Mapping the Washington Margin for Multi-Use

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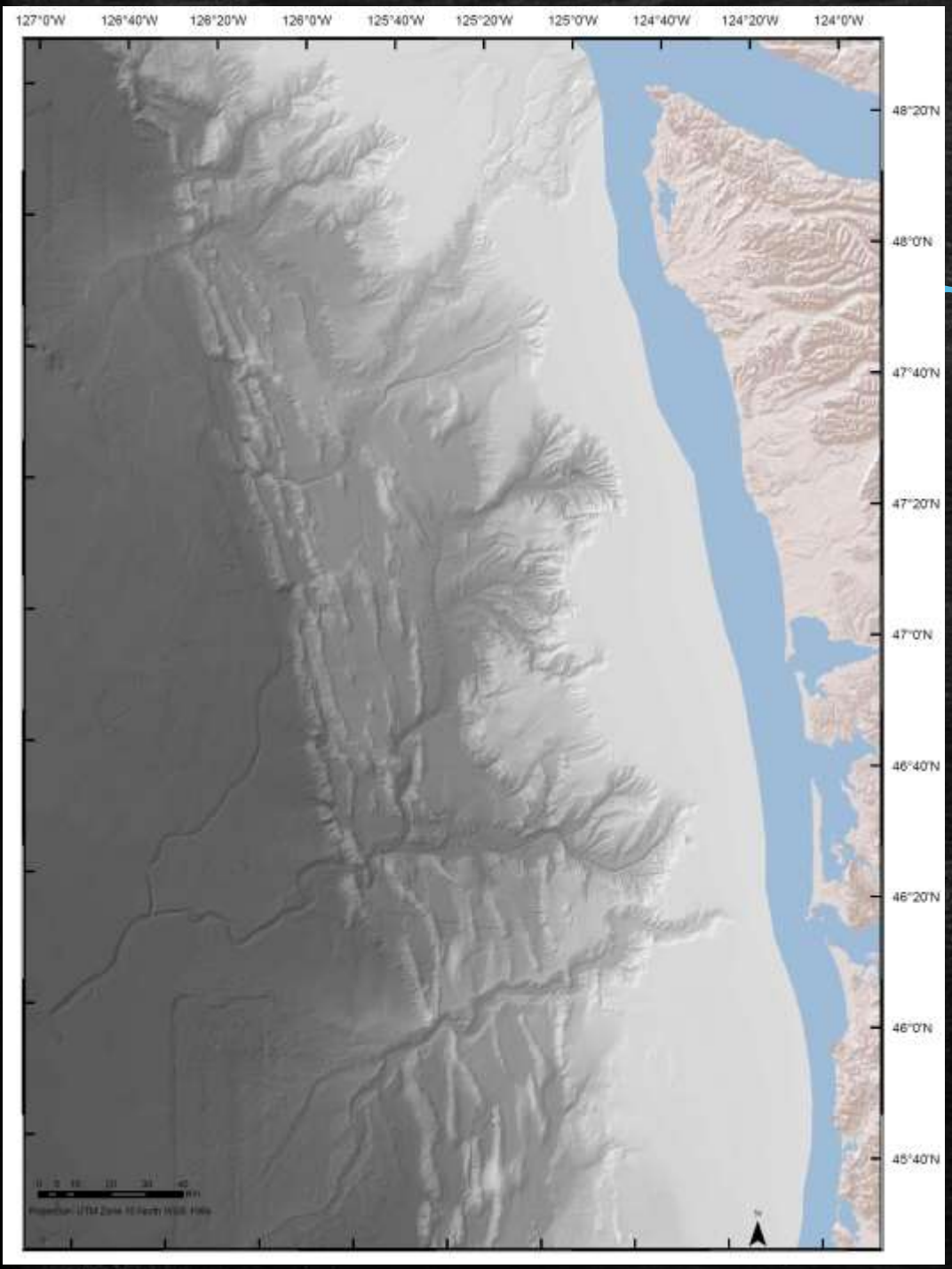


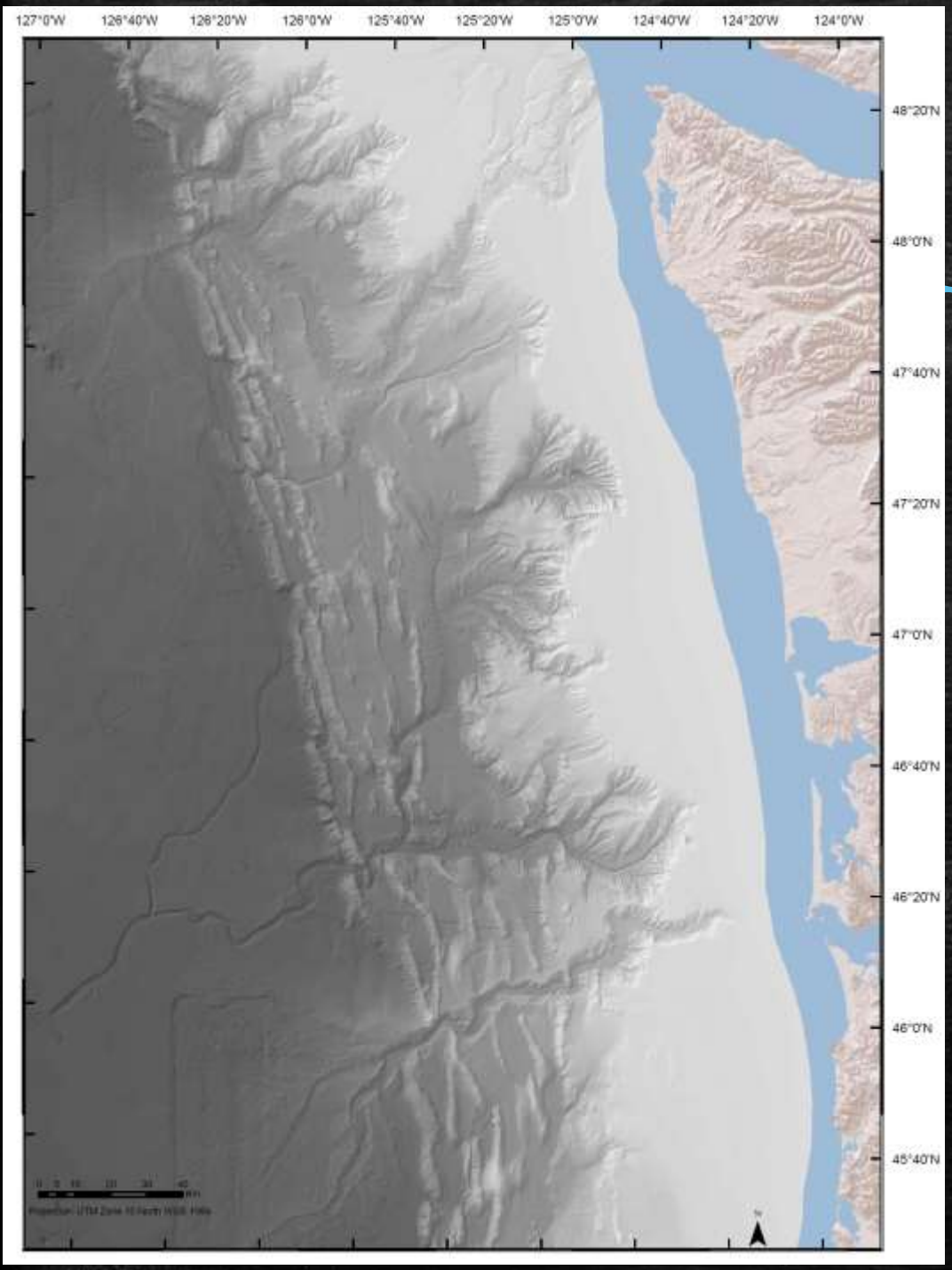
Northern Cascadia

Nearly complete multibeam (various resolutions) now exists. OSU cruises 1992-2012 cover ~ 80% of the continental slope of Washington. Other sources cover major portions of the southern Canadian slope.

Overall these data can support a ~ 100m grid in most areas, many areas of the slope ~ 35 m.

There are still some gaps, mostly on the upper slope.

Most of the shelf remains unmapped.



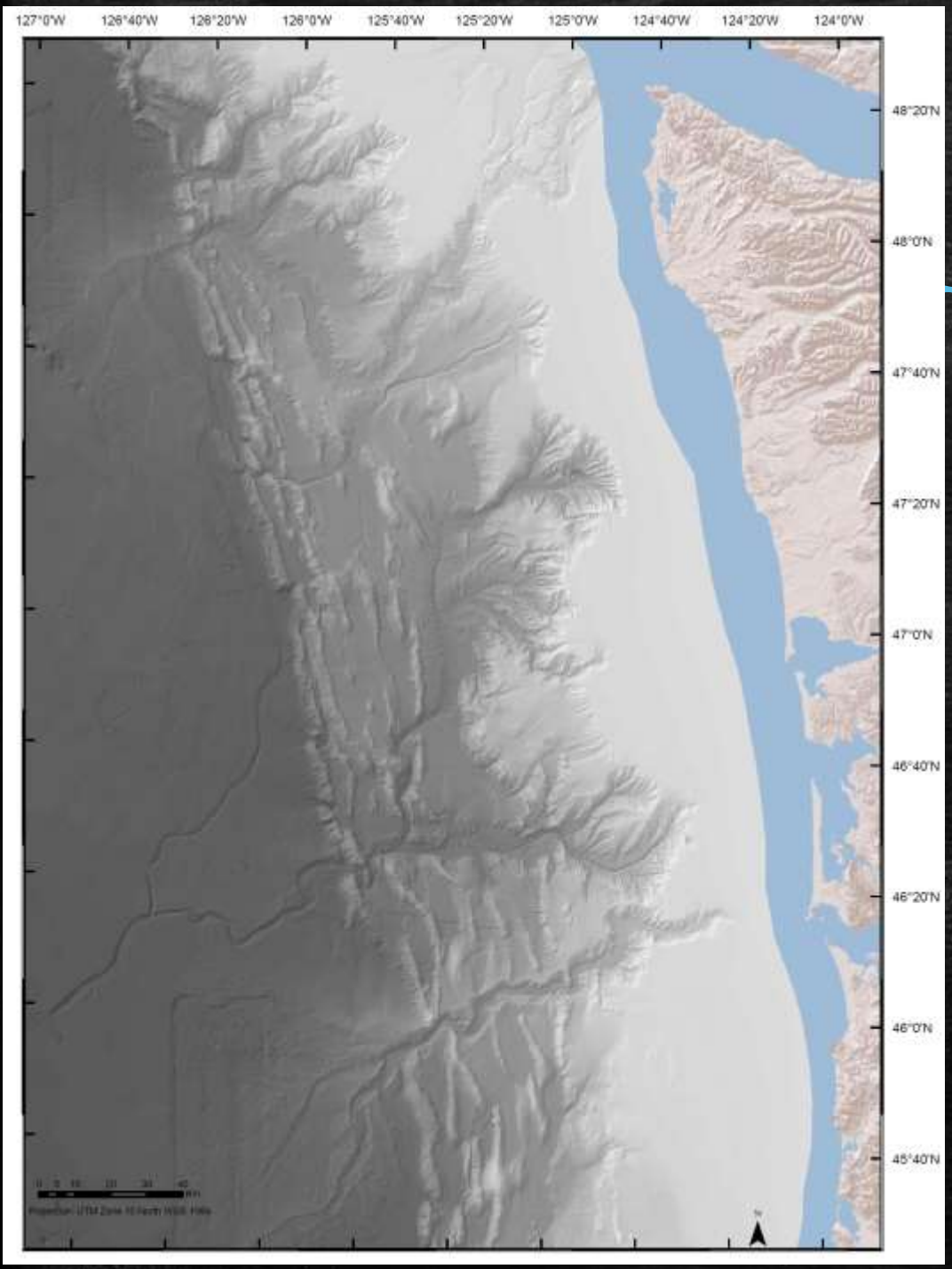
Mapping Systems

A wide variety of systems used:

Krupp Atlas Hydrosweep
"Classic" 16 beam SeaBeam
SeaBeam 2000
Kongsberg EM 120
Kongsberg EM 122 (chirp)
Kongsberg EM-300, 302
Elac Bottom chart
Reson SeaBat (various)

Sidescan:
AMS 60
AMS 150
SeaMARC 1A
Klein 50

Leadline!!



