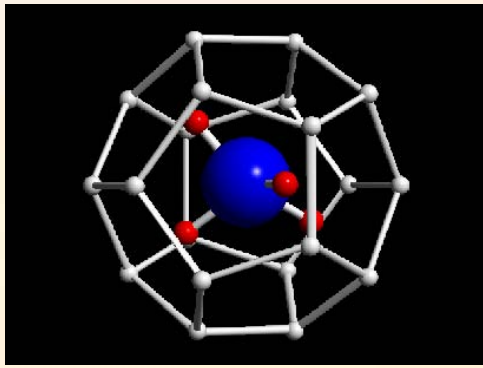
Assessment of the Resource Potential of Methane Hydrate in the Nankai Trough, Offshore Central Japan



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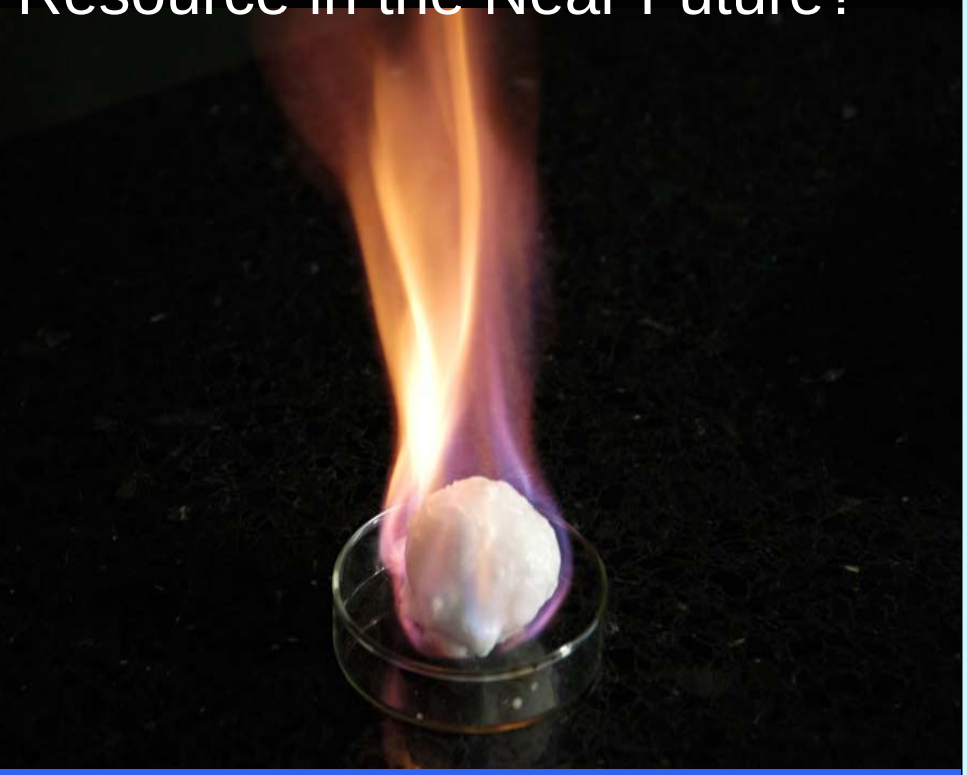
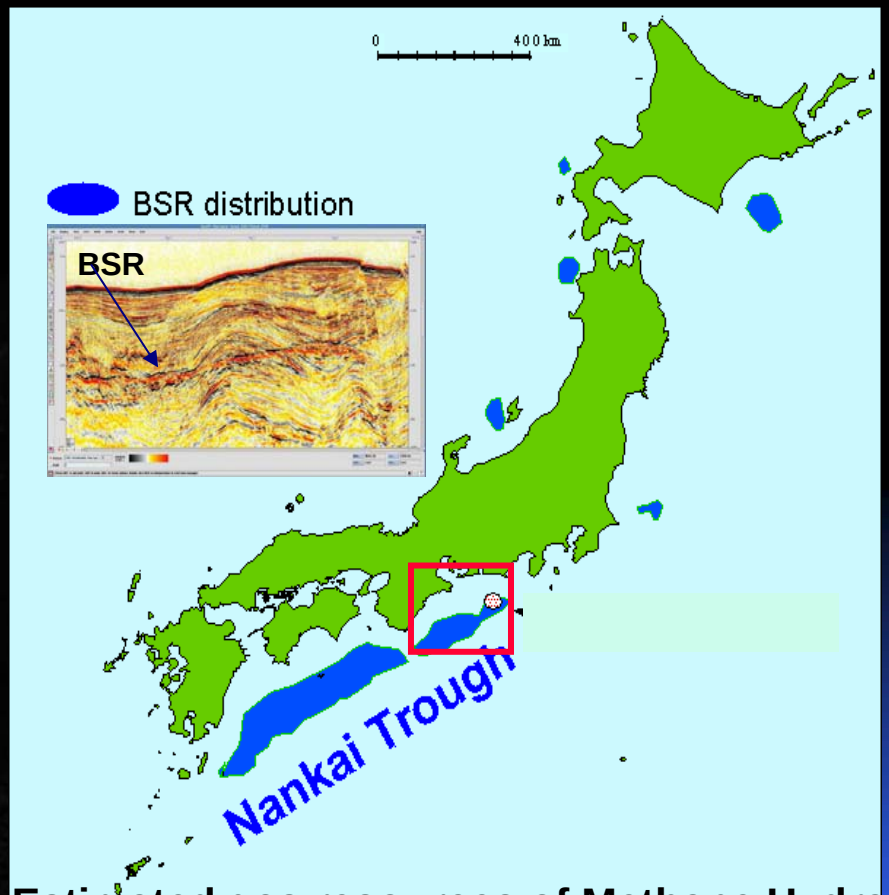
Methane Hydrate,
Resource in the Near Future?





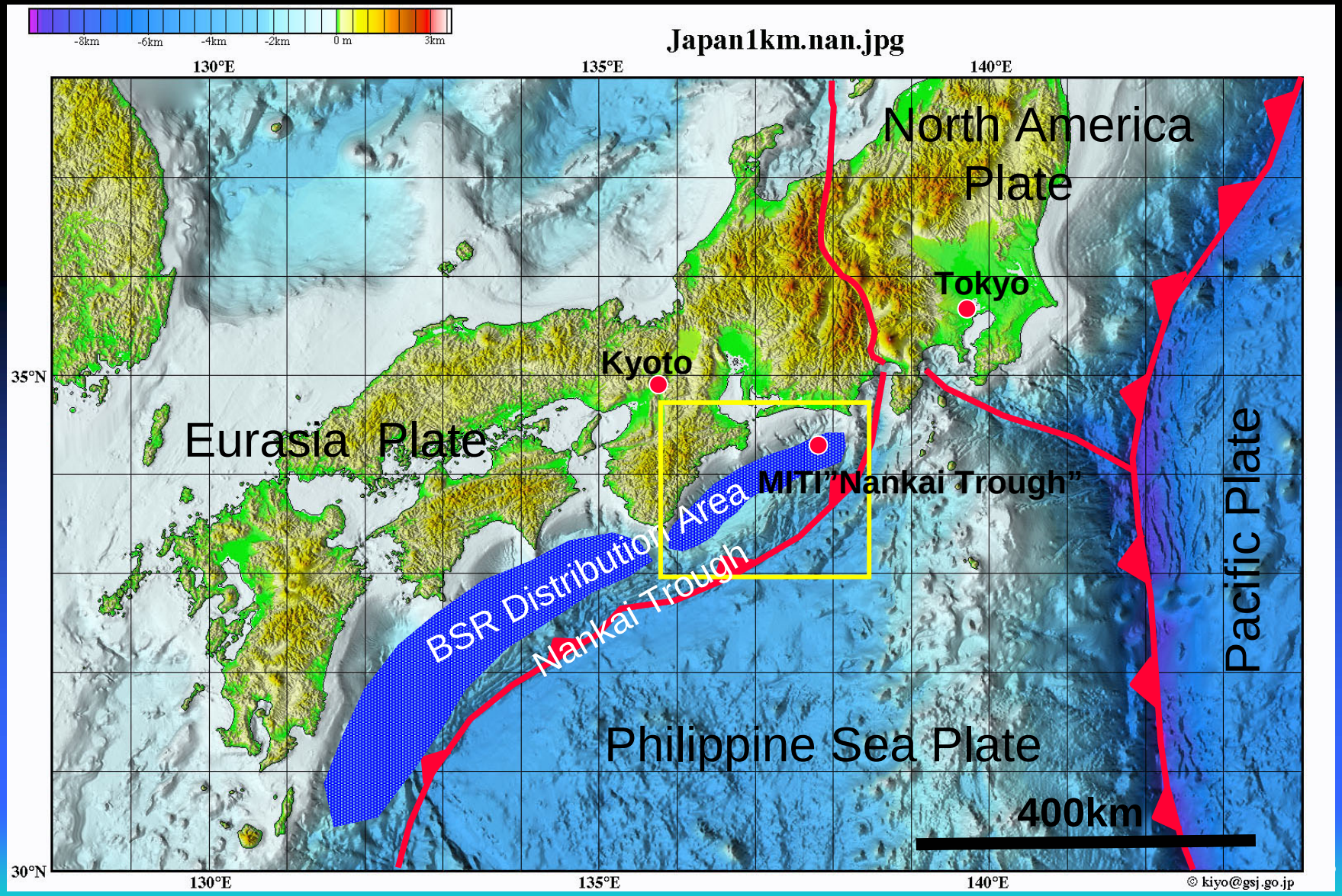
Estimated gas resources of Methane Hydrate

