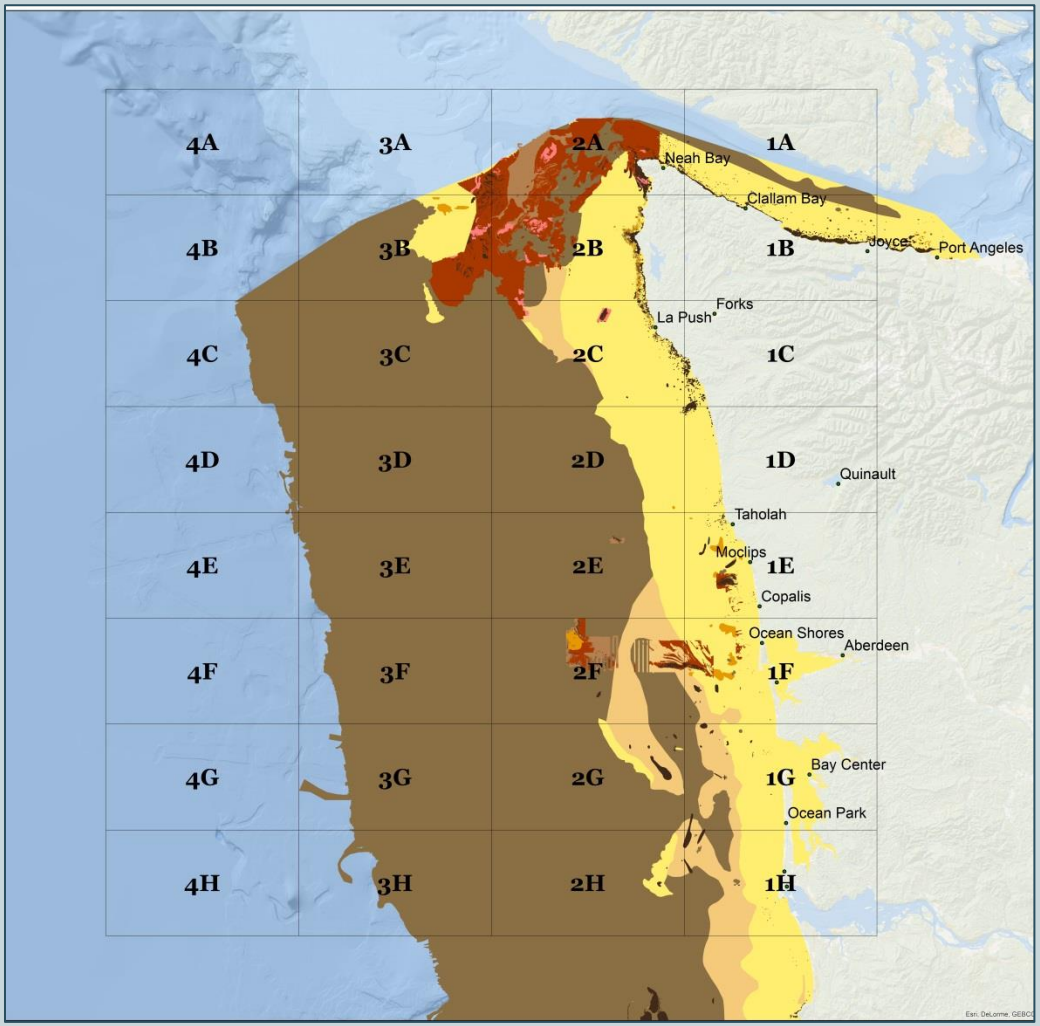
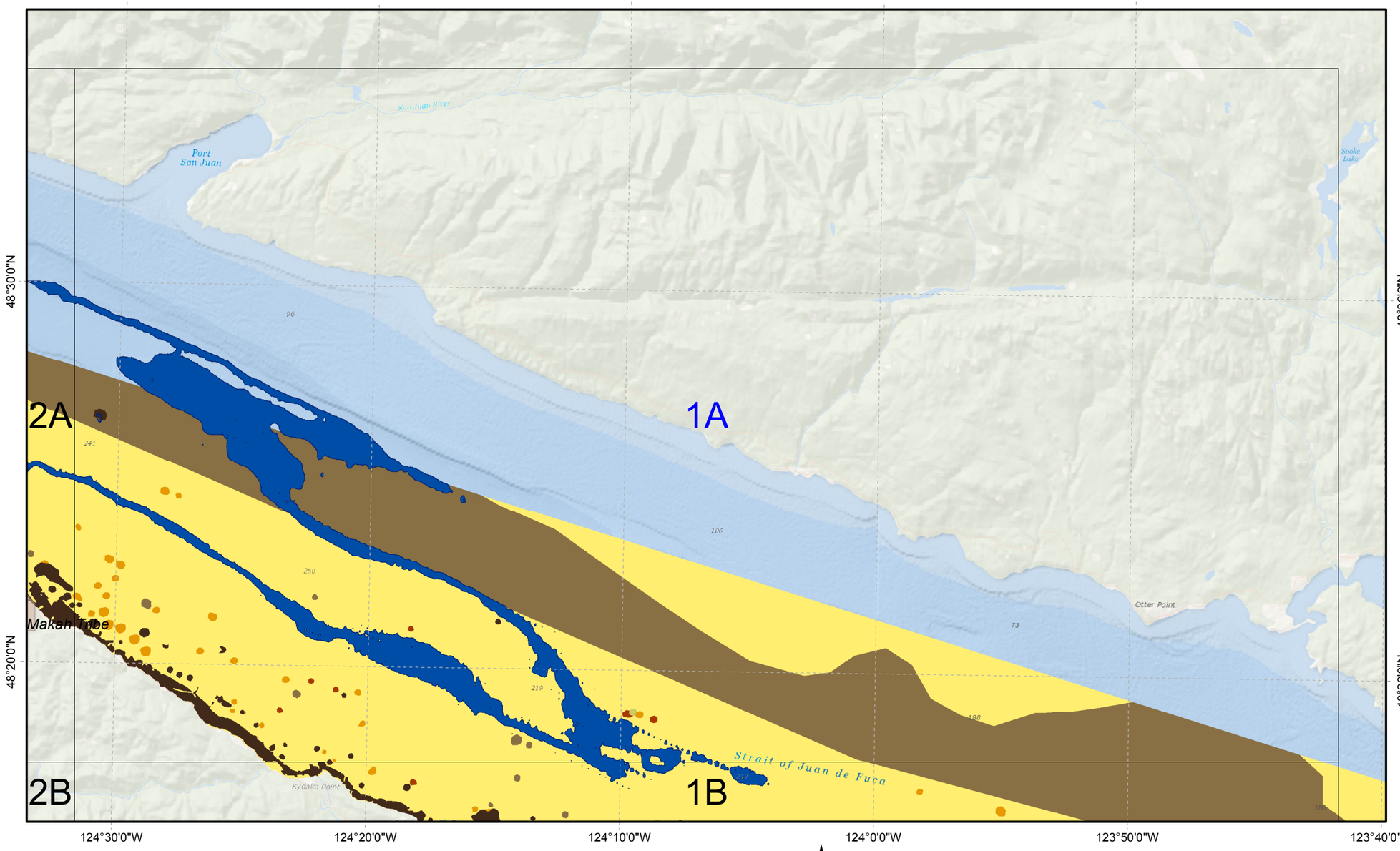
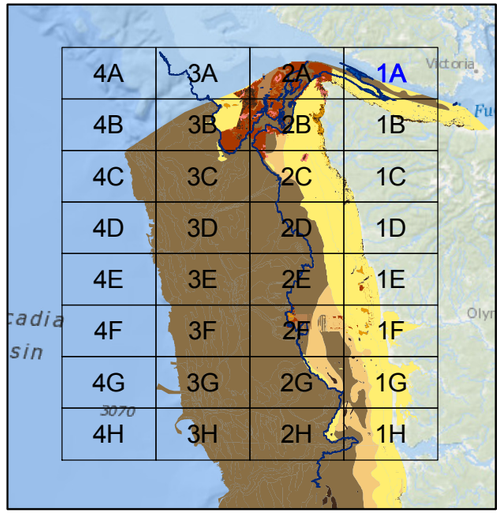
Washington State Outer Coast Seafloor Atlas – V1



A Sponsored Project from:
NOAA Olympic Coast National Marine Sanctuary – WA Department of Natural Resources
Oregon State University Active Tectonics & Seafloor Mapping Lab





200-210 m Contour

Approximate Shelf Break

OCNMS Seafloor Data

OSU ATL & SML Data

CMECS Substrate Group

- Bedrock
- Gravel
- Gravel Mixes
- Slightly Gravelly
- Mud
- Muddy Sand
- Sand
- Sandy Mud

UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 1A

Transverse Mercator Projection - Scale 1:200,000

World Geodetic System 1984 - Soundings in meters at MLLW

0 2.5 5 10 Nautical Miles

0 5 10 20 Kilometers

The WA State Outer Coast Seafloor Atlas overlays fine-scale seafloor data from Olympic Coast National Marine Sanctuary (2000-2013) on coarser-scale Surficial Geologic Habitat data from multiple sources compiled by Oregon StateUniversity Active Tectonics and Seafloor Mapping Lab (2003-2015). Habitat characterization is NOAA's Coastal and Marine Ecological Classification Standard (CMECS, 2012). Inconsistent habitat characterization is the result of overlapping scales between the two products.

125°20'0"W 125°10'0"W 125°0'0"W 124°50'0"W 124°40'0"W

48°30'0"N

48°20'0"N

Swiftsure Bank

Swiftsure Bank

3A 2A 1A

3B 2B 1B

Cape Flattery

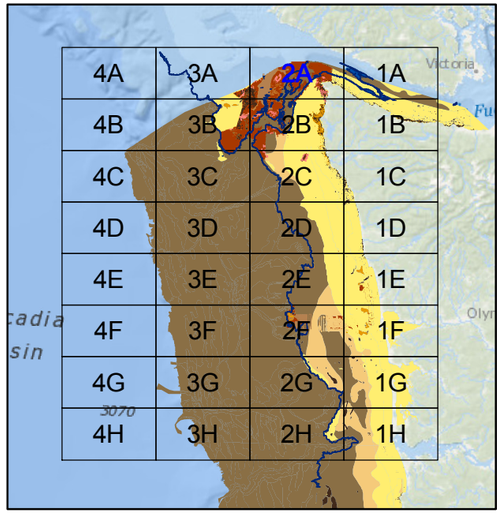
Koitlah Point

Neah Bay

Makah Tribe

Portage Head

125°20'0"W 125°10'0"W 125°0'0"W 124°50'0"W 124°40'0"W 124°30'0"W



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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 2A

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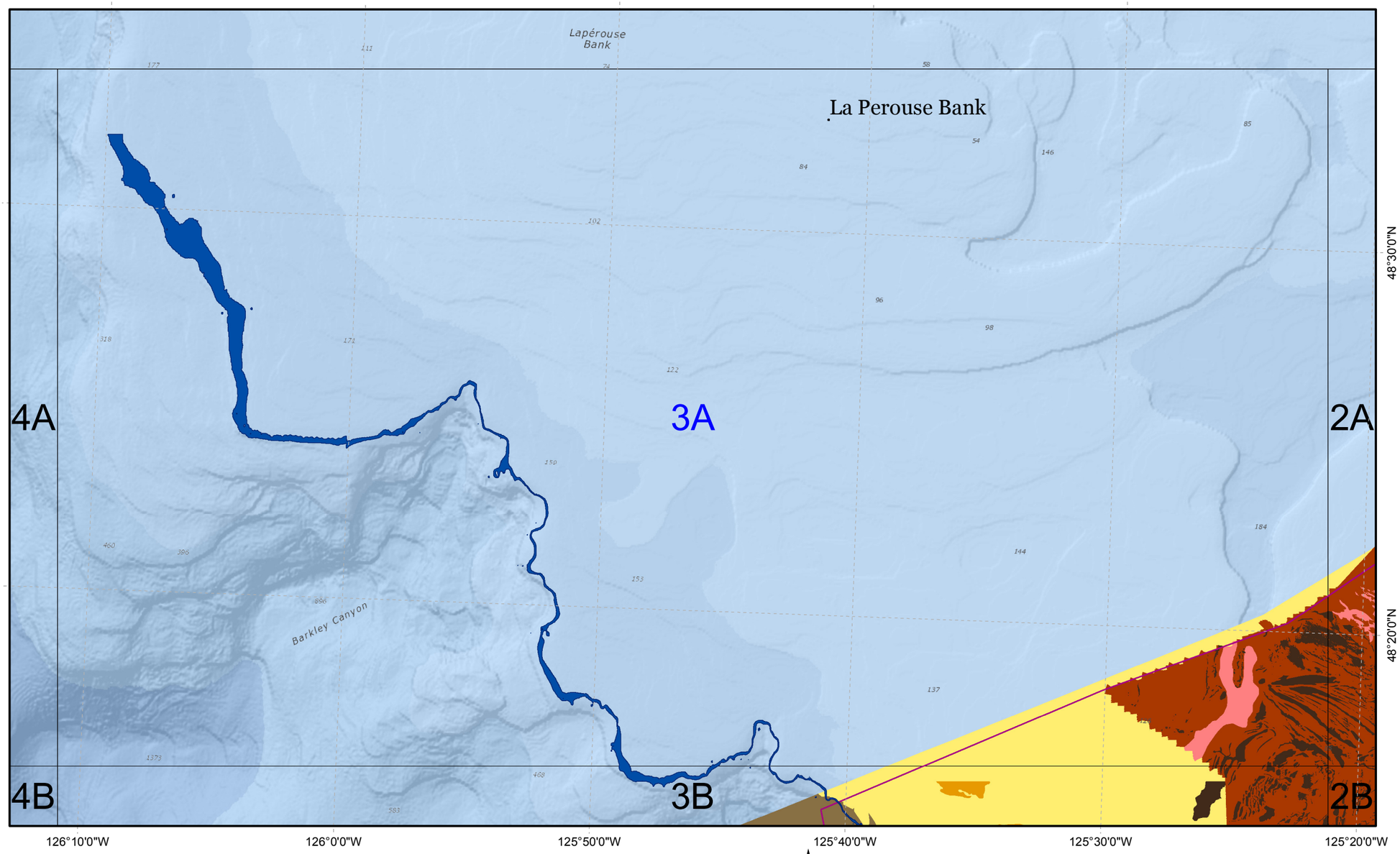

