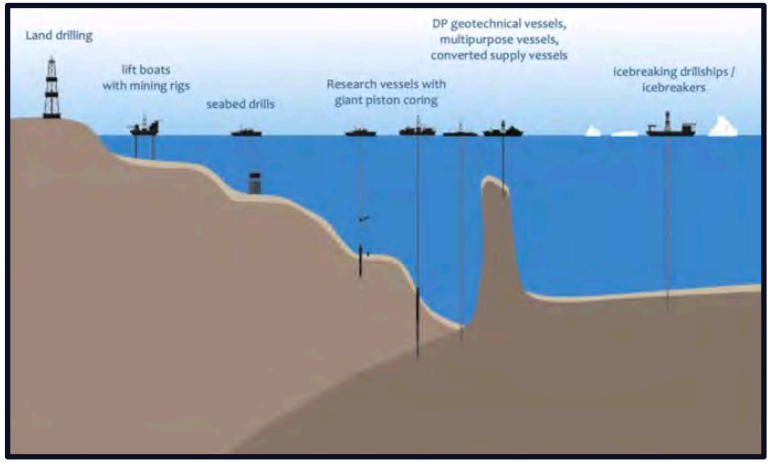
SCIENTIFIC OCEAN DRILLING

U.S. SCIENCE SUPPORT PROGRAM

FOCUS Virtual Workshop

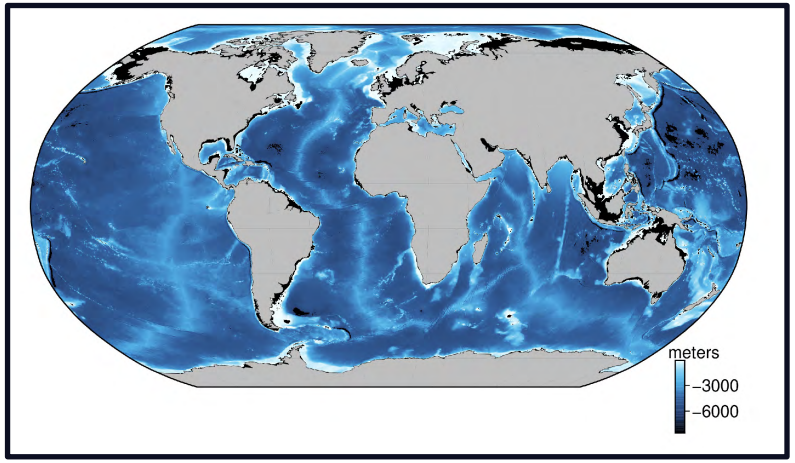
Technology and platforms available for scientific ocean drilling



February 21, 2024

Presented by: Justin Dodd
FOCUS Co-Chair

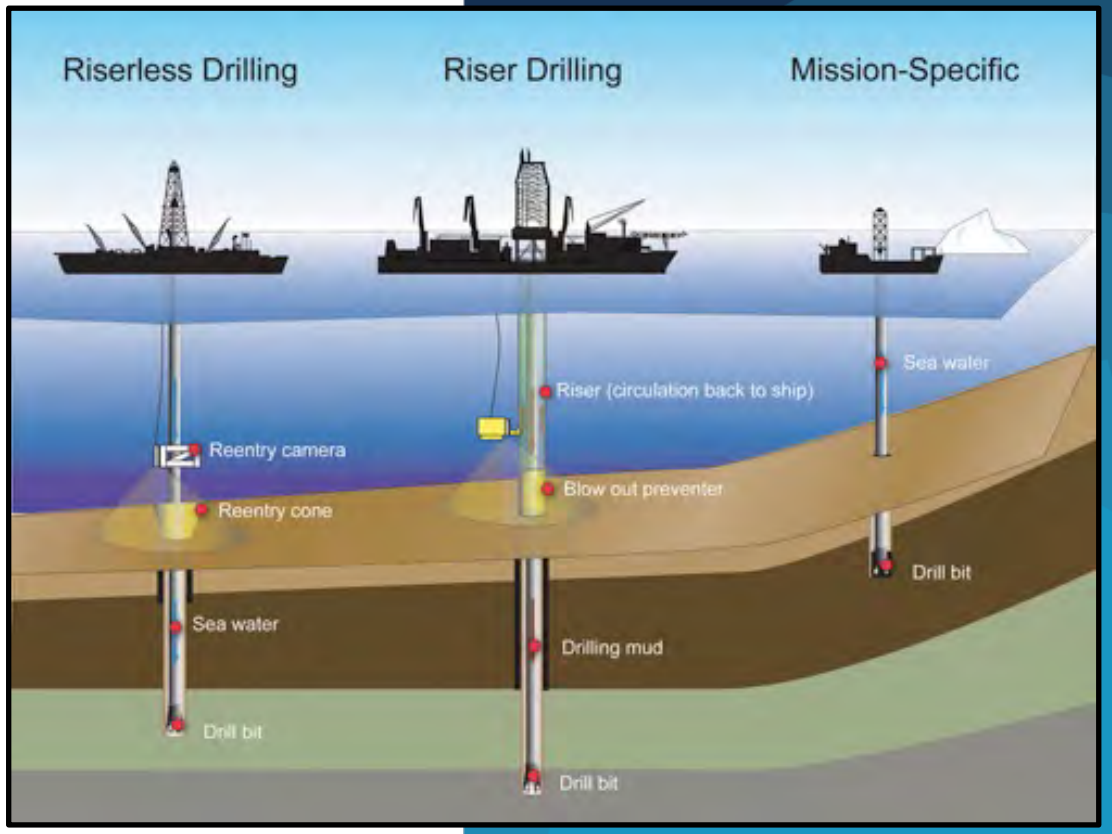
Peter B. Flemings (UT), Brandon Dugan (CSM), Steve Phillips (USGS), Tom Pettigrew (Pettigrew Inc.)



