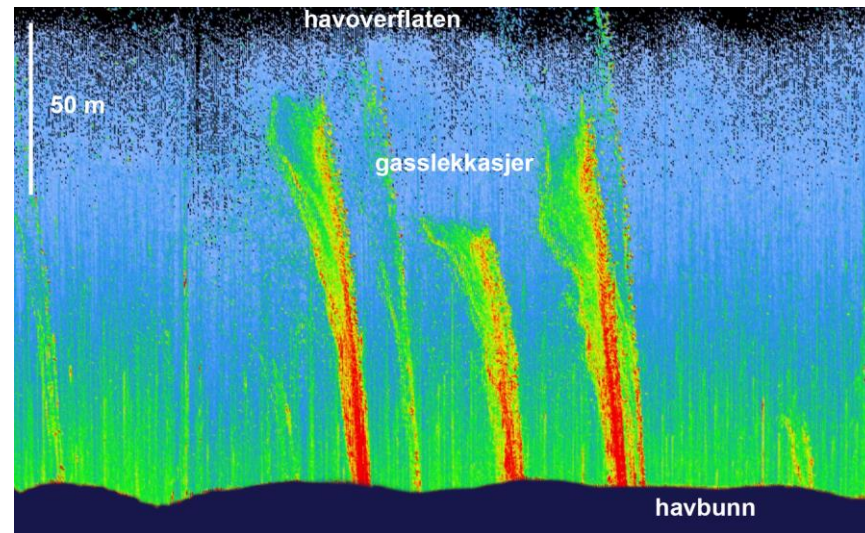


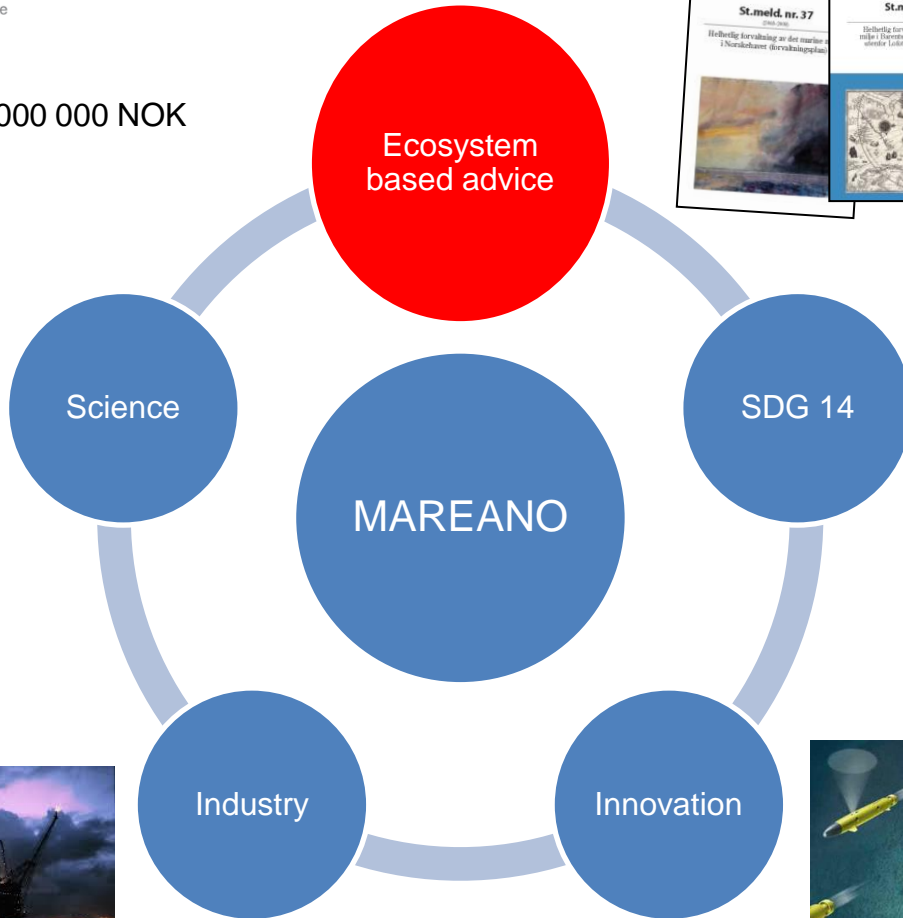
# KARTLEGGING AV GASSLEKKASJER I MAREANO-PROGRAMMET

*T. Thorsnes og Mareano-teamet –  
Norges geologiske undersøkelse*



Start 2005

Budget 2005-2021: 1100 000 000 NOK



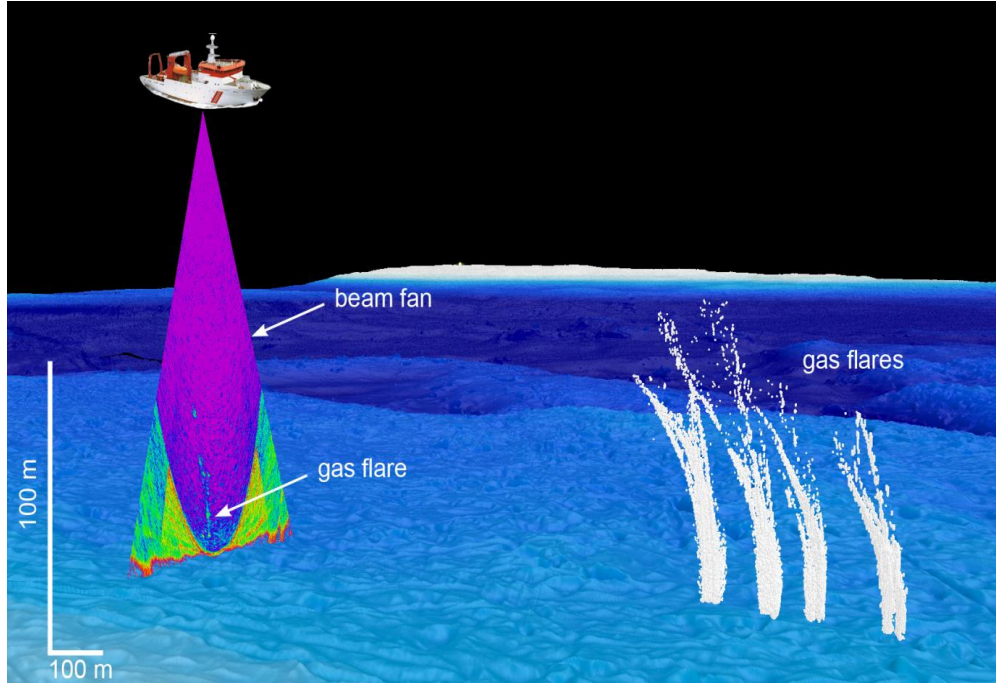
**SUSTAINABLE DEVELOPMENT GOAL 14**  
 Conserve and sustainably use the oceans, seas and marine resources for sustainable development




