CMRET CENTER FOR MARINE RESOURCES AND ENVIRONMENTAL TECHNOLOGY

STATUS OF THE PROJECT TO MONITOR A CARBONATE/HYDRATE MOUND IN MISSISSIPPI CANYON BLOCK 118 AND THE MOVEMENT OF HYDROCARBON FLUIDS WITHIN IT

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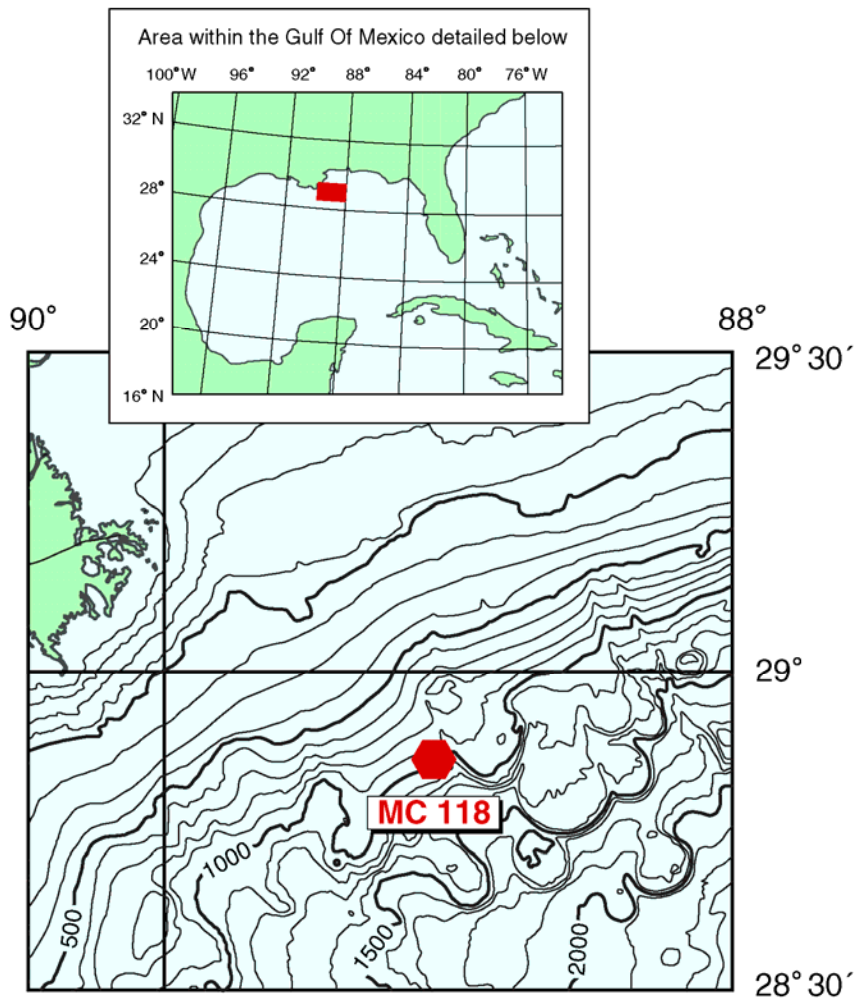
A carbonate/hydrate mound
approximately one kilometer in diameter
occurs in Mississippi Canyon Lease Block 118.

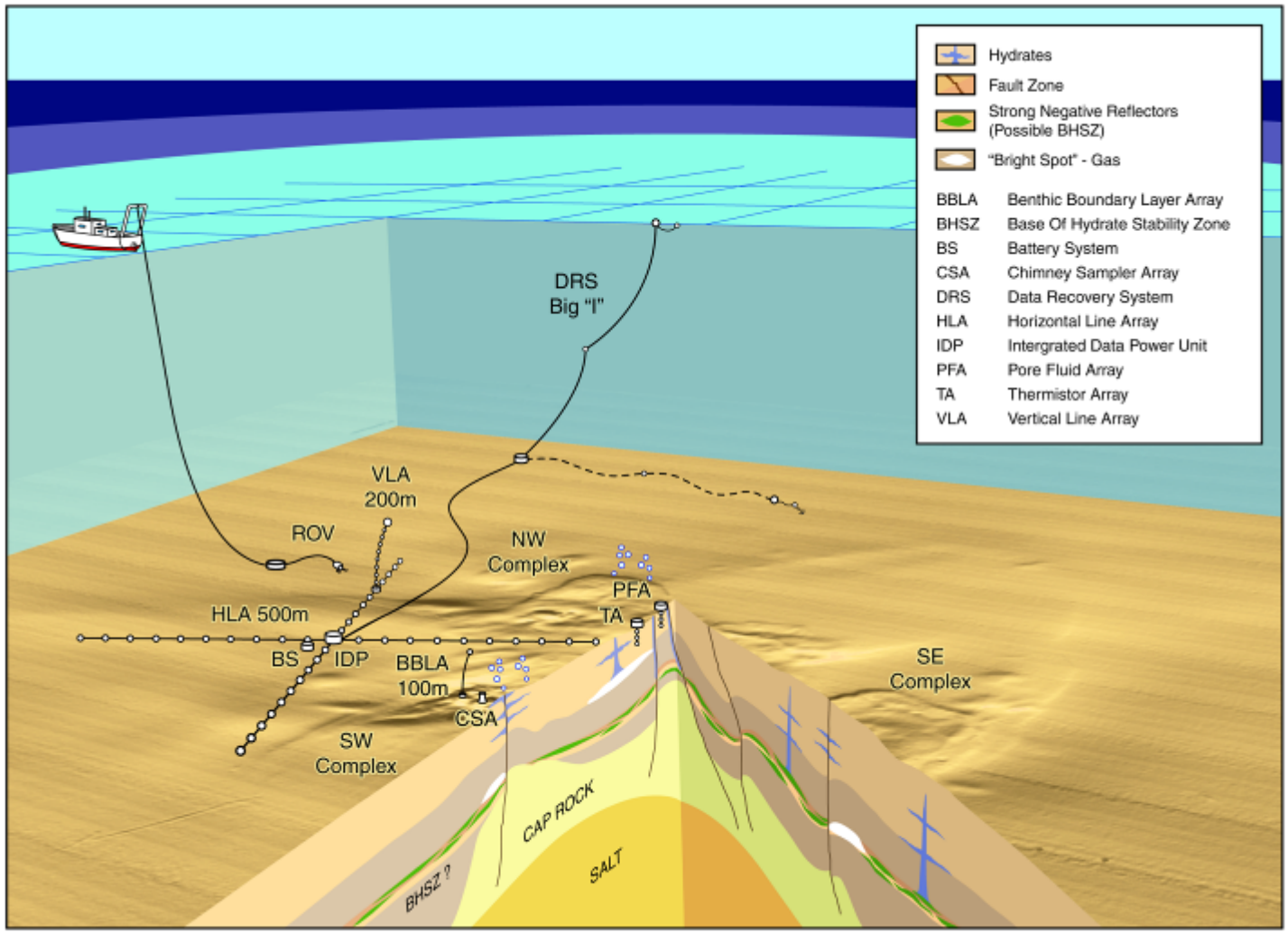
The Gulf of Mexico Hydrates Research Consortium
has chosen it to be the site of a multi-sensor,
multi-discipline sea-floor observatory.



Location of Mississippi Canyon Block 118 (MC118).

The observatory includes seismo-acoustic,

geochemical and micro-biologic sensors.



Gas Hydrate Sea-Floor Observatory - Mississippi Canyon Block 118

The intention is to monitor ambient seismo-acoustic noise,

fluid venting and environmental conditions

for a period of five to ten years.

The goal of the monitoring is to improve understanding of the plumbing system through which hydrocarbon fluids and water migrate within near-sea-floor sediments.

