DOE/NETL Methane Hydrate Conference
and 4th CT JIP Workshop
Denver 29th Sept - 1st Oct 2003

'Handling and Logging Gas Hydrate Pressure Cores on ODP Leg 204'

or

"Cores recovered under full pressure .....then what?"

Lessons for GoM

Peter Schultheiss
GEOTEK Ltd

Gas Hydrates

- Why Pressure Cores?

- Need cores at full in situ pressures to recover undisturbed samples

Stable only at high pressure and low temperature

- Pressure cores need to be analysed
  - Gas analysis
  - Non destructive logging for Physical Properties
  - Sub sampling for intrusive experiments

ODP Pressure Coring System (PCS)

- Used for recovering gas hydrates on ODP Leg 164 (Blake Ridge)
- Core is unlined and must be depressurised/degassed while in autoclave
- Successful but.....

- Disadvantages for other/further analysis
  - Small diameter
  - Maybe disturbed (top drive rotary core)
  - Cannot be transferred/logged/sub-sampled

HYACE = HYdrate Autoclave Coring Equipment

HYACINTH = Deployment of HYACE tools In New Tests on Hydrates

HYACINTH Partners:

NERC - British Geological Survey, UK

Technical University, Berlin, Germany

Technical University, Clausthal, Germany

University of Bristol/Cardiff, UK

Collaborating Party:

JOI / Ocean Drilling Program, USA

HYACE / HYACINTH

HYdrate Autoclave Coring Equipment
HYace In New Tests on Hydrates

New pressure coring developments (EU funded)

Objectives include

- To recover cores:
  - at in situ pressure (up to 250 bar/2500m initially)
  - in most lithologies (rotary and percussion coring systems)
  - with high quality (downhole driving mechanisms)

and enable

CORE TRANSFER / CORE LOGGING

&

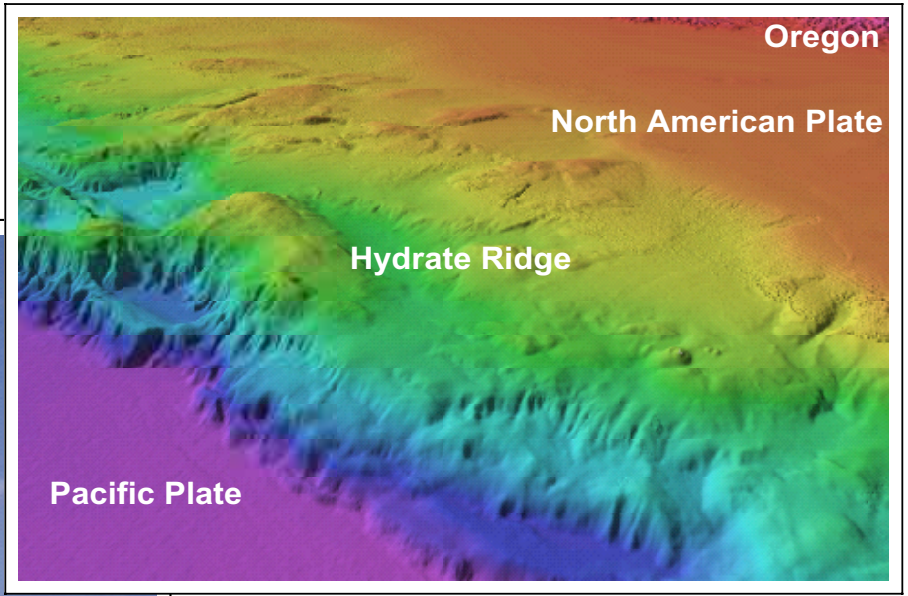
SUB SAMPLING

Hyacinth
Pressurised samples from the seabed

ODP Leg 204 July - Sept 2002

HYDRATE RIDGE (off Oregon)