Source: Øyvind Hagen

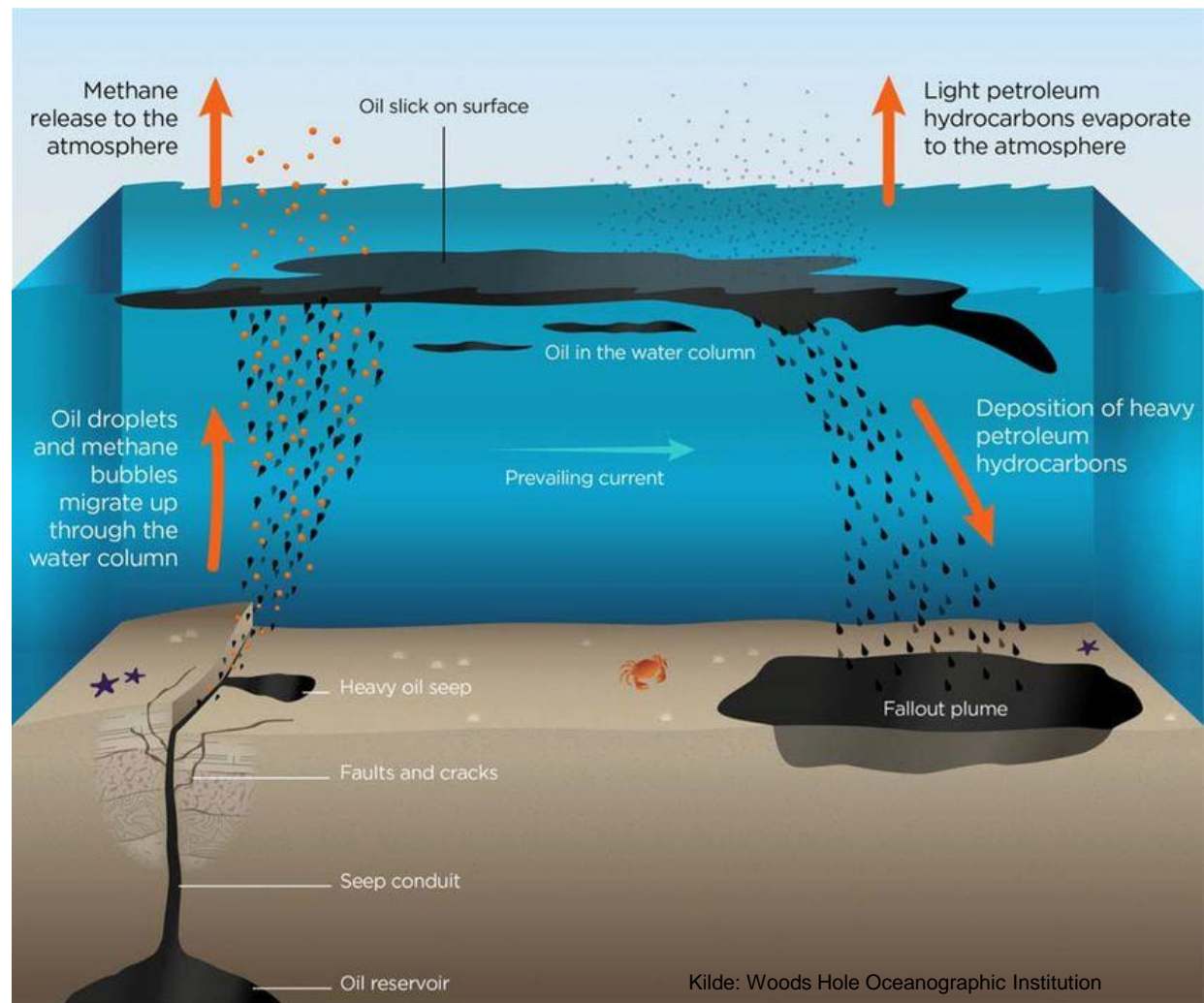
Source: NTNU/AMOS

# Hvorfor kartlegge gasslekkasjer?

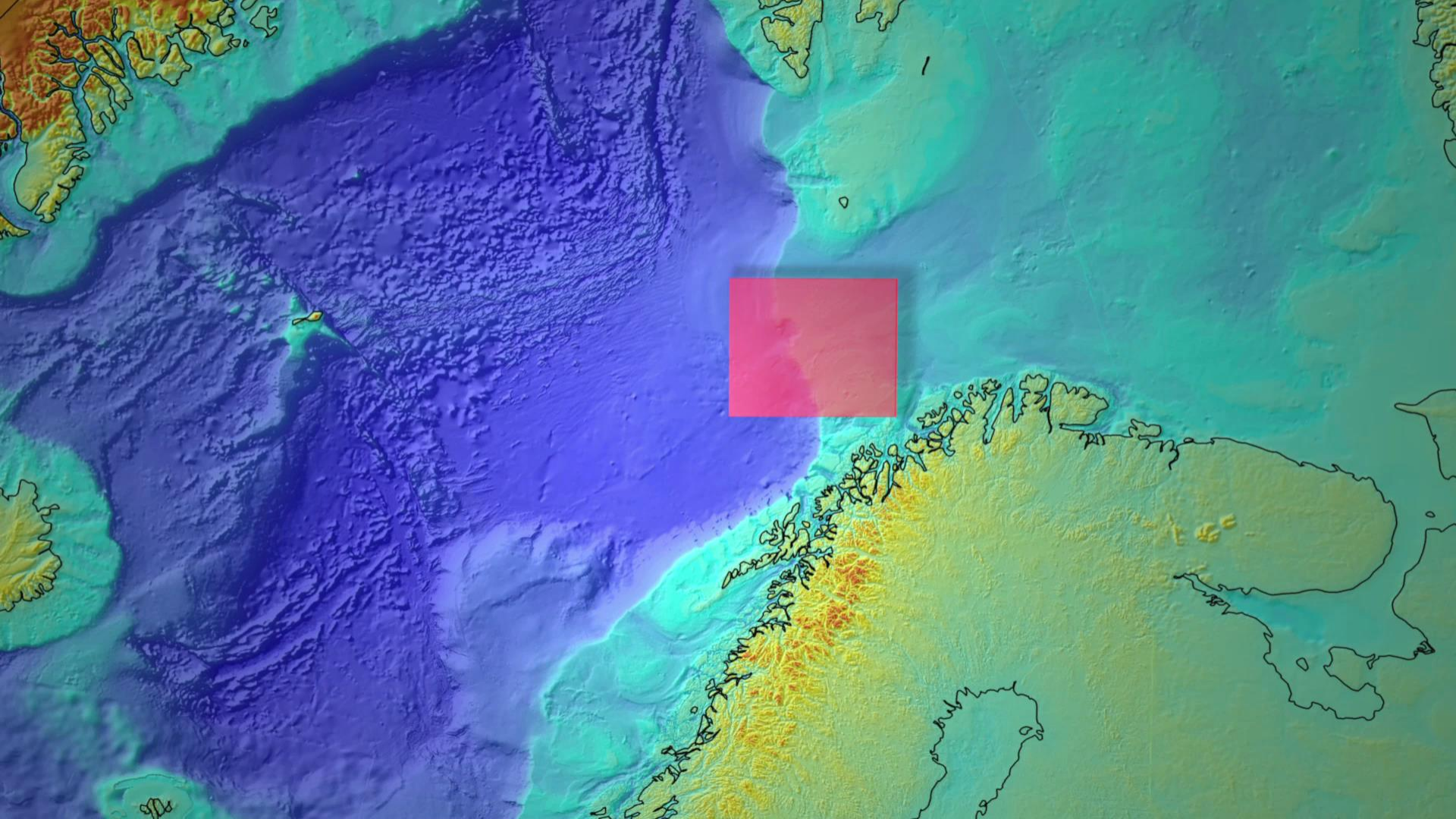


- Globalt karbonbudsjett (CH<sub>4</sub>, atmosfære)
- Havforsuring
- Habitater og biotoper, kjemotrofe samfunn
- Naturtyper i Norge – M11 (kaldt gassoppkomme/havkildebunn)
- Forståelse av petroleumssystemer
- Geofarer og menneskeskapte lekkasjer

