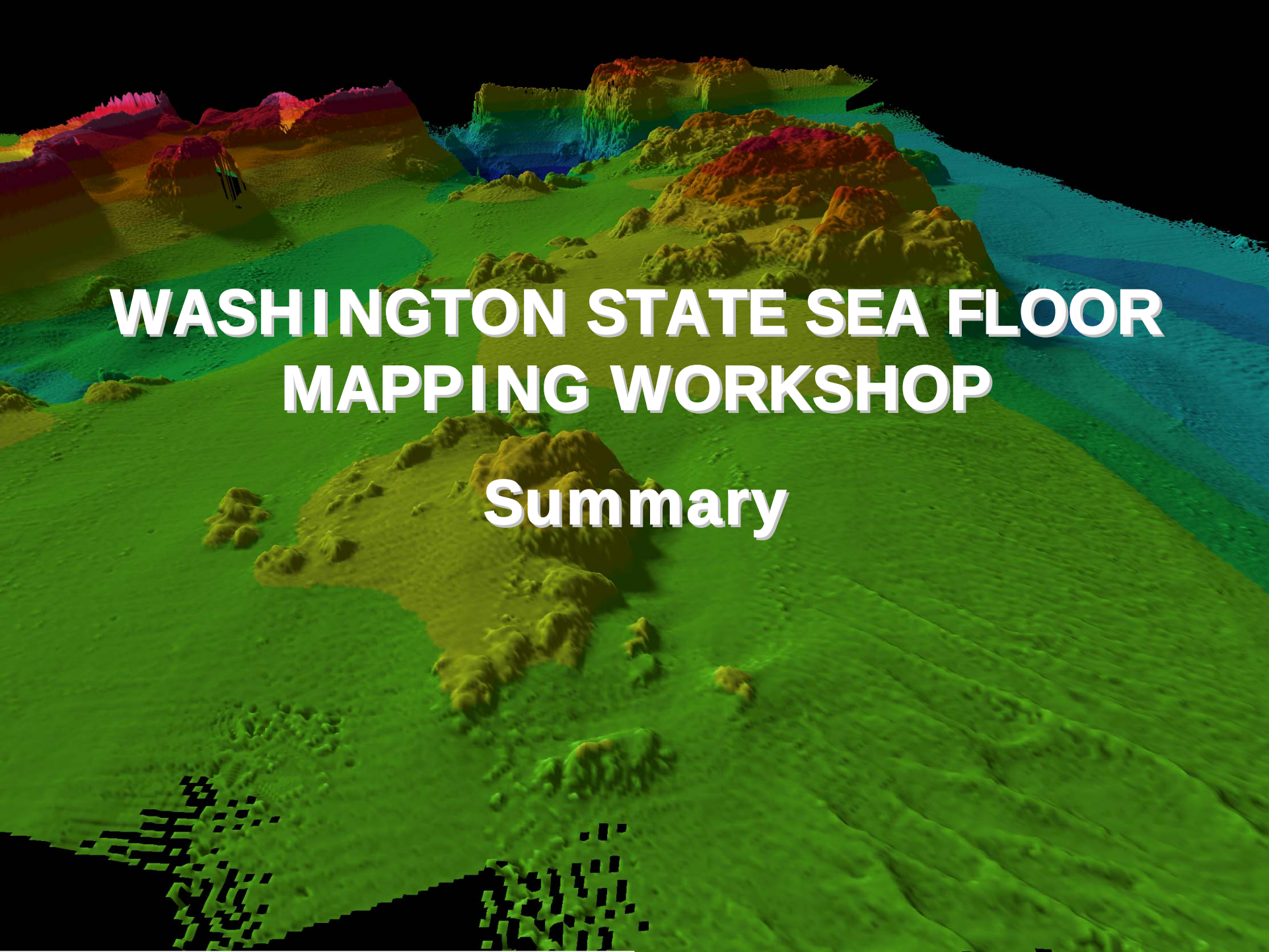


WASHINGTON STATE SEA FLOOR MAPPING WORKSHOP

Summary

Workshop Objectives

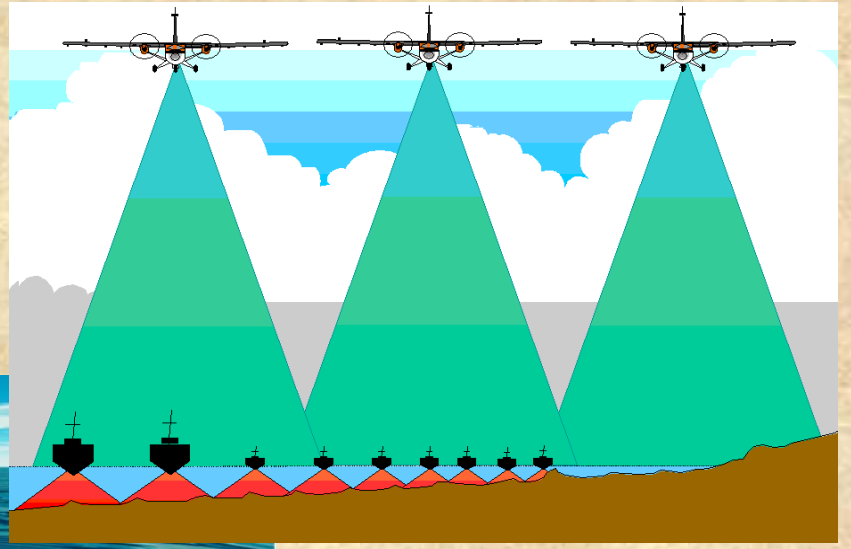
1. Highlight advanced technologies for imaging the seafloor and resulting products.
2. Foster discussion on the status of mapping and planned mapping efforts in Washington and other areas along the West Coast.
3. Determine data gaps and priorities for future mapping efforts.
4. Develop partnerships and next steps to advance mapping in Washington.

Sea Floor Maps - Why do we care?

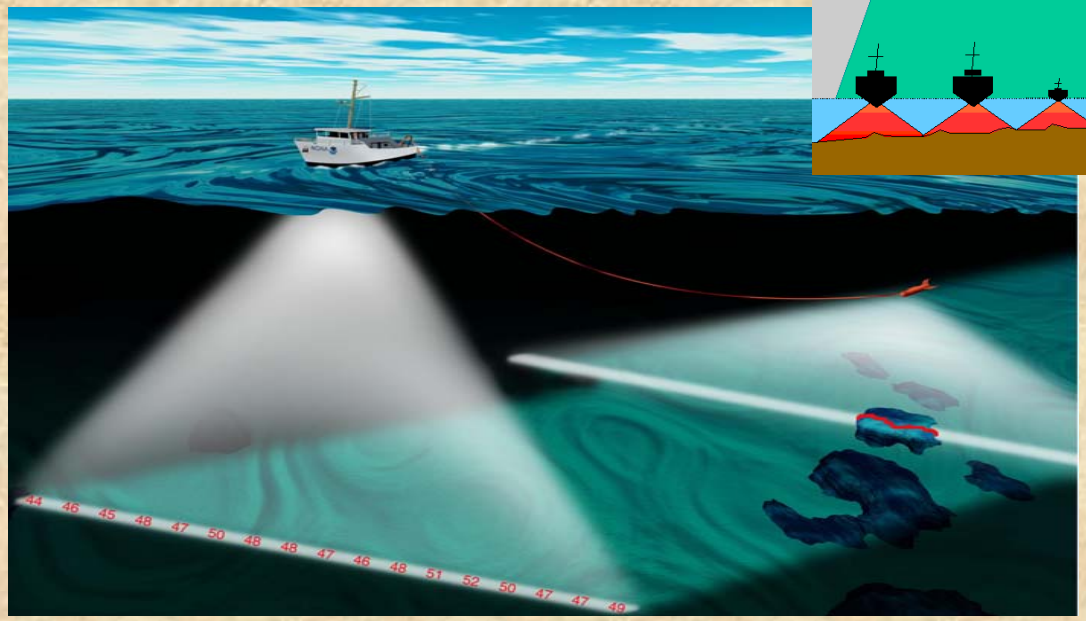
1. Safe navigation and commerce
2. Characterization of benthic habitats
3. Fisheries management, especially marine protected areas
4. Baselines for monitoring change (e.g., sea level impacts)
5. Sediment and contaminant budgets and transport, coastal processes
6. Regional sediment management, coastal erosion
7. Site evaluation - nearshore/offshore infrastructure
8. Earthquake and tsunami sources - hazard assessment
9. High-resolution for circulation and sediment transport modeling (e.g., inundation from storm surge or tsunamis)
10. Understanding geologic history and change