Within the hydrate stability zone,

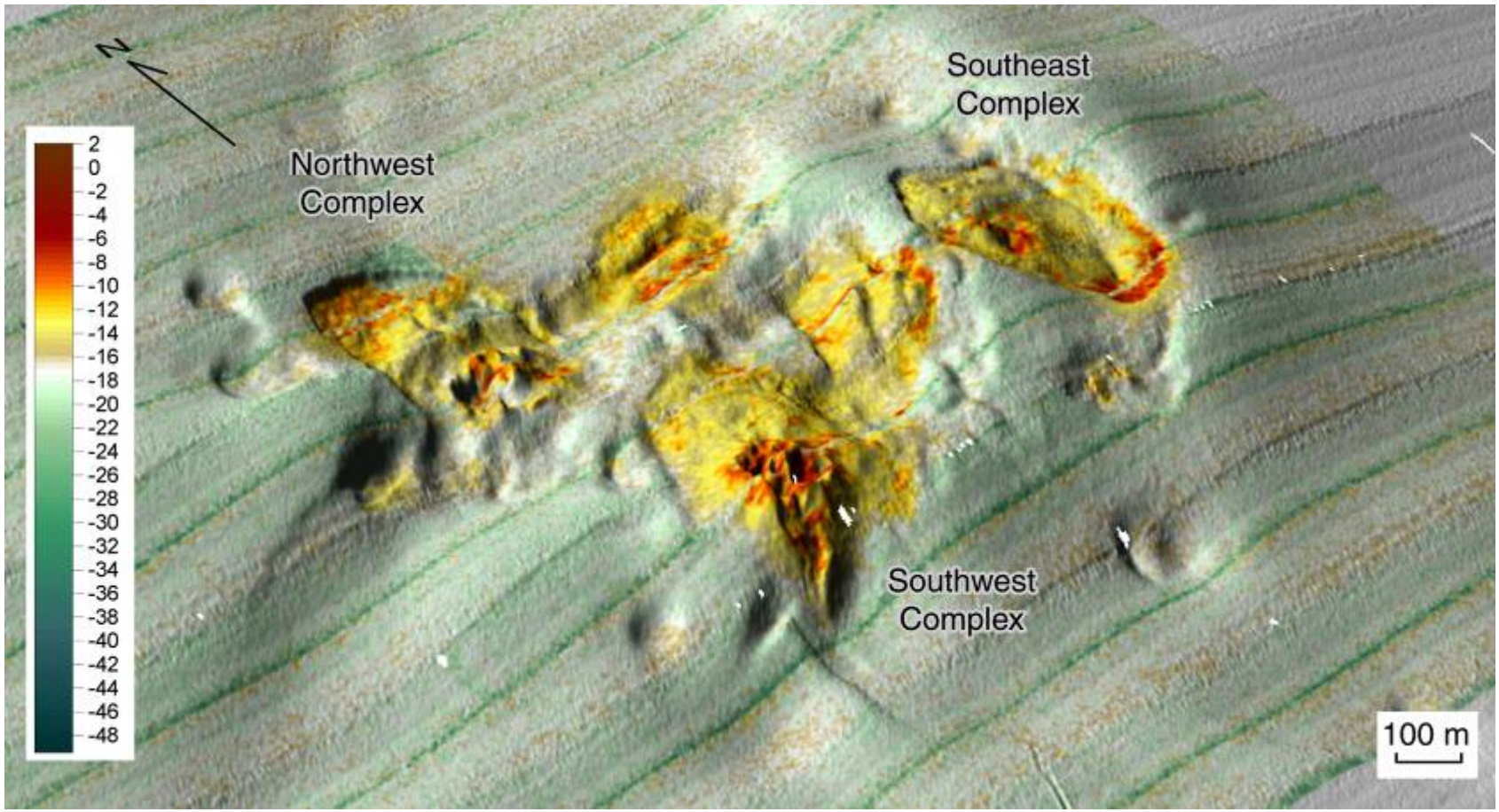
hydrates can form within the migration pathways

and possibly obstruct the plumbing to the point

that the migration paths are altered.

It is these alterations that monitoring is expected to detect.

Swath bathymetry from an AUV indicates that the mound's surface comprises three main clusters of craters that exhibit 2–6m bathymetric relief with individual craters being 5–60m in diameter.



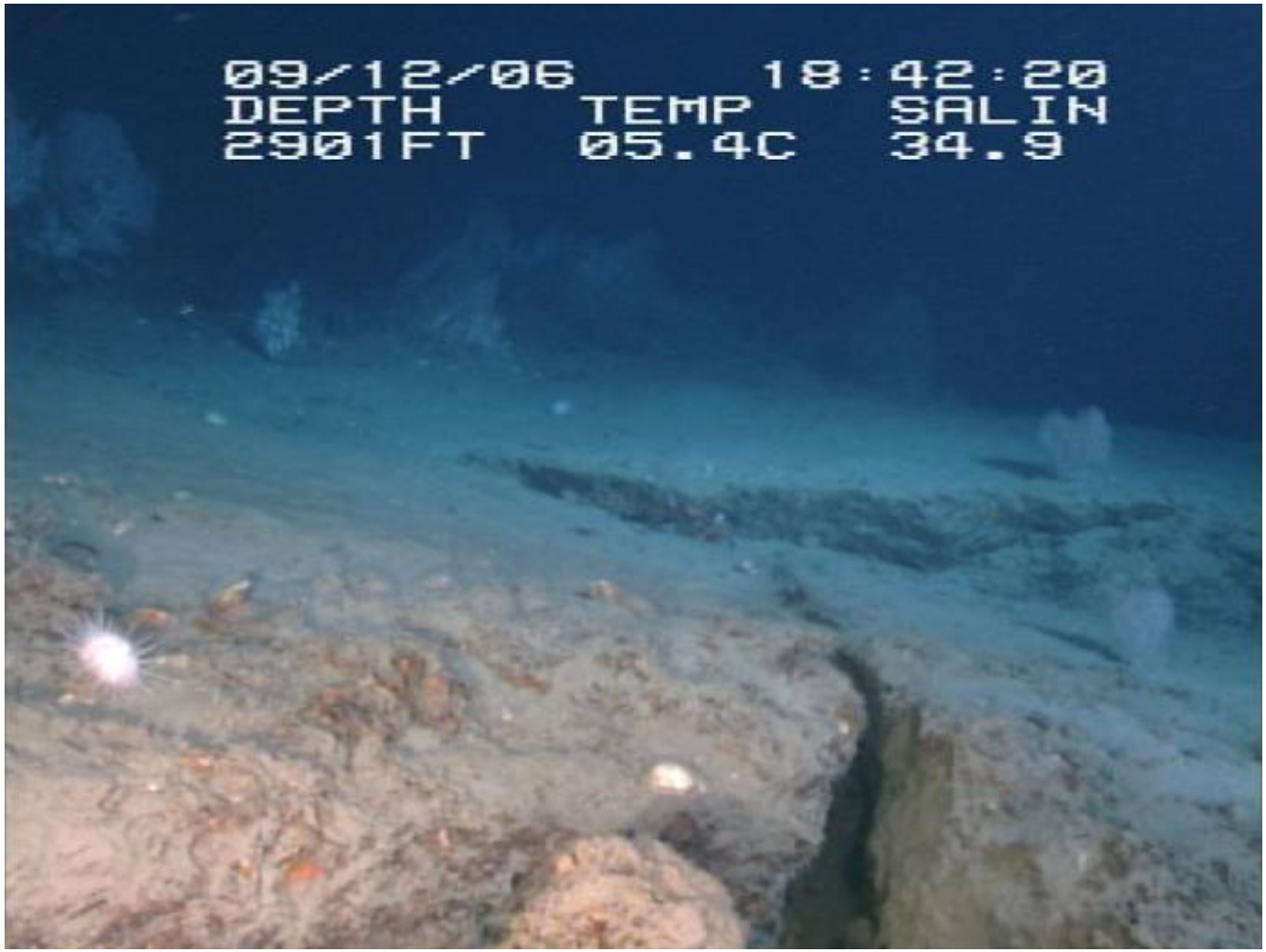
Backscatter image from swath bathymetry data showing SE, SW and NW complexes.

The SE complex is of low relief and no observable venting activity but many methanotrophic clam shells are evidence of past activity.

