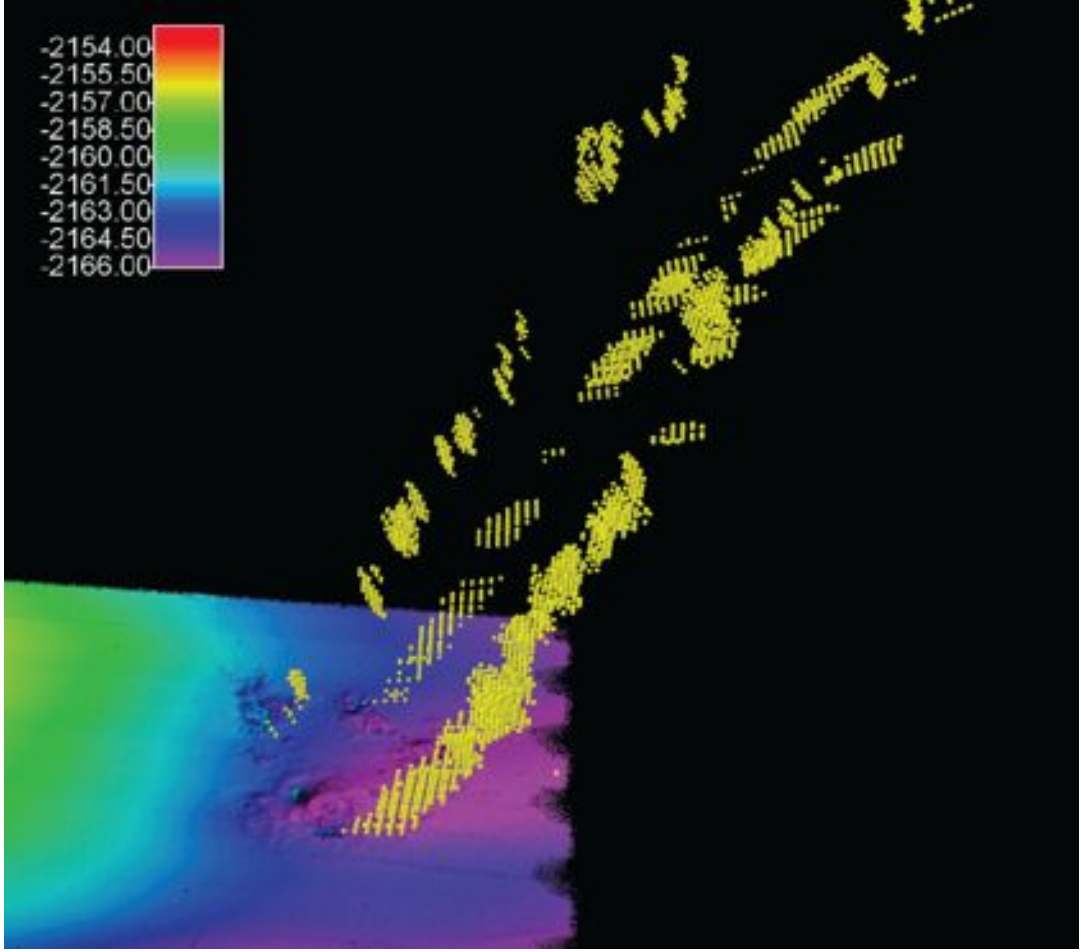
Evidence of Extensive Gas Venting at the Blake Ridge and Cape Fear Diapirs



L.L. Brothers, C.L. Van Dover, C.R. German, D.R. Yoerger, C.L. Kaiser, C.D. Ruppel, E. Lobecker, A.D. Skarke