> Nankai Trough: 0.4 - 4 x $10^{12}m^3$ (Krason, '92)

> Offshore Japan: 4.65 x $10^{12}m^3$ (Sato, '96)

Dose Methane Hydrate provide energy to Japan?
We need resource assessment in the Nankai Trough.

Geologic Settings of the Nankai Trough



A Seismic Section through the “Nankai Trough”

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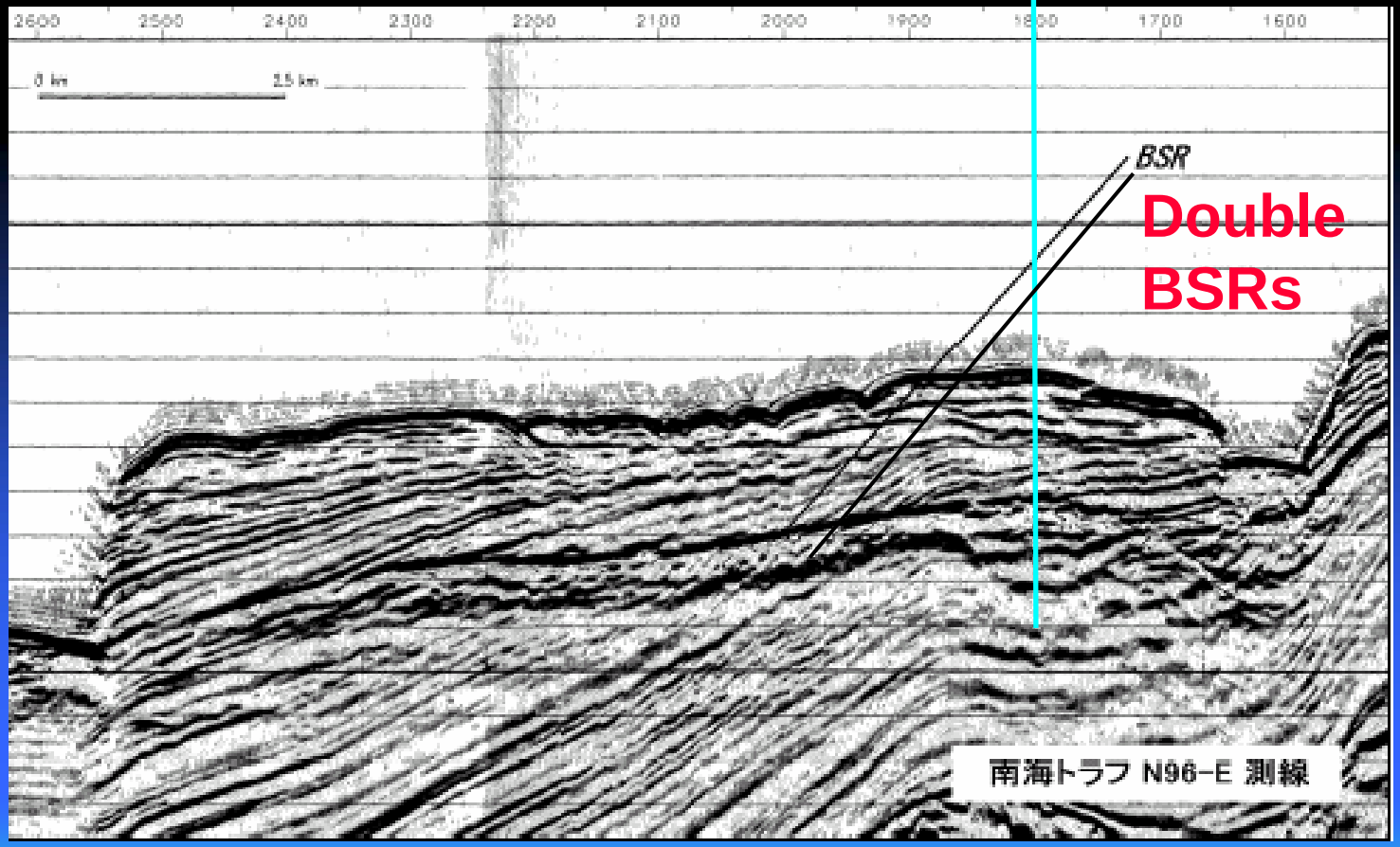
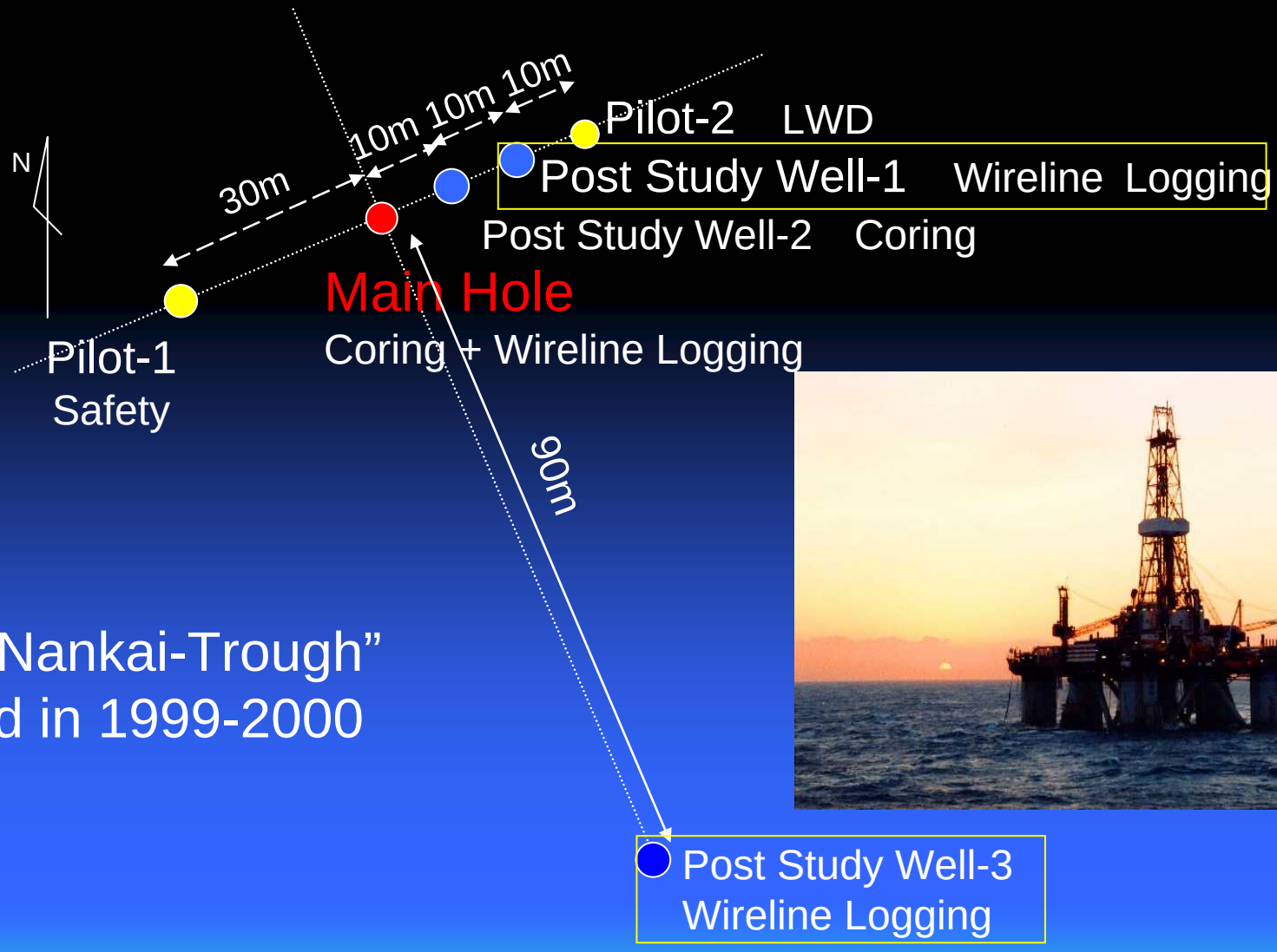
MITI“Nankai-Trough”

