

An Introduction to Seafloor Sample Repositories and Data Systems

Brendan Reilly

NSF-OCE Future of Seafloor Sampling Workshop

March 26, 2024

Woods Hole, MA

Institutional Repositories for Sediment and Rock Samples (NSF-OCE Data and Sample Policy)

Sediment cores, dredged rocks, grabs, and vent fluids from the seafloor are collected at great cost and are often of **benefit to the research community beyond the projects for which they were originally collected.**

In recognition of the value and use of these samples, the Marine Geology and Geophysics Program provides partial support for a limited number of institutional repositories. These and other similar repositories ensure that samples of sediment and rock collected from the seafloor are properly curated, preserved, and disseminated to qualified researchers



0 km 750 km 1500 km

Oregon State University
Marine and Geology Repository
 Supporting Earth, Ocean, and Antarctic Sciences

UNIVERSITY OF MINNESOTA
 Driven to Discover[®]
 College of Science and Engineering
CSD Facility • Continental Scientific Drilling

WHOI Seafloor Samples Laboratory

THE UNIVERSITY OF RHODE ISLAND
 GRADUATE SCHOOL OF OCEANOGRAPHY

MARINE GEOLOGICAL SAMPLES LABORATORY

COLUMBIA CLIMATE SCHOOL
LAMONT-DOHERTY EARTH OBSERVATORY
 Core Repository

The Polar Rock Repository
 Byrd Polar & Climate Research Center,
 The Ohio State University

UC San Diego | **SCRIPPS INSTITUTION OF OCEANOGRAPHY**

GEOLOGICAL COLLECTIONS
 Among the largest collections of marine geology samples in the United States.



marum
 Research Faculty
 University of Bremen

IODP Bremen Core Repository

International Ocean Discovery Program
 JOIDES Resolution Science Operator
Gulf Coast Repository (GCR)

Kochi Core Center



● NSF OCE-MGG Funded Repositories



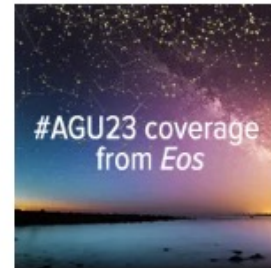
The Importance of Archiving the Seafloor

Marine geological sample repositories are vital for ocean science, climate change studies, and more. The value of their collections is growing amid efforts to meet rising demand for their services.

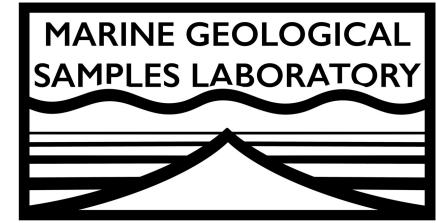
By Christina DiCenzo, Katherine A. Kelley, Nichole Anest, Cara Fritz, and Jeff Donnelly 18 January 2024



Cataloged containers of glass separates are stored in the Schilling Seafloor Glass Collection at the University of Rhode Island (URI) Marine Geological Samples Laboratory (MGSL). Glass is commonly chiseled from submarine lava rocks and stored separately to make filling sample requests for glass more efficient. Credit: Alex De Cicco



NSF OCE-MGG Funded Repositories



COLUMBIA CLIMATE SCHOOL
LAMONT-DOHERTY EARTH OBSERVATORY
Core Repository



WHOI Seafloor Samples Laboratory

<https://eos.org/features/the-importance-of-archiving-the-seafloor>

A long, brightly lit hallway with rows of white shelving units on both sides, receding into the distance. The perspective is from the center of the hallway, looking down its length. The lighting is even and bright, creating a clean, modern atmosphere. The shelving units are uniform and extend far into the background, suggesting a large-scale storage or research facility.

The Repositories are here to help YOUR science

The Repositories are here to help YOUR science

Involve the repositories early in your project planning and proposal writing—lots of work can happen in these facilities



The Repositories are here to help YOUR science

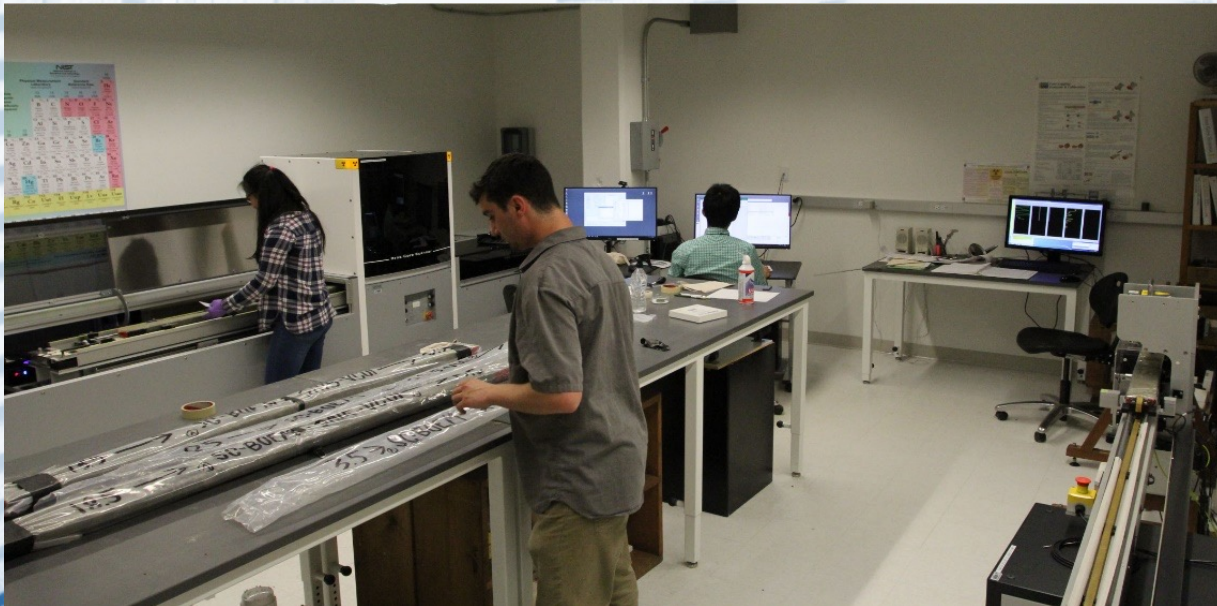
Curators and technicians are here to answer your questions, help you develop sampling strategies, and offer training



The Repositories are here to help YOUR science

Many analyses can be done at these facilities—store your samples and work on them too!

(e.g. Sedimentology, CT Scanning, XRF Scanning, Geophysical and Magnetic Measurements)



The Repositories are here to help YOUR science

Always improving to make our collections more discoverable and ready for decisions



National Centers for Environmental Information
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Index to Marine and Lacustrine Geological Samples

NOAA / NESDIS / NCEI / Maps / Sample Index

Layers

Filter Samples:

Repository: LDEO

Survey ID: All LDEO Cruises

Platform Name: All Platforms

Lake Name: All Lakes

Year: to

Device: All Devices

Water Depth (m): 1,000 to 3,000

Search Samples [X] Reset

Number of Samples Displayed: 5114

Show Table

More Information
Help

Attributes: VM14 (V1408):004PD:dredge (LDEO)

Lake: /

Survey (Alternate) ID: VM14 (V1408)

Sample: 004PD [Data and Images]

Device: dredge

Latitude: -54.9

Longitude: -39.1833

Water Depth (m): 1278

Date: 19580306

PI: /

Province: /

IGSN: DSR0005XT

Sample Comments: /

Storage: room temperature, dry

Back Zoom to

Position: -84.424°, -72.950°
Elevation: -1033 meters

We Want to Hear From You!

Breakout Session Day 1: Critical science questions that require seafloor sampling

Q4) How are current repositories and databases used to address your science questions?