USGS

U.S. Department of the Interior
U.S. Geological Survey

NSF

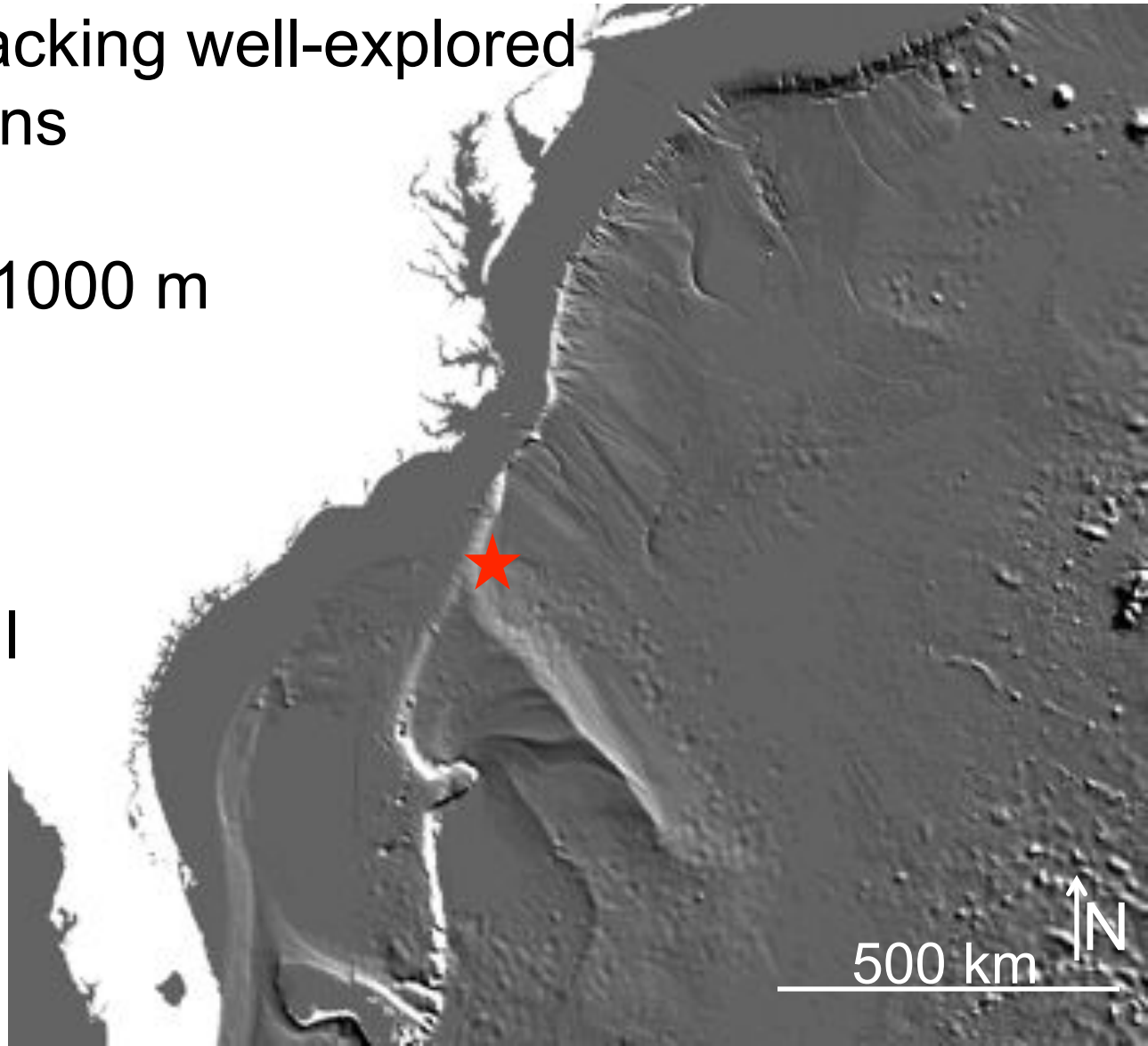
OCEAN EXPLORATION & RESEARCH

I. Background: Deep seafloor venting on the U.S. Atlantic Margin

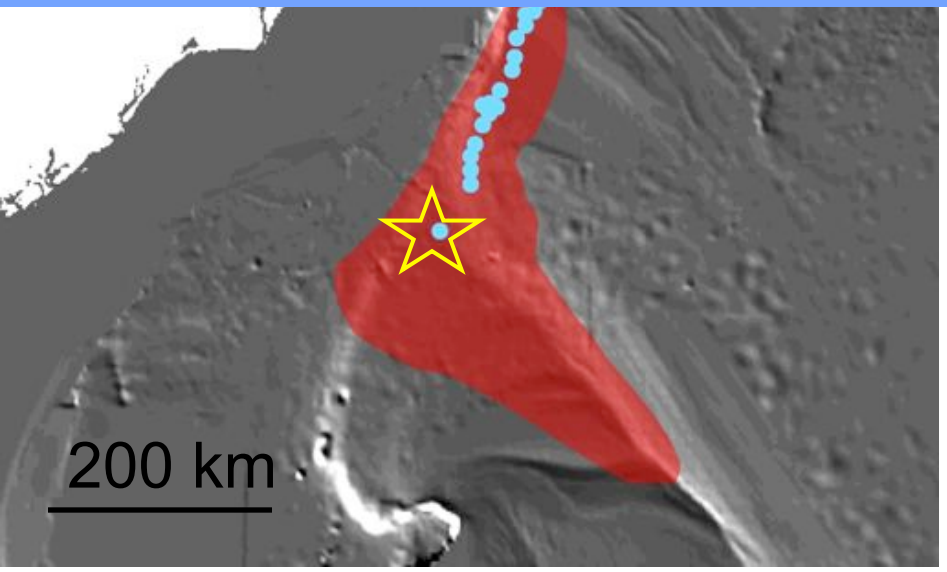
Passive Margin, lacking well-explored Thermogenic basins

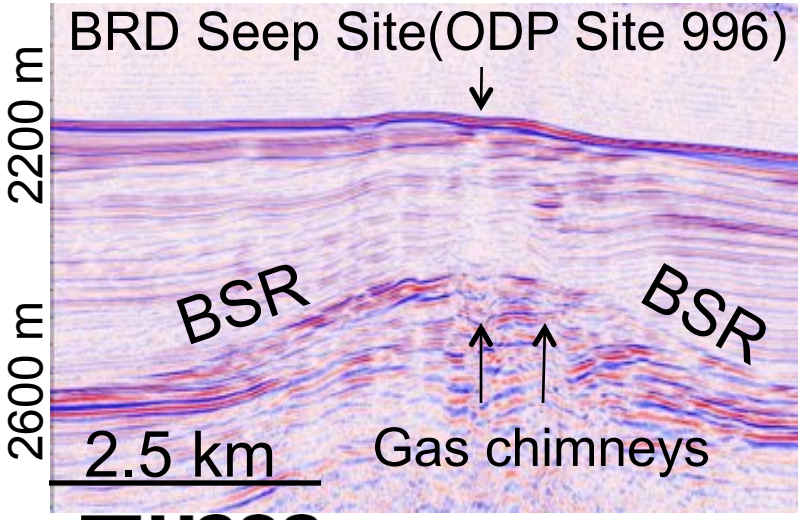
Only one seep > 1000 m water depth

The Blake Ridge Diapir Seep (Paull et al., 1995)



II. Background: The Blake Ridge Diapir Seep site





USGS From Hornbach et al., 2005

*Located in the Blake Ridge gas hydrate province (Dillion and Paull, 1983).

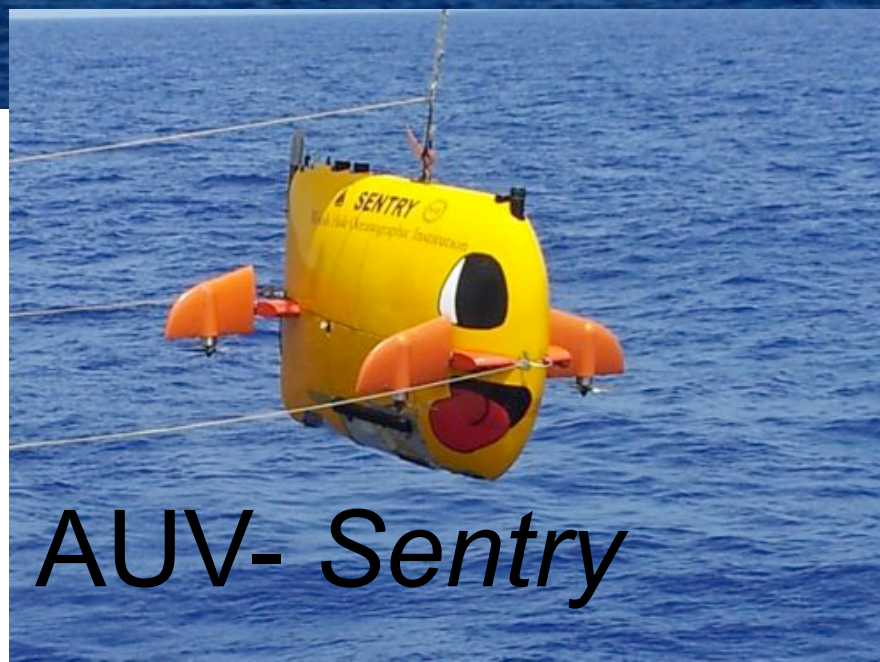
*Large, dilute low-saturation (2-11 % bulk volume) reservoir (Paull et al., 1996).

* Such a low-saturation accumulation is generally thought to typify the volumetric bulk of gas hydrate accumulations in marine sediments (Boswell and Collett, 2010).

II. The Problem: Is the Blake Ridge Diapir seep site anomalous?

July 2012 EX1205L1
Searching for evidence of seafloor methane escape at the Blake Ridge Gas Hydrate province

NOAA Ship
Okeanos Explorer



AUV- *Sentry*

USGS

II. Seep detection July 2012

NOAA Ship *Okeanos Explorer*

Water Column

EK 60 (18 kHz) EM302 (30kHz)

Bathymetry

EM302 (30kHz)

Subbottom Data

3.5 kHz Knudsen

AUV *Sentry*

Bathymetry

Reson 7125 (400kHz)

Side scan sonar

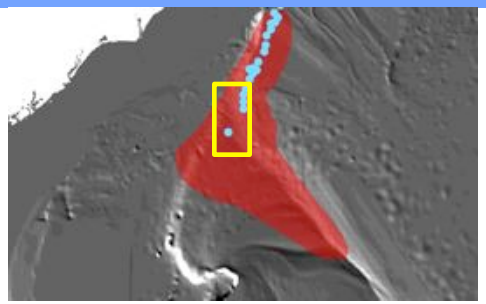
Edgetech 2200M (120/410kHz)