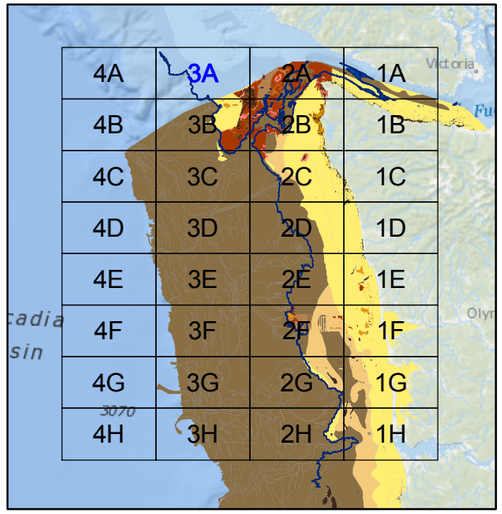

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 3A

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127°0'0"W 126°50'0"W 126°40'0"W 126°30'0"W 126°20'0"W

48°30'0"N

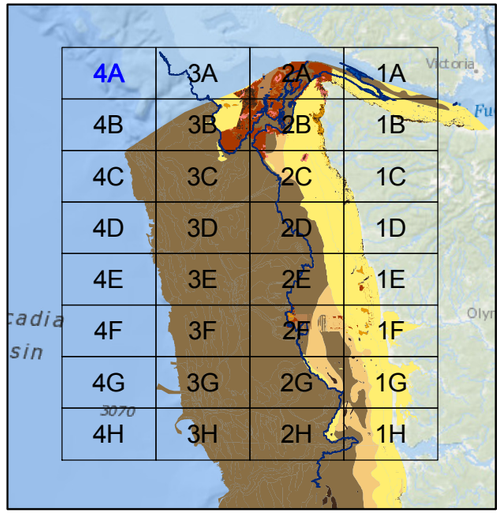
48°20'0"N

4A

3A

4B

3B



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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 4A

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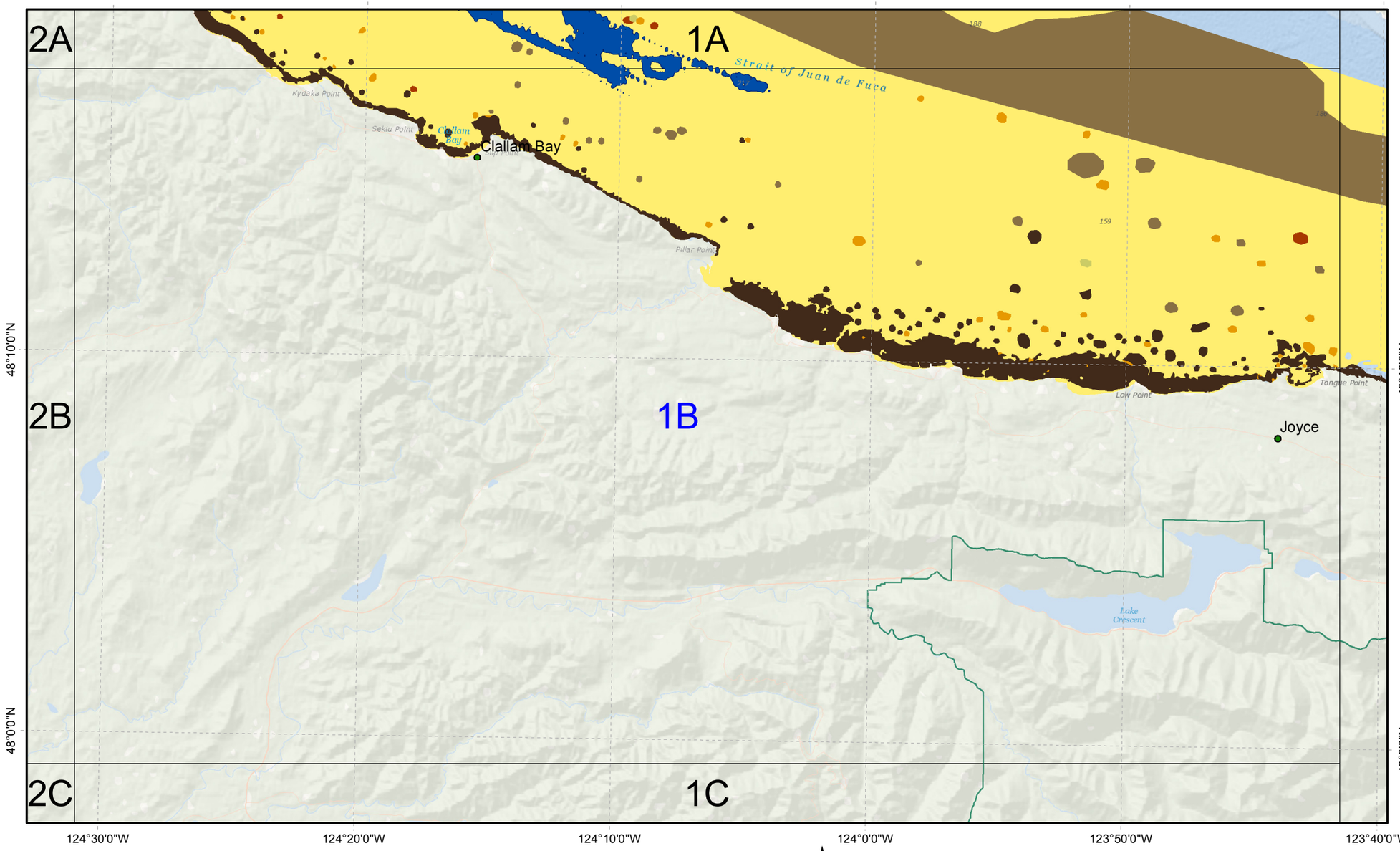

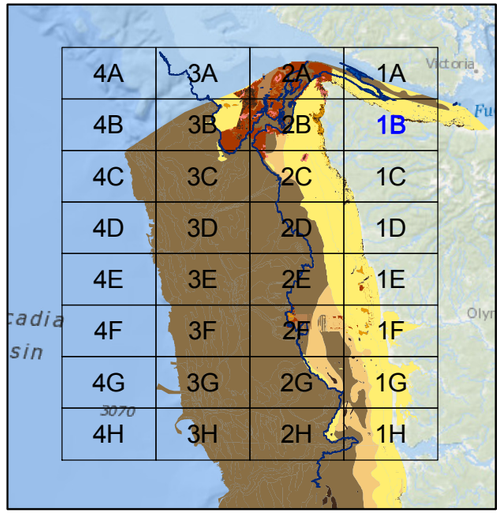

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 1B

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48°0'0"N

3A 2A 1A

3B 2B 1B

3C 2C 1C

Makah Tribe

Portage Head

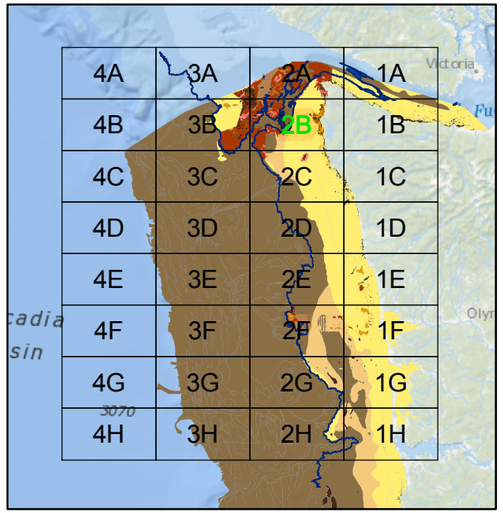
Point of Arches

Cape Alava

Ozette Lake

Cape Johnson

Juca Canyon



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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 2B

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48°0'0"N

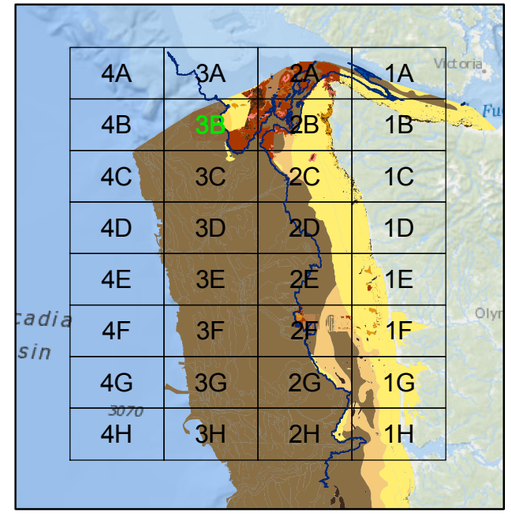
4A 3A 2A

4B 3B 2B

4C 3C 2C

Nitinat Canyon

Juan de Fuca Canyon



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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 3B

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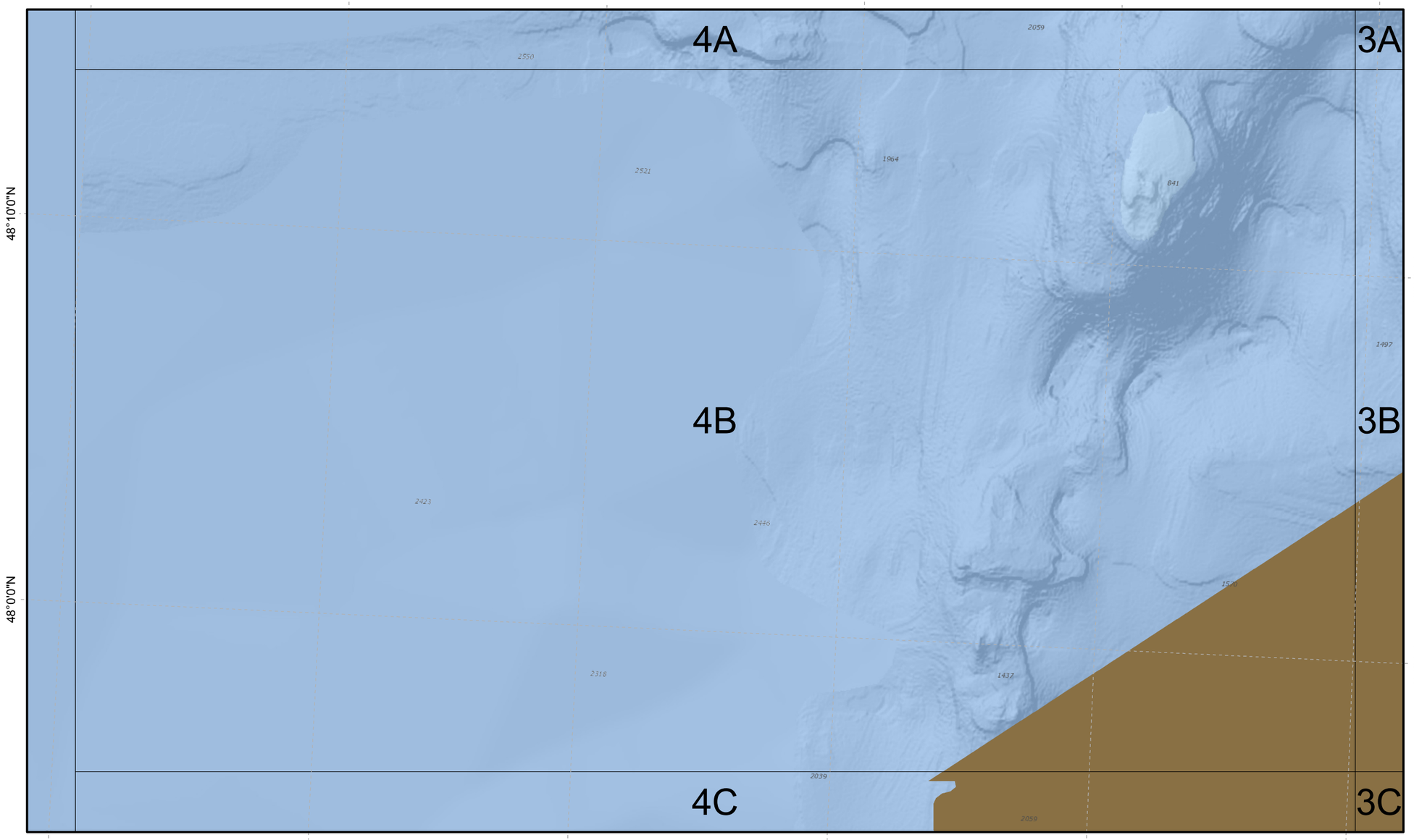

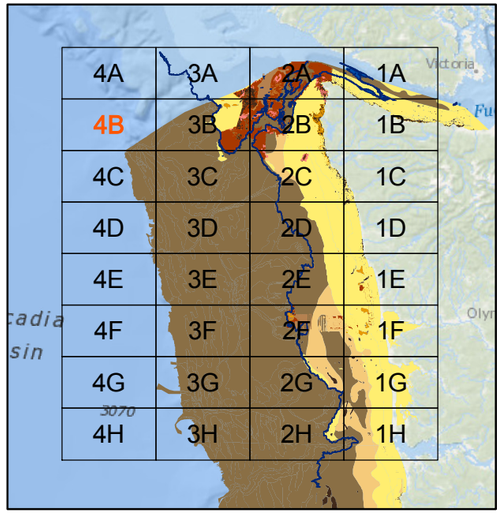

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 4B

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47°50'0"N

47°40'0"N

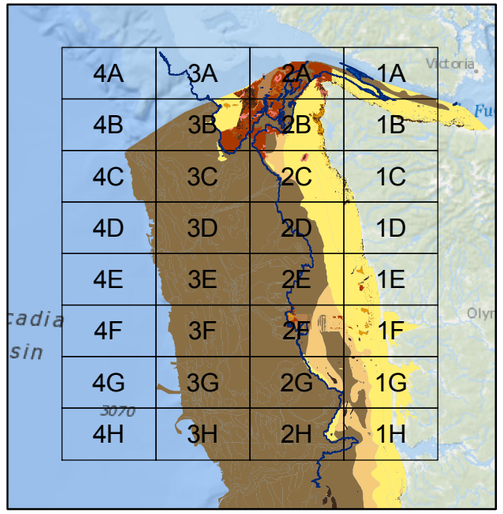
2B 1B 2C 1C 2D 1D

Forks

Hoh Tribe

Hoh River

Destruction Island



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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 1C