Breakout Session Day 2: Aligning seafloor sampling technology with critical science questions

Q5) What types of sample curation, preservation, and data system infrastructure are needed to maximize the benefit of seafloor sampling campaigns? To what extent can existing resources be used? What new approaches should be developed?

Day 3 Group Discussion: Sample Repositories and Databases

Repository and Data People at the Workshop

Rebecca Robinson

Director, URI Marine Geological Samples Laboratory

Jeff Donnelly

Director, WHOI Seafloor Samples Laboratory

Alan Mix, Kevin Konrad

Former Director/Curator, OSU Marine And Geology Repository

Brendan Reilly

Director, LDEO Core Repository

Erica Maletic

Curator, Polar Rock Repository

Saebyul Choe

Data Curator, SESAR and EarthChem Library

Andrea Thomer

Product Manager, SESAR

Clint Edrington

NOAA NCEI Marine Geology Data Manager
Index to Marine and Lacustrine Geologic Samples

Vicki Ferrini

Geo Map App
Director, Marine Geoscience Data System (MGDS)

Alex Hangsterfer (Virtual)

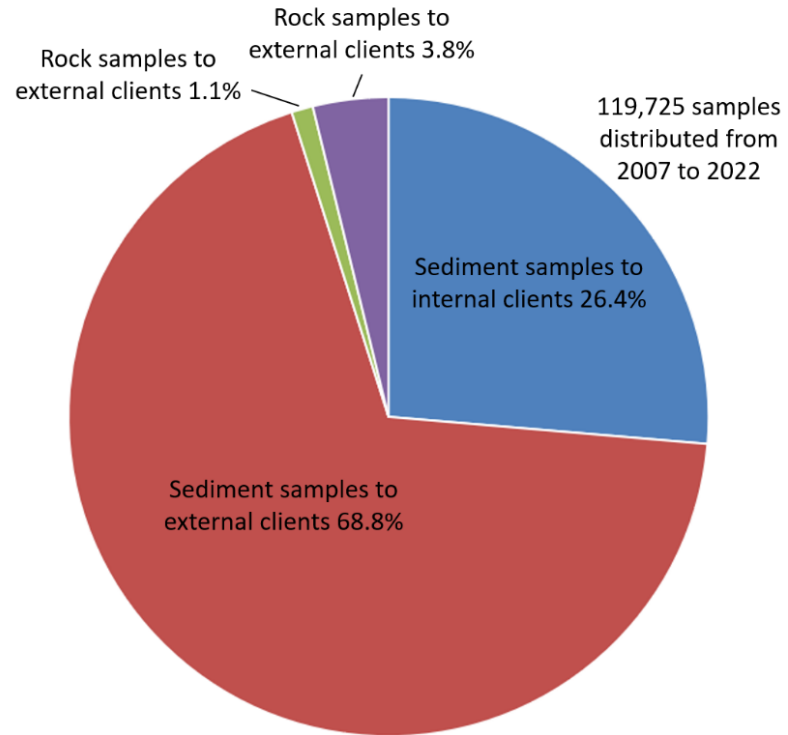
Curator, Scripps Institution of Oceanography Geological Collections



WHOI Sea Floor Samples Lab (SFSL)

About

- Established in the 1970's, our mission is to facilitate research and education through curating and providing access to our diverse collection of samples from the world's seafloor. This includes, but is not limited to rocks, lake and marine sediment, corals, shells, peat, and wood. We support the advancement of scientific knowledge by providing technical and analytical expertise, in addition to instrumentation and field equipment
- Collection consists of ~30,000 samples, consisting of sediment cores, rock dredges, coral cores, surface grabs, and samples collected by submersibles
- Average approximately 7400 samples distributed per year to researchers and educators over the last 15 years
- Outreach to students and educators of all ages
- Provide training on the use of various sampling equipment and collection and curation of seafloor materials



Sample Type	# holdings
Grabs	609
Alvin grabs	652
Alvin cores	76
Multi cores	1007
Gravity cores	2009
Piston cores	1426
Kasten	33
Box cores	237
<u>Vibracores</u>	250
Dredge samples	15984
Individual samples	7688
Total	29971

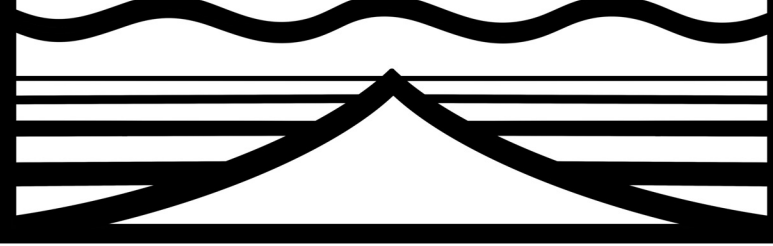
Collection and Sampling Statistics

Capabilities

- Geotek RXCT Scanner
- Malvern Mastersizer particle sizer analyzer
- Rock Saws
- Core splitting
- Vibracoring
- Multicoring
- Geoprobe