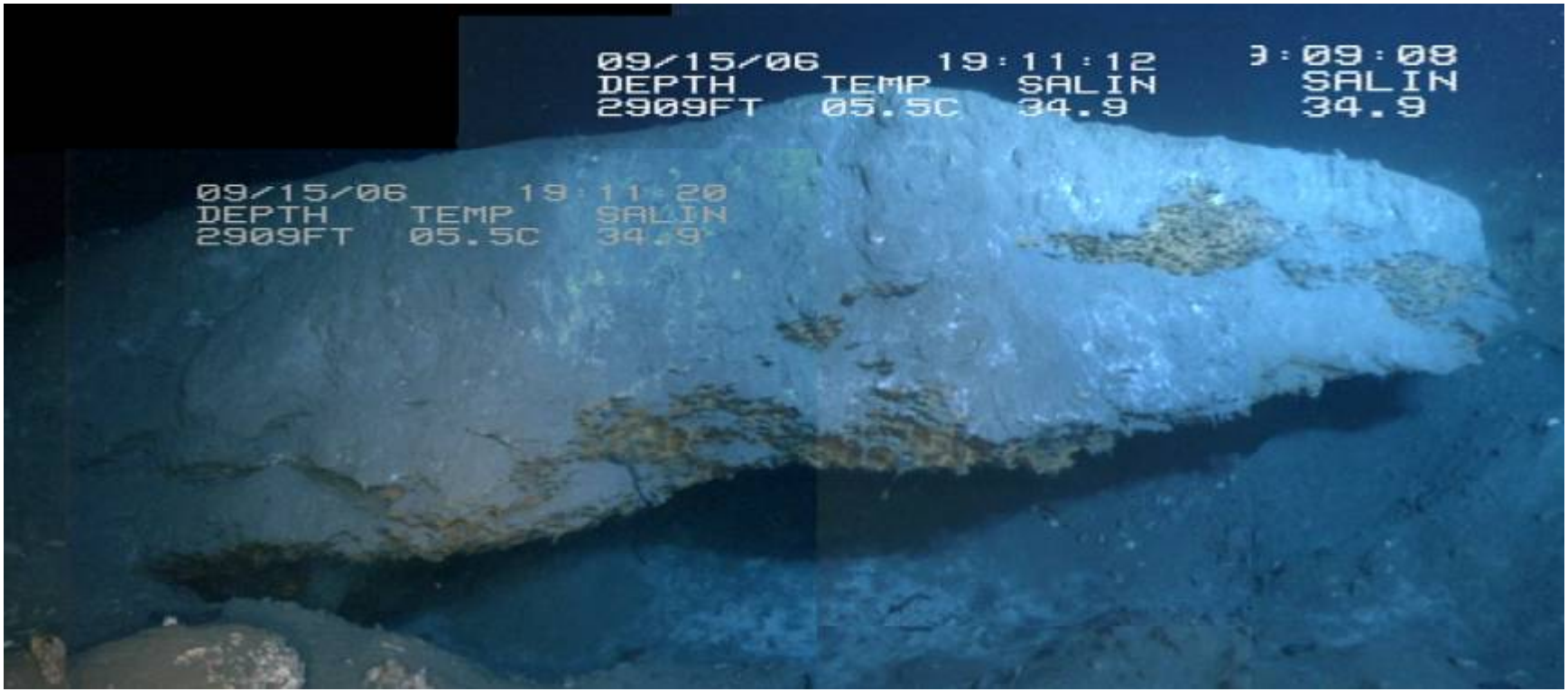
The SW complex is of moderate-to-high relief and a moderate-to-high level of venting activity.

The NW complex is of moderate-to-low relief and a moderate-to-low level of venting.

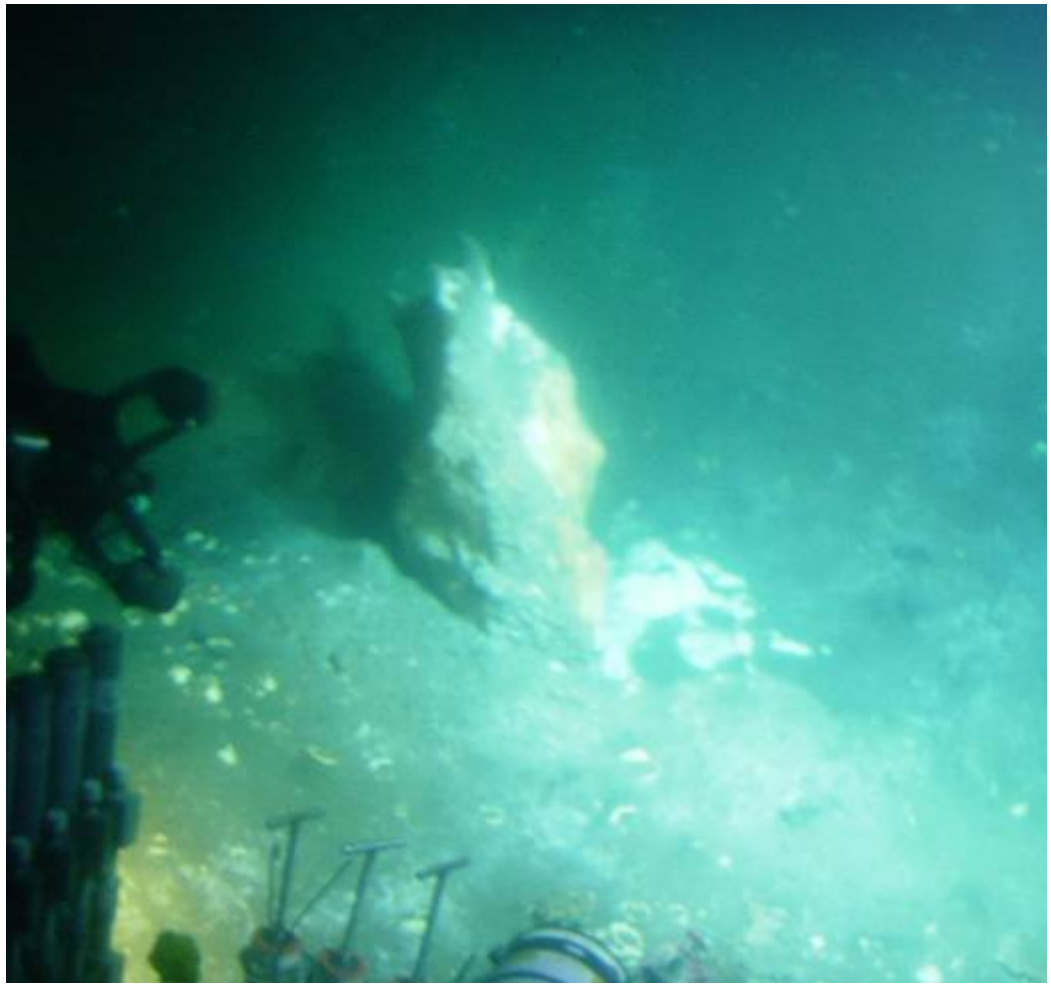
On the basis of geochemical results and visual observations, it is hypothesized that fluid migration was initiated in the SE complex, moved to the SW complex and is now in the process of moving to the NW complex.



Carbonate blocks paving crater floor in SW complex.



Composite photo of 6m by 2m by 1.5m hydrate outcrop in SW Complex.



Hydrate dyke ≈1m tall near outcrop on previous slide.

Hydrates in MC118 are structure II.

The gas contained in them is

70% methane, 12% ethane and 16% propane with

minor other hydrocarbon gases and CO_2

(analysis by Roger Sassen).

Seismic profiles have been acquired using a novel field geometry.