# Vanlige kilder







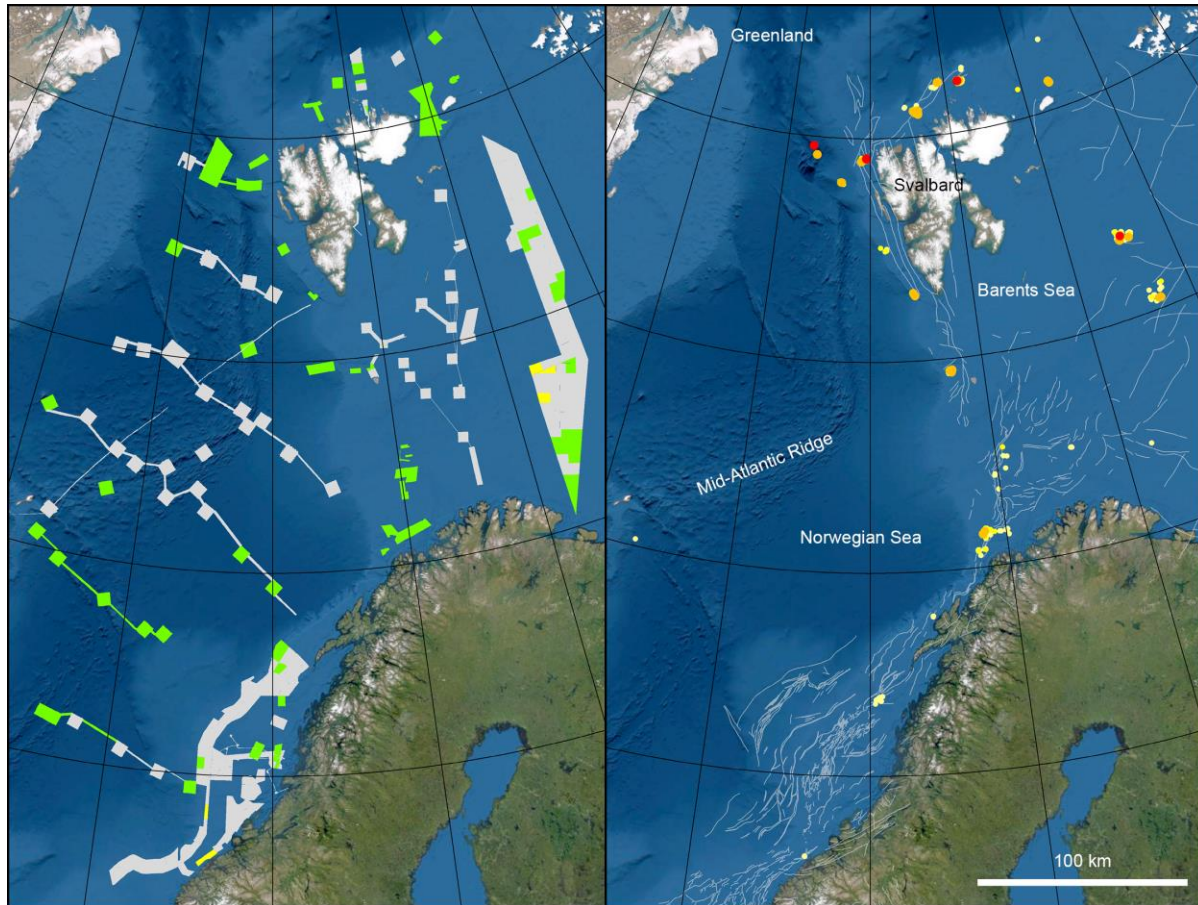




# Databasestruktur

Survey	Area	Lined	Comments	Latitude	Longitude	Depth	Height	Time	IntPr	Magnitude	Confidence	Comment	MultipleFlares
fgmg_2020_TF1n_cell007	Barents Sea	612	gas flare	75,999906	24,519262	78	72	07/18/2020 9:SC		3	50		2 flares
fgmg_2020_TF1n_cell007	Barents Sea	618	gas flare	76,057926	24,330579	75	50	07/18/2020 1:SC		3	20		
fgmg_2020_TF1n_cell007	Barents Sea	1064	gas flare	76,029288	24,3433	73	55	07/23/2020 2:SC		3	50		2 flares
fgmg_2020_TF1n_cell008	Barents Sea	668	gas flare	76,056816	24,571678	73	57	07/18/2020 2:SC		3	50		
fgmg_2020_TF1n_cell008	Barents Sea	681	gas flare	76,00401	24,56256	75	56	07/19/2020 1:SC		3	50		
fgmg_2020_TF1n_cell008	Barents Sea	685	gas flare	76,056693	24,607281	74	30	07/19/2020 2:SC		2	50		
fgmg_2020_TF1n_cell008	Barents Sea	686	gas flare	76,0474	24,60658	69	40	07/19/2020 3:SC		3	50		
fgmg_2020_TF1n_cell008	Barents Sea	686	gas flare	76,027193	24,593496	72	45	07/19/2020 3:SC		3	40		
fgmg_2020_TF1n_cell008	Barents Sea	687	gas flare	76,006727	24,579502	78	50	07/19/2020 3:SC		2	30		
fgmg_2020_TF1n_cell008	Barents Sea	705	gas flare	76,038492	24,562642	66	44	07/19/2020 6:SC		2	50		
fgmg_2020_TF1n_cell008	Barents Sea	708	gas flare	76,040147	24,624985	73	45	07/19/2020 7:SC		2	40		
fgmg_2020_TF1n_cell008	Barents Sea	716	gas flare	76,050727	24,656154	74	55	07/19/2020 9:SC		3	40		3 flares
fgmg_2020_TF1n_cell008	Barents Sea	717	gas flare	76,05033	24,662619	73	50	07/19/2020 1:SC		3	30		
fgmg_2020_TF1n_cell008	Barents Sea	717	gas flare	76,049851	24,6644	73		07/19/2020 1:SC		3	30		
fgmg_2020_TF1n_cell008	Barents Sea	717	gas flare	76,035496	24,654577	72	40	07/19/2020 1:SC		2	20		
fgmg_2020_TF1n_cell008	Barents Sea	721	gas flare	76,034001	24,668782	73	50	07/19/2020 1:SC		3	50		2 flares
fgmg_2020_TF1n_cell008	Barents Sea	726	gas flare	75,981255	24,645931	89	86	07/19/2020 1:SC		3	20		
fgmg_2020_TF1n_cell008	Barents Sea	729	gas flare	76,030854	24,694876	75	40	07/19/2020 1:SC		2	30		
fgmg_2020_TF1n_cell008	Barents Sea	737	gas flare	76,016561	24,70988	82	56	07/19/2020 1:SC		3	50		
FGMG-2018-GHB-BlockA	Garsholbanken	290	Gas flare, b	65,281221	7,422513	-331,59	250	08/28/2018 1:VB		5	80	wellbore 6507/8-8	
FGMG-2018-GHB-BlockA	Garsholbanken	290	Gas flare, a	65,28108	7,423173	-331,68	250	08/28/2018 1:VB		3	80	close to wellbore 6507/8-8	
FGMG-2018-GHB-BlockA	Garsholbanken	352	Gas flare, a	65,29489	7,359795	-335,71	55	08/29/2018 9:VB		4	70	wellbore 6507/8-7	
FGMG-2018-GHB-BlockA	Garsholbanken	376	Gas flare, a	65,336535	7,307818	-354,87	225	08/29/2018 2:VB		4	70	wellbore 6507/7-2	
FGMG-2018-GHB-BlockA	Garsholbanken	386	Gas flare, a	65,319593	7,260733	-345,75	195	08/30/2018 1:VB		3	80	wellbore 6507/7-4	
FGMG-2018-GHB-BlockA	Garsholbanken	410	Gas flare, b, s	65,368854	7,355483	-357,57	270	08/31/2018 8:VB		4	80	flares and spike located at Heidrun F	
FGMG-2018-GHB-BlockA	Garsholbanken	410	Gas flare, a, s	65,36906	7,355598	-357,31	270	08/31/2018 8:VB		3	80	flares and spike located at Heidrun F	
FGMG-2018-GHB-BlockA	Garsholbanken	427	Gas flare, a	65,358172	7,291264	-333,51	68	08/31/2018 1:VB		3	60	wellbore 6507/7-5	
FGMG-2018-GHB-BlockA	Garsholbanken	427	Gas flare, b	65,358042	7,317761	-350,43	85	08/31/2018 1:VB		3	60	wellbore 6507/7-6	
FGMG-2018-GHB-BlockA	Garsholbanken	447	Gas flare, b	65,300604	7,126189	-276,22	186	5:27:41 AM VB		3	80	wellbore 6507/7-11 S	
FGMG-2018-GHB-BlockA	Garsholbanken	447	Gas flare, a	65,300588	7,125654	-274,65	184	5:27:34 AM VB		2	70	wellbore 6507/7-11 S	
FGMG-2018-GHB-BlockA	Garsholbanken	470	Gas flare, a	65,319542	7,260824	-346,29	181	4:23:00 AM VB		3	80	wellbore 6507/7-4	
FGMG-2018-KvitoyaTrough_cell003		2691	Gas flare, a -	80,62498525	29,46253188	-311,29	206		VB	4	50	Checked by TT 28012021	
FGMG-2018-KvitoyaTrough_cell003		2691	Gas flare, b -	80,62533842	29,46769054	-319,77	203		VB	4	50	Checked by TT 28012020	
FGMG-2018-RFM		1381	Gas flare, a	81,02982958	22,31976264	-156,24	61		VB	4	60		
FGMG-2018-RFM		1381	Gas flare, b	81,03026871	22,32599876	-159,67	68		VB	4	40		