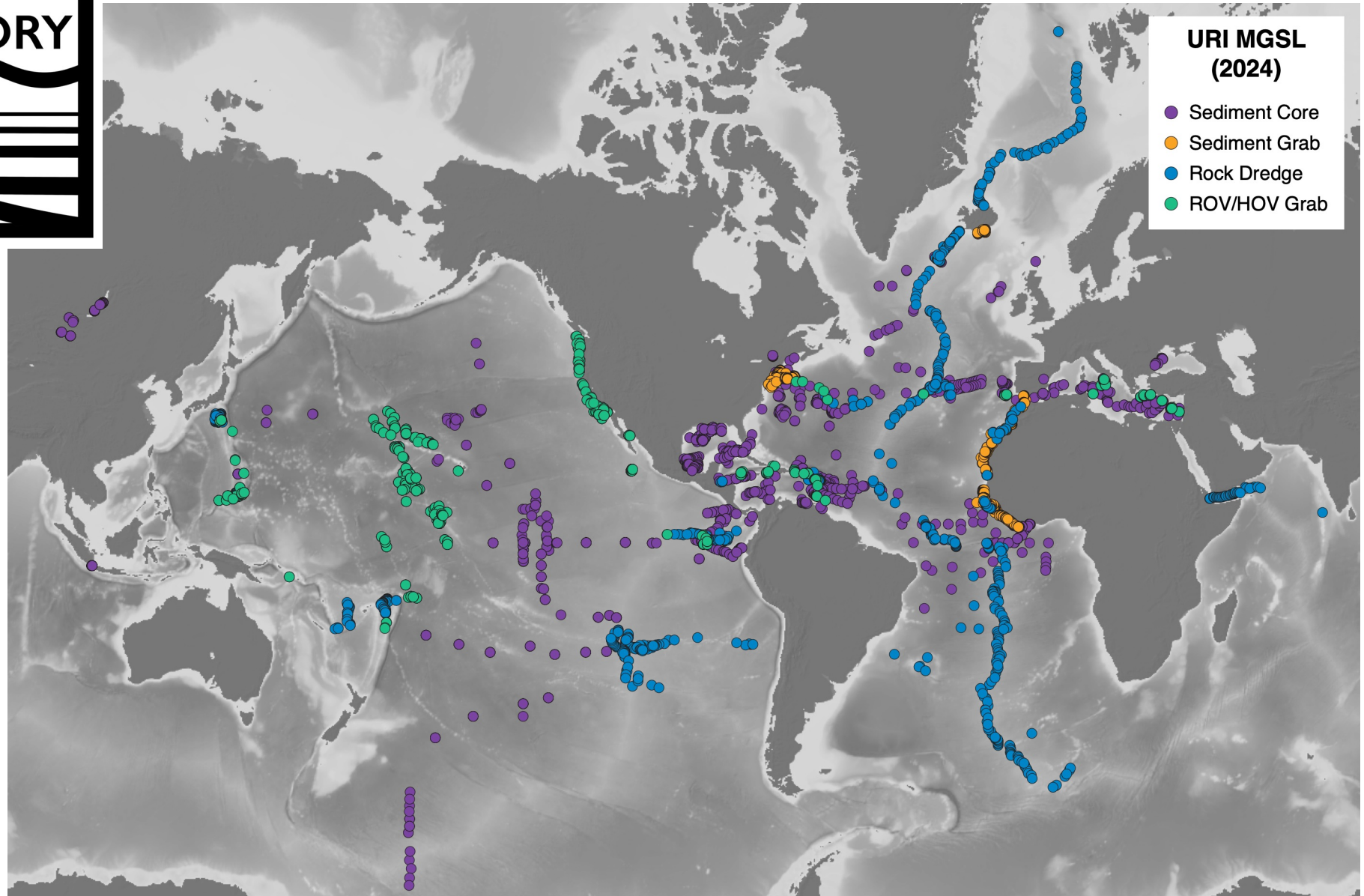


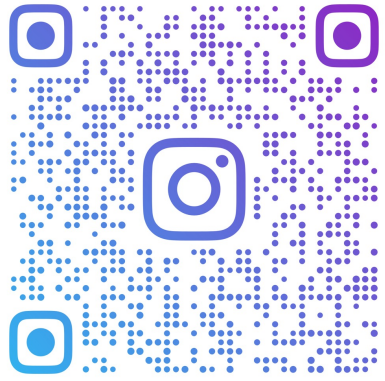
MARINE GEOLOGICAL SAMPLES LABORATORY



THE
UNIVERSITY
OF RHODE ISLAND
GRADUATE SCHOOL
OF OCEANOGRAPHY

- 3,000+ Dredges and sub-samples
- 8,000+ Cores and sub-samples
- 2,000+ ROV/HOV grabs
- 700 Surface sed grabs





URIMGSL

Major news at the URI MGSL



- \$1M+ in federal funds for renovation and expansion
- New full-time curator, Danielle Cares
- Busier than ever: 2023 marked an all-time high for annual sample requests
- We are on Instagram! @URIMGSL
- Contact us with inquiries or requests: mgsl@etal.uri.edu

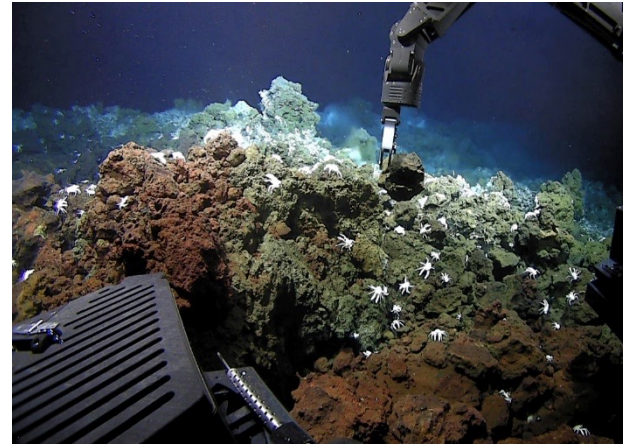
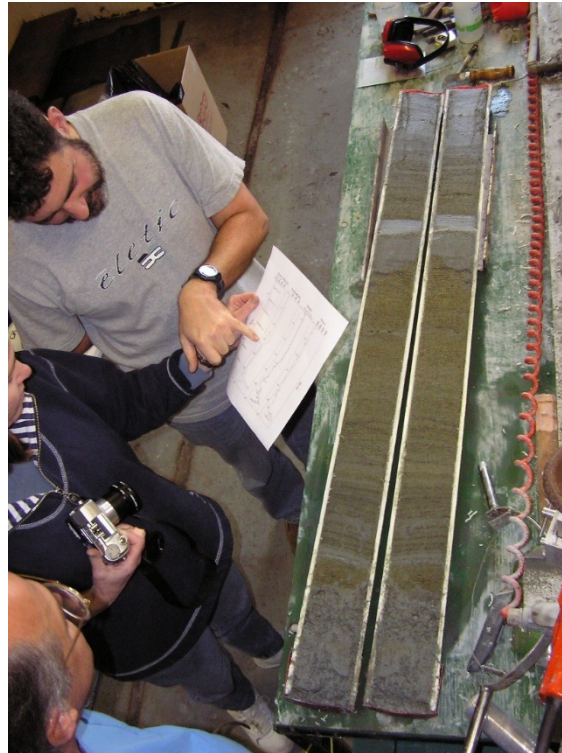
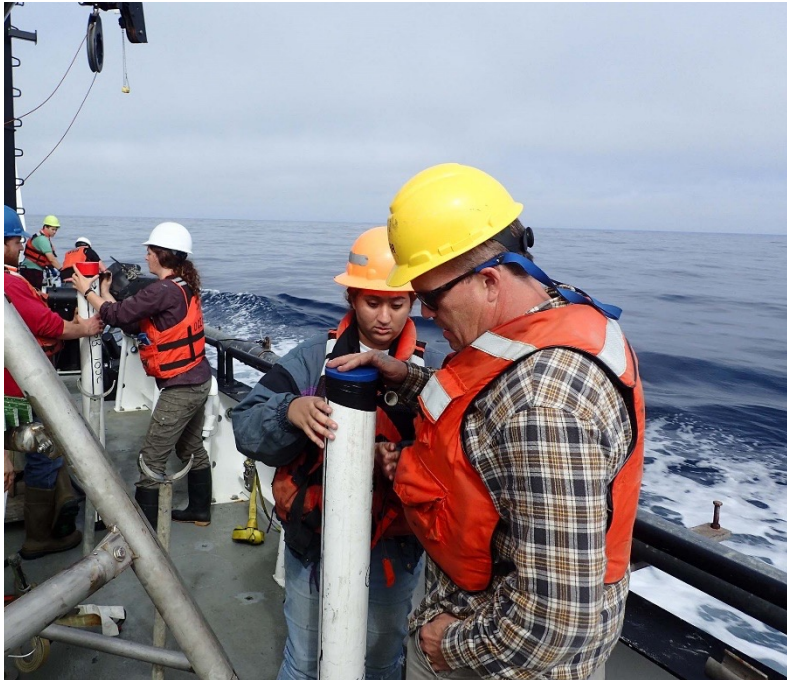