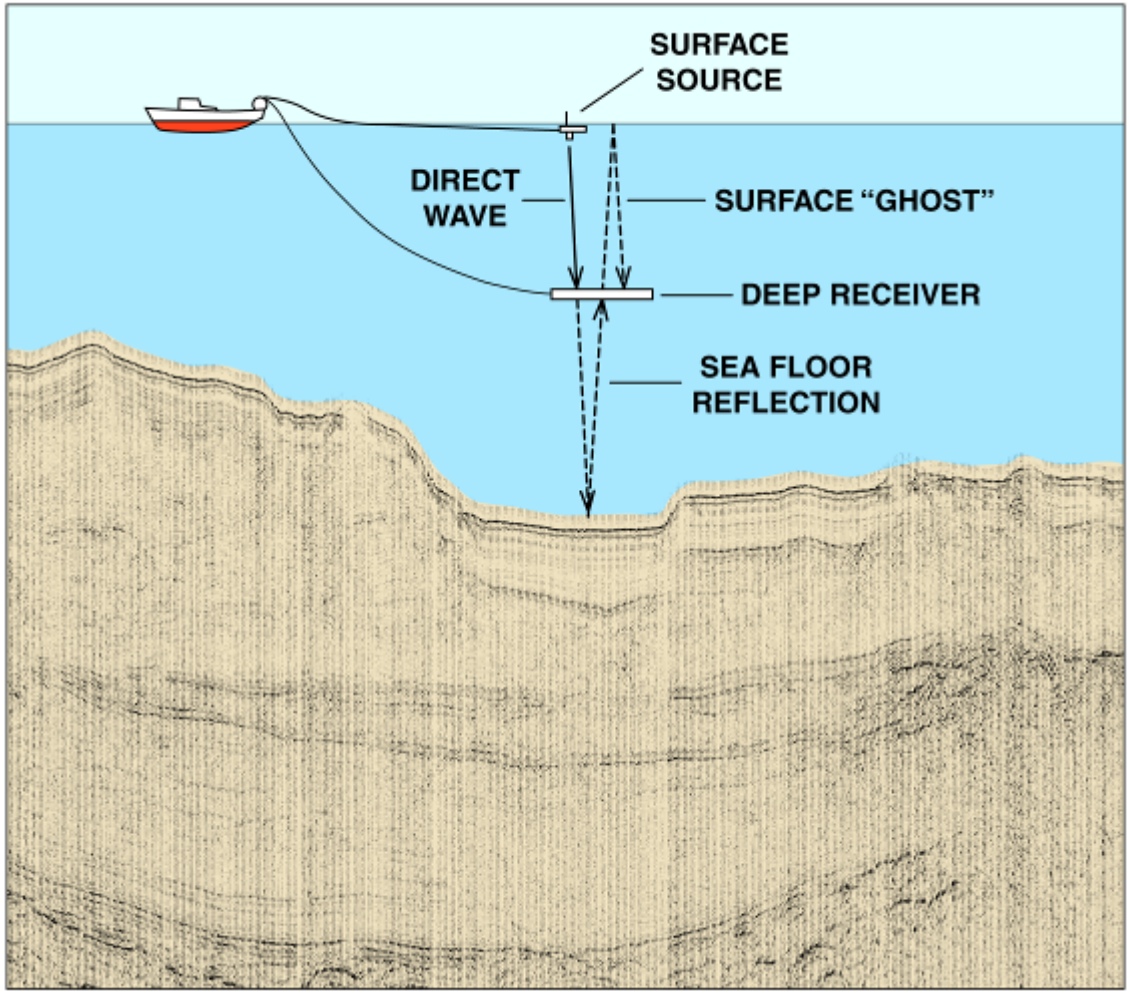
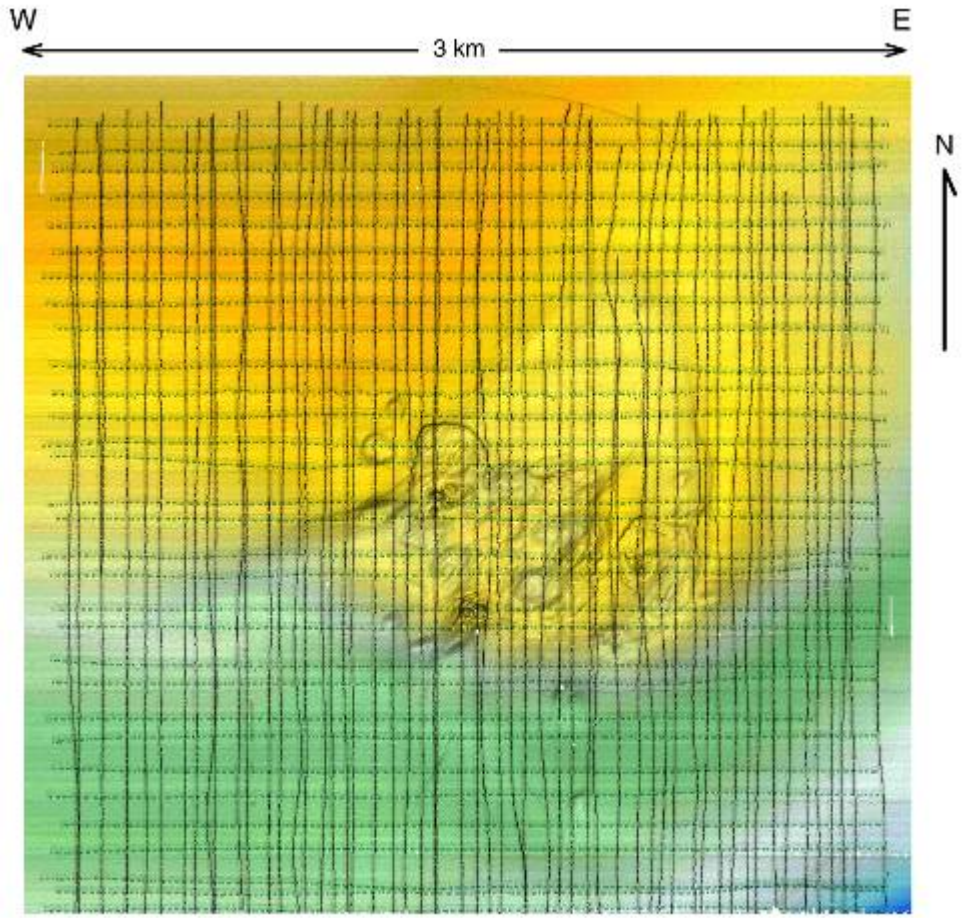


Illustration of surface-source/deep-receiver (SSDR) recording geometry.



Grid of SSDR profiles acquired over mound in MC118

SSDR data were digitized at

100,000 samples per second and 24 bits per sample with

the intention of eventually obtaining sub-meter resolution

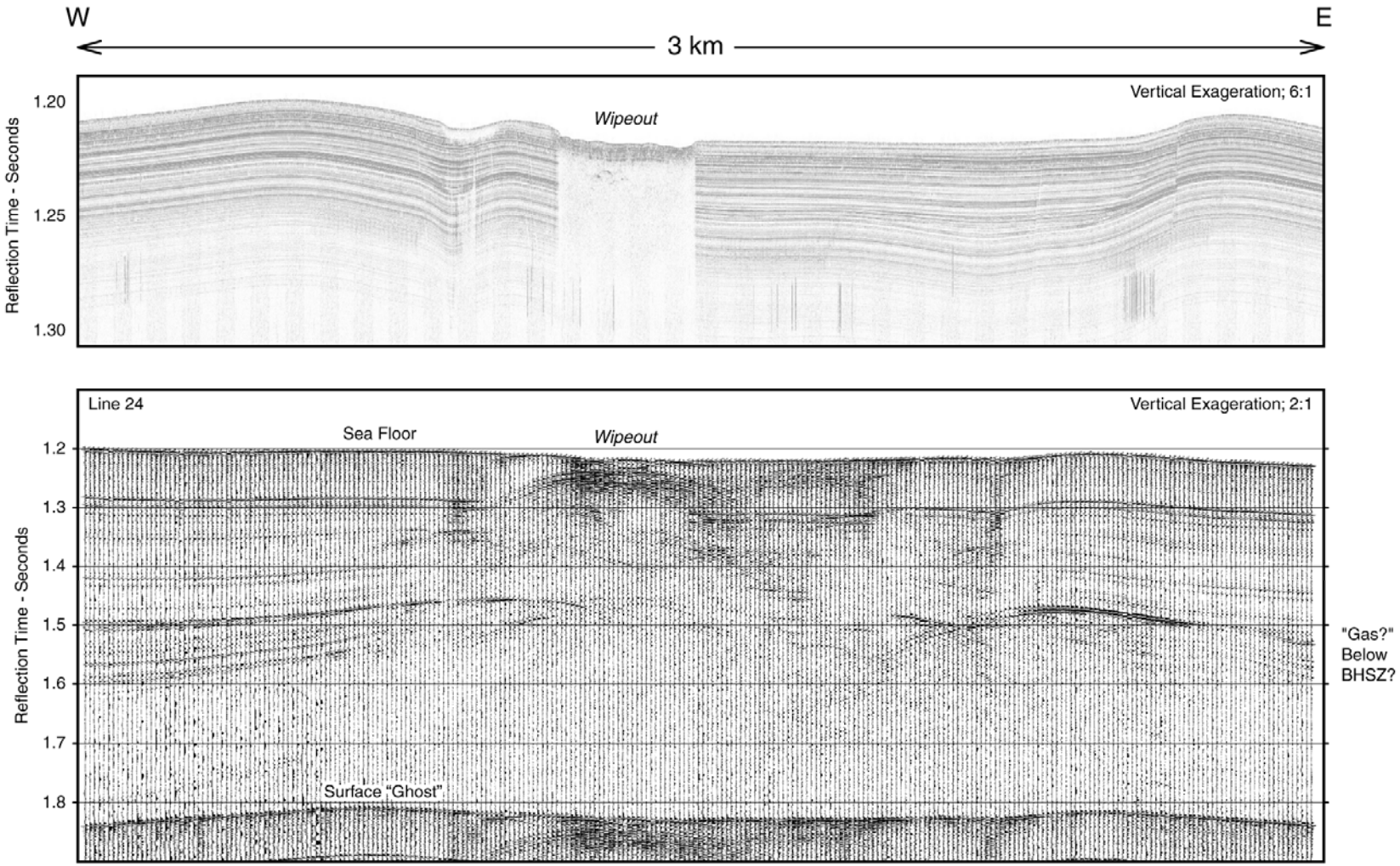
throughout the hydrate stability zone.