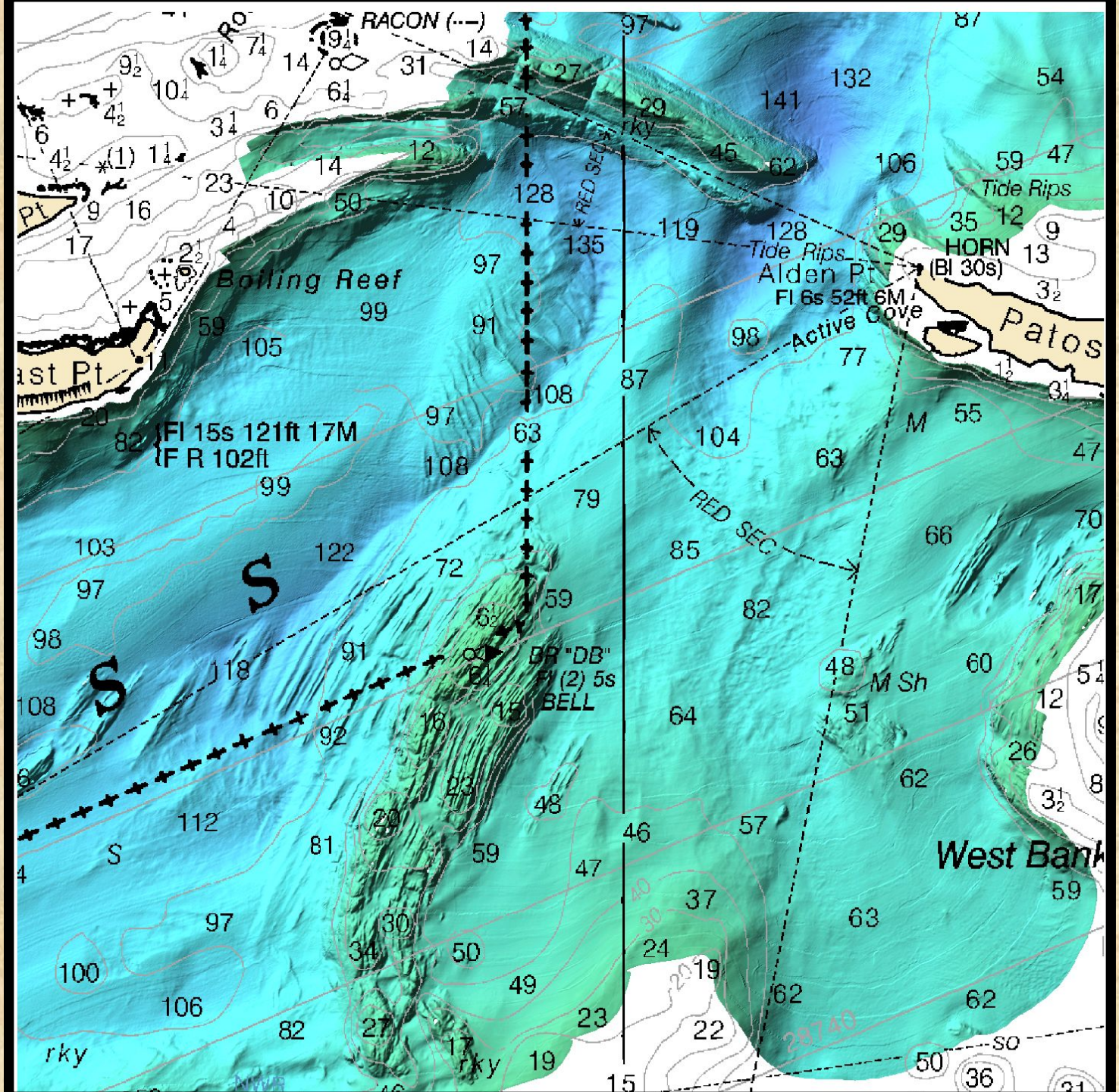
Seafloor Mapping Techniques

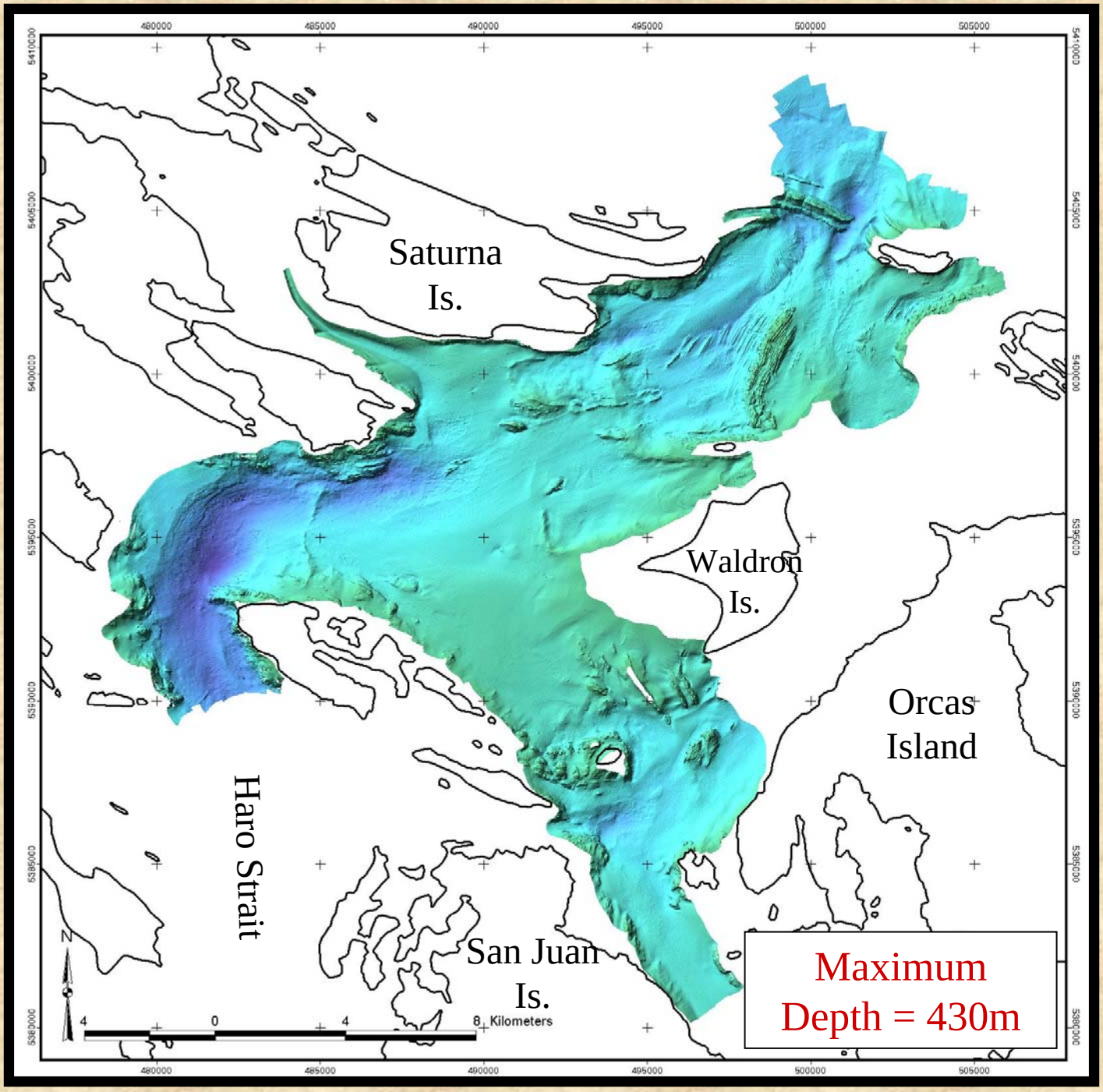
LIDAR in the Nearshore



Multibeam or Side-scan Sonar



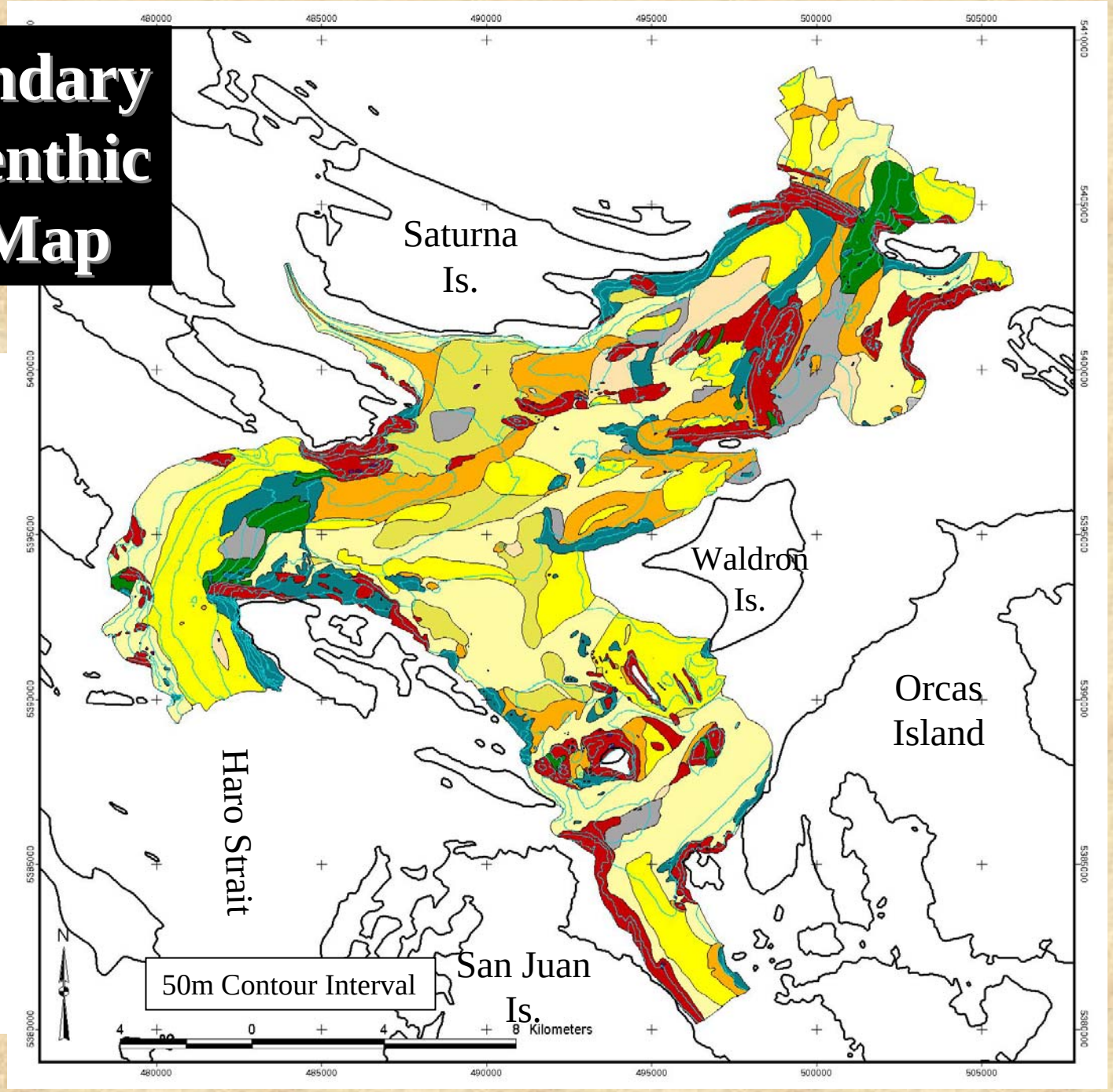

RACON (--)
Boiling Reef
Alden Pt
Fl 6s 52ft 6M
HORN
(Bl 30s)
Tide Rips
Active Cove
Patos
Fl 15s 121ft 17M
F R 102ft
RED SEC
BR "DB"
Fl (2) 5s
BELL
M Sh
West Bank
rky
S


Saturna Is.
Waldron Is.
Orcas Island
Haro Strait
San Juan Is.
Maximum Depth = 430m
N
4 0 4 8 Kilometers

