Overview of the International Ocean Discovery Program (FY2014-2024)

Outline

IODP Platforms, Expeditions, and Basic Stats

JOIDES Resolution (JR) Capabilities Overview

IODP Governance Model

JR Consortium Budget Model

Science Impact

Mitch Malone
Director, JOIDES Resolution Science Operator
Texas A&M University

Photo Credit: Thomas Ronge, IODP-JRSO

JOIDES Resolution
(US)

Chikyu
(Japan)

Mission Specific Platforms
(European Consortium)

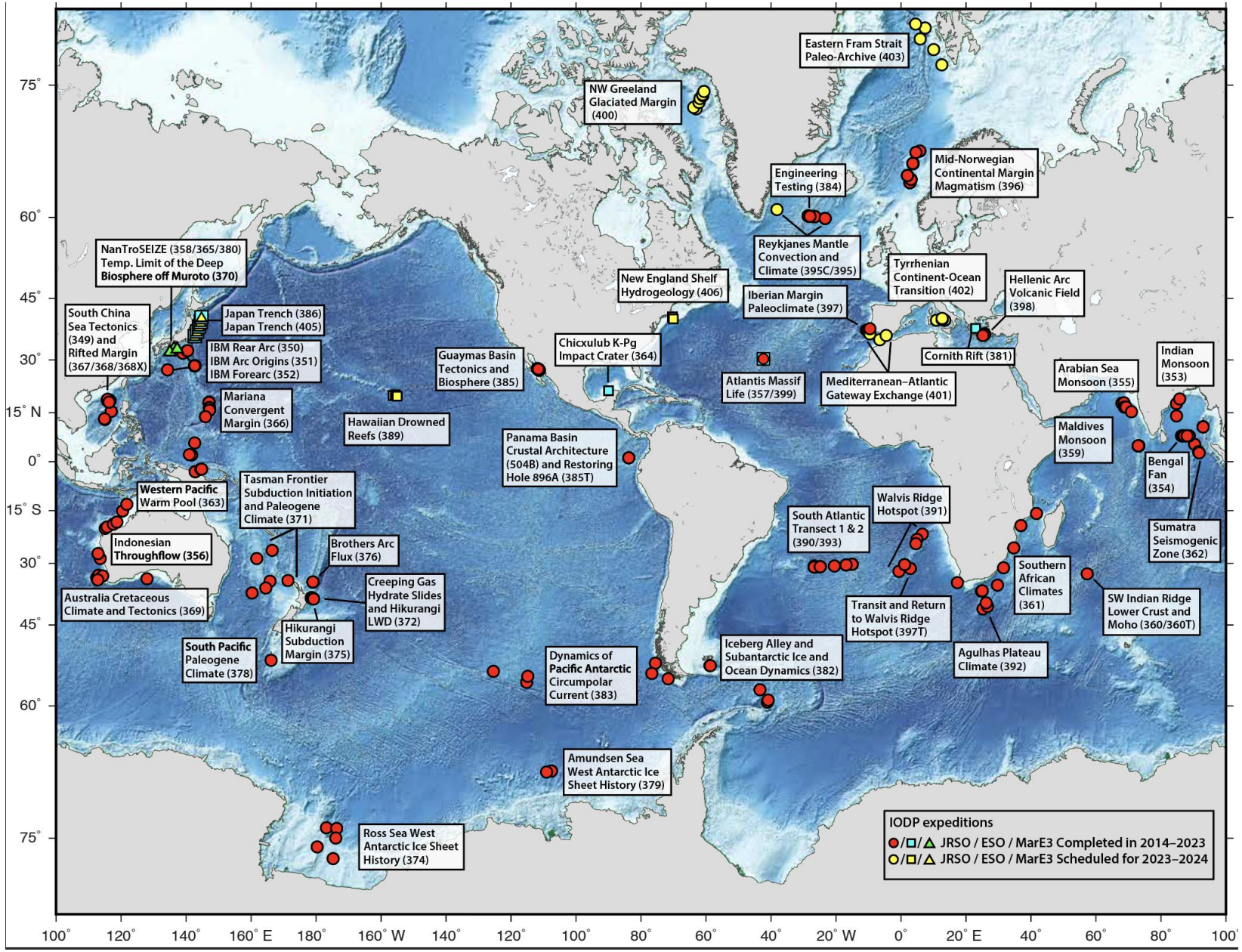
FY 2014–2024	JR	Chikyu	MSP
Total Expeditions	**46**	**5**	**6**
Completed (8/23)	42	4	4
Planned	4	1	2
Postponed COVID	5	0	1

IODP Operational Statistics

Platform	Sites	Holes	Core Recovered (m)	Recovery %
JOIDES Resolution*	193	530	78,067	69.8
Chikyu	6	18	1,085	65.8
MSPs#	28	80	3,373	79.8

*stats through Exp. 399 (June 2023)

includes a giant piston coring expedition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IODP expeditions
●/□/△ JRSO / ESO / MarE3 Completed in 2014–2023
○/□/△ JRSO / ESO / MarE3 Scheduled for 2023–2024
75°
60°
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15° N
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15° S
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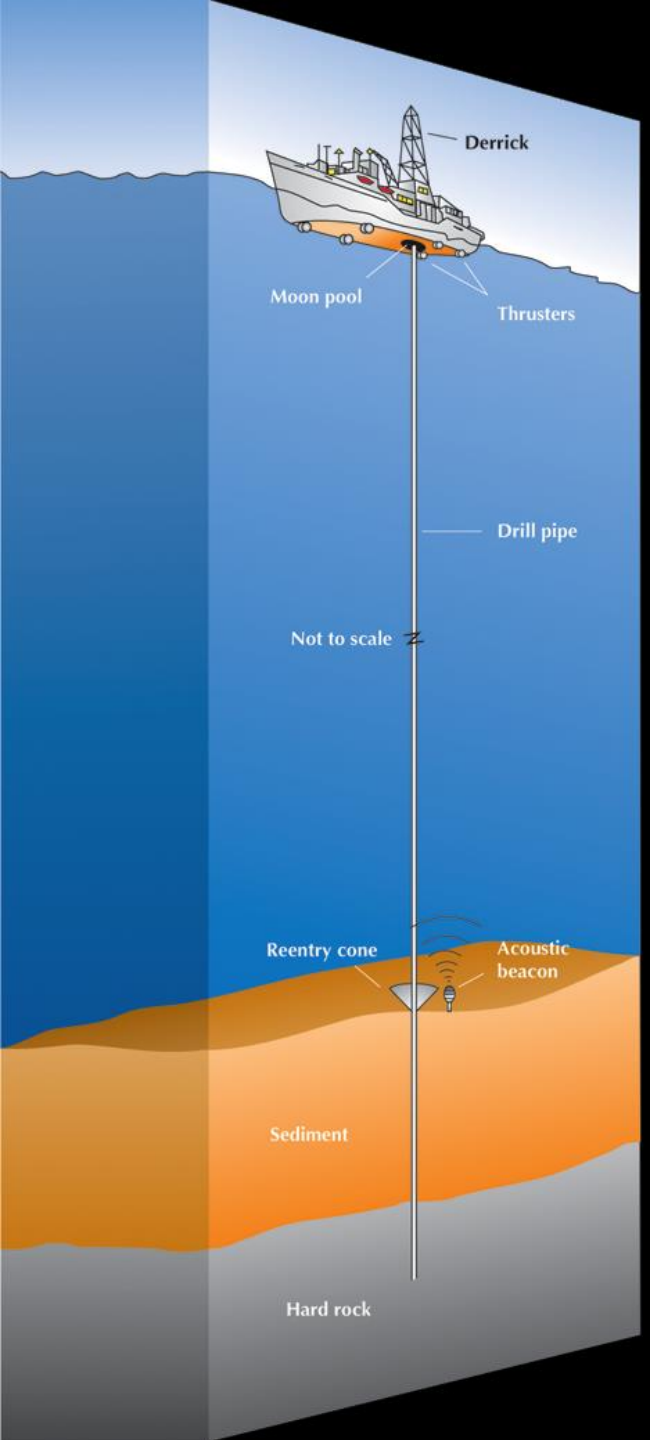
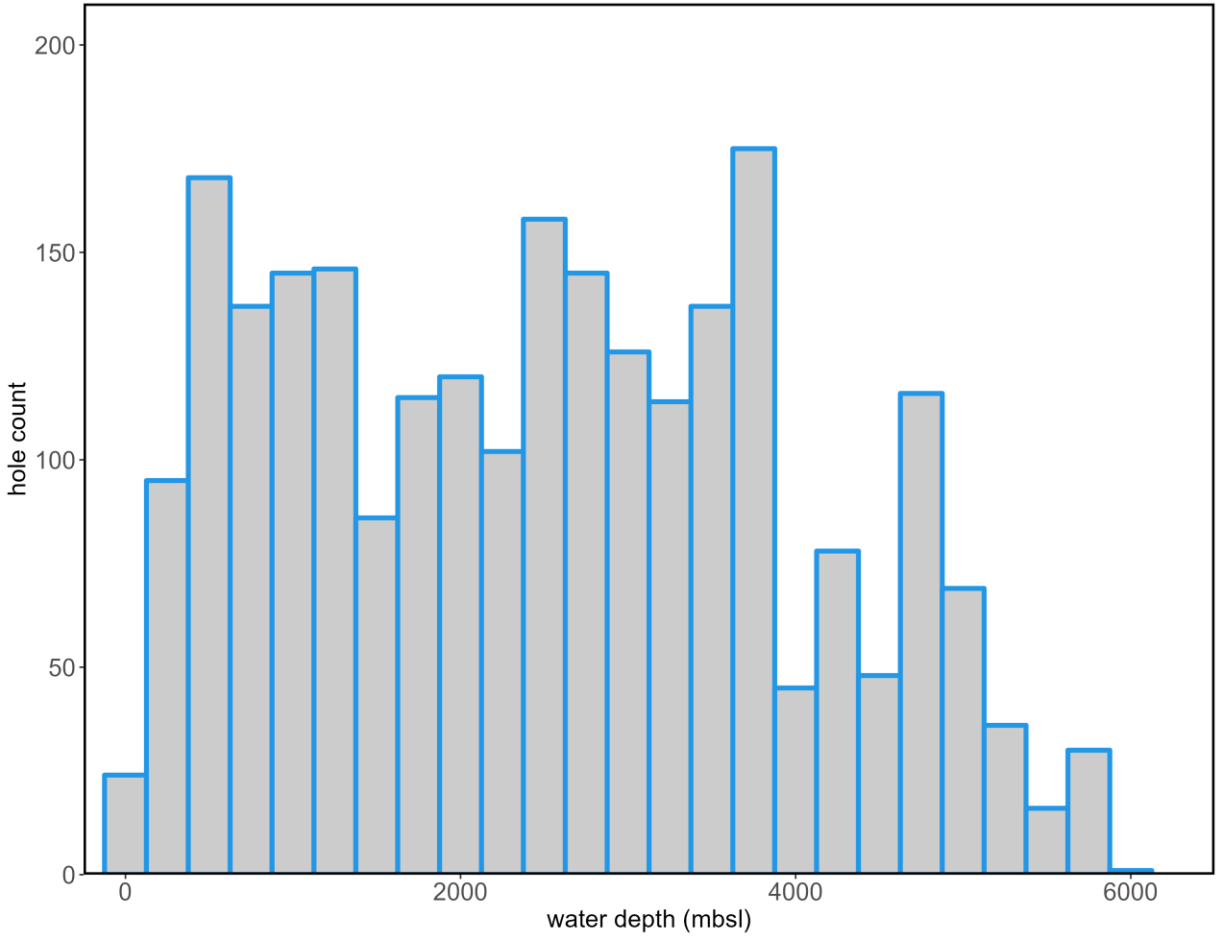
100° 120° 140° 160° E 180° 160° W 140° 120° 100° 80° 60° 40° 20° W 0° 20° E 40° 60° 80° 100°



