BOEM 101
& Deep Submergence Scientific Research

DeSSC Community Meeting

New Orleans

February 13, 2024

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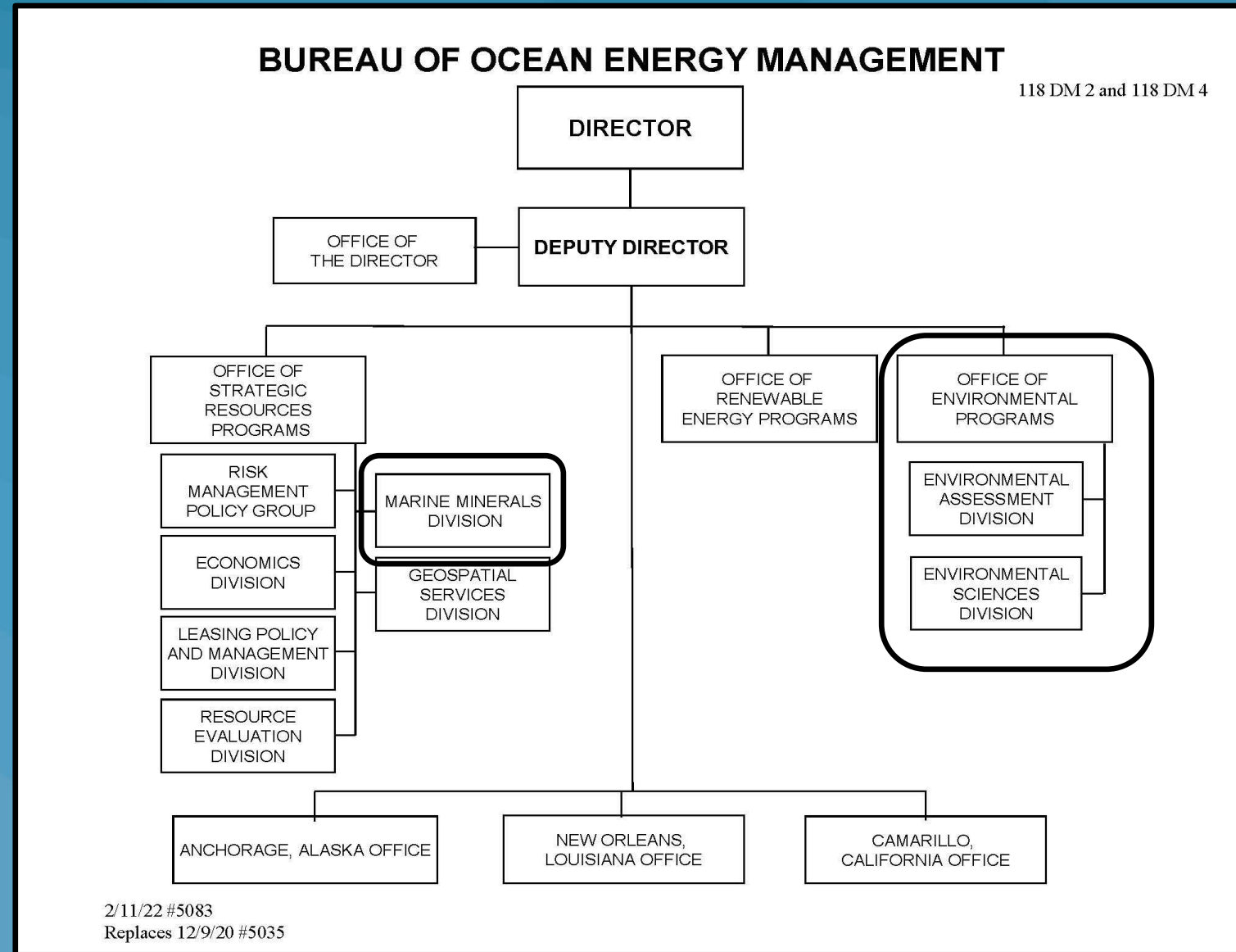Paul Knorr, Marine Minerals Division, paul.knorr@boem.gov

BOEM's Mission & Organization

The mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an **environmentally and economically responsible** way.

