

Gulf of Mexico

MHFAC Meeting, April 4, 2017



Prior Gulf of Mexico Major Field Projects

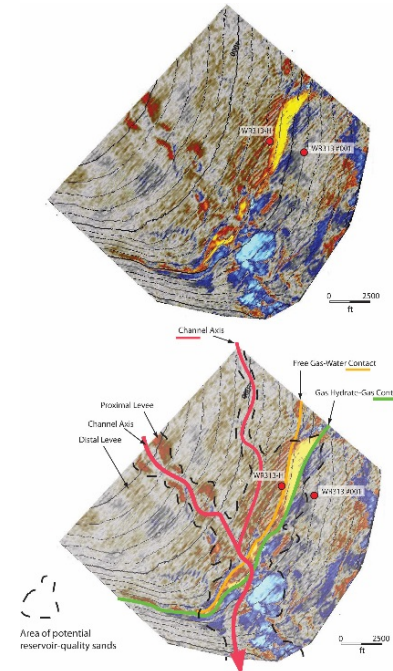
In Partnership with a Chevron-led International "Joint Industry Project"

• JIP Leg I (2005): Assessing drilling hazards

- Confirmation of ability to safely drill through GH as it most commonly exists in the GoM.
- First acquisition of physical property data from cores acquired and maintained under pressure. Full science volume published

• JIP Leg II (2009): Prospecting for resource-grade deposits

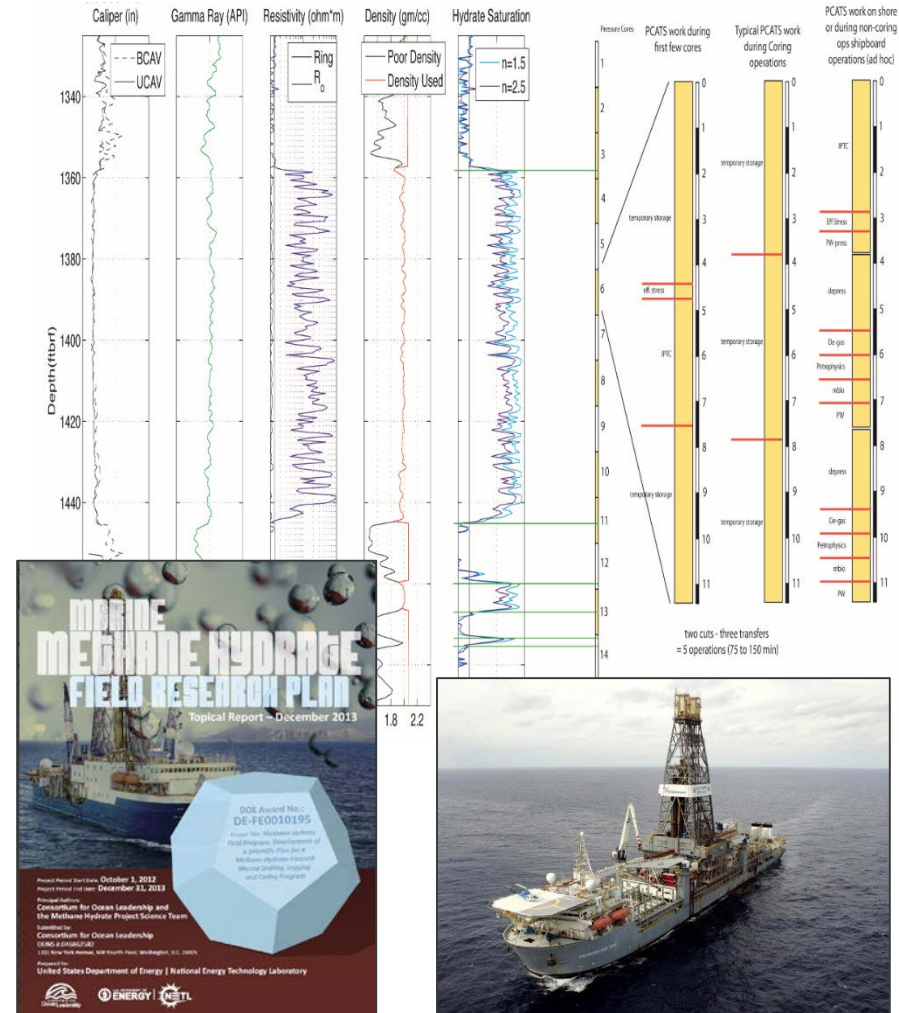
- Confirmed the occurrence of GH in sands in the GoM and provided initial test of 2008 BOEM assessment of 5,000+ tcf potential within GoM sands.
- Confirmation of program-developed G&G prospecting approach. (2 of 3 sites drilled contained high-saturation GH in sand reservoirs. 6 of 7 wells drilled contained GH in close accordance with pre-drill predictions).
- Acquisition of State-of-the-Art LWD data. Publication of Scientific Results Volume featuring DOE-USGS-BOEM-SCHL-Fugro collaboration.
- Subsequent adoption of program approach within the National Programs in India and Korea and expanded collaboration internationally. Expanded credibility with industry.