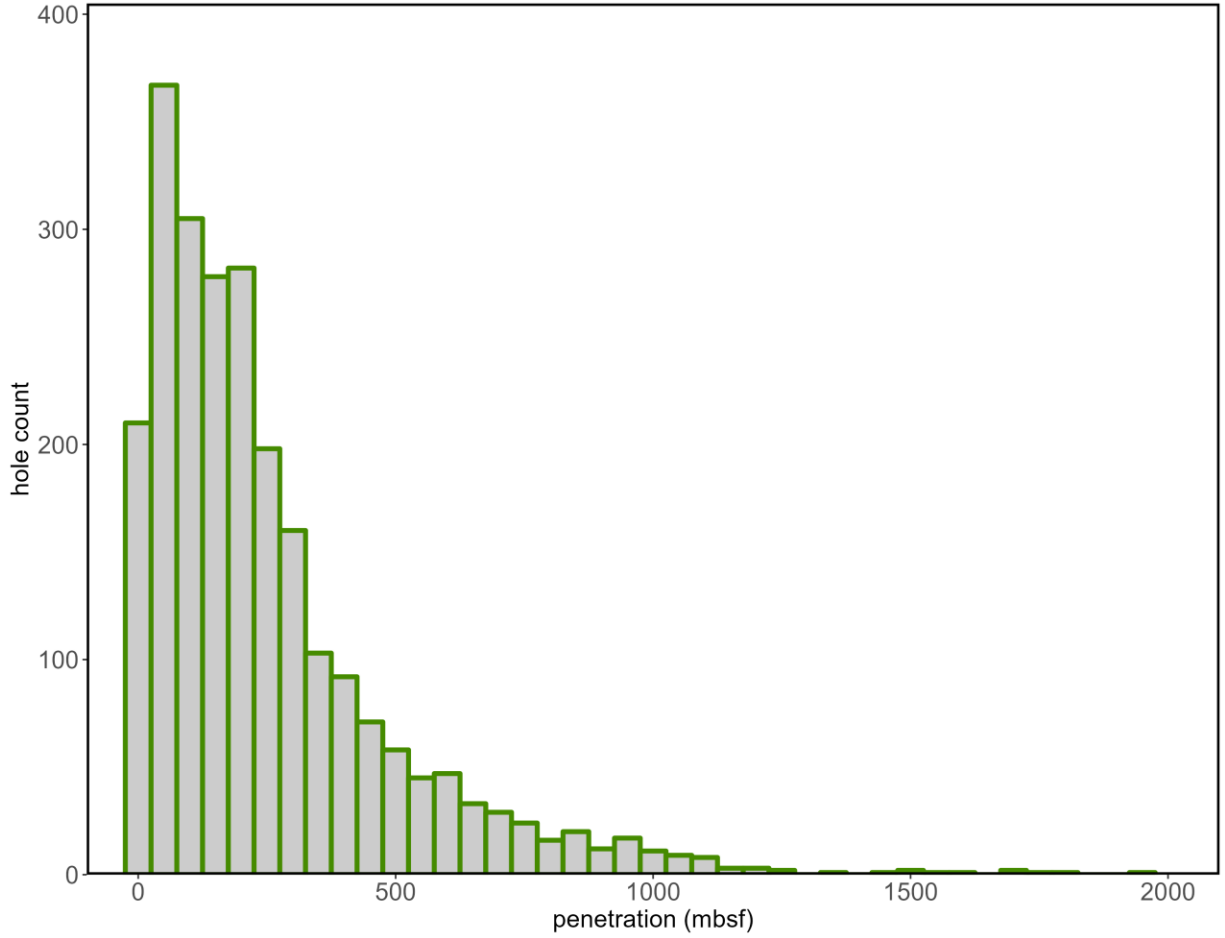
JOIDES Resolution Specs and Capabilities

- Efficient, nimble facility with customized coring capabilities (continuous wireline, 9.5 m long cores with bespoke coring tools)
- Rapid pipe tripping (600 m/hr) and wireline coring retrieval system (12,000 m/hr)
- Water Depth range >75 m to ~6 km
- Total Pipe length = 6.5 km
- Deepest Penetrations
  - 2111 m, Costa Rica Rift (hard rock)
  - 1927 m, Canterbury Basin (sediments)
- Experienced crew; rig crew coring specialists
- Experienced technical support staff

JR Water and Penetration Depth Distributions



40% of holes> 3000 m



46 holes> 1000 m

Data for all JR expeditions (ODP, IODP-1, IODP-2)

IODP Governance

IODP Forum

JR partners

ECORD, ANZIC, Brazil, China, India, S. Korea

NSF

JR Facility Board

EMA/ECORD

ECORD Facility Board

MEXT

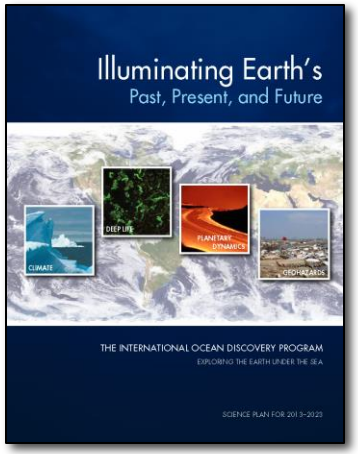
***Chikyu* IODP Board**

Chikyu partners

ECORD

IODP Proposal Review

Science Community Proposals ⟷ Science Plan



Support Office and Site Survey Data Bank

Science Evaluation Panel (SEP)

Environ. Prot. and Safety Panel (EPSP)

JR Facility Board

ECORD Facility Board

***Chikyu* Facility Board**

IODP FORUM

Funding Model for JR Operations for IODP

- Total Annual Contributions: **$64.5M → $60.5M**
  - US Annual Funding: **$48M**
  - International Partner Funding: **$16.5M → $12.5M** (FY23)

- JR Annual Budgets: **$62.9M** (FY15) →**$71M** (FY23)
  - JRSO proposal estimated $71M for FY23 using 2.5% inflationary increase

- Partner One Time Contributions (CPPs): $**24M** (Exps. 349, 355, 367, 368)

- Cost efficiencies at operator applied to future years operations

Science Impact

- Post-expedition moratorium and research time lag
  - 4-5 years post expedition before main science party output hits journals
  - COVID

- Publication Statistics
  - Number of Publications
  - Citations
  - High Impact Journals
  - Published annually: http://www.iodp.tamu.edu/publications/reports.html