FOCUS Goals for Today

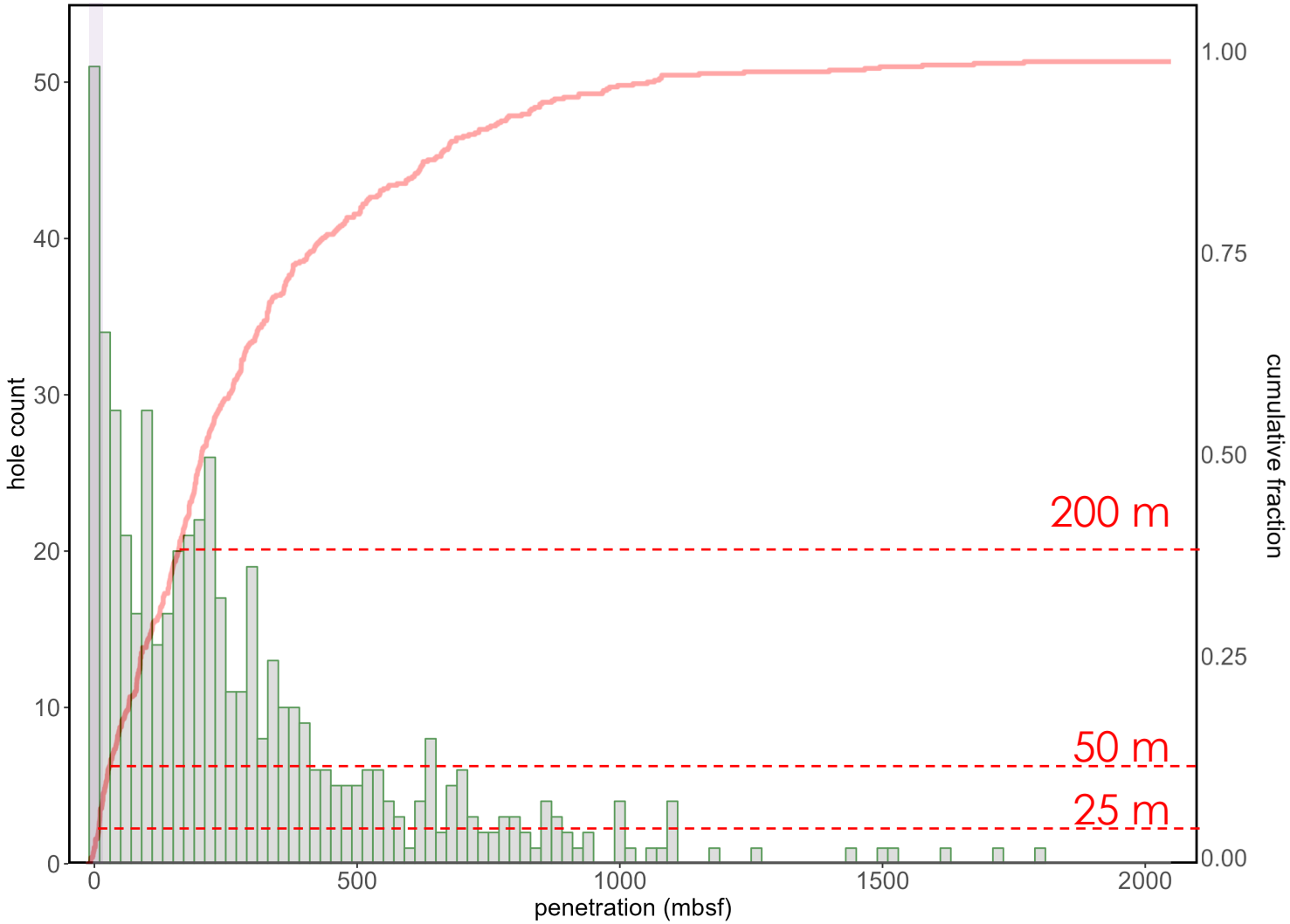
- explore the Technology and Platforms available to address KEY US scientific ocean drilling questions

- current IODP model
  - Riserless Drilling (JR)
  - Riser Drilling (Chikyu)
  - Mission Specific Platforms



