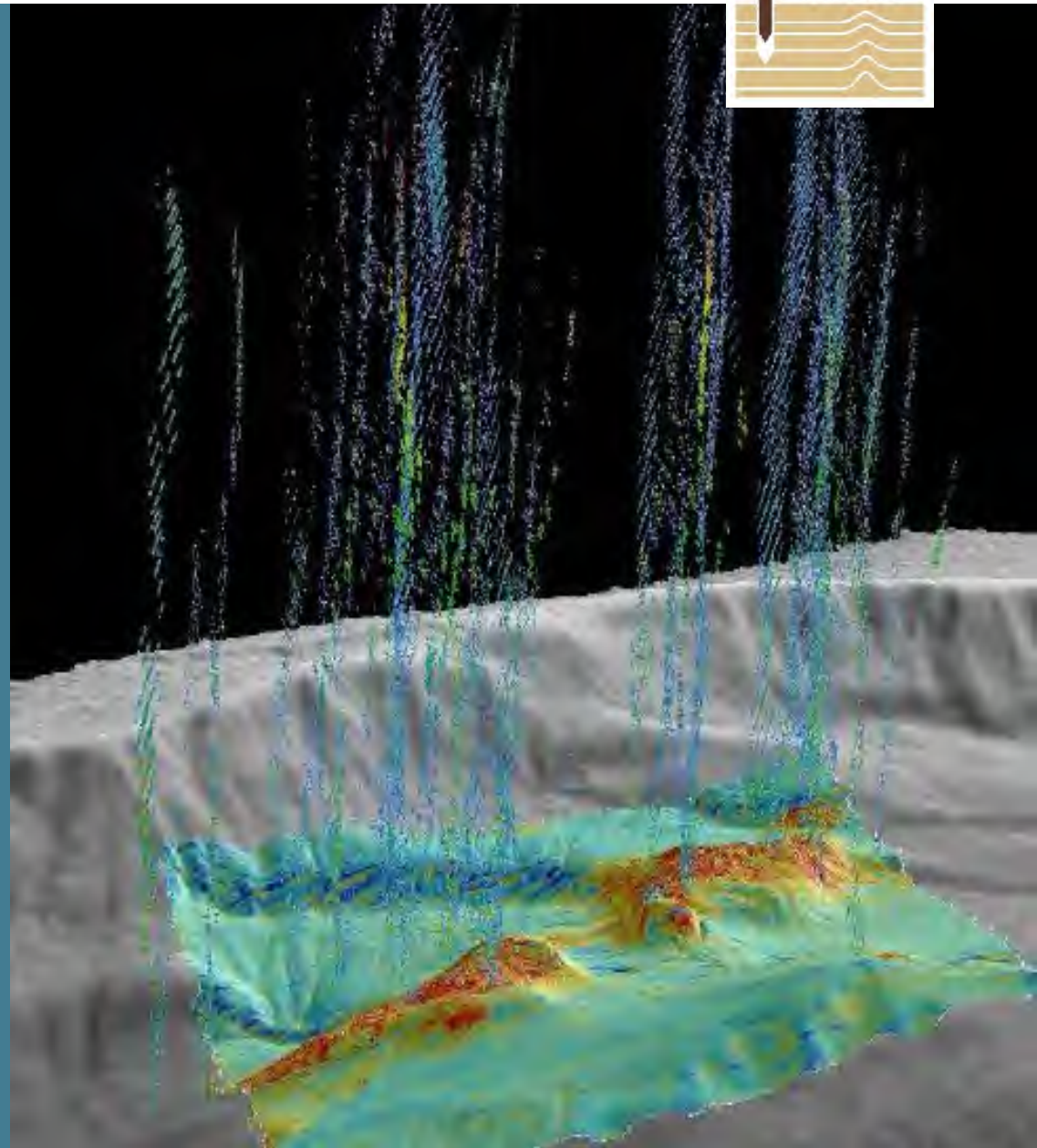


## Smart Survey Approach: Multibeam Echosounder and Integrated Water Column Data as an Added Value for Seep Hunting

HYDRO 2016 – 8 November 2016

Marco Filippone

- Introduction, Multibeam Sonars & water column
- Seep Origin
- Seep Hunting Methodology
- Multibeam and Water Column Analysis / Data Management
- Seep Hunting Campaign Benefit