Initially, SSDR data were resampled

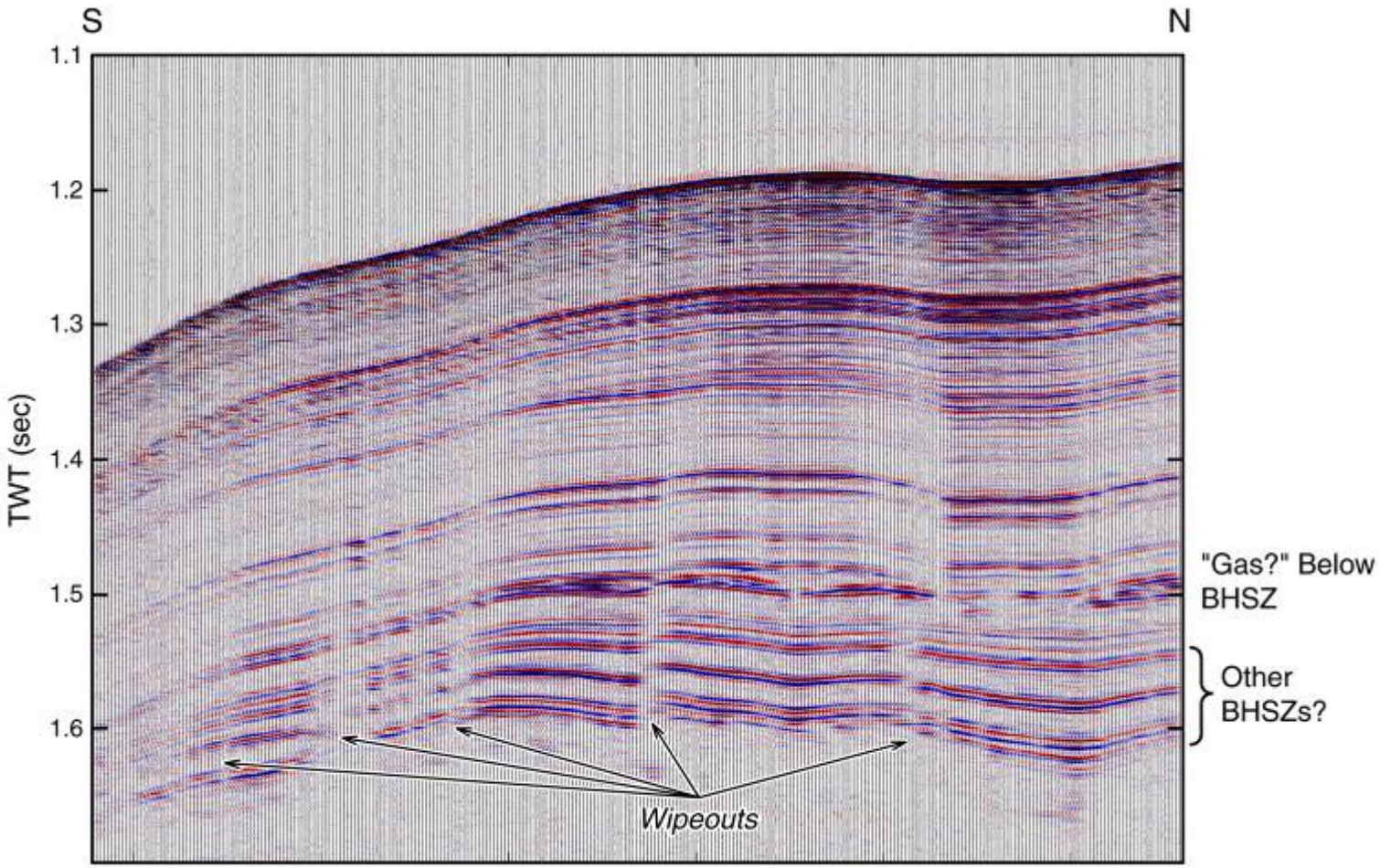
to 25,000 samples per second

so that industry-standard software

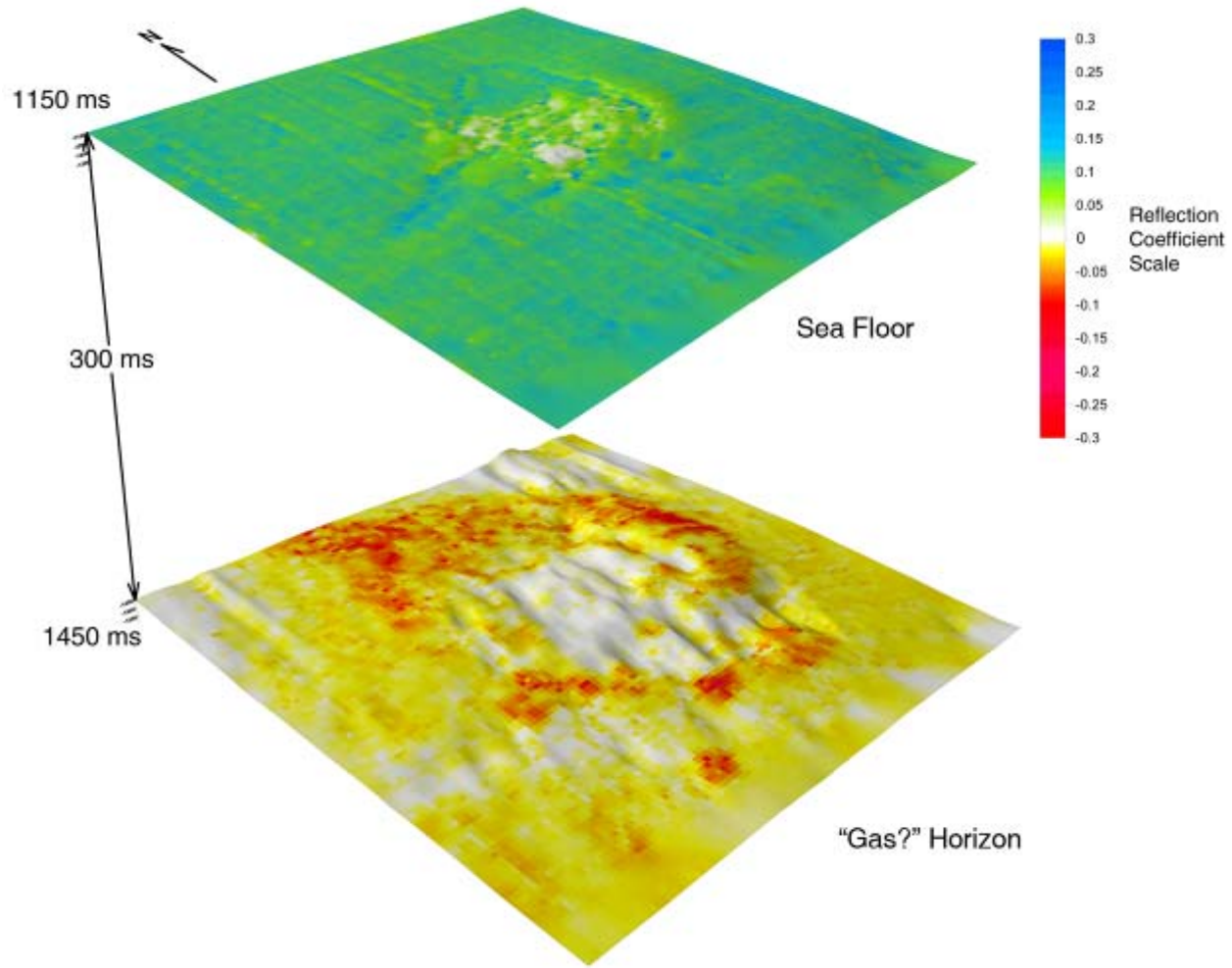
could be used to obtain processed images.