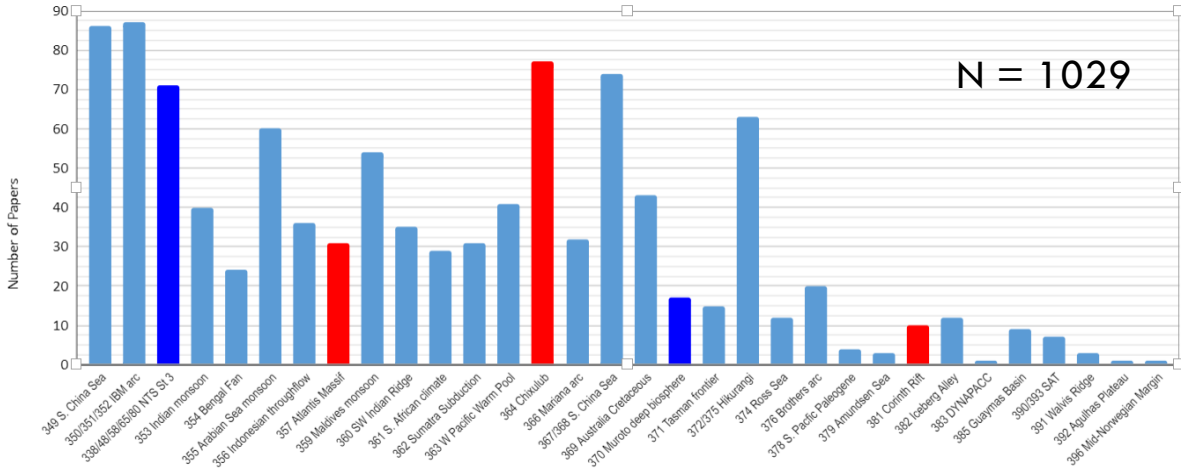
- Expeditions mapped onto IODP Science Plan Themes

- Selection of science findings from high impact publications

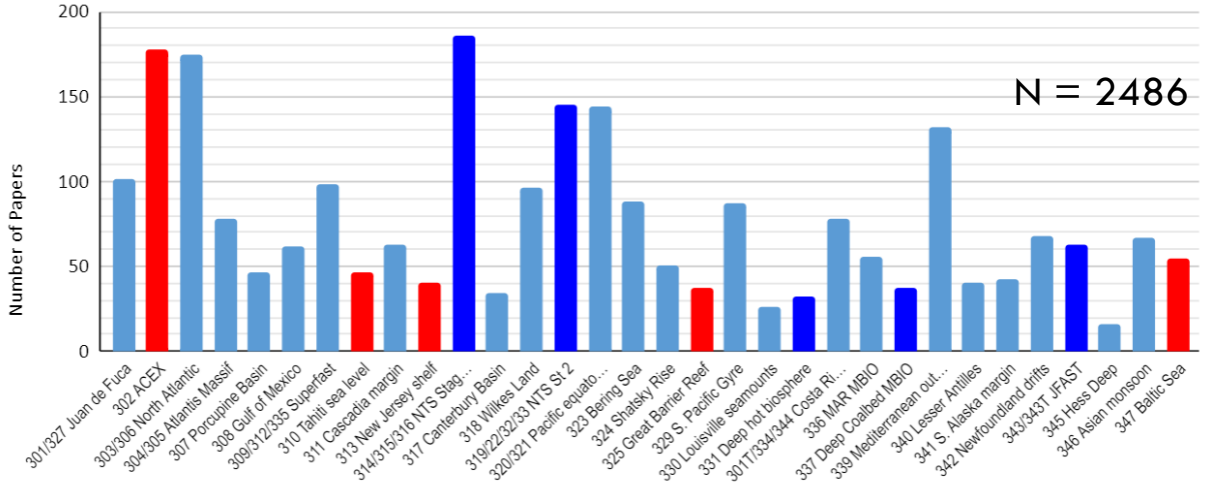
Exp. 397 sample party
55K+samples, Feb 2023

Science Impact: Publications/Expedition

International Ocean Discovery Program (2014-Present)



Integrated Ocean Drilling Program (2003-2013)



Science Impact: Citations/Expedition

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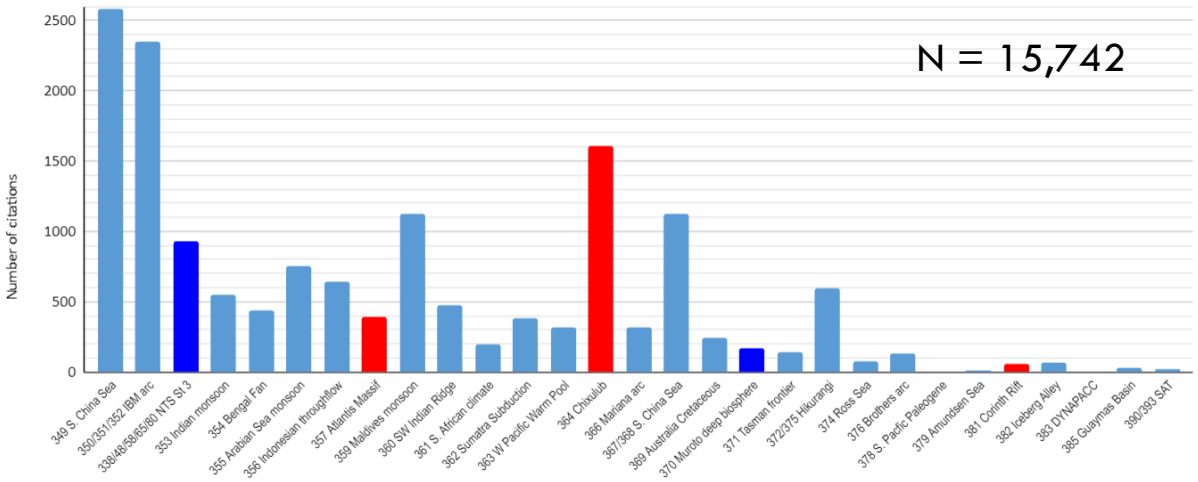

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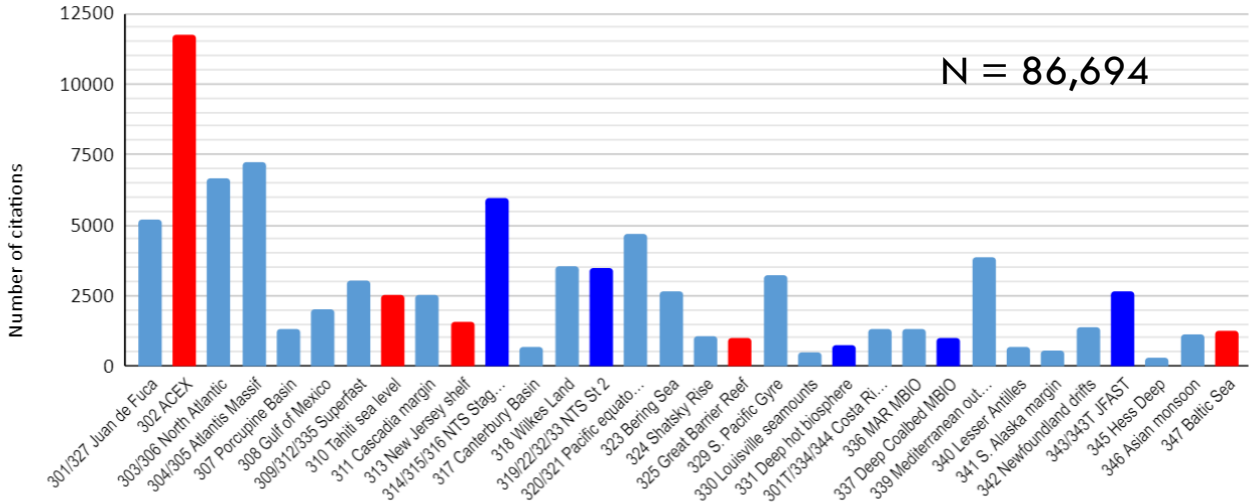
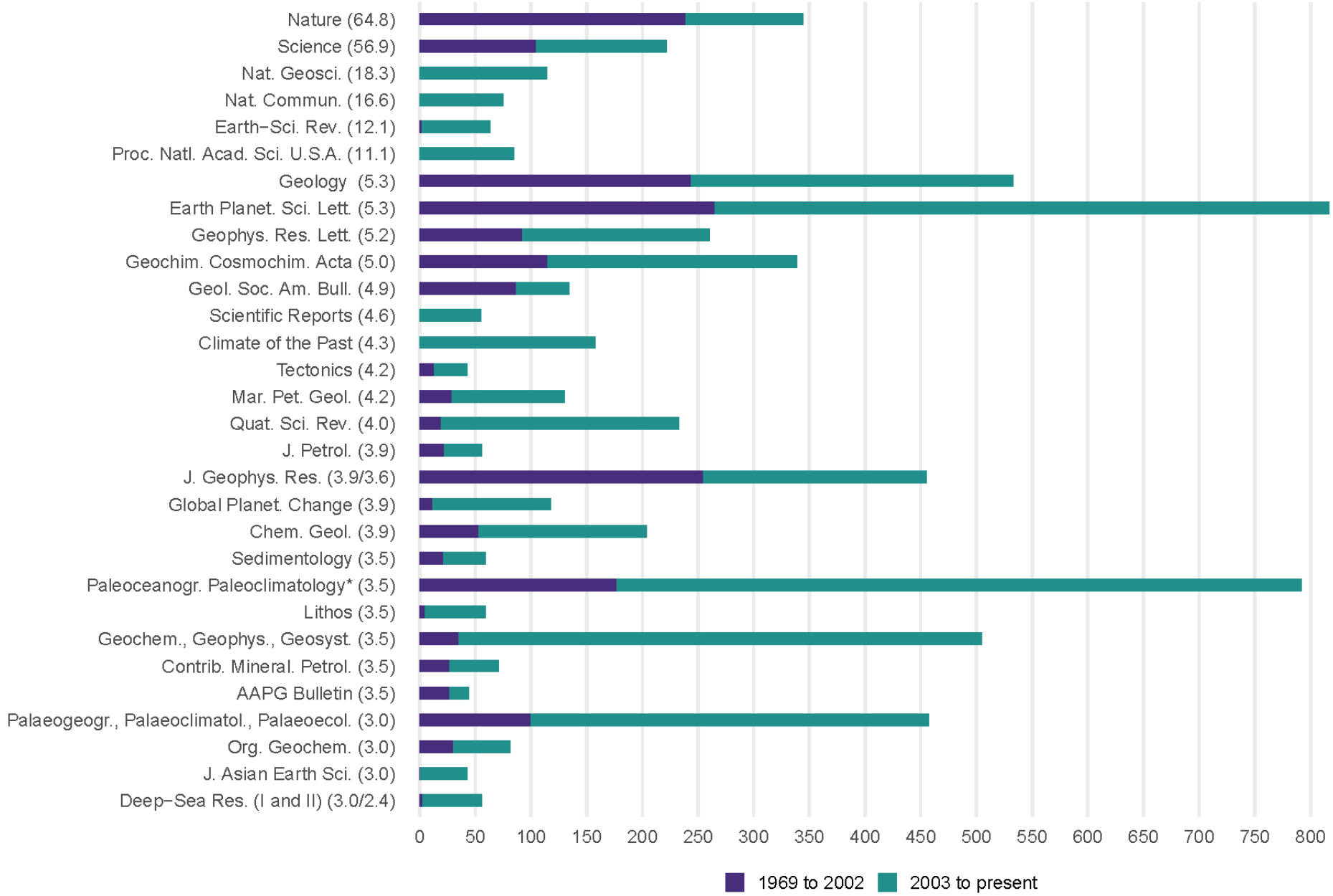