First scientific use of new HYACE/HYACINTH tools and equipment

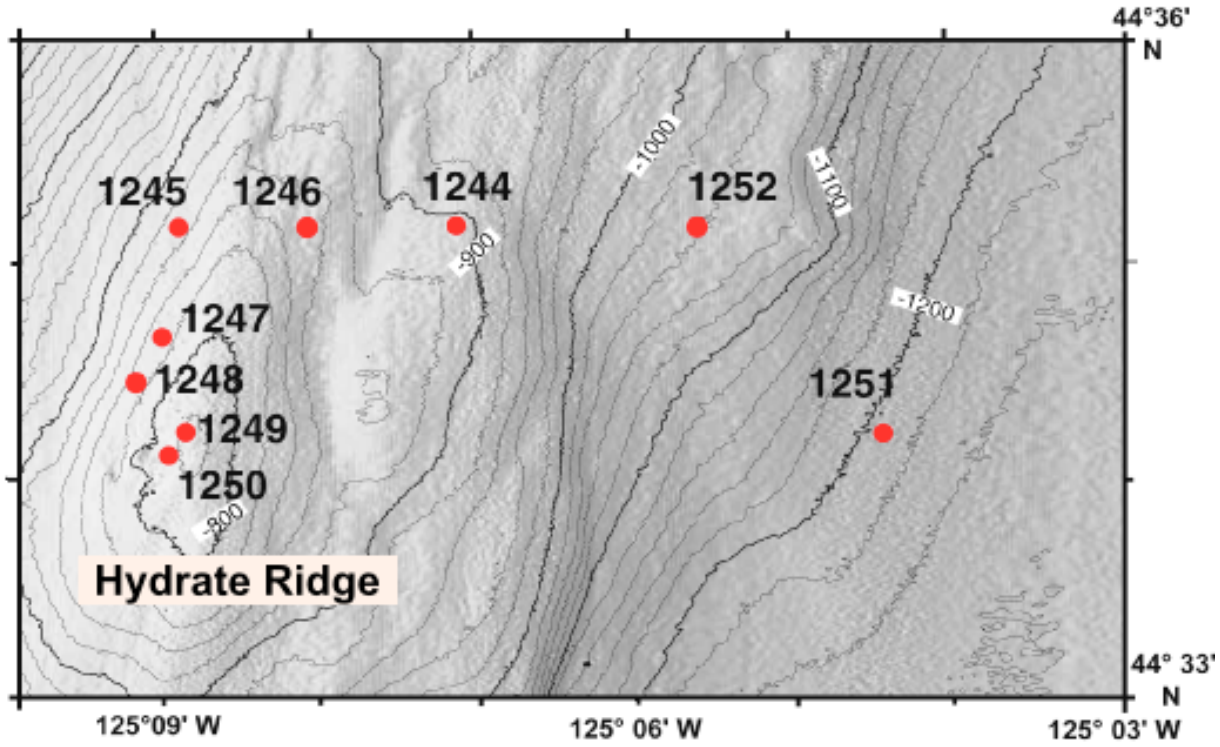


The ODP Drilling Vessel, JOIDES Resolution

Hyacinth

Pressurised samples from the seabed

ODP Leg 204 drill sites



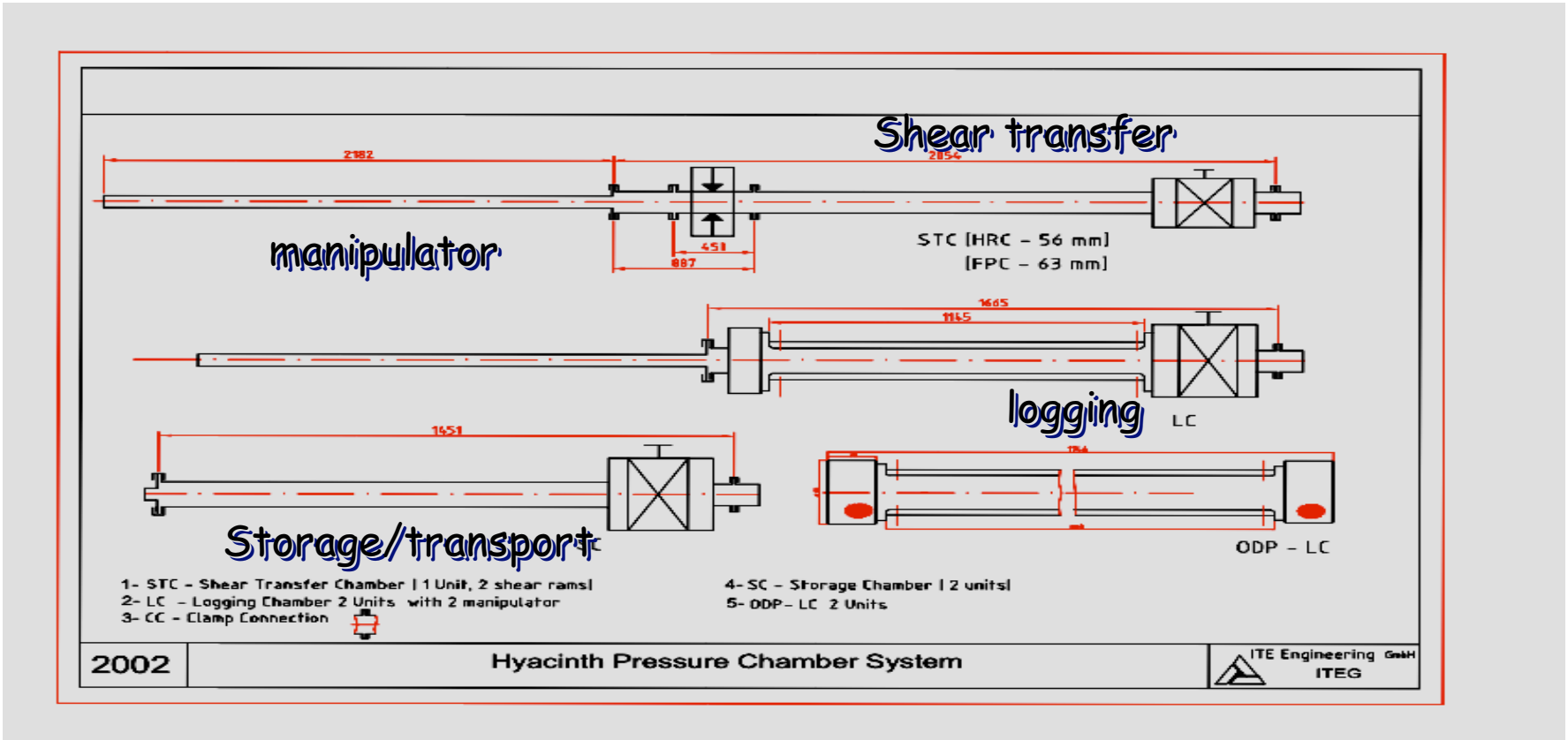
Range of sites at different depth and sedimentary settings to determine nature and distribution of gas hydrates

HYACINTH equipment

- Fugro Pressure Corer (FPC)
  - downhole percussion drive
- HYACE Rotary Corer (HRC)
  - down hole rotary drive
- **Shear Transfer chamber**
- **Logging chamber**
- **Storage chamber**
- **Vertical Multi Sensor Core Logger**

HYACINTH Pressure Chambers

Core Autoclave → Manipulator - Shear Transfer Logging
Storage/transport - Sub-Sampling

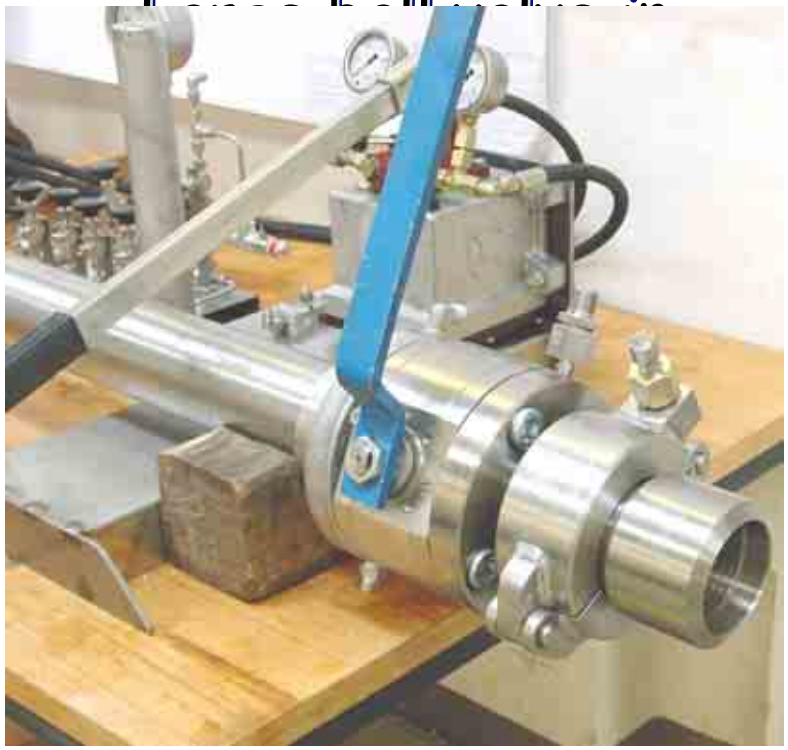


Pressure core
recovered
and autoclave
separated from main
tool.
Autoclave connected to
shear transfer
chamber

