Phase II Core Handling and Core Analyses Issues:
Infrared Imaging of Cores

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Overview of Presentation

- Infrared imaging of gas hydrate-bearing cores: concept and background information
- Summary of IR data collection, analysis, and results from Leg 204
- Advances possible for the Gulf of Mexico JIP
- Summary, possible discussion topics

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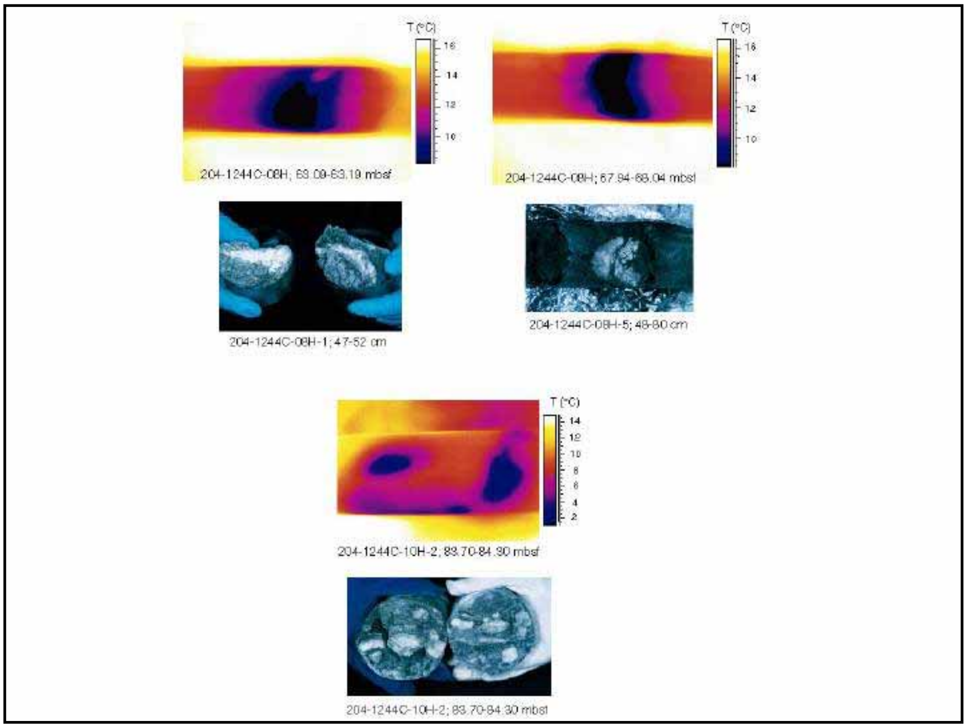
Background