# Status januar 2021



Vannkolonnedata er samlet inn siden 2010, fra ca. 170 000 km<sup>2</sup>

50 000 km<sup>2</sup> ferdigtolket

33 796 linjer tolket (16.2.2021)

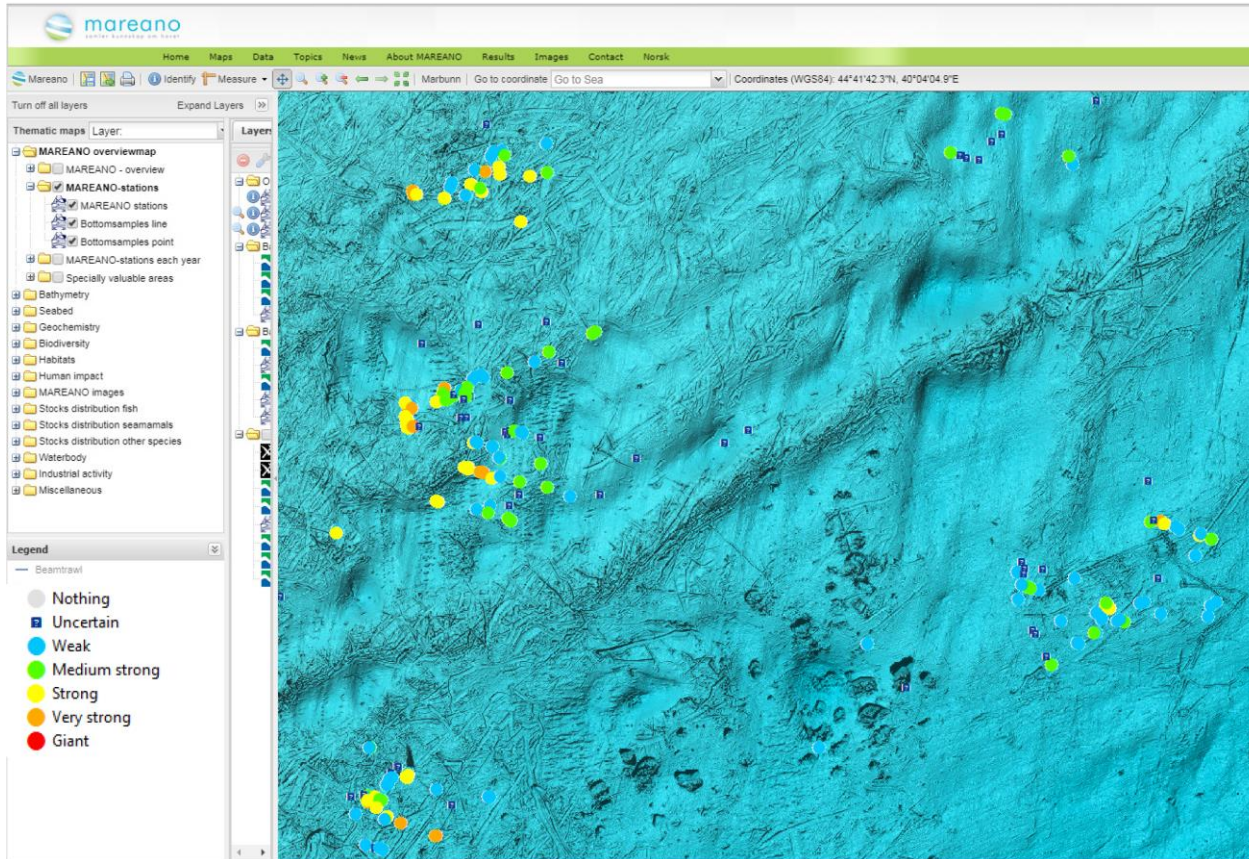
3041 objekter identifisert

1941 regnes som sannsynlige til sikre gasslekkasjer

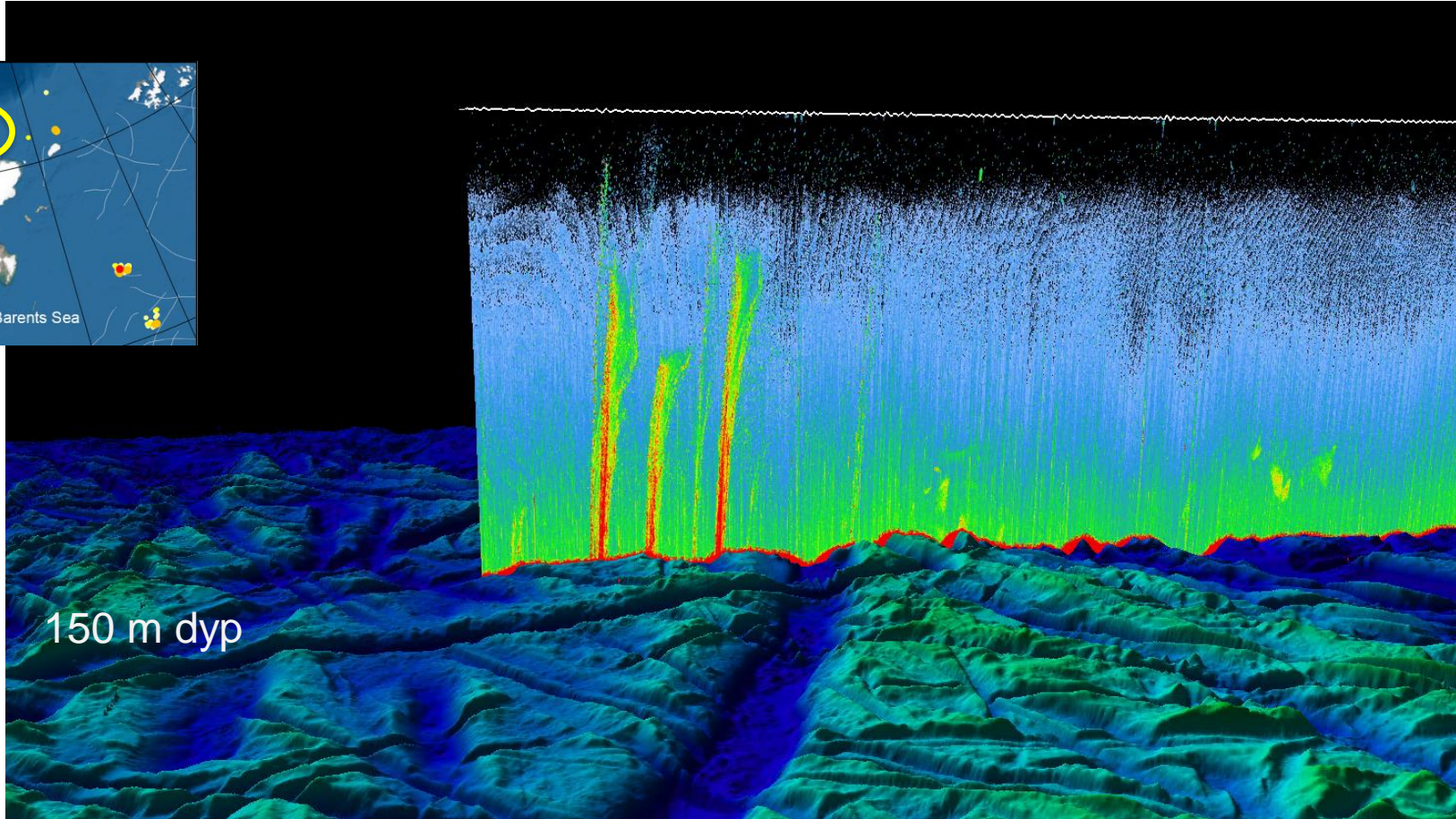
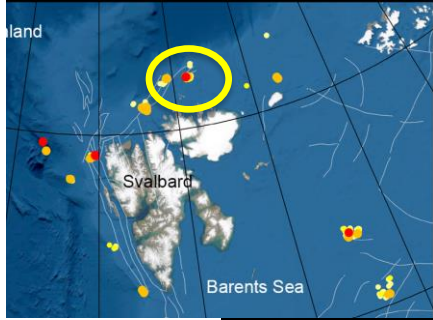
Hovedsakelig naturlige gasslekkasjer, men lekkasjer fra brønner forekommer også