Mapping Systems

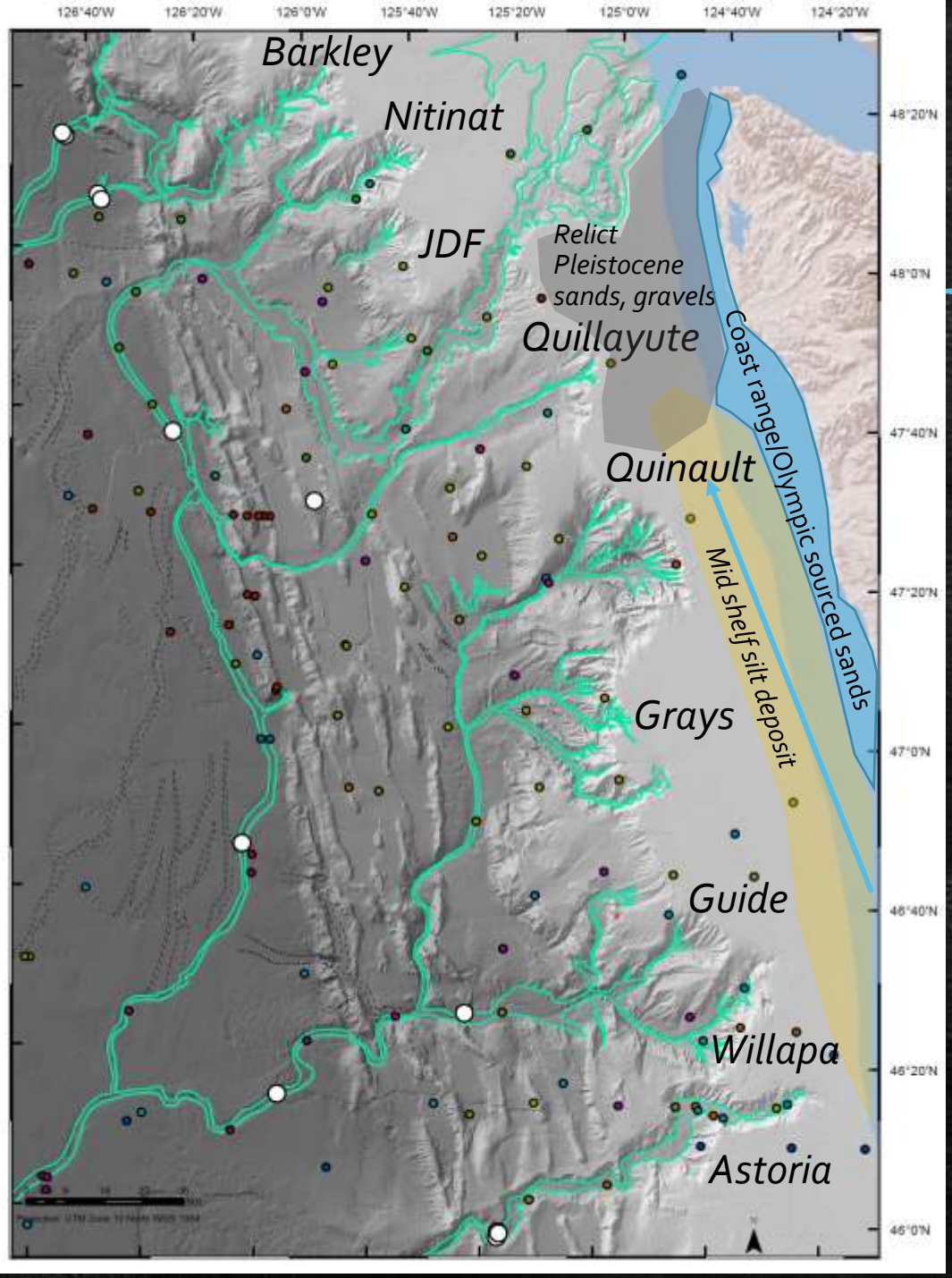
Standards used:

None.

Well, at least all the multibeam systems were designed to IHO standards for position and depth accuracy. Some used NOAA hydrographic protocols.

Otherwise, these data were not collected to any common standard, or even common datum.

Prior to 2008, this area was "Classified"



Northern Cascadia

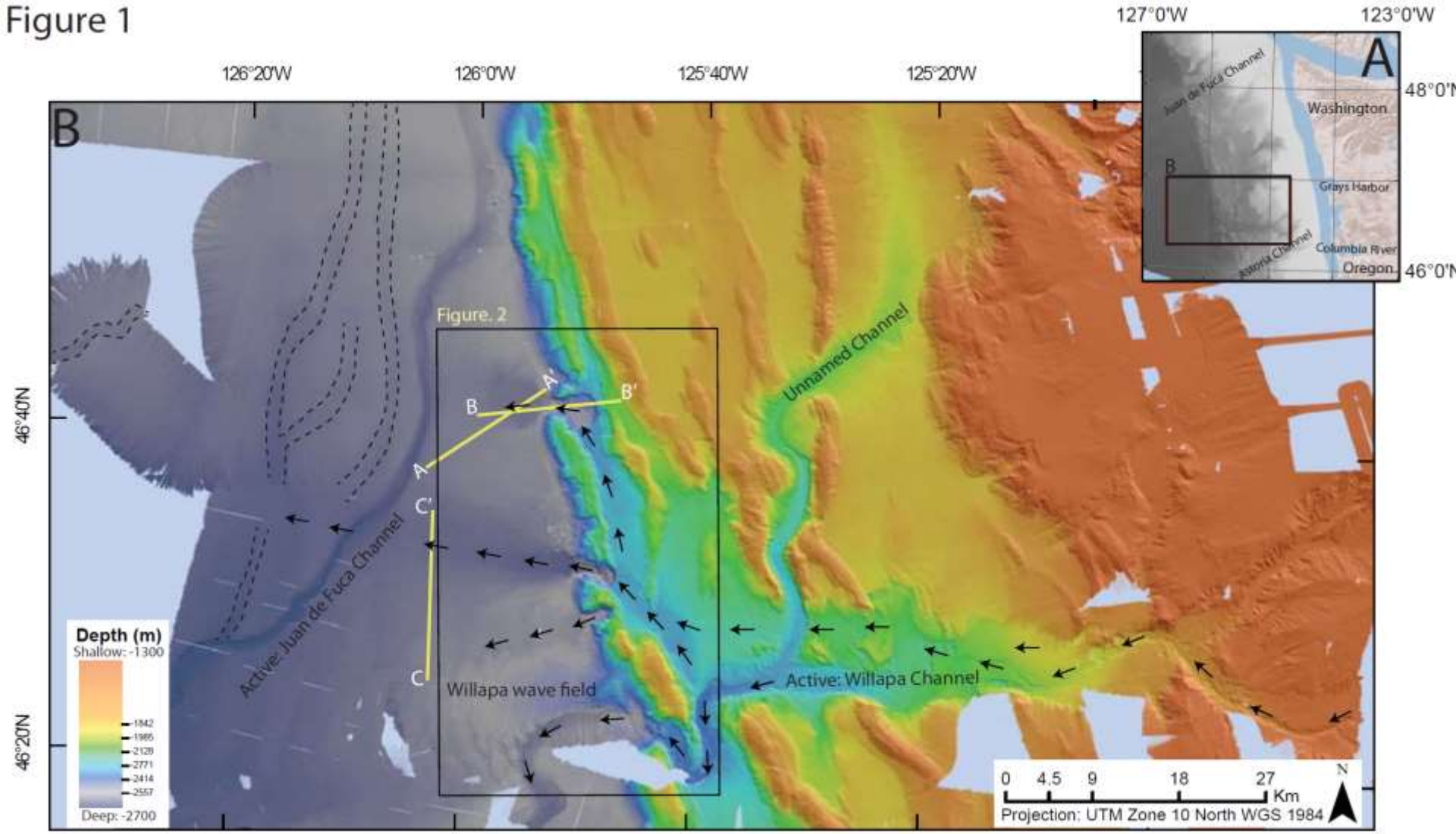
Here are the major Canyon/Channel Systems and the primary sediment sources on the shelf.

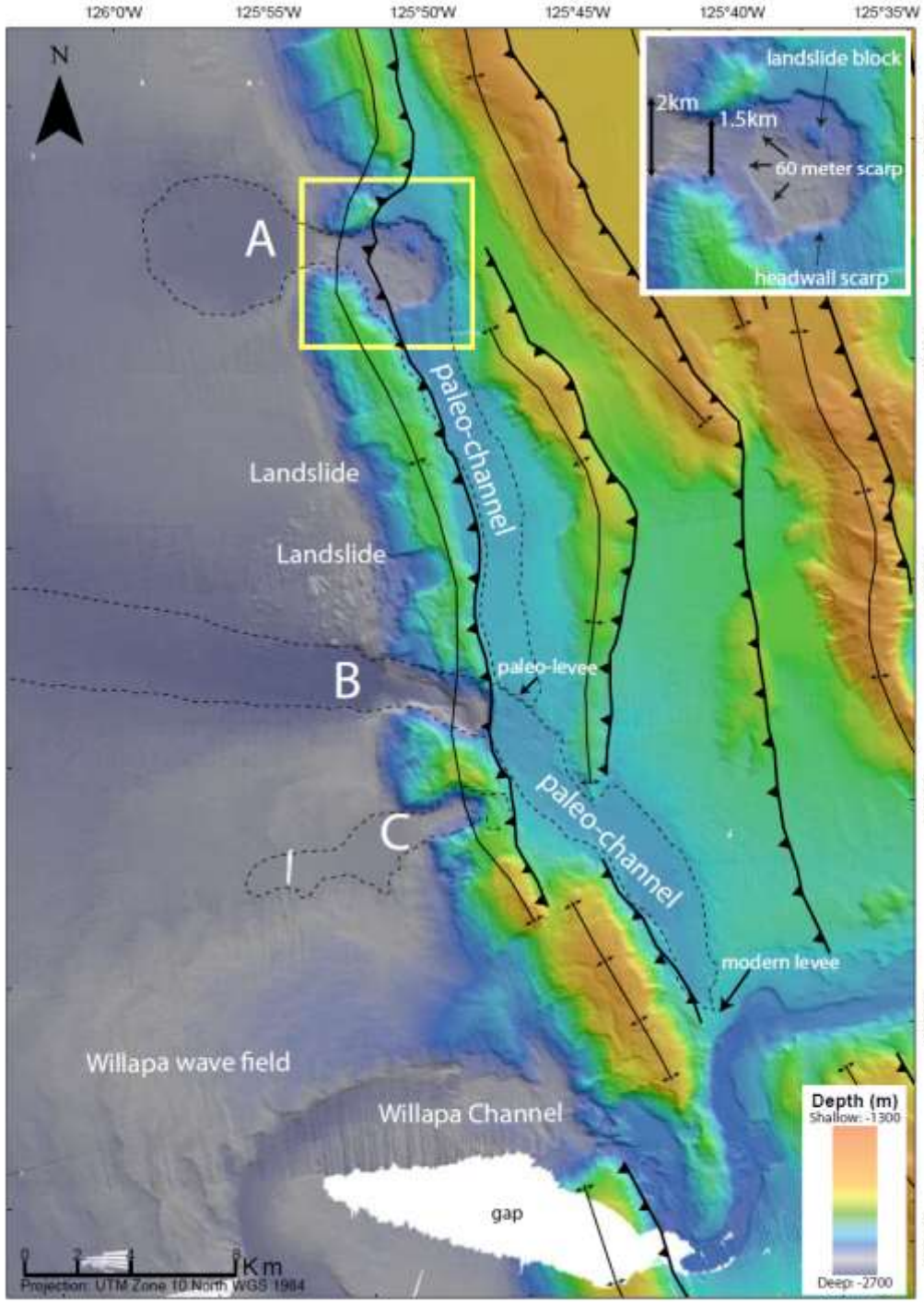
Offshore, the continental slope is dominated by the Fold-thrust belt of the Cascadia subduction zone.