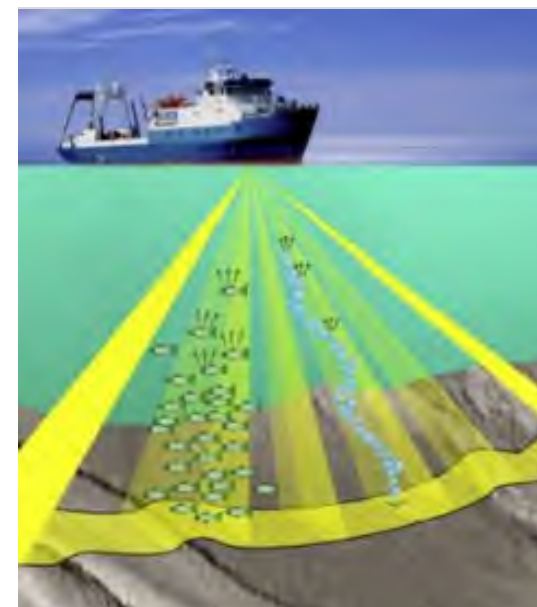
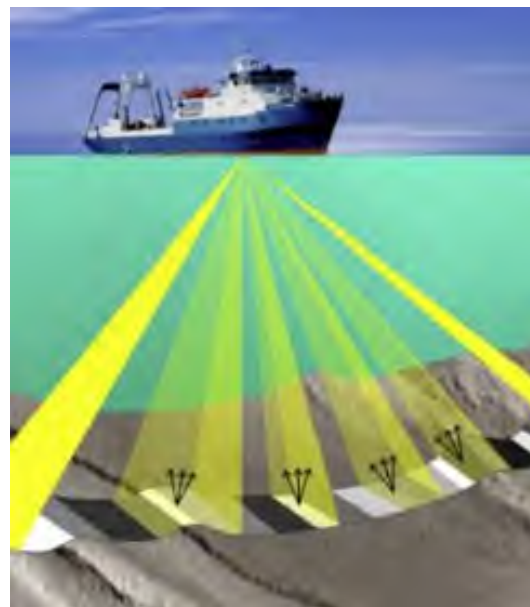
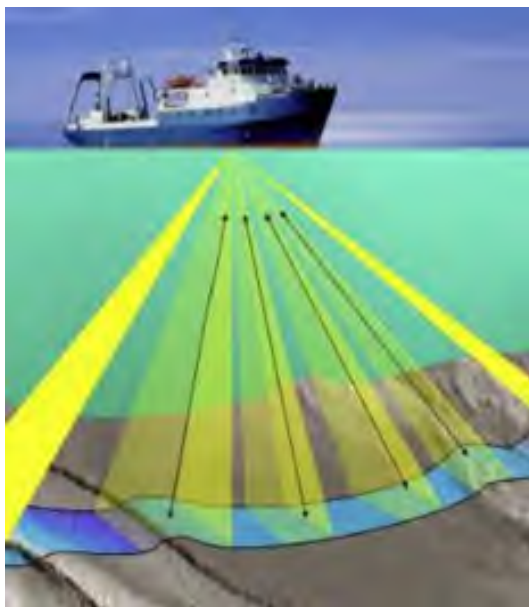
# Introduction: Multibeam Sonar and Water Column

Large-area seafloor coverage offered by the “swath” system from a single pass of the survey platform, providing superior navigation data compared to that obtained by single-beam bathymetric sounders.

MBES backscatter is similar to side scan sonar backscatter, and can be used to infer seafloor hardness and roughness characteristics an extremely valuable measurement when studying seafloor surficial geology.

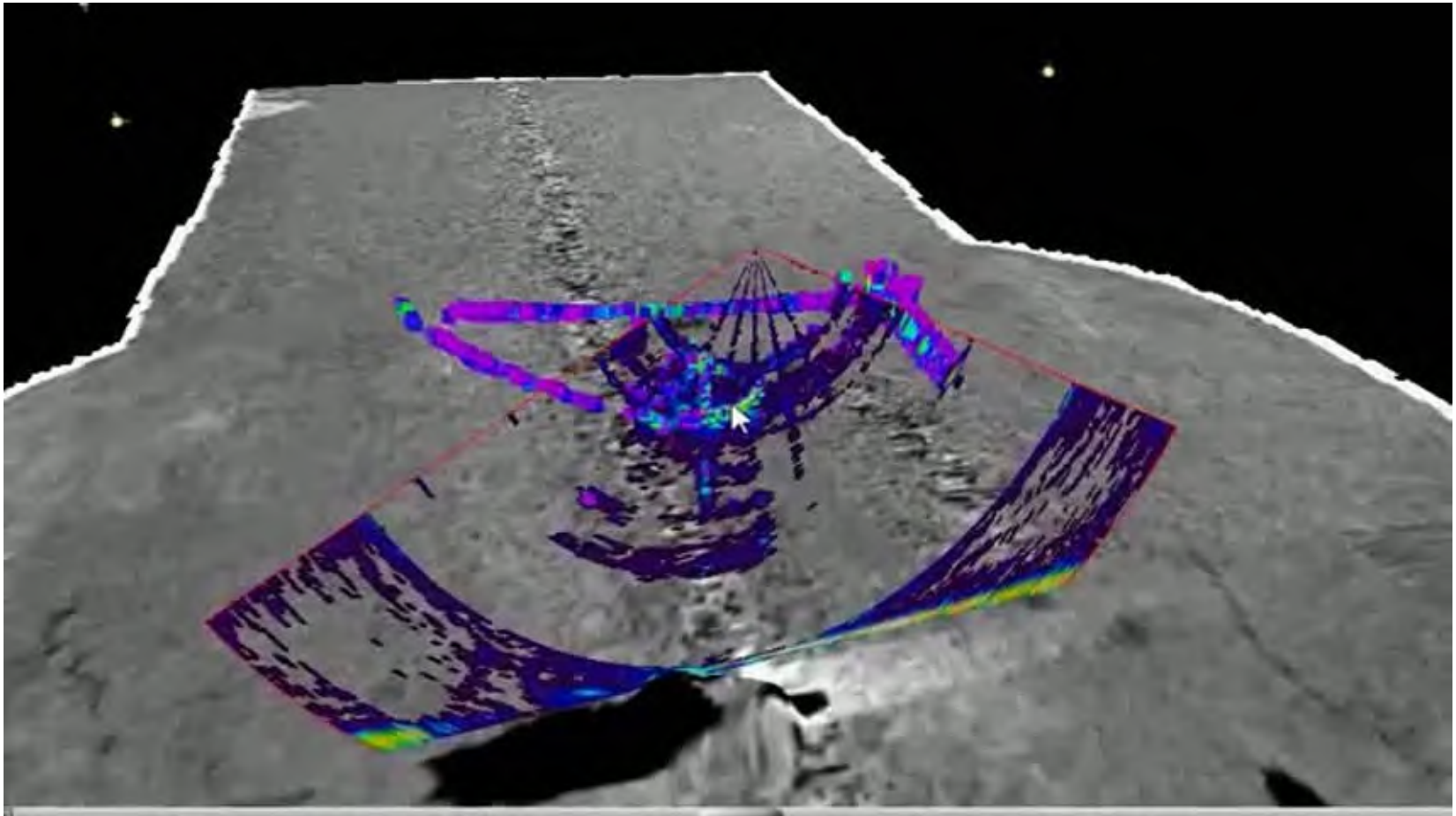
MBES acoustic returns may also be detected from objects in the water column (i.e. above the seafloor) that scatter the emitted sound pulse.