High Impact Journals



IODP Science Plan

Climate and Ocean Change: Reading the Past, Informing the Future

CHALLENGES

1 | How does Earth's climate system respond to elevated levels of atmospheric CO_2?
2 | How do ice sheets and sea level respond to a warming climate?
3 | What controls regional patterns of precipitation, such as those associated with monsoons or El Niño?
4 | How resilient is the ocean to chemical perturbations?

Earth Connections: Deep Processes and Their Impact on Earth's Surface Environment

CHALLENGES

8 | What are the composition, structure, and dynamics of Earth's upper mantle?
9 | How are seafloor spreading and mantle melting linked to ocean crustal architecture?
10 | What are the mechanisms, magnitude, and history of chemical exchanges between the oceanic crust and seawater?
11 | How do subduction zones initiate, cycle volatiles, and generate continental crust?

Biosphere Frontiers: Deep Life and Environmental Forcing of Evolution

CHALLENGES

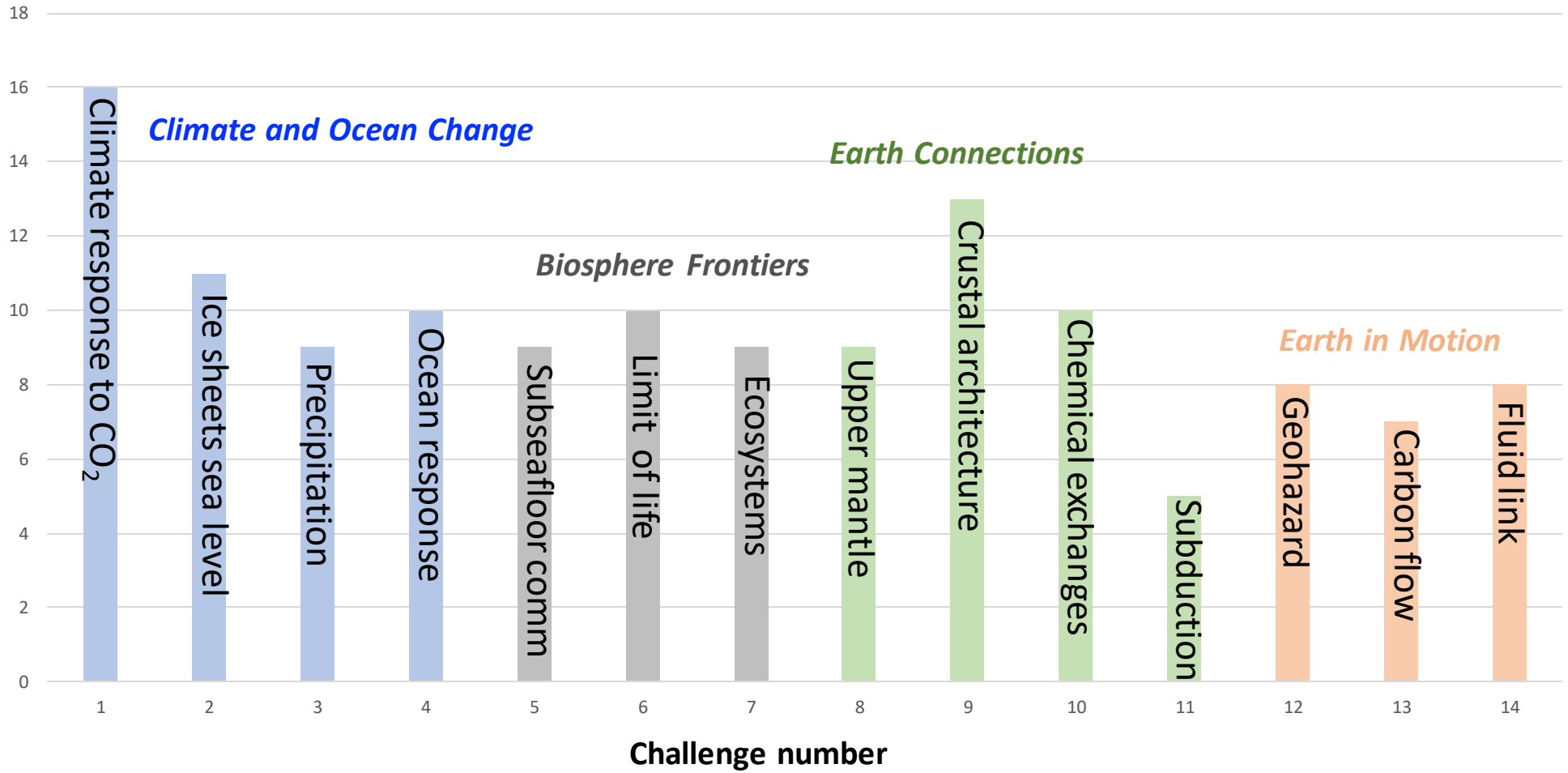
5 | What are the origin, composition, and global significance of deep subseafloor communities?
6 | What are the limits of life in the subseafloor realm?
7 | How sensitive are ecosystems and biodiversity to environmental change?