NW

SE

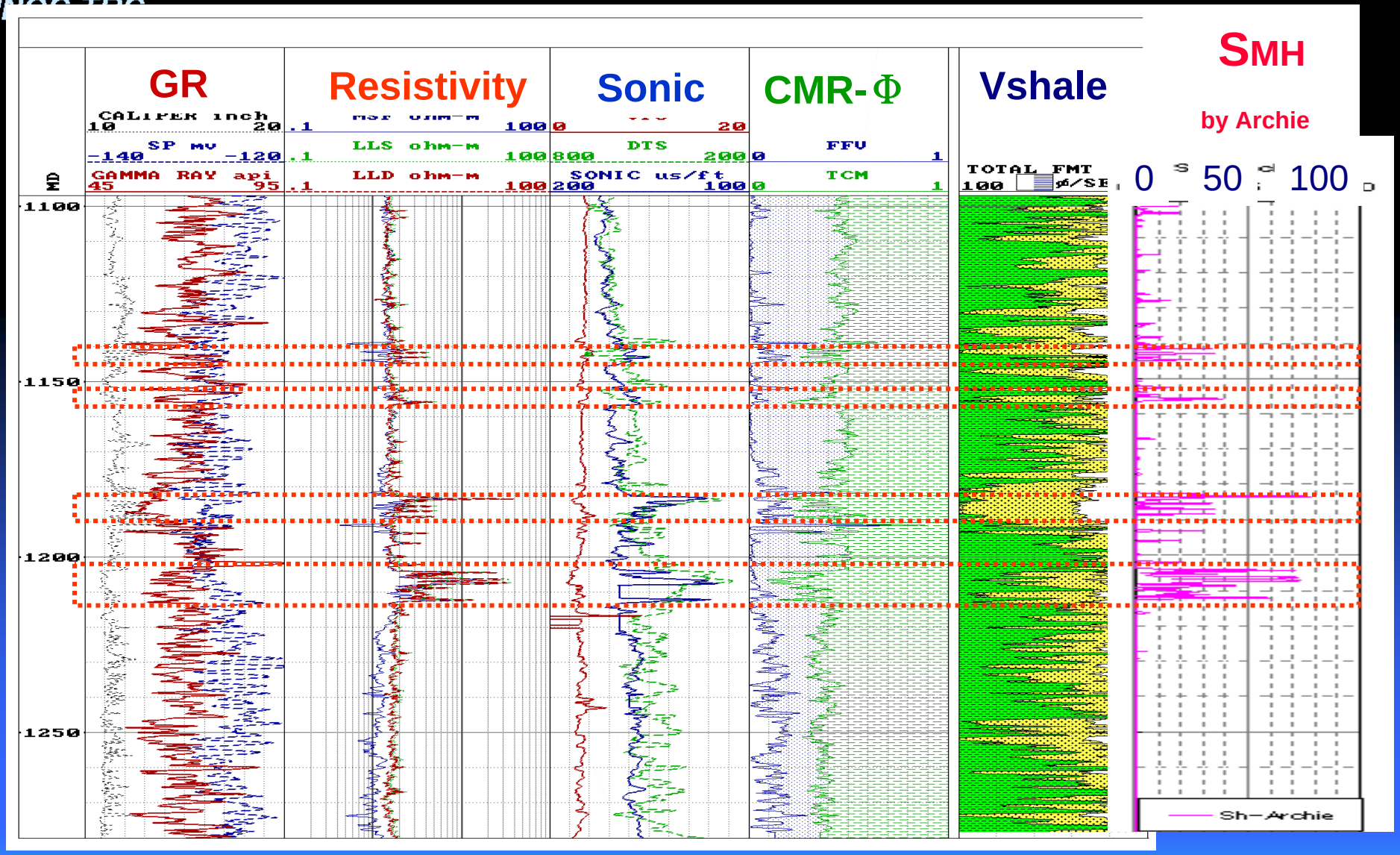


Well distribution of MITI ”Nankai Trough”