Transboundary Marine Benthic Habitat Map

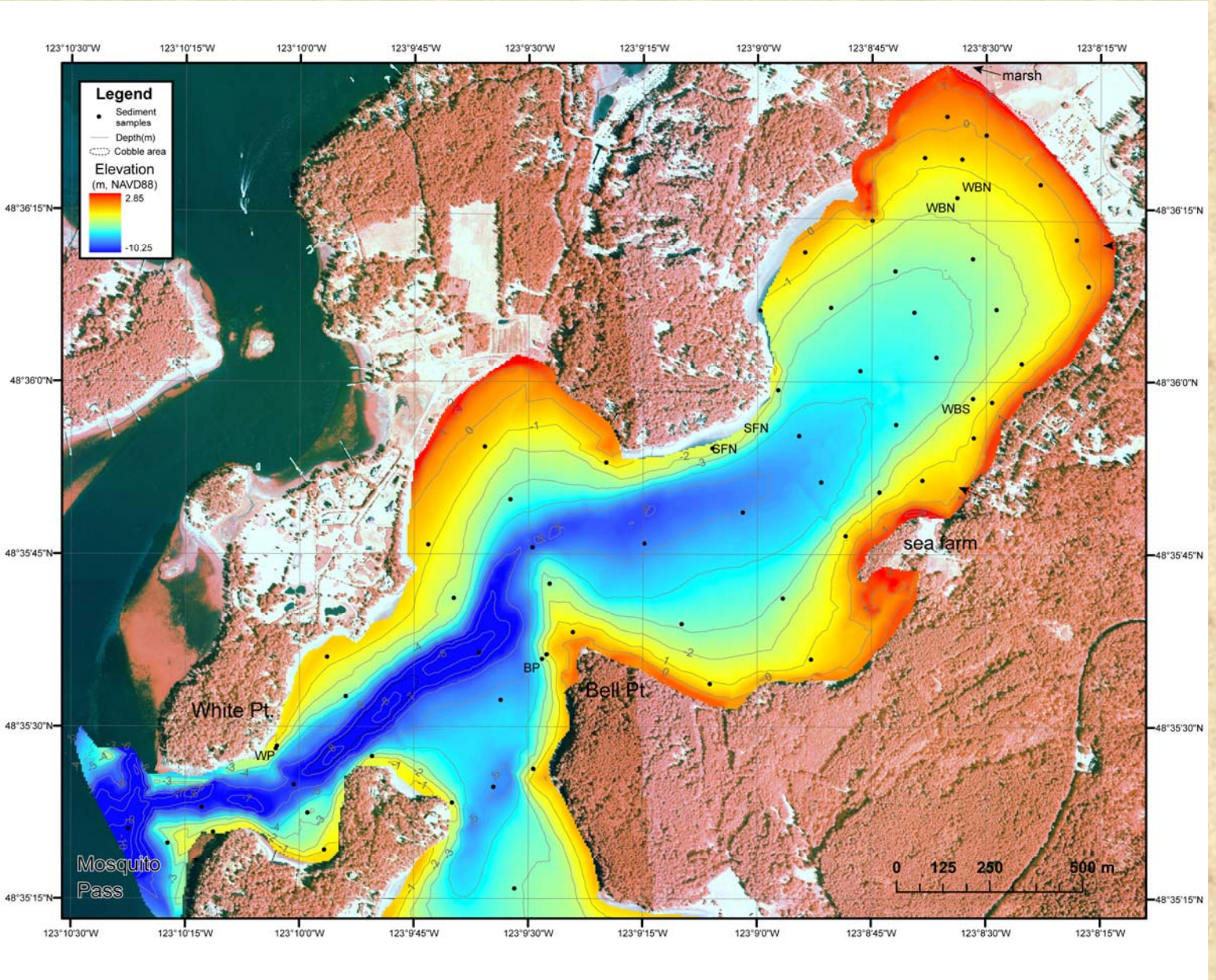
Habitat Code

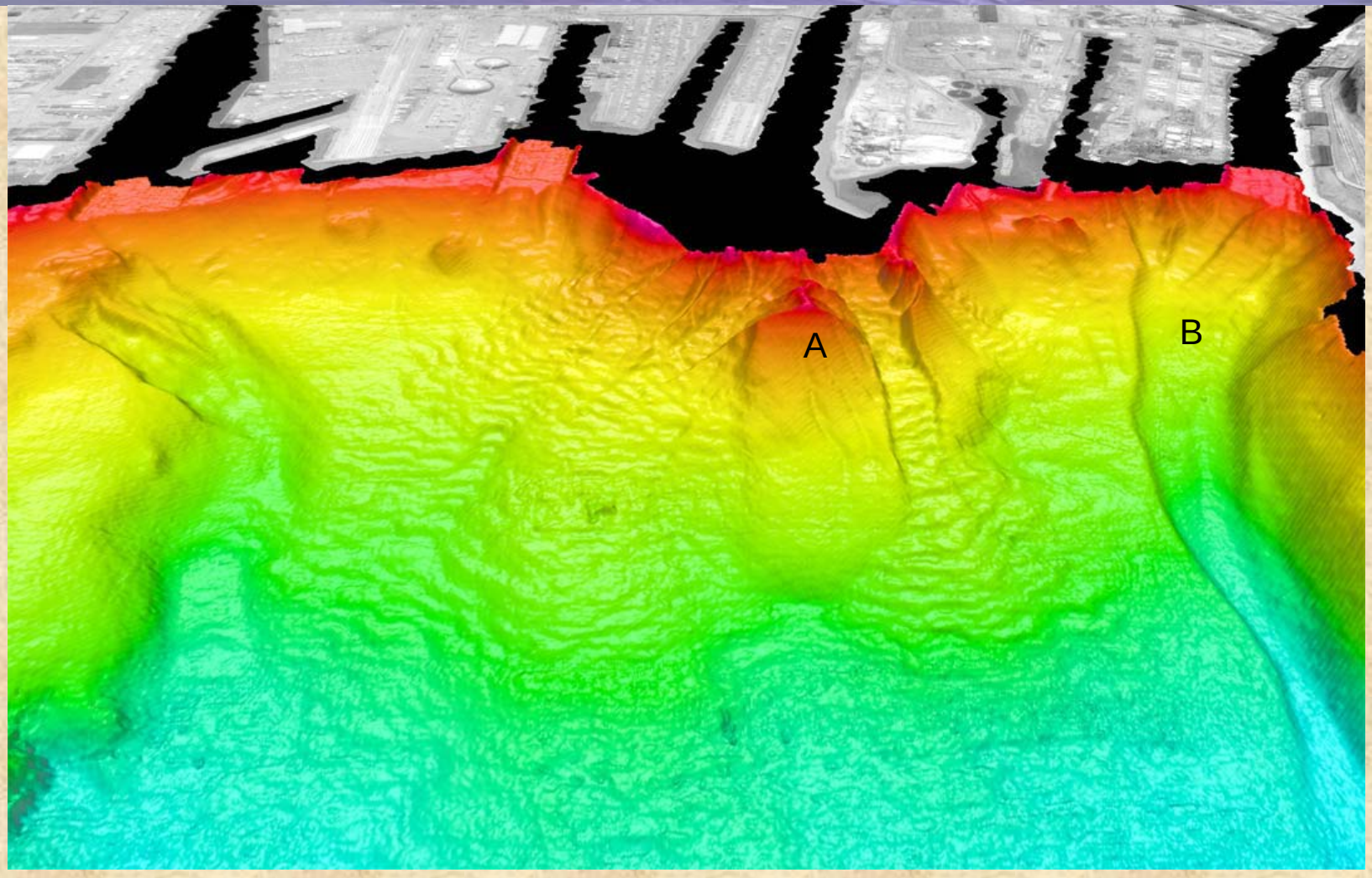
- lhd_d/s
- lhe_f/s
- lhp/(b?)_s
- lme/f_u
- lmg/w_s/b?
- lmm_s
- ls_u
- lsg_u/r
- lsm_c/s
- lsw_u/h
- no_data



High-res Bathymetry

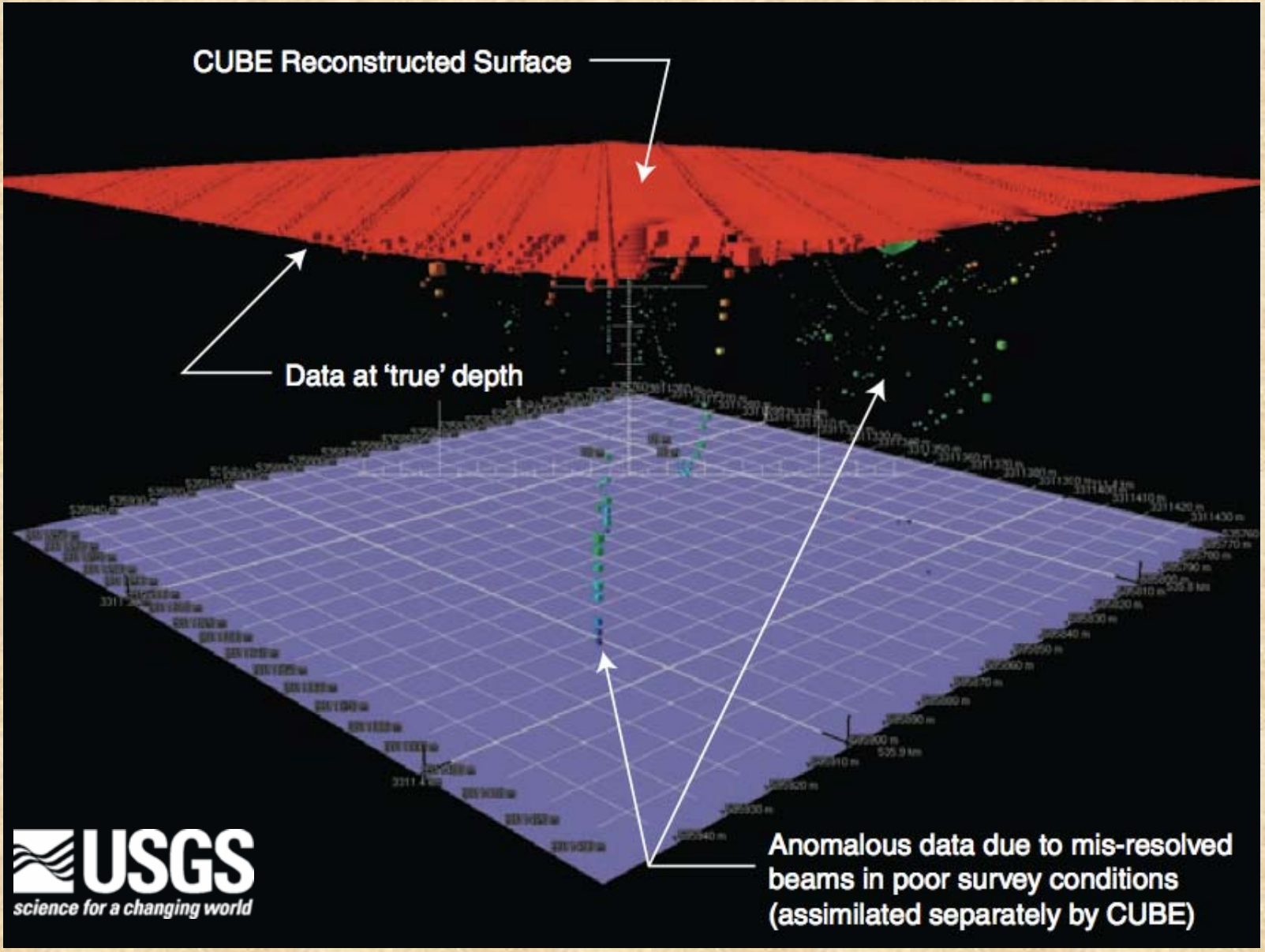
Vertical RMS ±10 cm



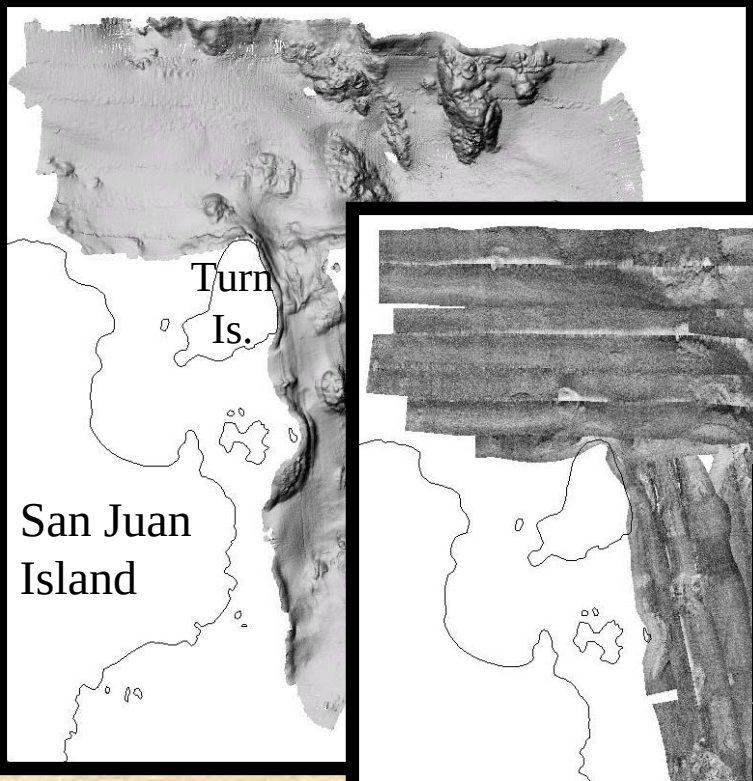


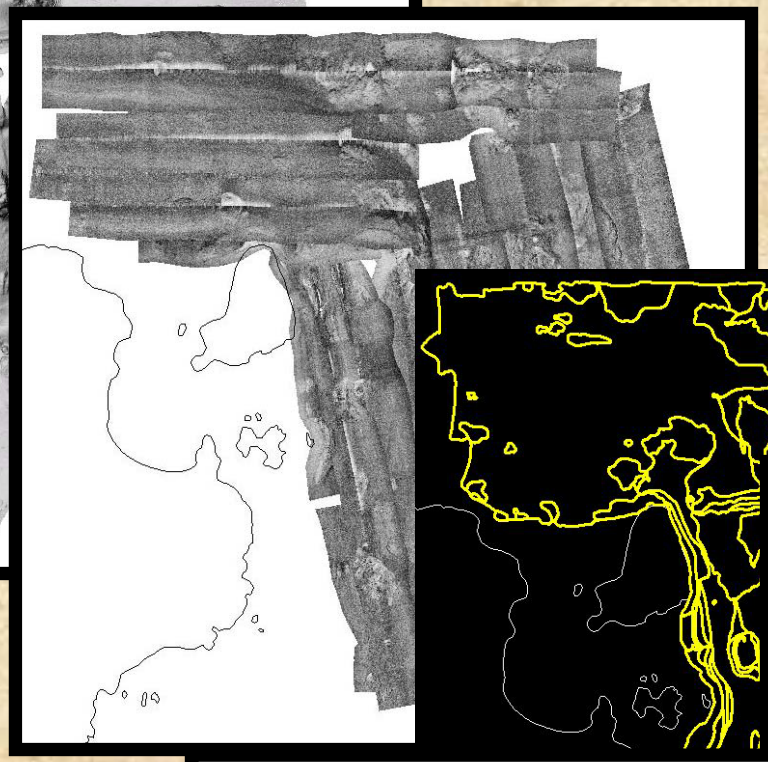
Perspective view looking southeast over Puyallup Delta near Tacoma WA. Depths in this image ranging from 1m to about 130m. The distance across the bottom of the image is about 2.5km and the vertical exaggeration is 10x. The large deposit in the middle of the view (A) is a disposal site abandoned in the mid 1980's and has since been split by a slump. The large landslide scar on the right side of image (B) was caused by an 1894 landslide.