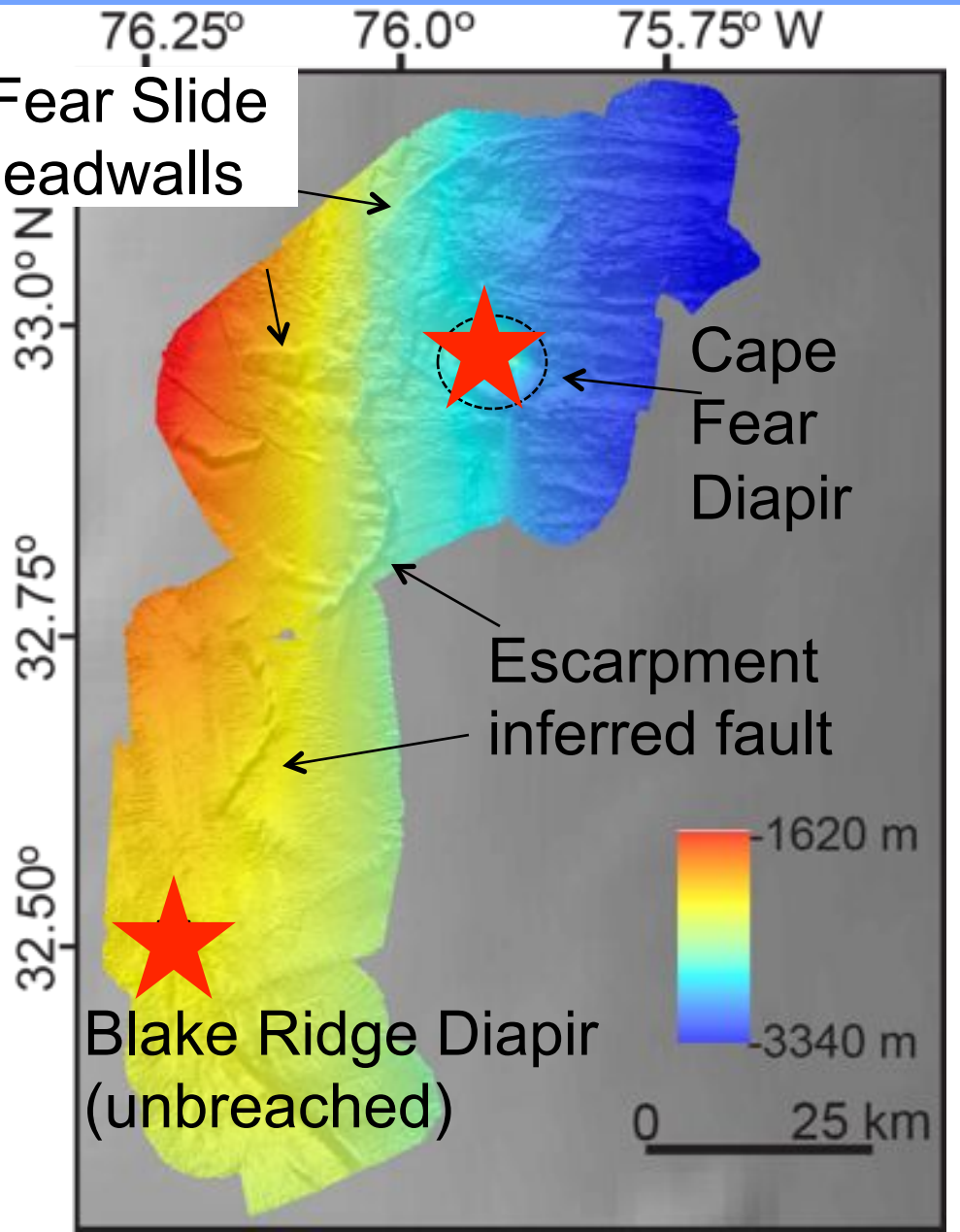
Photo Survey

~3.5-7 s sampling interval

USGS

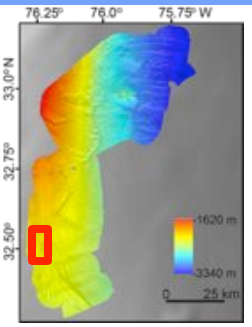
III. Results: Bathymetry & Water Column Anomalies

