Quantitative Multibeam Sonar Seep Bubble Gas Flux Discrimination and Mapping its Geochemical Fate

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Pilot Study Project Goals and Challenges

• Characterize the spatial and temporal variability of seep emissions over a significant area and time.

• Quantify transient emission event (blowout) magnitude and frequency.
Pilot Study
Project Goals and Challenges

Seep emission quantification
Discrimination between fish and seeps
Power and data management
Why Spatial and Temporal Scales?

- To understand controlling physical parameters.
- To understand the representability of results.
- To establish a baseline for long-term trends.
- Long term flux monitoring.

Most water-column and sediment hydrate related properties are derivative of the bubble flux.
Study Roadmap

• Scanning Multibeam Sonar
• Laboratory Calibration
• Field Calibration and Testing (SB Channel)
• Field Deployment (Arctic)
• Field Deployment (Gulf of Mexico - Spring 2010)
A Seabed Multibeam Sonar Scanning Bubble Monitor

– Rotator position and multibeam sonar are both recorded on an embedded computer.
– Sonar (Imagenex) is low power but low dynamic range (8-bit).
– Control gain on a ping by ping basis to expand dynamic range (Multiping).
Laboratory Calibration

UCSB Wind-wave channel

Flow control manifold
Laboratory Calibration Goals

- Return versus flow.
- Effect of time variations on flow.
- Geometric effects.
- Bubble-size effects.
Shallow Field Calibration

The Coal Oil Point seep field - a natural laboratory to test data strategies and equipment function (and learn !!!).
Geologic Control of Seepage

Leifer et al., 2009
Multibeam Sonar Map
Shallow Water Rotator Data

Shane Seep (5/18/09)

Also maps seafloor
Four dimensional maps
In-situ Field Calibration
Arctic Submerged Permafrost

1400 Gt CH$_4$ Sequestered
Arctic Submerged Permafrost

1400 Gt CH₄ Sequestered or is it?
Aug-Sept. 2009 Arctic Deployment
Arctic Rotator Data
Next Efforts

• System Deployment in Gulf of Mexico for Autonomous Multihour Recording
• COP seep field calibration re-deployment
• Pogo deployment on an instrumented Lander
• Laboratory deployment
• Publications (and MS Thesis)!!!!
Fate of the Seep Gas Fate

In situ Methane Measurements in the Santa Barbara Channel using GC and MIMS Analyses
Transect on 9/28/2009

- Methane concentration in µm/L

Transect

Interpolation
Transect on 9/30/2009

Methane concentration in µm/L
Shallow Thermal Mapping

Provisional

coutesy D. Tratt, Aero
Complex Structure at Trilogy Seep
Complex Atmospheric Structure at Trilogy Seep
20-40 cm mapping shows a thermal plume associated with enhanced oxygen transfer

- $T < 0.02 \text{C}$
- $DO < 0.006 \text{mg/L}$
- $Z < 1 \text{ mm}$
Thanks!!!