Only ~600 employees total to carry out this mission

https://www.boem.gov/newsroom/fact-sheets

BUREAU OF OCEAN ENERGY MANAGEMENT

118 DM 2 and 118 DM 4

- DIRECTOR
- OFFICE OF THE DIRECTOR
- DEPUTY DIRECTOR
- OFFICE OF STRATEGIC RESOURCES PROGRAMS
  - RISK MANAGEMENT POLICY GROUP
  - ECONOMICS DIVISION
  - LEASING POLICY AND MANAGEMENT DIVISION
  - RESOURCE EVALUATION DIVISION
  - MARINE MINERALS DIVISION
  - GEOSPATIAL SERVICES DIVISION
- OFFICE OF RENEWABLE ENERGY PROGRAMS
- OFFICE OF ENVIRONMENTAL PROGRAMS
  - ENVIRONMENTAL ASSESSMENT DIVISION
  - ENVIRONMENTAL SCIENCES DIVISION
- ANCHORAGE, ALASKA OFFICE
- NEW ORLEANS, LOUISIANA OFFICE
- CAMARILLO, CALIFORNIA OFFICE

2/11/22 #5083
Replaces 12/9/20 #5035

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Resource Program Areas

Oil & Gas

BOEM manages the nation's offshore O&G resources to ensure that exploration and development activities are conducted in a safe and environmentally sound manner.
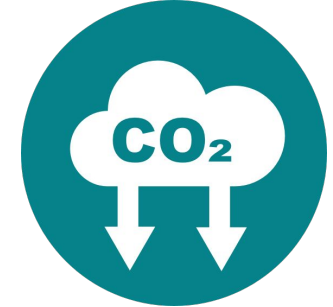
Renewables

BOEM is responsible for offshore renewable energy development in Federal waters. Development is anticipated from offshore wind energy, ocean wave energy, and current wave energy.

Marine Minerals

BOEM manages non-energy marine minerals on the OCS to foster ecosystem health and restoration while addressing the U.S. marine mineral resources needs.
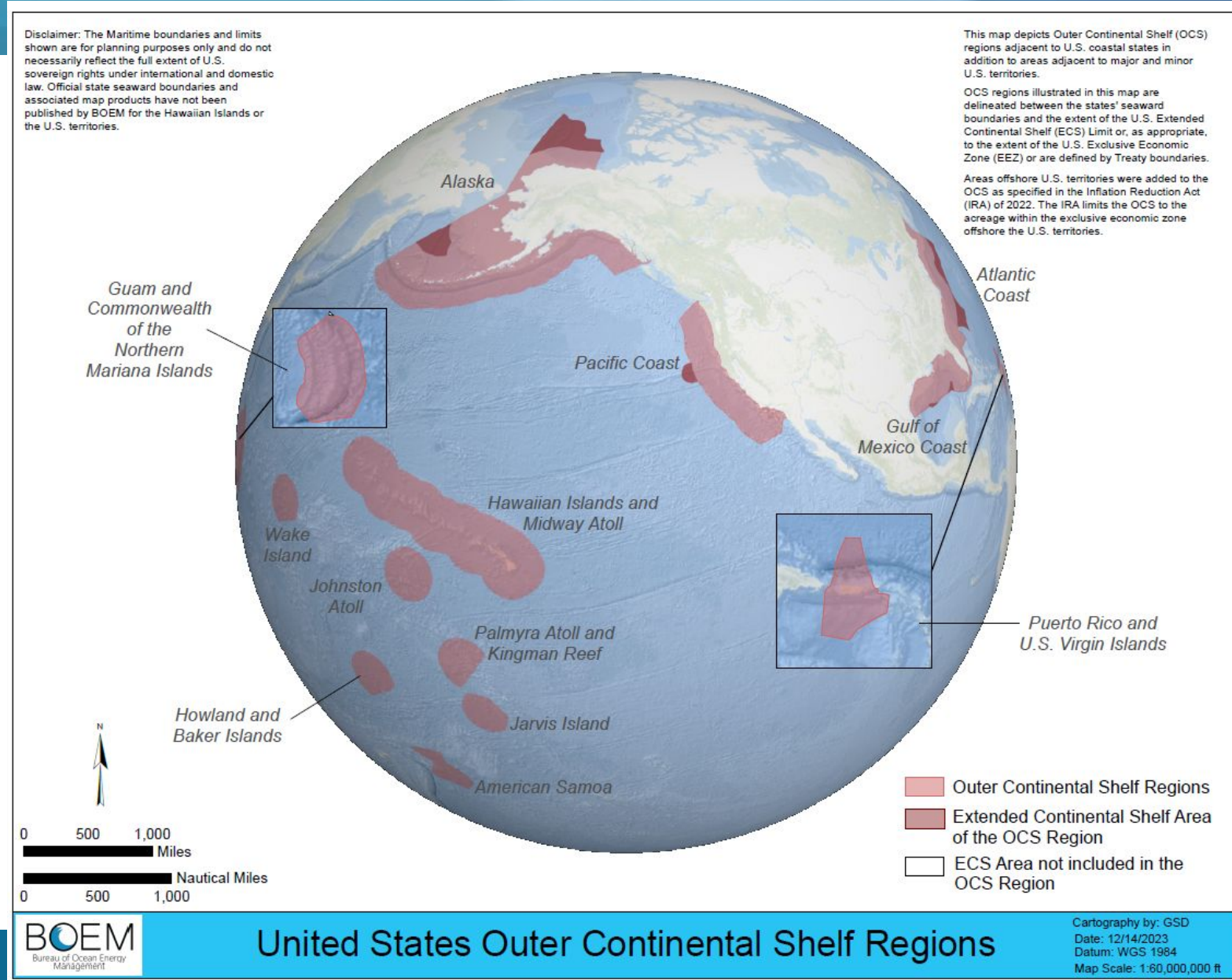
Sub-seabed carbon sequestration