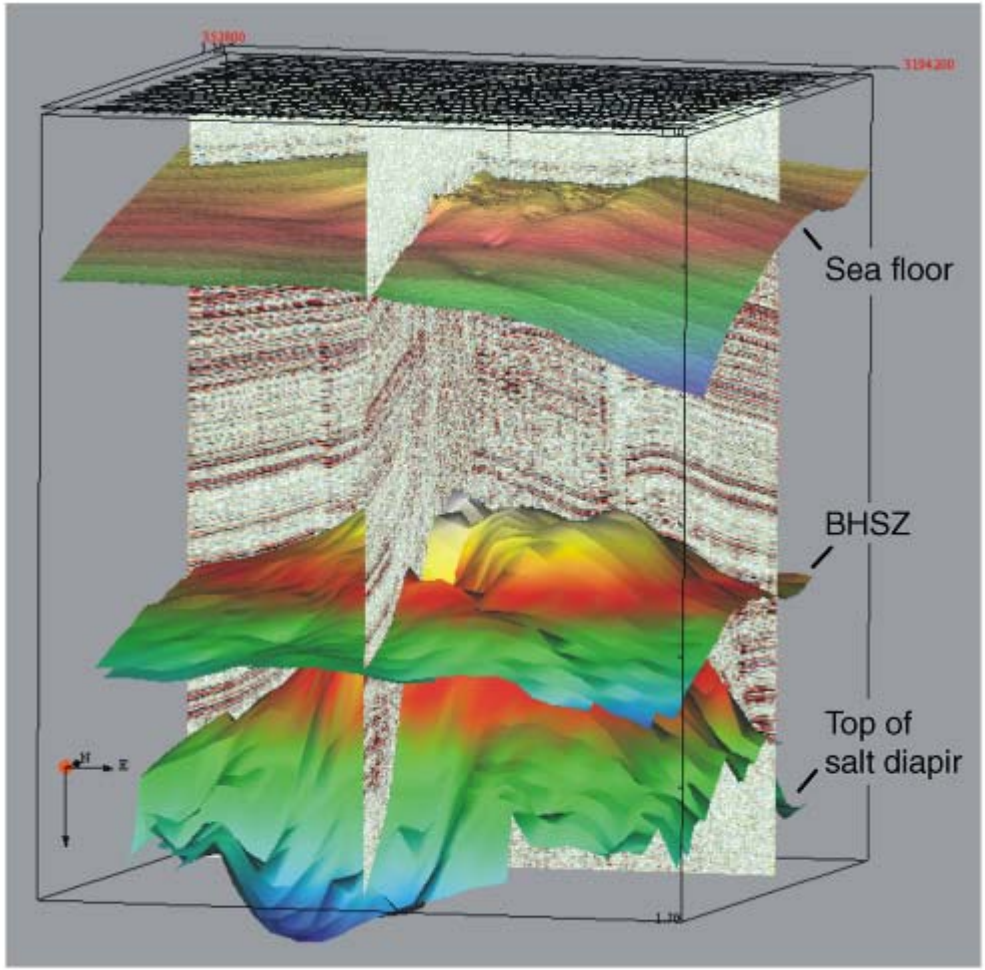
Chirp-sonar and SSDR profiles across a wipeout zone due to scattering.



SSDR profile showing near-vertical wipeout zones extending upward from faults across the base of the hydrate stability zone.



Normal-incidence p-wave reflection coefficients on SSDR grid.



Pseudo-3D image constructed from SSDR grid.

After viewing initial images, an effort

to upgrade the Consortium's seismic software

to full 100,000 sample per second capability

was initiated.

The upgrade includes implementing

empirical mode decomposition in the time domain

and parallel processing on the Consortium's

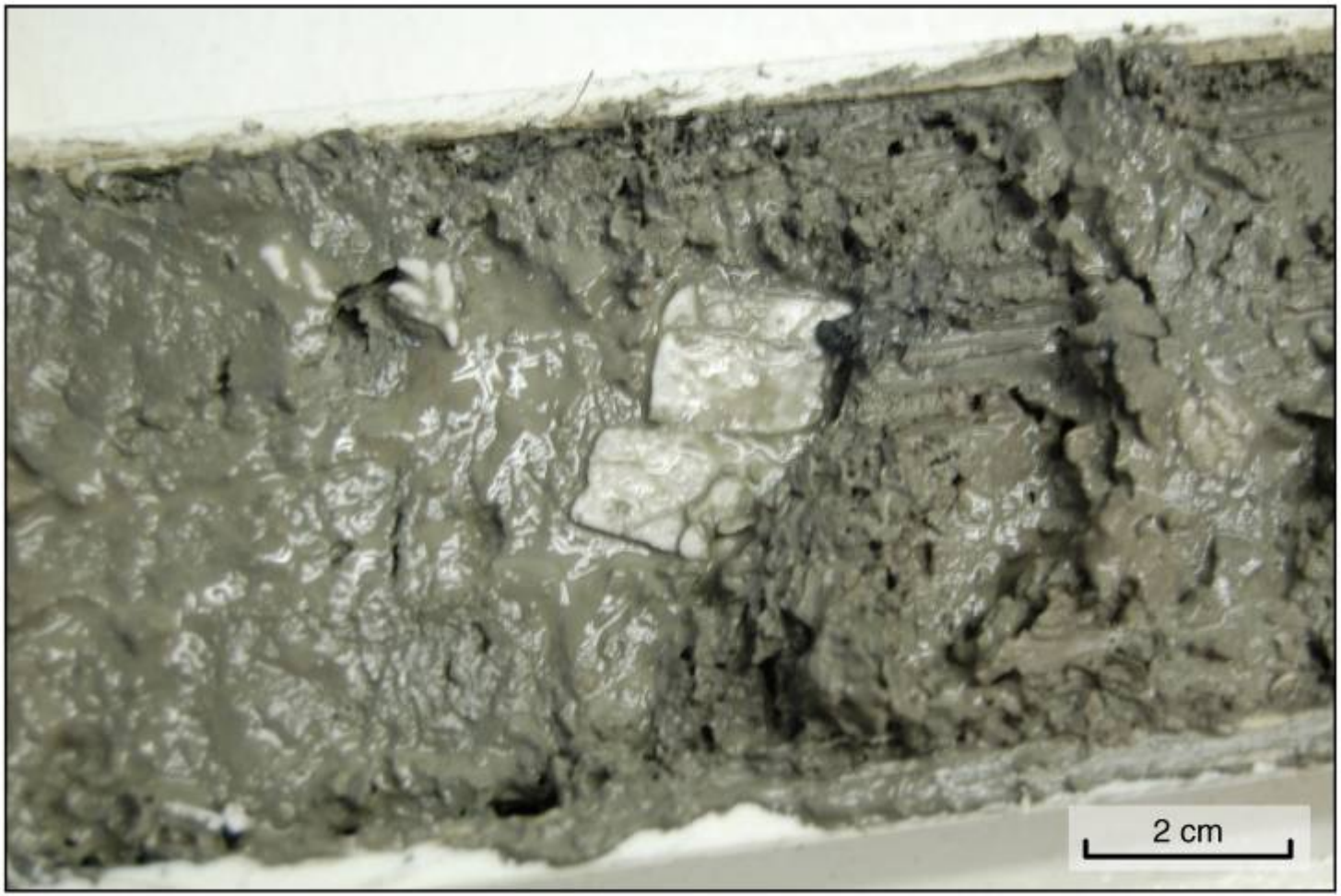
64-node "Seawulf."