Images adapted from [Lurton, 2002](http://www.fugro.com)

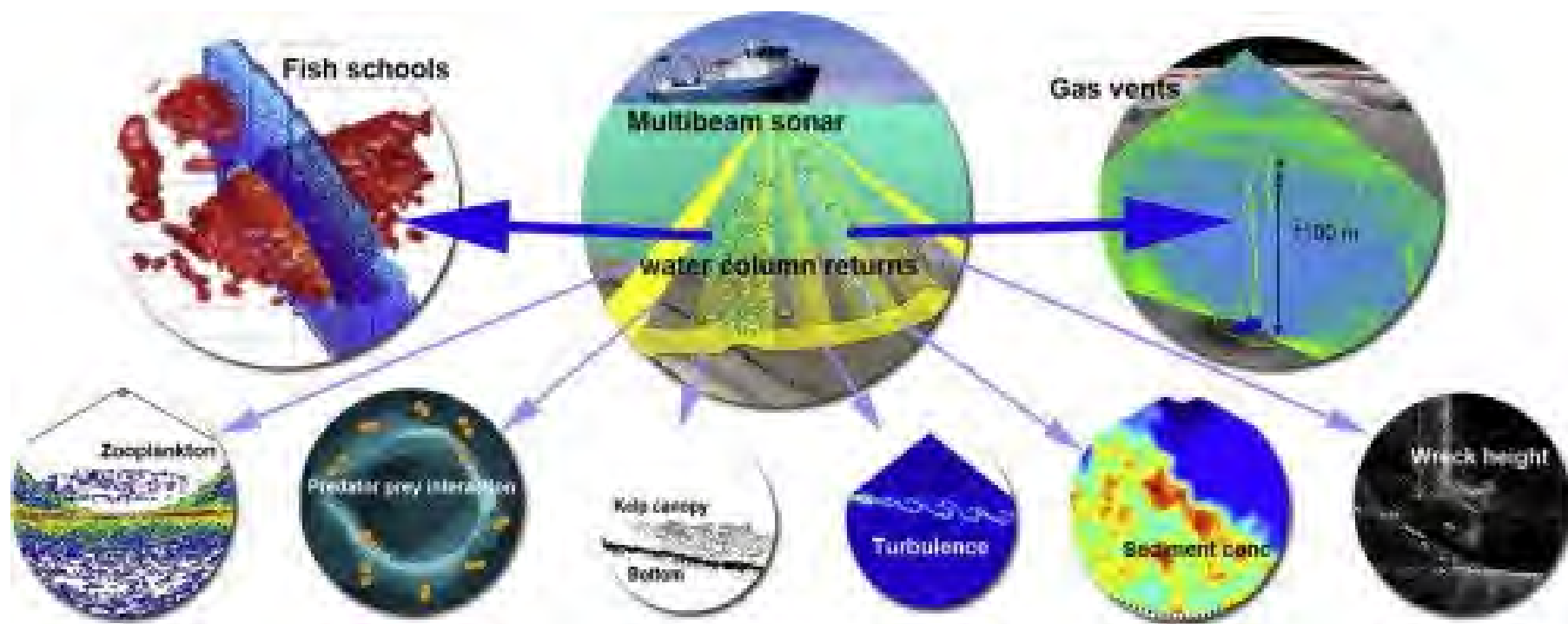


## Introduction: Multibeam sonar and water column

Water column mapping is used to explore hydro acoustic scatterers within the marine environment that are found between the ocean surface and the seafloor.