..... but first cool in an Ice bath

- Used for rapidly cooling autoclave and other chambers.
- Used to precool chambers before core transfer
- Ideally use in cold room

Pressure Chamber connections and transfers
Quick clamps and large diameter ball valves



Shear Transfer Chamber and Manipulator

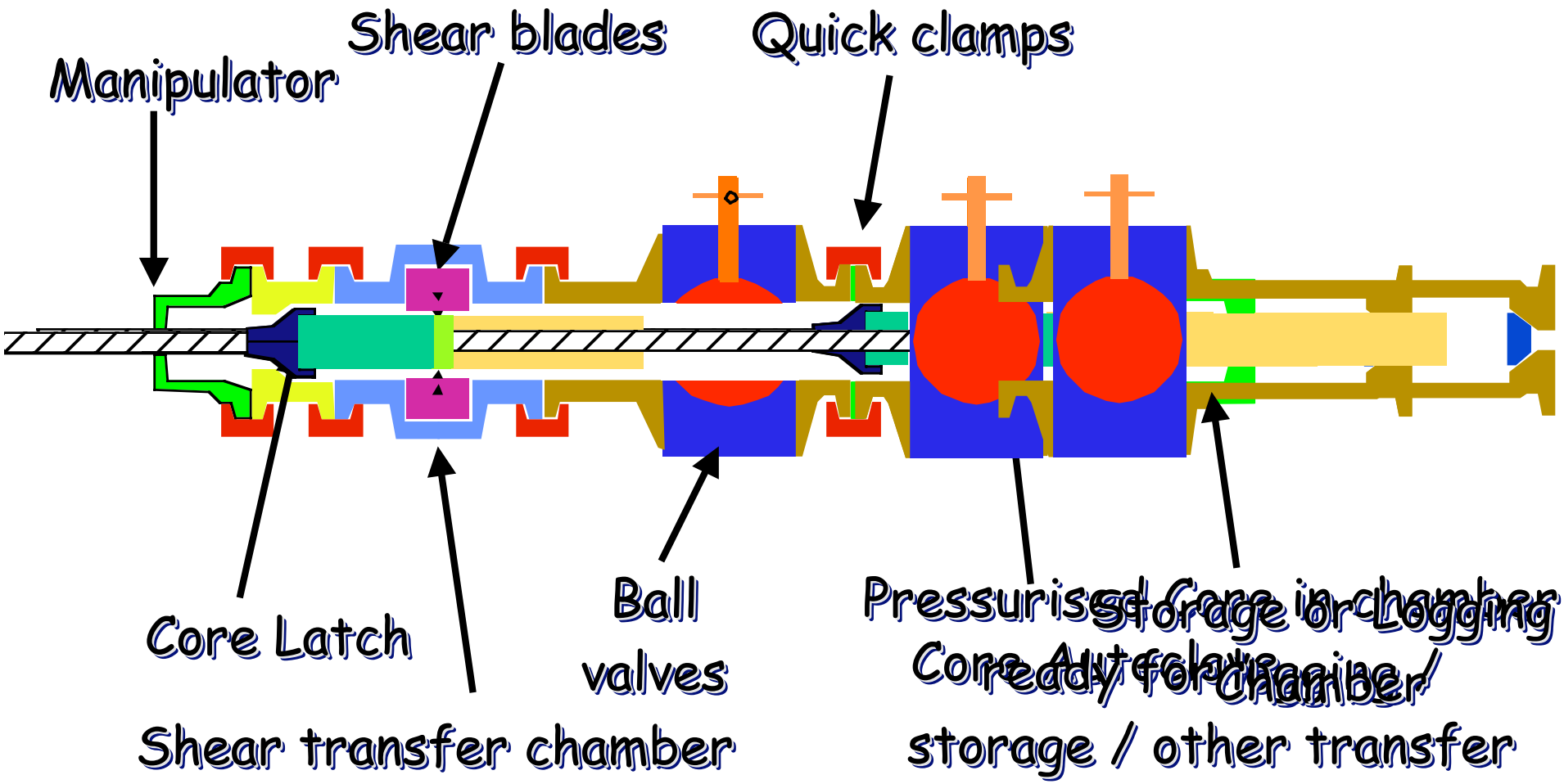
Latches and pulls core from HRC and FPC Autoclaves
Pushes core from one chamber to another

Core Transfer under Pressure

not to scale

Hyacinth

Pressurised samples from the seabed



Keeping the core cold with ice bags while transferring

Ideally this would be done in cold room.

Logging Chambers with wound GRP pressure case and logging window

Storage/Transport Chambers

- Pressure Gauge
  Relief Valve
  Burst Disc

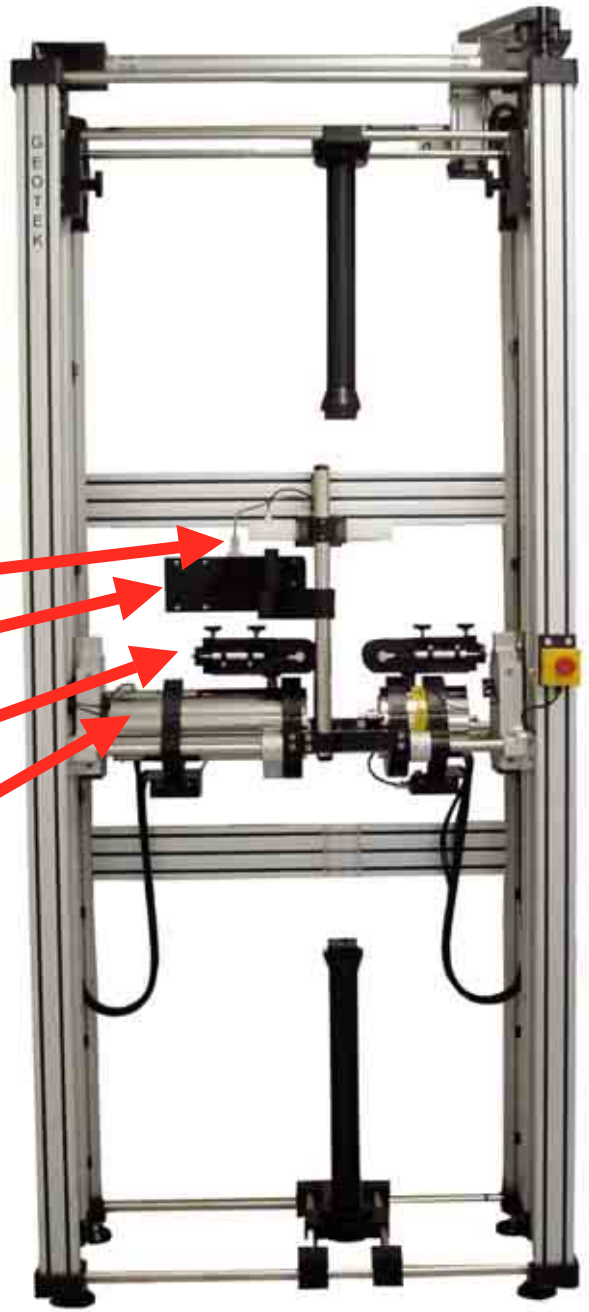
Vertical Multi Sensor Core Logger V-MSCL