It is expected to be tested in January 2009,

at the geophysical laboratory

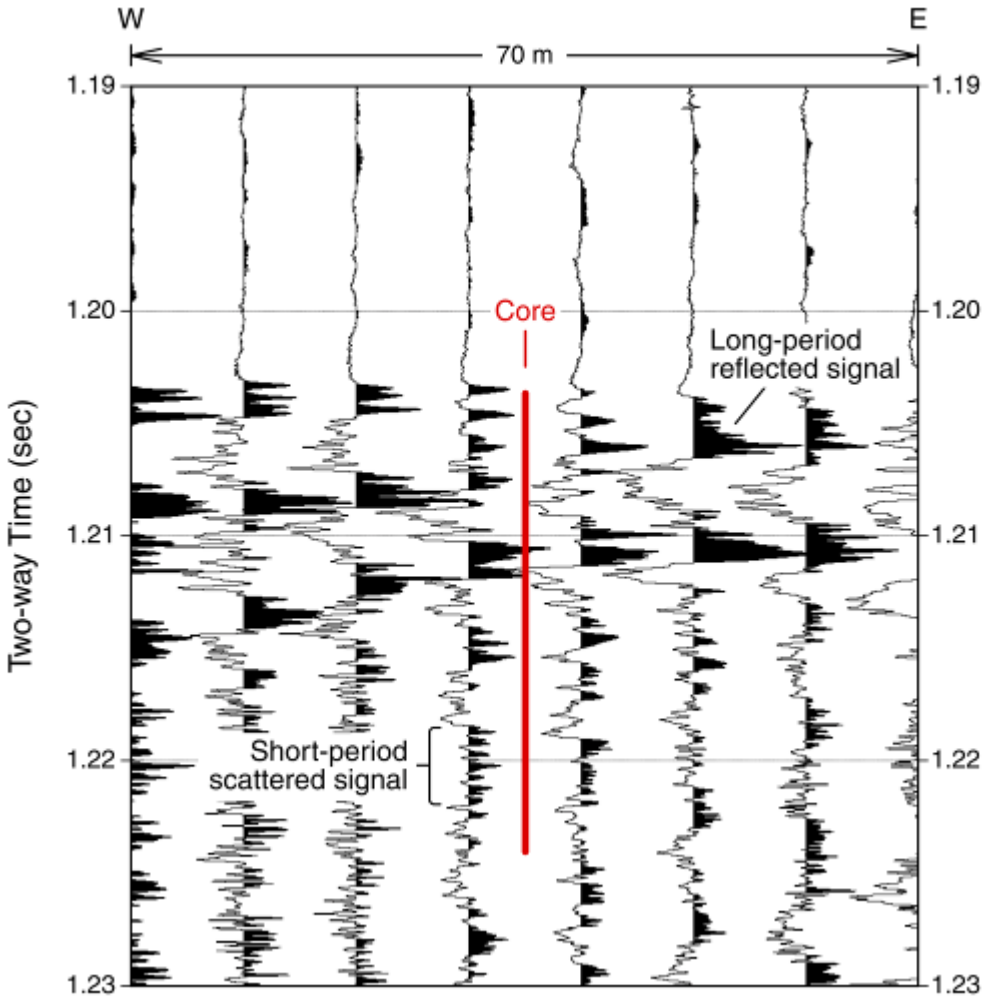
of the University of South Carolina.

In the spring of 2008, hydrate was recovered from a 10m gravity core in the NW complex.



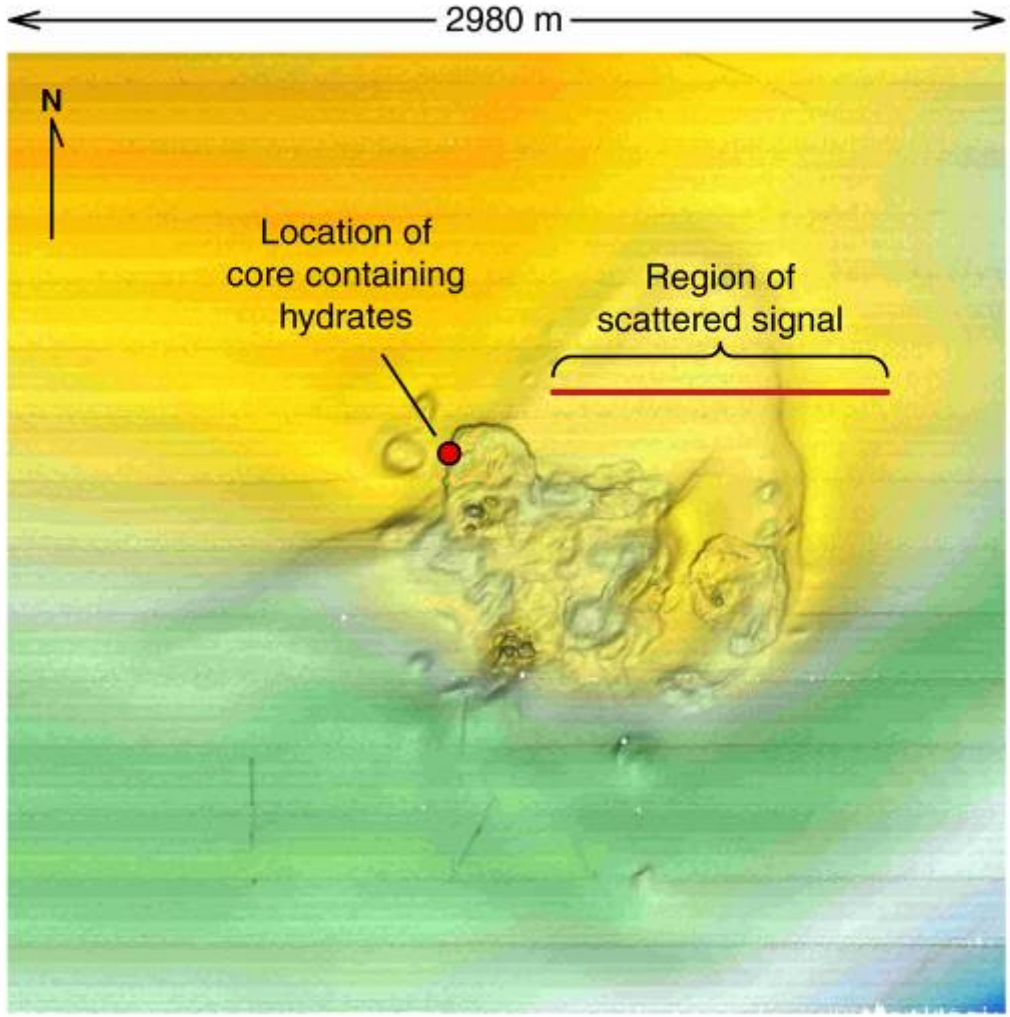
Hydrate nodule in fine-grained sediment cored from fracture zone.

An SSDR profile across the core site displayed a short-period signal similar to what had been considered “noise” when observed on other profiles.



SSDR traces across site of core containing hydrate nodule.

Since the short-period signal could be energy scattered from local inhomogeneities, a nearby profile was reprocessed using the software upgrade without parallel processing.


2980 m
N
Location of
core containing
hydrates
Region of
scattered signal

Empirical-mode decomposition was used

to separate the short-period signal

from the longer-period reflected signal.