MITI“Nankai-Trough”
Drilled in 1999-2000

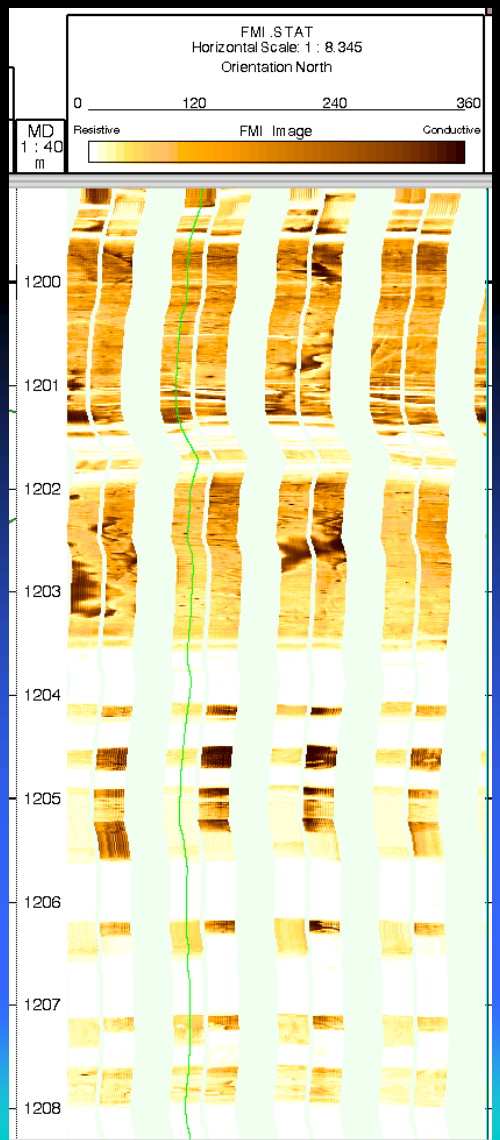
Logging Data and Hydrate Distribution



Post Well No.1, Wire Line Logging

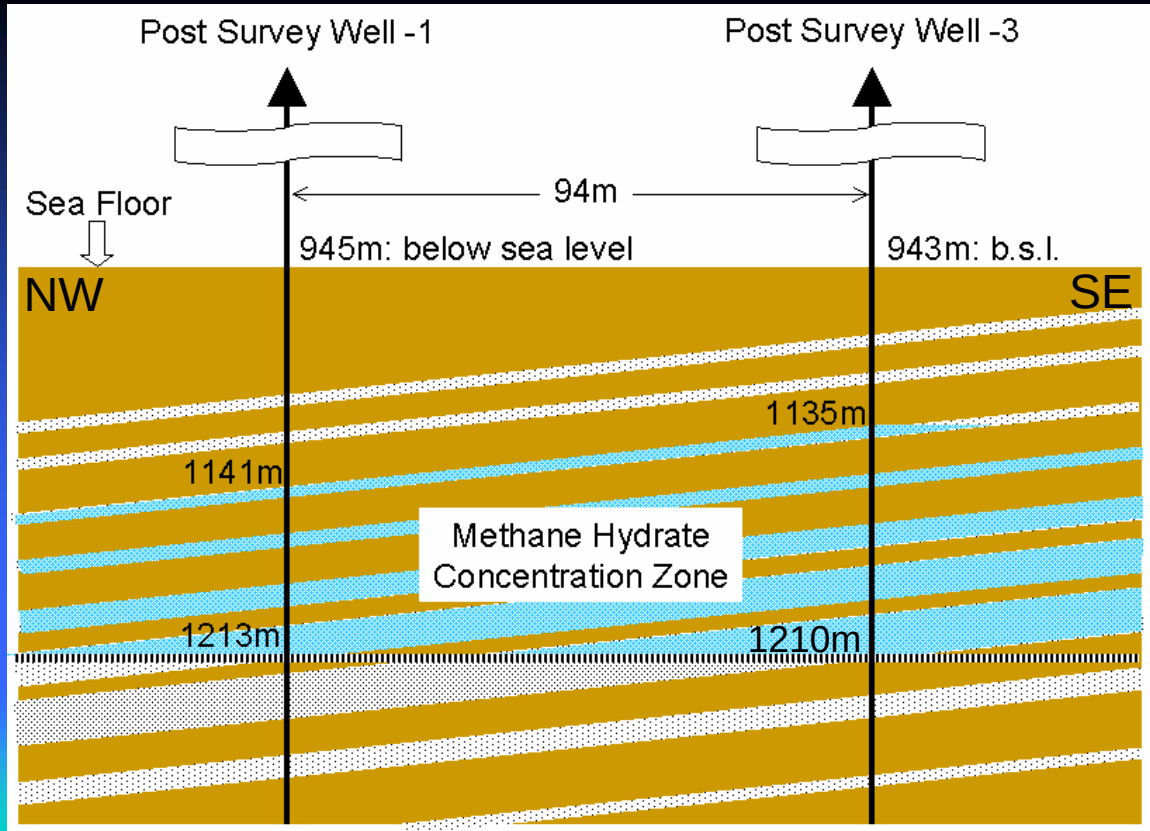
Occurrences of Methane Hydrate

Formation Micro Image

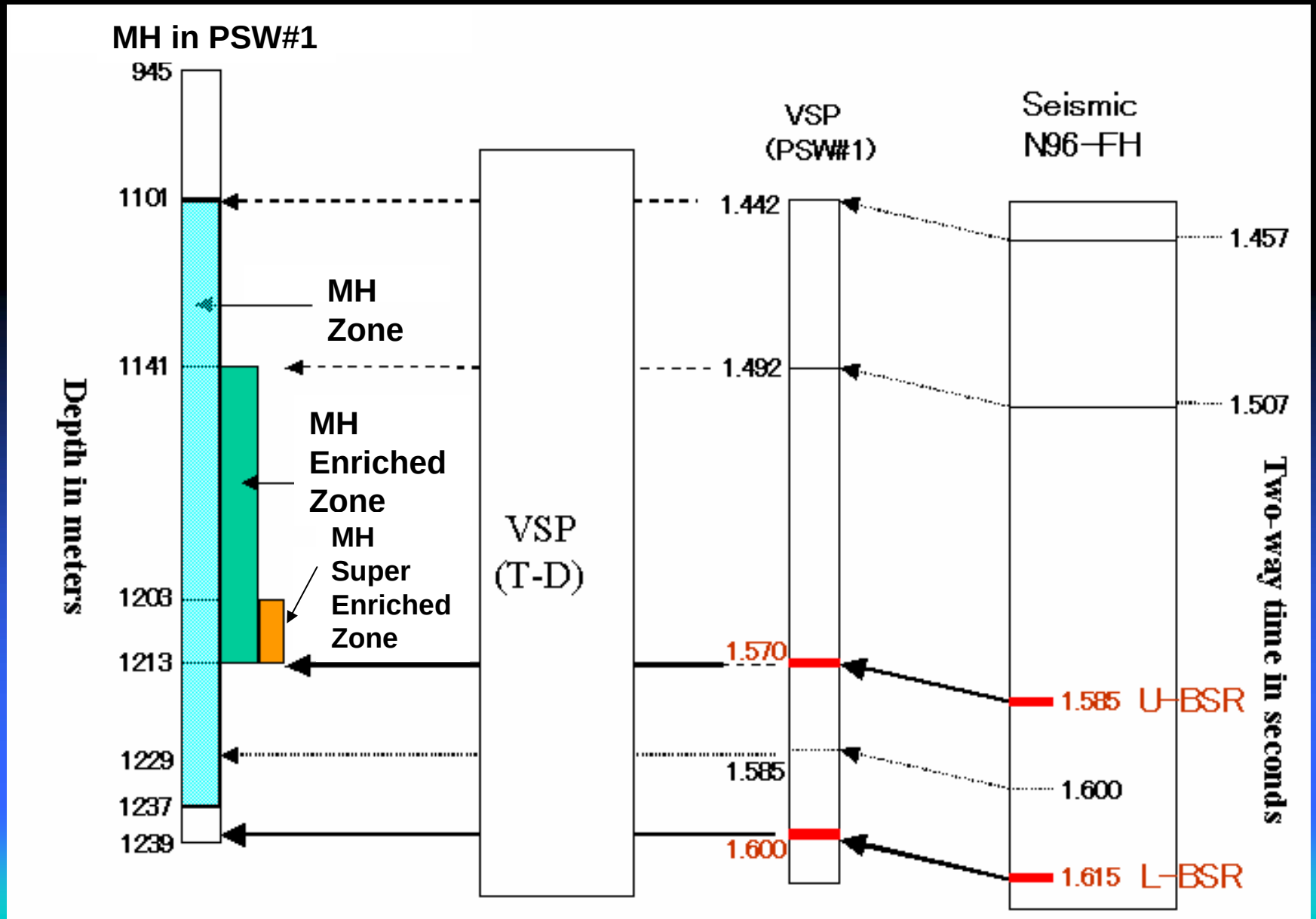


CORE

CORRELATION



Correlation between Seismic and Well data



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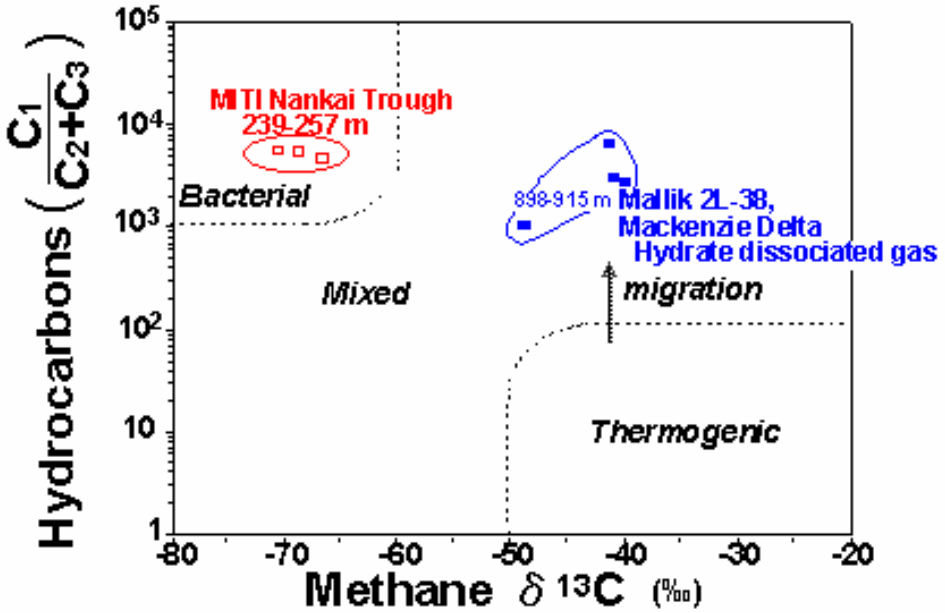
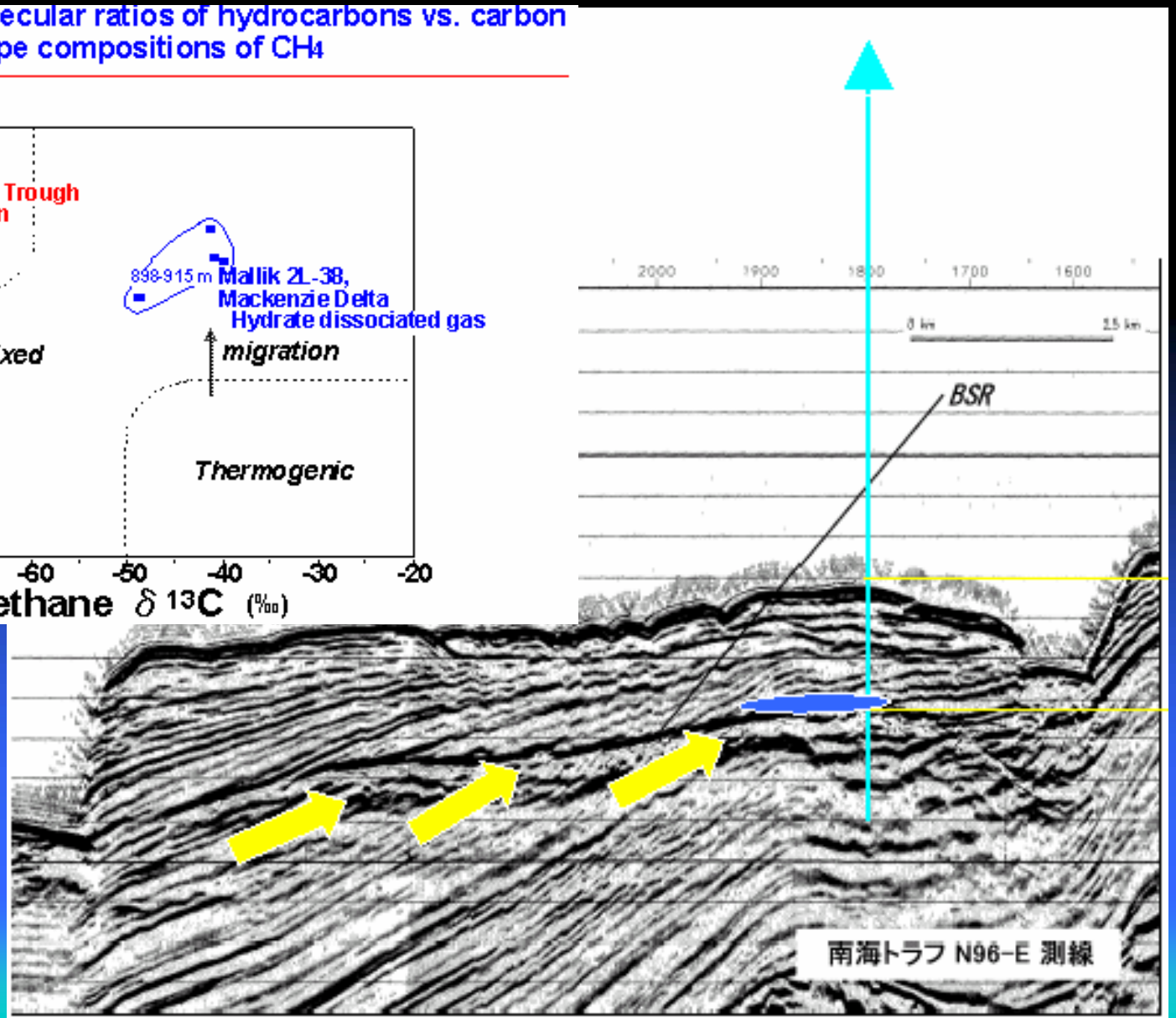
Origin of Methane in the Nankai Trough

Interpretive plot of molecular ratios of hydrocarbons vs. carbon isotope compositions of CH_4





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Current R&D Program 2001/2016

- METI's Advisory committee was organized in June 2000 and have discussed the middle to long term R&D program aiming to produce Methane Gas from Methane Hydrate-bearing sediments offshore Japan
- In July 2001, A report "Japan's Exploitation Project on Methane Hydrate" was disclosed in public domain.
- This program has three phased, 16 years term and focus on five areas : Exploration, Modeling, Field testing, Development and Environment.

Japan's Methane Hydrate Exploitation Program

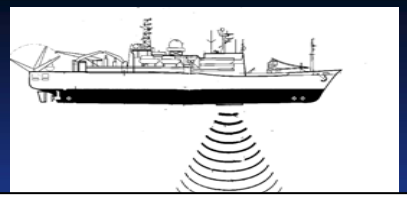
Phase 1	FY2001	2002	2003	2004	2005

On-shore production test, Mallik, Canada (first)

On-shore production test, polar area (second)

Establishment of production technologies

Phase 1 final evaluation



Investigation of occurrence in the Nankai Trough (seismic survey etc.)