Post JIP Leg-2 Activities

Goal: Gather samples and known sites: Continue Exploration/Resource Confirmation

- **JIP Leg-2 data (3 sites w/ no core/gas/fluid samples) left many questions**
 - Reservoir and seal petrophysics
 - What controls hydrate occurrence (thermodynamics; lithology)
 - How are hydrate reservoirs generated and maintained?
 - How common?
- **DOE-USGS-Chevron developed extensive plans for Leg-3 coring within Industry Protocols**
 - GoM JIP increasingly challenged by regulatory uncertainty and increasing internal risk aversion.
 - In 2013, Chevron ended the project.
 - DOE initiated activities to assess opportunities in other sectors (service industry, IODP)
- **In 2014, DOE Awarded a new project (UT-Austin)**



UT-Austin Project: GoM²

Pressure-coring at known sites and exploration of high-value new sites

Expedition – 1 (Spring 2017)

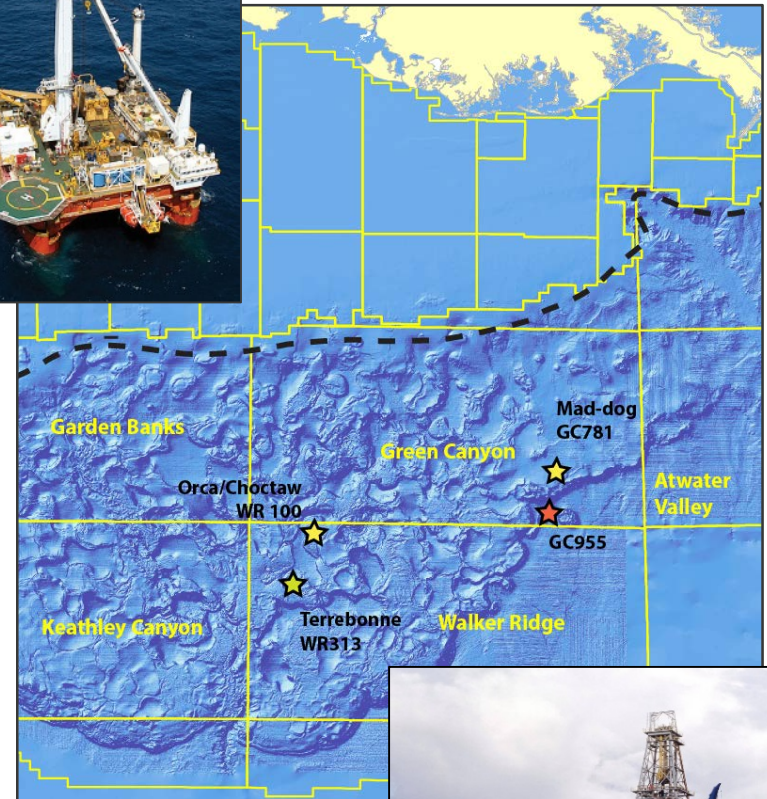
- Single site, two-hole, test of pressure corer, core transfer and core analysis. 20 deployments.
- Full science program (UT, DOE-NETL, USGS, Geotek)
- Land and shop tests conducted, final corer designs. Two bit configurations to be tested.
- Helix Q4000 contracted: UT expending significant effort in addressing project liabilities.