Exon and Arculus, 2022

Future of US Scientific Ocean Drilling

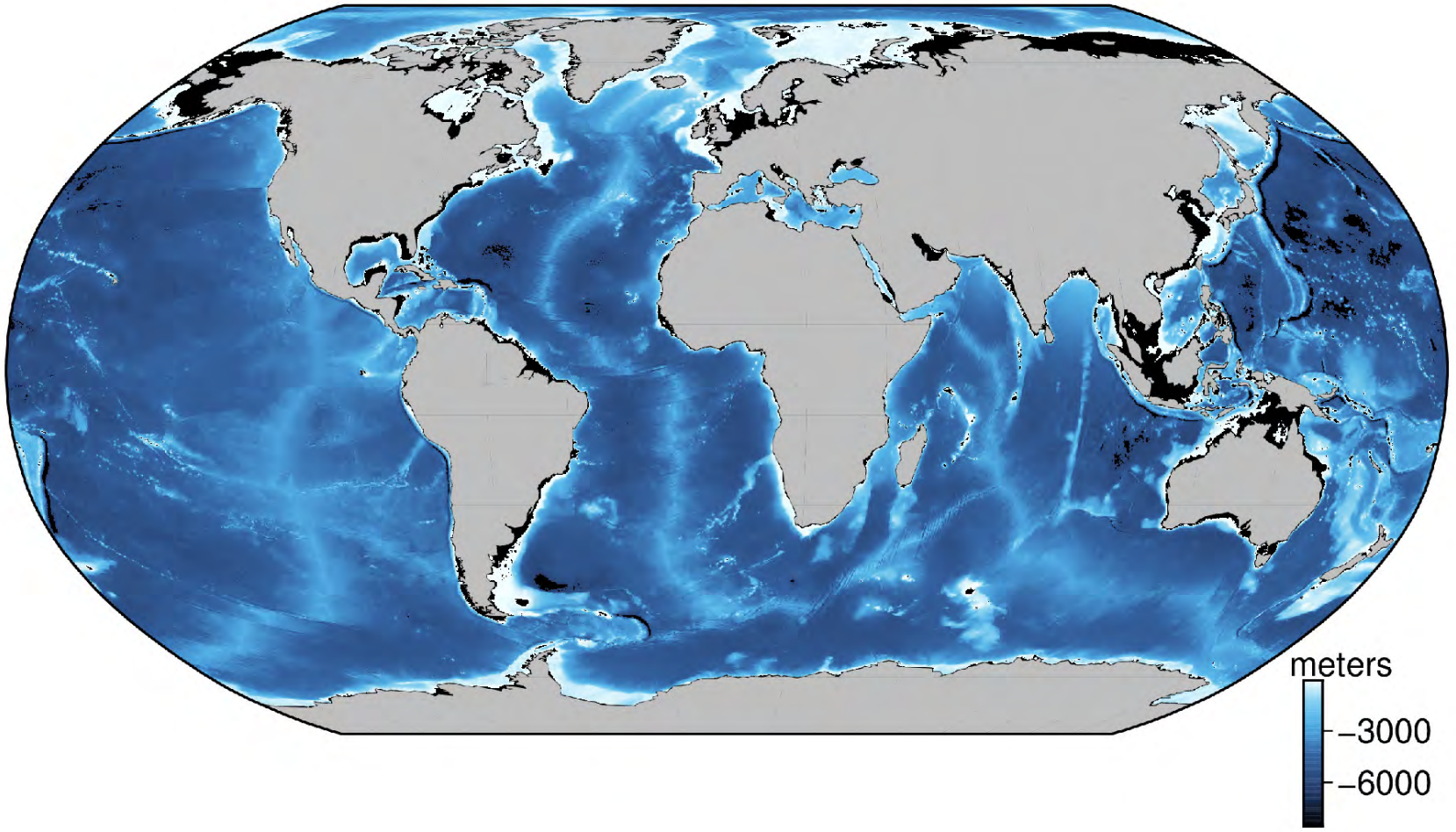


Drilling Depth and Scientific Objectives

- 40% IODP holes <200 m subseafloor
- balance key science questions with technological limitations

Data courtesy of L. Childress (IODP); figure Maureen (Mo) Walczak (Oregon State University)