# Web-publisering på mareano.no i 2021

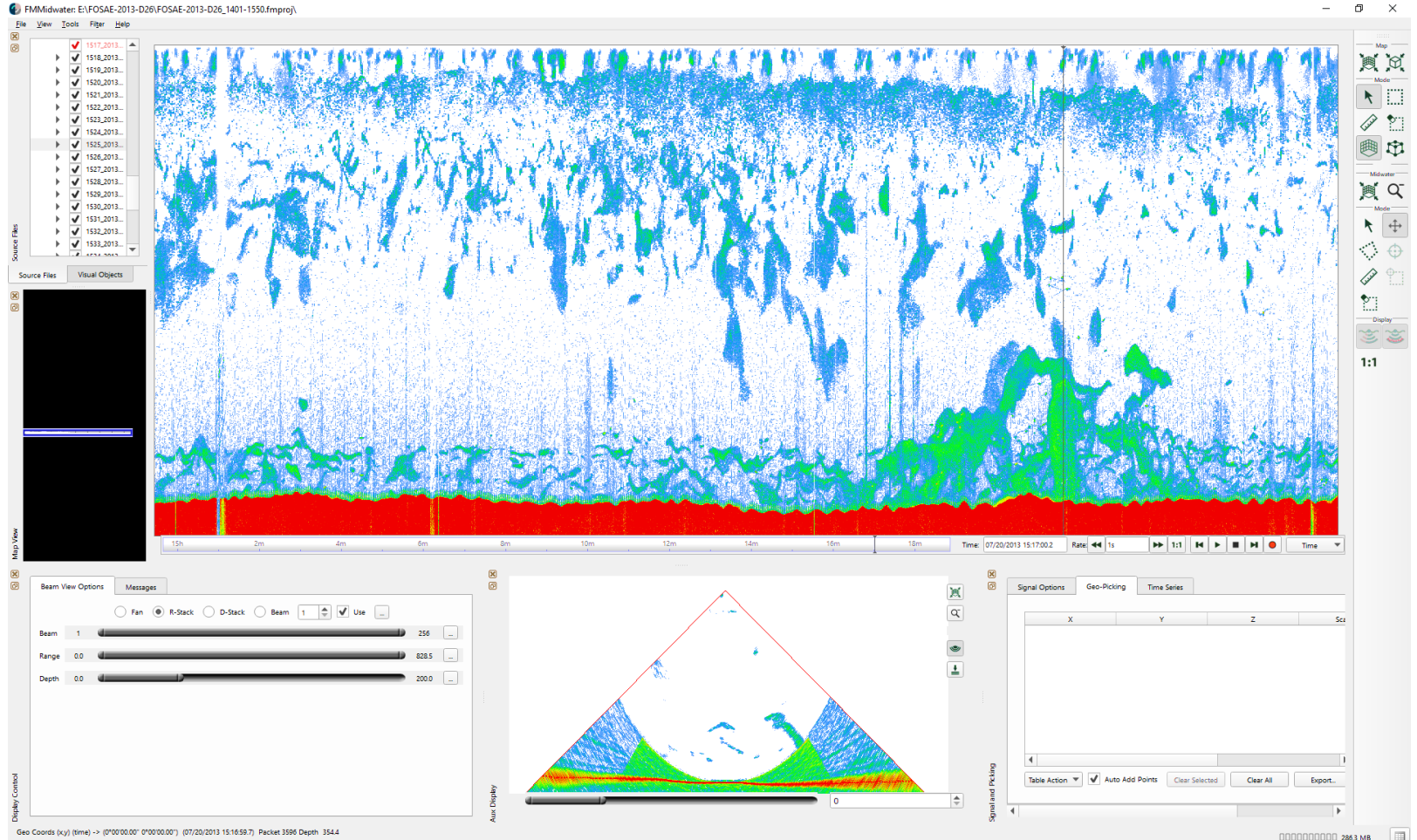


- Nedlastbar
- DOI
- Observasjoner av MDACs
- Eksterne observasjoner
- Under publisering