Expedition – 2 (2019/2020)

- Logging, MDT, and pressure coring at multiple sites.
- FY19 of FY20 from *Joides Resolution* (pending IODP approval)



Helix Q4000 (exp-1)



Joides Resolution (Exp-2)

PCTB: PCATs: Transfer: UT-A Labs

Pressure Core Tool w/ Ballvalve: Pressure Core Analysis Tools



PCCTs; PNATs

Pressure Core Characterization Tools (US): Pressure-core Nondestructive Analysis Tools (AIST, Japan)

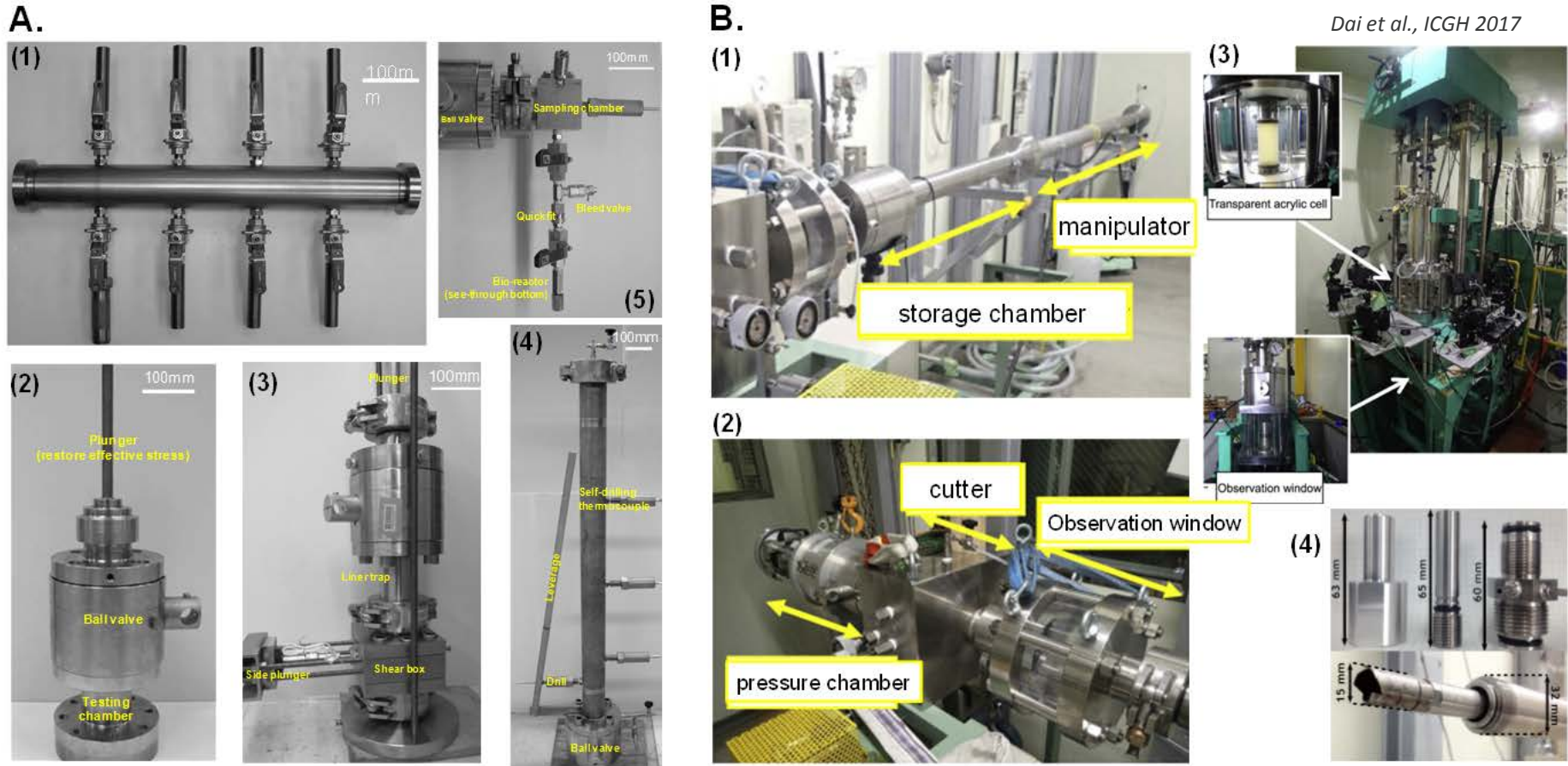


Figure 2: Photos of the developed pressure core characterization tools. (A) The PCCT systems [29-31]: (1) IPTC, (b) ESC, (3) DSC, (4) CDC, (5), BIO. And (B) the PNATs system [32-34]: (1) manipulator, (2) cutter, (3) TACTT, and (4) a sub-sampler for X-ray CT.