Currently in rulemaking process and early program development following leasing mandate in Bipartisan Infrastructure Law.

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Jurisdiction – Recently Expanded

- Leasing and stewardship authority over the Outer Continental Shelf (OCS), the federal seabed adjacent to States

- Following 2022 Inflation Reduction Act, OCS now includes US Territories, and (we think) Possessions

- U.S. in Dec. 2023 also claimed Extended Continental Shelf beyond EEZ (dark red)

- New total acreage = ~3.2 billion acres

- No jurisdiction within National Marine Sanctuaries and Marine National Monuments; close coordination of any BOEM activities in vicinity

United States Outer Continental Shelf Regions

BOEM Environmental Studies

https://www.boem.gov/environmental-studies

- **Environmental Studies Program** develops, funds, and manages rigorous scientific research to inform policy decisions
- Information needed on:
  - environmental impacts from BOEM-authorized activities (before, during, and after)
  - status, trends, and resilience of potentially impacted natural and cultural resources and socioeconomic qualities
  - compliance with various federal statutes (e.g., NEPA, ESA/MMPA, NHPA, etc.)
- The program has provided over $1 **b**illion for research since its inception in 1973.
  - Annual total budget <$30M, no increases in decade
- Stakeholder idea submission process

Example Data Needs and Approaches (all Programs/Regions)

Some Data/Information Needs:

o Identify and delineate energy and mineral resources and associated habitats;

o Environmental conditions, biological communities, cultural resources, and human uses;

o Potential environmental and socioeconomic impact producing factors and impacts of offshore energy and mineral development activities.

Some Approaches:

o Partnerships and collaborators essential – limited funding (leveraging a necessity)

- o Very involved in interagency leveraging efforts: National Ocean Mapping, Exploration, and Characterization (NOMEC) & National Oceanographic Partnership Program (NOPP)

o Gather objective scientific data in **advance** of any significant development;

o Proactively engage stakeholders to gather and consider input in planning and management processes;

o Conduct concurrent environmental and resource fieldwork whenever possible (more cost efficient);

- o Focus on environmental and resource characterization field efforts that ground-truth and improve predictive models.