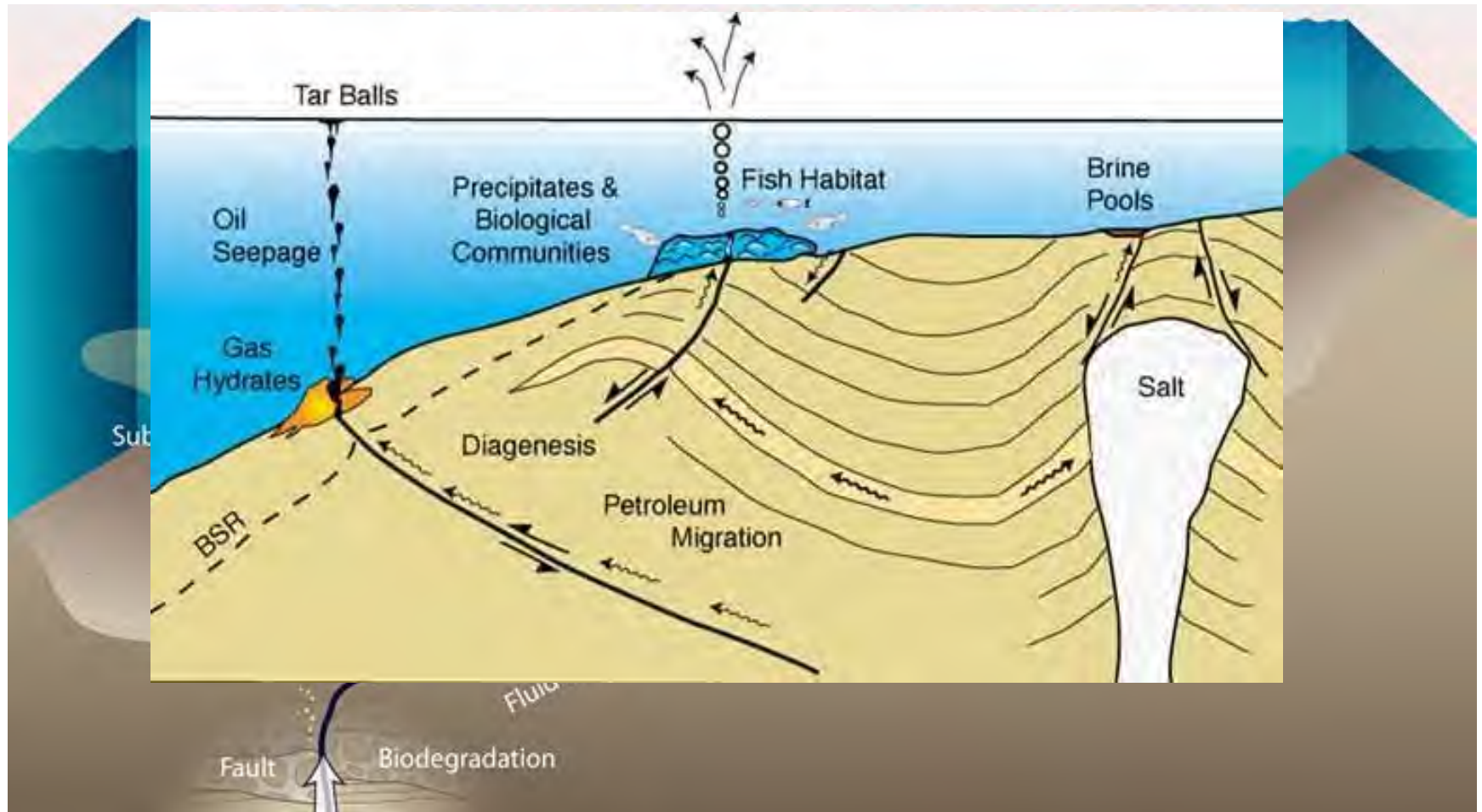


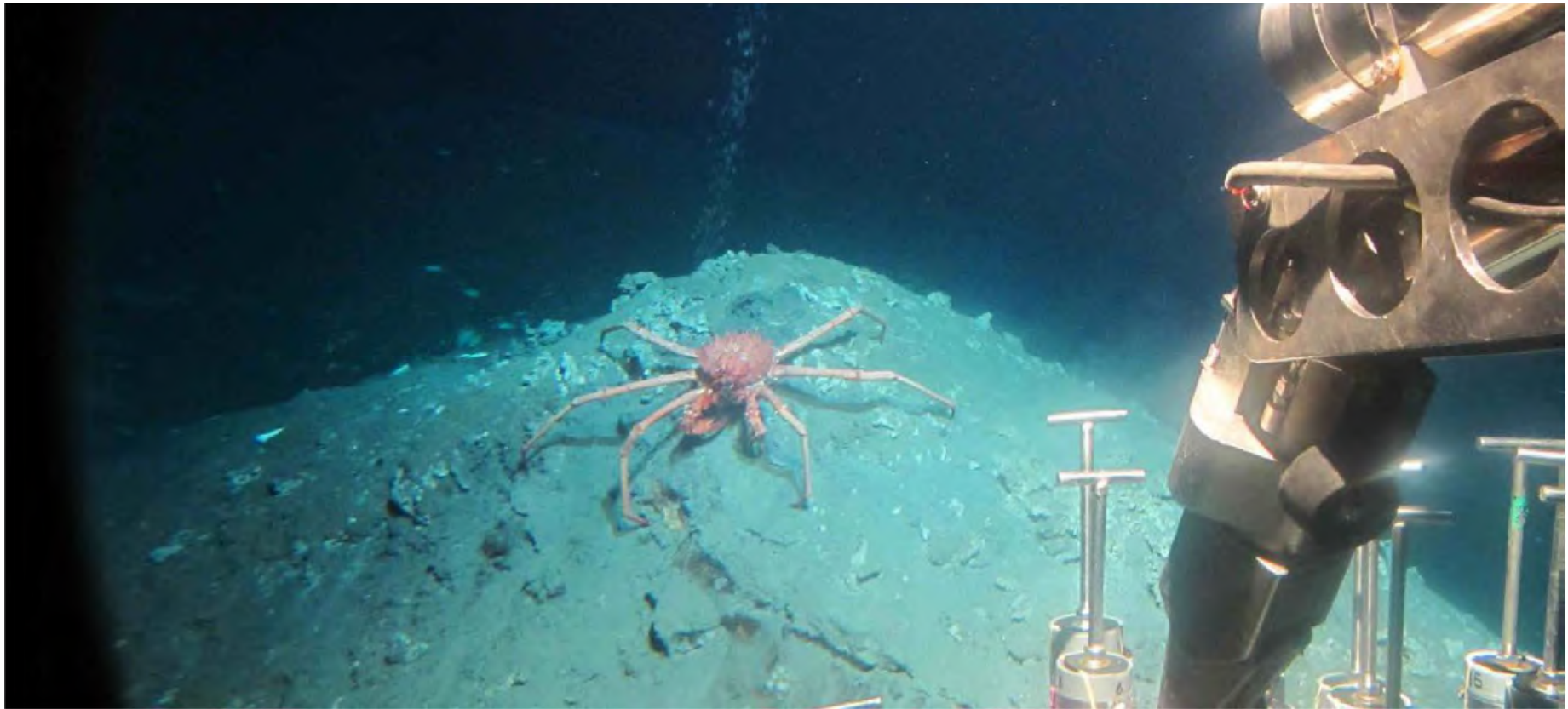
# Introduction: Multibeam sonar and water column