2017 "Marine Test": Expedition-1

May 1, 2017 is Current Estimated Mobilization Date



Expedition 1: Logistics

A Major Undertaking by the UT-Austin Team



- Ship Contract
- Service Co. Contracts
- Insurance and Bonding
- Establishment of dock-side laboratory
- BOEM Permitting
- BSEE Permitting
- DOE NEPA, etc...
- Personnel Training
- Equipment Shipment/Logistics

Expedition 1: Operations

All Dates Subject to Change



- **Load onto Helix Q4000 @ Brownsville dock: (2 d)**
- **Sail to Green Canyon 955 (day 4)**
- **sea trials/inspections (day 6)**
- **Official mobilization (day 7)**
- **Spud 1st Hole (day 9)**
 - R/U with Cutting-shore version of PCTB
 - Drill to core point at 8,056': Cut/Retrieve Cores 1 - 6 to 8,116'
 - Drill to 8,151': Cut/Retrieve Cores 7-10 to 8,182'
 - Drill to 8,441': Wireline Log
 - Cement and Abandon
- **Spud 2nd Hole (day 15)**
 - R/U with Face-bit version of PCTB
 - Same Program (w/o wireline logging)
- **Science Chiefs and advisors assess and dispense with cores – Fill 20 1 m storage vessels**
- **Demobilization (day 20-22)**

Expedition 1: Objectives

Tool Testing and Science

Tool Development

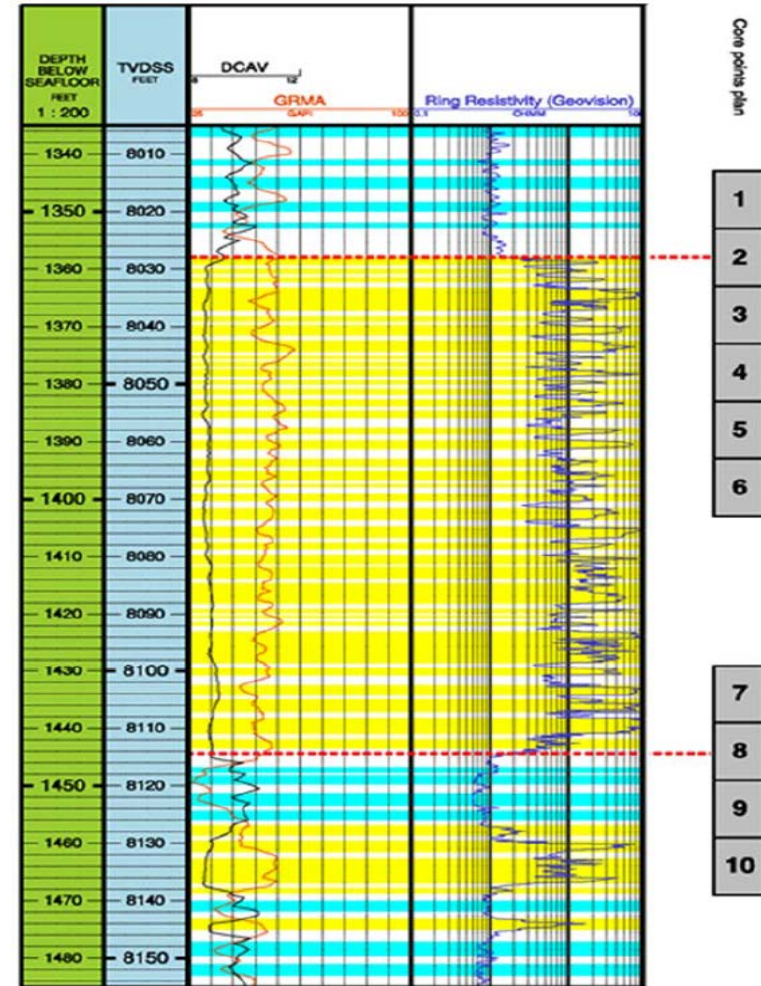
- Confirm reliability of “cutting shoe” configuration of PCTB
- Test “face-bit” version (designed to mitigate sample disturbance)
- Test core handling and transfer protocols

Science Objectives

- Sampling will target seal, contacts and main reservoir section.
- Petroleum System: gas source; reservoir quality; permeability
- Petrophysics and pore-scale occurrence of GH
- Reservoir architecture and lateral heterogeneity?
- Controls on GH occurrence; top, middle, and bottom