Magnetic Susceptibility

Electrical Resistivity

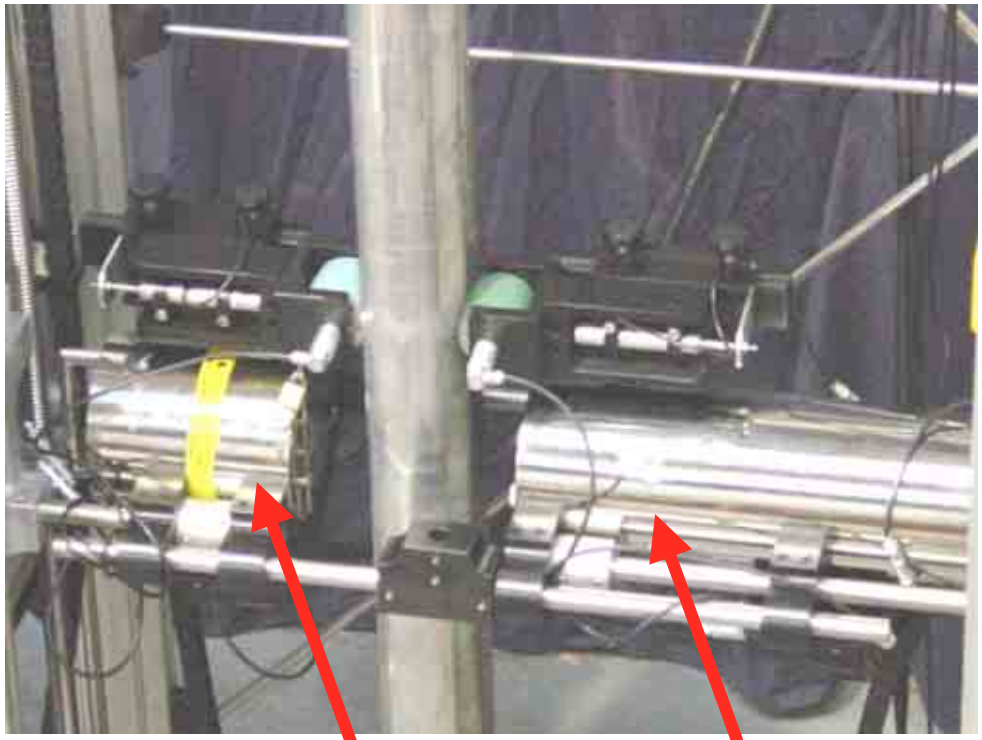
P - Wave Velocity

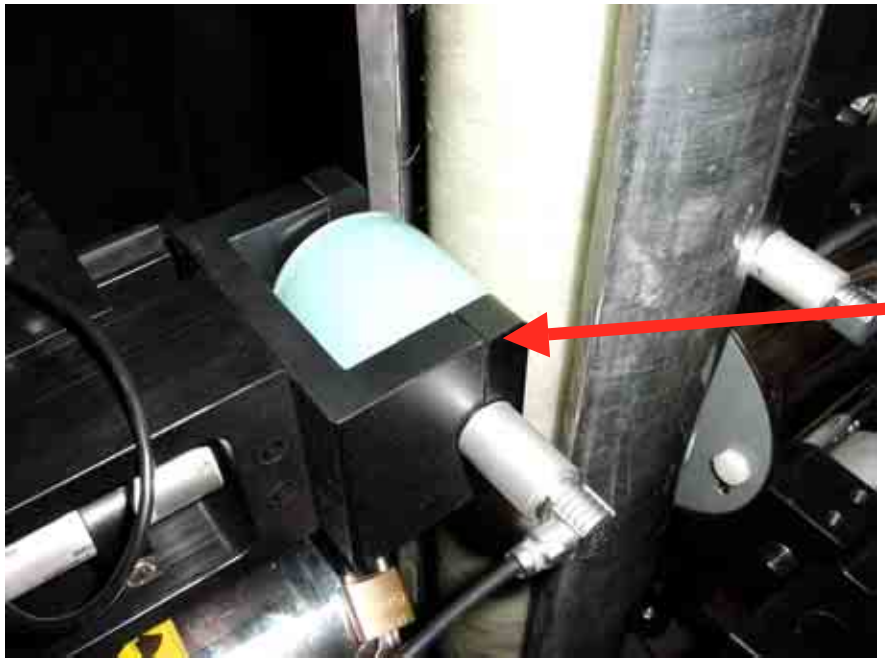
Gamma Density



Not all measurements can be made easily on pressure cores
Effects from steel and thick GRP

GRP Logging chamber enables gamma density and P-Wave velocity through 'viewing window'