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DeSSC-relevant Challenges and Opportunities

- Recent expansion of BOEM's Outer Continental Shelf jurisdiction without accompanying budget expansion

- Areas of BOEM mission interest for data collection prioritized by jurisdiction, resource presence, and potential impacts
  - Supportive of NOMEC e.g., Priorities Report: https://www.whitehouse.gov/wp-content/uploads/2022/10/NOMEC_OEC_Priorities _Report.pdf

- Limited funding for field work, no vessels in our direct control

- General shortage of procurable deep (>4000m) submersible assets

- Generally more information about energy resources than mineral resources, but growing interest/need including ecological

- 1.5+ year lead time for (most) new environment studies funding; Somewhat less lead time for other BOEM operational funding

- Interagency Agreements (NOAA, National Science Foundation – Academic Research Fleet), Cooperative Ecosystem Studies Units network, Contracts (competitive)

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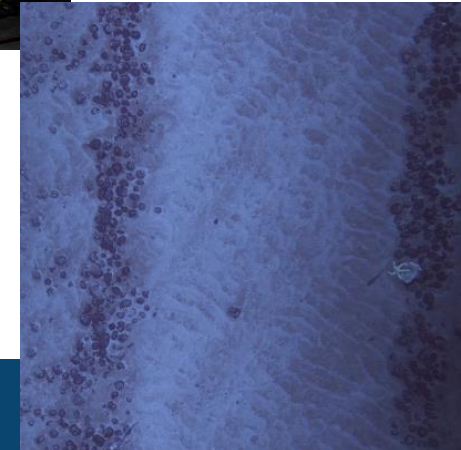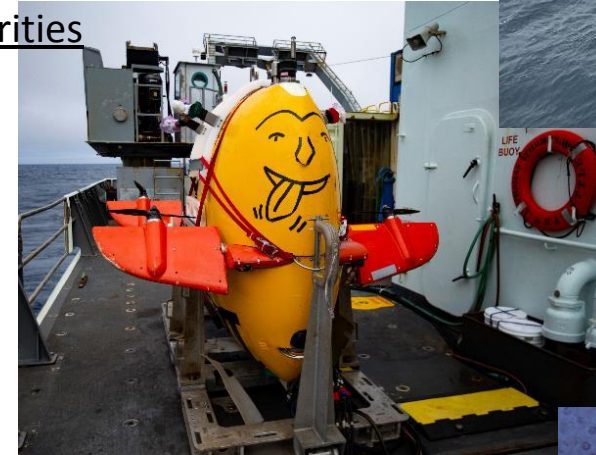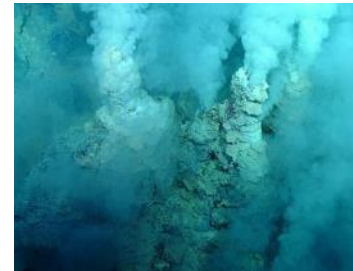
U.S. Critical Minerals

- Non-fuel mineral or mineral material essential to U.S. economic and national security

    - Supply chain is vulnerable to disruption (import-reliant, low production)

    - Serves a vital function in the manufacturing of a product

- List developed by USGS, updated every 3 years

    - Revised USGS 2022 list adds Ni / Zn, total of **50** minerals

Source: USGS

Source: USGS

Source: NOAA

Critical Minerals Occurring Offshore

Yellow = Occur in marine minerals within the US Exclusive Economic Zone

- Aluminum
- **Antimony**
- Arsenic
- Barite
- Beryllium
- **Bismuth**
- Cesium
- Chromium
- **Cobalt**
- Fluorspar
- **Gallium**
- **Germanium**
- Graphite
- Hafnium
- Indium

- **Lithium**
- **Magnesium**
- **Manganese**
- **Nickel**
- **Niobium**
- Rubidium
- Tantalum
- **Tellurium**
- **Tin**
- **Titanium**
- Tungsten
- **Vanadium**
- **Zinc**
- **Zirconium**

Platinum Group Metal

- **Iridium**
- **Palladium**
- **Platinum**
- **Rhodium**
- **Ruthenium**

Rare Earth Elements

- **Scandium**
- **Yttrium**
- **Lanthanum**
- **Cerium**
- **Praseodymium**
- **Neodymium**
- **Samarium**
- **Europium**
- **Gadolinium**
- **Terbium**
- **Dysprosium**
- **Holmium**
- **Erbium**
- **Thulium**
- **Ytterbium**
- **Lutetium**

The types of critical minerals that occur in offshore deposits are used in transportation **(lithium, cobalt, manganese)** and defense and national security **(germanium, rare earth elements)**

Table adapted from 86 FR 71083

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Offshore Critical Minerals: Types of Deposits