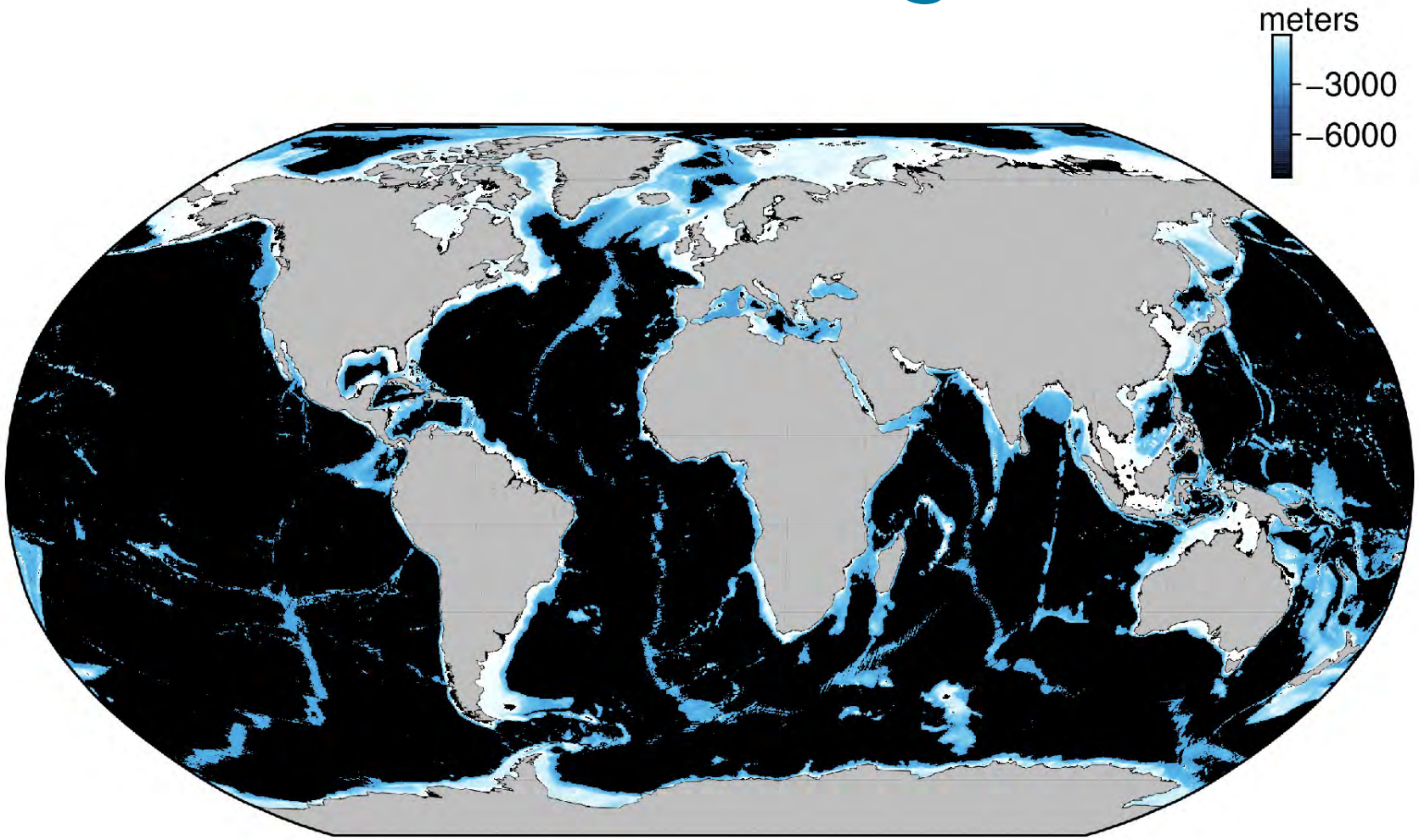
Future of US Scientific Ocean Drilling



Thought Exercise:

What water depths are required to achieve your science goals?

Future of US Scientific Ocean Drilling



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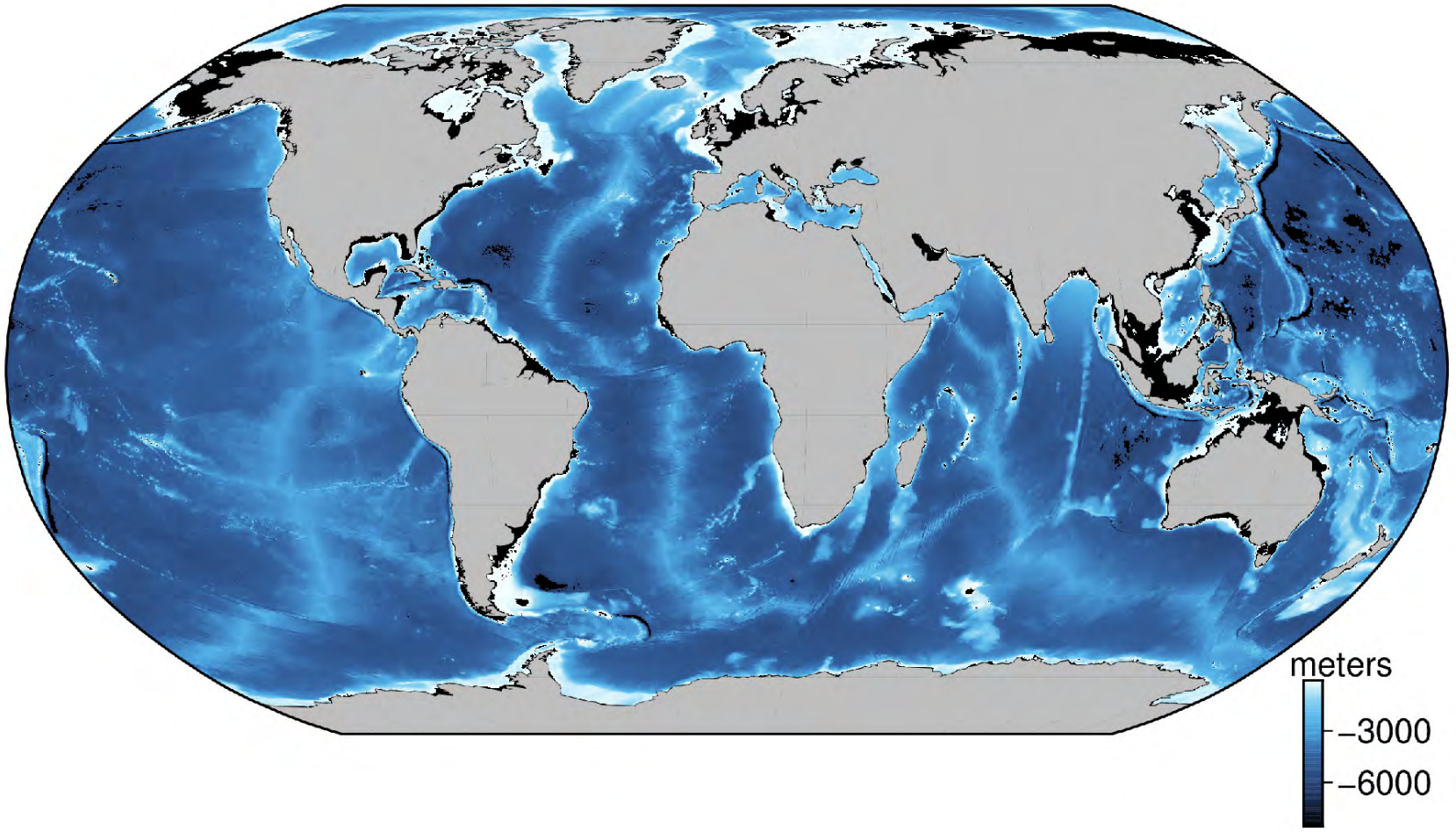