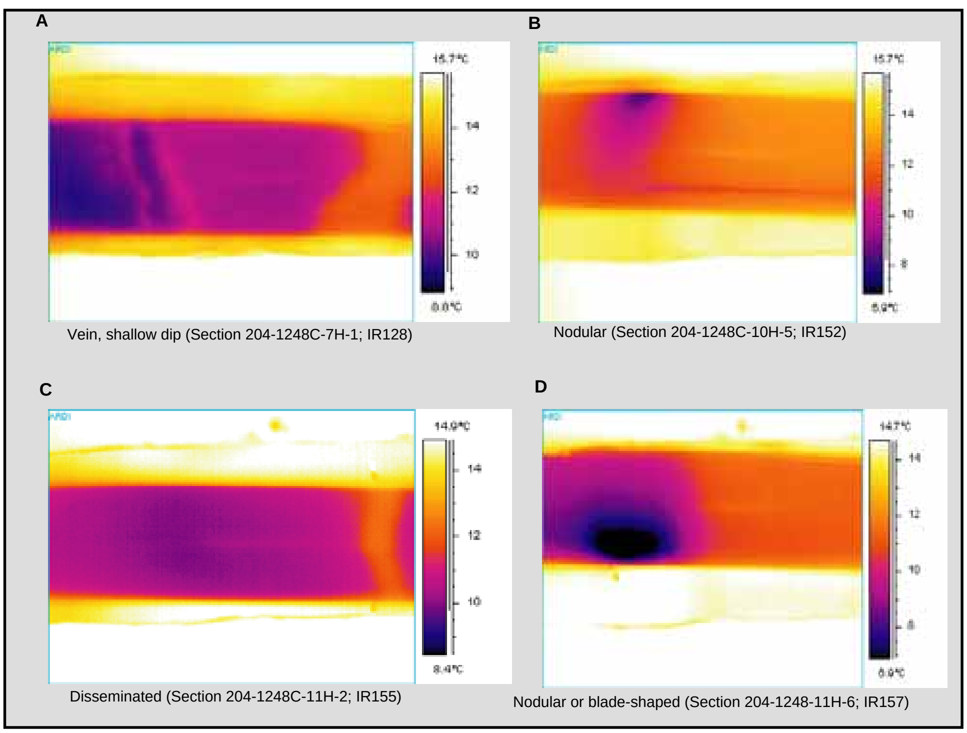
- IR imaging cameras readily detect cooling of core caused by the endothermic dissociation of gas hydrate and methane gas expansion/ exsolution
- Significant advantages over previous temperature detection methods
- Initial trials on Leg 201 and Mallik
- Full implementation on Leg 204, Hydrate Ridge
- Key results:
  - ***Immediate identification of hydrate bearing zones in core***
  - ***New, independent proxy data set for gas hydrate abundance, distribution, and texture***

FLIR SC-2000 IR Camera used on Leg 204

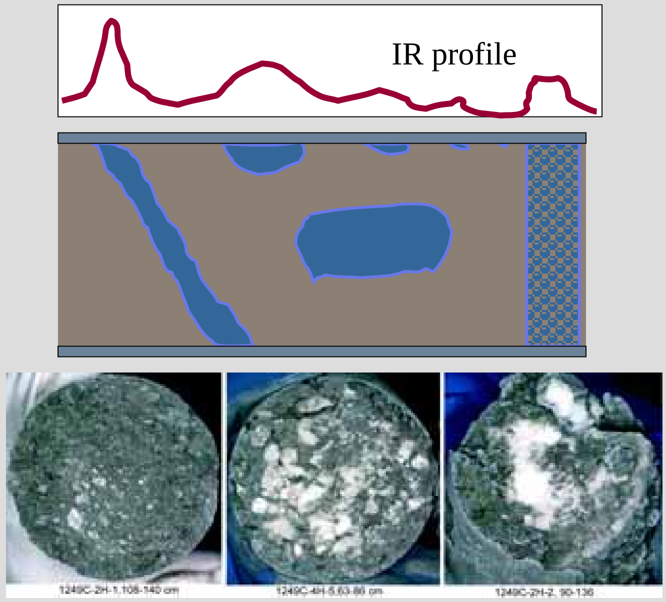
Approach Used on Leg 204

- Imaging Cameras:
  - Two FLIR ThermaCam SC 2000
  - AVIO Neo Thermo model TVS-610 (Nippon Avionics Co. Ltd)
- Track mounted *and* handheld
- Continuous imaging of most cores (approx. 3.0 km)
- Data reduction and partial analysis performed shipboard
- IR images and data linked to direct observation of hydrate for selected cores


T (°C)
204-1244C-08H; 63.09-63.19 mbsf
204-1244C-08H; 67.94-68.04 mbsf
204-1244C-08H-1; 47-52 cm
204-1244C-08H-5; 48-80 cm
204-1244C-10H-2; 83.70-84.30 mbsf
204-1244C-10H-2; 83.70-84.30 mbsf


A
Vein, shallow dip (Section 204-1248C-7H-1; IR128)
B
Nodular (Section 204-1248C-10H-5; IR152)
C
Disseminated (Section 204-1248C-11H-2; IR155)
D
Nodular or blade-shaped (Section 204-1248-11H-6; IR157)