Transverse Mercator Projection - Scale 1:200,000
World Geodetic System 1984 - Soundings in meters at MLLW

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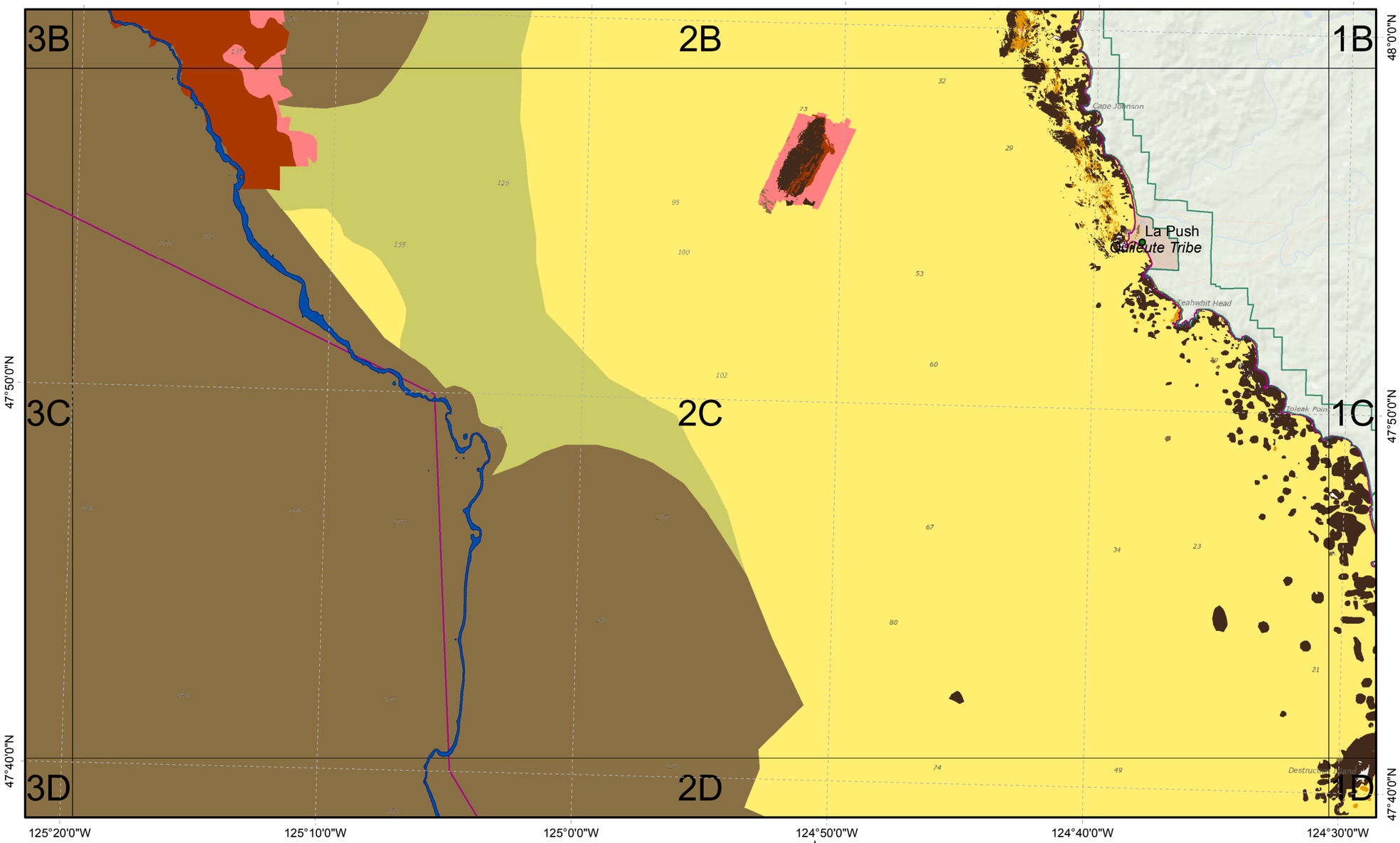

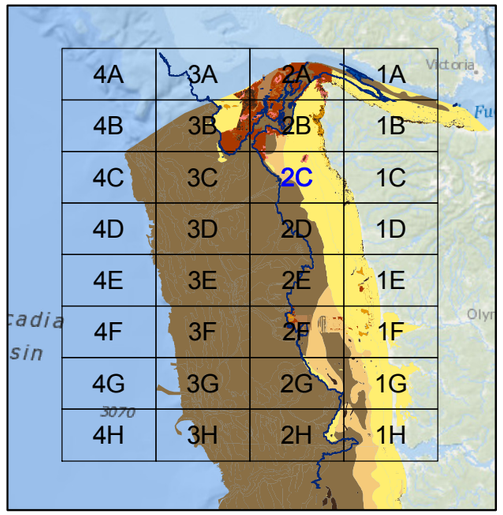

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Washington State Outer Coast Seafloor Atlas: Map Page: 2C

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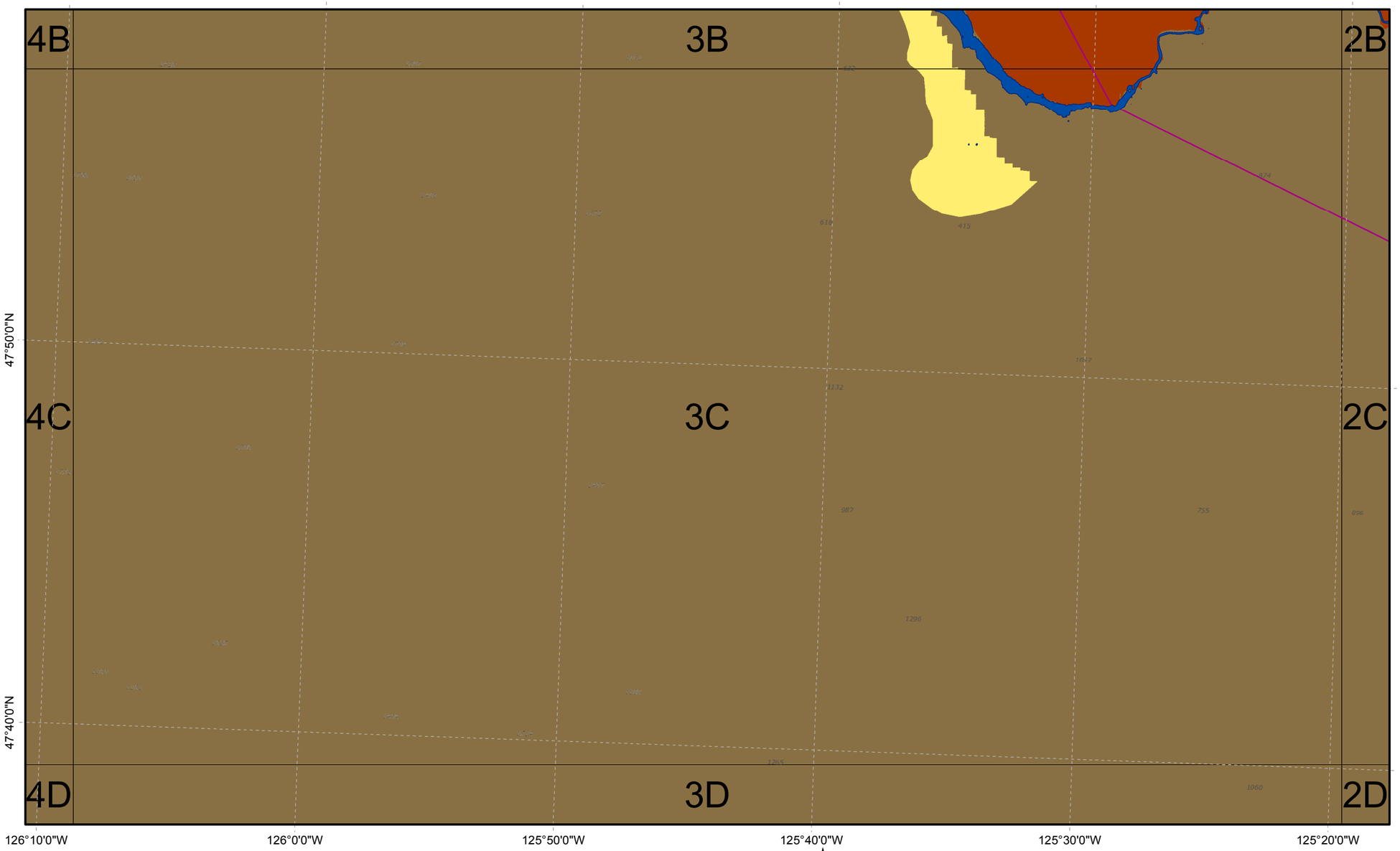

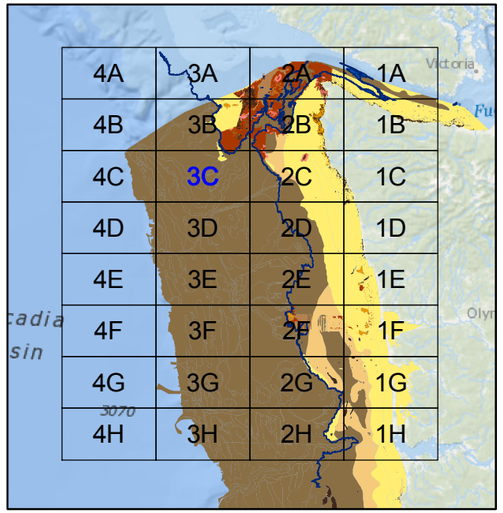

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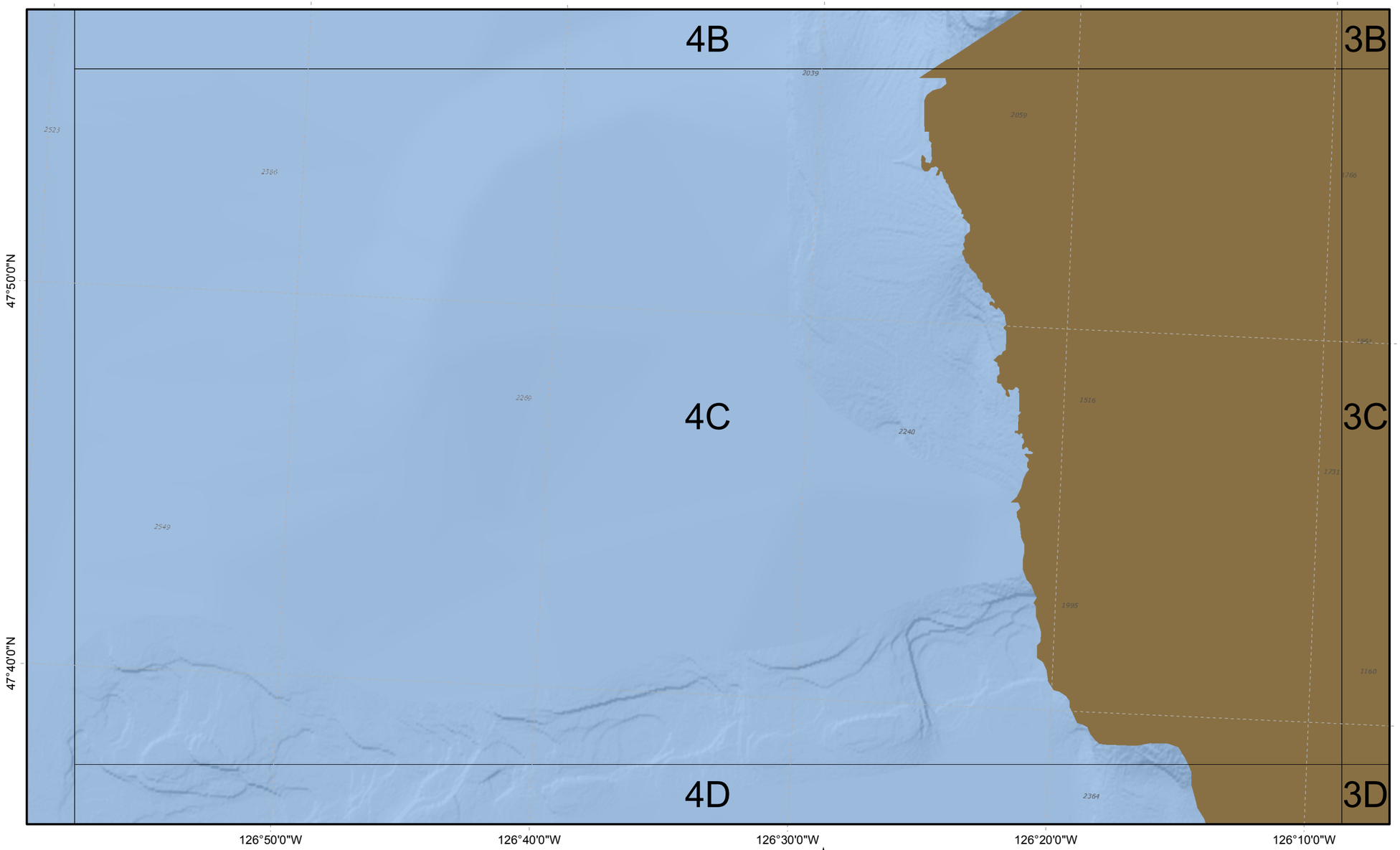