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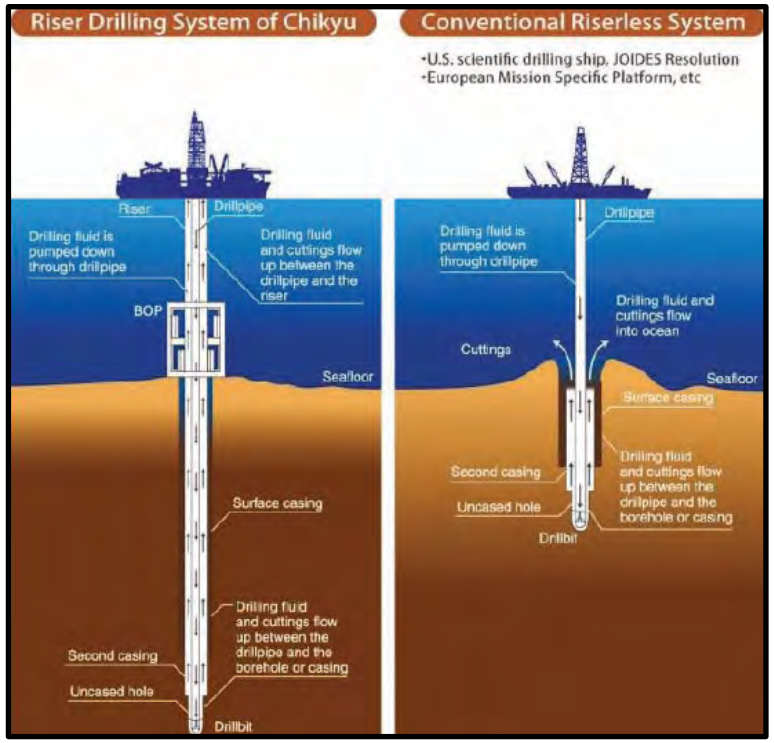
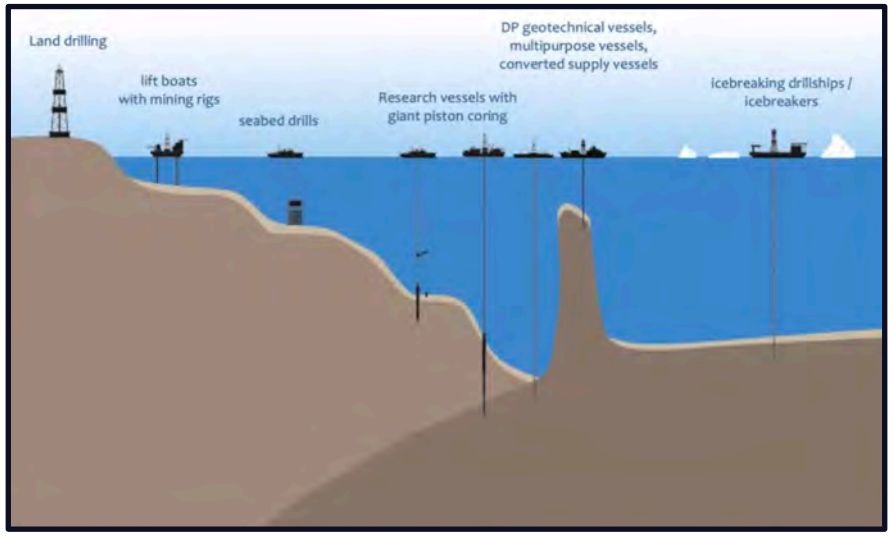
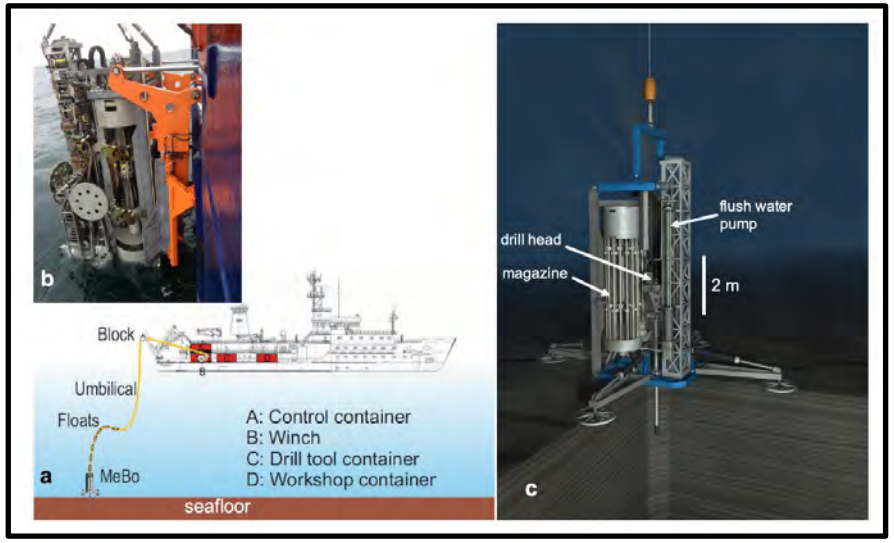


JAMSTEC/IODR/ National Academies of Sciences





Gohl et al., 2017

- make use of a portfolio of scientific ocean drilling options
- identify new opportunities to address key science questions

Outline

- **Goal:** Pursue ocean drilling as we know it
- History of Ocean Drilling (with and without JR)
- Example vessels to pursue ocean drilling as we know it
- How might our science approach change if we use “available” vessels