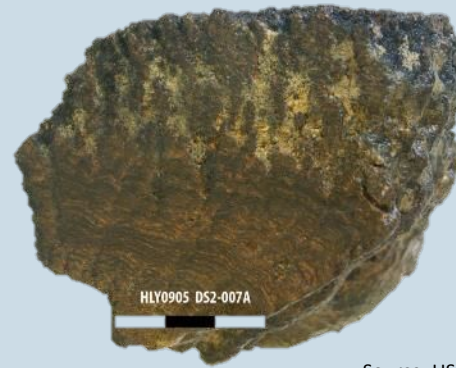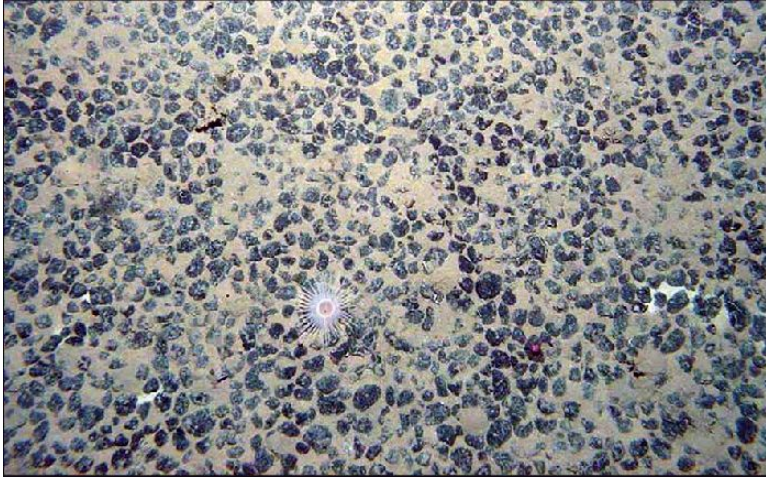| Manganese (or Polymetallic) Nodules	Ferromanganese Crust	Seafloor Massive Sulfides
Source: BOEM Source: USGS	HLY0905 DS2-007A Source: USGS	Source: BOEM
Depth: 4,000 to 7,000m **Occurrence**: Abyssal plains **Extent**: Occur in all ocean basins **Growth Rate**: **2-10 mm / million years** **Critical Minerals**: **Cobalt, manganese, REE, tellurium, platinum, bismuth, niobium, zirconium**	**Depth**: 600 to 7,000m **Occurrence**: Seamounts **Extent**: Central and western Pacific **Growth Rate**: **1-4 mm / million years** **Critical Minerals**: **Cobalt, manganese, REE, tellurium, platinum, bismuth, niobium, zirconium**	**Depth**: 100 to 7,000m **Occurrence**: Hydrothermal magmatic precipitates **Extent**: Globally along active tectonic boundaries **Growth Rate**: **varies up to ≤ cm / day** **Critical Minerals**: **Antimony, bismuth, gallium, tellurium, germanium**
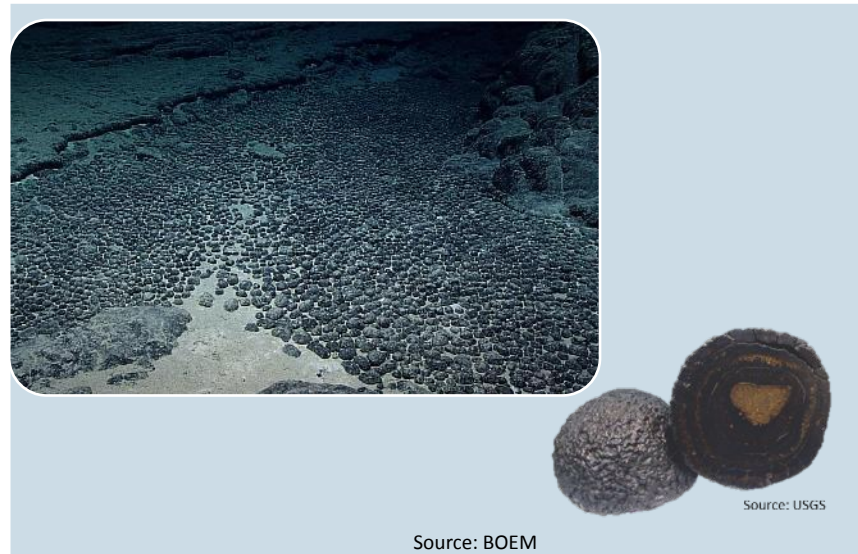
Types of Mineral Deposits