Water column image application adapted by Lurton and [Keir Colbo et al](#)

# Seep origin





## Seep Communities Make Great Acoustic Echoes!

*Adapted from Seep Hunting & Geochemical Campaigns, J. Gharib et al.*

# Seep Hunting Methodology

Acoustic signals travel to the seafloor's surface

Sound hits the seafloor and echoes back to the ship

Travel time related to depth  
Creates a picture of the seafloor

= BATHYMETRY

Acoustic signal may bounce off soft, med, or hard seafloor

Hard surfaces return stronger signals

Hard surfaces often related to active or recent seeps

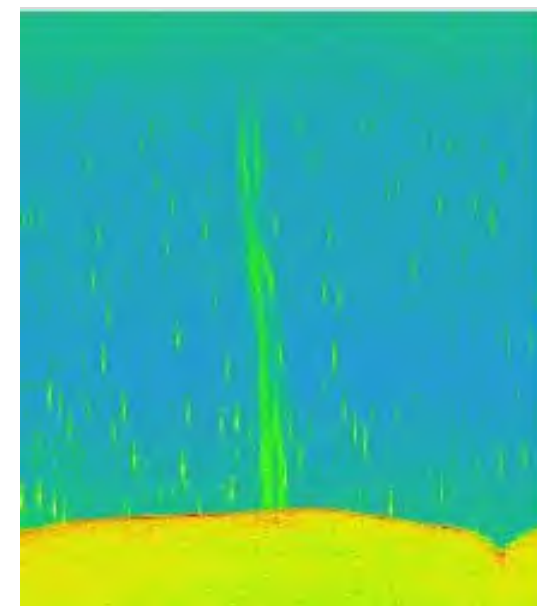
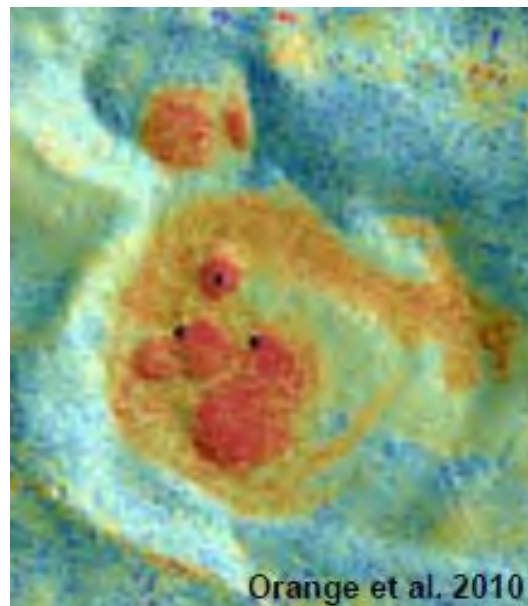
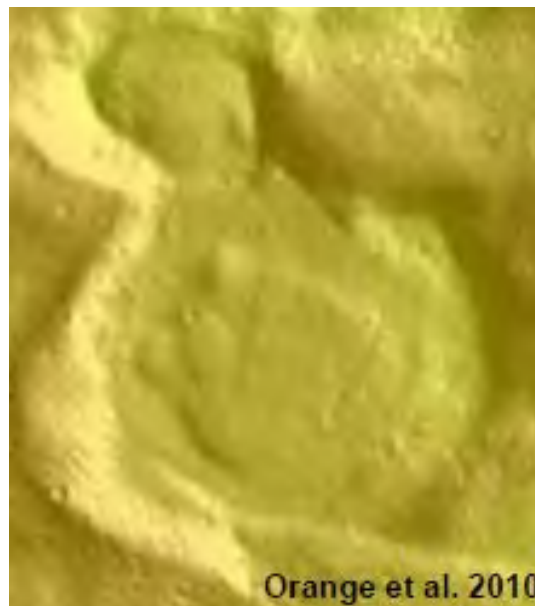
= BACKSCATTER INTENSITY

Acoustics are disrupted by travelling through different mediums (water vs. gas)

Careful data processing can identify this disruption

Clear Indicator of active seep

= GAS PLUMES





# Seep Hunting Methodology

Highly-skilled scientific team carefully assesses geologic structures, backscatter intensity, and water column anomalies