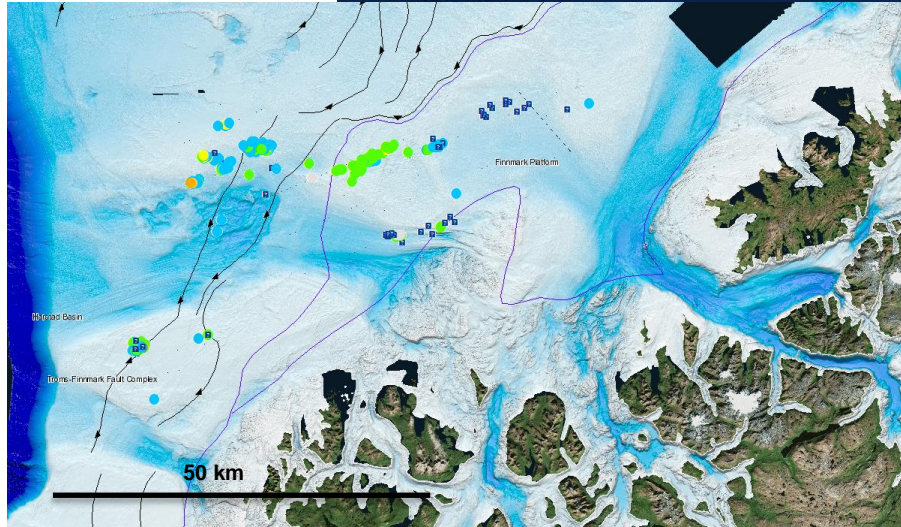


# Mer biologi enn gass...





# Case study - Håkjerringdjupet



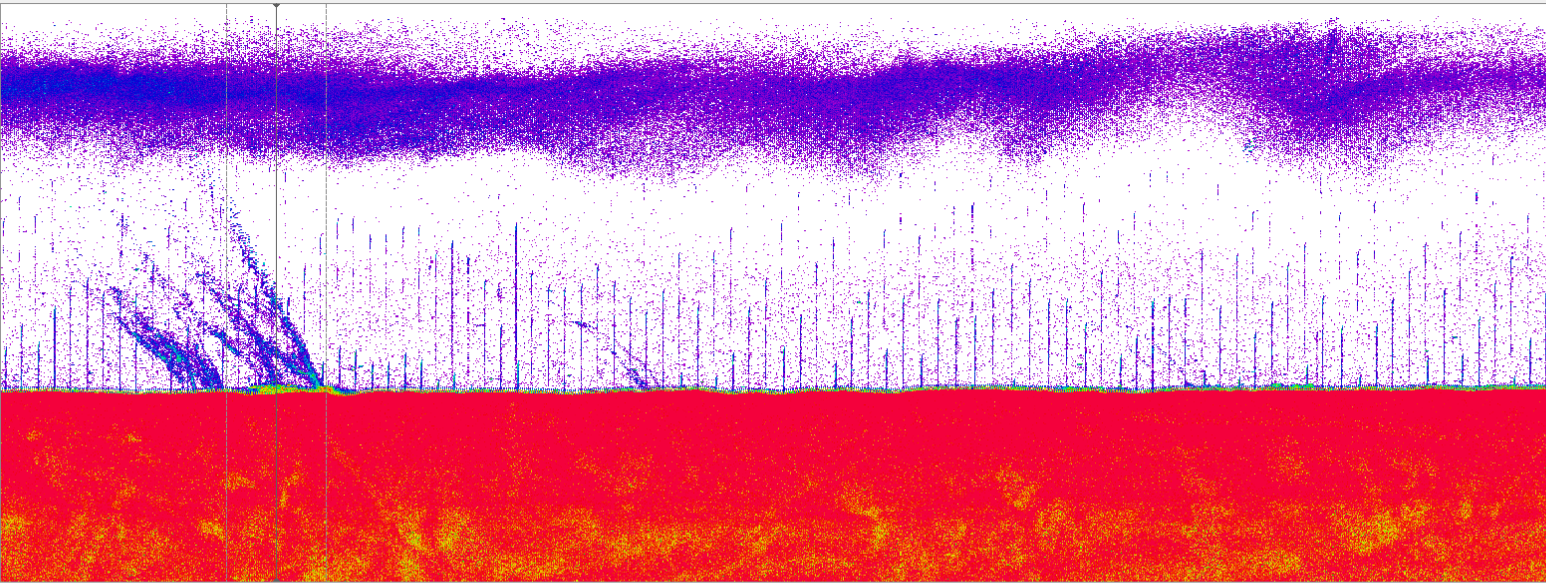
## Samarbeid med Lundin

- Forståelse petroleumssystemer
- Kjemotrofe samfunn
- Korallrev og MDACs



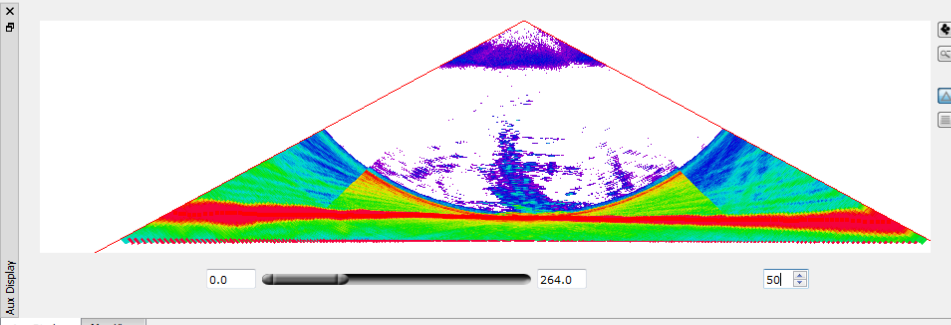


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- 0510\_20100513\_015100\_FG\_R...



15m 5m 10m 15m 20m 25m Time: 05/12/2010 14:58:38.0 Rate: 1s

Source Files Visual Objects



Aux Display Map View Geo Coords (x,y) (time) -> (18.296412°E 70.797098°N) (05/12/2010 14:58:37.7) Packet 270 Range 226.0 Amplitude 37.0