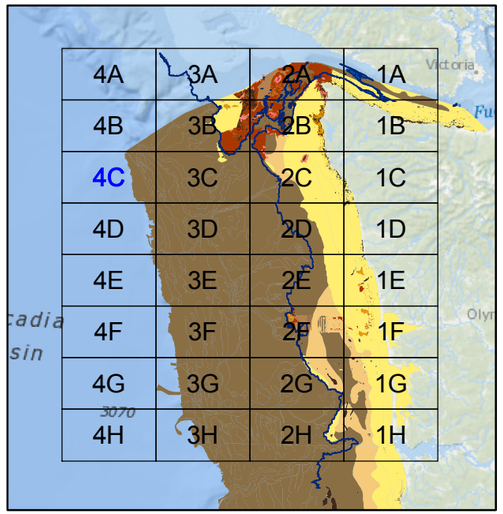

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2C 1C

2D 1D

2E 1E

Destruction Island

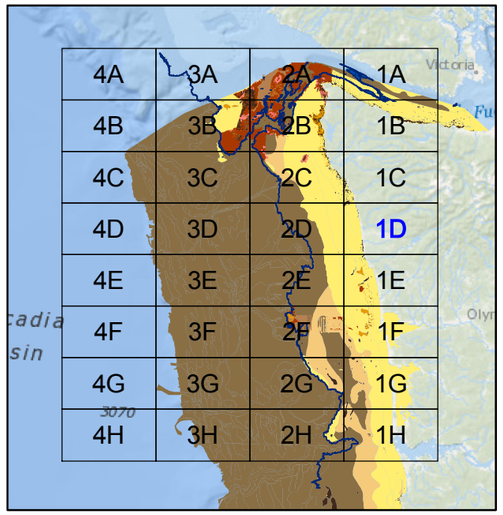
Quinault Nation

Lake Quinault

Quinault

Quinault River

Cape Elizabeth



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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 1D

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3D 2D 1D

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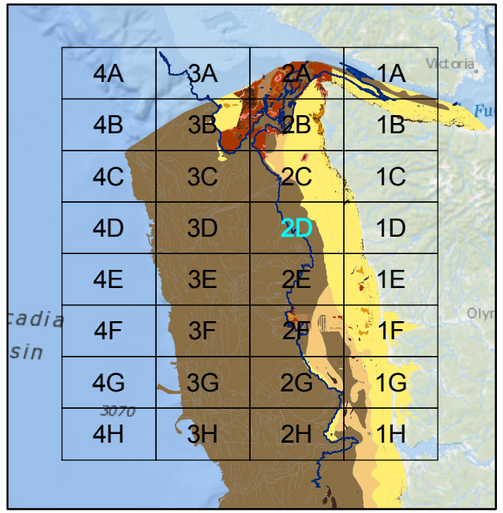

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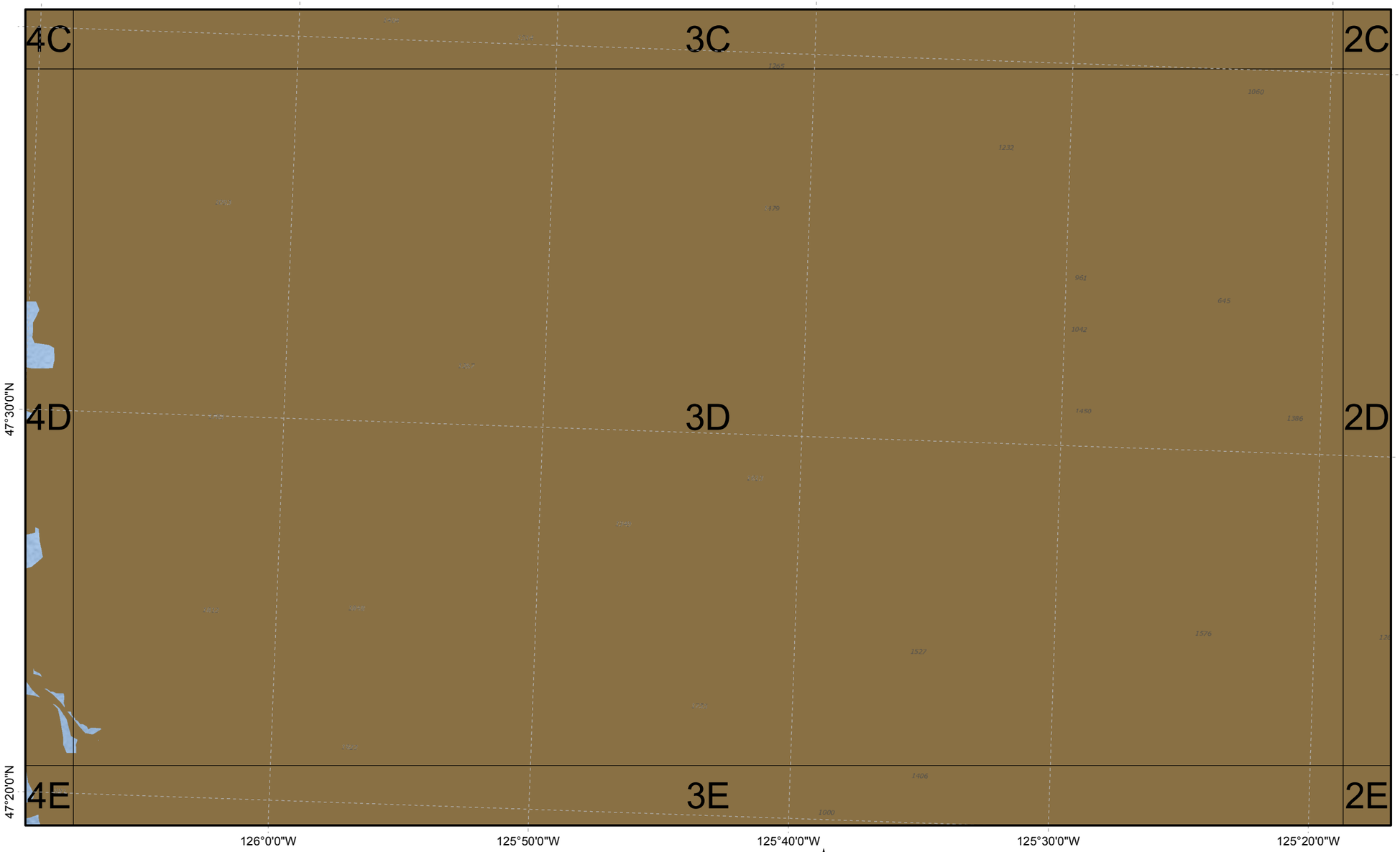

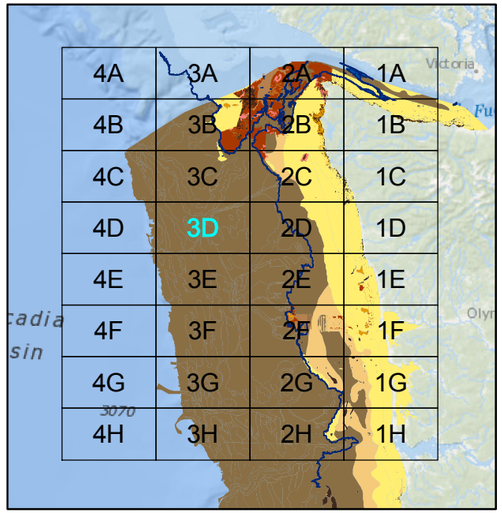

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Transverse Mercator Projection - Scale 1:200,000
World Geodetic System 1984 - Soundings in meters at MLLW

0 2.5 5 10 Nautical Miles

0 5 10 20 Kilometers

The WA State Outer Coast Seafloor Atlas overlays fine-scale seafloor data from Olympic Coast National Marine Sanctuary (2000-2013) on coarser-scale Surficial Geologic Habitat data from multiple sources compiled by Oregon StateUniversity Active Tectonics and Seafloor Mapping Lab (2003-2015). Habitat characterization is NOAA's Coastal and Marine Ecological Classification Standard (CMECS, 2012). Inconsistent habitat characterization is the result of overlapping scales between the two products.

126°50'0"W 126°40'0"W 126°30'0"W 126°20'0"W 126°10'0"W

47°40'0"N

47°30'0"N

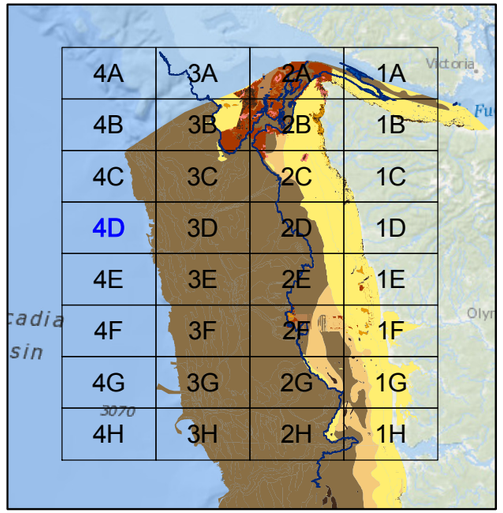
47°20'0"N

4C 3C

4D 3D

4E 3E

2364 2377 2459 2386 2468 2441 2542 2406 3070



200-210 m Contour

Approximate Shelf Break

OCNMS Seafloor Data

OSU ATL & SML Data

CMECS Substrate Group

- Bedrock
- Gravel
- Gravel Mixes
- Slightly Gravelly
- Mud
- Muddy Sand
- Sand
- Sandy Mud

UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 4D

Transverse Mercator Projection - Scale 1:200,000
World Geodetic System 1984 - Soundings in meters at MLLW

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124°30'0"W 124°20'0"W 124°10'0"W 124°0'0"W 123°50'0"W 123°40'0"W

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2D 1D

2E 1E

2F 1F

Taholah

Quinault Nation

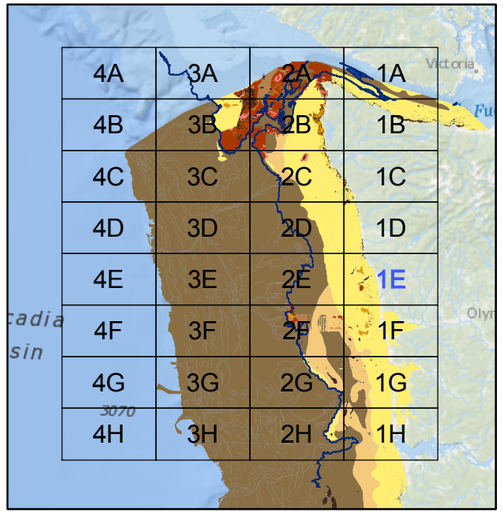
Moclips

Copalis

Cape Elizabeth

Point Grenville

Quinault River



200-210 m Contour

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 1E

Transverse Mercator Projection - Scale 1:200,000

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125°20'0"W 125°10'0"W 125°0'0"W 124°50'0"W 124°40'0"W 124°30'0"W

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3D 2D 1D

3E 2E 1E

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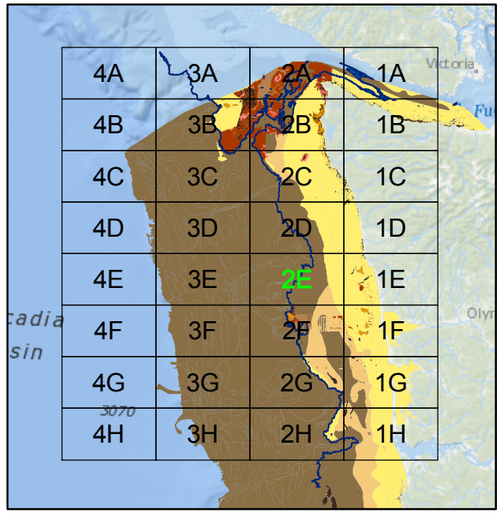

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 2E

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World Geodetic System 1984 - Soundings in meters at MLLW

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4D 3D 2D

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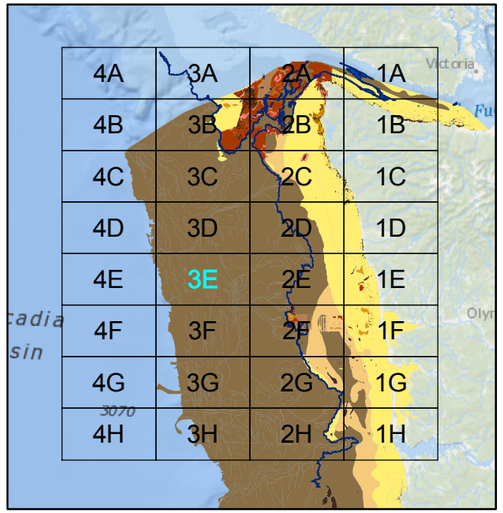