Active systems shown in green, relict Pleistocene systems in dashed grey.

These two paleochannels were mapped as inactive in 1999…

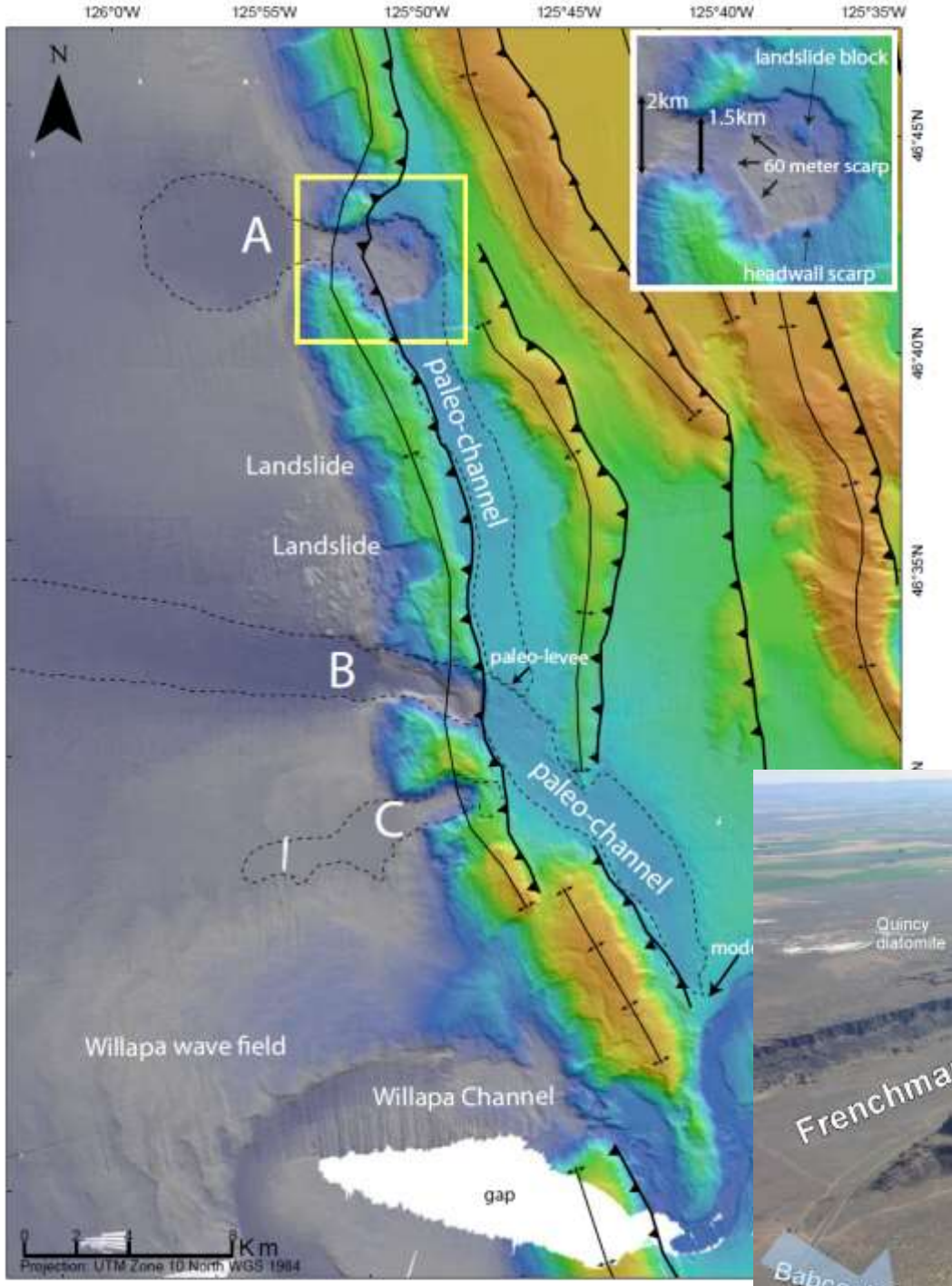
Figure 1



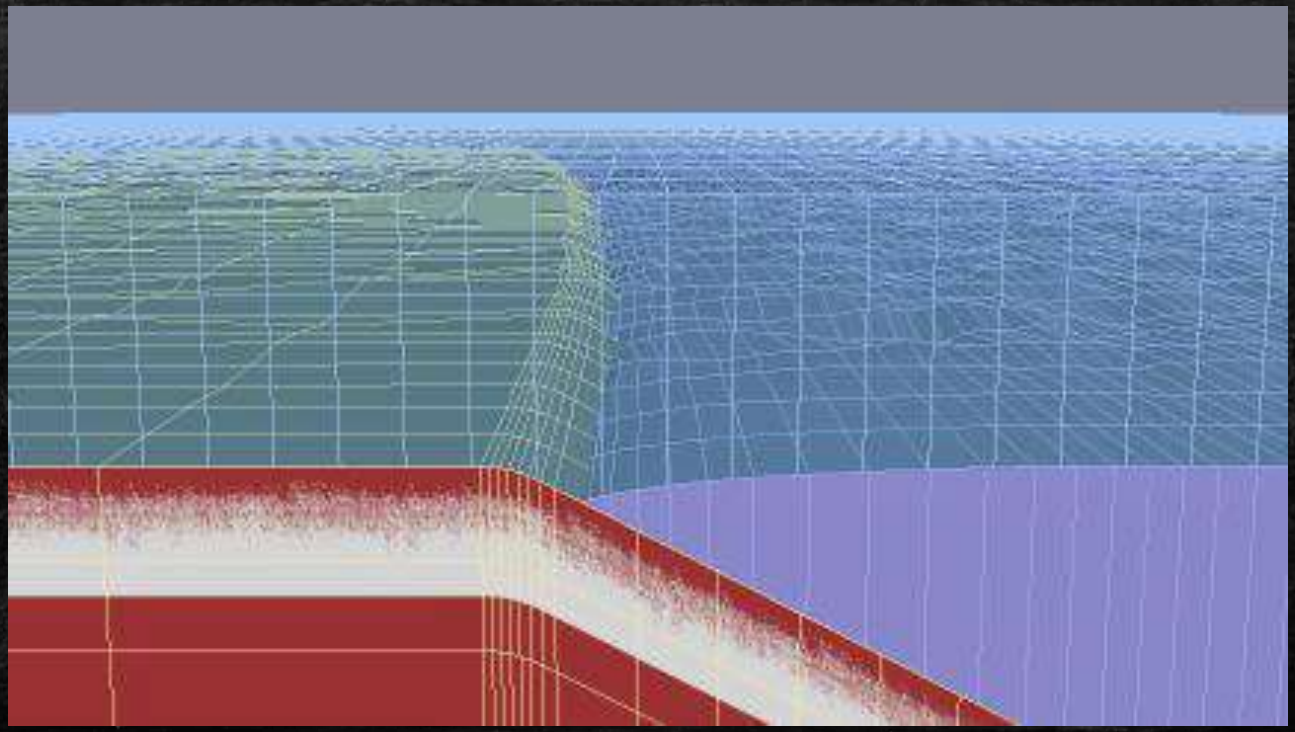


- The two features "A" and "B" extend westward across the fall line at nearly right angles, indicating a high flow regime

- J. Beeson et al 2013, in revision.