Work with client to prioritize coring / geochemistry targets

= SAMPLE STRATEGY

Core barrel is navigated precisely and accurately to target

Scientists compare location of core barrel to target in real time

Core at intended target location

= BEST SAMPLE

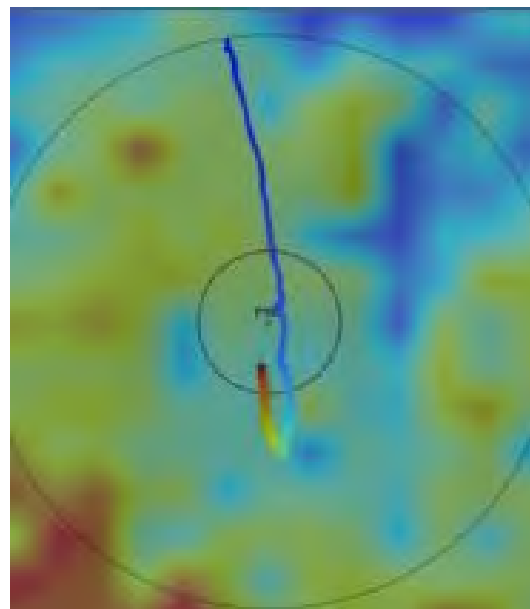
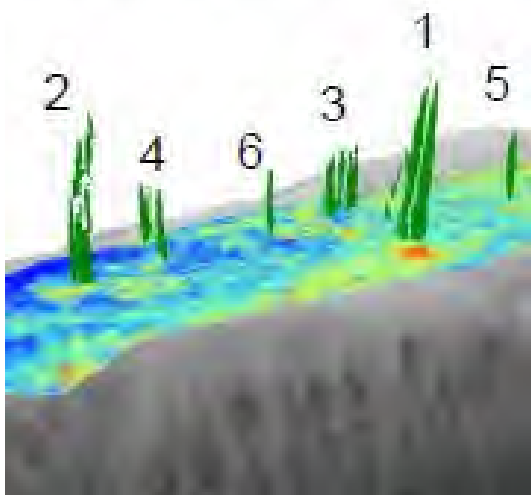
Proper core handling minimizes contamination

Onboard, real-time preliminary geochemistry answers exploration questions

Advanced analyses onshore

= BEST GEOTECH RESULT

Rank / Priority

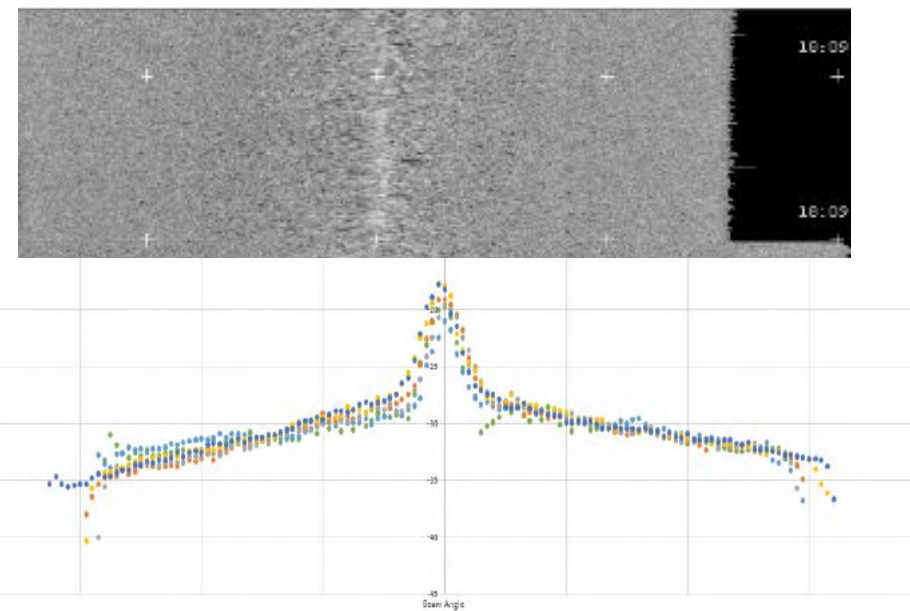
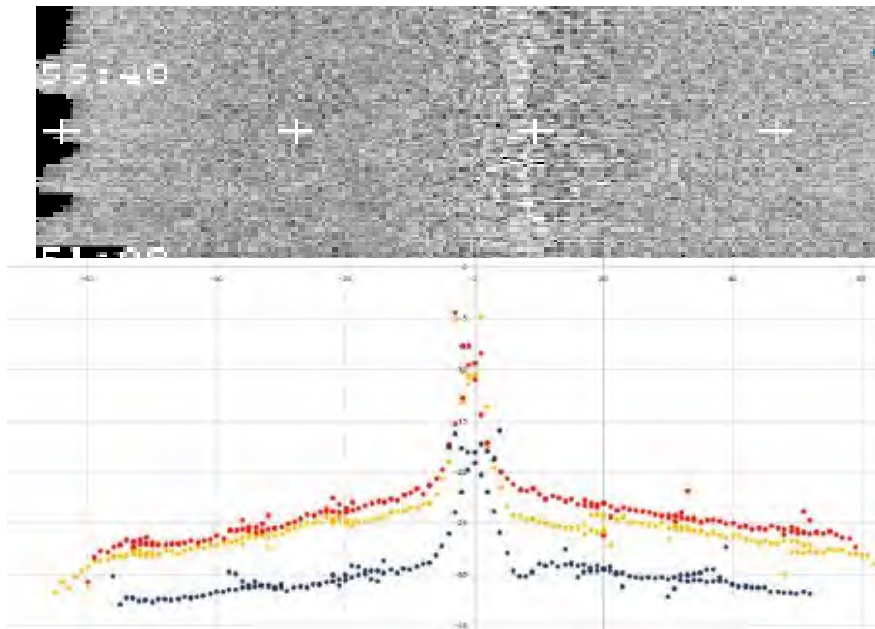