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 3E

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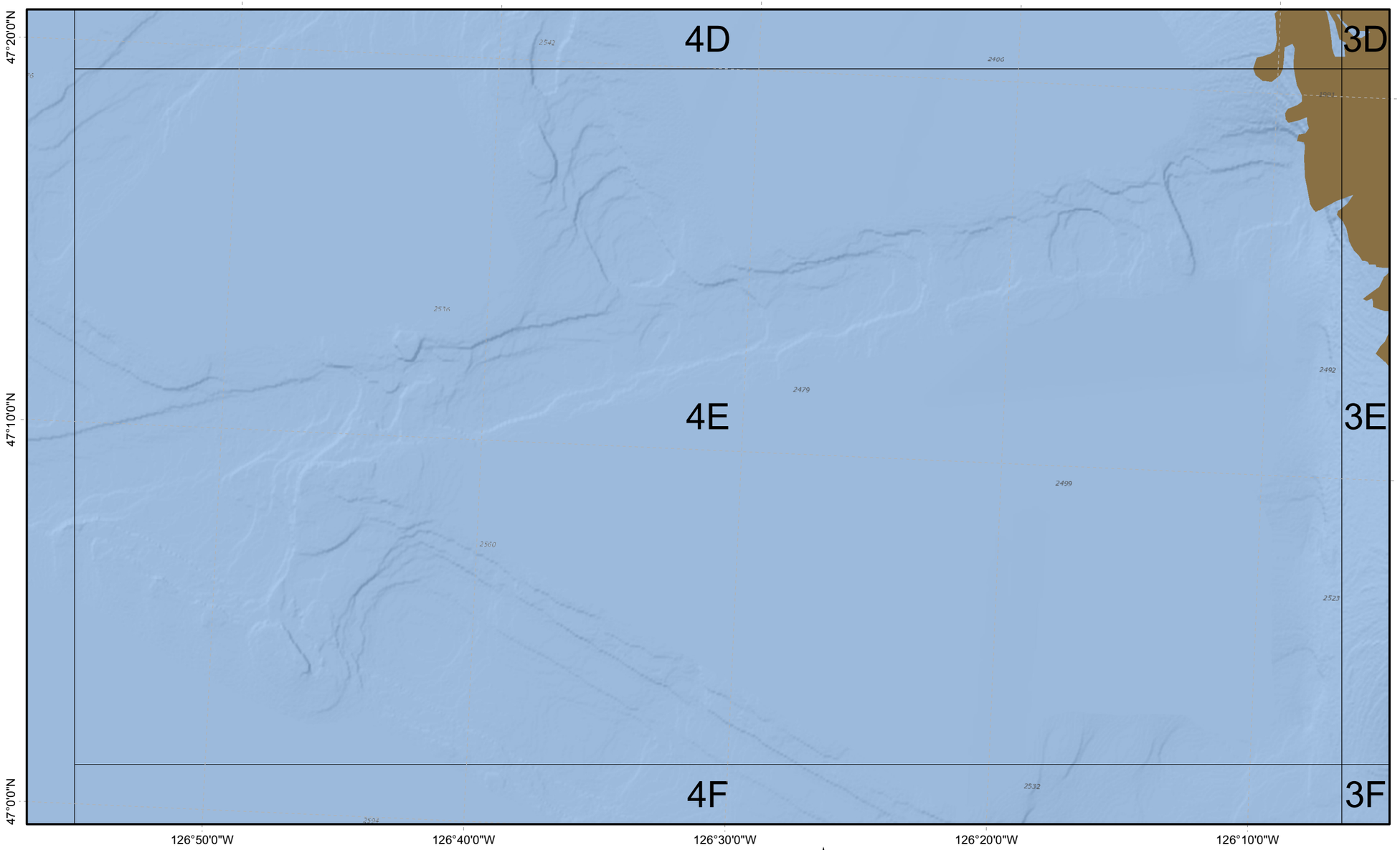

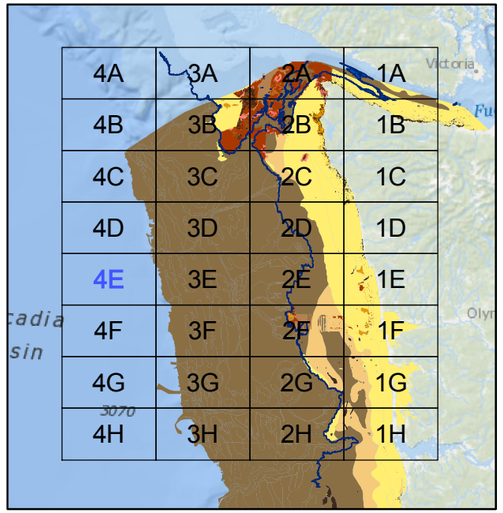

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 4E

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47°0'0"N

46°50'0"N

2E 1E

2F 1F

2G 1G

Ocean Shores

North Bay

Aberdeen

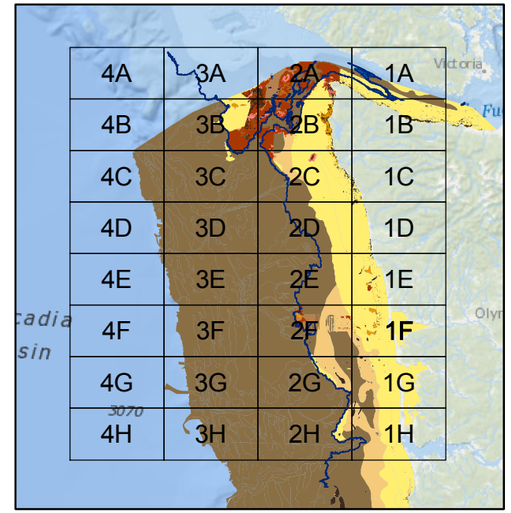
Grays Harbor

Point Brown

Point Chehalis

Westport

South Bay



200-210 m Contour
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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 1F

Transverse Mercator Projection - Scale 1:200,000
World Geodetic System 1984 - Soundings in meters at MLLW

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3E 2E 1E

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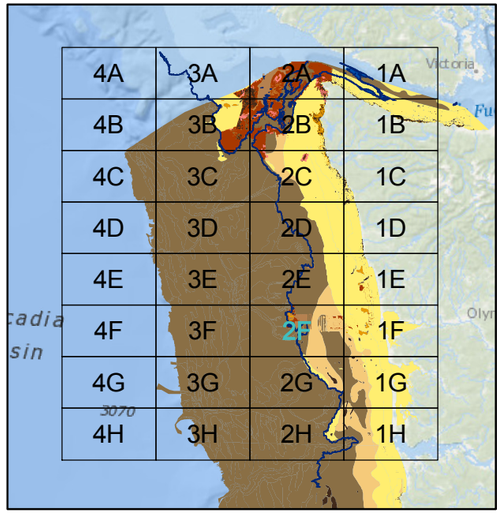
3G 2G 1G



200-210 m Contour

Approximate Shelf Break

OCNMS Seafloor Data

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 2F

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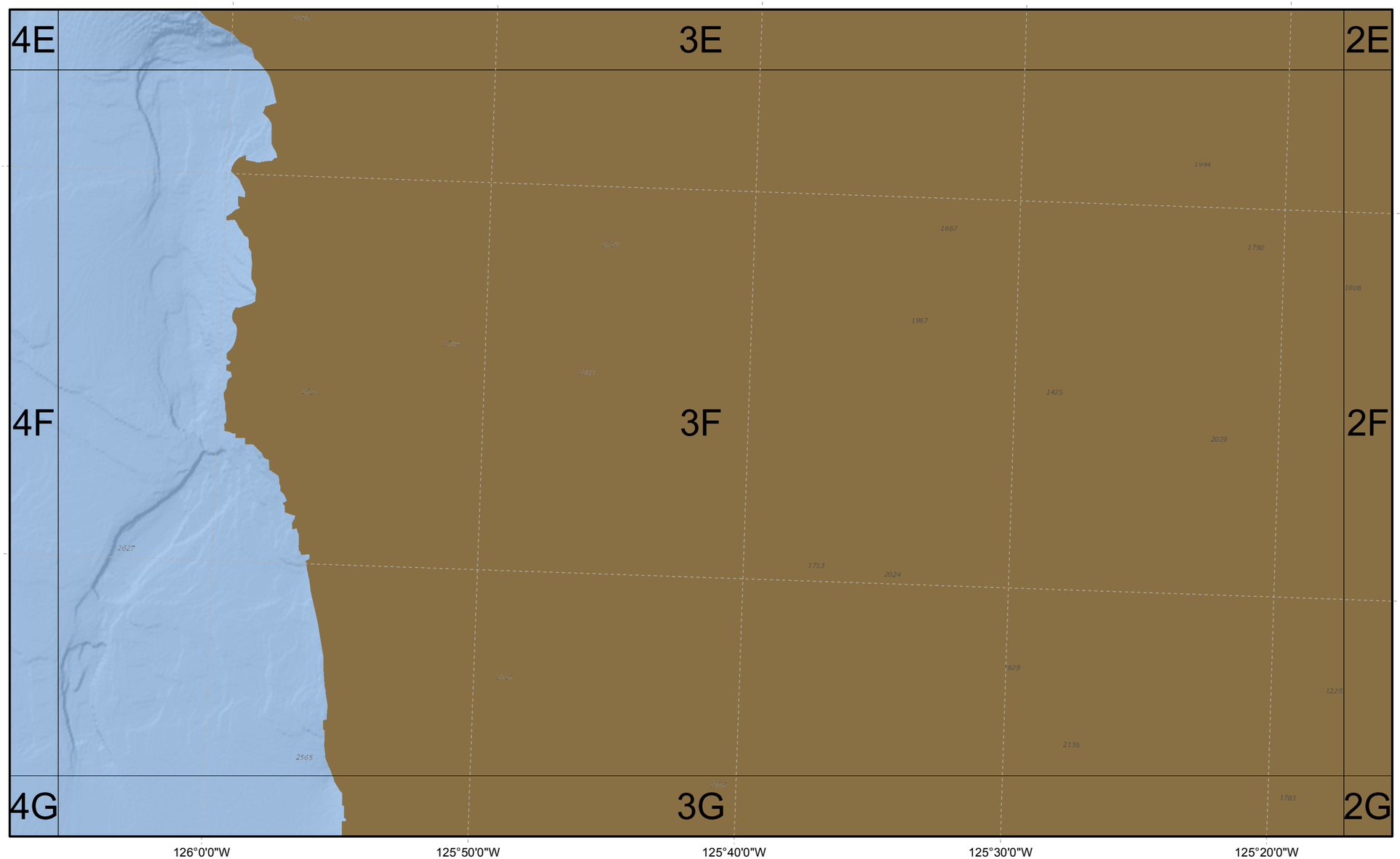

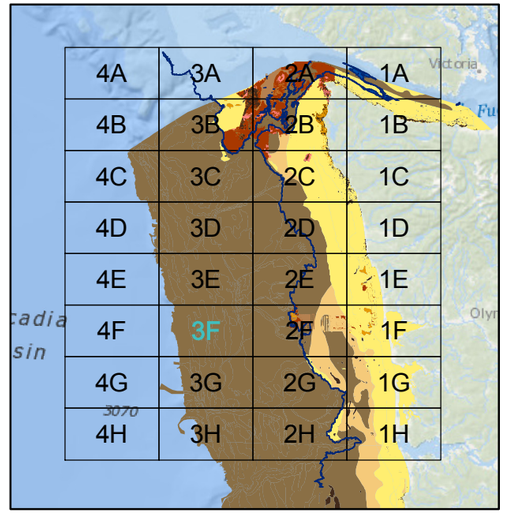

200-210 m Contour
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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 3F

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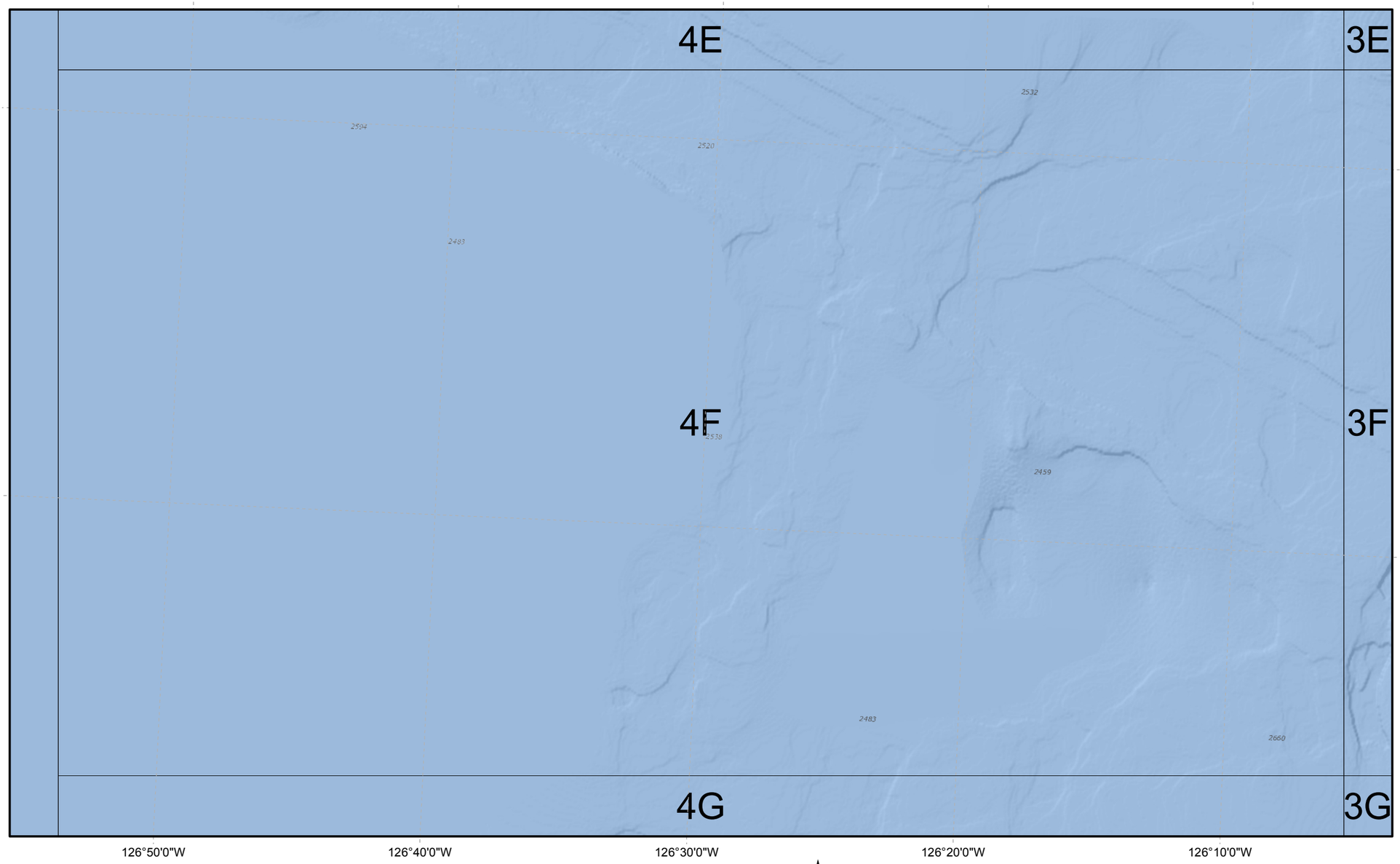