Signal Options Geo-Picking Time Series

Amplitude Power Sv Ts Custom

Clip -92.10 -6.11 0.00

Beam View Options Messages

Fan Stacked Beam 1 Use

Beam 1 256

Range 0.0 339.0

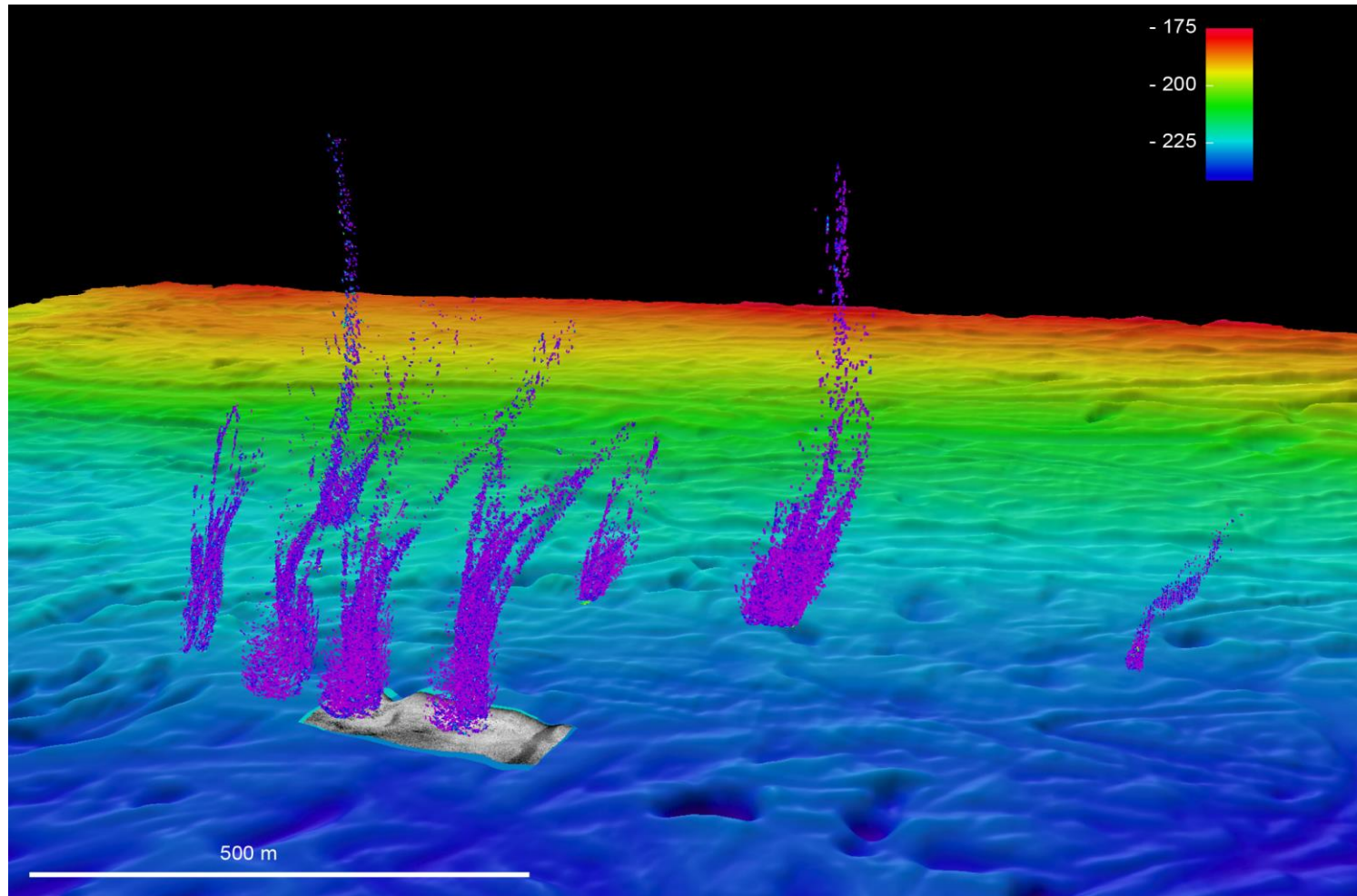
Depth 0.0 589.9

Map Mode

Midwater Mode

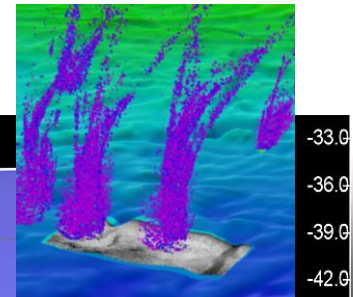
Display

### 3D- bilde av havbunn og gasslekkasjer - Håkjerringdjupet



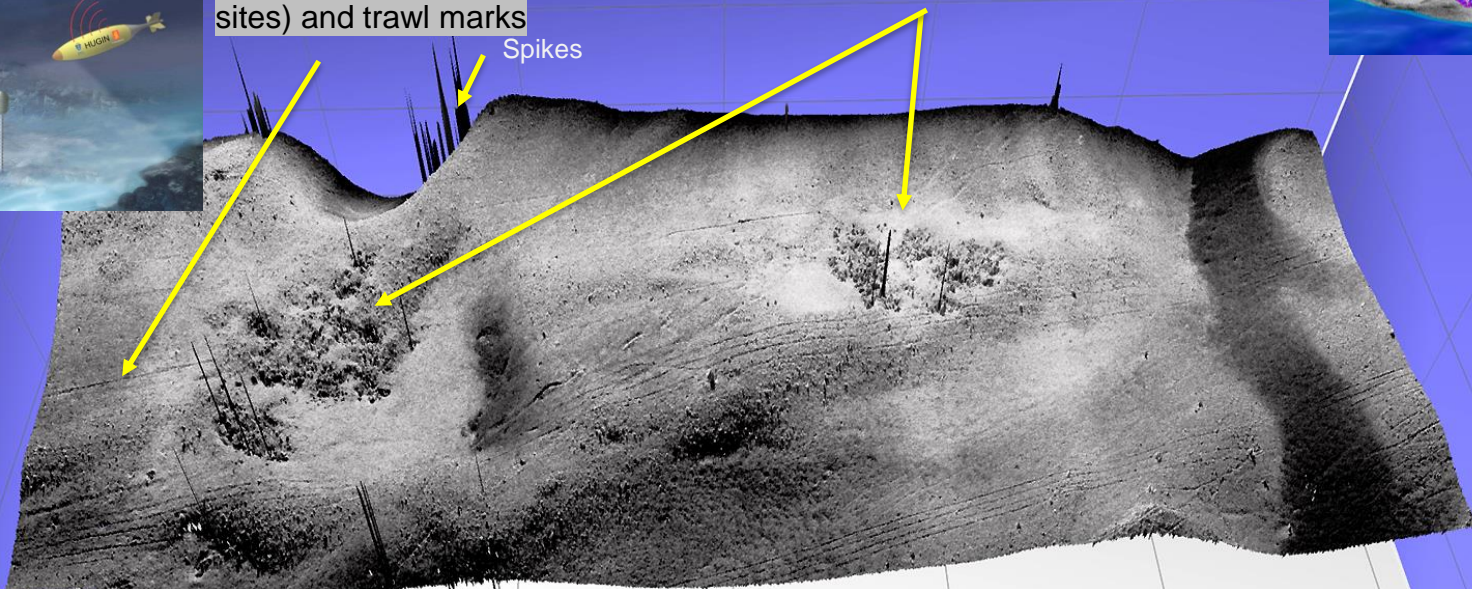


# «Nærbilde» - registrert med AUV og SAS



SAS image draped over 3D model. Note carbonate crust fields (gas emission sites) and trawl marks

Spikes



-33.0  
-36.0  
-39.0  
-42.0  
-45.0  
-48.0  
-51.0  
-54.0

-225.00 m  
-230.00 m  
-235.00 m

Strategy for Detection and High-Resolution Characterization of Authigenic Carbonate Cold Seep Habitats Using Ships and Autonomous Underwater Vehicles on Glacially Influenced Terrain

Bole Thorsnes<sup>1</sup>, Strym Chand<sup>1</sup>, Harald Brunstad<sup>1</sup>, Arne Logstrup<sup>1</sup> and Pålter Lågstad<sup>1</sup>



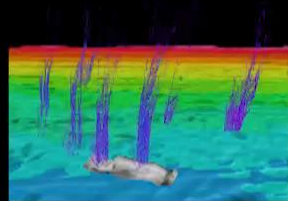
ARTICLE  
November 6, 2013 | Accepted 1 Aug 2014 | Published 1 May 2015  
Timescales of methane seepage on the Norwegian margin following collapse of the Scandinavian Ice Sheet

Bole Thorsnes<sup>1</sup>, Strym Chand<sup>1</sup>, Harald Brunstad<sup>1</sup>, Arne Logstrup<sup>1</sup>, Pålter Lågstad<sup>1</sup>, Steen Sævi<sup>2</sup>, Christl E. Gundersen<sup>3</sup>, Sørensen K. Isachsen<sup>4</sup>, Ole Morten Sjöberg<sup>5</sup>, Sørensen Sørensen<sup>6</sup> & Harald Brunstad<sup>1</sup>