Oregon State University

MARINE AND GEOLOGY REPOSITORY

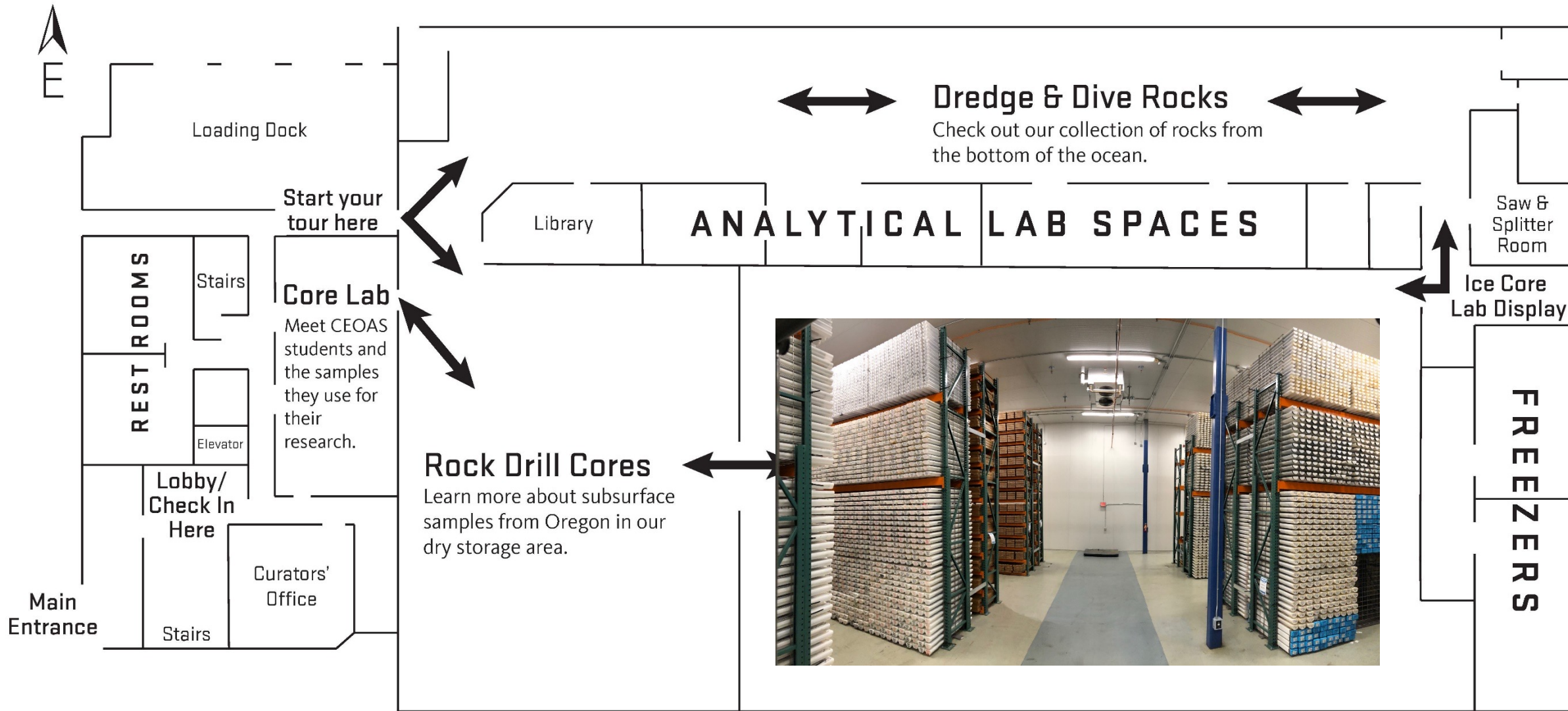
Supporting Earth, Ocean, and Antarctic Sciences

Our mission is to facilitate research, education, and the advancement of scientific knowledge through access and preservation of our diverse collection of rock, lake, and marine sediment samples from around the world's oceans, including the Arctic and the Southern Oceans.



OSU MARINE & GEOLOGY REPOSITORY

Map for self-guided tour of the facility and its collections

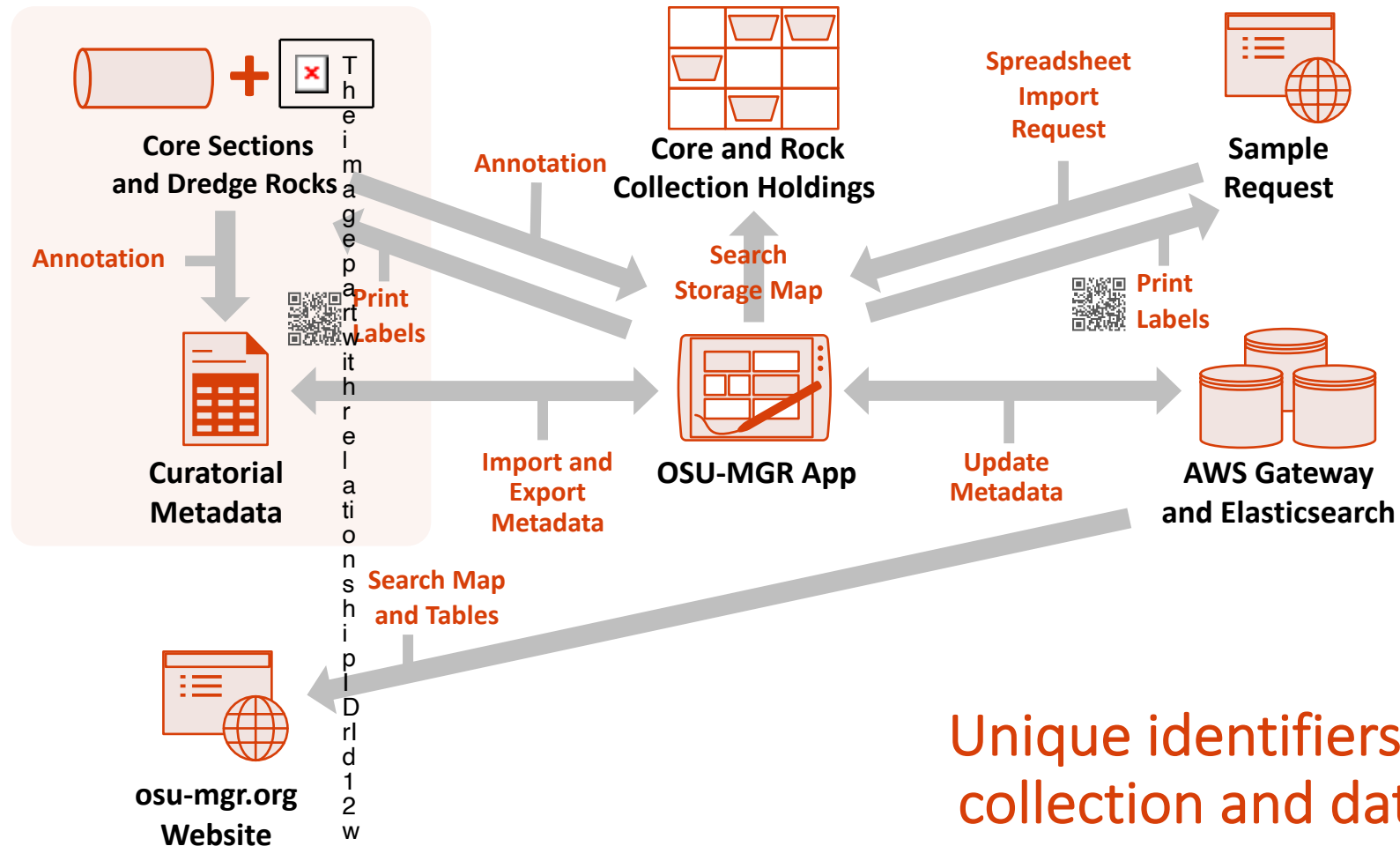


OSU-MGR Collections Update

- **The Marine Geology and Geophysics Collection:**
 - 15,200 m of marine sediment from over 6,600 core sites
 - Over 560 m of lake sediment from over 200 core sites
 - 8,060 m of terrestrial drill core from 29 sites
 - 1,600 sediment trap samples
- **The Antarctic Core Collection:**
 - Largest collection of geological samples from the Southern Ocean
 - Over 18,500 m of deep sea core sediment from 7,370 core sites
- **Dredge and Dive Rock Collection:**
 - More than 14,600 rocks from 529 dredges
 - 528 manganese nodules
 - 365 rock samples from 187 ROV dives sampled by NOAA in marine national monuments in the Pacific Ocean



OSU Marine and Geology Repository (OSU-MGR)