# Multibeam water column analysis and data management

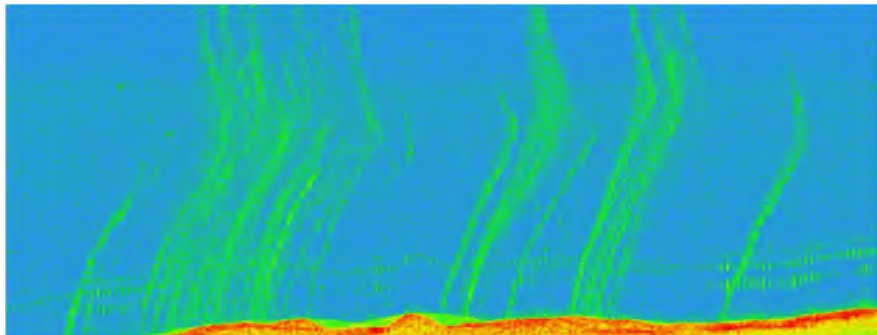
## BS calibration:

There can be significant systematic errors (biases) in backscatter. Need to be able to recognize:

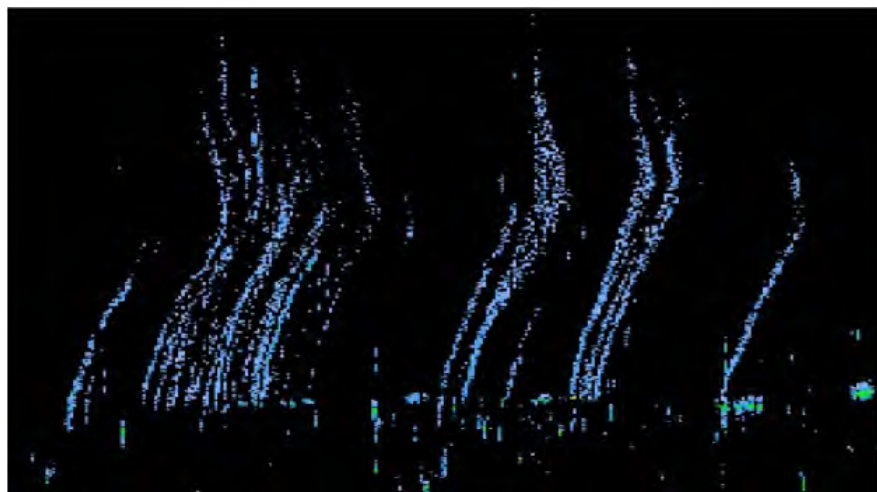
- Step-changes associated with across-track sectors
- Port vs. Starboard differences
- Difference between fore- and aft-ping in Dynamic (multi-ping) mode
- Differences between modes
- Differences between vessels