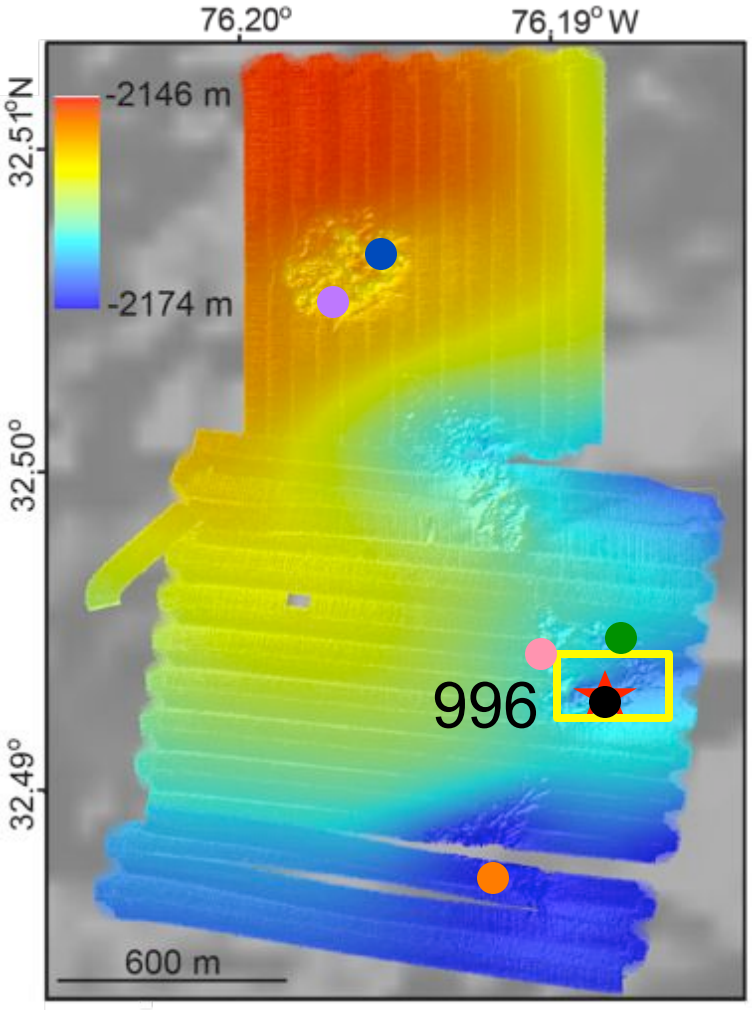


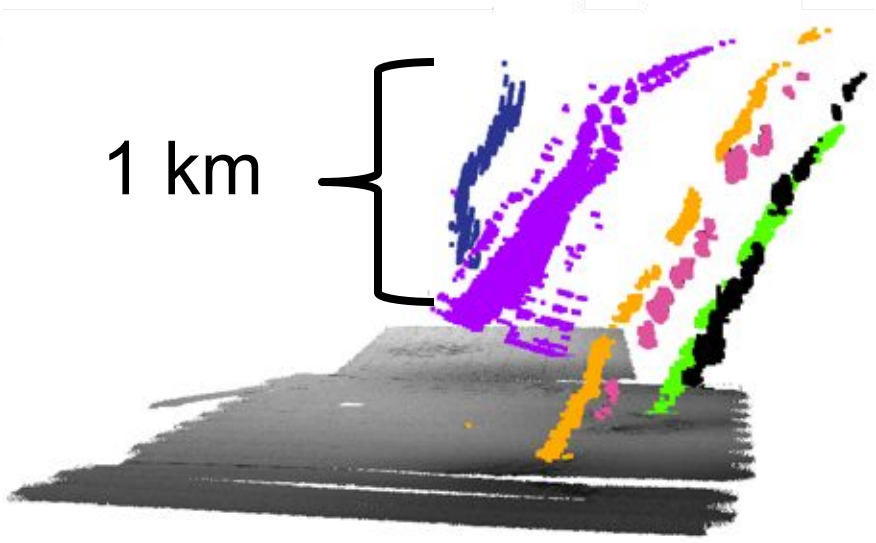


USGS

IV. Results: AUV Bathymetry & Water Column Anomalies



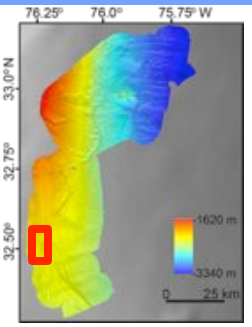


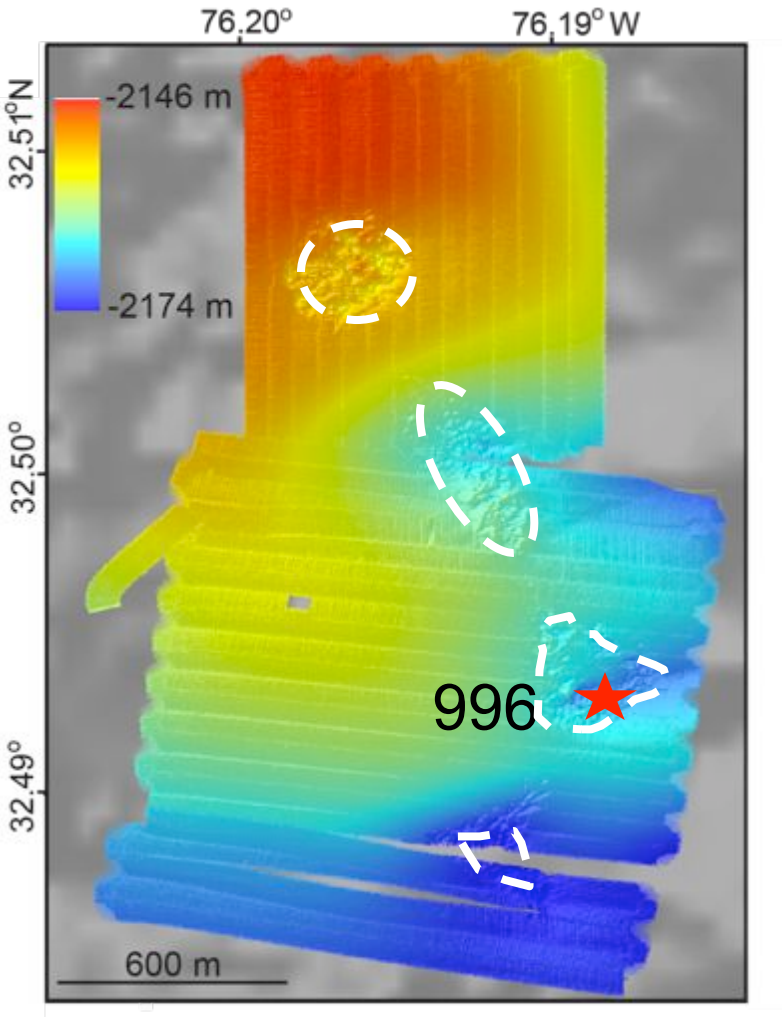


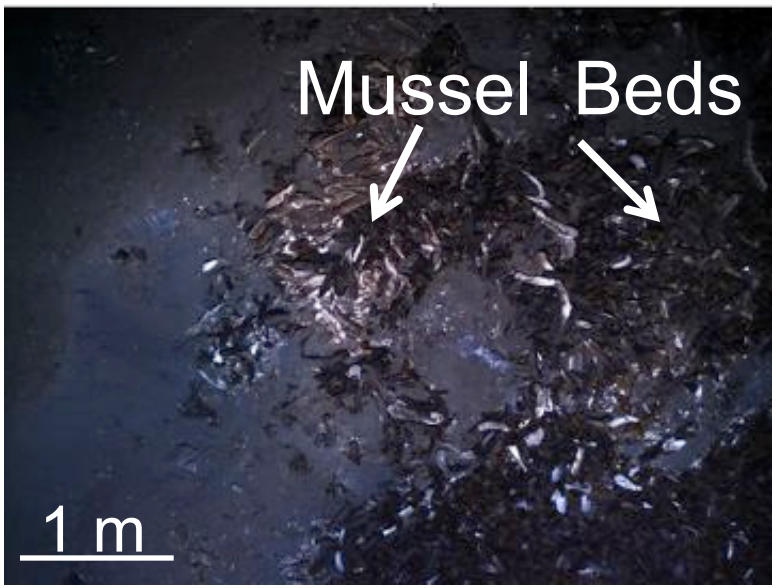
Plumes present outside the known Blake Ridge Diapir seep (mapped Van Dover et al., 2003)