Earth in Motion: Processes and Hazards on Human Time Scales

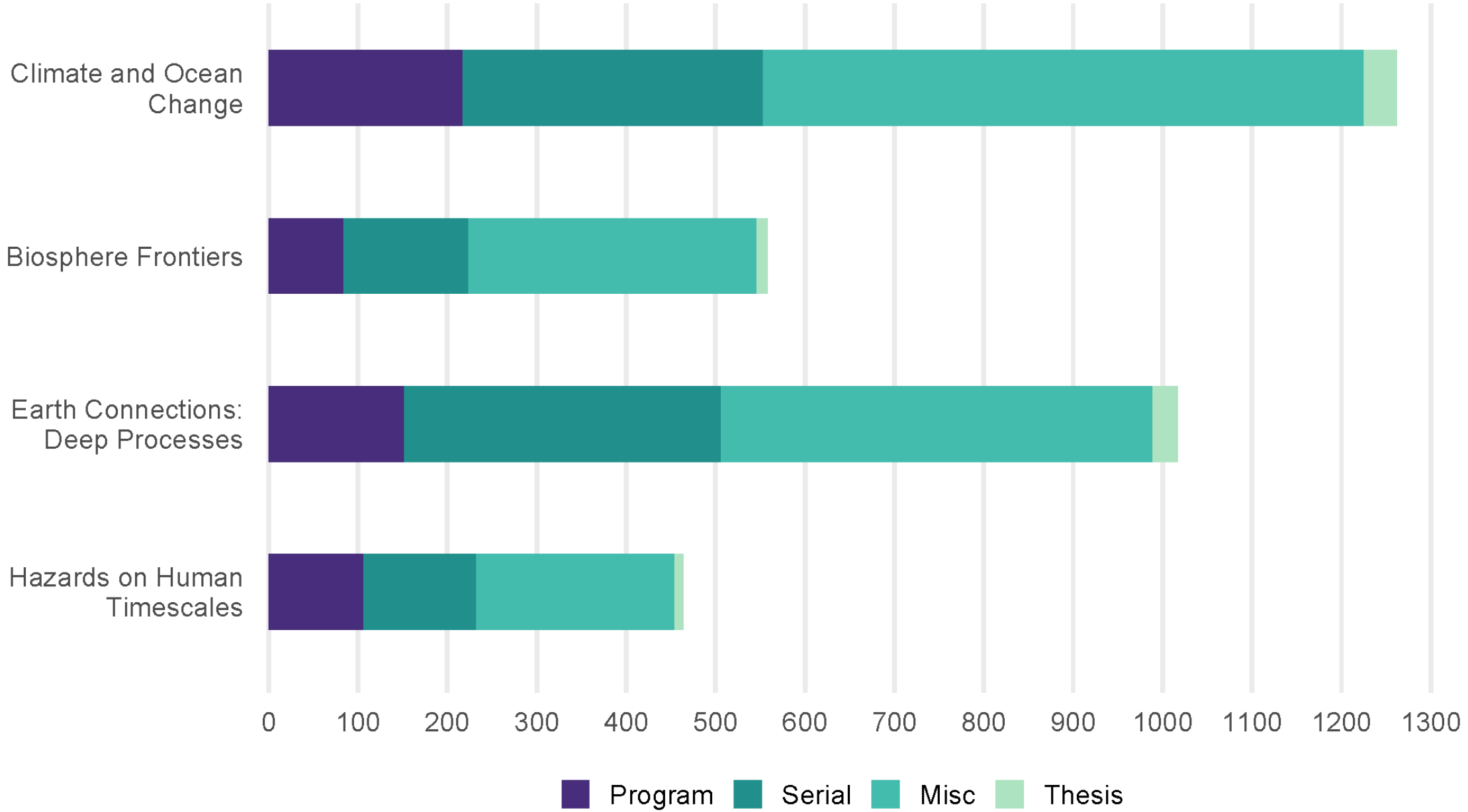
CHALLENGES

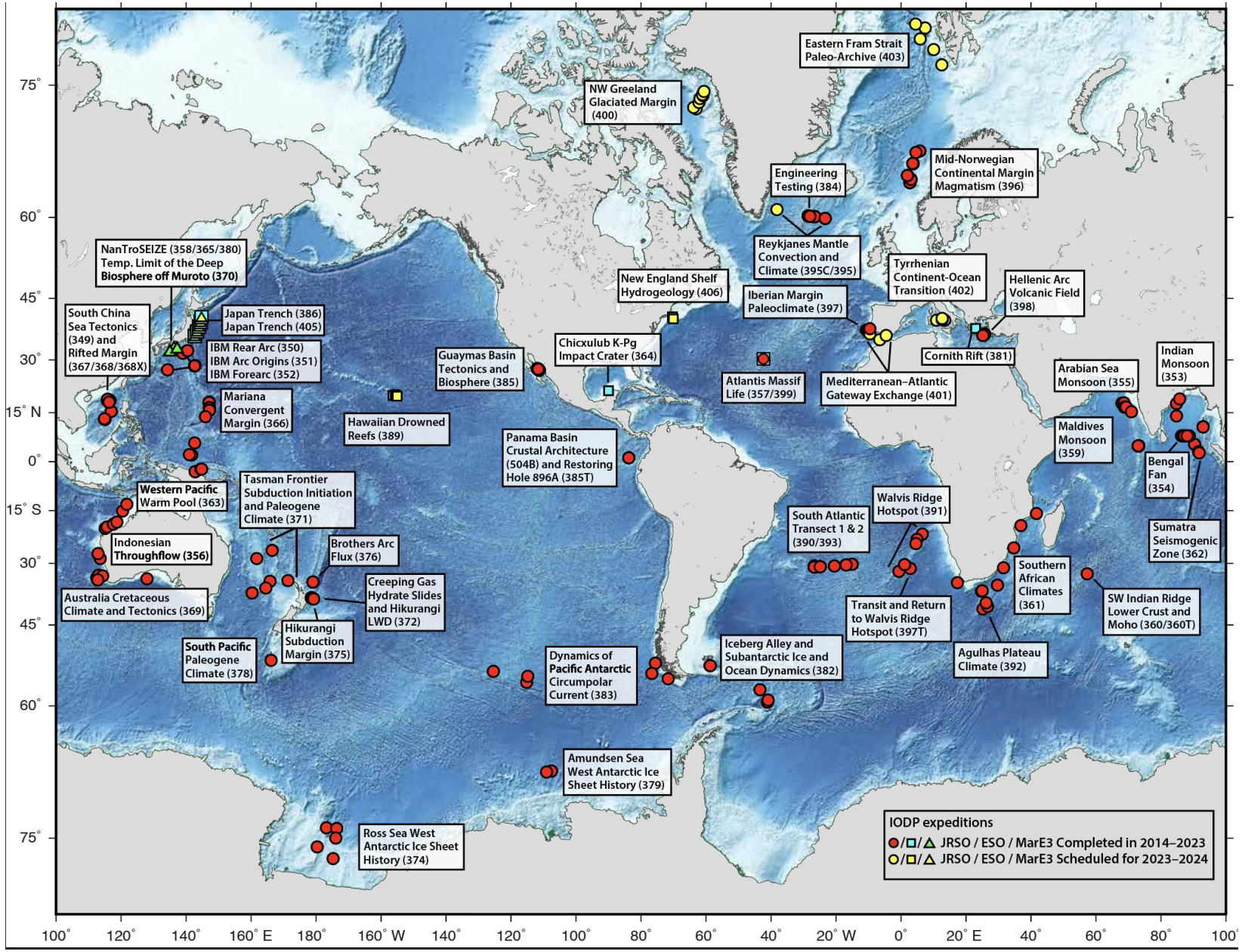
12 | What mechanisms control the occurrence of destructive earthquakes, landslides, and tsunami?
13 | What properties and processes govern the flow and storage of carbon in the subseafloor?
14 | How do fluids link subseafloor tectonic, thermal, and biogeochemical processes?

Expeditions/Science Plan Theme



IODP Publications by Science Plan Theme

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100° 120° 140° 160° E 180° 160° W 140° 120° 100° 80° 60° 40° 20° W 0° 20° E 40° 60° 80° 100°

A Selection of IODP Significant Findings

CLIMATE AND OCEANS

- Validated model-predicted increased monsoon precipitation and extreme variability due to GHG forcing with reconstruction of Pleistocene summer monsoon rainfall record
- Refined the timing and origin of the onset of the modern SA Monsoon
- High latitude cooling around Antarctica in the Miocene drove changes in precipitation patterns in Australia and SE Asia from 12- 8 Ma
- Indian Ocean salinity build up during glacials impacted deglacial circulation recovery via the Agulhas Leakage
- Documented the influence of precession in the Early Pleistocene

A Selection of IODP Significant Findings

CLIMATE AND OCEANS

- Northward shift in Antarctic icebergs and sea ice melt key to AMOC reorganization during glacials
- Antiphased dust deposition and productivity in the Antarctic Zone over 1.5 million years
- A larger than present WAIS explains very large sea-level amplitude in the early middle Miocene
- Thick sequence of impact rock and breccia elucidates initial conditions in the immediate aftermath of the Chicxulub impact event
- Rapid recovery of marine ecosystems at the Chicxulub crater
- Massive volcanism triggered mid-Cretaceous ocean acidification (OAE2)

A Selection of IODP Significant Findings

BIOSPHERE FRONTIERS

- Global diversity of microbial communities in marine sediments
- Documentation of low biomass, diverse microbial population survival strategies in lower crustal rocks
- Dependence of microbial abundance and activity at temperatures >30°C in deeply buried sediments
- Demonstration of an active methanogenic and sulfate reducing population in deeply buried sediments (1200 m) at temperatures up to ~120°C
- Variation and diversity of community composition and function in a complex, hydrothermally active submarine volcano

A Selection of IODP Significant Findings

EARTH CONNECTIONS

- Basement rocks formed during inception of the Izu-Bonin-Mariana subduction system consistent with spontaneous subduction initiation

- Distinct magmatic progression and rapid formation in the Izu-Bonin-Mariana forearc indicates internal vertical forces initiation ("spontaneous")

- Complex, far-field uplift and depression accompanied the inception of the Tonga-Kermadec subduction system and may have involved elements of both spontaneous and induced elements.

- Fast lithospheric extension without mantle exhumation during breakup of the South China Sea indicates a structure between the magma-rich and magma-poor endmembers

- Carbonated silicate melts, previously only predicted by experimental studies, first reported in South China Sea