Exploratory drilling offshore Japan

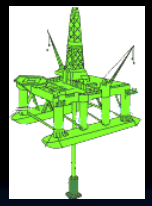
Intermediate evaluatio

Selection of offshore production test site

Fundamental studies (exploration techniques, dissociation methods, production technologies, environmental impact assessment, etc.)

Japan's Methane Hydrate Exploitation Program

Phase 2 FY2007 -- 201



Offshore production test (offshore Japan), feasibility study, environmental impact study, etc.

Phase 2 final evaluation

Phase 3 FY2012 -- 2016

Preparation for commercial production (economic feasibility, environmental impact, etc.)

Final evaluation

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Resource Volume Estimation

The established method for a calculation of conventional gas reserves will be applied in general to the estimation of MH resources

$$Gi = A \times \Delta Z \times \Phi \times Sh \times E$$

Gi : Total amount of dissociated methane gas

A : Total area of the distribution of MH
estimated from BSR distribution

ΔZ : Net thickness of MH bearing zone
obtained from well and seismic data?

Φ : Porosity
obtained from well and seismic data?

Sh : MH saturation
obtained from well and seismic data?

E : Methane gas yield*
$172m^3$ x 90% (based on experiment of synthetic hydrate)

*Volume Factor x occupation ratio of methane in hydrate cages

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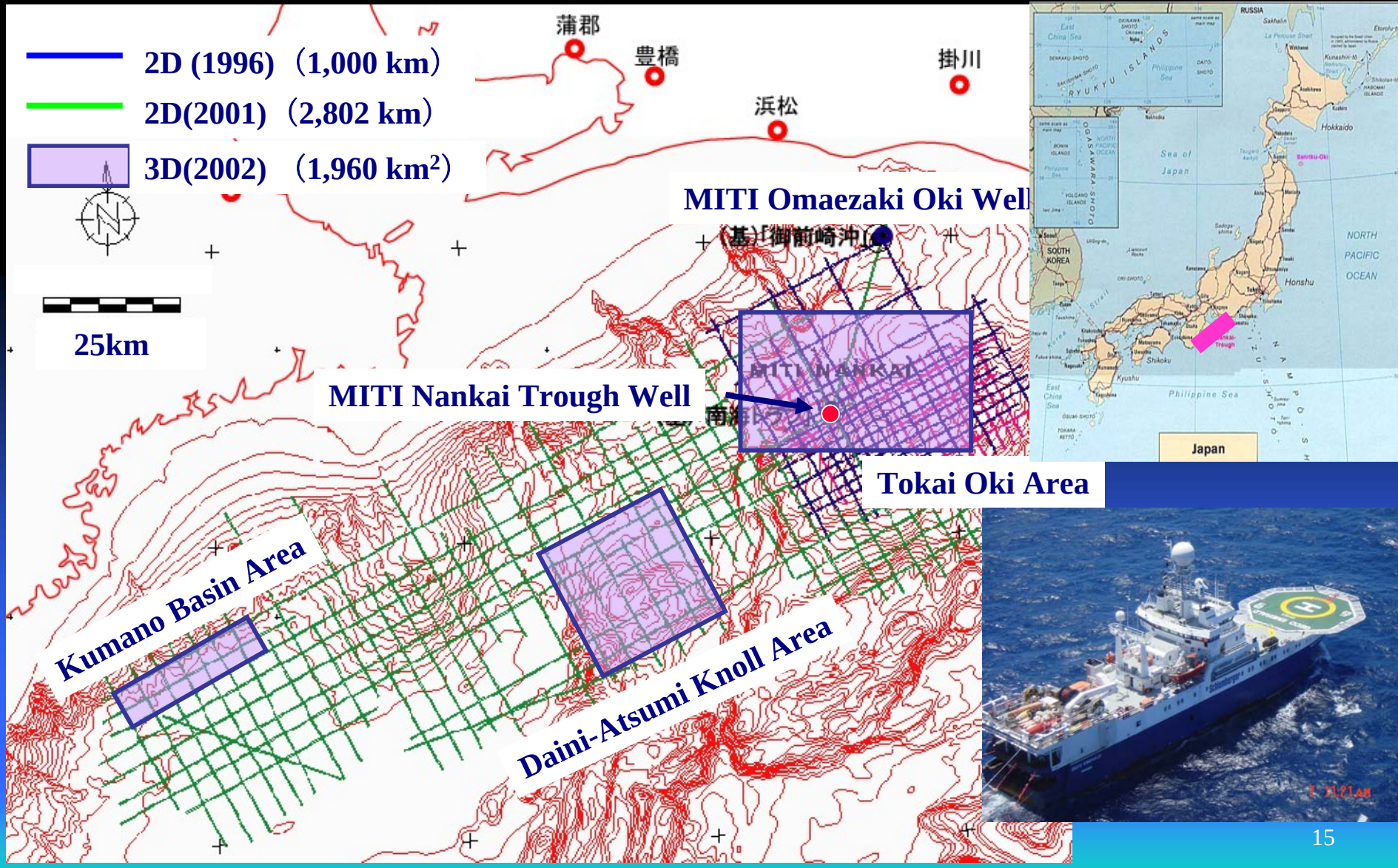
How shall we estimate the distribution of MH in three dimension with high accuracy?