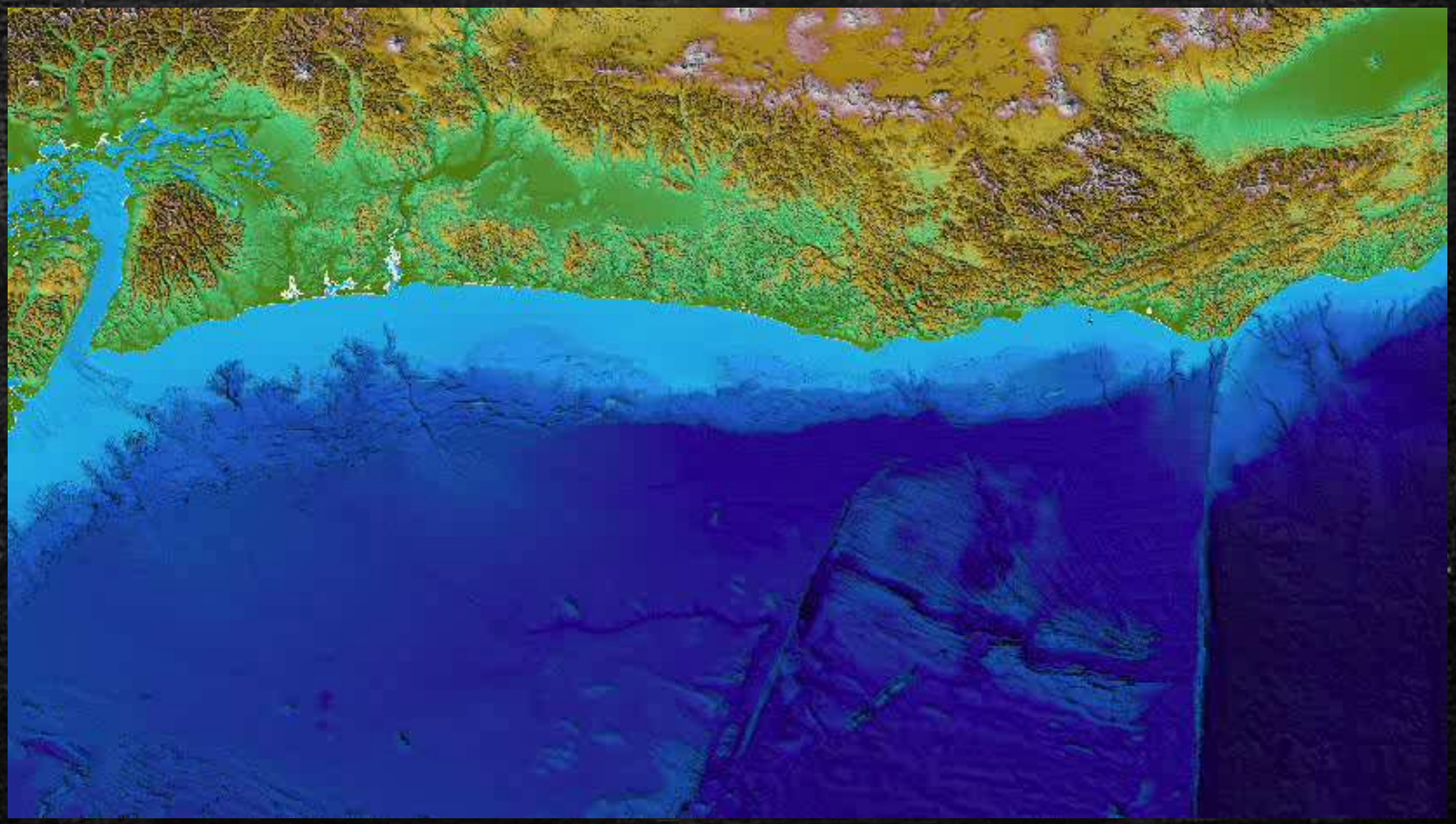


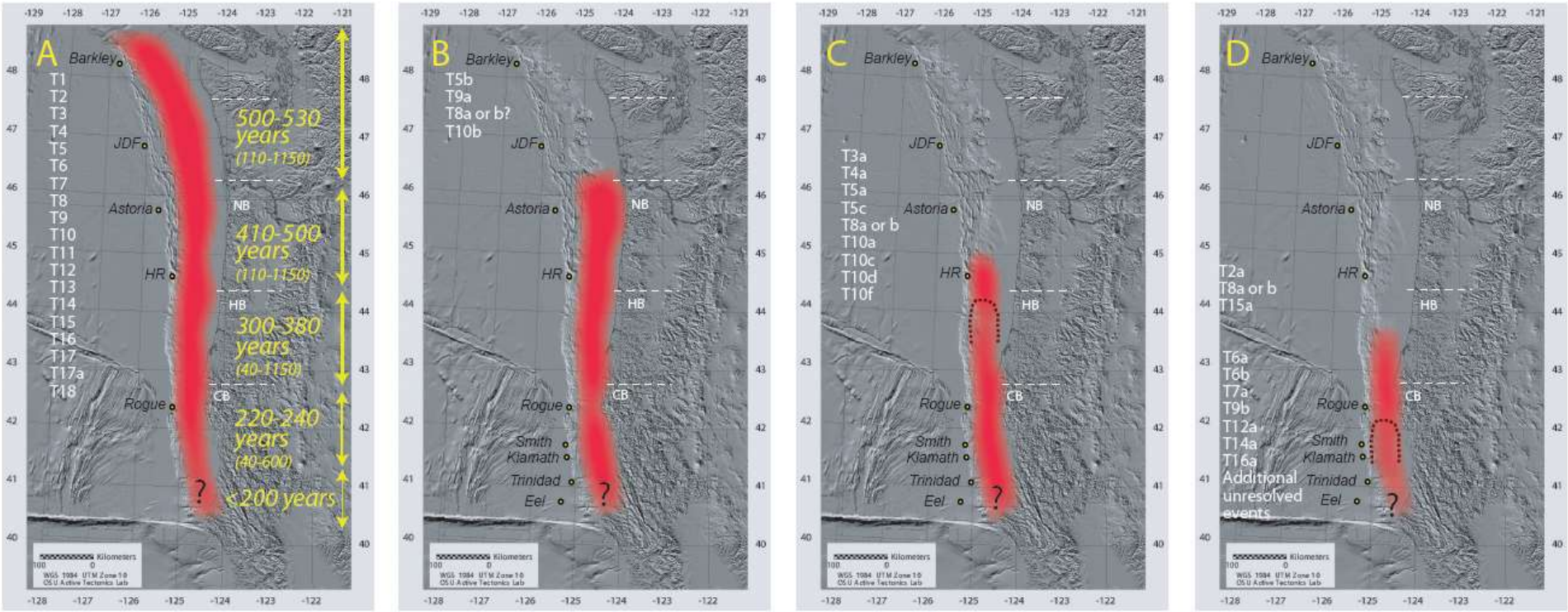
- The two features "A" and "B" are interpreted as submarine "coulees" similar to those observed onshore and most likely related to the Missoula flooding events of the deglacial period.



What actually happens during the earthquake?

Synchronous turbidity currents are triggered within a few minutes of each other along the length of the margin

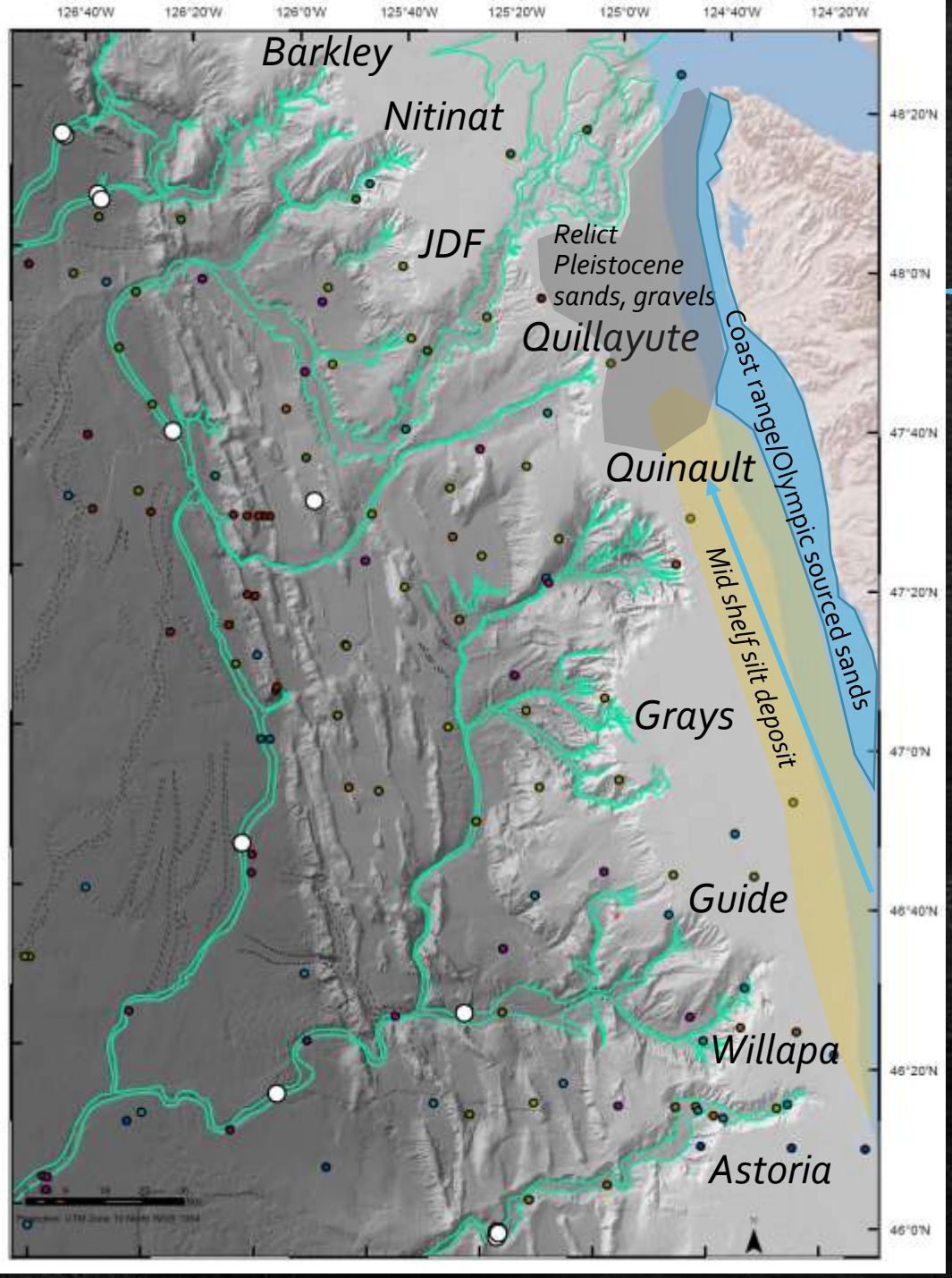




Rupture lengths from paleoseismic data, past 10,000 years. Segment boundaries are roughly compatible with ETS segment boundaries proposed by Brudzinski et al., 2007 and Boyarko et al 2010) though both sets of boundaries are quite crude.

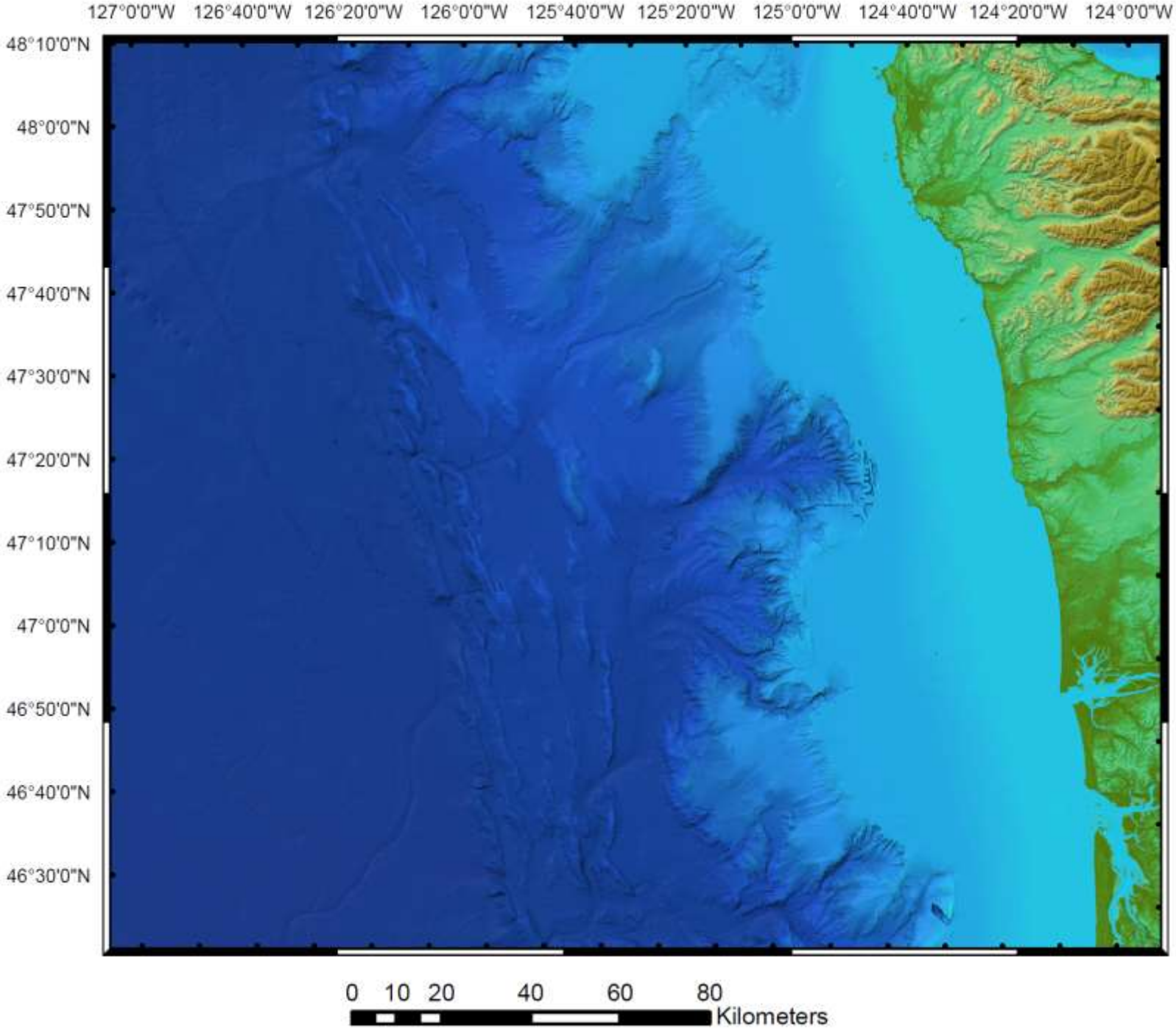
While recurrence interval is ~ 500 years in northern Cascadia, it is only 220-240 years in the south. (220 years in the past ~ 3000 years). The NSAF recurrence during this time is similar, ~200 years.