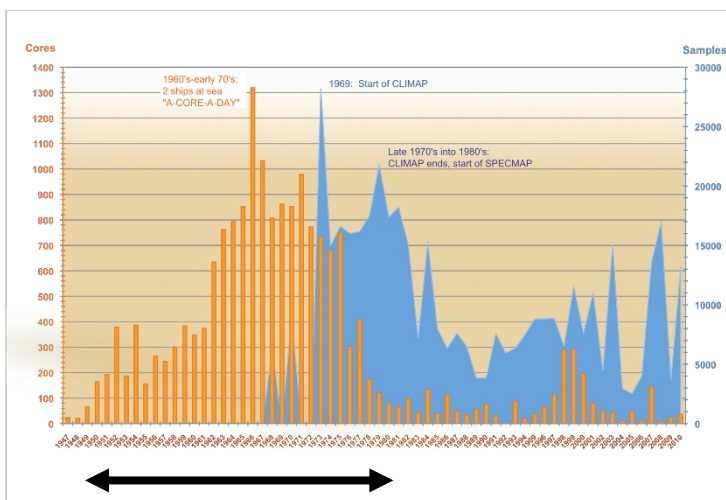
Unique identifiers are essential to collection and data management



COLUMBIA CLIMATE SCHOOL

LAMONT-DOHERTY EARTH OBSERVATORY

Core Repository



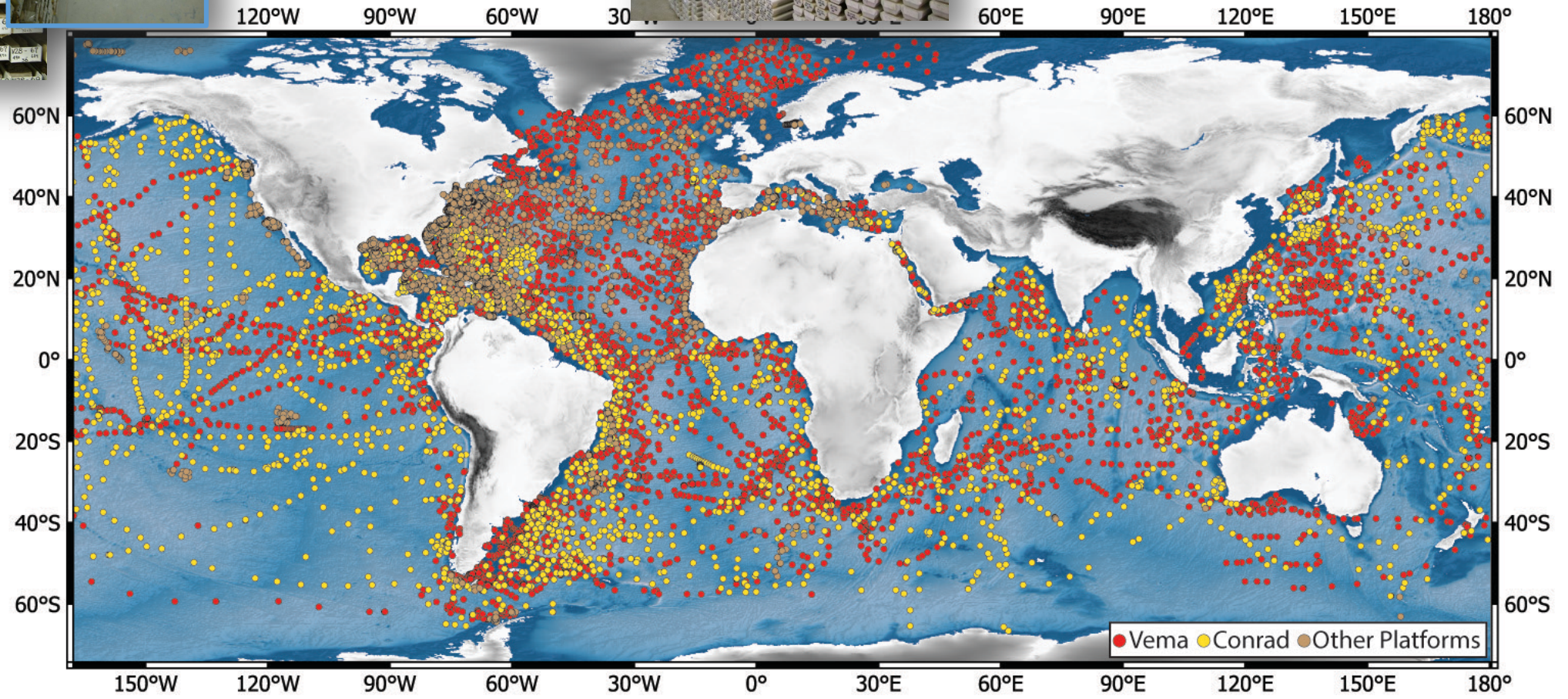
1950s-1970s 'A Core A Day'
on RV Vema and Conrad

1970s & 1980s CLIMAP/SPECMAP

- First core taken by Maurice Ewing in 1947 on RV Atlantis
- “A core a day” philosophy built a truly global collection while RV Vema and RV Conrad were active
- Pre 1984 cores in dry storage area (5,380 sq. ft.) and post 1984 cores in refrigerated storage (4,666 sq. ft.)
- In addition to physical samples, we also archive historical materials, cruise data, seafloor photographs, and more
- Additional lab space includes ‘automatic’ washing stations, sedigraphs, coulometer, benchtop XRD, Geotek Multi Sensor Track (MST), and an ITRAX XRF core scanner



Total Cores	20,244
Dry Stored	14,111
Wet Stored	6,133
Dredges/Grabs	2,808
Coral Cores	541
Wetland Cores	143



 **COLUMBIA CLIMATE SCHOOL**
LAMONT-DOHERTY EARTH OBSERVATORY
Core Repository



The Polar Rock Repository

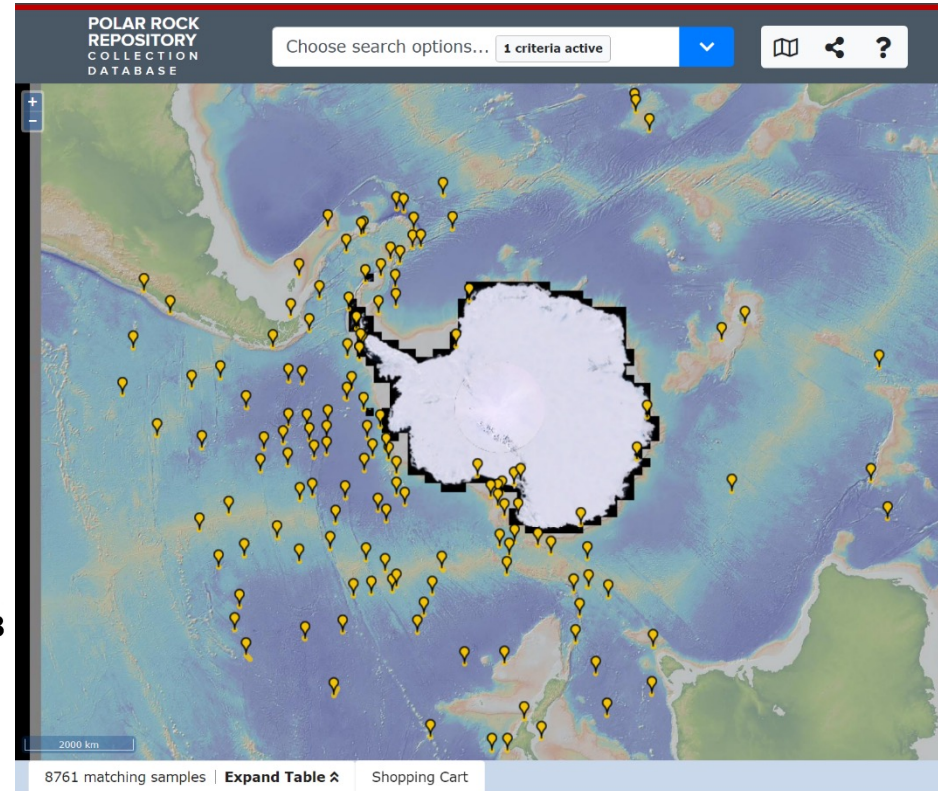
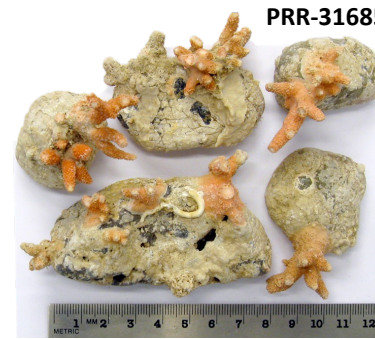
Byrd Polar & Climate Research Center,
The Ohio State University