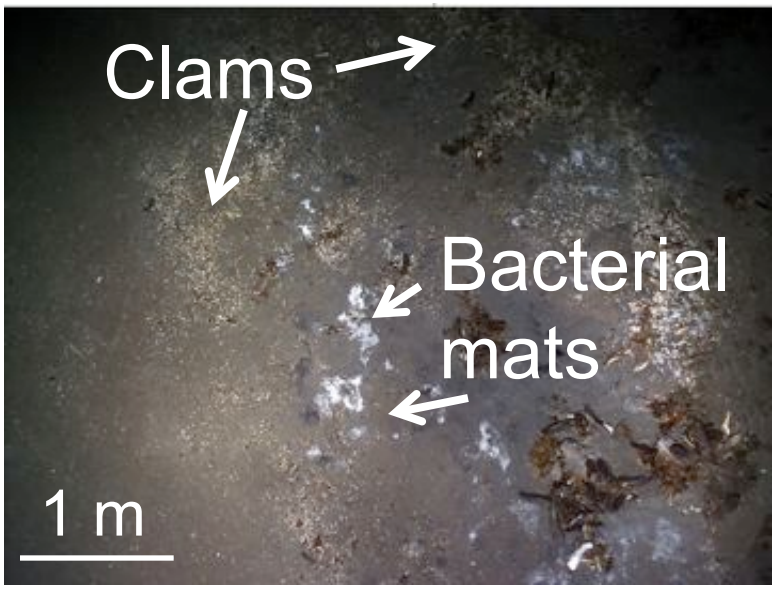
USGS

IV. Results: AUV Bathymetry & Photos



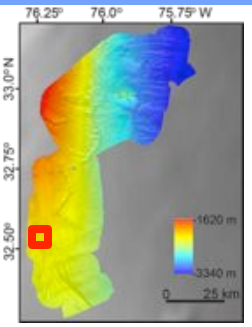




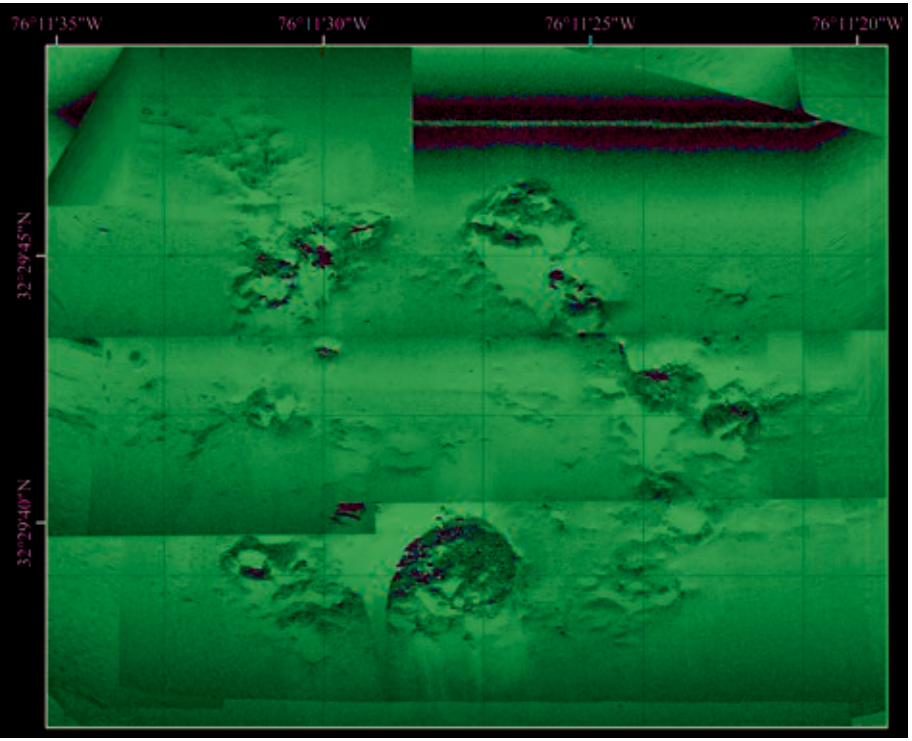


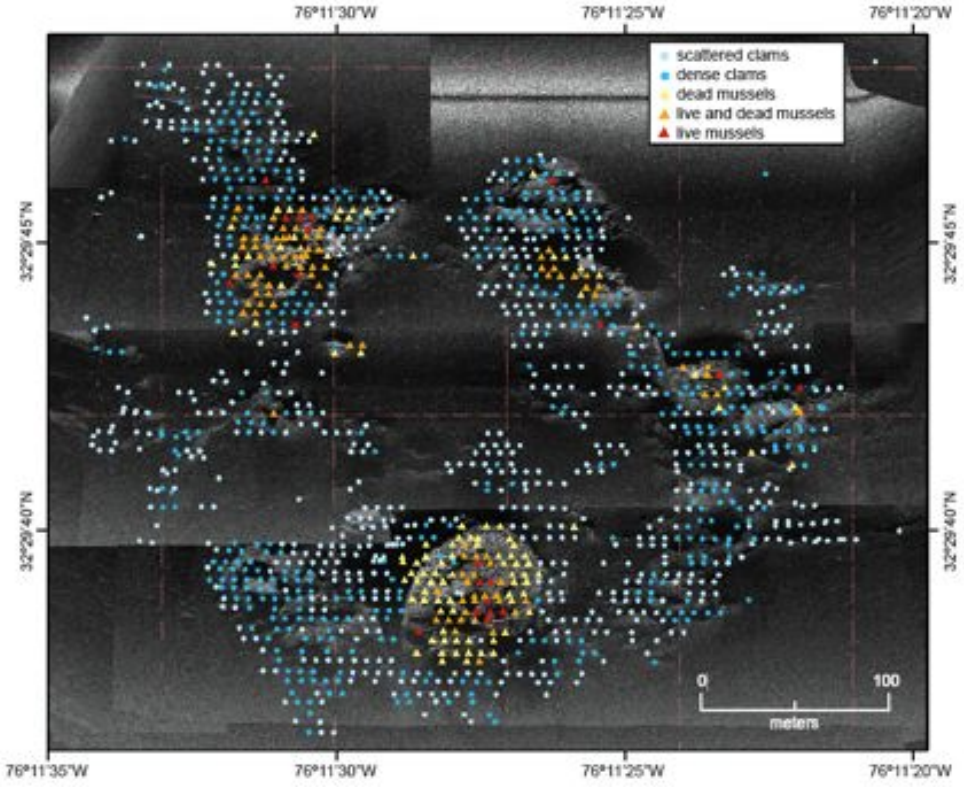
USGS

IV. Results: AUV SSS & Photos



Chemosynthetic communities: A potential proxy for geochemical gradients in the shallow sediments



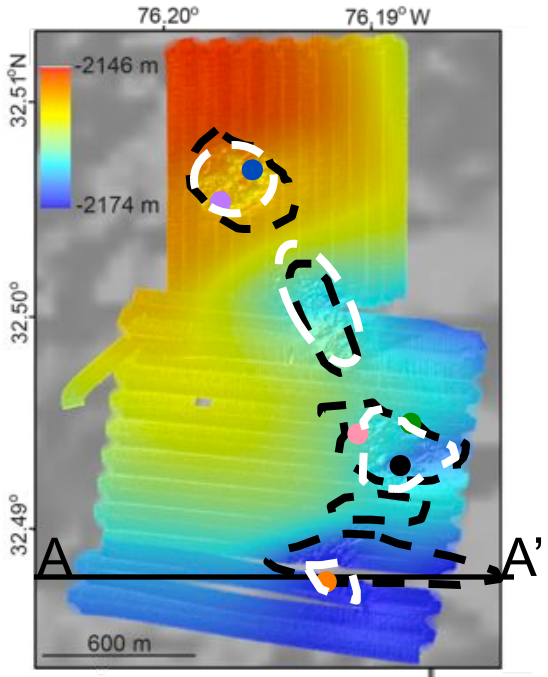


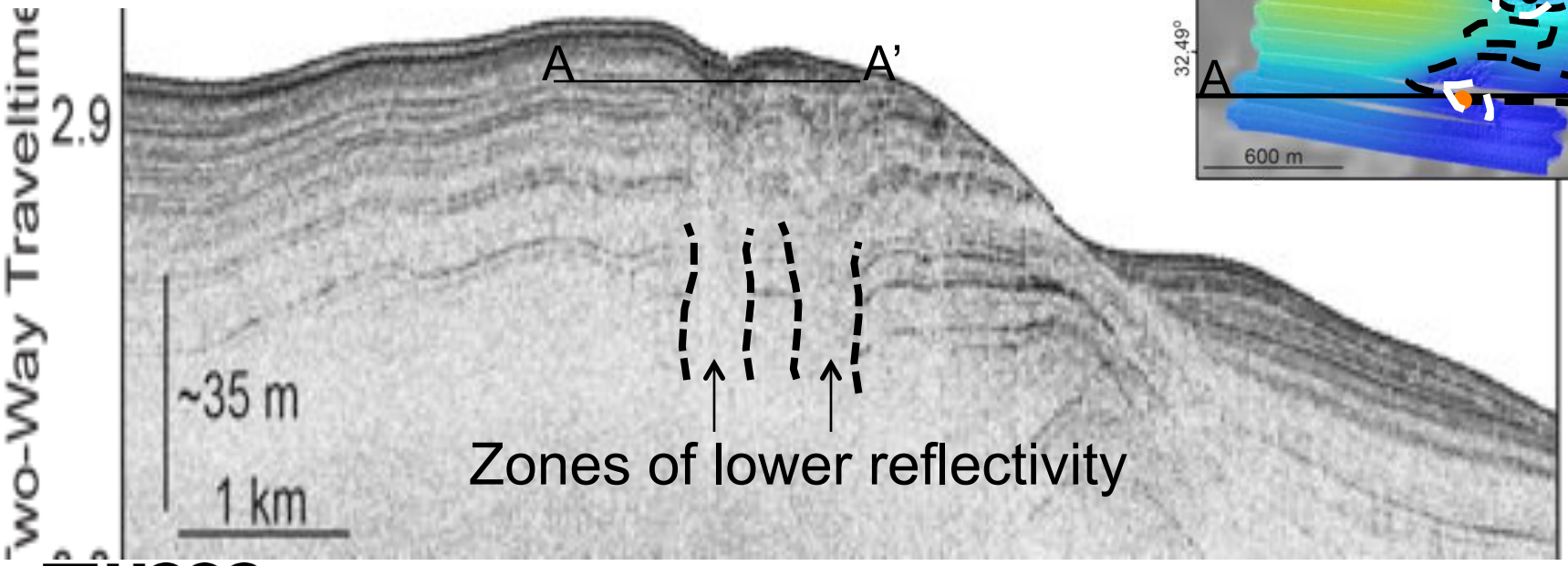
USGS

Wagner et al., *In Revision*

IV. Results: Subsurface Pathways

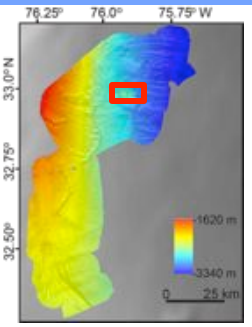
Fluid Migration pathways resolved from -40 mbsf to ~1000 m in the water column