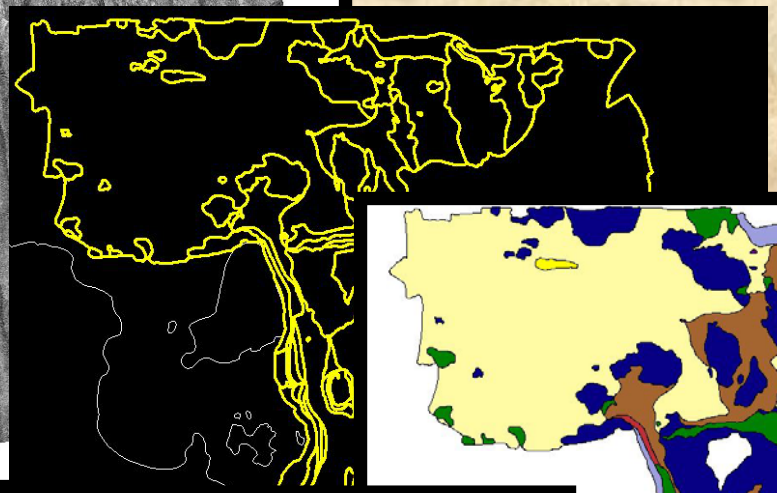
Calder and Mayer (2001)

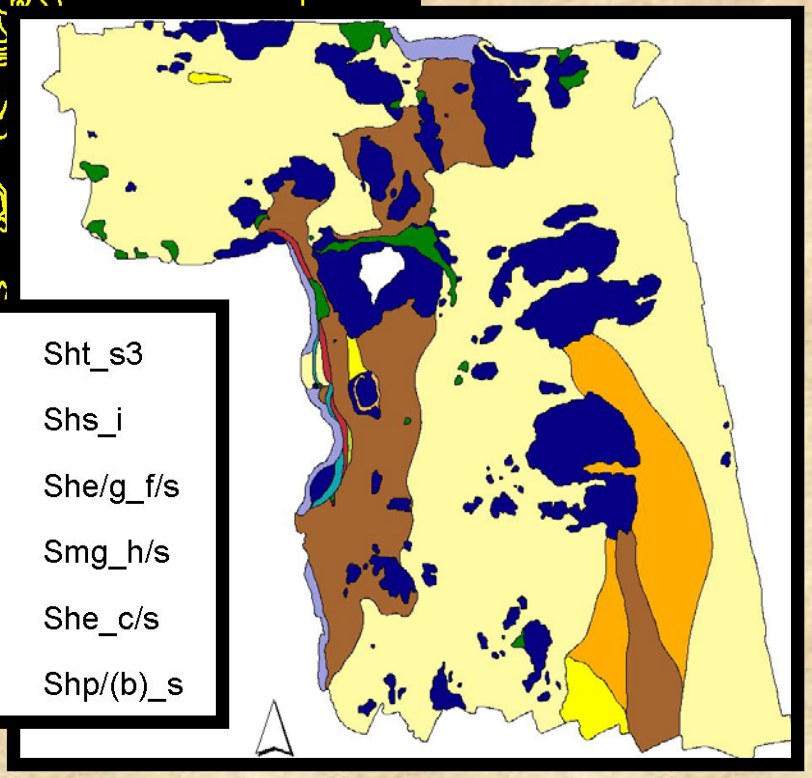


Creating a Habitat Map



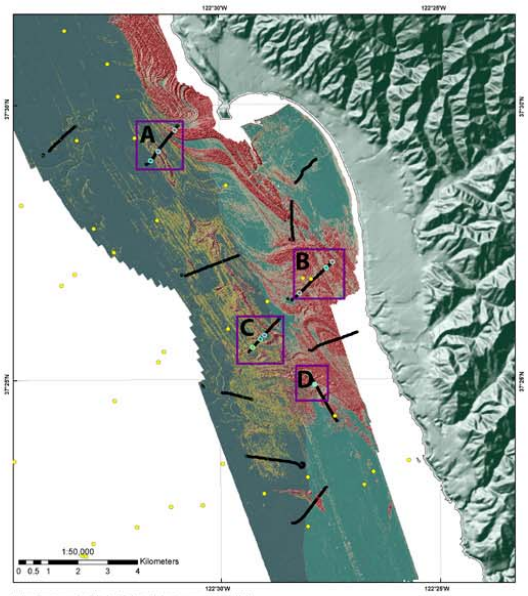




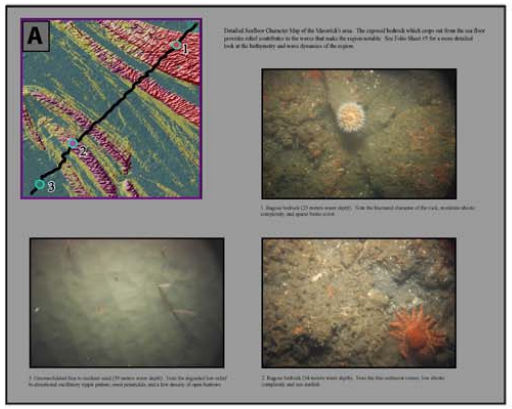


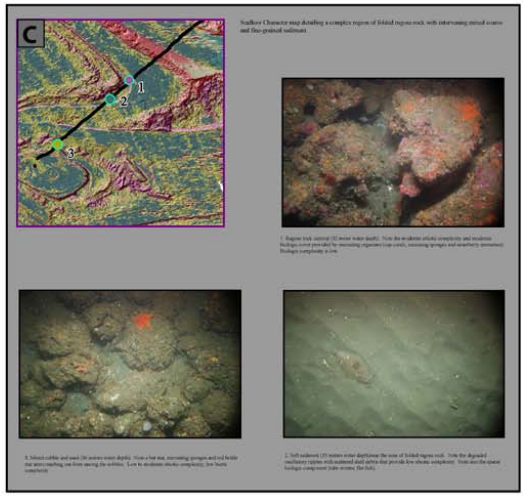
	Ss_u/(s?)		Sht_s3
	Ssw_u/r(s?)		Shs_i
	Ssm_u/r(s?)		She/g_f/s
	Ss_h/s		Smg_h/s
	Sht_s1		She_c/s
	Sht_s2		Shp/(b)_s

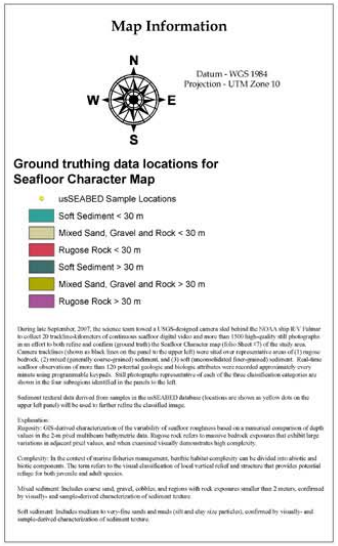
Ground-truthing and Biological Features



Seafloor Character map (from Folio sheet #7) showing the location o camera tracklines (black lines) used to refine and ground truth the classification. Locations of the detailed subregions (A through D) and seabashed sediment sample locations (yellow circles) are also shown.







Critical Areas Remaining

334 Total Square Nautical Miles

High Commercial Traffic Volume
Inadequate Charts
Compelling Request
Extensive Petroleum/Hazmat material transport
Low Under Keel Clearance

Priority 1

116 Total Square Nautical Miles

Navigation Significant: < 20 fathom depth
Survey vintage pre-1940
Petroleum transport > 1,000,000 tons
or Coal transport > 600,000 tons
or Chemical/Waste transport >100,000 tons
or Cargo > 5,000,000 tons
or Passenger transport > 10,000

Priority 2

2,429 Total Square Nautical Miles

Navigation Significant: < 20 fathom depth
Survey vintage pre-1940
Not Priority 1

Priority 3

991 Total Square Nautical Miles

Navigation Significant: < 20 fathom depth
Survey vintage pre-1970
Not Priority 1 or Priority 2