Scientific Ocean Drilling

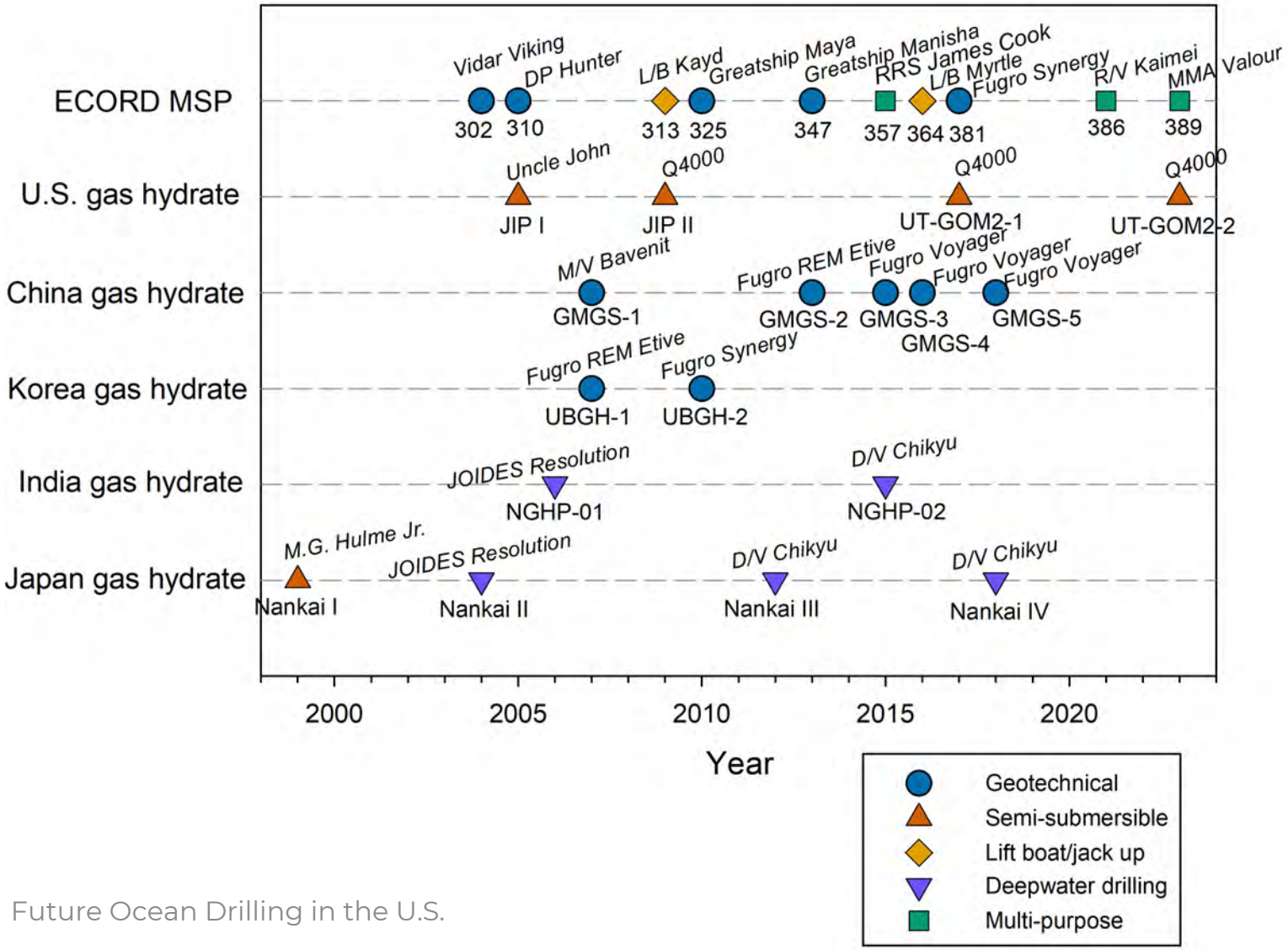
- Traditional IODP
  - Conventional Coring (APC, XCB, RCB)
  - Logging While Drilling
  - Install observatories
  - Penetrometers
  - Wireline logging
- Other Capabilities
  - Pressure Coring
  - Other?