- Most valuable data for detecting MH thickness is “Well Data” which shows the subsurface geological information directly, but the data can only provide the “point information”.
- For the estimation of MH distribution, correlation between seismic data (seismic characteristics such as attribute) and well data (MH thickness, saturation etc.) is very important.

Seismic Campaign in the Nankai Trough Region in 2001-2002



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Criteria of FY 2003 drilling site selection

1) Areas, sandy reservoirs are expected
   - A) with strong amplitude BSR
   - B) with weak amplitude BSR
   - C) without BSR in the continuous sedimentary facies as above
2) Areas with the interval velocity anomalies on seismic data
   - A) with BSR
   - B) without BSR in the continuous sedimentary facies as above
3) Area observed unique characteristics of BSR such as double BSR
4) Area observed BSR in the geological structure

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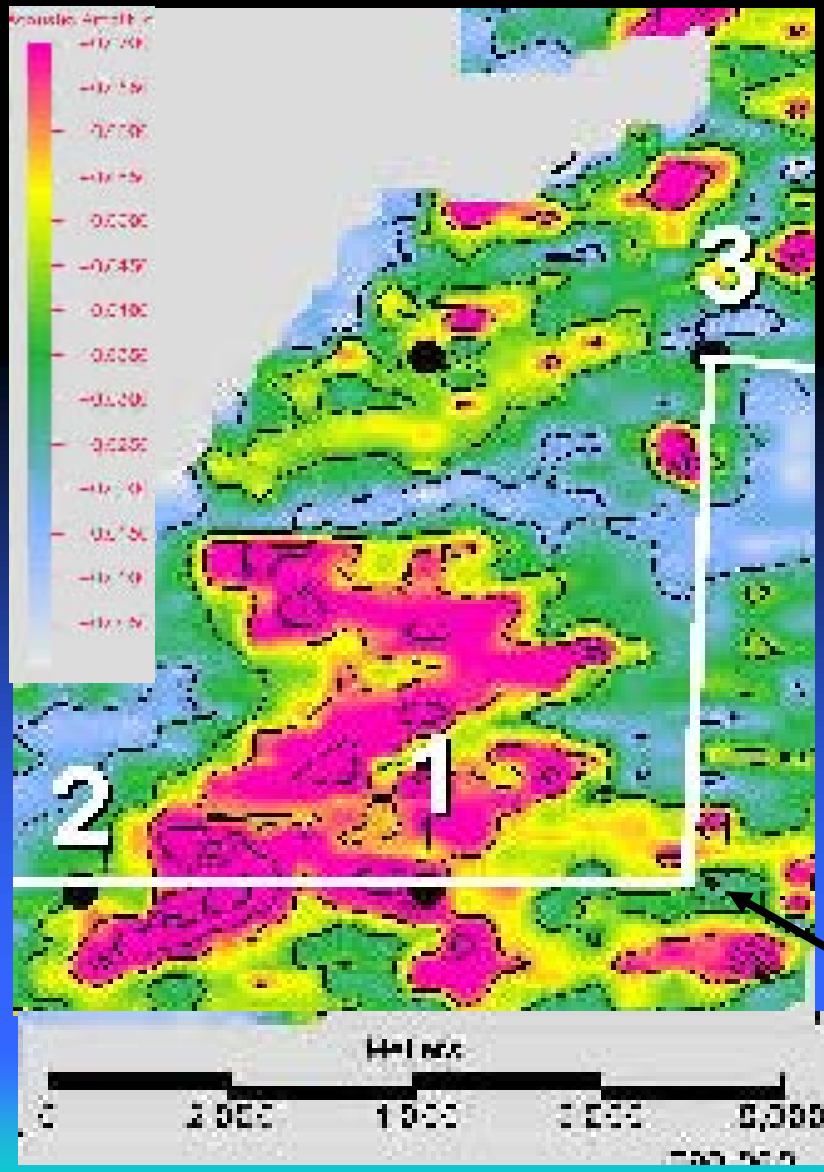
BSR Amplitude Anomalies Map in a Part of Tokai Oki Area



A) with strong amplitude BSR

B) with weak amplitude BSR

C) without BSR in the continuous sedimentary facies as above

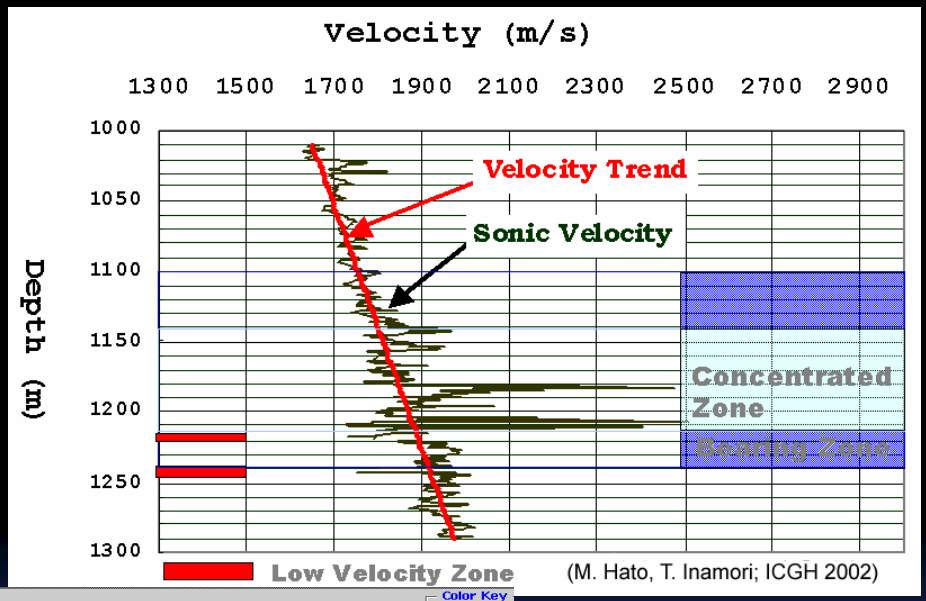
MITI"Nankai Trough" Drilled in 1999-2000