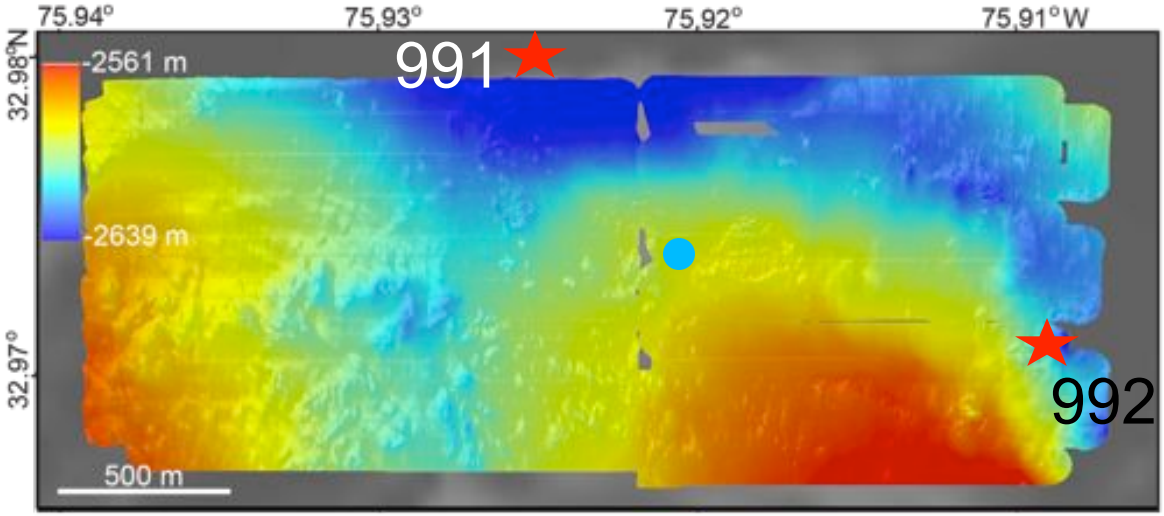


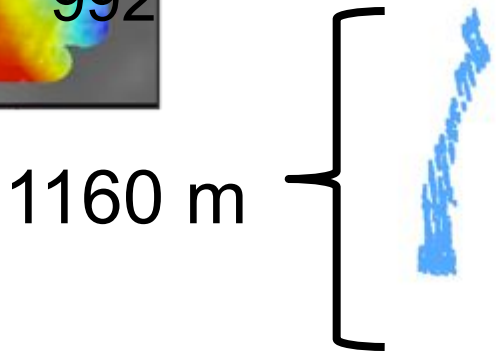
USGS

IV. Results: AUV Bathymetry & Water Column Anomalies



Plume within 1 km of drill sites that found no active venting and minimal evidence for past venting





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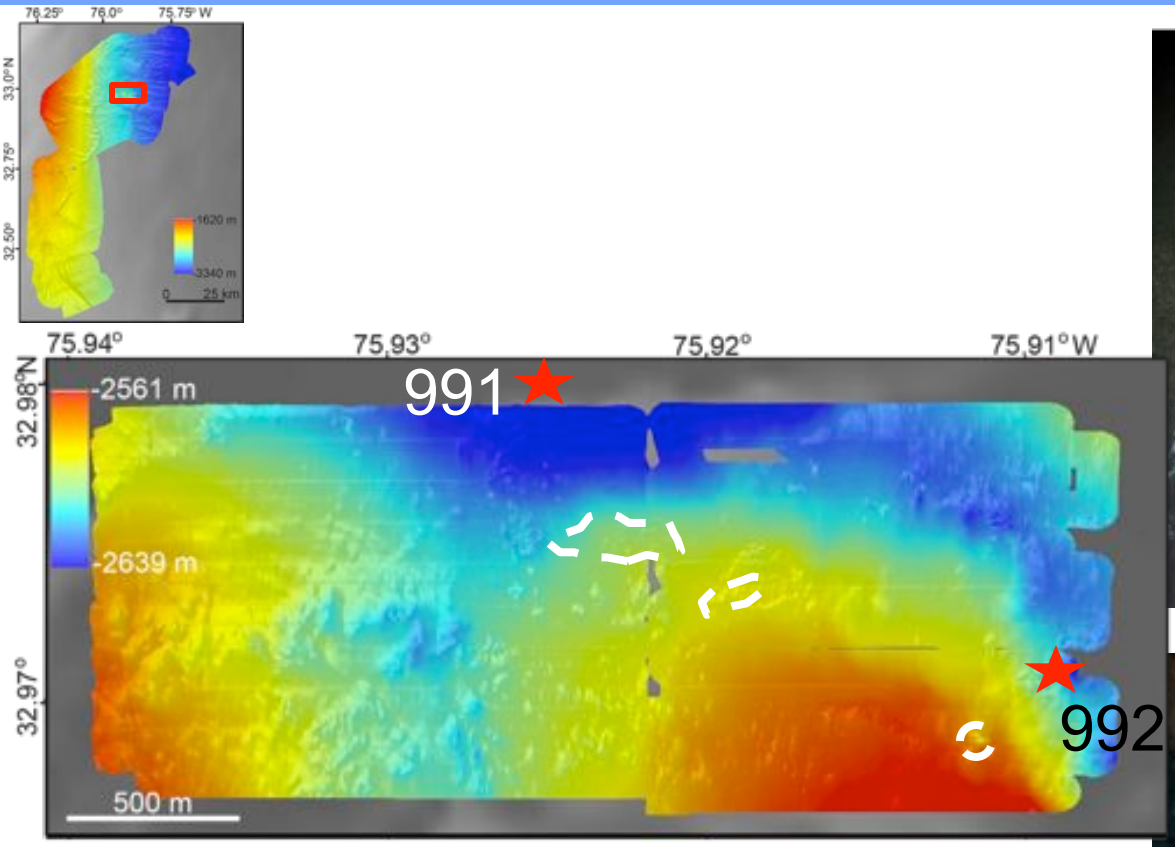
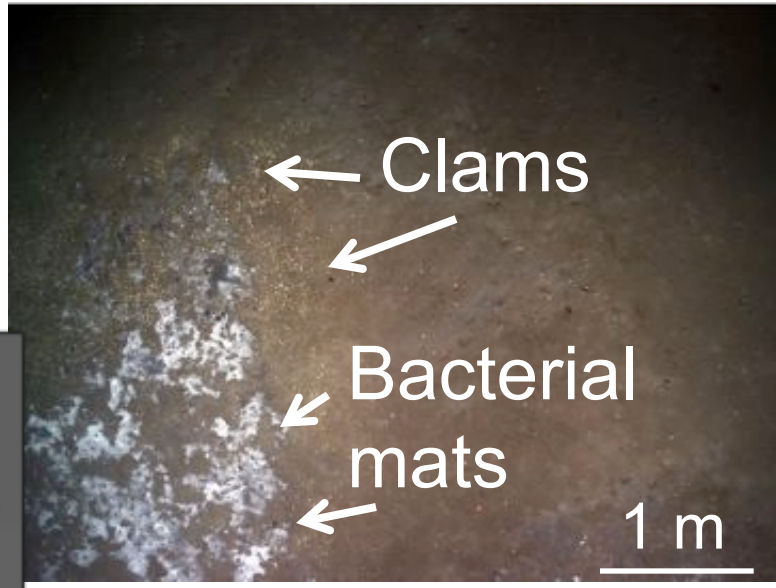
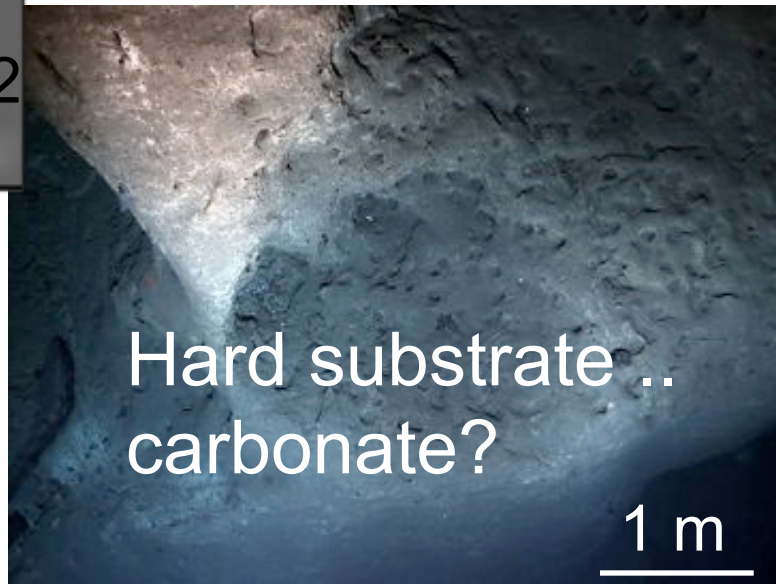
IV. Results: AUV Bathymetry & Photos