Credit: International Ocean Discovery Program

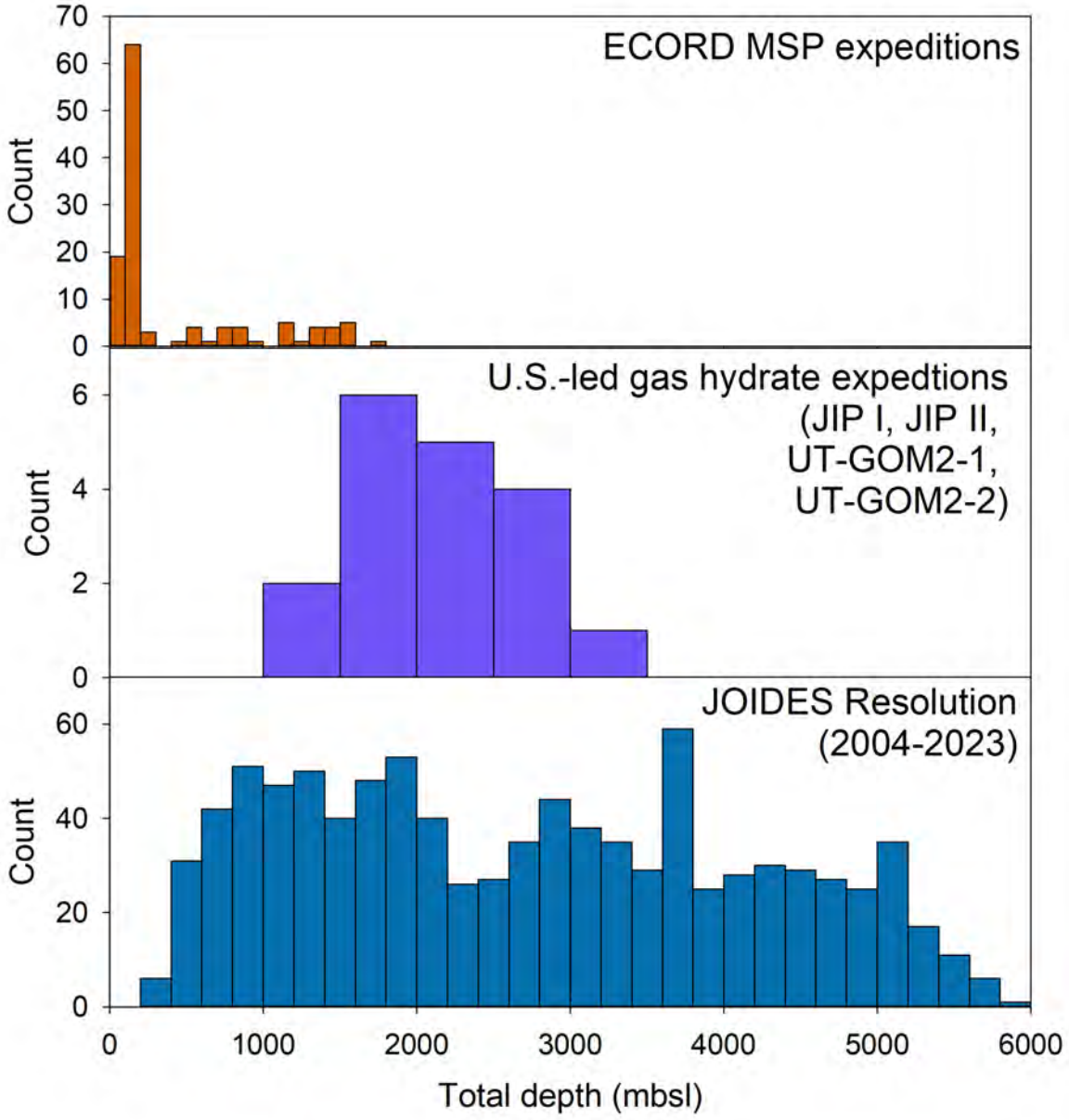
Credit: JAMSTEC

Credit: ECORD

Mission Specific Platforms (MSP) – past 25 years –



Total drilling depth comparison



N=121 holes
Range: 32 to 1715 mbsl
Median: 127 mbsl

N=18 holes
Range: 32 to 3093 mbsl
Median: 2149 mbsl

N=944 holes
Range: 342 to 5523 mbsl
Median: 2621 mbsl

Credit: DSmith/ECORD/IODP

Some ‘cheaper’ vessels: Max. Hook Load Comparison

Hook Load

- Helix Q4000: 650t
- Helix Q5000: 750t
- Helix Q7000: 661t
- *Joides Resolution*: 600t
  - Total Drilling Depth 6000m

Some ‘cheaper’ vessels: Max. Hook Load Comparison

Hook Load

- Fugro Synergy: 193t
  - Total Drilling Depth 2500+m
- Geoquip Speer: (?)
  - Total Drilling Depth 360m
- Geoquip Saentis: 50t
  - Total Drilling Depth 600m
- Geoquip Dina Polaris: 120t
  - Total Drilling Depth 2500m


Fugro Synergy


Geoquip Speer


Geoquip Saentis


Geoquip Dina Polaris

Geotechnical Vessels – Shallow Water Jack UP

- 335 Class - L/B Robert (SeaCor Marine)
  - Total Drilling Depth ?
  - Max hook load: ? ~800m total pipe
  - 5.5” API drill string

(https://seacormarine.com/vessel/l-b-robert-335-class)

Max. Drilling Depth Comparison

VESSEL	MAX HOOK/ DERRICK LOAD	TOP DRIVE OR HEAVE COMPENSATOR LOAD LIMIT	MAX STRING LENTH IODP TAPERED PIPE	MAX STRING LENGTH 5-1/2" RENTAL PIPE	MAX STRING LENTH 5-7/8 RENTAL PIPE
Unit	US ton	US ton	ft (m)	ft (m)	ft (m)
JOIDES Resolution	600	400	18,800 (5,750) (3)	15,744 (4,800) (1)	16,400 (5,000) (1)
Helix Q7000	661	650	23,000 (7,000) (1)	15,744 (4,800) (1)	16,400 (5,000) (1)
Helix Q5000	750	750	23,000 (7,000) (1)	15,744 (4,800) (1)	16,400 (5,000) (1)
Helix Q4000	650	650	23,000 (7,000) (1)	15,744 (4,800) (1)	16,400 (5,000) (1)
Geoquip Dina Polaris	132	?	n/a (4)	5,384 (1,640) (2)	5000 (1525) (2)
Geoquip Saentis	50	44	n/a (4)	1,800 (550) (3)	1668 (500) (3)
Fugro Synergy	193	275	7,200 (2200 m) (2)	8,600 (2,600) (2)	8,000 (2,400) (2)

1. Limited by pipe strength
2. Limited by hook load capacity
3. Limited by heave compensator or top drive capacity
4. Hook load, heave compensator, or top drive load limits make running a tapered string impactable

Max string length include 100,000 lb overpull + 30,000 ft-lb torque + 40,000 lb BHA weight + 80% safety factor
All pipe assumed minimum premium grade with 80% remaining body wall
Geoquip Speer Spec sheet does not provide sufficient information to assess, but states total drilling depth is 360m