Priority 4

801 Total Square Nautical Miles

Navigation Significant: < 20 fathom depth
Survey vintage 1970-1993

Full Bottom Coverage Era

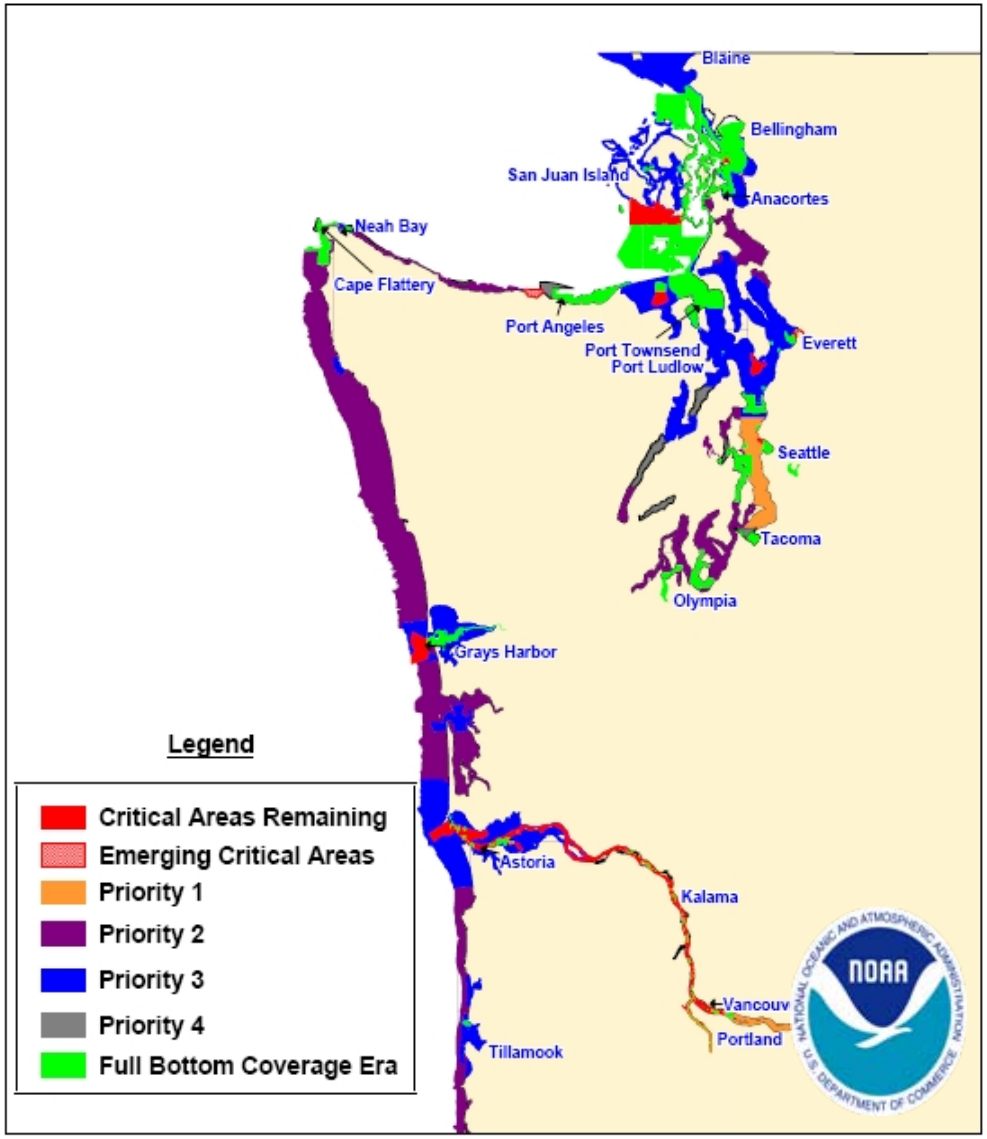
601 Total Square Nautical Miles

Completed Critical/Navigationaly Significant Areas
Survey vintage post-1993

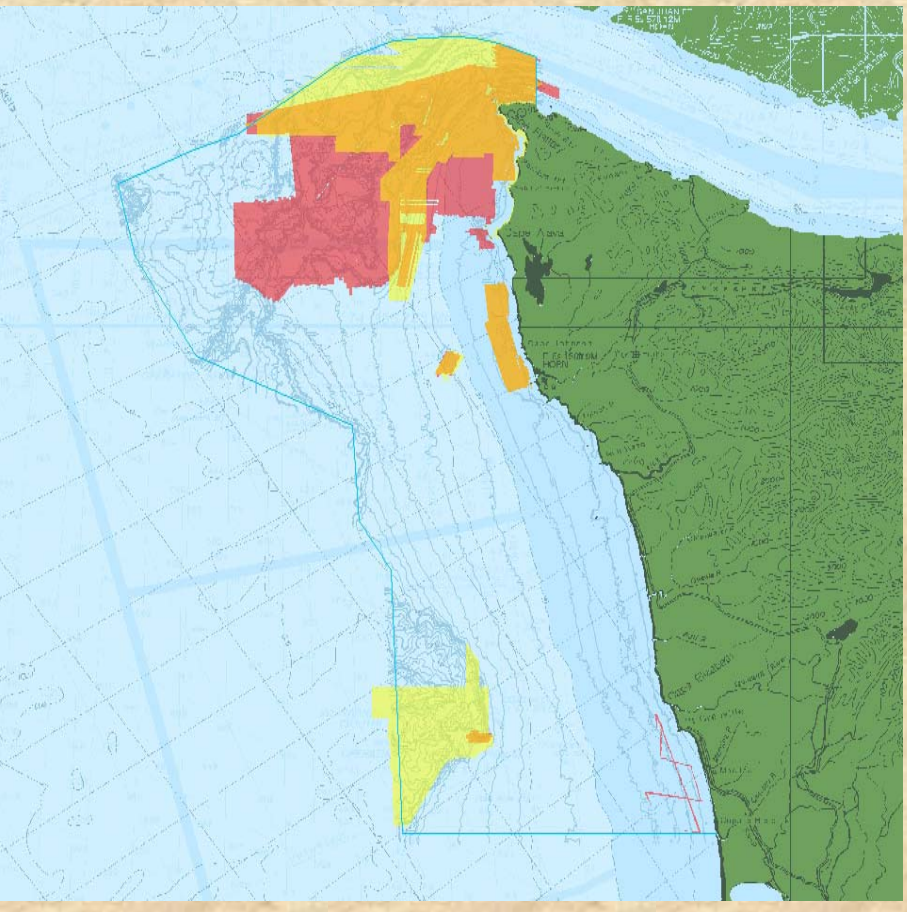
NOAA Hydrographic Survey Priorities - West Coast

Washington

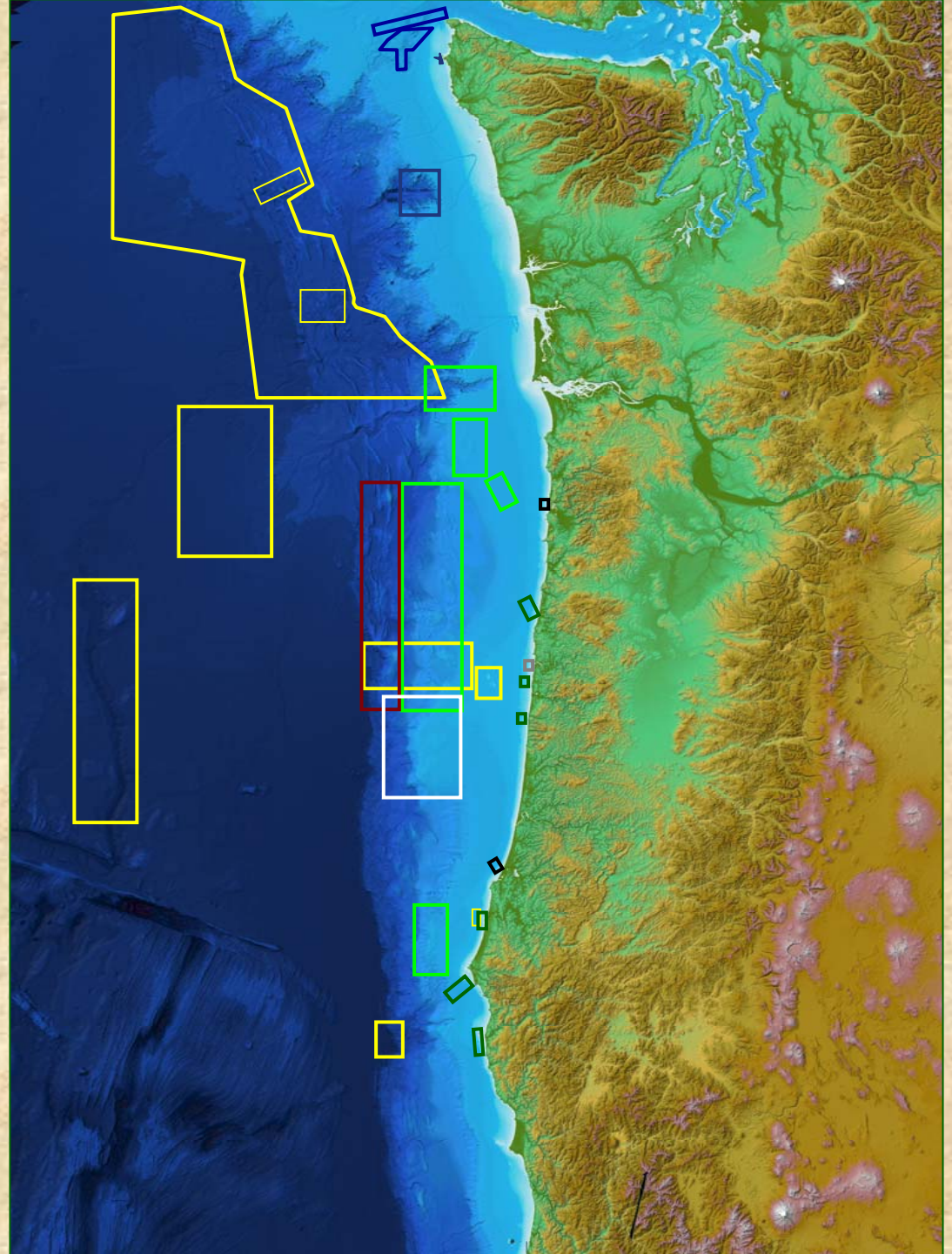
2007



Olympic Coast NM Sanctuary-Mapped Areas Through 2007

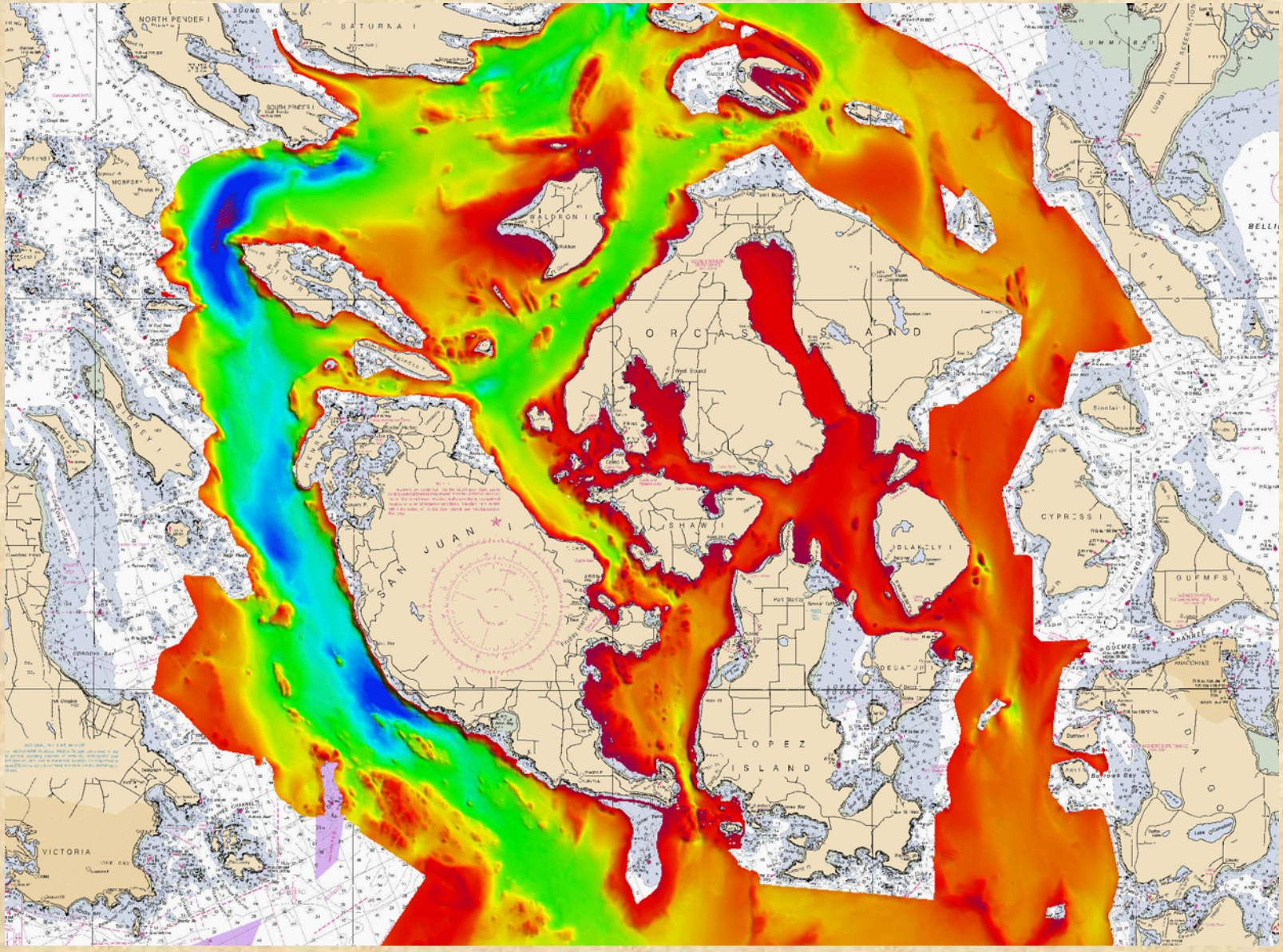


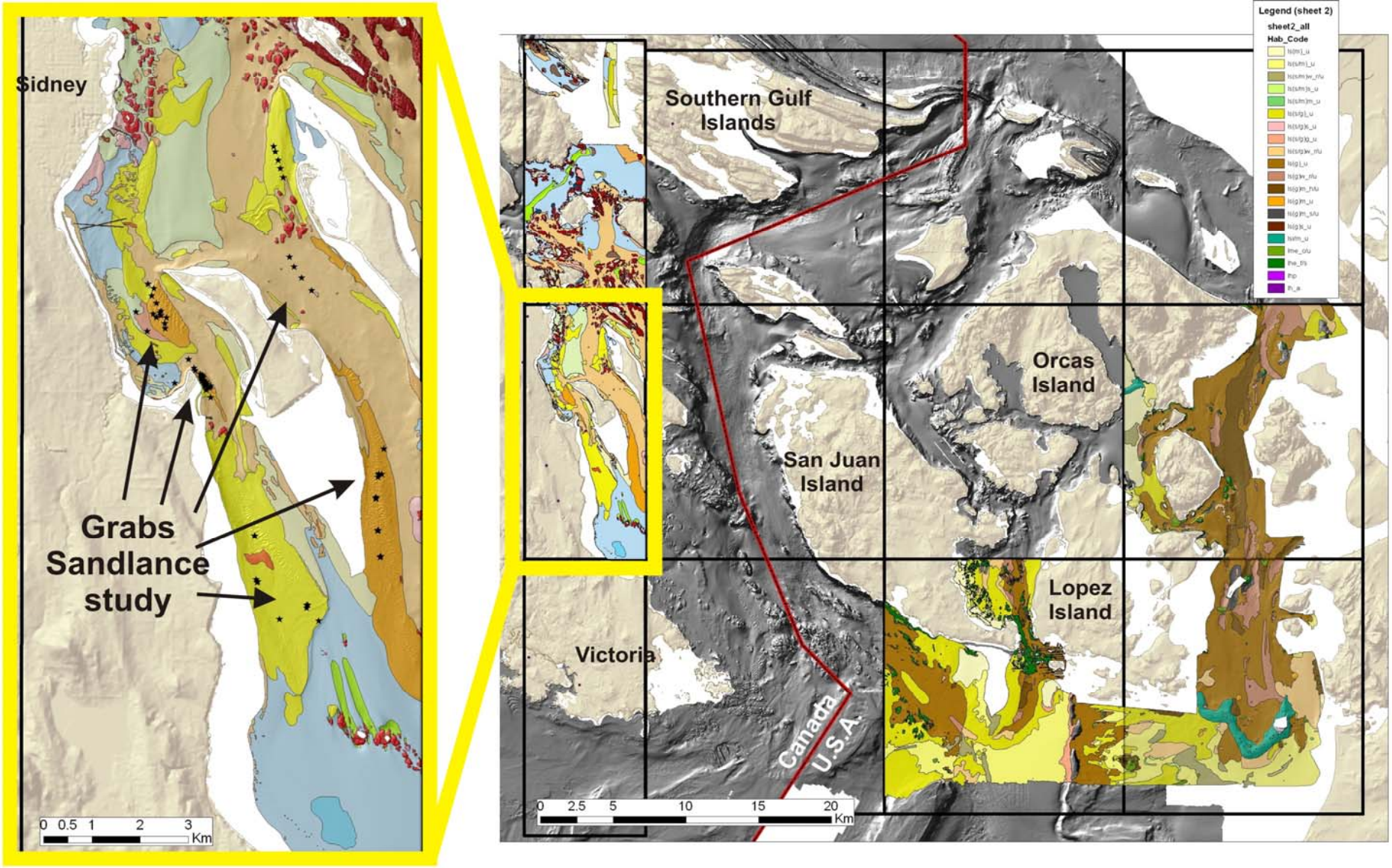
- Red = Side Scan
  Yellow = Multibeam
  Orange = dual coverage
- < 25% Mapped
- Data Catalog at OCNMS web site: http://olympiccoast.noaa.gov/research/mapping/welcome.html