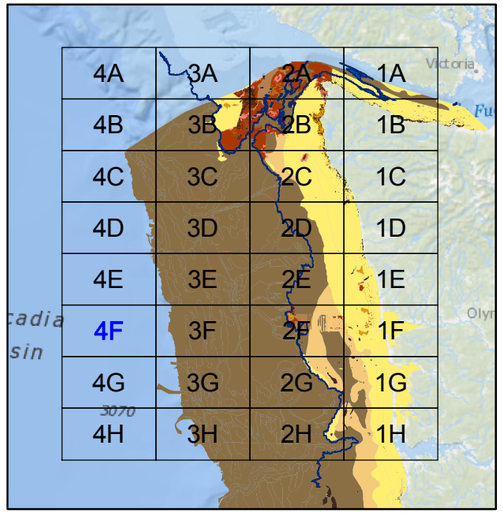

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 4F

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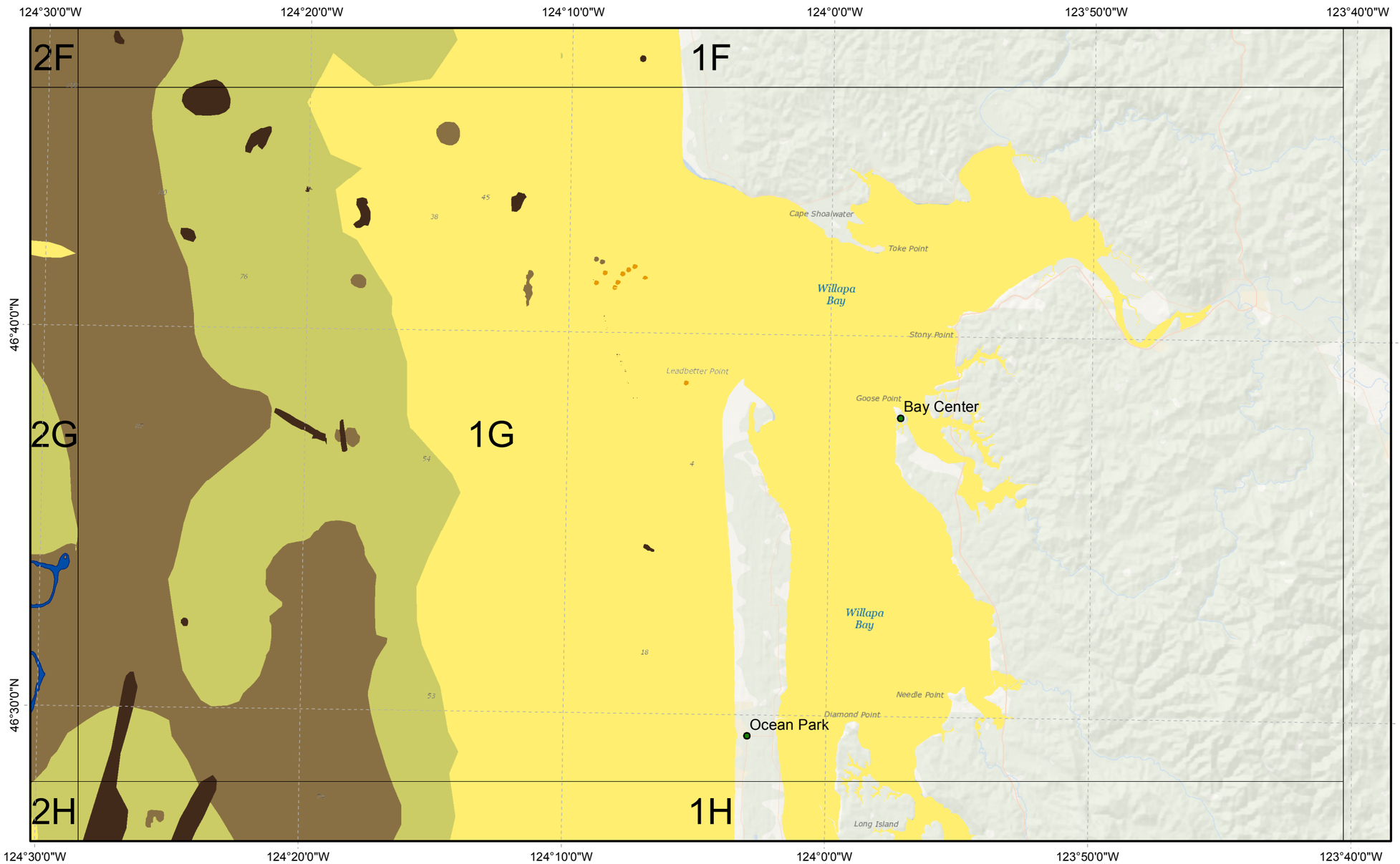

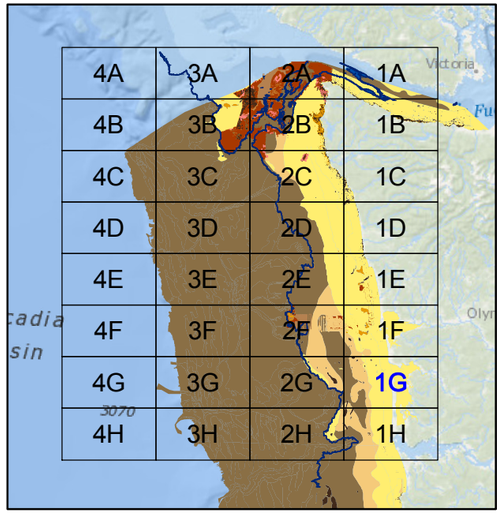

200-210 m Contour
Approximate Shelf Break

OCNMS Seafloor Data
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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 1G

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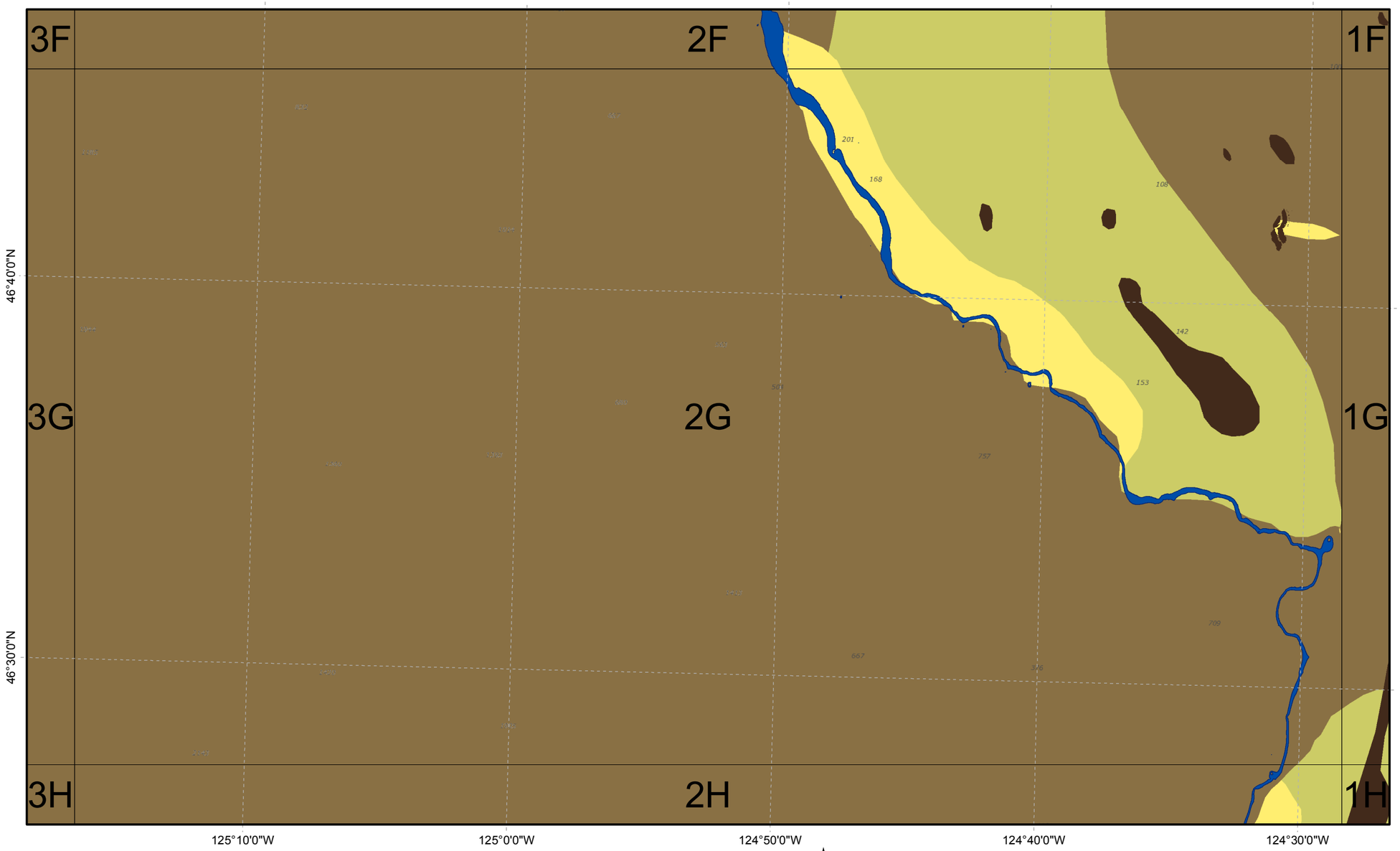

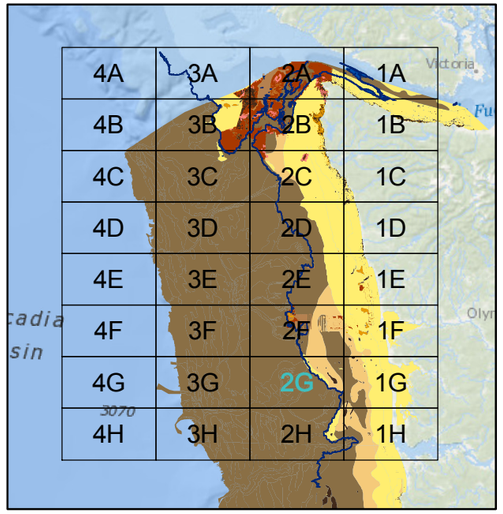

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 2G

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4F 3F 2F

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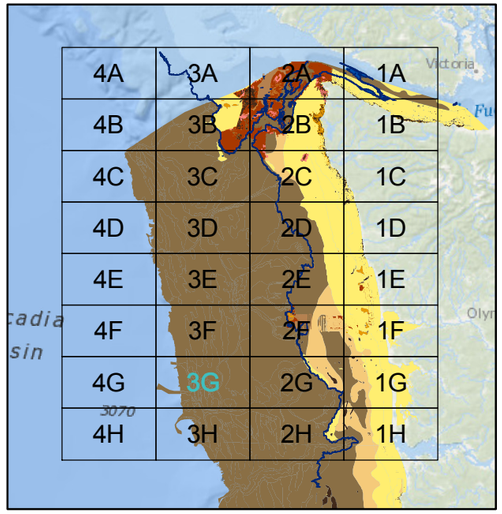

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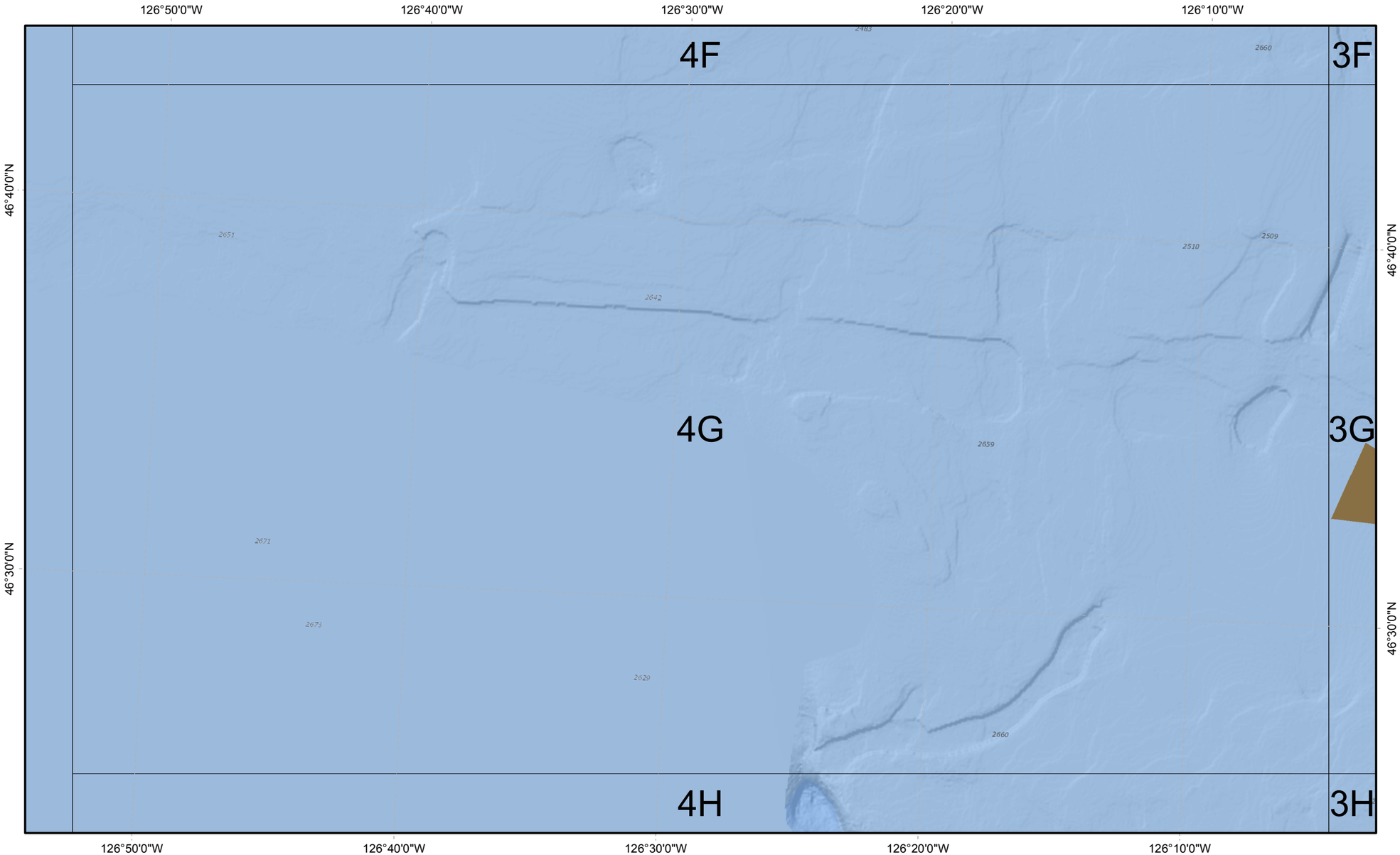