Impact of hydrate distribution on thermal images



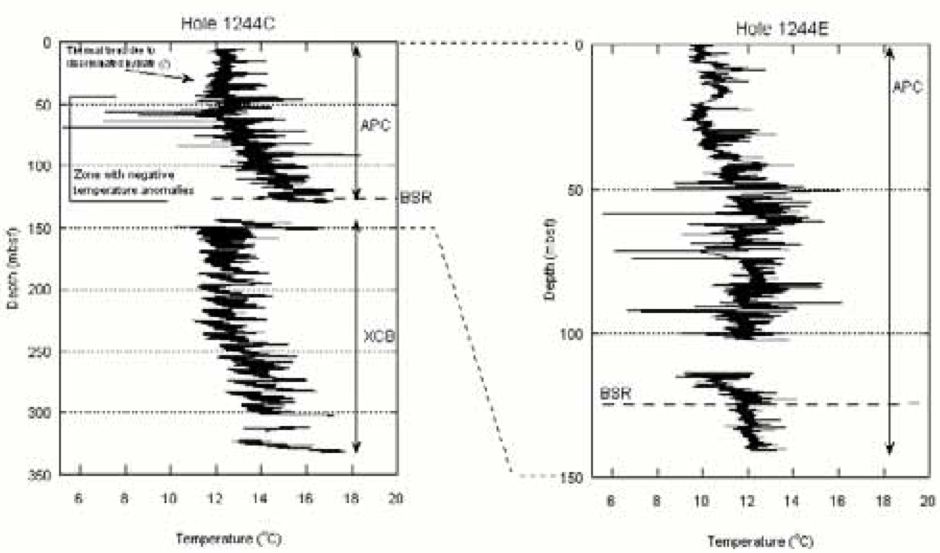
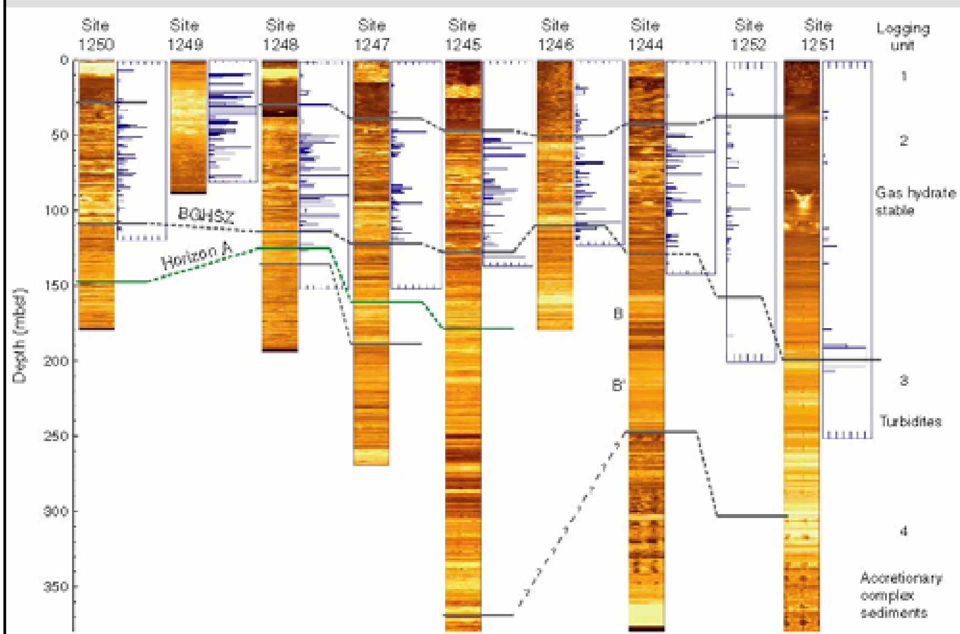


Figure 1244-H-2



Scientific Results from IR Imaging, Leg 204

- Gas hydrate at Hydrate Ridge occurs as discrete mm to decimeter sized features of widely different morphologies *(Key issue: how much pore-filling hydrate is there?)*
- Provides independent method of estimating continuous gas hydrate abundance as a function of depth. Shows systematic decrease from the summit to flank to slope basin *(Key issue: how do we optimize the information from multiple gas hydrate proxies?)*
- Down-core temperature profiles confirm thermal structure of individual cores *(Key issue: Origin is not known, may be related to gas expansion or thermal input from coring)*