Velocity Anomalies

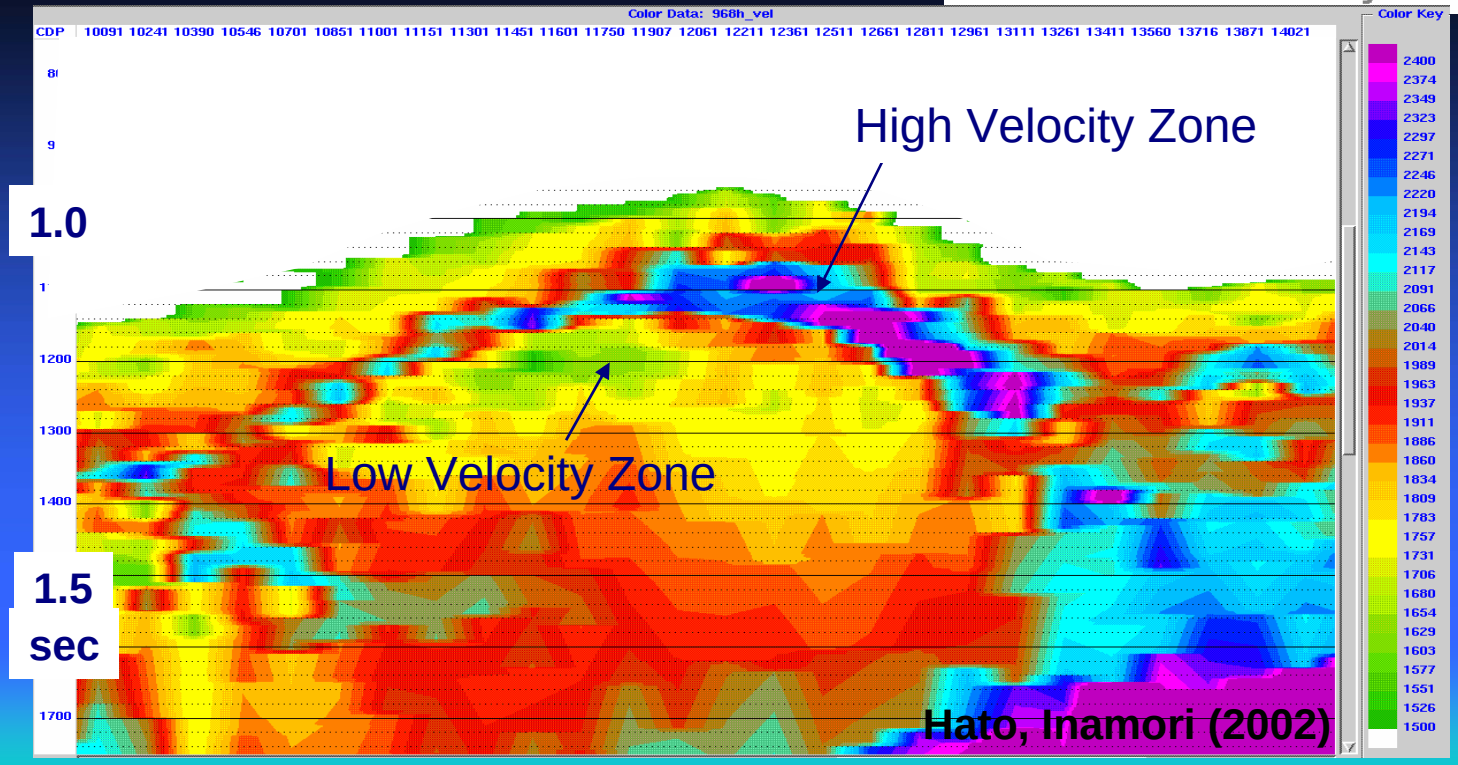
Net Pay and/or Concentration

⬇

Sonic Velocity

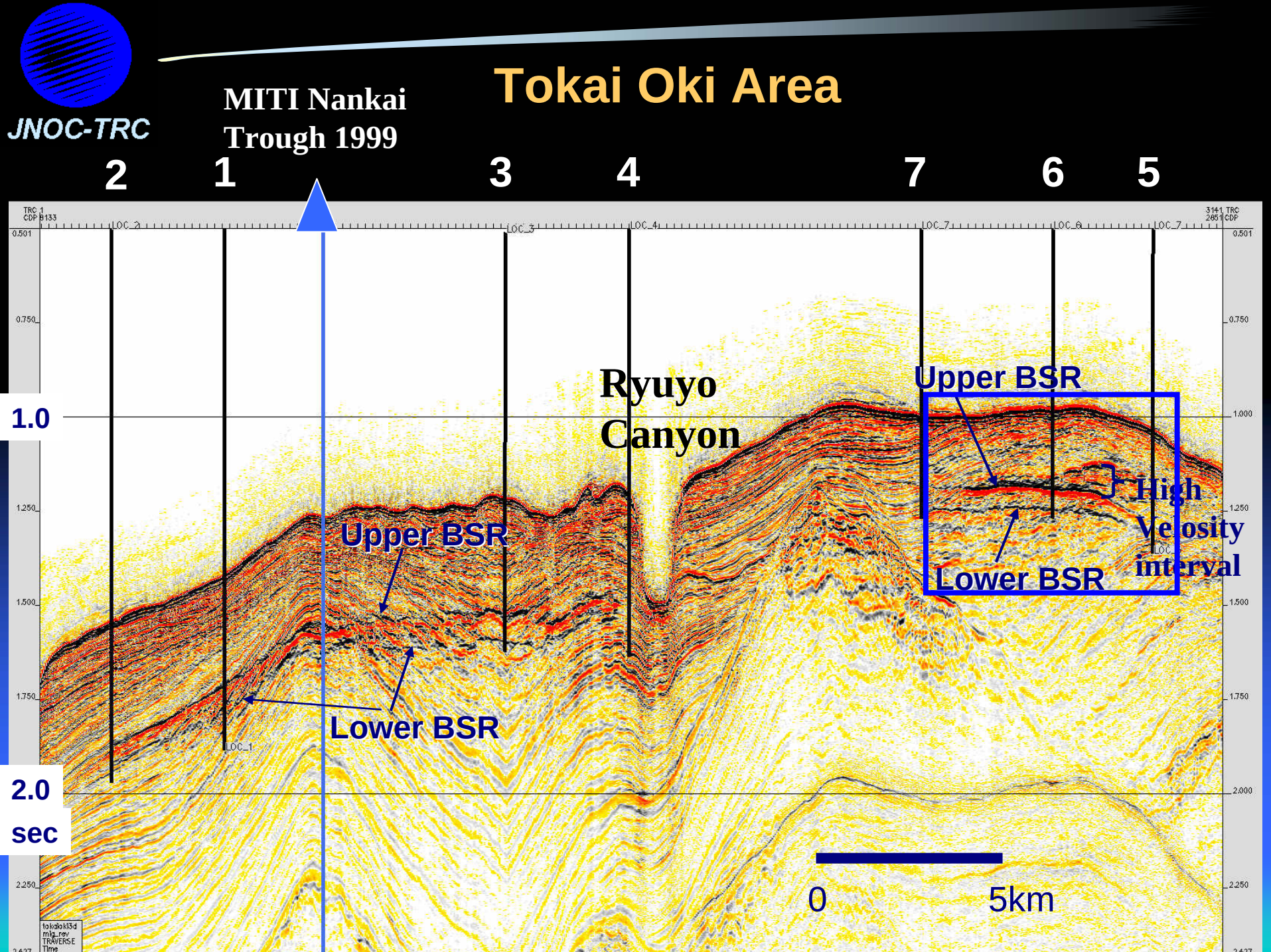


(M. Hato, T. Inamori; ICGH 2002)



Hato, Inamori (2002)