Gamma source & detector

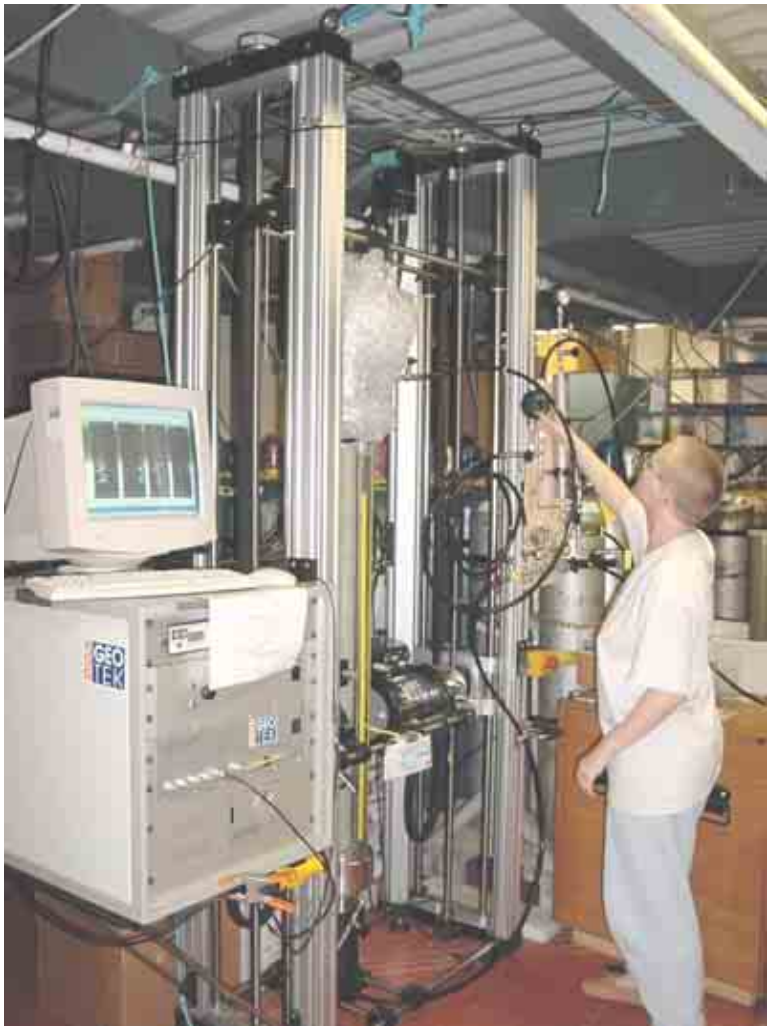
Rolling P-Wave transducers

In practice gamma density was most valuable and this can also be logged through steel storage chamber

Pressure Core Logging and gas sampling

Use vertical core logger because:

- Only single core sections
- Small space requirement
- Bleed gas from top of core during depressurisation



Ideally done in cold room (4 deg C).

Keeping the sample cold during logging and degassing.

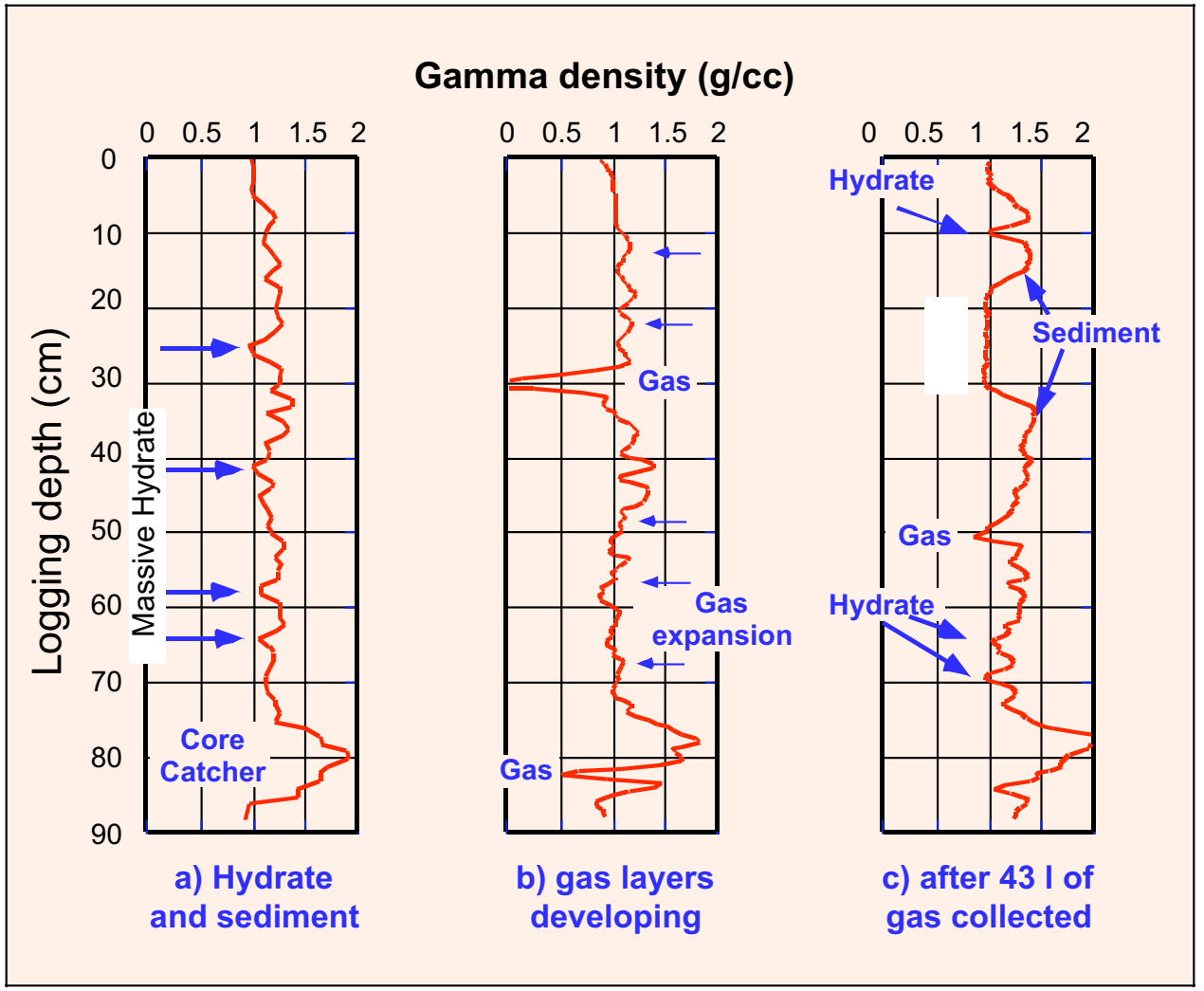
Ideally the logging should be in cold lab

Vertical MSCL subsequently fitted in small (10 ft) cold logging container

This works well as a small dedicated mobile lab either offshore or onshore

HRC-4 (Core 204-1249F-2E) massive hydrate core

Multiple density logs obtained during degassing enabled the hydrate/sediment structure to be interpreted