Key Challenges

- Limited time (a function of cost): Will require efficiency in core acquisition and processing
- Balancing science & tool development: expanded program to 20 cores storage chambers to mitigate risks
- Finding/close offset to JIP well without crossing faults



IODP CPP#887

Conduct Multi-site Scientific Drilling from the *R/V Joides Resolution*

Within the IODP Structure

- Access to world's premier scientific drilling vessel
- IODP cost contribution, staffing, and liability coverage
- Expedited treatment due to proponent cost contribution
- 60-days of ship time when the JR is back in the region
- IODP scientific and safety reviews/approvals

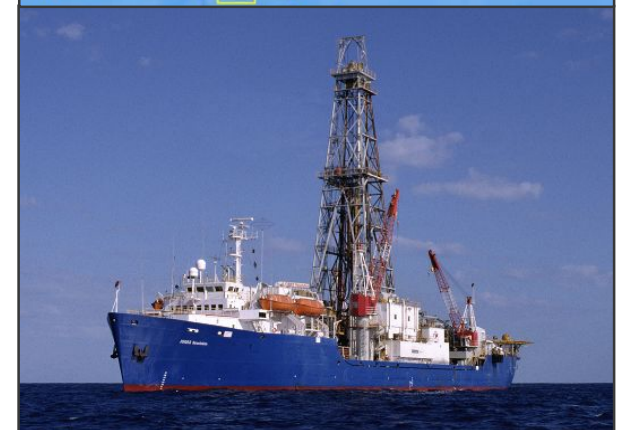
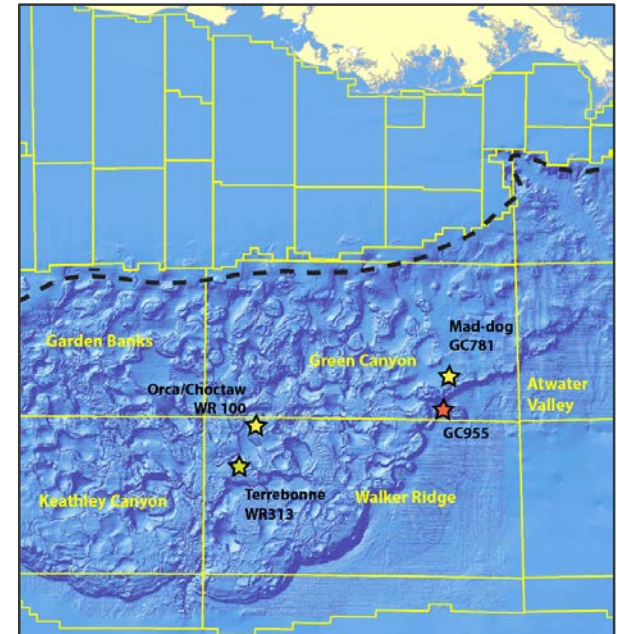
Current Proposal Status Reviews Positive

- Science reviews positive for Terrebonne and Orca/Choctaw basins
- Further review needed for Mad-dog site
- Submitted most recent Addendum March 2
- Safety review for all Sites May 2 at TAMU

Scheduling by JR Facilities Board this Summer

- Likely to sail FY2019 or FY2020

P. Flemings (UT-Austin): R. Boswell (DOE): M. Bowles (U. Bremen): T. Collett (USGS): R. Colwell (Oregon St.): A. Cook (Ohio St.): D. Divins (UNH): D. Goldberg (LDEO): G. Guerin (LDEO): M. Lever (Zurich): A. Malinverno (LDEO): D. Sawyer (Ohio St.): T. Shanahan (UT-Austin): E. Solomon (U. Wash.): F. Wang (Shanghai Jiao Tong U.)



Science Justification

Core twins of 2009 JIP WR313 G&H Holes

- Gas and fluid chemistry; GH Habit; Microbiology
- Reservoir and Seal Petrophysics
- Confirm GH Saturation/Log Interp Validation
- Inform Geosystems Modeling (NETL-Stanford)

Extend further up-dip for Core Hole #3

- Third Blue sand penetration
- Second Orange sand penetration
- Potential Green sand penetration
- Elucidate controls re proximity to BGHS, P, T...

Drill analogous system in Shallow Regime (Orca or Mad dog)

- Impedance contrast change
- Seal competence
- Pressure - Temperature - Age