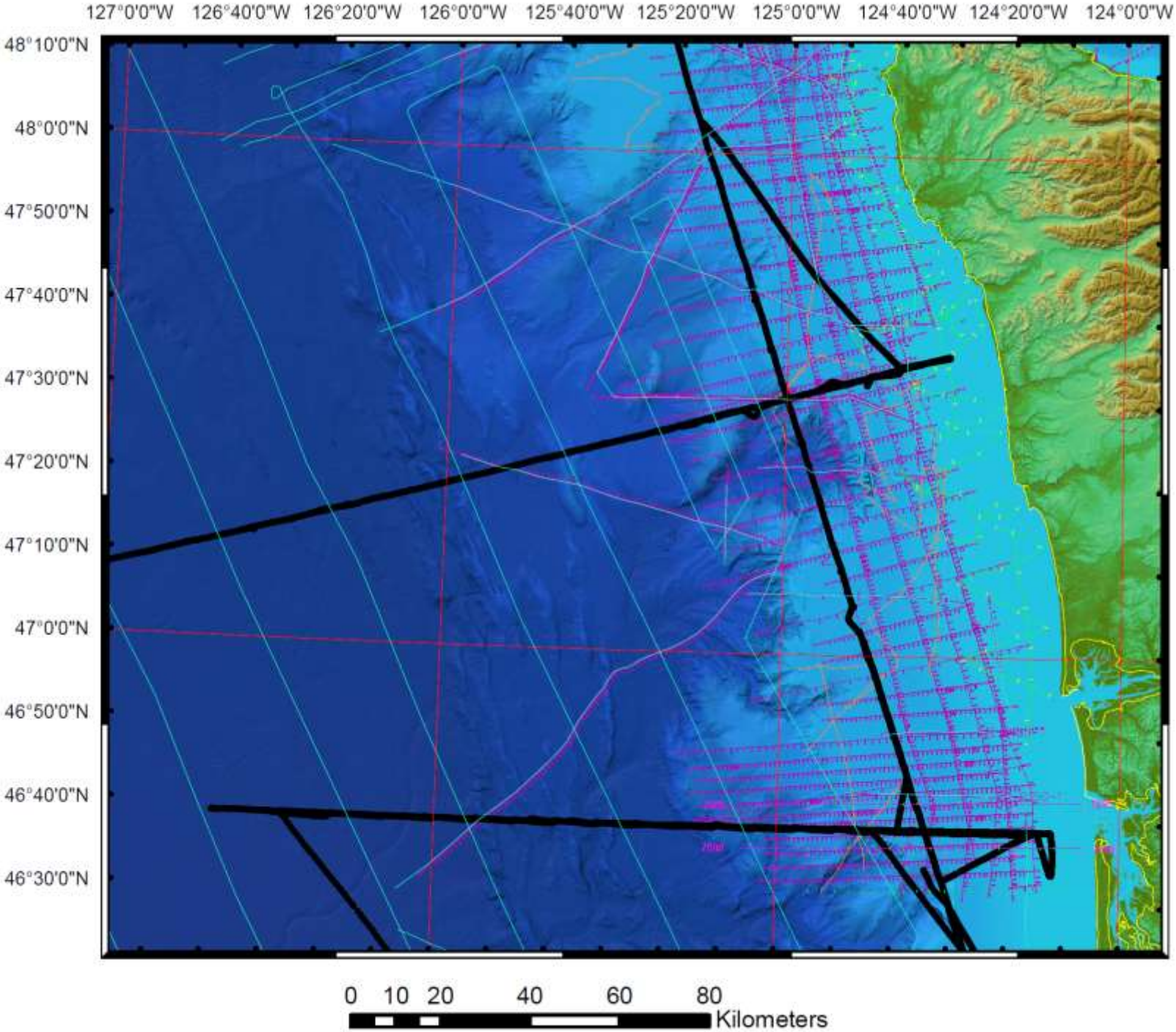
A video of the earthquake sequence can be downloaded at:
http://www.cambridge.org/us/knowledge/isbn/item6642716/?site_locale=en_US



Data mining not quite complete.

Many many cores exist offshore to groundtruth the continental slope maps. There are more on the Washington shelf (not shown) that have only partly been used.


127°0'0"W
126°40'0"W
126°20'0"W
126°0'0"W
125°40'0"W
125°20'0"W
125°0'0"W
124°40'0"W
124°20'0"W
124°0'0"W
48°10'0"N
48°0'0"N
47°50'0"N
47°40'0"N
47°30'0"N
47°20'0"N
47°10'0"N
47°0'0"N
46°50'0"N
46°40'0"N
46°30'0"N
0 10 20 40 60 80
Kilometers


127°0'0"W
126°40'0"W
126°20'0"W
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125°20'0"W
125°0'0"W
124°40'0"W
124°20'0"W
124°0'0"W
48°10'0"N
48°0'0"N
47°50'0"N
47°40'0"N
47°30'0"N
47°20'0"N
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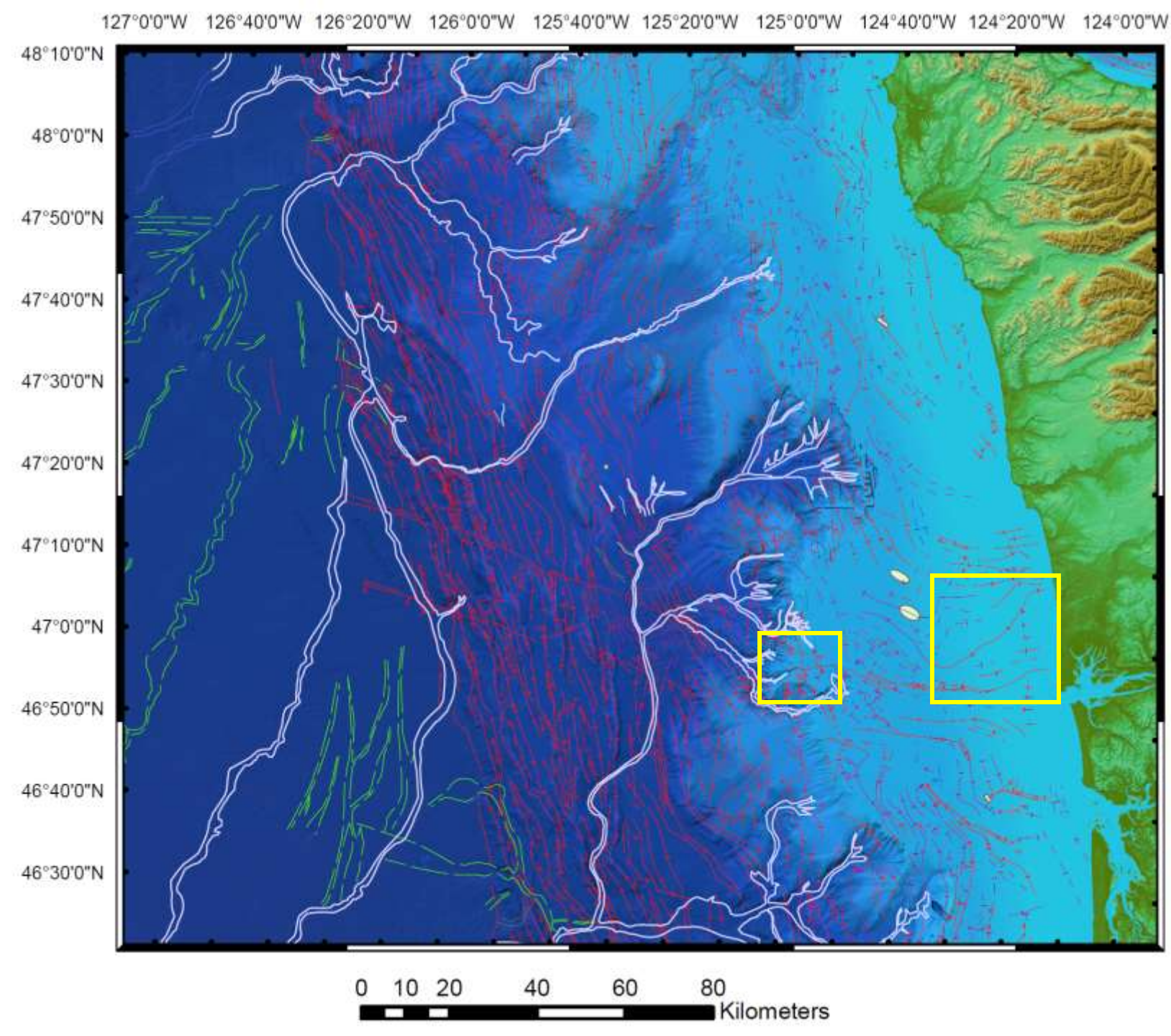
46°30'0"N
0 10 20 40 60 80
Kilometers