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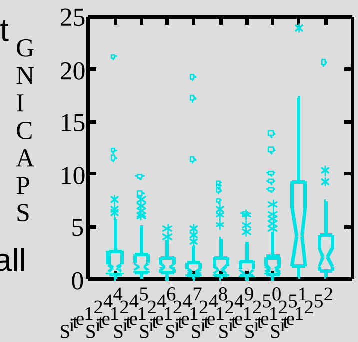
Statistical analysis of IR data

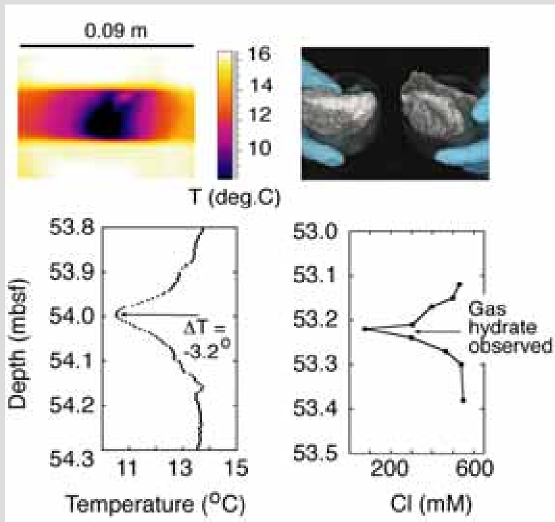
- What are the basic statistical properties of the IR anomaly data?
  - Overall depth distribution
  - Frequency
  - ΔT
  - Thickness
  - Spacing
- How do IR anomalies correlate with other data?
  - Initial test on 1245B
  - Preliminary comparison with limited other data
  - Initial results encouraging

Anomaly Spacing

- Significant difference in the spacing exists among the three domains (slope basin has largest spacing)
- No significant difference was found in the spacing among texture types
- K-S test indicates that site 1251 and site 1252 are different from all other sites



Relationship between thermal anomaly from IR camera and chloride concentration anomalies



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Possible advances in IR imaging of gas hydrate cores for the Gulf of Mexico JIP

(Prioritization criteria: 1) Improvement in resource estimates 2) Improvement in ability to exploit the resource)

- Highest Priority
  - Enhanced imaging system taking full advantage of camera data rate
  - Generation of images of full core circumference
- Moderate priority
  - Routine use of multiple IR imaging passes
  - Automated image merge and anomaly detection
- Low priority
  - Automated core marking

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Benefits from highest priority enhancements to IR imaging of cores

- Enhanced imaging system taking full advantage of camera data rate
  - Reduces time for IR data collection
  - Integrates smoothly with typical core handling
  - Allows more rapid sampling and preservation of gas hydrate
- Generation of images of full core circumference
  - Provides true dip on hydrate lenses or layers
  - Dip *and* strike if core oriented to support assessment of the importance of structural control on gas hydrate occurrence
  - Allows sampling of all gas hydrate zones

Summary and Discussion Topics

- IR imaging of gas hydrate cores provides:
  - A unique window on gas hydrate occurrence, including abundance, distribution, and overall texture
  - Near instantaneous information on the location of gas hydrate in a given core, providing a previously unavailable guide to sampling
- Possible Topics for discussion:
  - What are the operational issues for IR imaging in the GoM? *(Phase II Core Handling Plans)*
  - Evaluation of proposed priorities for IR imaging enhancements *(Phase II Core Handling Plans)*
  - What is the priority of IR imaging compared to other gas hydrate proxies? *(Phase II Core Handling, Logging, and Analysis Plans)*
  - What is the optimal approach to combining the full range of proxies for gas hydrate? *(Phase II Core Handling, Logging, and Analysis Plans)*