Making the inaccessible available to all

- The PRR collection includes >61,000 samples from Antarctica, the Southern Ocean, and surrounding regions
- Samples from seamounts, abyssal plains, rift zones
- Glacial dropstones, Mn nodules

Over 8,700 dredge samples online

- Collections from the Eltanin, Edisto, Hero, Laurence M. Gould, and Nathaniel B. Palmer
- Larger dredge clasts have been individually cataloged, described, and photographed
- Supporting metadata included
- Marine invertebrates noted
- Petrologic features noted



8761 matching samples | [Expand Table](#) | [Shopping Cart](#)

[Check All](#) | [+ Add Selected to Shopping Cart](#) | [Download all results \(CSV\)](#)

[<< Previous page](#) 8751 to 8761 of 8761 results

TABLE THUMBSHEET

Image	Repository #	Primary Field #	Vessel Name	Cruise Number	Ship Station Number	Rock Name	Dredge Lat Start	Dredge Lon Start	Dredge Lat Finish	Dredge Lon Finish	Starting Depth (mbsl)	Finishing Depth (mbsl)	Surface Features	Sam Des
	PRR-61483	LMG04-04 Bag8 [11]	Laurence M. Gould	LMG04-04	--	Granite	-63.497	-56.446	-63.492	-56.450	261	332	--	[pir mic]
	PRR-61484	LMG04-04 Bag9	Laurence M. Gould	LMG04-04	--	Argillite	-63.497	-56.446	-63.492	-56.450	261	332	Marine invertebrate/coral	Fine [drc]

The Polar Rock Repository

Byrd Polar & Climate Research Center,
The Ohio State University

Easily Searchable Database

- Over 30 search criteria options
- View images of each sample

[Check All](#)
[+ Add Selected to Shopping Cart](#)
[Download all results \(CSV\)](#)
[TABLE](#)
 THUMBSHEET
 [IMAGE:](#)

PRIMARY SECONDARY



Online Sample Request System

[Check Out](#)

[Check All](#)
[- Remove from Cart](#)
[Download all results \(CSV\)](#)

Image	Repository #	Primary Field #	Kind of Object	Rock Name	Sample Description	General Notes	Mountain/Island Name	Region	Weight
	PRR-4423	KB-1	Dredge	Granodiorite	leuco sodaclase granodiorite c(more...)	Sample is from dredging collec(more...)	Kainan Bay	Marie Byrd Land	480 g
	PRR-4424	KB-2	Dredge	Rhyolite	rhyolite porphyry; 2 pieces	Sample is from dredging collec(more...)	Kainan Bay	Marie Byrd Land	91 g
	PRR-4425	OP-15-1a	Dredge	Dacite	dacite porphyry; 3 pieces	Sample is from dredging collec(more...)	--	Antarctic Peninsula	1623 g

Choose search options... 1 criteria active

Quick Search
Zoom to location on map, then choose quick search option below to search in region.

[All Rock Samples](#)
[All Dredges](#)
[All Unconsolidated](#)

[Photographs](#)

Current Criteria
Kind of Object: Dredge

Add Criteria

Select field...

Select field...

Popular Fields

- Kind of Object
- Rock Name
- Rock Type
- ID Number
- Geographic Location
- Stratigraphic Name
- Chronology
- Weight
- Susceptibility
- Positioning Method
- Keywords
- Collector
- Donor
- Field Year Collected
- Fossils
- Minerals Observed
- Surface Features
- Analyses

[Perform Search](#)



In-person/Zoom visits encouraged
Find Curator Erica Maletic for more information (and a sticker)





SESAR²

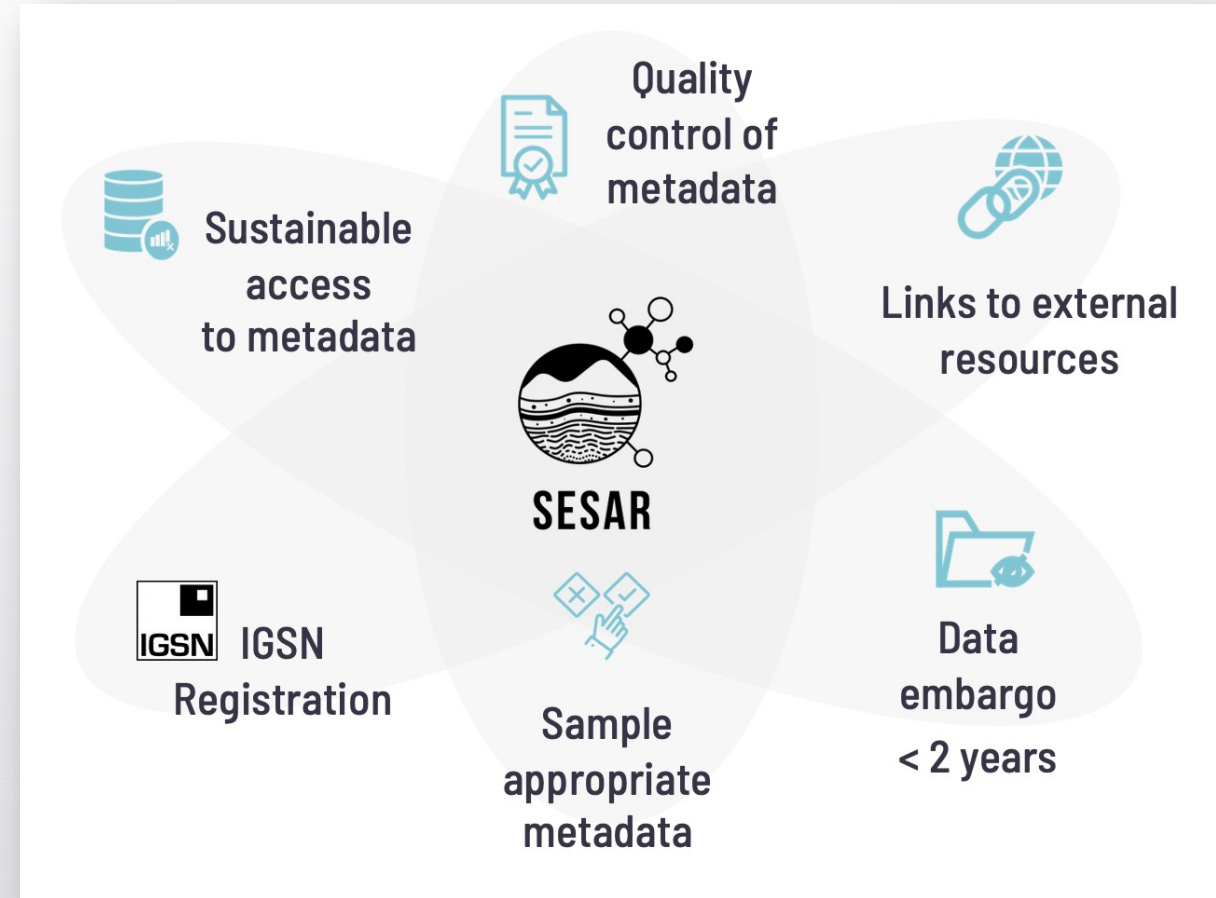
System for Earth & Extraterrestrial Sample Registration

What is SESAR?