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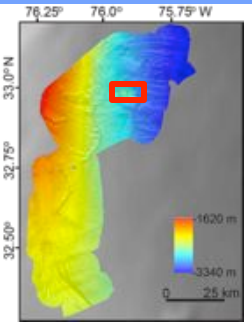
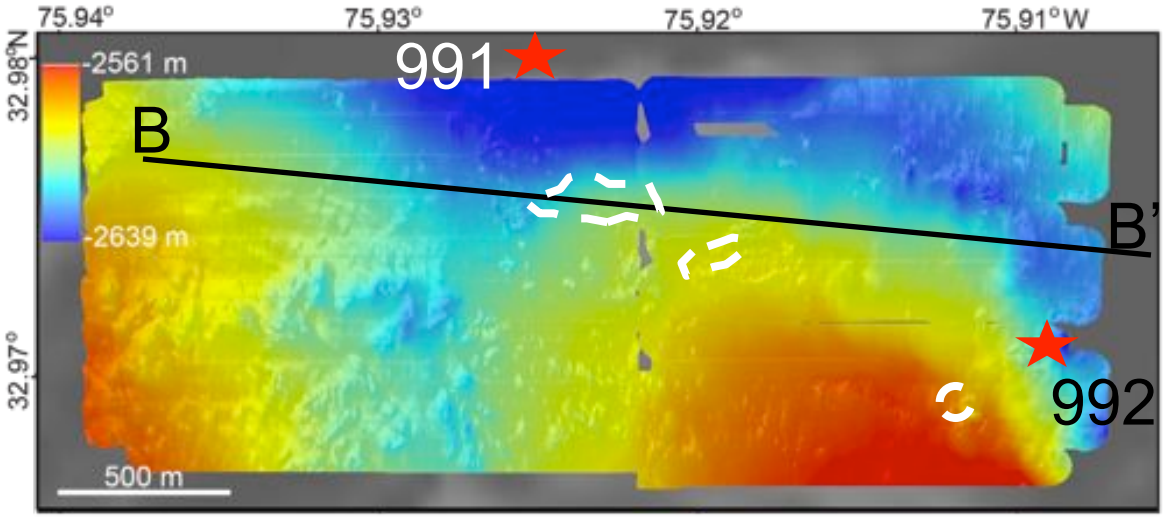
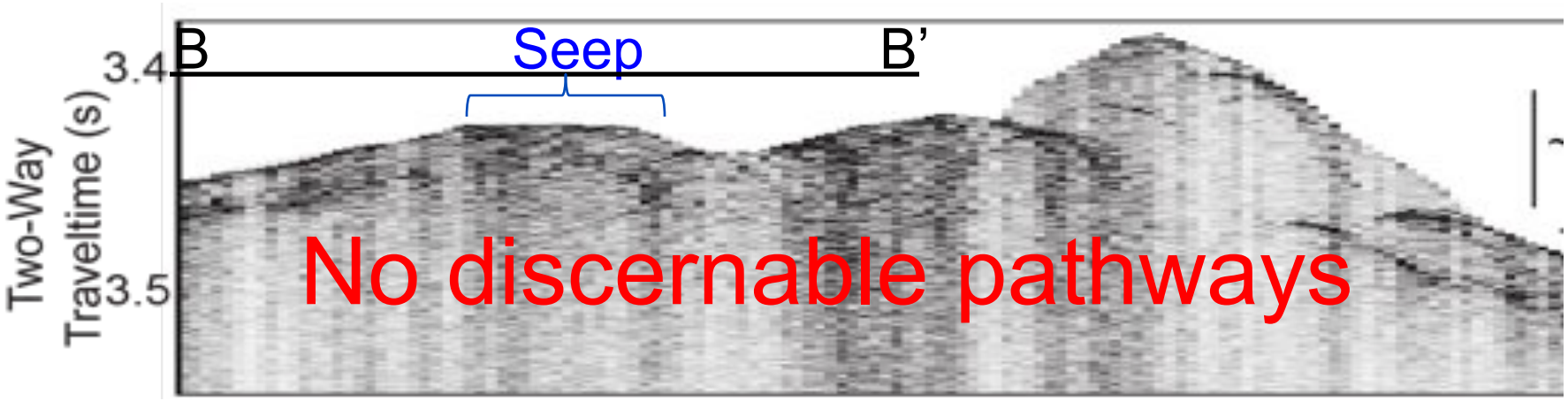
IV. Results: Subsurface Pathways







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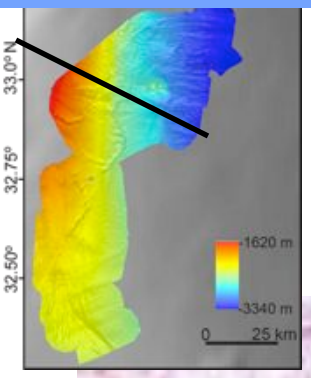
IV. Results: Subsurface Pathways