Tokai Oki Area



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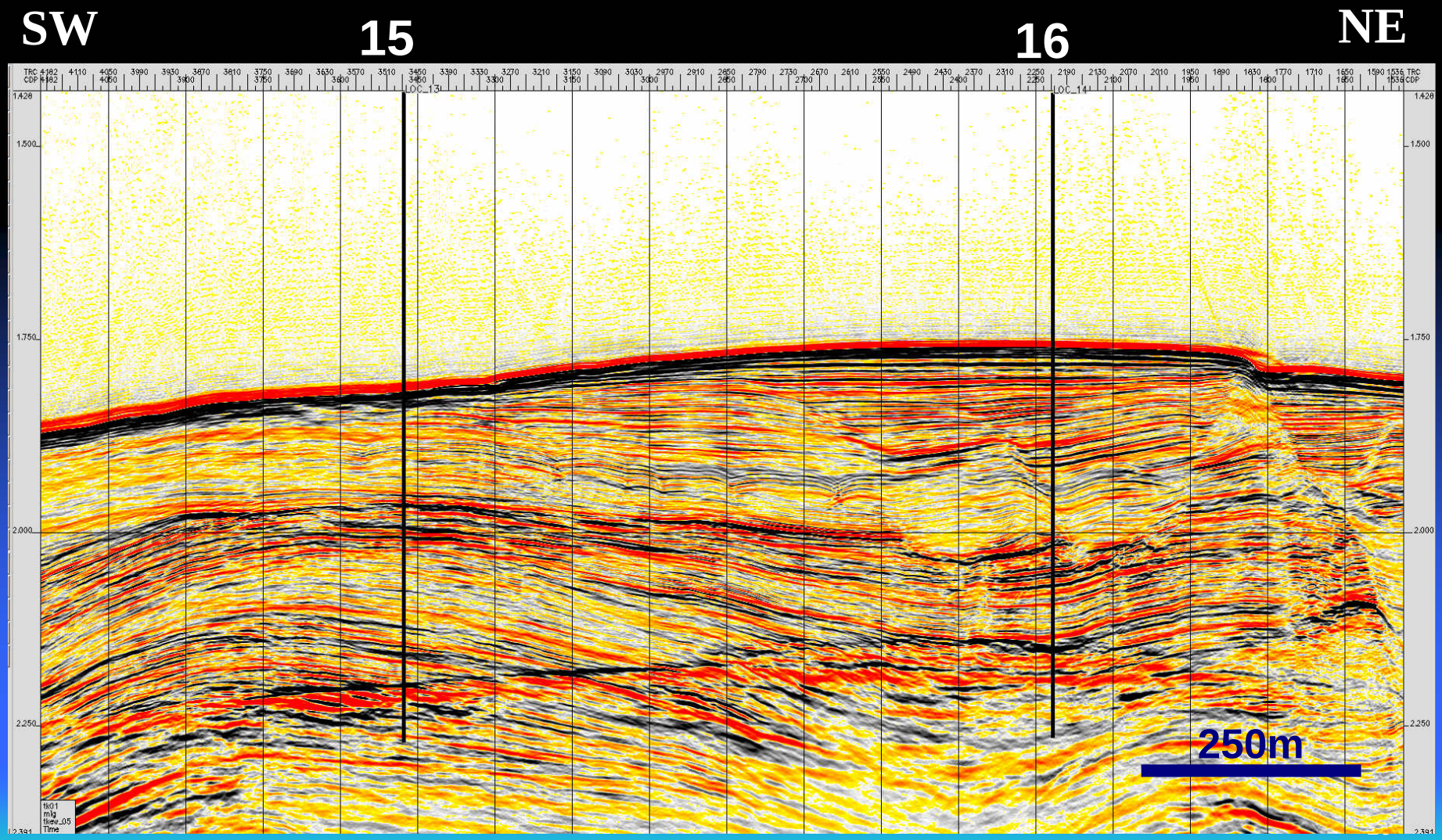
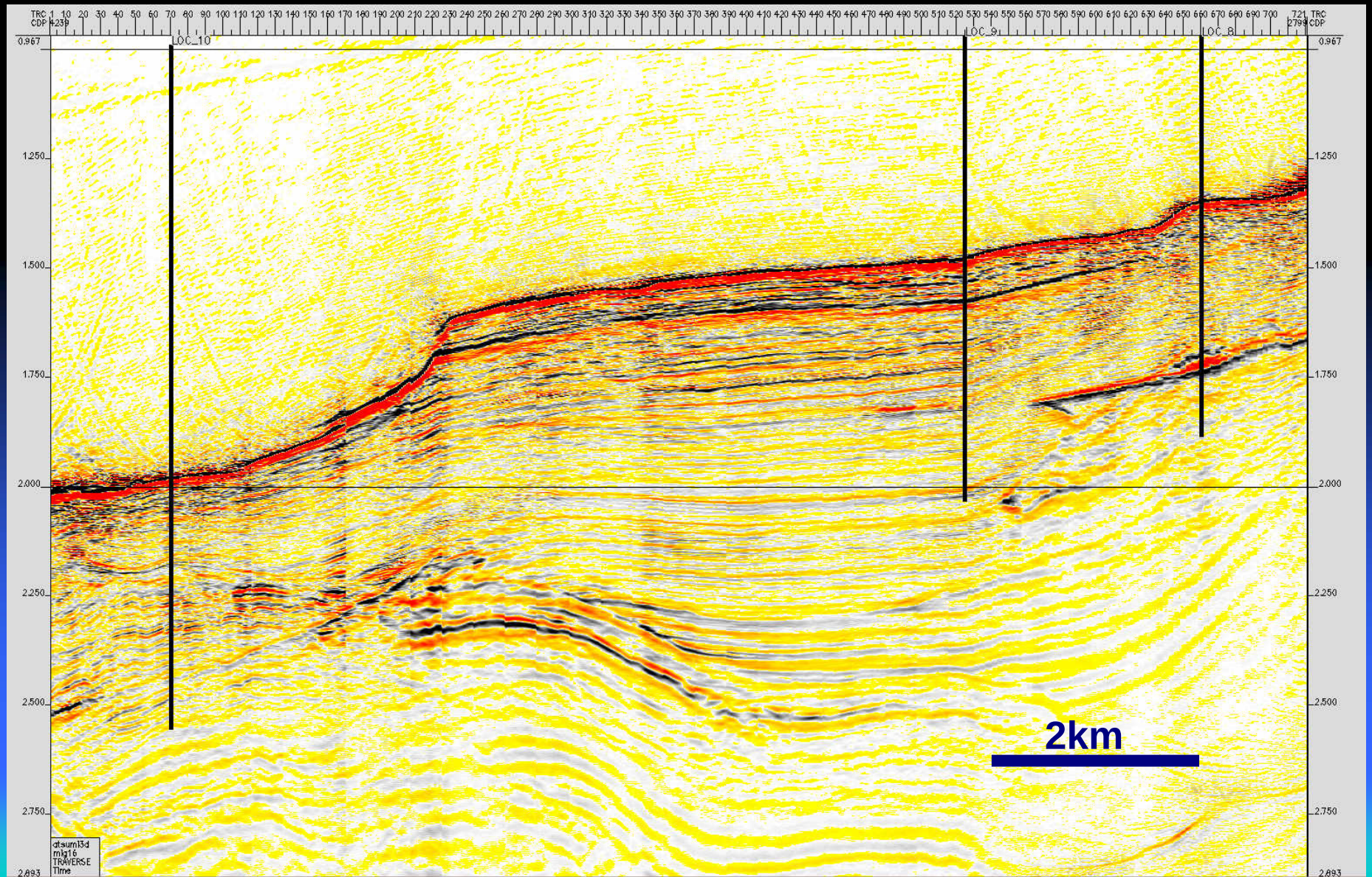
Tokai Oki Area



Daini Atsumi Knoll Area



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Drilling Program 2004

JOIDES Resolution (Riserless)

Period : January – May 2004

Planning Drilling Sites : about 15

LWD : 15, Wireline : 2,

Full Core : 2, Spot Core :10, ….

Purpose in Resource Evaluation

1. Calibration of Seismic Data
2. Clarify Occurrence of Methane Hydrate
   - ➡ Find out thick Hydrate Beds for future Production Test
3. Obtain Core Samples for Laboratory Work

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Summary

- MITI"Nankai Trough" revealed an existence of MH in turbidite sandstone in the Nankai Trough Area.
- MH pore saturation of 20 to 80% was detected by geophysical logging.
- Double BSRs are correlated to MH concentration by VSP data.
- To establish seismic response(BSR amplitude, seismic attribute and/or velocity anomaly) as a tool for resource assessment with correlation to well data is important.
- To clarify hydrate occurrence in the Nankai Trough, multi-well drilling campaign is planned in early next year.

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Mallik Research Well for MH Production Test in 2002

Participants :
JNOC-TRC,
GSC,
GFZ,
USGS,
USDOE,
ONGC/Gail,
ICDP,
BP –Chevron-Burlington, & Japex as Field Coordinator

International Symposium "From Mallik to the Future" to be held Dec. 8-10 in Chiba, Japan

Please come to http://www.mh21japan.gr.jp/ for information and registration.

Thank you very much