SESAR is a community platform that facilitates **discovery, access, and reuse of samples**, and connects samples with the knowledge ecosystem derived from them (articles, data, images).

Primary services

- ❑ Workspace for sample metadata management
- ❑ Curatorial review of metadata & user support
- ❑ Searchable sample catalog for discovery/access
- ❑ Registration of sample metadata and minting of IGSNs at DataCite





Why Use SESAR²

- Improve discovery & access of your samples & collections
- Safely store & share information about your samples
- Track your samples & sample data in the literature
- Comply with funders' & publishers' requirements for FAIR samples with IGSN

NSF - OCE Data & Sample Management Policy:

"All physical geological samples (solid, gas, liquid) must be assigned unique sample identifiers (IGSNs), and this identifier for the samples and any analyses associated with those samples should be referred to in any publication. IGSNs can be generated from the online IEDA IGSN assignment tool."

AGU Author Resources:

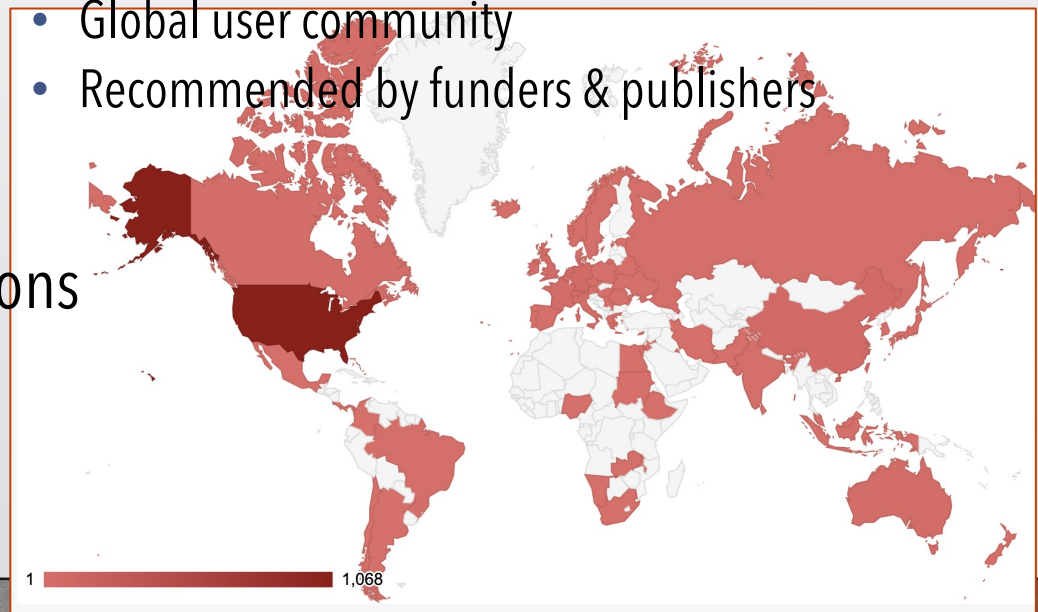
"AGU recommends the use of IGSNs for citing samples reported in manuscripts. ... We strongly encourage authors to register samples with an IGSN Allocating Agent and obtain IGSNs and use them throughout their manuscript, tables, and archived data sets."

How to Use SESAR²

- Establish a personal or institutional account
- Decide on your preferred registration option
 - Create customized batch registration forms
 - Contact SESAR if you want to use the API
- Submit your sample metadata!
- Contact info@geosamples.org if you have questions
- Visit the SESAR web site for Help resources
 - <https://www.geosamples.org/resources/help>

- >5 million samples in the SESAR Catalog
 - Wide range of sample types: Solid, fluid, gas, bio, synthetic
- >1,600 users (Individual researchers & institutions)
 - E.g., museums, NSF-funded sample & core repositories

- Global user community
- Recommended by funders & publishers



The Index to Marine and Lacustrine Geological Samples (IMLGS)

- Established in 1977, the IMLGS is a **community designed and maintained** resource that enables scientists to **find and access**:
 - i. **Digital geological data** gleaned from seabed and lakebed geological samples collected worldwide
 - ii. **Physical samples** underlying the digital data and curated at **partner sample repositories**
- Simply put, the IMLGS is a “**one-stop shop**” **data discovery and access tool**
- **Purpose:** To promote new research on existing samples curated at **partner sample repositories**

Active Community Involvement

- Antarctic Core Collection (Oregon State University)
- British Ocean Sediment Core Research Facility
- Continental Scientific Drilling
- Geological Survey of Canada
- GEOMAR Helmholtz Centre for Ocean Research Kiel
- International Ocean Discovery Program
- Lamont-Doherty Earth Observatory
- National Museum of Natural History
- National Oceanic and Atmospheric Administration
- Oregon State University
- Polar Rock Repository, Ohio State University
- Scripps Institution of Oceanography
- U.S. Geological Survey
- University of Rhode Island
- Woods Hole Oceanographic Institution



Data Discovery and Access

The IMLGS Web App: 234,204 samples as of March 14, 2024

The screenshot displays the IMLGS Web App interface. At the top, the NOAA logo and "National Centers for Environmental Information" are visible. The main title is "Index to Marine and Lacustrine Geological Samples (IMLGS)". Below the title, there are navigation links for "Samples", "Cruises", and "Repositories".

On the left side, there is a filter panel with the following options:

- 234,204 out of 234,204 samples
- Repository --
- Platform --
- Device --
- Cruise --
- Lake --
- IGSN: Date: YYYYMMDD
- Water Depth (m): min max
- Sample Attributes:
 - Lithologic Composition --
 - Texture --
 - Rock Mineralogy --
 - Rock Weathering --
 - Rock Metamorphism --
 - Geologic Age --
 - Rock Lithology --
 - Rock Glass Remarks & Mn/Fe O
- Zoom to Selected
- Reset
- Table View

The main area is a world map showing a dense distribution of colored points representing geological samples. A search bar at the top right says "Find address or place". At the bottom left of the map, there is a coordinate display: "XY 163.682325°, -14.360885°". The map is powered by Esri, GEBCO, Garmin, and NaturalVue. The NOAA logo is also present in the bottom left corner of the screenshot.



Data Discovery and Access

e.g., The “Data and Information for Sample ID AMPH01AR-002P” page

Data and Information for Sample AMPH01AR-002P

Repository	Scripps Institution of Oceanography
Ship/Platform	Argo
Cruise ID	AMPHITRITE
Leg	AMPH01AR
Sample ID	AMPH01AR-002P
Sampling Device	core, piston
Latitude/Longitude	19.4, -123.683
Water Depth (m)	4,422
Date Sample Collected	1963-12-06
Storage Method	refrigerated
Core Length (cm)	417
Core Diameter(cm)	5
Repository Archive Overview	https://dx.doi.org/doi:10.7289/V5757KRR

- [AMPHITRITE Trackline Geophysics at NCEI](#)
- [AMPHITRITE Trackline Geophysics at NCEI](#)
- [AMPHITRITE Trackline Geophysics at NCEI](#)
- [AMPHITRITE data at SIO Explorer](#)
- [AMPHITRITE data at SIO Explorer](#)
- [AMPHITRITE data at SIO Explorer](#)
- [AMPHITRITE data at NCEI](#)
- [AMPHITRITE data and information at UCSD Library](#)
- [AMPHITRITE data and information at UCSD Library](#)
- [AMPHITRITE data and information at UCSD Library](#)

EXPORT INTERVAL DATA

Interval 1: 0 to 237 cm in core
Primary Lithologic Composition: terrigenous
Primary Texture: mud or ooze
Secondary Lithologic Composition: zeolites
Secondary Texture: sandy mud or ooze
Other Component 1: fish teeth
Other Component 2: manganese
Geologic Age: unknown
Comments: PELAGIC CLAY