127°0'0"W
126°40'0"W
126°20'0"W
126°0'0"W
125°40'0"W
125°20'0"W
125°0'0"W
124°40'0"W
124°20'0"W
124°0'0"W
48°10'0"N
48°0'0"N
47°50'0"N
47°40'0"N
47°30'0"N
47°20'0"N
47°10'0"N
47°0'0"N
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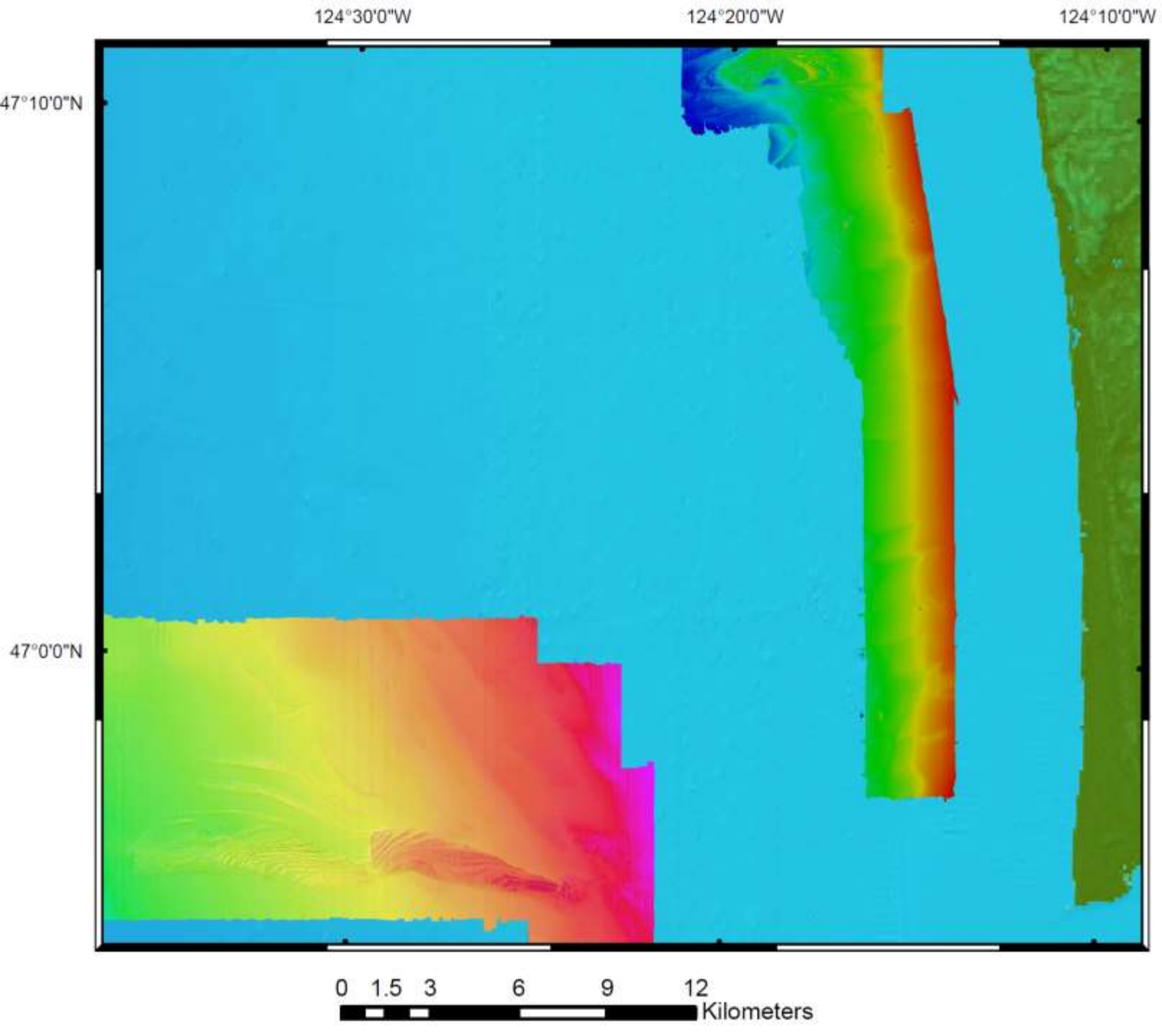
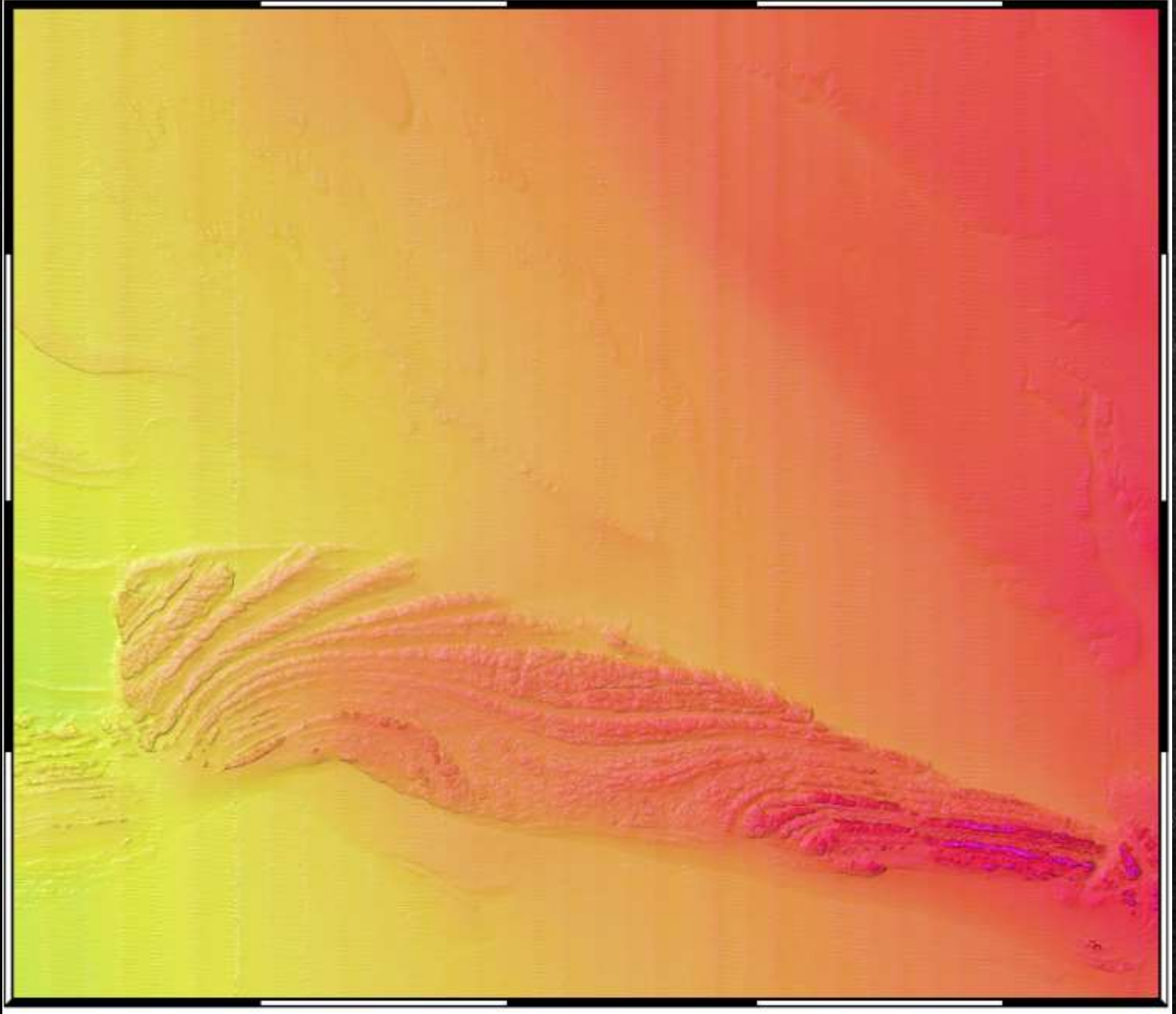
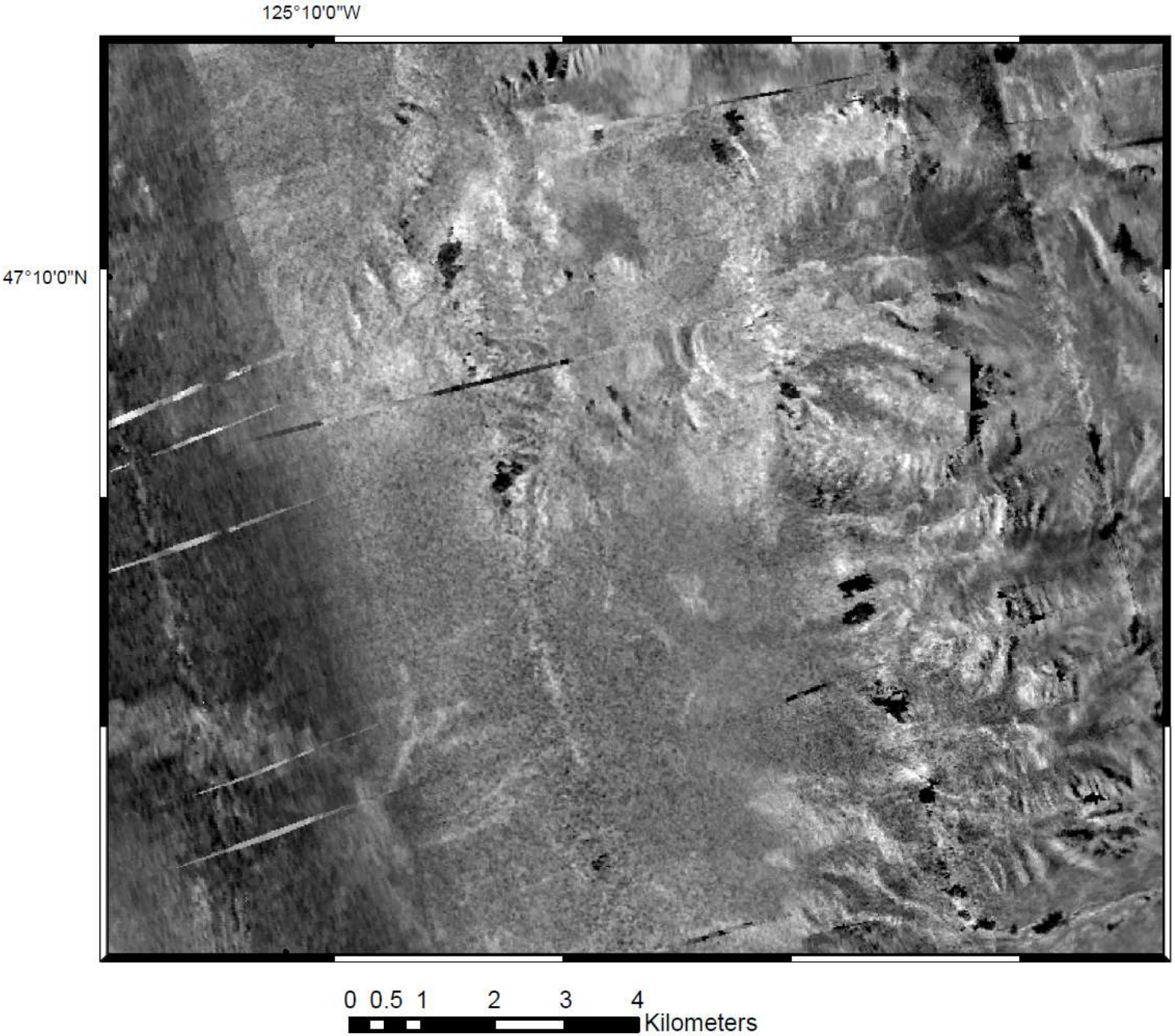
46°40'0"N
46°30'0"N
0 10 20 40 60 80
Kilometers