- OSU
- OSU/NOAA
- NOAA/NOS
- NOAA/MBARI
- NOAA OCNMS
- NOAA PMEL
- ODFW
- Industry

San Juan Mapping Project

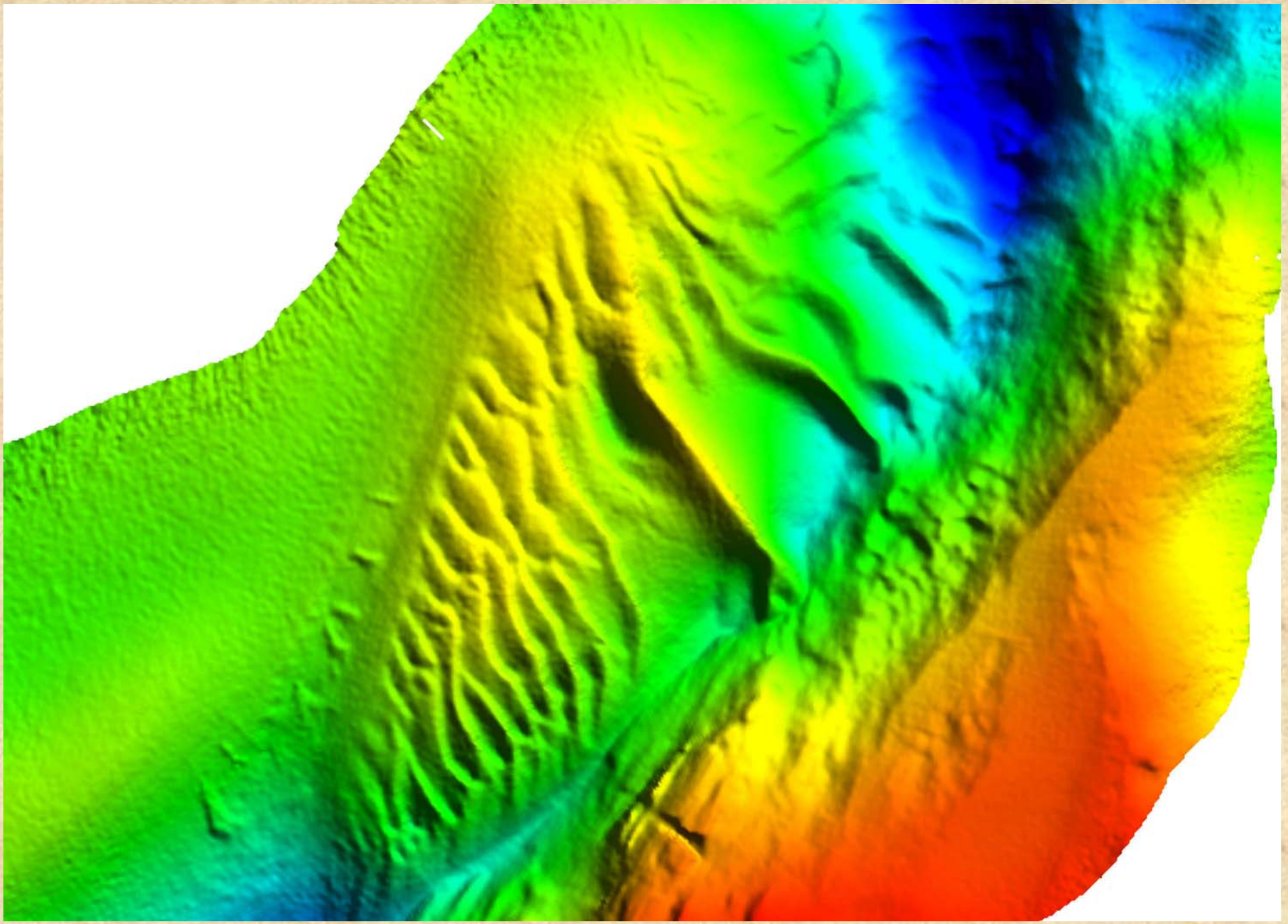




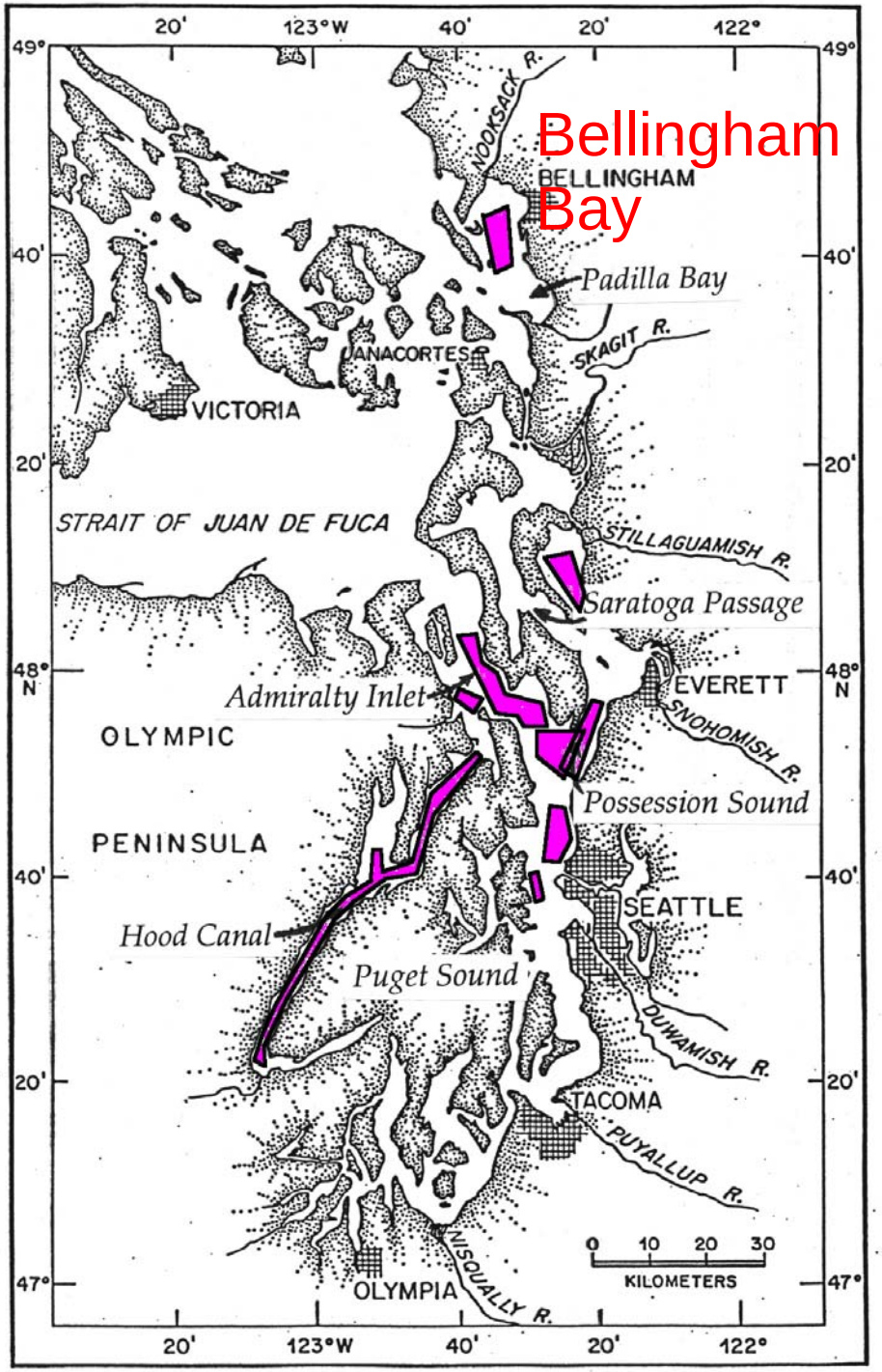
Sheet11 Habitats

Hab_code, Hab_Desc

- **lh_a, Pipeline**
- **lhe_f/s, Upper Cretaceous sedimentary Nanaimo Group exposure**
- **lhe_f/s, Undifferentiated bedrock exposure fractured and glacially scoured**
- **lhp, Pinnacle or boulder**
- **lme_c/u, Veneer of sediments covering bedrock and in place exposed**
- **ls(b)_a/u, Riprap (boulder)**
- **ls(b/c)_a/u, Former vessel loading facility**
- **ls(m)_u, Mud**
- **ls(m)_h/u, Hummocky Mud**
- **ls(m)m_u, Pockmarks (mud)**
- **ls(s)_u, Sand**
- **ls(s)w_u, Sandwaves**
- **ls(s)m_s/u, Current scoured depression in sandy sediments**
- **ls(s)m_u, Sand mound**
- **ls(s/g)_u, Sand and gravel**
- **ls(s/g)_h/u, Hummocky sand and gravel**
- **ls(s/g)w_u, Sand and gravel subaqueous dunes**
- **ls(s/g)_s/h/u, Hummocky and scoured sand and gravel**
- **ls(s/g)m_u, Sand and gravel mound**
- **ls(s/g)_a/u, Anthropogenically modified sand and gravel**
- **ls(s/m)_u, Sand and mud**
- **ls(s/m)m_s/u, Current scoured depression in sand and mud sediments**
- **ls(s/m)m_u, Sand and mud mound**
- ★ **Grab_sample_PC**