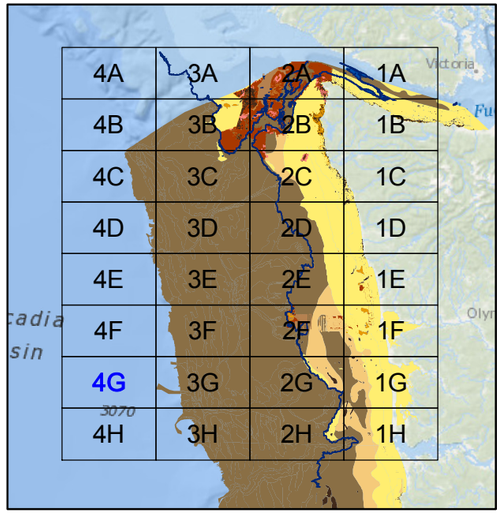

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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 4G

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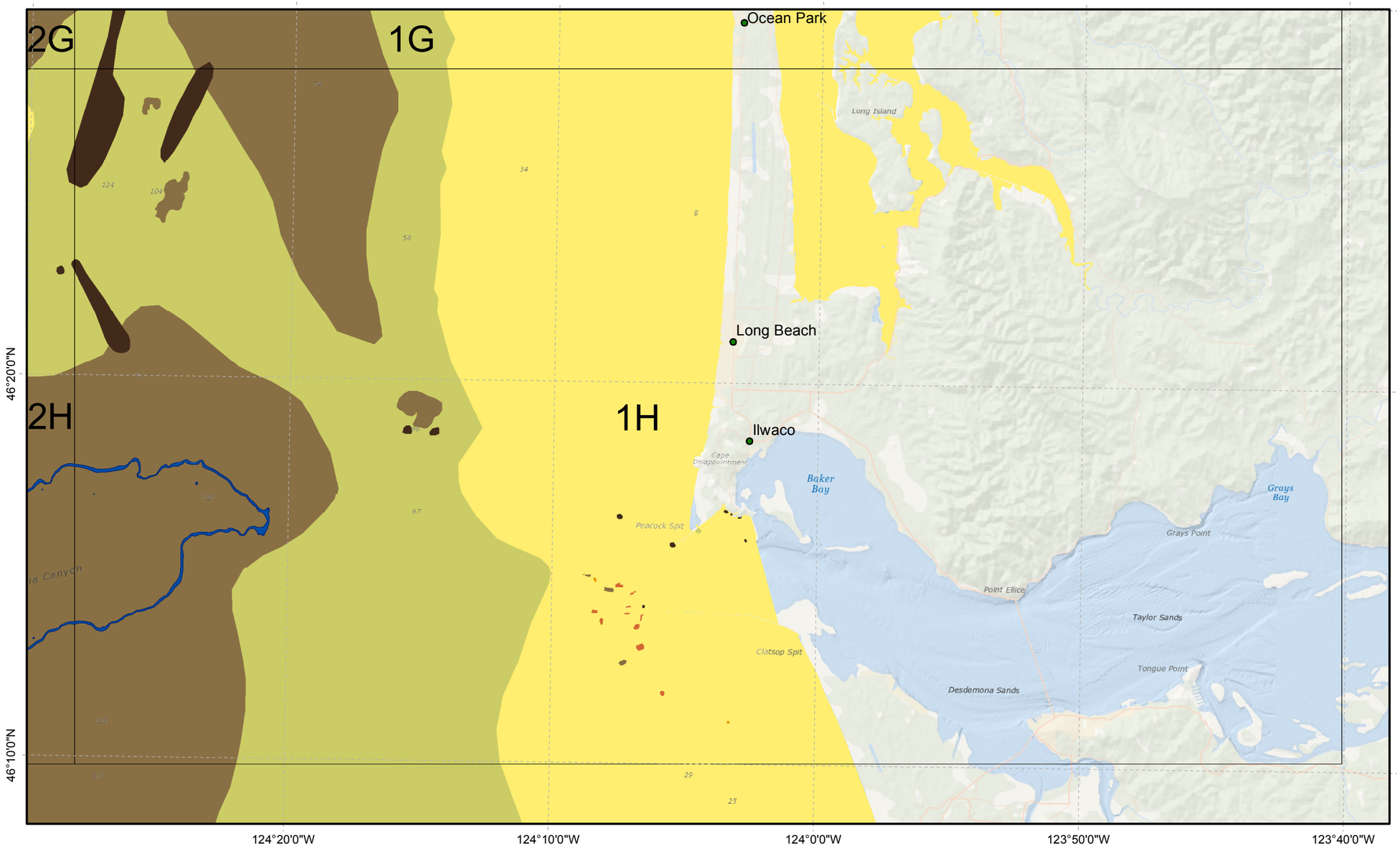

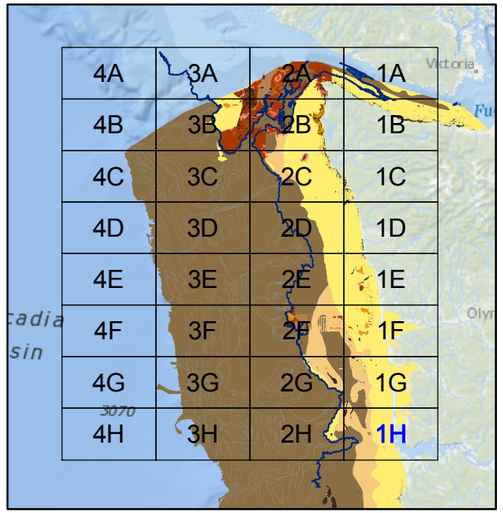

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UNITED STATES - WEST COAST

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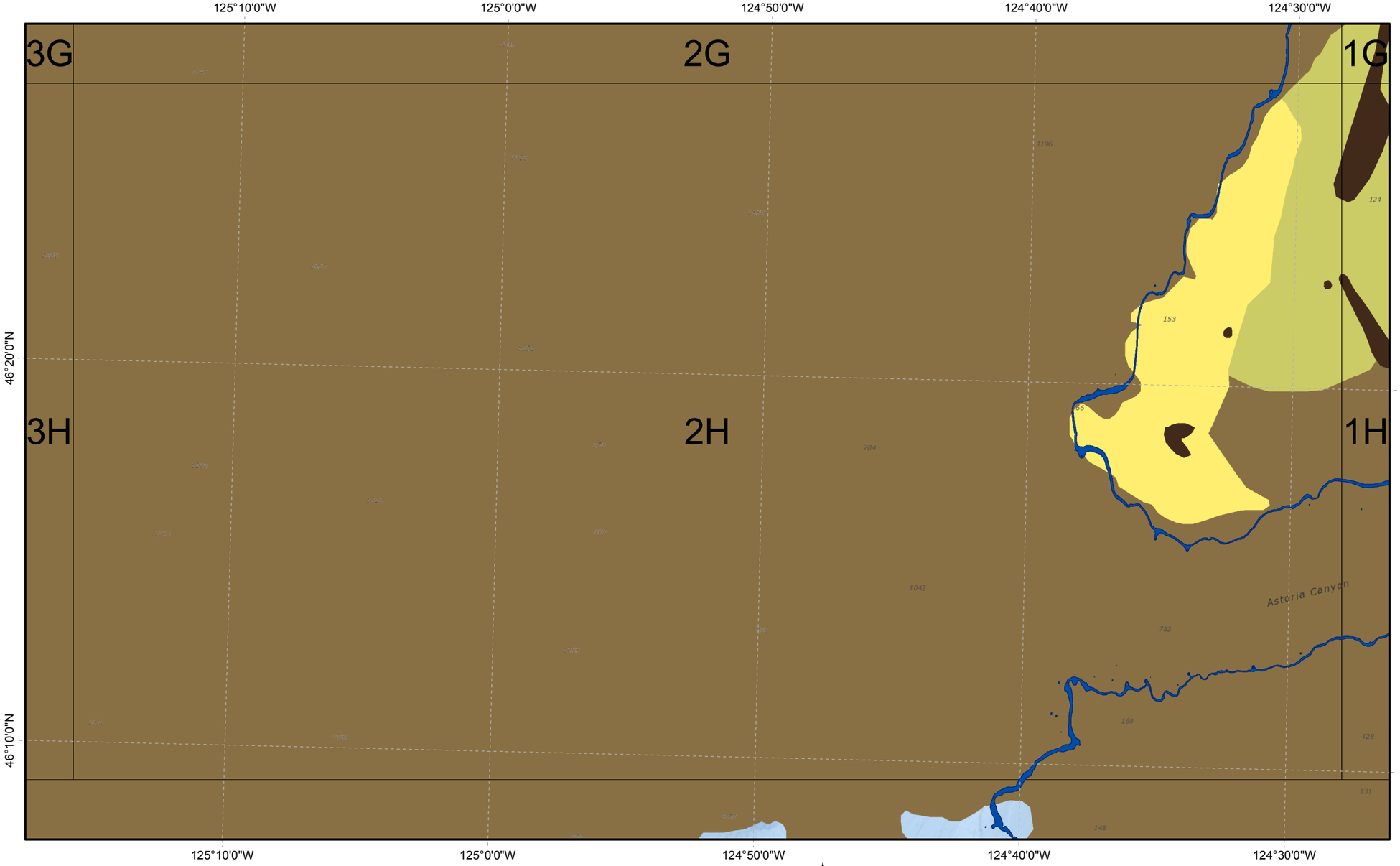

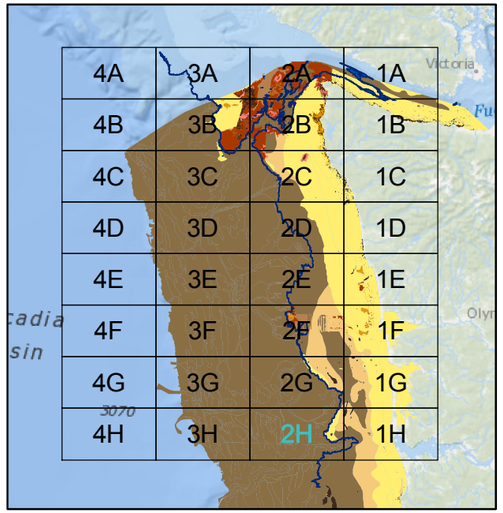

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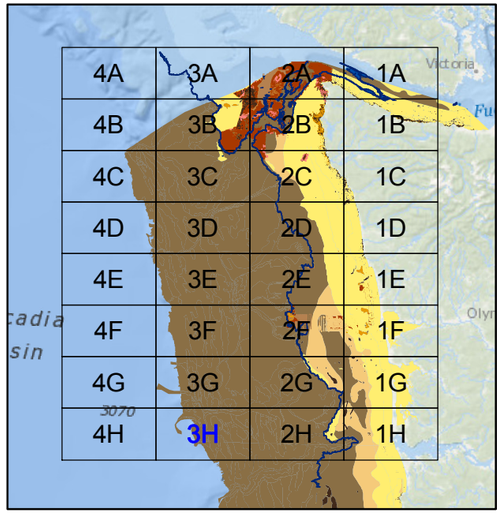
4G 3G 2G

4H 3H 2H



200-210 m Contour

Approximate Shelf Break

OCNMS Seafloor Data

OSU ATL & SML Data

CMECS Substrate Group

- Bedrock
- Gravel
- Gravel Mixes
- Slightly Gravelly
- Mud
- Muddy Sand
- Sand
- Sandy Mud

UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 3H

Transverse Mercator Projection - Scale 1:200,000
World Geodetic System 1984 - Soundings in meters at MLLW

0 2.5 5 10 Nautical Miles

0 5 10 20 Kilometers

The WA State Outer Coast Seafloor Atlas overlays fine-scale seafloor data from Olympic Coast National Marine Sanctuary (2000-2013) on coarser-scale Surficial Geologic Habitat data from multiple sources compiled by Oregon StateUniversity Active Tectonics and Seafloor Mapping Lab (2003-2015). Habitat characterization is NOAA's Coastal and Marine Ecological Classification Standard (CMECS, 2012). Inconsistent habitat characterization is the result of overlapping scales between the two products.

126°50'0"W 126°40'0"W 126°30'0"W 126°20'0"W 126°10'0"W

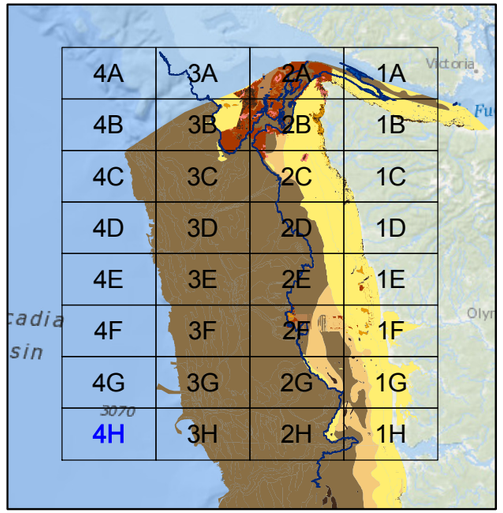
46°20'0"N

46°10'0"N

4G 3G

4H 3H

2660 2670 2702 2679 2690 2719 2677



200-210 m Contour

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- Sand
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UNITED STATES - WEST COAST

Washington State Outer Coast Seafloor Atlas: Map Page: 4H

Transverse Mercator Projection - Scale 1:200,000
World Geodetic System 1984 - Soundings in meters at MLLW

0 2.5 5 10 Nautical Miles

0 5 10 20 Kilometers

The WA State Outer Coast Seafloor Atlas overlays fine-scale seafloor data from Olympic Coast National Marine Sanctuary (2000-2013) on coarser-scale Surficial Geologic Habitat data from multiple sources compiled by Oregon StateUniversity Active Tectonics and Seafloor Mapping Lab (2003-2015). Habitat characterization is NOAA's Coastal and Marine Ecological Classification Standard (CMECS, 2012). Inconsistent habitat characterization is the result of overlapping scales between the two products.