The amplitude of the short-period signal

was then increased to enhance it

relative to the reflected signal before

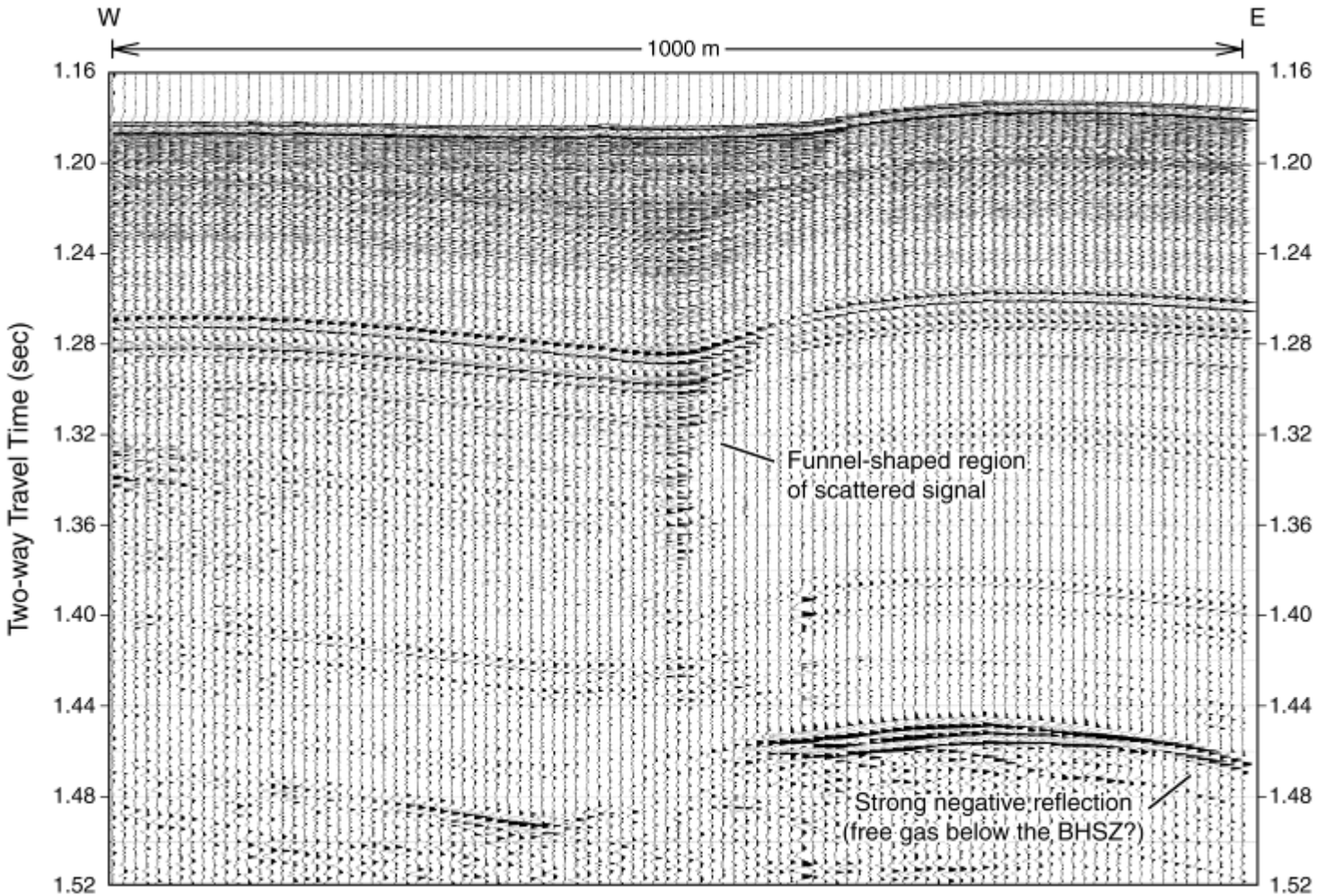
the two types of signal were recombined.

The result shows that

the short-period signal occupies

a funnel-shaped region that appears

to emanate from a fault deeper in the section.



SSDR profile showing funnel-shaped region of scattered signal.

At present, it is hypothesized that

the short-period signal is scattered from

inhomogeneities within fluid-migration pathways,

possibly hydrate accumulations or free-gas zones.

In the short term,

the hypothesis will be tested

during coring and profiling programs.

In the longer term,

the hypothesis can be proven

by drilling and coring boreholes

where the short-period signal is present.

If the hypothesis is true,

the scattered signal will constitute

direct seismic evidence that can be used for

identifying and quantifying migrating fluids.

ACKNOWLEDGMENTS

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Swath bathymetry data were recorded/processed by C&C Technologies of Lafayette, Louisiana, and reprocessed by the Department of Earth Science at the University of Rome "La Sapienza."

SSDR profiles were acquired with the assistance of Specialty Devices Inc. of Plano, Texas, and recorded/processed using software by Lookout Geophysical Company of Palisade, Colorado.

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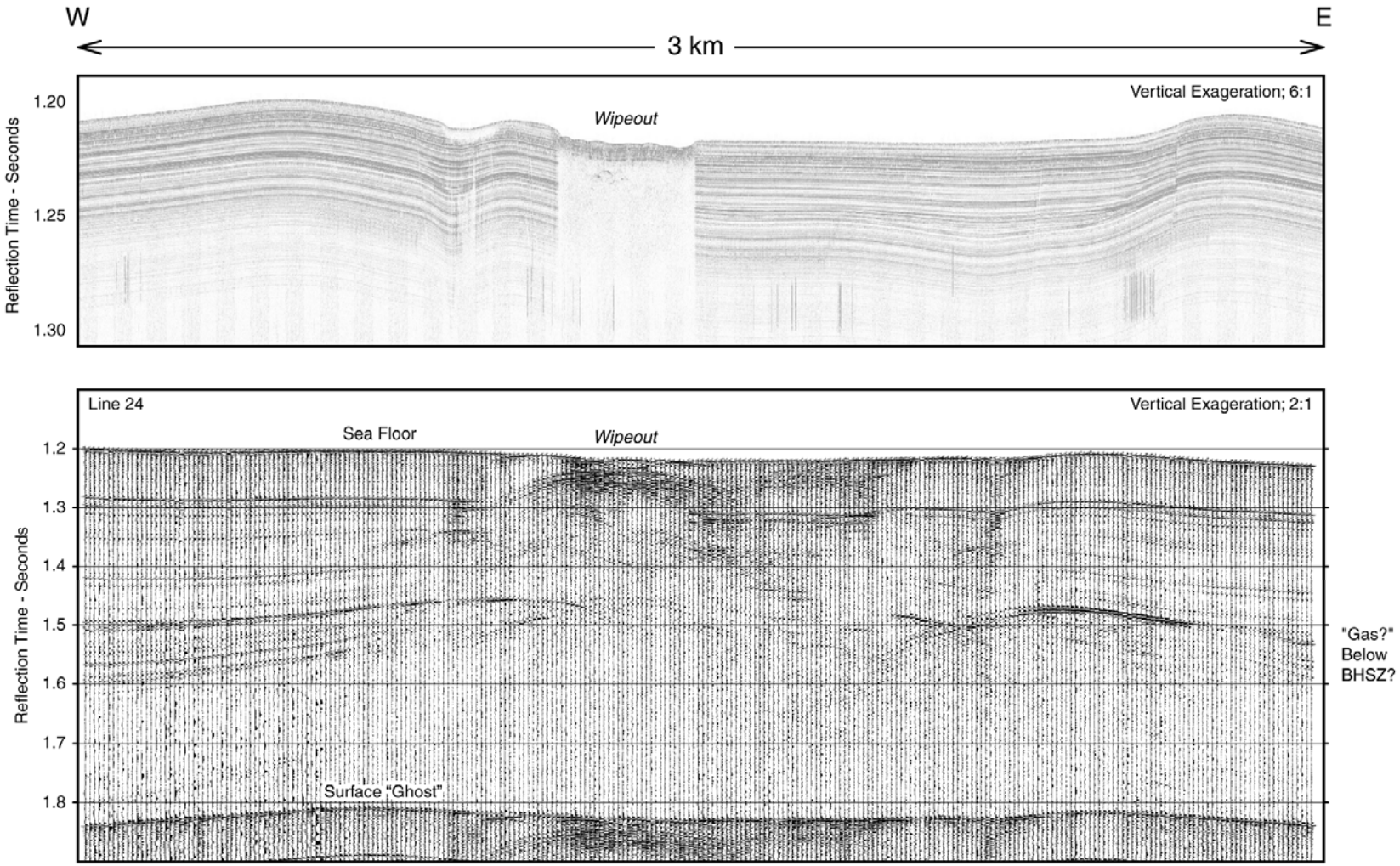

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