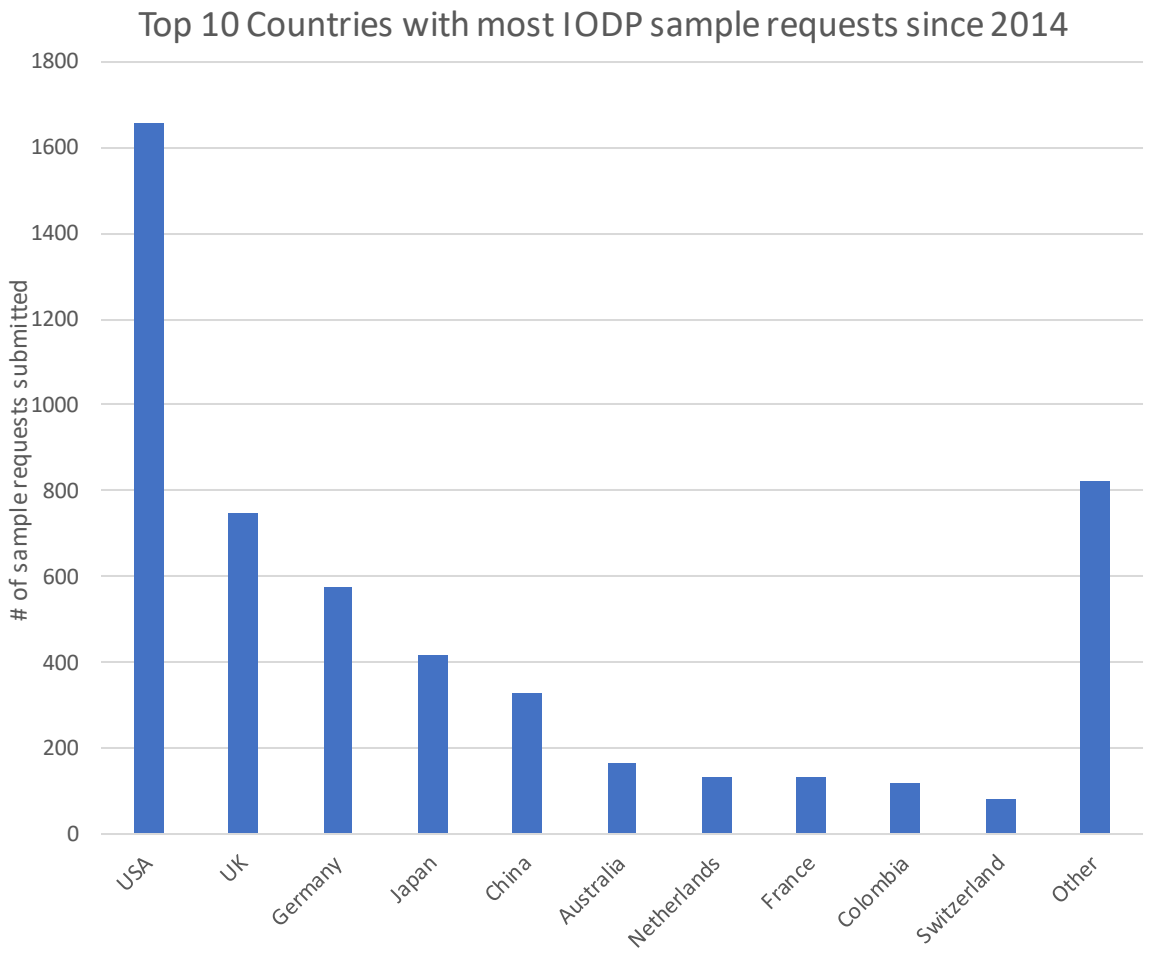
- Low temperature serpentine alteration by seawater may explain anomalies in the marine Si budget

A Selection of IODP Significant Findings

EARTH IN MOTION

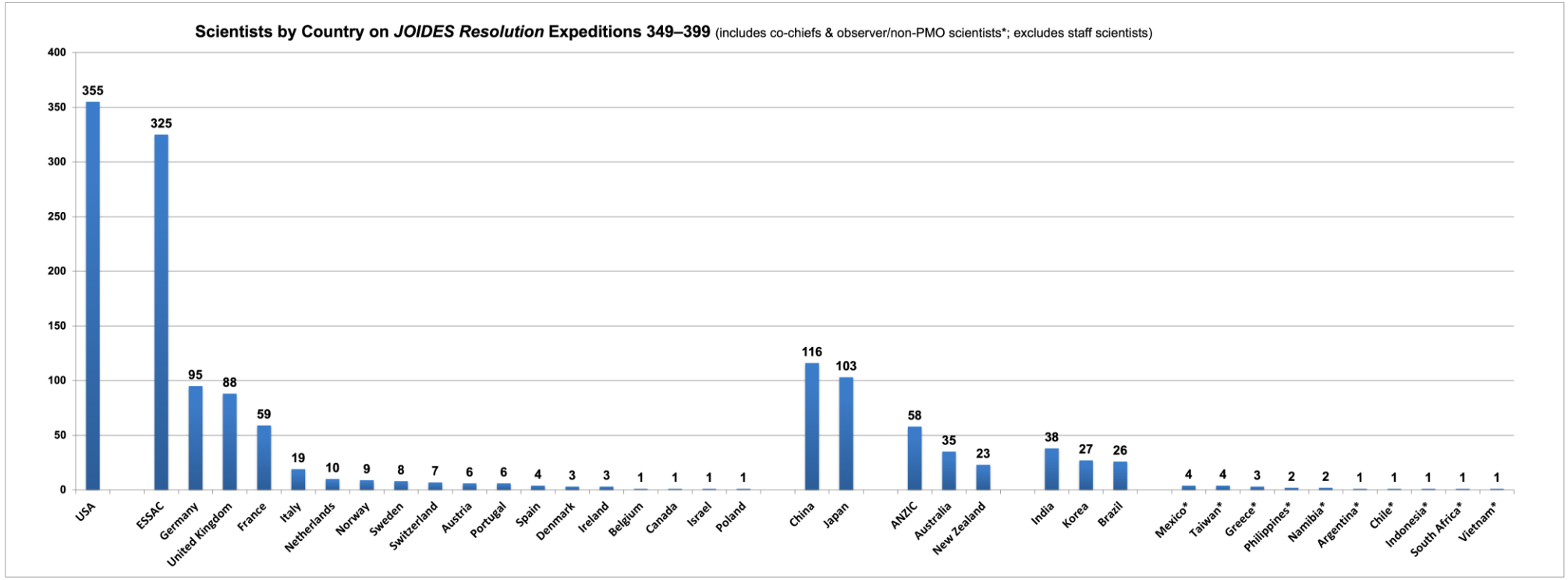
- Extensive submarine Antarctic margin landslides linked to past climate change and depositional preconditioning triggered by seismicity associated with glacioisostatic readjustment
- Validated the dynamic collapse model for the origin of the peak ring in the Chicxulub crater
- Sediment dehydration strengthening of fault-forming sediments drives shallow slip in thickly sedimented Sumatran megathrust
- Lithological and geometric heterogeneities may lead to low slip behavior on the northern Hikurangi margin
- Near-zero frictional healing rates and common weak phyllosilicates in the subduction zone promote low stress, slow slip events on the northern Hikurangi margin
- Newly identified slow slip earthquakes in the Nankai Trough accommodate 30-50% of the plate motion over a 6-yr monitoring period

Legacy Sampling, 2014-2023



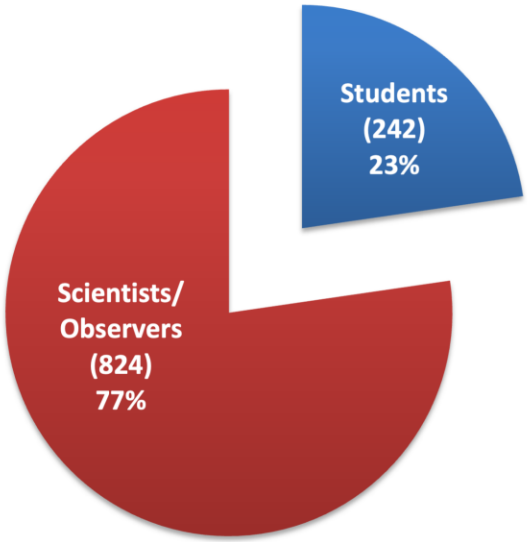
	GCR	BCR	KCR	Total
Requests	1680	2098	1450	5183
Samples	164,623	265,088	193,154	622,865

JR Staffing: Scientists by Country

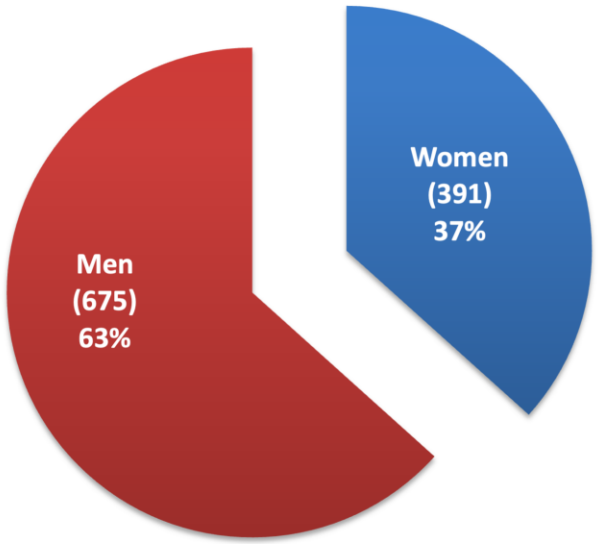


JR Staffing

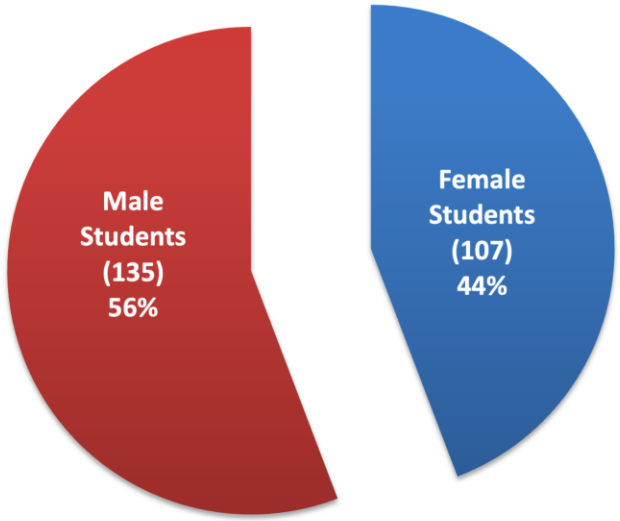
Students Compared to PhD Scientists
***JOIDES Resolution* Expeditions 349–399**
(1066 total)