Source: IOM Joint Organization (2009)

Polymetallic Nodules

Source: Drew (2009) Oceanus

Seafloor Massive Sulphides (SMS)
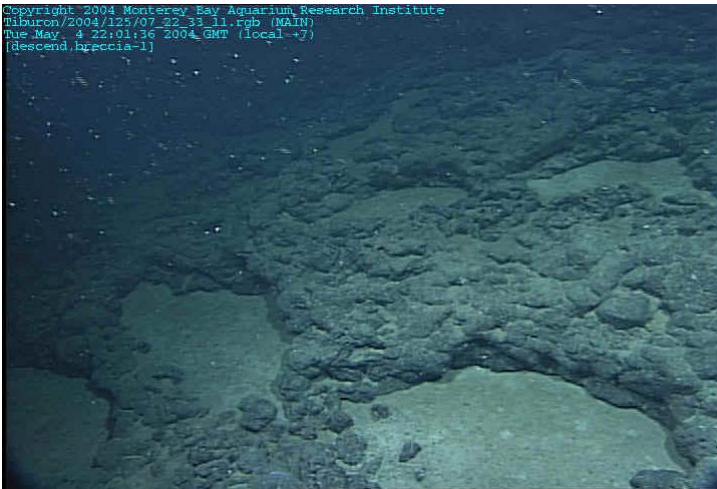
Source: Monterey Bay Aquarium Research Institute (MBARI), Southern Patton Escarpment, CA

**Cobalt-Rich Ferromanganese Crusts**

Source: USGS, Folly Beach, SC

Heavy Mineral Sands

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Exploration – data and information needs

- **Baseline information**
  - Bathymetry / backscatter / subbottom profile
  - Water column profiles (CTD+)
- **Mineral information**
  - Absence or presence (drop cams or similar method)
  - Extent (not just one location)
  - Resource abundance, density, composition
- **Environmental information**
  - Biota (nodule, seabed, and water column)
  - Water and sediment chemistry
  - Current information (bottom, intermediate, surface)

Source: USGS

Source: BOEM

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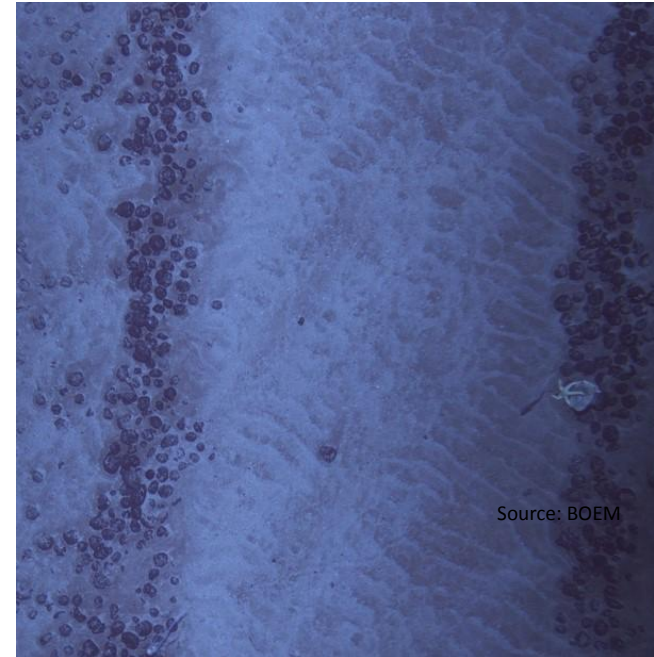
Blake Plateau Research

Document 50 km^2 study area with:

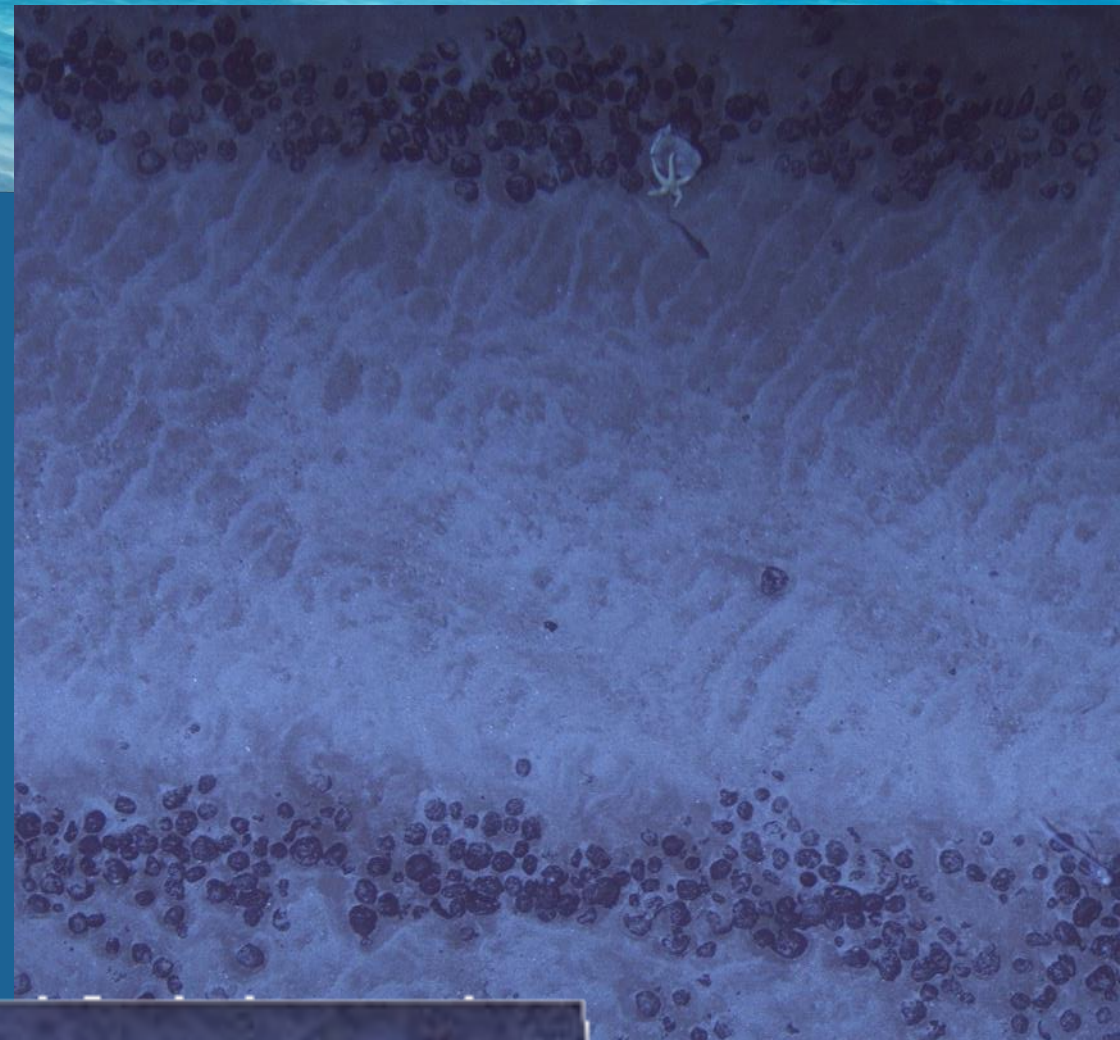- ~ **550,000 high resolution photos**
  - 12 megapixels at 5 m flight height
- **Fine scale bathymetry data**
 - 1 m or better, most at 0.5 m
- **Side-scan sonar**
- **Sub-bottom profile and magnetometry**