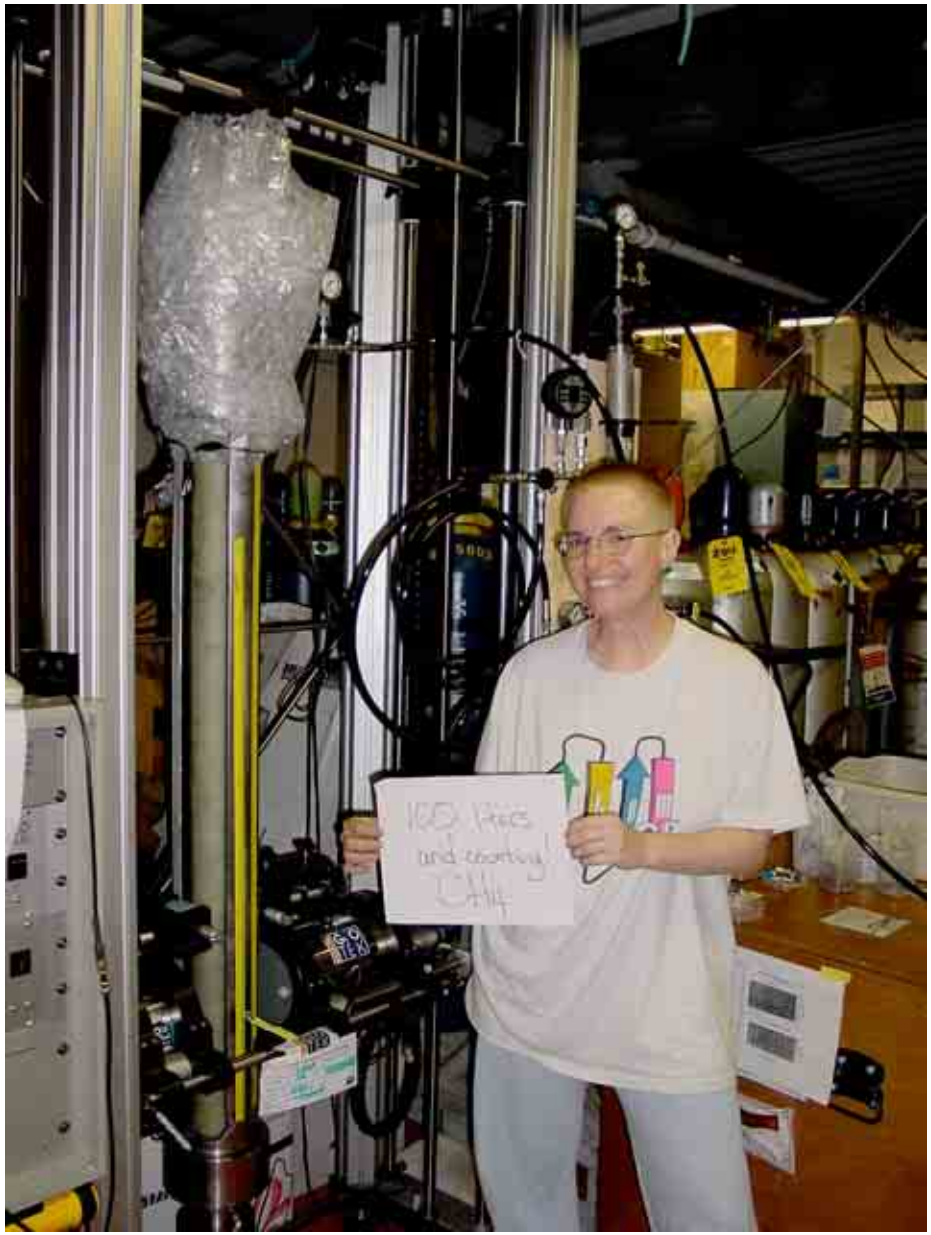
Massive hydrate from nearby core after being preserved in liquid nitrogen

HRC-4 massive hydrate core

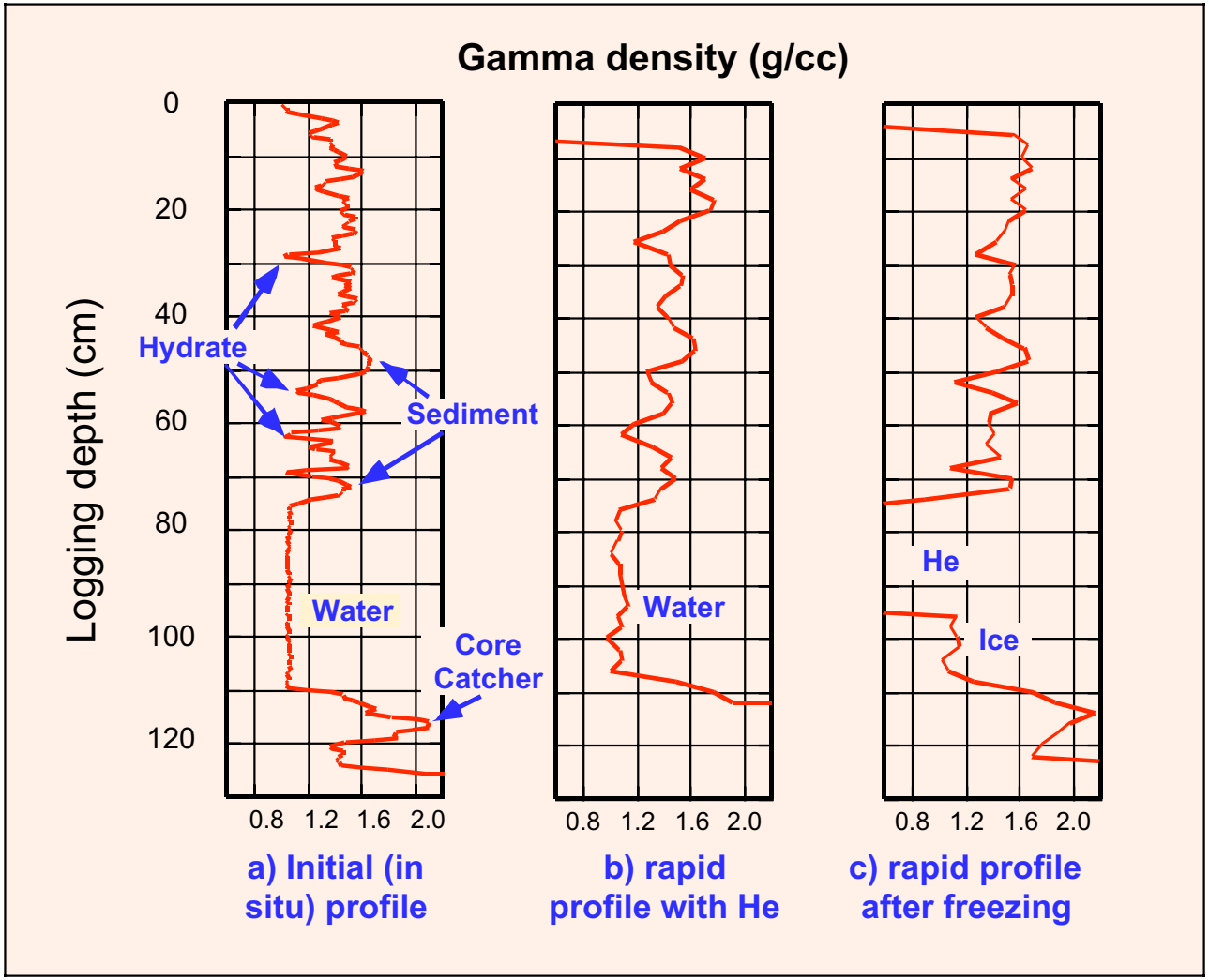
101.5 litres of gas collected

(99.9% methane)