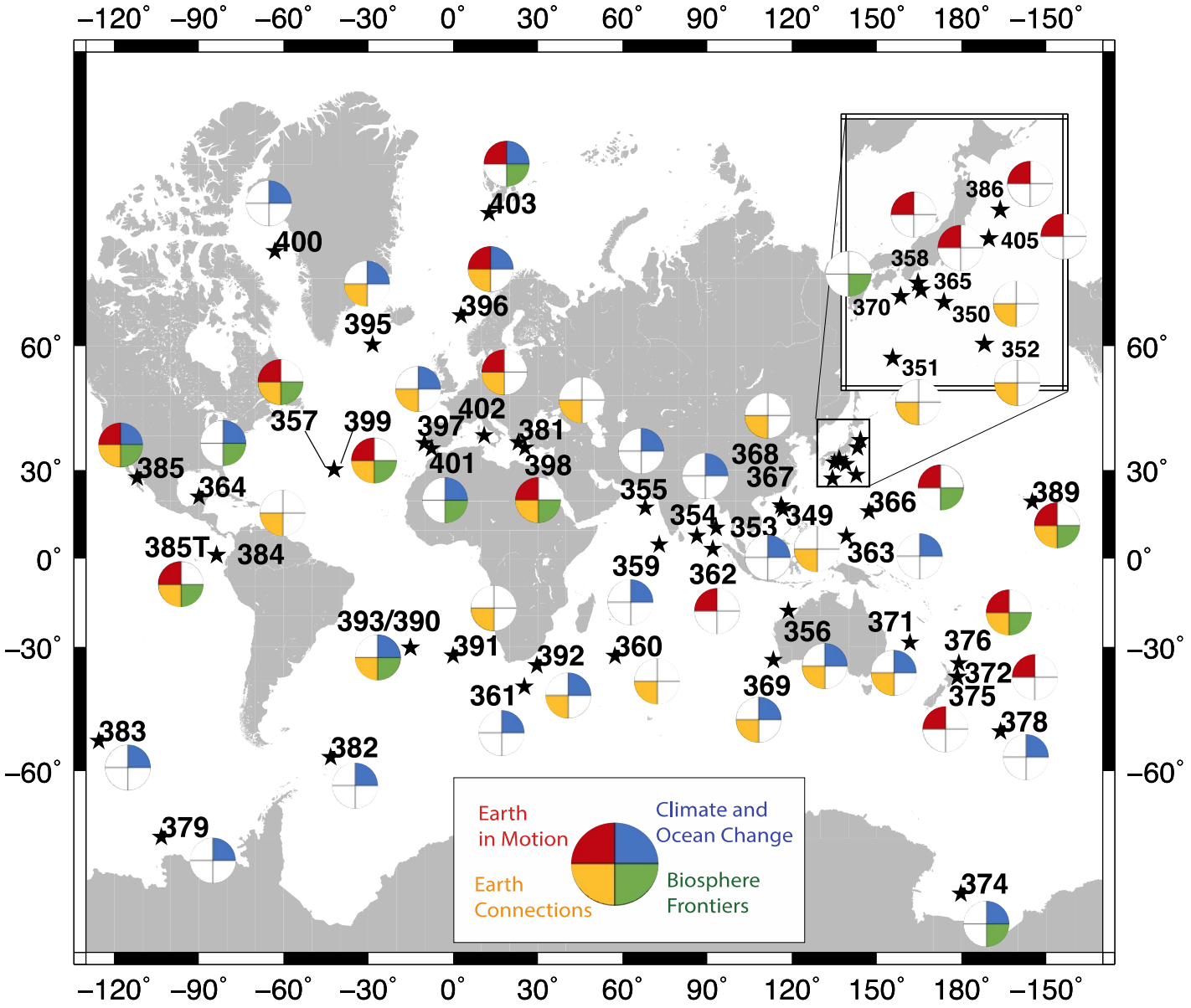
Scientist Gender
***JOIDES Resolution* Expeditions 349–399**
(1066 total)



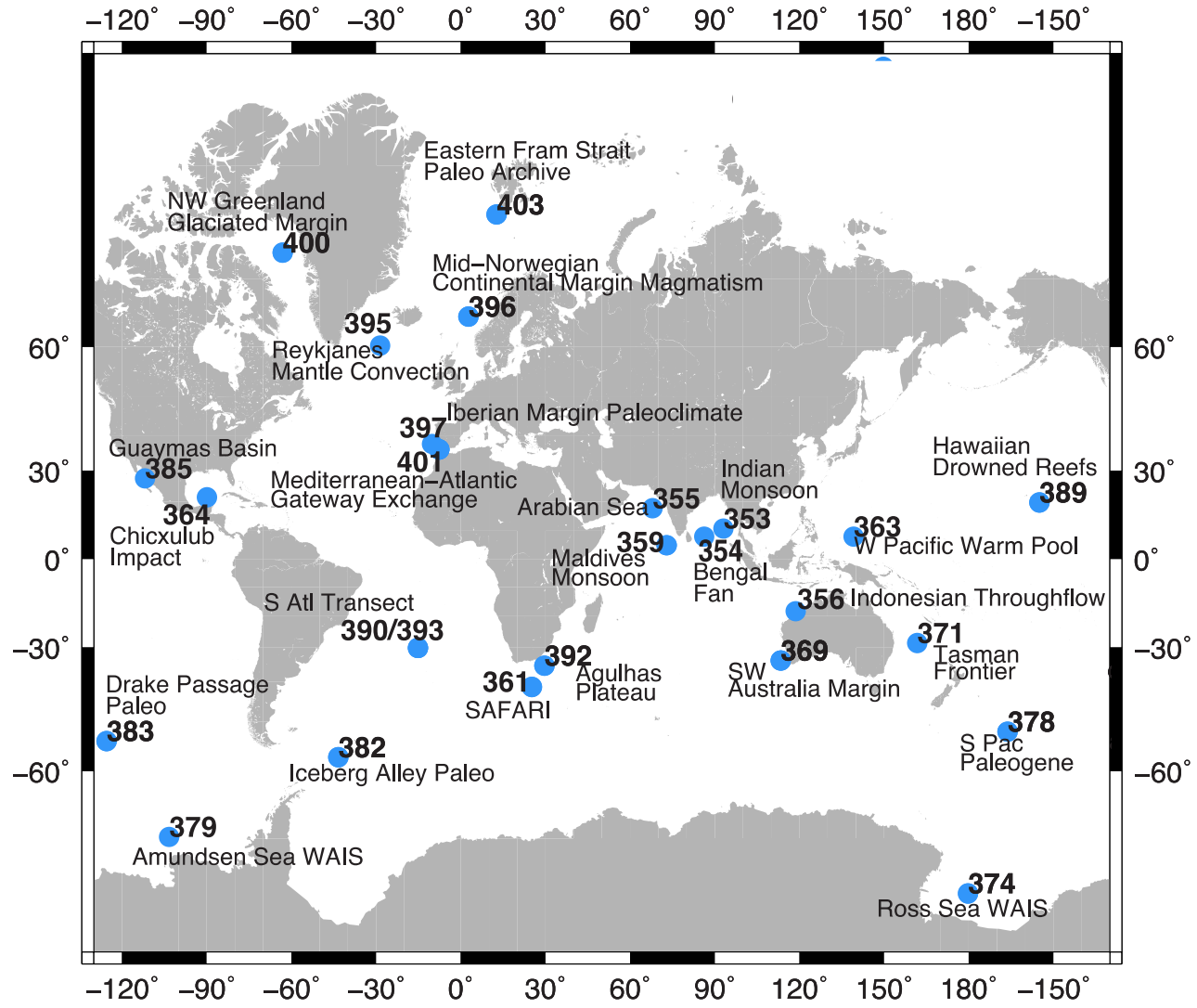
Students by Gender
***JOIDES Resolution* Expeditions 349–399**
(242 total)