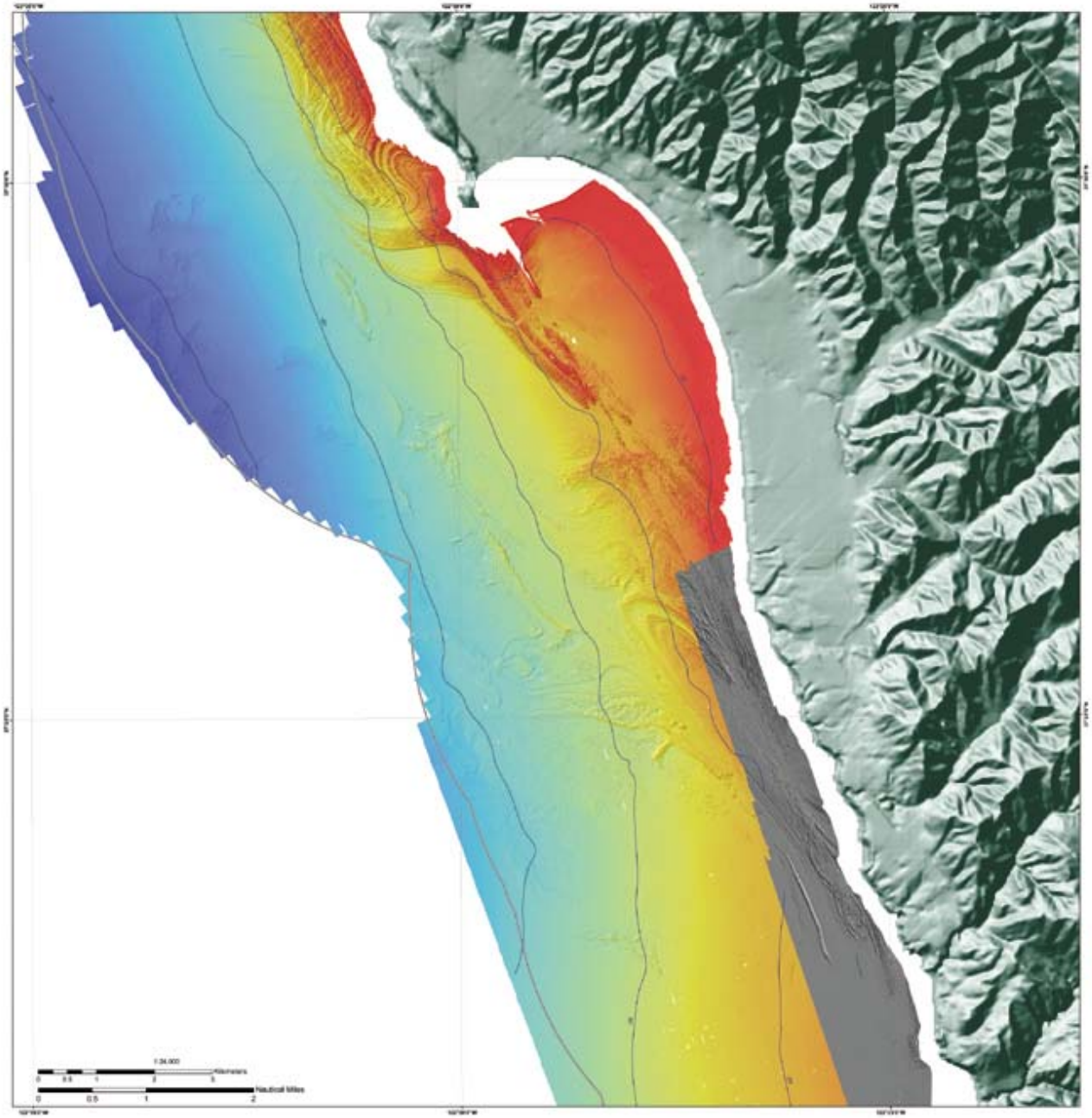
Sponge Reefs



University of Washington

EM300 Mapping in Greater Puget Sound

Shaded Panels Show Areas With More Than Single Track Coverage



Central California Mapping Project

Half Moon Bay Sheet

DRAFT

October, 2001

Map Information

Datum - WGS 1984
Projection - UTM Zone 10

3-mile limit

10 m depth contours (generalized)

Depth (2m Digital Elevation Model)

Minimum: 2 meters

Maximum: 55 meters

Seafloor surface model colored by depth

Fine-scale seafloor geomorphology is revealed in shaded relief and colored by depth in this digital elevation model (DEM) created from multibeam sonar bathymetry data gridded at 2 m horizontal resolution.

NOTE: Areas of the seafloor for which depth grids and backscatter images are available are shown with color-coded depth values. For the area with a grey-scale hillshaded image, only geotiffs are available.

Coastal Conservancy

USGS
science for a changing world

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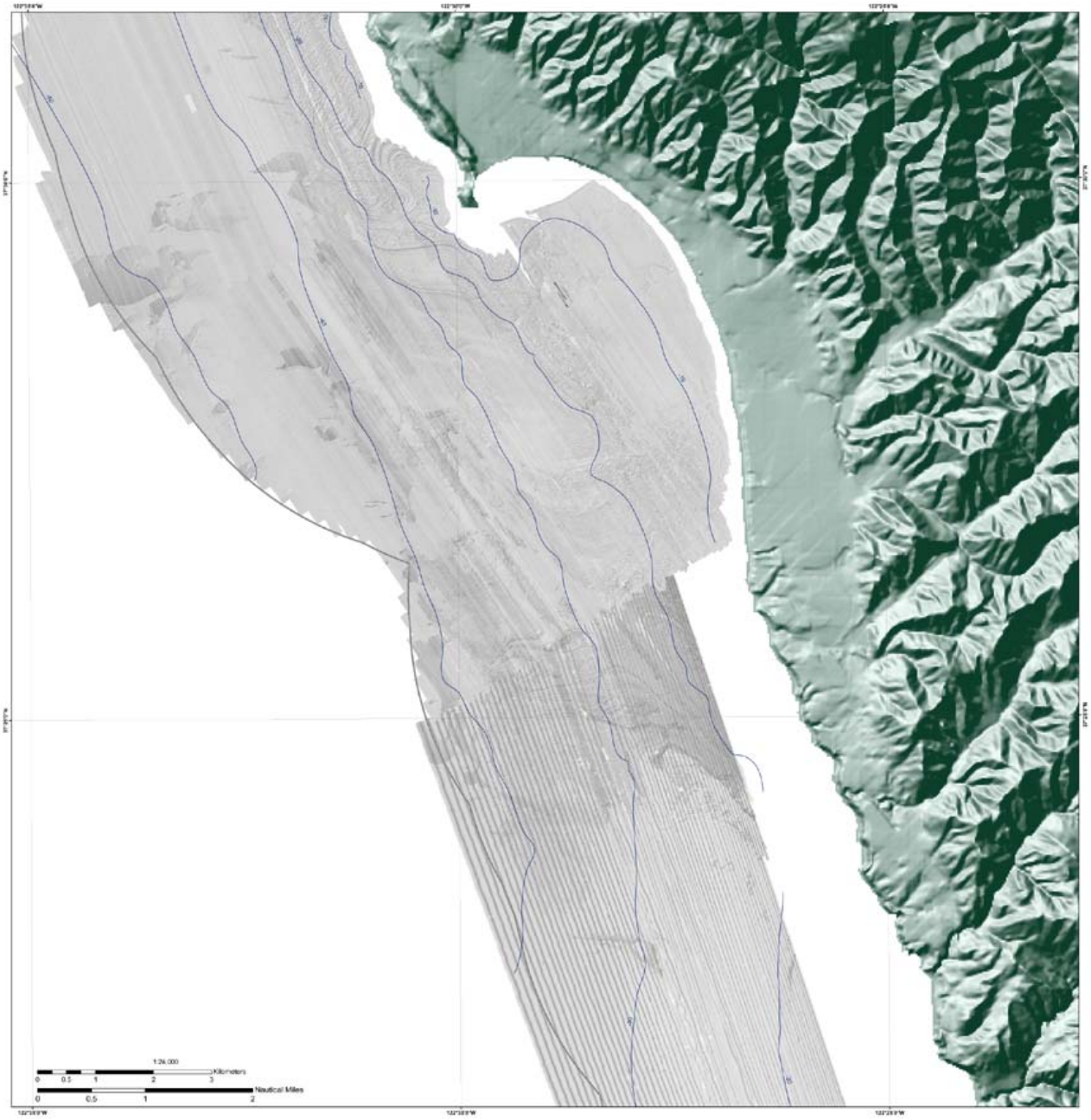
CGS



Central California Mapping Project

Half Moon Bay Sheet

DRAFT

October, 2003

Map Information

Datum - WGS 1984
Projection - UTM Zone 10

3-mile limit

10 m depth contours (generalized)

Acoustic Backscatter Intensity - 50 cm resolution

High : 255

Low : 0

Acoustic backscatter over shaded relief bathymetry

Acoustic backscatter (also known as sidescan sonar) mosaics provide an indication of seafloor texture and sediment type as represented by the intensity of sonar echo return strength. Harder and rougher bottom types typically return stronger sonar echos (darker pixels) while softer bottom types return weaker echos (lighter pixels). Acoustic shadows (areas shielded from insonification and thus having no echo return) are depicted as white. Here the 50 cm resolution acoustic backscatter data have been draped over the 2m bathymetric data depicted in hill shade to give a composit rendering of seafloor texture and geomorphology.

NOTE: The parallel light/dark stripping running north and south in the lower half of the acoustic backscatter mosaic is an artifact that will be removed from this draft product during subsequent data processing.

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SEAFLOOR MAPPING LAB CSU MONTEREY BAY

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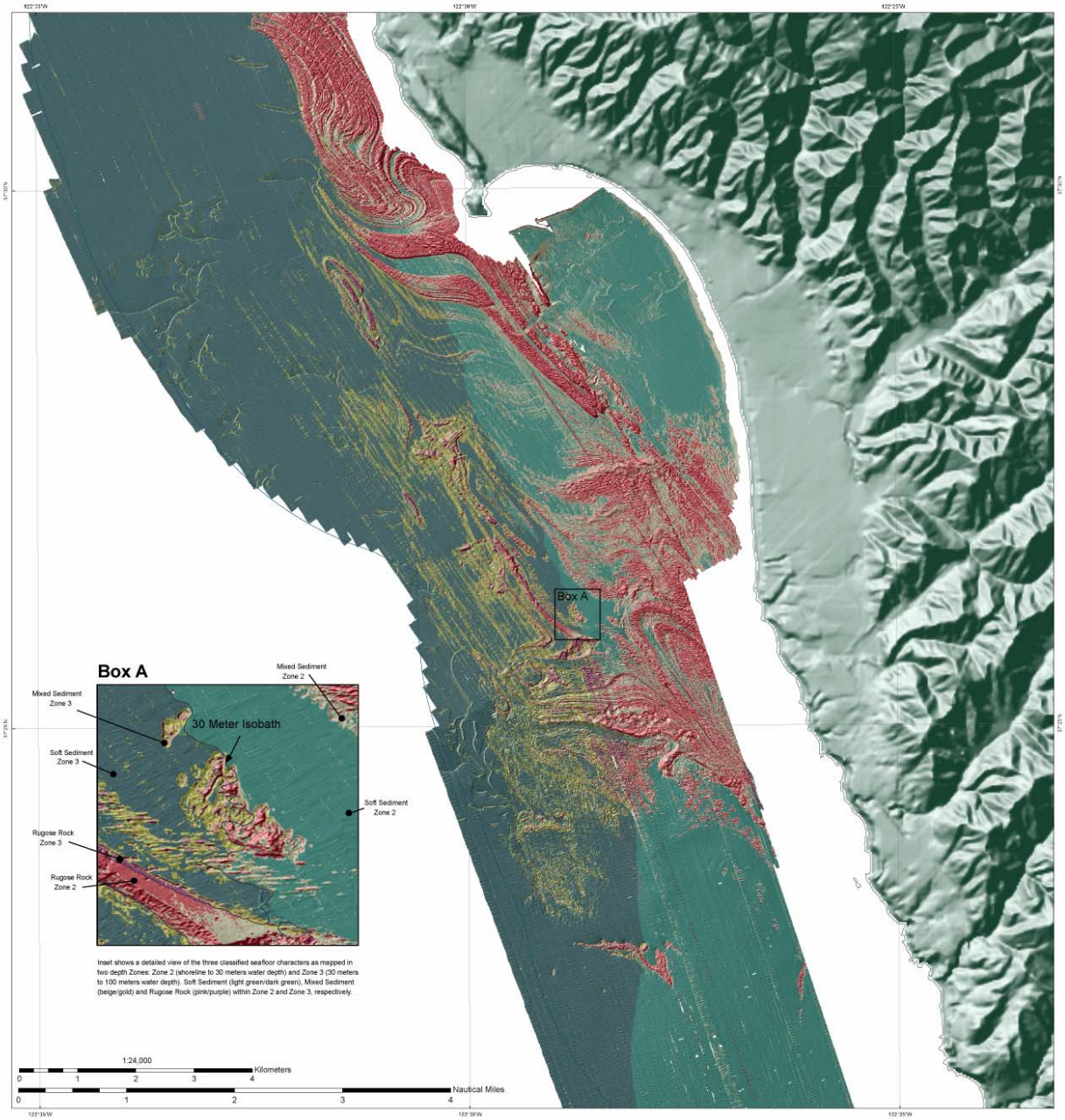
WATERSHED HABITAT STUDIES

CGS CALIFORNIA GEOLOGICAL SURVEY



Inset shows a detailed view of the three classified seafloor characters as mapped in two depth Zones: Zone 2 (shoreline to 30 meters water depth) and Zone 3 (30 meters to 100 meters water depth). Soft Sediment (light green/dark green), Mixed Sediment (beige/gold) and Rugose Rock (pink/purple) within Zone 2 and Zone 3, respectively.