# Multibeam water column analysis and data management

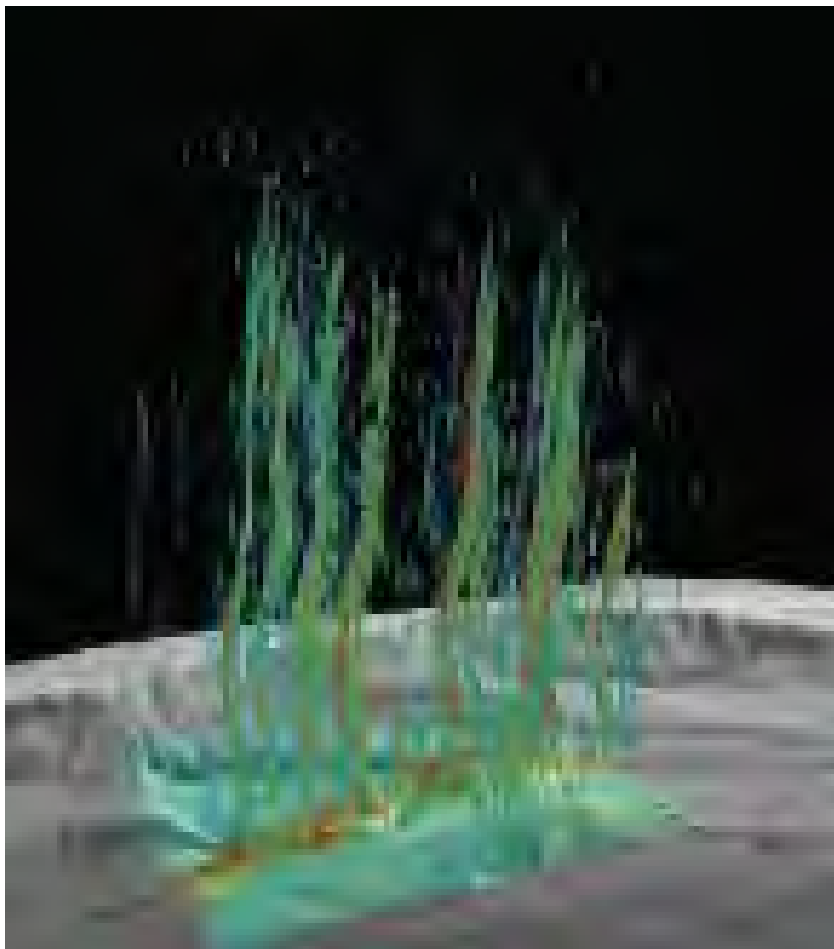


Stacked view of successive multibeam pings showing midwater plumes

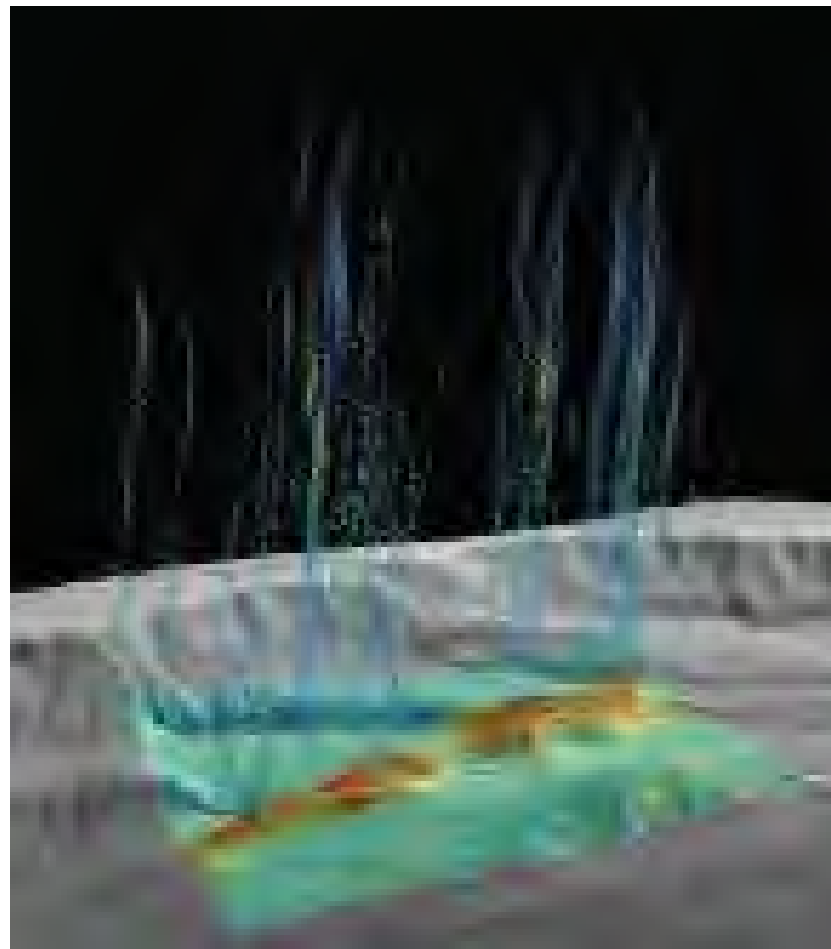


Filtered plumes using the new feature detector toolset in FMMW.

# Multibeam water column analysis and data management



*Filtered plumes using the new feature detector toolset in a Fledermaus Scene.*

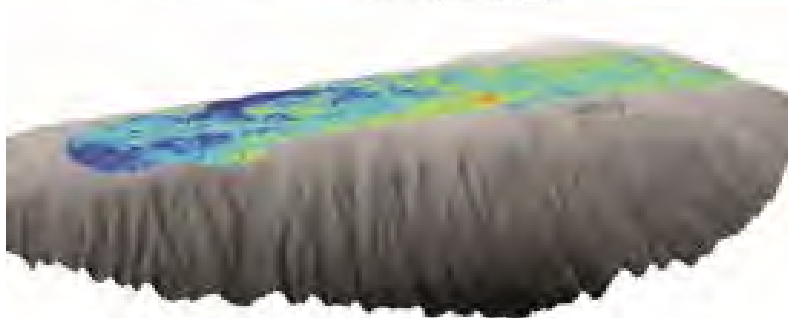


*Filtered plumes after a cluster analysis to improve midwater resolvability of plume shape and seafloor emission site*

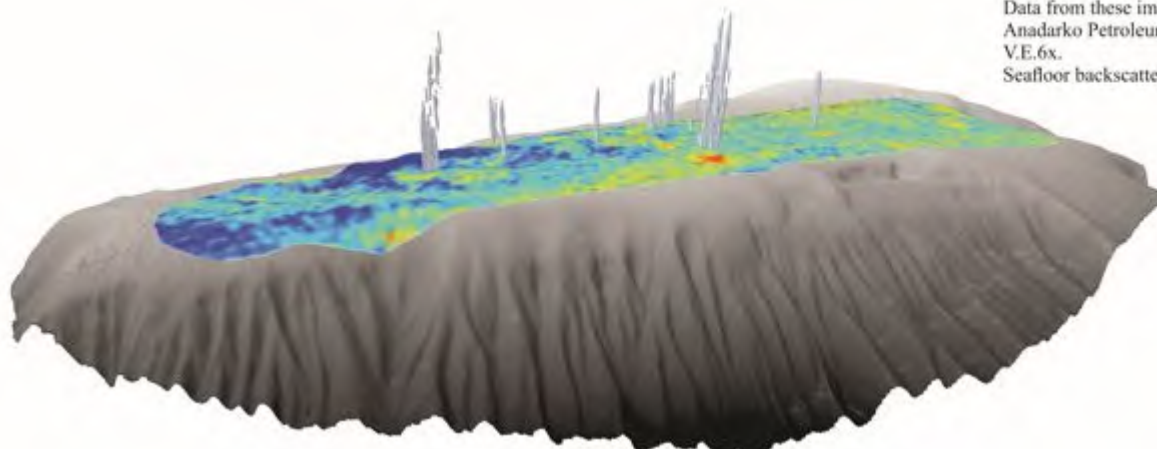
# Multibeam water column analysis and data management



*Bathymetry surface from multibeam data*



*Backscatter data is superimposed on bathymetry surface*



Data from these images courtesy of  
Anadarko Petroleum Company,  
V.E.6x.  
Seafloor backscatter - high = red.

*Combined surfaced*

# Seep hunting campaign benefit

Maximize return on investment & aid decision making:

- Onboard experts can optimize ship time by making decisions based on the acquired data
- Provide guidance for prioritizing future exploration work
- Quickly map most or all of your lease block
- Seep campaign results will show you where to carry out more expensive exploration work
- Lack of convincing evidence for a viable hydrocarbon source means you can spend your resources elsewhere





Thank you

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