Interval 2: 237 to 247 cm in core



EXPEDITION - AMPH	Core number	Latitude	Longitude	Water depth (m)	Visual units - Depth in core (cm)	Microfossils										Age	Additional notes	Sampled interval (cm)	
						Calc.	Sil.	Nannos	Forams	Rads	Diatoms	Fish debris	Zeolites	Glass shards	Other mineral grains				Mn modules
	1PG	23°16'N	121°14'W	4051	*30-139	*0	*0	C	*R	*F	1	*28					?	1	25-32, 73-83, 128-137
	1P	23°16'N	121°14'W	4051	0-18			R	C	R	F	*	*			*S D	?	1	Top
					21-70				R	C	F			M			?		2 35cm, Bottom
	2PG	19°24'N	123°41'W	4422	*20-147		*0	C	*F	*F	*C						?	2	3 20-22, 142-144
	2P	19°24'N	123°41'W	4422	0-417			F	F	C	F						?	2	0-2,
						F	*0	C	C	C	C						?	4	100, 230-232, 300, Bottom
	3PG	15°04'N	125°05'W	4459	*20-119	*0	*C	*F	*F	F	F			S		QUAT/?	R/?	3	5 20-22, 70, 115-117
	3P	15°04'N	125°05'W	4459	0-194	R	*C	*F	*C	*0	F	1	50			QUAT/?	F/?	4	6 0-2, 135-137
					194-477	R			C										
	4G	8°31'N	127°25'W	4740	0-8	R	C	C	C	C									
					8-124				*C	*C-0									
	5G	8°15'N	127°29'W	4520	0-8	C	C	C	C	F									
					13-82	R	C	C	C	R									
					127-178				C	F	F								
	6PG	4°52'N	128°21'W	4460	*10-17	C	C	C	C	C									
					17-40	C	C	C	C	C									
					77-99	C	C	C	C	F									
					118-175	F	C	C	C	C	R								
	6P	4°52'N	128°21'W	4460	0-13	C	C	C	C	*C									
					13-62	C	*F	C	*F										

NOAA NATIONAL CENTERS FOR ENVIRONMENTAL INFORMATION

Trackline Geophysical Data
National Geophysical Data Center

Request Data [HELP](#)

Trackline MGD77T Advanced

Other Data Files / Size

Total: 1 file(s) / 1.27 MB

Email Enter your email

Filter results below:

10 records per page

Data Available	Survey ID	Institution	Ship	Year	Date Added	Types	Select
<input checked="" type="checkbox"/>	AMPH01AR	Scripps Inst Oceanograph	Argo	1963	1960-02-26	B M	<input checked="" type="checkbox"/>

Showing 1 to 1 of 1 entries

[First](#) [Previous](#) [1](#) [Next](#) [Last](#)



Metadata: The Unsung Hero of the IMLGS

- Curators describe their samples using an agreed upon metadata
 - Including a suite of controlled vocabulary sets

Sample Information (sampling event: core, grab, dredge, drill hole)

- **Facility Abbreviation** - entered up to ten alphanumeric characters
- **Institution Code** - entered , two digit integer
- **Ship Code** - entered , two digit integer
- ***Ship/Platform** - from institution, maximum 30 alphanumeric characters
- ***Cruise Identifier** - from institution, maximum 30 alphanumeric characters
- ***Sample Identifier** - from institution. Unique within a cruise (for a sampling device), maximum 30 alphanumeric characters
- **Date Sample Collected** - form YYYYMMDD
- **Date Sample Collection Ended** (if not same as above) - form YYYYMMDD
- ***Latitude/Longitude** (maximum five decimal places; - = South or West):
 - Latitude - form +/-DD.DDDDD
 - Longitude - form +/-DDD.DDDDD
- **Lat/Lon type flag** - 1 digit, m=minutes; d=decimal degrees
- **Water Depth** - corrected meters, no decimal, 5 digit integer. (beginning depth for dredges)
- **Ending Water Depth** (dredges only) - corrected meters, no decimal, 5 digit integer.
- ***Sampling Device** (see device list)
- **Storage Method** (see storage list)
- **Core Length** - 6 digit integer total length in centimeters
- **Core Length mm** - 2 digit integer additional precision in millimeters
- **Core Diameter** - 3 digit integer, in centimeters (round to nearest whole centimeter and place real value in comment)
- **Core Diameter mm** - 2 digit integer, additional precision in millimeters
- **Principal Investigator** (last name, first name of P.I.) up to 26 characters
- **Physiographic Province** (see province terms)
- **Lake Name**
- **IGSN** (obtain from SESAR or add later)
- **Leg** - leg within cruise, or alternate/standard leg identifier
- **Sample Comments** - up to 2000 characters of comments pertaining to entire sample, do not use nonstandard characters
- **Publish** - "Y" added after entry approved for publication by repository
- **Previous State** - internal field

- **Sampling device *** (historic code):
 - core, undifferentiated (0)
 - core, box (G)
 - core, camera mounted (H)
 - core, dart (N)
 - core, free-fall (E)
 - core, gravity (D)
 - core, hand-held (J)
 - core, kastenlot (P)
 - core, multicorer (O)
 - core, piston (C)
 - core, grab (G)
 - core, dredge (D)
 - core, camera mounted (H)
 - core, dart (N)
 - core, free-fall (E)
 - core, gravity (D)
 - core, hand-held (J)
 - core, kastenlot (P)
 - core, multicorer (O)
 - core, piston (C)
- **Storage method** (historic code):
 - frozen (A)
 - refrigerated (B)
 - room temperature, dry
 - room temperature, moist
- **Lithologic composition** (historic code):
 - Calcareous
 - calcareous, algae (L)
 - calcareous, biogenic (B)
 - calcareous, coral (G)
 - calcareous, foraminifera (C)
 - calcareous, nannofossils (E)
 - calcareous, nonbiogenic (A)
 - calcareous, oolites (I)

- **Rock Descriptors:** (~~deprecated, use rock lithology below.~~ originally used in place of textural term, with blank composition)
 - allogenic limestone (5)
 - authigenic limestone (6)
 - chert or porcelanite (7)
 - erratic rock (9)
 - evaporite (8)
 - metamorphic rock (3)
 - plutonic igneous rock (2)
 - terrigenous clastic sedimentary rock (4)
 - volcanic igneous rock (1)
- **Geologic Ages:**
 - unknown (00)
 - Quaternary (10)
 - Holocene (11)
 - Pleistocene (12)
 - Tertiary (20)

- **Rock Mineralogy:**
 - major minerals
 - alkali feldspar (K-spar) (E)
 - amphibole (amph) (D)
 - feldspathoids (f) (G)
 - olivine (ol) (B)
 - plagioclase (pg) (A)
 - pyroxene (opx/cpx,px) (C)
- **Rock Lithology:**
 - igneous:
 - intrusive/plutonic
 - igneous (intrusive/plutonic) (0)
 - igneous (intrusive/plutonic), anorthosite (0E)
 - igneous (intrusive/plutonic), clinopyroxenite (0Q)
 - igneous (intrusive/plutonic), diorite (0X)
 - igneous (intrusive/plutonic), dunite (0J)
 - igneous (intrusive/plutonic), gabbro (0A)
 - igneous (intrusive/plutonic), gabbro, ferro (0D)
 - igneous (intrusive/plutonic), gabbro, olivine (0B)
 - igneous (intrusive/plutonic), gabbro, quartz (0C)
 - igneous (intrusive/plutonic), granite (0T)
 - igneous (intrusive/plutonic), granodiorite (0U)
 - igneous (intrusive/plutonic), harzburgite (0K)



An aerial photograph of a large stadium, likely the Allianz Arena in Munich, Germany, with a blue color overlay. The stadium's seating tiers and structural elements are visible from above.

Thanks!

Next up: Lunch
Meet back here at 1315
for breakout sessions