Examples of Pacific CM Field Research

- Southernmost portion of Hawaii EEZ
  - 2023: E/V *Nautilus* hybrid mapping/water column characterization
  - 2024: NOAA Ship *Okeanos Explorer* multibeam surveys
  - 2024: USGS-led R/V *Kilo Moana* sampling cruise to ground-truth USGS models and gather environmental data (e.g., eDNA, sediment/fauna)
- Minerals and Ecosystems of the Remote Pacific: USGS-led
  - Purpose – Collect abyssal nodule resource information in high priority remote areas of the US EEZ
  - Looking to piggyback on other expeditions (e.g., UNOLS, NOAA, other) with geology (box-cores) and mid-water biology data collections
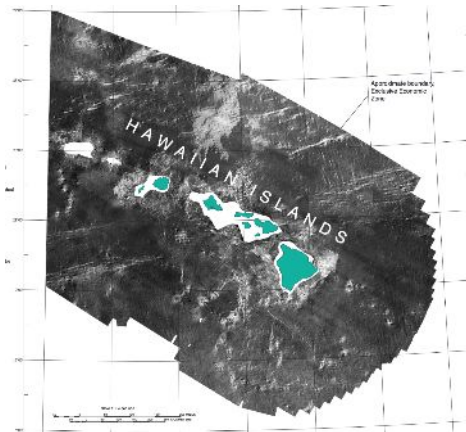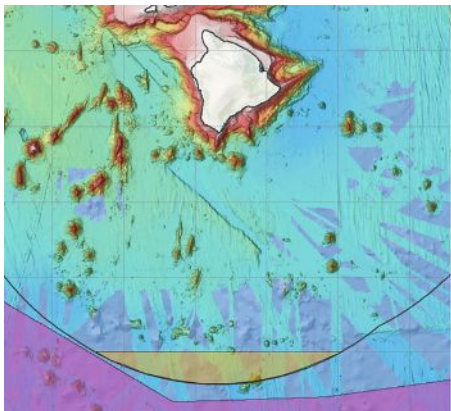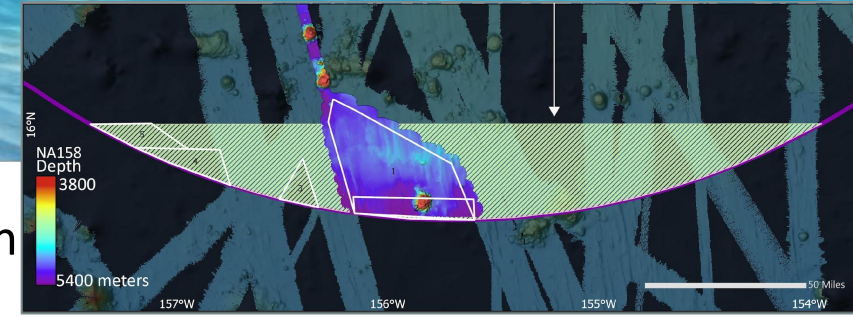
USGS

Type	Resource Information Needs	Suggested Tools	High Priority Regions Based on Economic Potential	Additional Recommended Areas
Polymetallic Nodules	Presence/absence, extent, abundance, composition, surrounding environment and fauna	Box core, TV or free fall grab, video, AUV, ROV	American Samoa, CNMI, Guam, Jarvis, Wake, Kingman and Palmyra, Johnston Atoll, Howland and Baker	Hawaiian Islands, Clarion-Clipperton Zone (outside U.S. EEZ)
Ferromanganese Crusts	Presence/absence, thickness, extent, composition, surrounding environment and fauna	ROV, AUV, video, dredge, drill	Magellan seamounts east of Mariana arc, northern Kingman and Palmyra seamounts,	Liliuokalani Ridge Seamounts); Northwestern Hawaiian islands, Johnston Atoll and Wake Island
Seafloor Massive Sulfides	Presence/absence, surface and below seafloor extent, composition, surrounding environment and fauna	ROV, AUV, video, coring, drilling, electromagnetics	Mariana arc and backarc; Gorda Ridge	American Samoa; Aleutian Islands

Consortium for Ocean Leadership Priorities Workshop – Marine Resources Section Summary

BOEM / CM-relevant mission needs

- Focus ocean exploration in geographic areas where there is a predicted future federal management need;

- Prioritize CM activities related to abyssal nodules

- Identify and support exploration operations that meaningfully address mineral resource information needs:
  - Ensure that field work is implemented in a manner that can be used to inform the USGS marine mineral prospectivity models;
  - Consider additional operational capabilities;
  - Support the development of novel assessment methods --including low-cost initial exploratory methods;
  - Supplement mapping with systematic sampling.

CAPSTONE, NOAA, 2015

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