50 m

Bathymetry grid size 20 cm. Sonar grid size 5 cm

Data: Lundin/NGU/FFI



# Carbonate crusts and fauna in Håkjerringdjupet

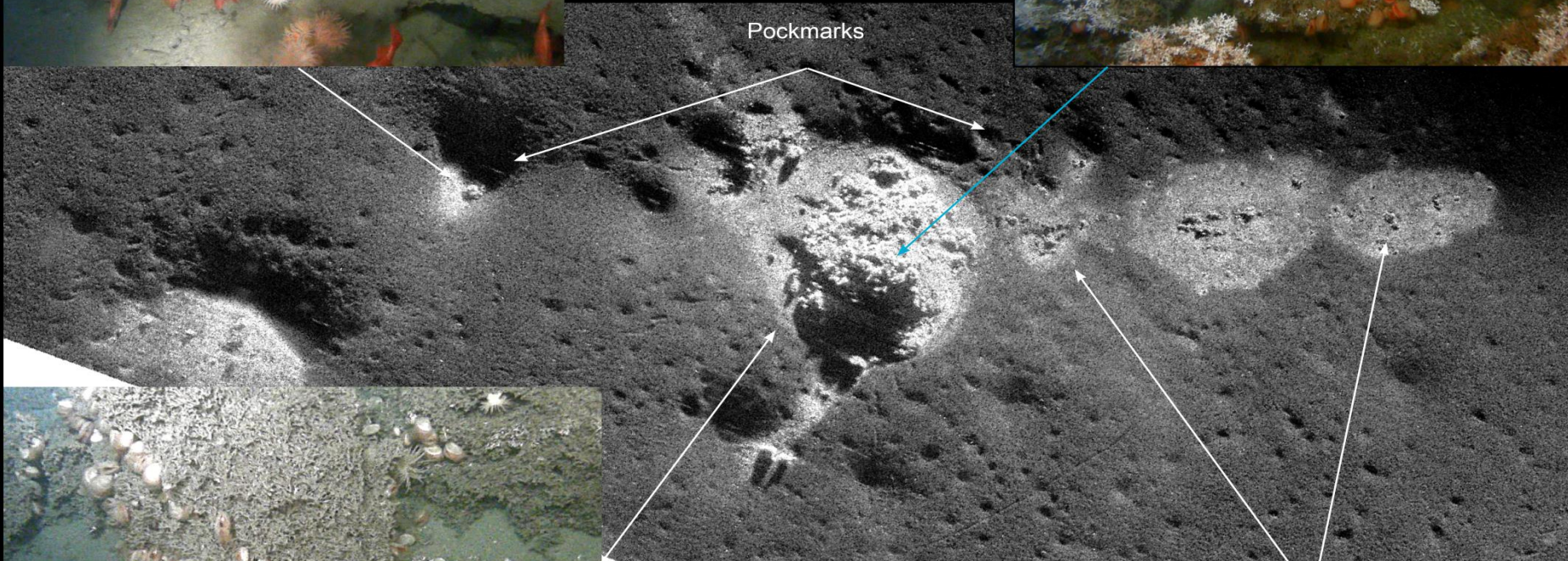
Video: MMT. Source: Lundin Norway

*Video compilation: Terje Thorsnes, NGU*





SAS and ROV imagery  
– crusts and coral  
mounds linked to gas  
seeps



Pockmarks

25 m

Carbonate crusts





# Felt, brønner og rørledninger - OD



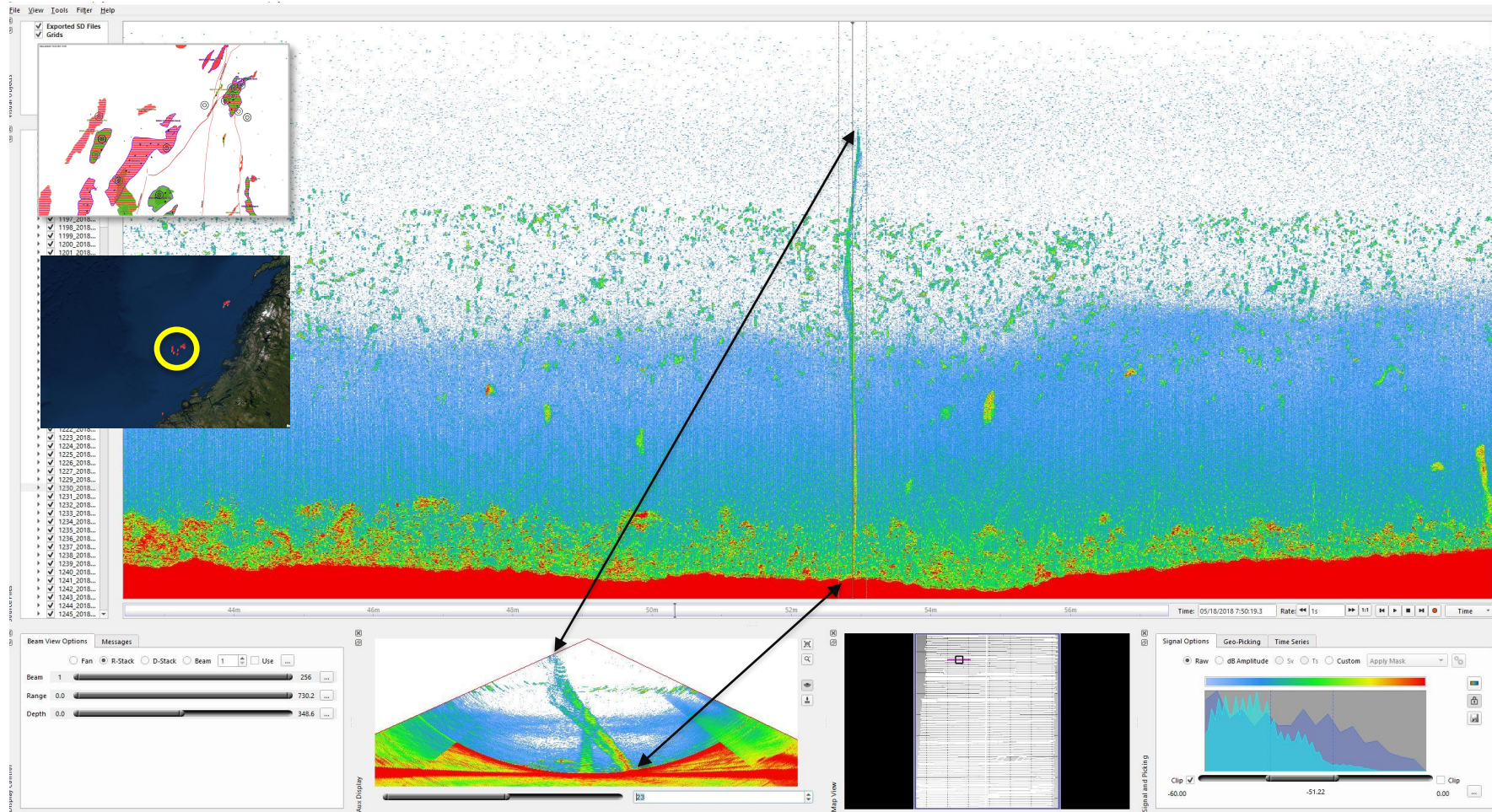
# Observerte gasslekkasjer







# Gasslekkasje – 6506/11-10 (Hades-Iris)





# Et spekulativt sidesprang...



**KILDESPORING AV MILJØGIFTER I KVEITE FRA YTRE SKLINNADJUPET**

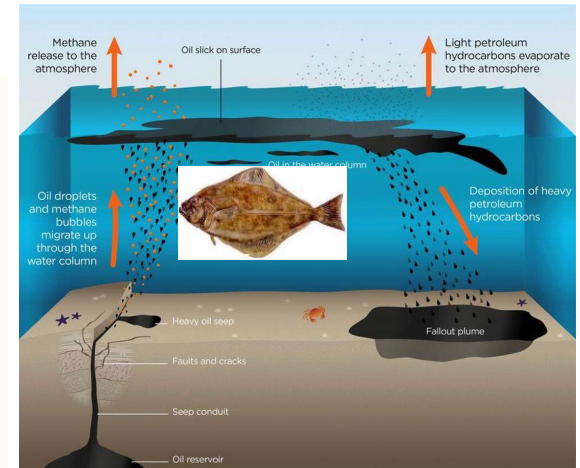
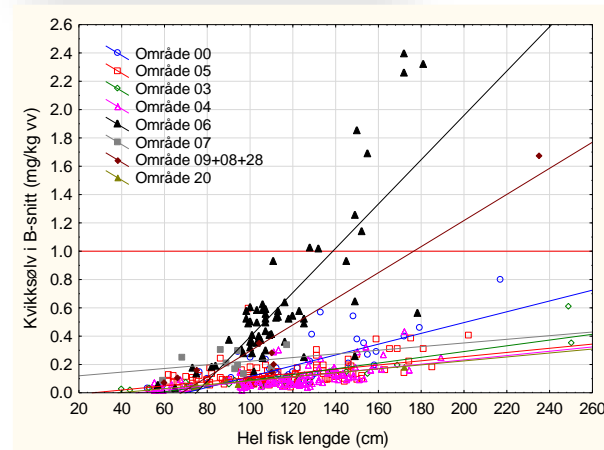
Analysér av miljøgifter i sediment og rødpolser, oppsummering av eksisterende kunnskap og anbefalinger videre

Bente Nilsen, Shepan Boltov og Berge Holte (Havforskningsinstituttet)  
Henning K.B. Jensen og Terje Thoranes (Norges Geologiske Undersøkelse)

**mareano**  
samlér kunnskap om havet

**NORGES GEOLOGISKE UNDERSØKELSE**  
- NGU -

RAPPORT FRA HAVFORSKNINGEN NR.



# Konklusjoner

- Mareano – vannkolonnedata fra ca. 170 000 km<sup>2</sup>
- Ca. 50 000 km<sup>2</sup> er tolket, 33796 linjer
- Totalt ca. 3 000 objekter identifisert, og ca. 1900 regnes som sannsynlige til sikre gasslekkasjer
- «Visuell styrke» – fra svak til meget sterk
- Noen gasslekkasjer når sannsynligvis opp til havoverflaten
- Gasslekkasjer fra brønner på Garsholbanken
- Mulig kobling med forhøyde kvikksølvnivåer i kveiter i Ytre Sklinnadjupet?
- Database og kart publiseres i 2021