METADATA

Cartographic Note:

The WA State Outer Coast Seafloor Atlas overlays fine-scale seafloor data from Olympic Coast National Marine Sanctuary (2000-2013) on coarser-scale Surficial Geologic Habitat data from multiple sources compiled by Oregon StateUniversity Active Tectonics and Seafloor Mapping Lab (2003-2015). Habitat characterization is NOAA's Coastal and Marine Ecological Classification Standard (CMECS, 2012). Inconsistent habitat characterization is the result of overlapping scales between the two products.

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V1 Olympic Coast Seafloor Mapping Data 2000-2013

1. Credits

Romsos, C. Goldfinger, C., Black, B., Wright,. 2015. Habitat Classification, Bathymetry and Backscatter Maps of Washington State. Scale 1:250,000. NOAA Olympic Coast National Marine Sanctuary, Oregon State University, Washington State Dept. of Natural Resources.

Additional acknowledgement is given to several branches of NOAA, USGS, and Cal State Seafloor Mapping Lab.

II. Summary

OCNMS Seafloor Maps are a compilation of 35 surveys conducted by the Olympic Coast National Marine Sanctuary (OCNMS) between 2000 and 2014 using a variety of remote sensing technology and data processing technologies. These surveys have been cleaned, edgematched, and re-classified by Dr. Chris Goldfinger and Physical Scientist Chris Romsos at the Oregon State University Active Tectonics and Seafloor Mapping Lab in Corvalis, Oregon in 2015.

III. Description

OCNMS conducted 35 sidescan and multibeam sonar surveys between 2000 and 2014. Under a contract from OCNMS and WA Dept. of Natural Resources, the Cooperative Institute for Marine Resources Studies (CIMRS) investigators Dr. Chris Goldfiner and Faculty Research Assistant Chris Romsos cleaned, re-imaged, edgematched, applied existing groundtruthing data, and reclassified these surveys, identifying surficial habitats using the Greene et al. and the Coastal and Marine Ecological Classification Standard for habitat characterization. From this compiled habitat map they created the scalable Seafloor Atlas for the northern extent of OCNMS.

IV. Supplemental Information

Original OCNMS habitat maps were automated image classifications (supervised) Output raster imagery was originally converted to polygon format (for attribution with the Greene, et al. classification scheme) at the native pixel resolution. This resulted in a number of problems.
1) The resultant polygon data sets maintained the misclassifications of the original;

2) The resultant polygon datasets were so large that their file sizes significantly impeded visualization;

3) The micro-scale classifications were not standardized across the study area and;

4) Interpretation and management could not be maintained at such fine scales.

OSU minimized the effects of classification errors, aided in rendering speed, and created a final product at an minimum mapping unit of 100m2. This was the same scale as the Oregon State Waters Mapping Program for continuity between WA and Oregon. Polygons smaller than 100m2 were eliminated (a GIS term and operation) by merging them into neighboring polygon of greater area. That operation did not significantly change the overall habitat type and proportion of composition in the final assessment. It removed noisy speckling in most areas of the map.

V4 – Surficial Geologic Habitat Maps for Washington and Oregon

I. Credits

Please credit the Oregon State University, Active Tectonics & Seafloor Mapping Lab (AT&SML), NOAA Fisheries Northwest Fisheries Science Center, and the Bureau of Ocean Energy Management when using this dataset. Additional contributions provided by: the Oregon Department of Fish and Wildlife, NOAA Biogeography Branch, and The Nature Conservancy. Additional map product inputs were provided by: the Seafloor Mapping Lab of California State University Monterey Bay, the Center for Habitat Studies at Moss Landing Marine Labs, the Olympic Coast National Marine Sanctuary, and NOAA Fisheries Northwest Fisheries Science Center.

Larger Work Citation: Goldfinger C, Henkel, SK, et al. 2014. Benthic Habitat Characterization: Volume 1 Evaluation of Continental Shelf Geology Offshore the Pacific Northwest. US Dept. of the Interior, Bureau of Ocean Energy Management, Pacific OCS Region. OCS Study BOEM 2014-662. 161 pp

II. Description

This data set delineates geological seafloor characteristics of the continental margin of the United States West Coast adjacent to Washington, Oregon, and Northern California. The data set depicts seafloor substrate types as interpreted from a multitude of seafloor mapping surveys, including multibeam sonar, sidescan sonar, sediment grab samples, cores samples, seismic reflection profiles, and still or video images. Seafloor types are classified according to three unique classification schemes: (1) The Active Tectonics and Seafloor Mapping Lab's SGH codes, (2) Greene et al. (1999) deep-water marine benthic habitat scheme, and (3) the Coastal and Marine Ecological Classification Standard's Substrate Component (CMECS). In the Washington Outer Coast Seafloor Atlas, the Surficial Geological Habitat is symbolized using the CMECS classification.

This dataset has been developed since 2002 and is now at version 4.0. Version 4.0 SGH Map provides significant changes and modifications from previous versions. The major modifications from previous versions are as follows:

1. Merged in new local-scale habitat maps from detailed mapping at 13 sites over Washington, Oregon, and Northern California.

2. Implemented numerous attribute table clarifications and modifications including a clarification of the use of primary, secondary lithologic type.

3. Added CMECS Substrate Component codes by crosswalking SGH codes to CMECS SC codes.

4. Appended habitat polygons for Northern California from the 2005 EFH Consolidated GIS Volume 1 (2004) data set (geohab_woc.shp) developed by Gary Greene and the Center For Habitat Studies at Moss landing Marine Labs. Significant modifications or updates to continental shelf and slope habitat types of Northern California were made to the Greene et al. map based upon newly available bathymetry in the region.

5. Appended California State Waters mapping Program Tier II map products for northern California. The Tier II habitat maps used in this regional habitat map were acquired, processed, archived, and distributed by the Seafloor Mapping Lab of California State University Monterey Bay and are available in their original form at: http://seafloor.otterlabs.org/SFMLwebDATA.htm

III. Supplemental information

Surficial Geologic Habitat Maps for Washington and Oregon Lineage:

Version 1 Map Products: Version 1.1, Published in 2003 for the Pacific Fishery Management Council's Essential Fish Habitat EIS. Version 1.5, Distributed to Terralogic GIS, First significant revision to Version 1.1, included the addition of rock polygons at Hydrate Ridge, a significant revision to the spatial extent and representation of the Columbia River Mud Plume, and changes to habitat interpretations to the NW corner of the OCNMS.

Version 2 Map Products: Version 2.0, A copy of Version 1.5, but without the predicted rock outcrop polygons that were merged by Terralogic GIS. Version 2.1, Included ODFW RoxxAnn classified polygons at Seal Rock, Oregon. Available on the PaCOOS SDE database as "noaasde.sde.ORWA_SGH_IOOS" and "noaasde.sde.surficialHabitat". Also distributed as a shapefile called "SGH_V2_SED". Version 2.2, Andy Lanier's thesis work was added to the Oregon upper slope and outer shelf. Available on the PaCOOS SDE database as "noaasde.sde.NSDE_Or_Wa".

Version 3 Map Products: Version 3.0, This map version incorporates the work of Melinda Agipito, what we call the "NOAA Smoothsheet data", as seabed type interpretations for the coastal waters of Oregon. The large midshelf reef offshore Bandon Oregon (outside state waters and not Bandon Reef) was also remapped in this version after re-evaluating the historic seismic dataset in the region. Metadata for this file is out of date (dating back to Version 2.2) and users should be aware of this metadata synchronization issue with Versions between 2.2 and 3.5. Version 3.1,

This map version incorporates the work of both Melinda Agipito and Keith Karageorge, what we call the “NOAA Smoothsheet data”, as seabed type interpretations for the coastal waters of Washington and Oregon. The polygon shapefile also includes background polygons for continental lands and other ocean areas and was distributed as WC_V3_1.shp via the PaCOOS West Coast Habitat Data Portal. Metadata for this file is out of date (dating back to Version 2.2) and users should be aware of this metadata synchronization issue with Versions between 2.2 and 3.5. Version 3.1 includes seabed habitat types mapped by Gary Greene's and distributed to PSMFC in 2003. These polygons have been point simplified to increase rendering speed and are not full resolution polygons available through the original work. See the Pacific Coast Groundfish Essential Fish habitat Project, Consolidated GIS Data Volume 1, Physical and Biological Habitat CD set for the source CA data. Version 3.2, This version is identical to V3.1 with one less polygon record (sliver fixed). Metadata for this file is out of date (dating back to Version 2.2) and users should be aware of this metadata synchronization issue with Versions between 2.2 and 3.5. *Version 3.2.1*. This intermediate working version incorporates polygons for the Columbia River. This version may have been shared with researchers but should be considered a developmental branch from V3.1 and V3.2 that was never completed. The purpose of this development branch (spring 2009) was to add estuary polygon areas for Oregon and Washington. There are no other significant differences between V3.1, V3,2, and V3.2.1 Metadata for this file is out of date (dating back to Version 2.2) and users should be aware of this metadata synchronization issue with Versions between 2.2 and 3.5. Version 3.5, (Oregon State Waters Only) – This data product covers only the 3 nautical mile State Waters of Oregon, but significantly revises portions of this area from any earlier map versions. The primary change is updated habitat interpretations for the northern portion of Oregon’s Territorial Sea, primarily in the vicinity of proposed marine reserves. This revision was completed through qualitative visual interpretations of high resolution bathymetric, and backscatter data, and ground truth data collected during seafloor mapping surveys in 2009 and 2010. This revision applies only to areas north of Cape Arago, although the surveys also occurred at Cape Arago reef and to the south. The purpose of this version was to provide improved seafloor habitat mapping in areas previously lacking high resolution seafloor data in order to assist the state of Oregon with marine reserve design. Given the time constraints of the marine reserves process, there was limited time to develop the habitat data fully. The objective of the visual classification methods was to identify or update mappings of rock outcrop and patchy sediment distributions in these target areas. The visual classification resulted in more coarsely-defined (less accurate, precise, or repeatable) habitat features than had we employed computer-generated supervised classification techniques. This version is considered an interim product and should be used with caution in any application of these data. The next release of Oregon’s Benthic Habitat dataset will be developed incorporating all newly-acquired seafloor data (below) mapped using supervised classifications. Please note that post V3.5, site specific, supervised classifications are available for download at the Active Tectonics and Seafloor Mapping Lab’s webpage (http://activetectonics.coas.oregonstate.edu). Oregon State Waters Mapping Program multibeam sonar survey data mapped using visual classification and included in V3.5: H12123,

H12124,H12125,H12127, H12128,H12129, OSWMP Newport, and USGS Depoe Bay Oregon State Waters Mapping Program multibeam sonar survey data not classified or used for V3.5: H12122, H12122plus, Seaside, Netarts, H12126,OOI Newport,OSWMP South Beach,Florence, BOEM Lakeside (Siltcoos), Cape Arago, Cape Blanco, and Humbug Mountain Version 3.6: A composite of Versions 3.1 and 3.5. Version3.5 was clipped to the Oregon Territorial Sea boundary (3nm) resulting in removal of habitat data in federal waters off Oregon and Washington from the beach to the Abyssal Plain (approx. 0-3000m) that existed in all previous versions. In version 3.6, the federal waters data (Version 3.1) was added back into the shapefile.

Version 3.6: Habitat interpretation classification was modified to accommodate analyses associated with Oregon's spatial planning process. A simplified reclassification of habitat types was applied to an added field [NEDA_reclas]. Two rule sets for the reclassification were necessary owing to differences in the original classifications: one rule was applied to WA and OR; the other to CA. - For WASHINGTON and OREGON: (1) Habitat type 'Rock' = either SGH_Lith_1 or SGH_Lith_2 type is 'rock', 'boulder', or 'boulder/sand'; (2) Habitat type 'Sand' = Both SGH types are sand, or SGH_Lith_1 is sand and SGH_Lith_2 is mud, or SGH_Lith_1 is sand and SGH_Lith_2 is blank. . (note: the single polygon with SGH_Lith_1 of Sand and a SGH_Lith_2 of mud/shell was classed as Sand); (3) Habitat type 'Mud' = Both SGH types are mud, or SGH_Lith_1 is mud and SGH_Lith_2 is sand, or SGH_Lith_1 is mud and SGH_Lith_2 is blank. (4) Habitat type 'Gravel, Cobble, Shell, or Mixed' = all other combinations that don't fit into one of the 3 preceding categories. - For CALIFORNIA: (1) 'Rock' = SGH_Lith_1 or SGH_Lith_2 is 'rock' or 'island'; (2) 'Sand' = SGH_Lith_1 and/or SGH_Lith_2 is 'soft' and depth is 200m; (4) 'Gravel, Cobble, Shell, or Mixed' = all other combinations that don't fit into one of the 3 preceding categories.

Surficial Geologic Habitat Maps for Washington, Oregon, and Northern California Lineage: Version 4.0: The first surficial geologic habitat map from the Active Tectonics and Seafloor Mapping Lab to include updates and interpretations in California (Northern California). See abstract and purpose for more information about this dataset.

Place Names

I. Credits

The Geographic Names Information System (GNIS), developed by the U.S. Geological Survey in cooperation with the U.S. Board on Geographic Names, contains information about physical and cultural geographic features in the United States and associated areas, both current and historical (not including roads and highways). The database holds the Federally recognized name of each feature and defines the location of the feature by state, county, USGS topographic map, and geographic coordinates.

Other feature attributes include names or spellings other than the official name, feature designations, feature class, historical and descriptive information. The database assigns a unique feature identifier, a random number that is a key for accessing, integrating, or reconciling GNIS data with other datasets. The GNIS is our Nation's official repository of domestic geographic feature names information.

II. Summary

For the Washington Outer Coast Seafloor Atlas, only 19 place names were selected from the GNIS system: Aberdeen, Bay Center, Clallam Bay, Copalis, Forks, Ilwaco, Joyce, La Push, Long Beach, Moclips, Neah Bay, Ocean Park, Ocean Shores, Port Angeles, Quinault, Taholah, Westport, La Perouse Bank, and Swiftsure Bank.