Very localized shallow pathways

Line PR82X59

BSR

BSR

Seep, 991, 992

3 s

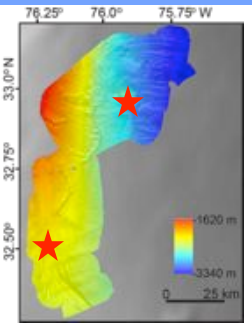
4 s

5 s

6 s

5 km

V. Discussion: Plumes

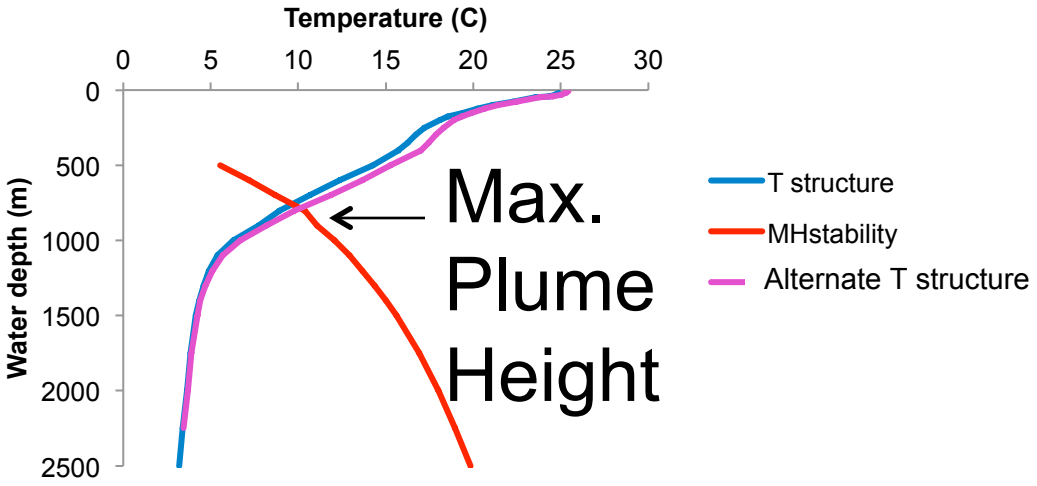


* Imaged in multiple passes in variable weather conditions

* All within 20 meters of benthic chemosynthetic communities

* Plumes do not rise above the water column hydrate stability zone

*Gas Hydrate likely plays a role in bubble ascension



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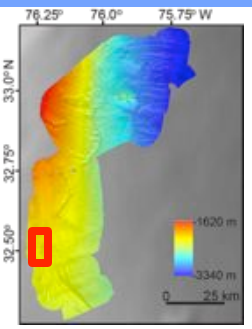
V. Discussion: 996 Still Venting…



(Paull et al., 1995)

1995 Geophysical/ Deep tow survey (Paull et al., 1995)

1996 ODP Leg 164 (Paull et al., 1996)

2001, 2003 Alvin Dives (Van Dover et al., 2003; Heyl et al., 2007)

2012

USGS

Released an estimated 1.541×10^{-1} tons of Carbon

VI. Conclusions

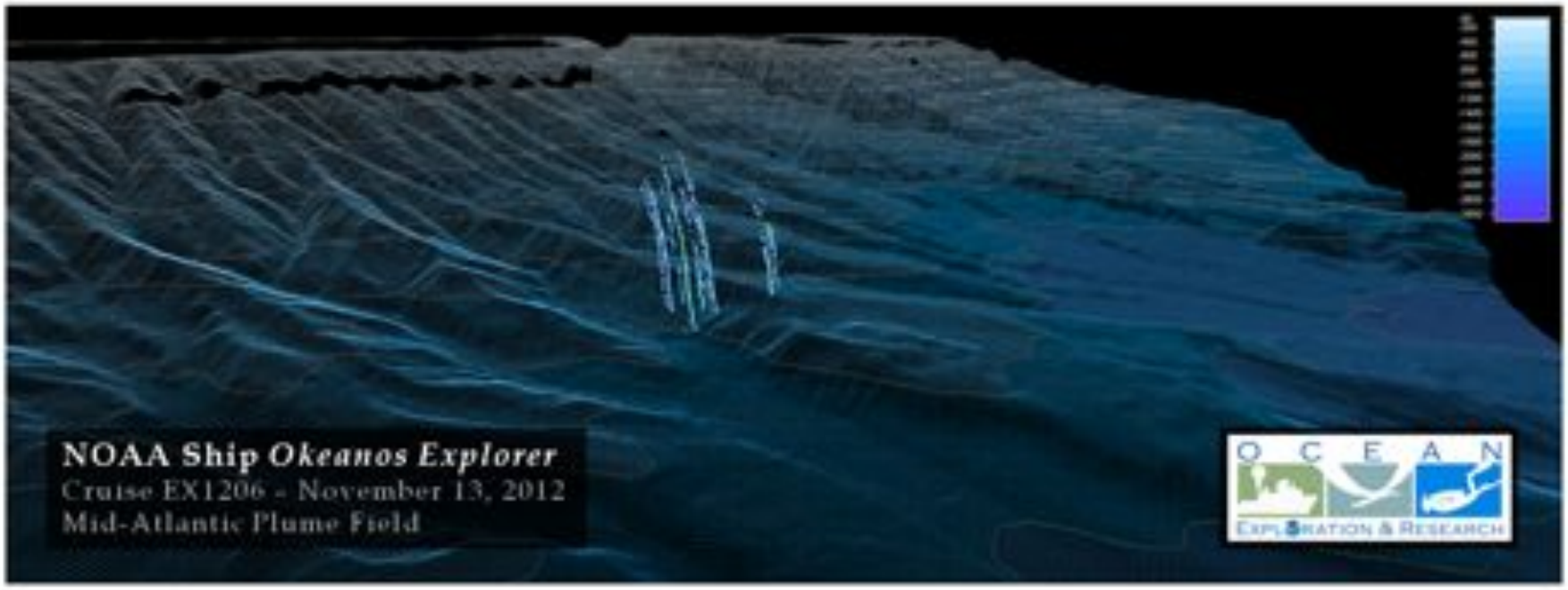
*Even at the known Blake Ridge Diapir, seabed fluid flux more spatially extensive then previously known

*Active Fluid venting at Cape Fear Diapir

*Reevaluate what we expect from ‘low-flux’ settings, especially those punctuated with diapirs

USGS

VI. Conclusions



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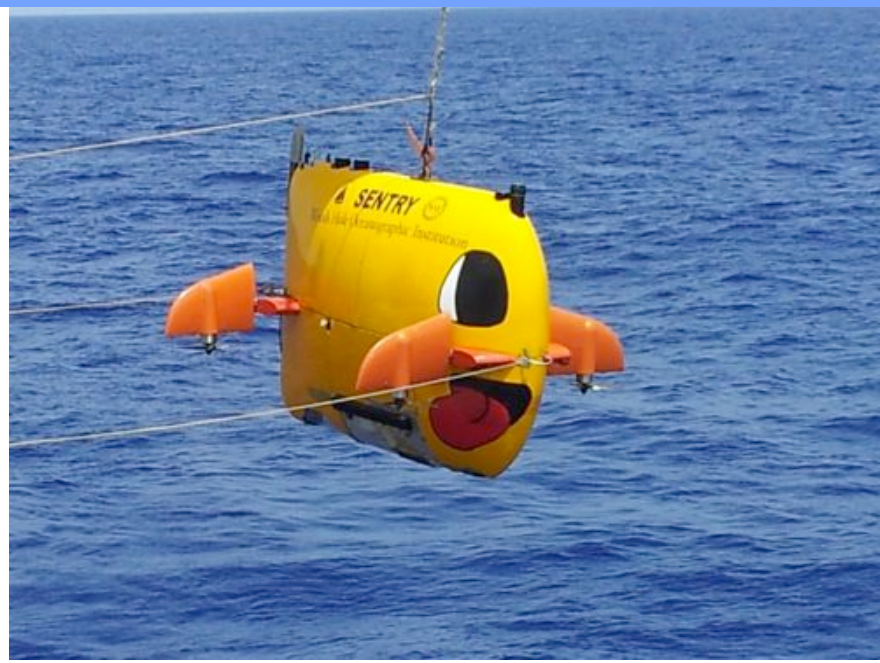
Acknowledgements/Questions

Related Friday Poster Sessions

OS51D. Ocean Exploration Posters

OS51E. Science at Sea: Results from the oceanographic research fleet Posters



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