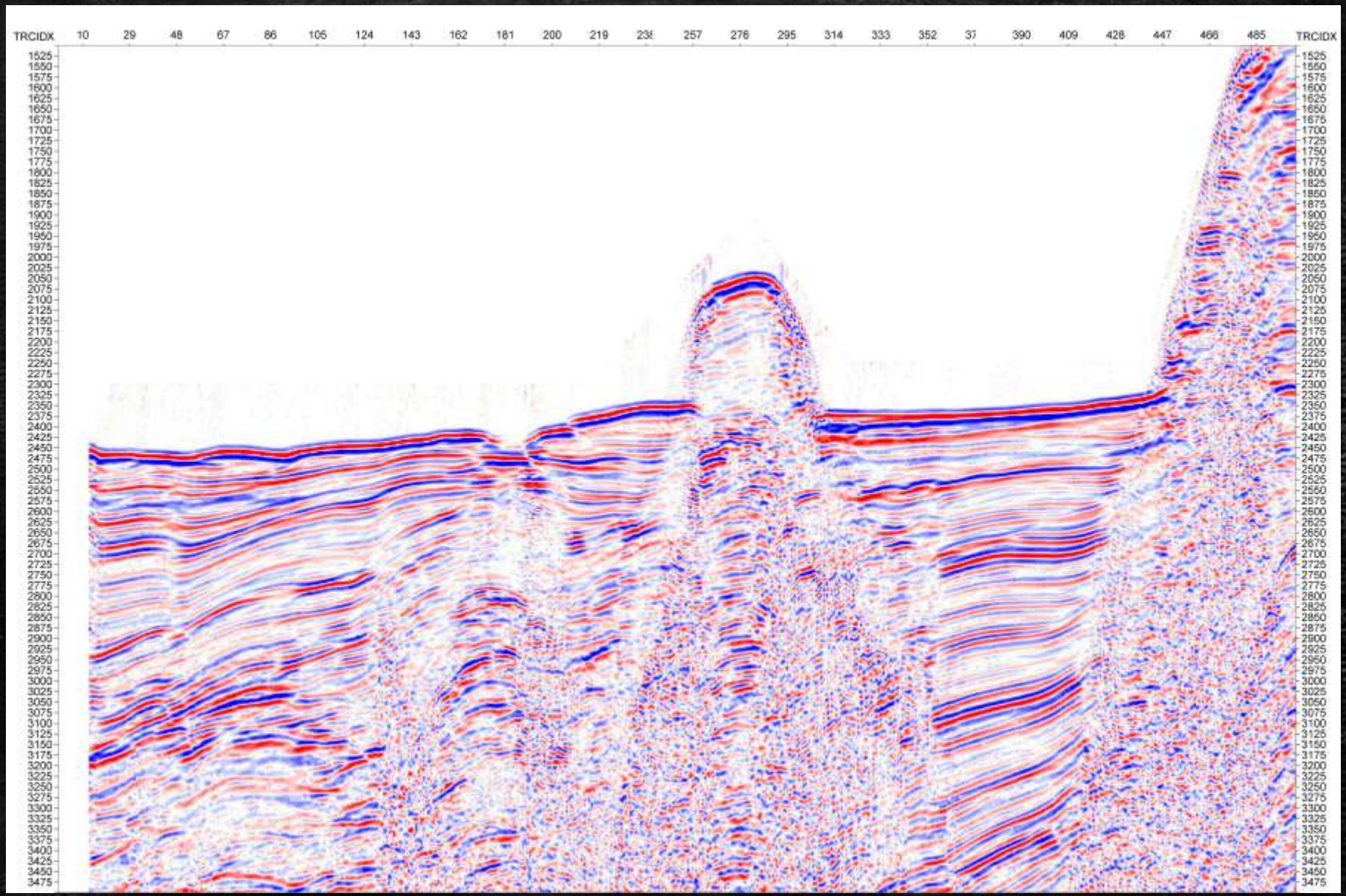

124°30'0"W
124°20'0"W
124°10'0"W
47°10'0"N
47°0'0"N
0 1.5 3 6 9 12
Kilometers

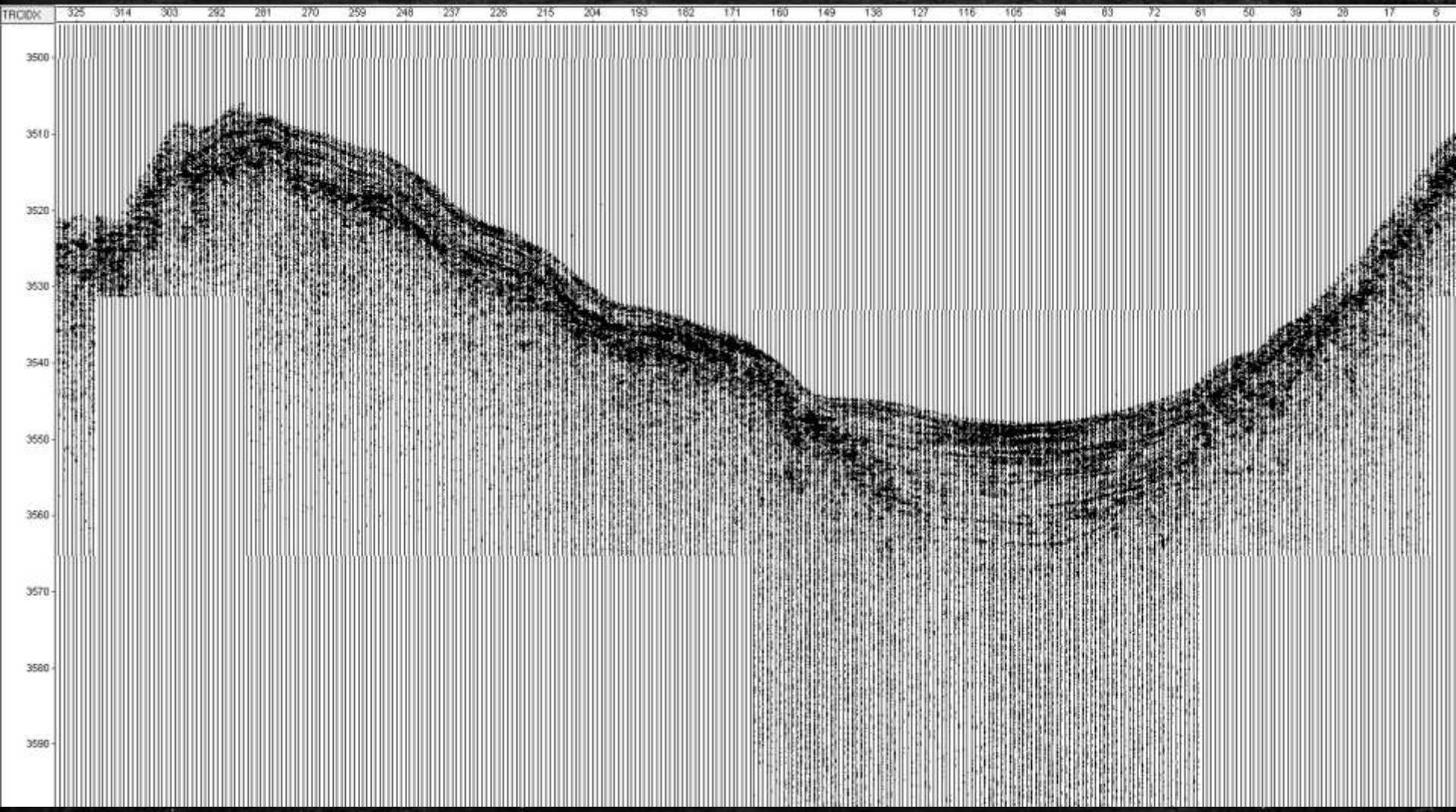


0 0.35 0.7 1.4 2.1 2.8
Kilometers


125°10'0"W
47°10'0"N
0 0.5 1 2 3 4
Kilometers

Mapping and modeling outcrops and their probabilities regionally in areas without multibeam sonar data.




