

n-C17/pristan-, n-C18/phytan- og pristan/phytan-forholdet fremgår af tabel 2.1

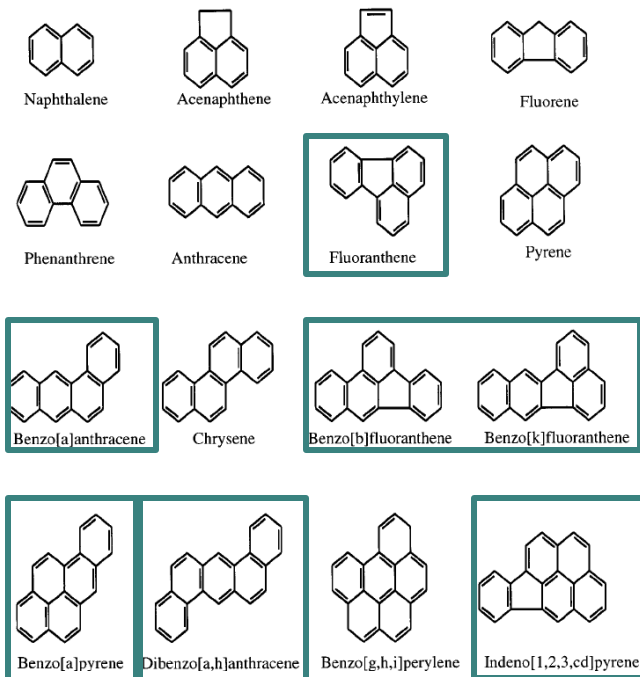
Tabel 2.1: Oversigt over forholdene benyttet til bestemmelse af nedbrydningsgraden.

Prøvenr.	Prøvenavn	Dybde m.u.t	C17/pristan	C18/phytan	Pristan/phytan	Forvitrings grad	Um (%)
862-2025-04857201	HB4	1,0	1,7	2,3	1,4	Ikke forvitret (frisk)	10
862-2025-04857202	HB4	1,5	0,5	0,2	1,2	Delvist forvitret*	10
862-2025-04857203	HB4	2,0	0,0	0,1	1,2	Stærkt forvitret	10

=> Leakage

Just did a follow up, with more samples being compared to the original data

US EPA – 16 (all parent PAH, C0)



Next: PAH(16)

“Infinite” possibilities!
(so much scientific knowledge regarding
the PAH(16) fingerprint)



Easier to say that something is
different than equal!

Line of evidence:
See the forest for the trees

Thank you for your time and attention
Don't hesitate to reach out if you'd like
to continue the discussion.



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