Hydrate = 38% of core by volume



HRC-7 containing massive hydrate logged in storage chamber before being preserved in liquid nitrogen



HRC-7

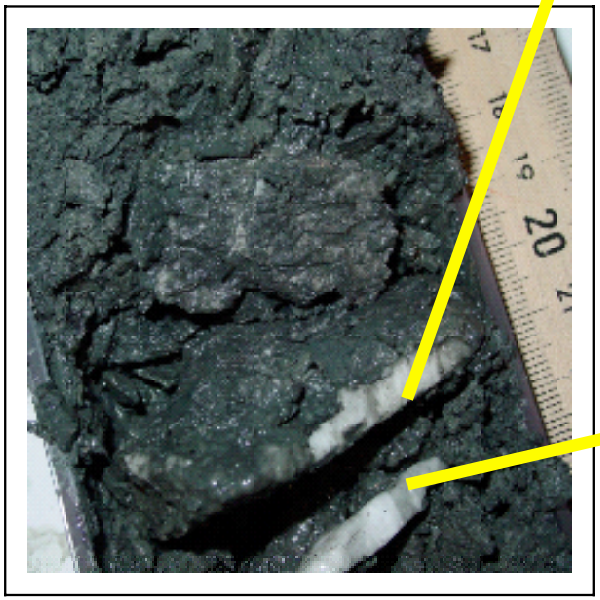
- water replaced by He
- frozen (-20 C)
rapidly depressurised
and
transferred to LN