Central California Mapping Project

Half Moon Bay Sheet

DRAFT

October, 2007

Map Information

N
W E
S

Datum - WGS 1984
Projection - UTM Zone 10

3-mile limit

Seafloor Character Map

Zone 2 - shoreline to 30 meters water depth	Zone 3 - 30 meters to 100 meters water depth
Soft Sediment	Soft Sediment
Mixed Sand, Gravel and Rock	Mixed Sand, Gravel and Rock
Rugose Rock	Rugose Rock

This seafloor character map was produced using video-supervised maximum bathrod classification of the bathymetry and backscatter (intensity of return) signals from sonar systems. A summary of the video data collected for the purpose of supervising the classification is shown on Folio Sheet #6. Derivative roughness (rugosity), intensity variability (homogeneity and entropy) and backscatter intensity were used as variants in the classification. The substrate classes have been divided into the California Marine Life Protection Act depth zones mapped in this area: zone 2 (intertidal to 30 meters) and 3 (30 to 100 meters). This interpretation is draped over shaded relief bathymetry shown in Folio Sheet #2.

Soft sediment, thick deposits composed of sand and mud, comprises 71% of the region (104 sq km) - 30 square kilometers in depth zone 2 and 74 sq km in zone 3. Mixed sand, gravel and rock, where sediment typically forms a thin veneer over bedrock, comprises 16% of the area mapped (23 sq km) - 13 sq km in zone 2 and 10 sq km in zone 3. Rugose (complex, rough) rock comprises the final 13% (30 sq km) of the region - 16 sq km in zone 2 and 4 sq km in zone 3.

	Total		Water depth		Water depth	
	percent	sq km	percent	sq km	percent	sq km
Soft sediment	71	104	30	30	70	74
Mixed sand, gravel and rock	16	23	4	13	7	10
Rugose	13	30	10	10	2	4

NOTE: Regions lacking one of the component datasets (bathymetry or backscatter) could not be classified. These regions are shown in either white, for regions which were not classified due to lack of bathymetry data, or grey for regions which were not classified due to lack of backscatter data.

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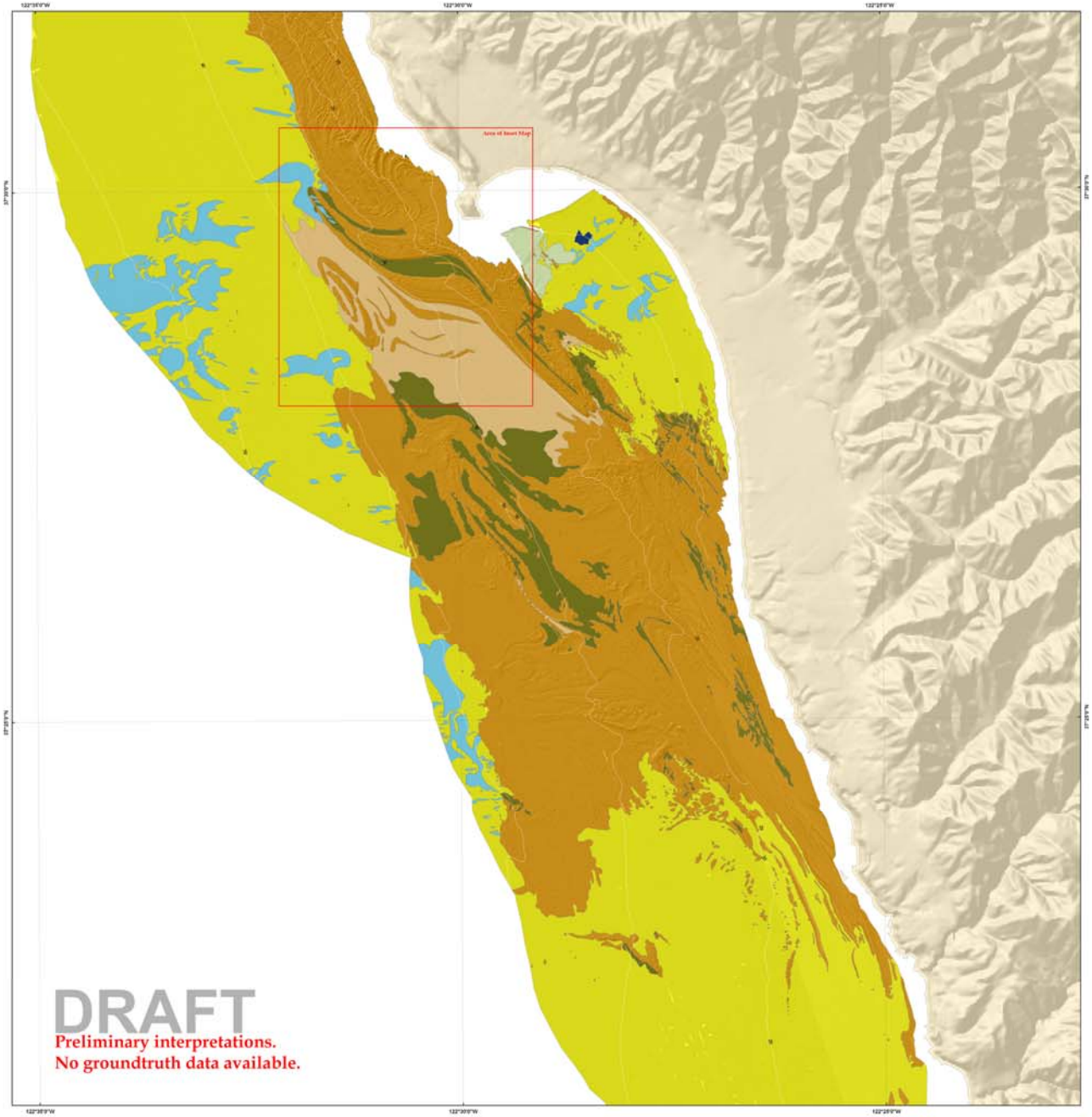
CENTER FOR HABITAT STUDIES

CGS CALIFORNIA GEOLOGICAL SURVEY



Central California Mapping Project

Half Moon Bay Sheet

DRAFT

Benthic Habitat Map

Map Information

N
W E
S

Map Scale - 1:24,000

Datum - WGS 1984
Projection - UTM Zone 10

Contour Interval - 10 meters

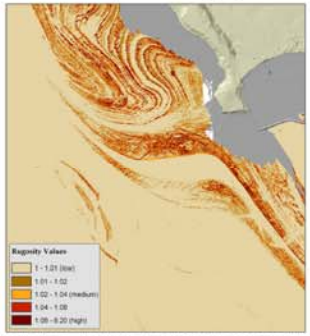
Kilometers
0 1 2 4

Nautical Miles
0 0.5 1 2

Explanation

Habitat code	Habitat description	Geologic Unit
Sd(s)_u	Unconsolidated sediment - Sand	Qms
Sd(s?/g?)_u	Unconsolidated sediment - Sand/Gravel?	Qml
Sd(s?/g?)m/w_r/u	Rippled scour depressions - Coarse Sand? and Gravel?	Qml
Sc_a	Dredge spoils (anthropogenic)?	af
Sm_r/u	Sediment covered bedrock	Q/Tpm
Sbd/l_r/d	Rock outcrop - flat/low rugosity	Tpm
Sbd_r/d	Bedrock outcrop - medium to high rugosity	Tps

Inset map - Seafloor Rugosity



Rugosity analysis provides a ratio of surface area to planar area, which is an important and quantifiable component of seafloor habitat.

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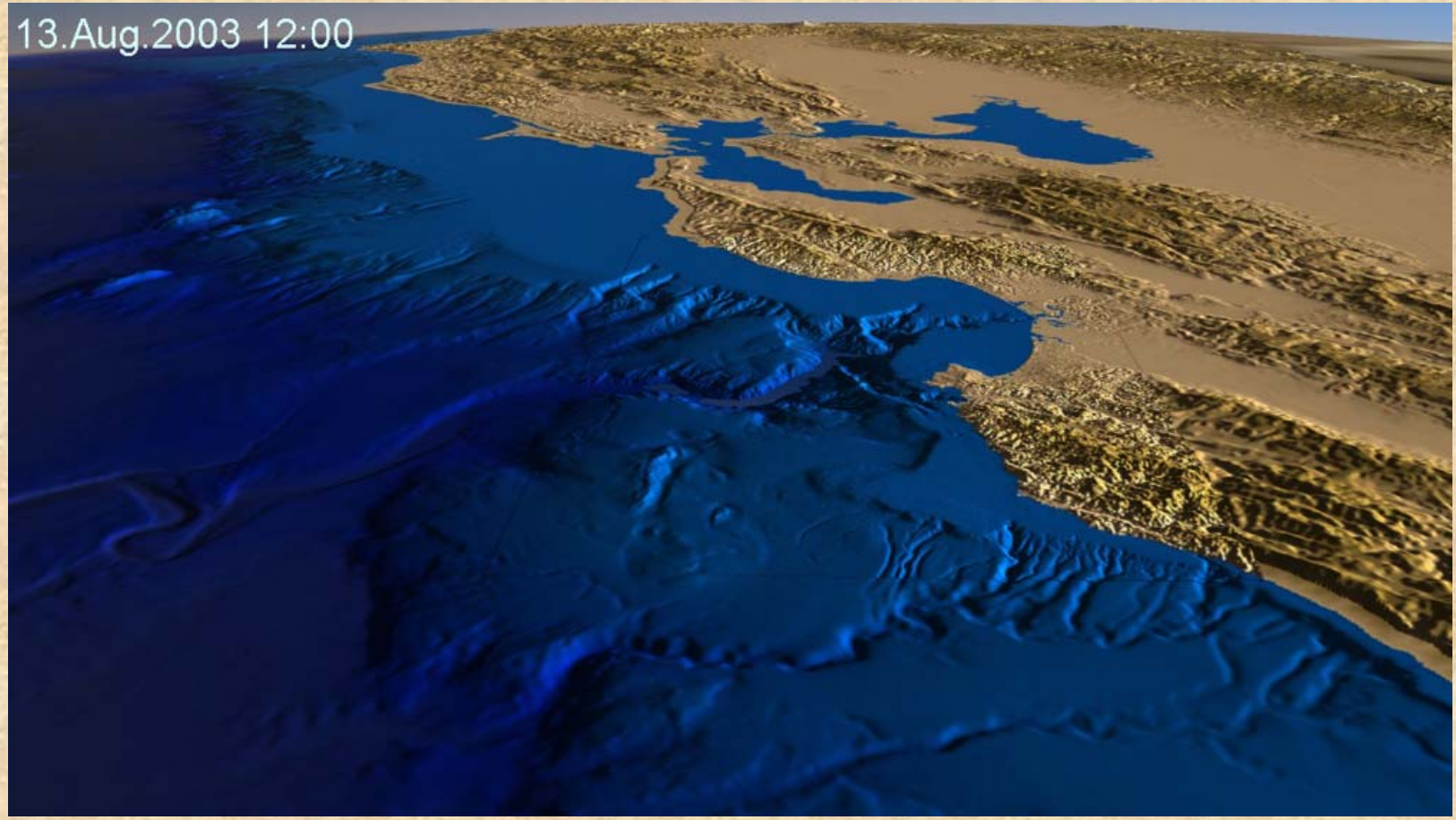
13.Aug.2003 12:00

From Here

- Complete summary maps – status and gaps in Washington data
- Prioritization of areas, but it’s all important.
- Develop partnerships to leverage planned mapping
- Identify a mechanism for advancing mapping in Washington comprehensively

Identify a mechanism for comprehensively mapping the Washington seafloor

Options:

- **Federally driven**
- **State or local driven**
- **Consortium of partners (federal, state, private, tribal)**