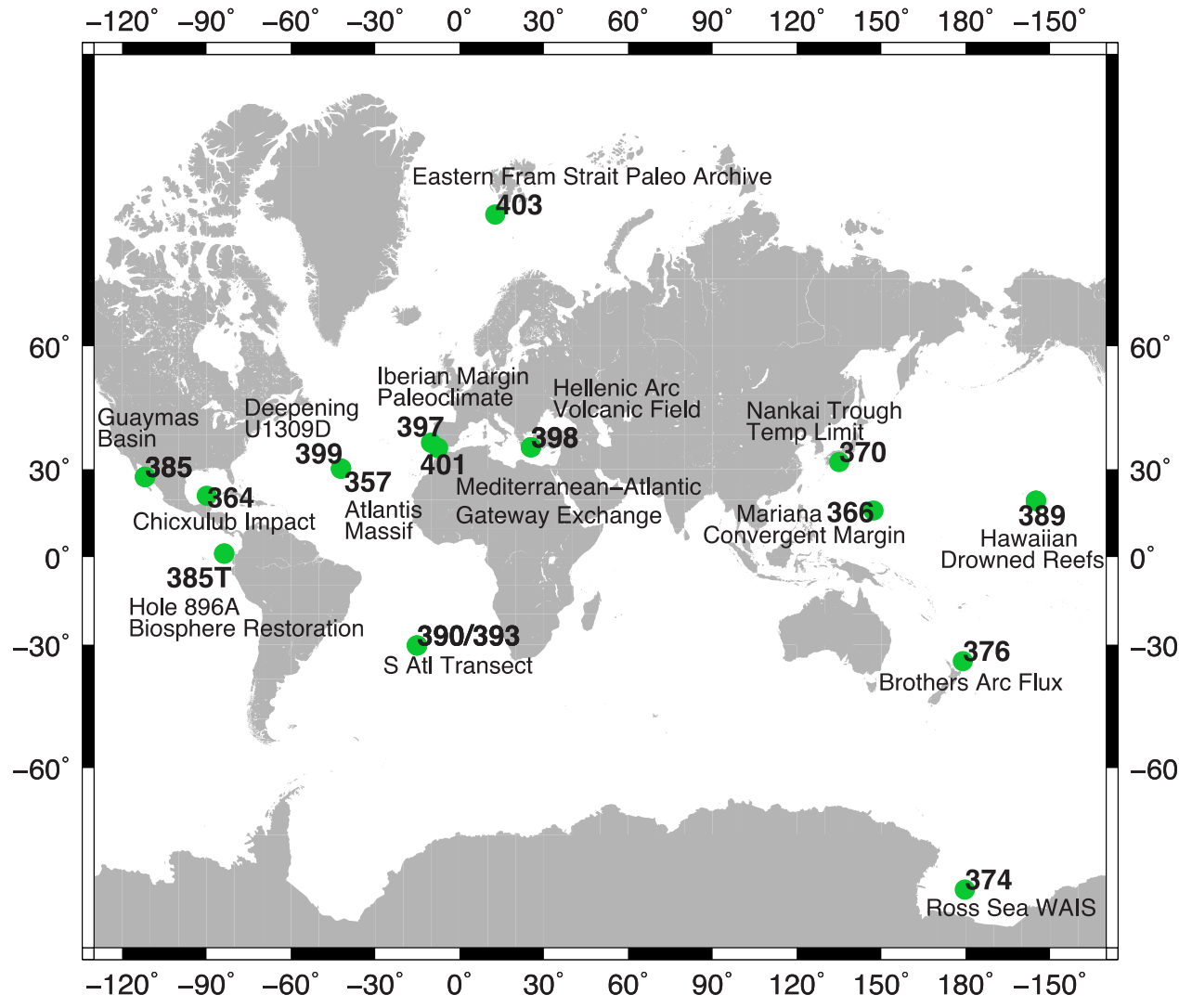
Science Plan Theme Distribution

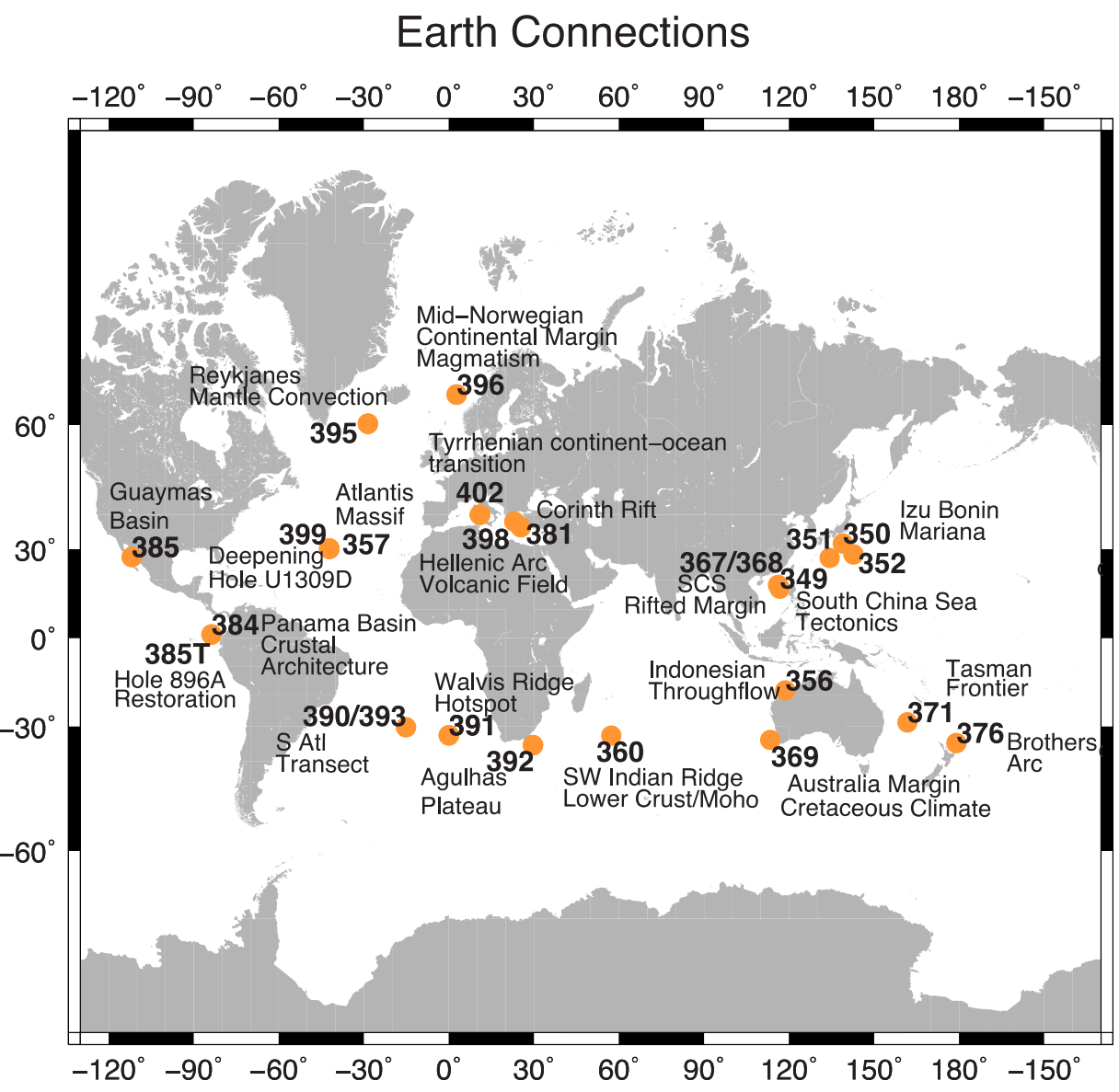


Climate and Ocean Change



Biosphere Frontiers




Earth Connections
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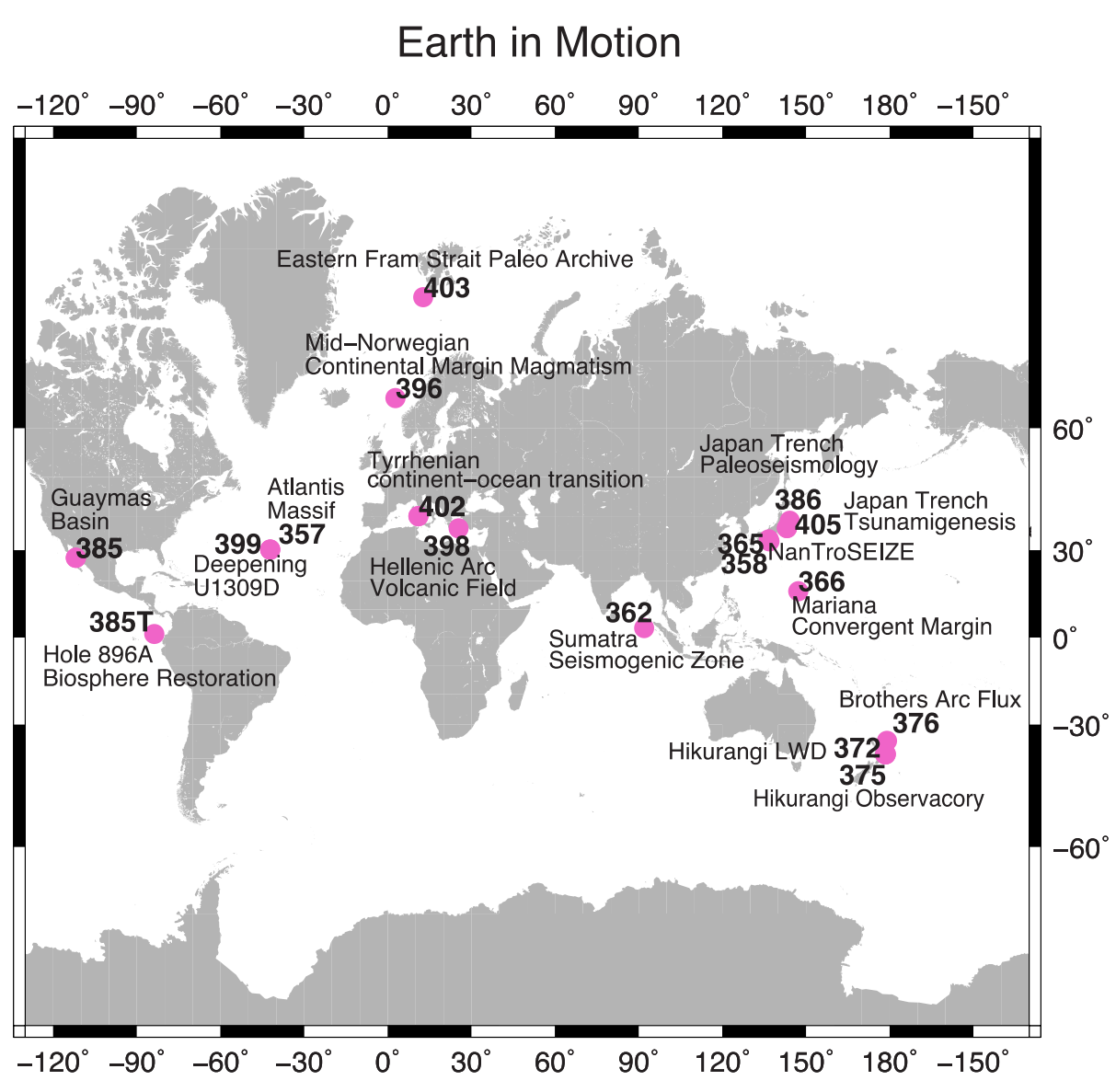
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