Seabed Drilling Systems

MeBo 200

Max Water Depth: 4000 m
Max Sampling Depth: 200 m
Sampling diameter: 63 mm

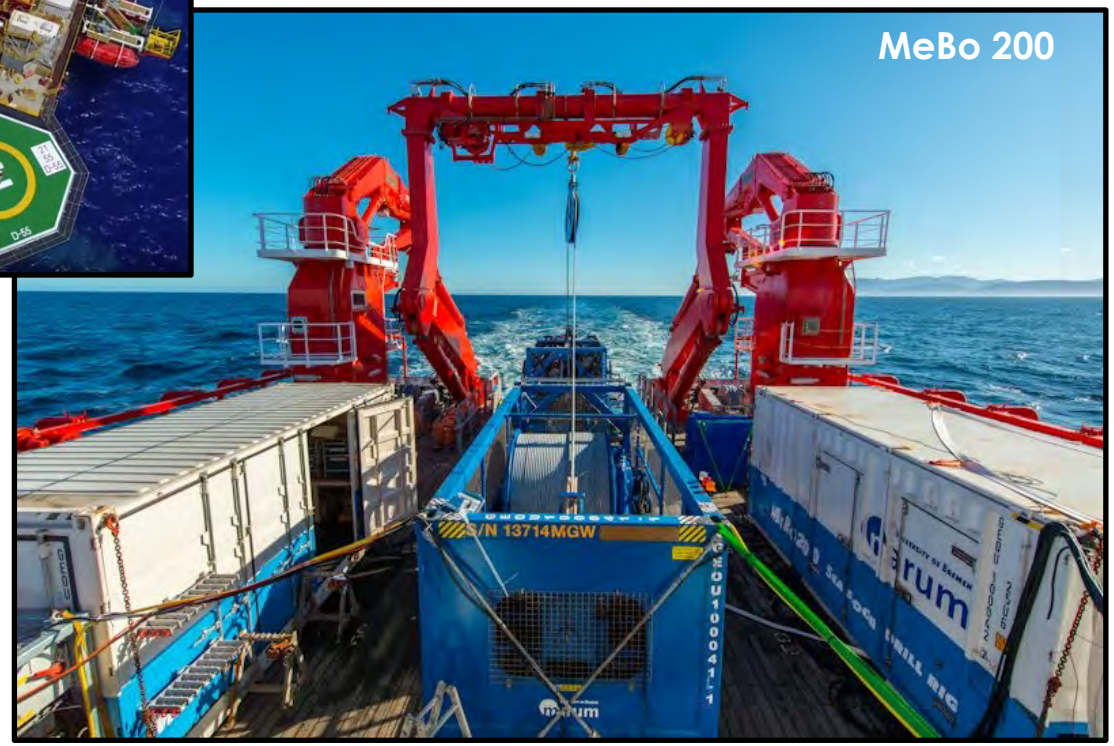
Williamson & Associates ACS

PROD5		
4,000m	Max Water Depth	General
>150m	Max Sampling Depth	
100m	Max Casing Depth	
72mm	Sampling Diameter	Hard Rock Sampling
2.75m/Barrel	Core Length	
130hp	Rotary Coring Power	
75mm	Sampling Diameter	Soft Sediment Sampling
2.75m/Barrel	Core Length	
>12t	Max Push Thrust	

SPECIFICATIONS

Total Weight (air)	10,000 kg (without tools and core samples)
Total Weight (sea)	7,730 kg (without tools and core samples)
Operating Depth	4,000 m
Device Envelope	8.1 m length x 3.8 m width x 5.8 m height
Drill Tool Type	Modified HQ standard (up to PQ standard)
Hole Diameter	96 mm (PQ, 122.6 mm)
Core Diameter	63.5 mm (PQ, 85.0 mm)
Core Depth (total)	100 m (HQ standard, expandable to 150 m)

Containerized Science!



Onboard Measurements:

1) Ephemeral properties
2) Safety (e.g. head-space gas)

Shore Based:

- 24-7 all other core analyses

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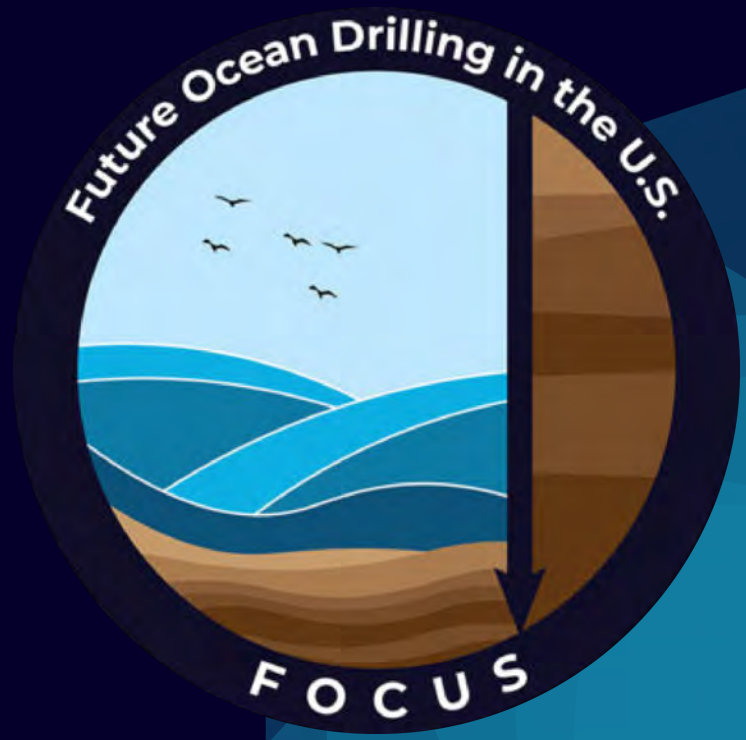
Future Ocean Drilling in the U.S. (FOCUS)



1) Over the next 5 – 15 years, US scientific ocean drilling will primarily be conducted on leased vessels. What are the potential benefits of this approach to addressing the key scientific questions of the US scientific ocean drilling community?

2) What platform and technological requirements are necessary to address the US science priorities in different water depths? How does the ability to access a range of water depths impact our ability to address our science questions?

3) Thinking ahead, do your primary science questions require the development of technologies beyond our current capabilities? What barriers are there when thinking about using alternative vessels / technologies to address key science questions?