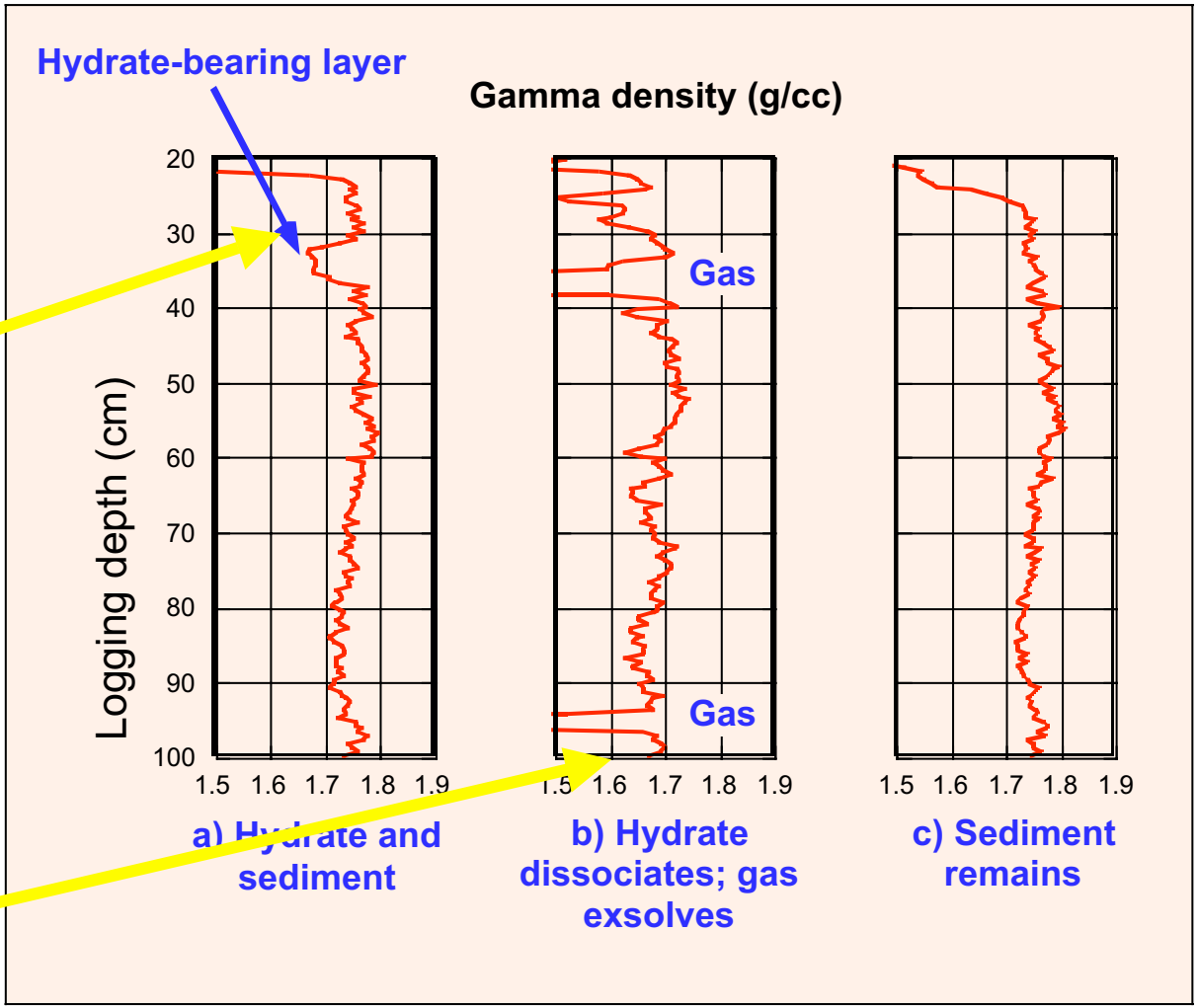
preserved
hydrate

FPC-9 (Core 204-1244E-8Y)
Density profiles during degassing

3.8 litres gas evolved - small volumes hydrate <0.5 % by volume

2 thin layers of hydrate confirmed by X-rays and chloride anomalies





Thin hydrate vein from nearby core

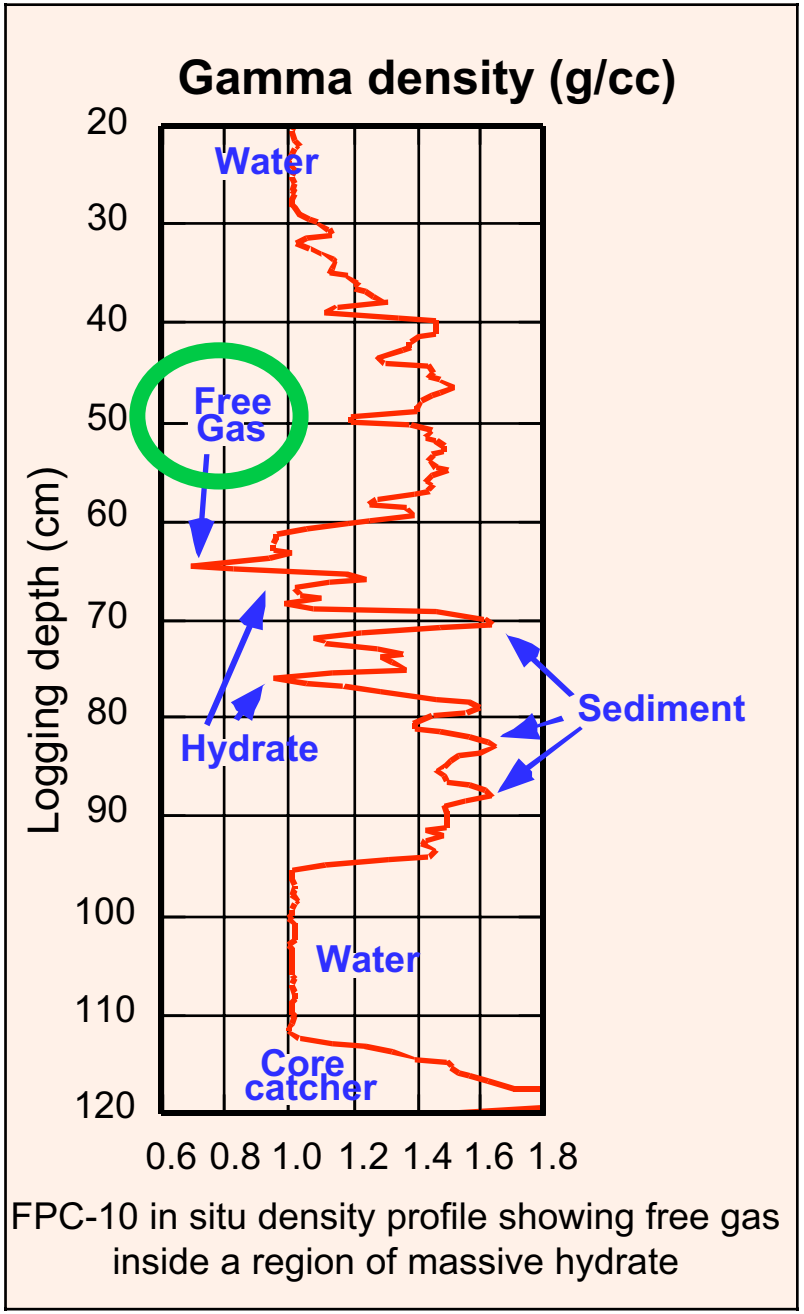
Hydrate vein

Hydrate moose

FPC-10 (Core 204-1244H-2Y) 'reference core' Gamma Density profile measured in storage chamber

Shows massive hydrate layers and in situ free gas

Transported to ODP TAMU



FPC-10 in situ density profile showing free gas inside a region of massive hydrate

FPC 10
A 'natural' massive hydrate reference core?

Transported to ODP in storage chamber for further study

Core logging in the reefer at ODP (TAMU) - with temperature control

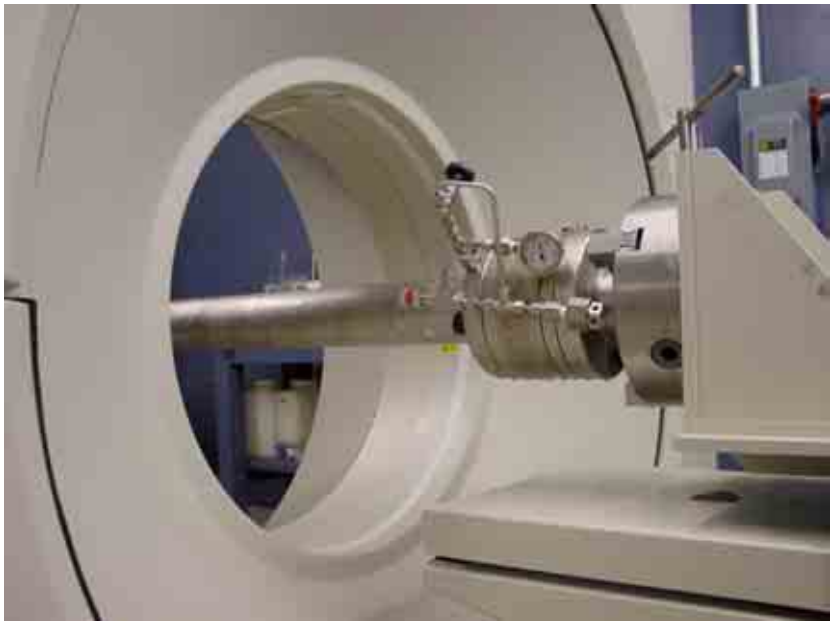
FPC-10 - same density profile showing successful storage and transport. Subsequently logged repeatedly and degassed.

CT scanning in steel pressure vessels?

Not practical - very poor resolution

use

Gamma Rays - slow - but much better penetration



PCS degassing and gas sampling

Worth noting.....

PCS cores and other cores in steel pressure vessels could also be density logged (1,2,3D) using gamma ray attenuation

Stronger gamma sources or lower spatial resolution would speed up logging

Also logged APC and XCB hydrate cores that had been rapidly repressurised in steel pressure tubes under methane.

These logs help determine the contents prior to sub sampling.

Hyacinth

Pressurised samples from the seabed

Beyond Leg 204

Pressure core handling and pressure core logging - where next? .... GOM what next?

Better 'cold' handling techniques from rig floor to lab

Improved logging techniques from inside pressure chamber.

Electrical Resistivity / Ultrasonics - others?

Determine hydrate structure/distribution using 3D gamma ray tomography inside steel pressure vessel?

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END

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