TRCIDX:
325 314 303 292 281 270 259 248 237 226 215 204 193 182 171 160 149 138 127 116 105 94 83 72 61 50 39 28 17 6
3500
3510
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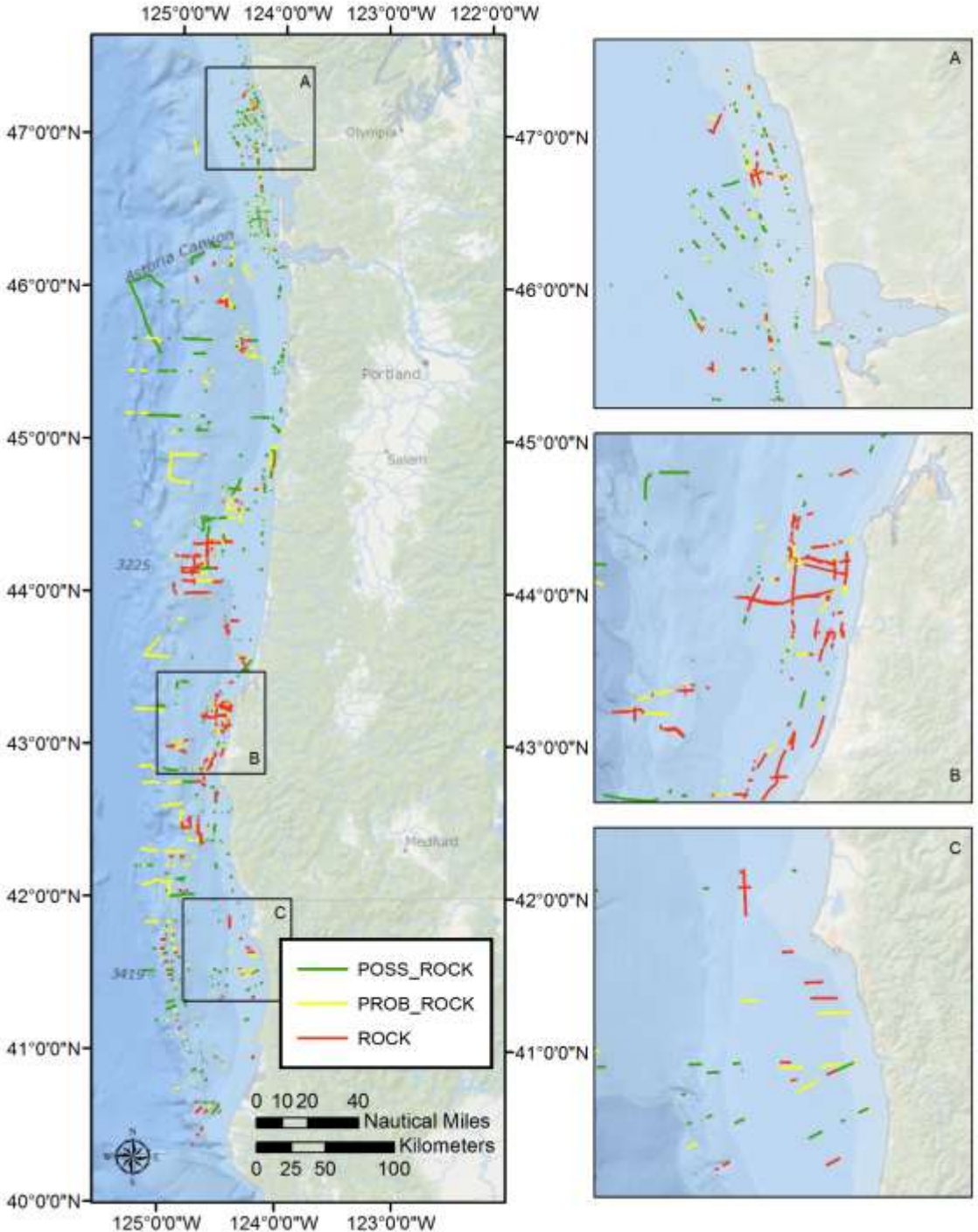
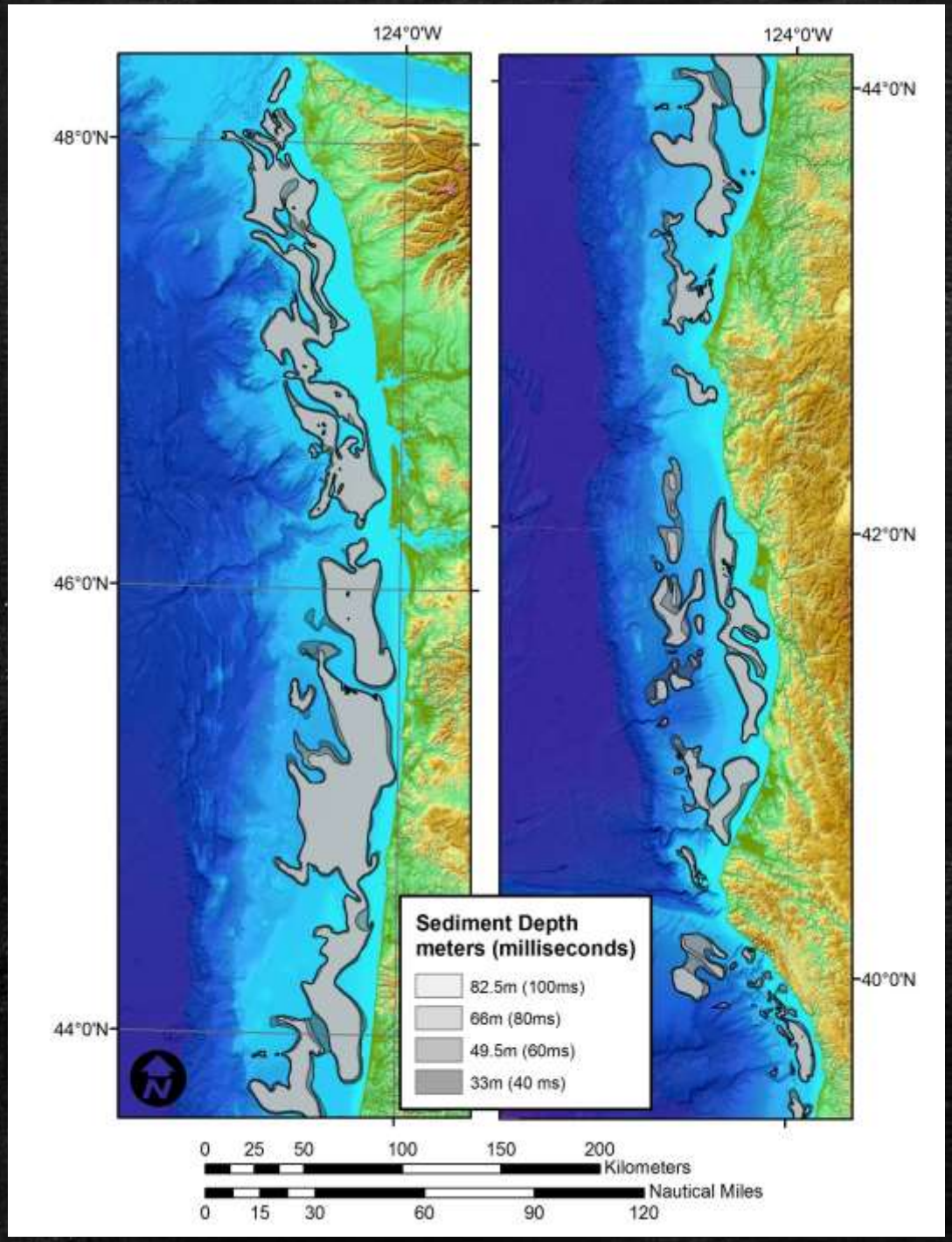
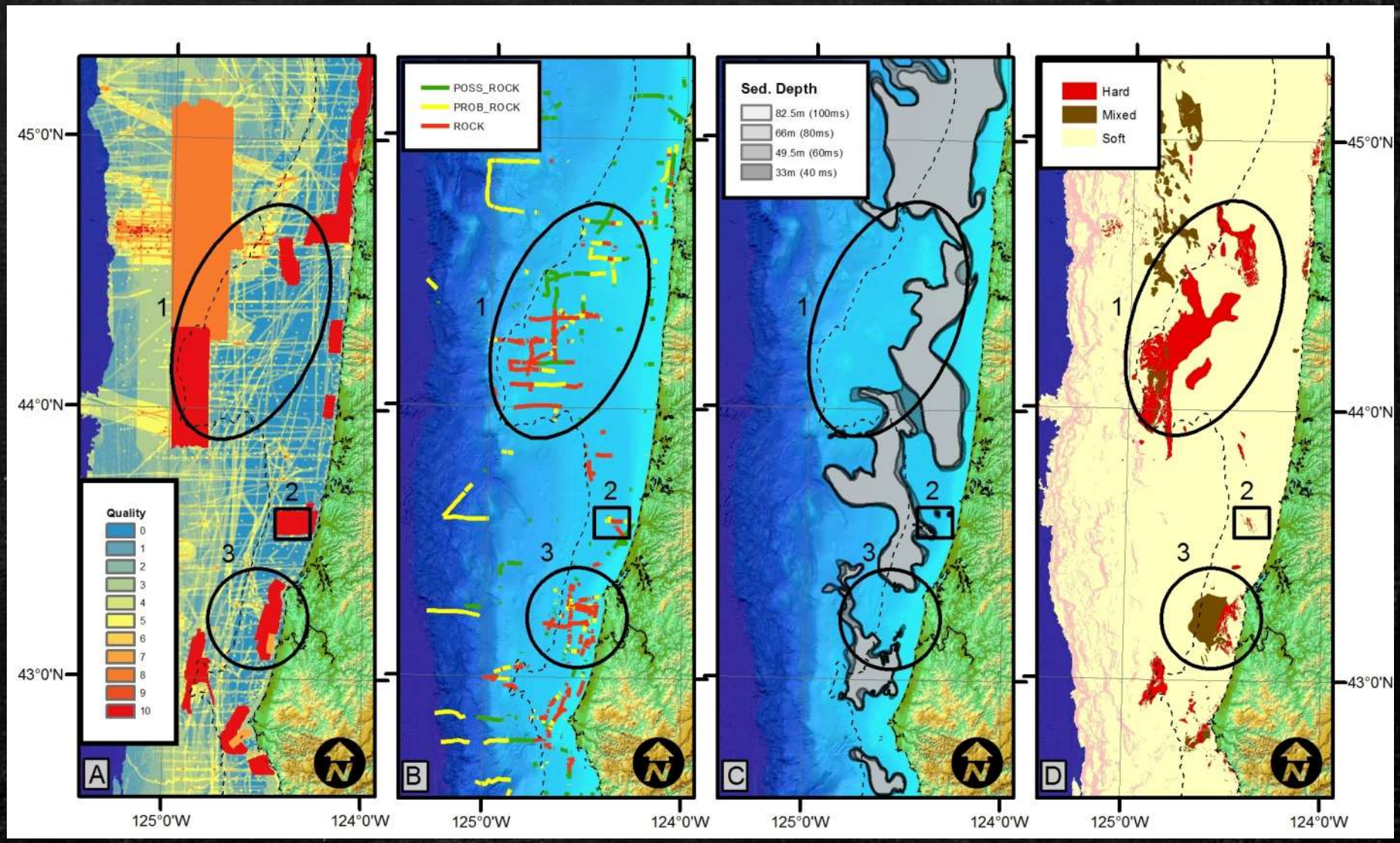
3530
3540
3550
3560
3570
3580
3590



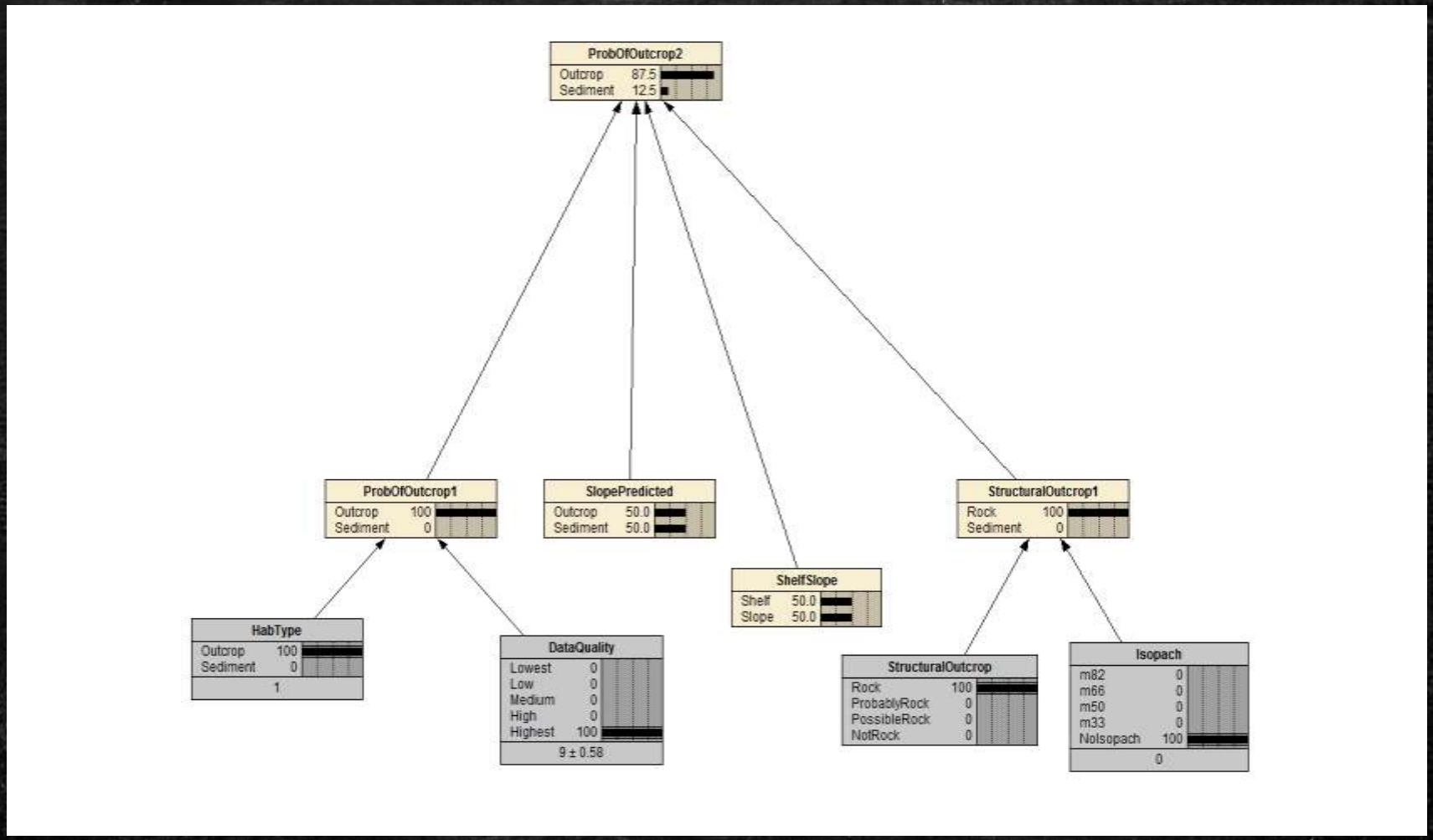
The "gummy worm" map showing probability of rock outcrop along reflection profiles.



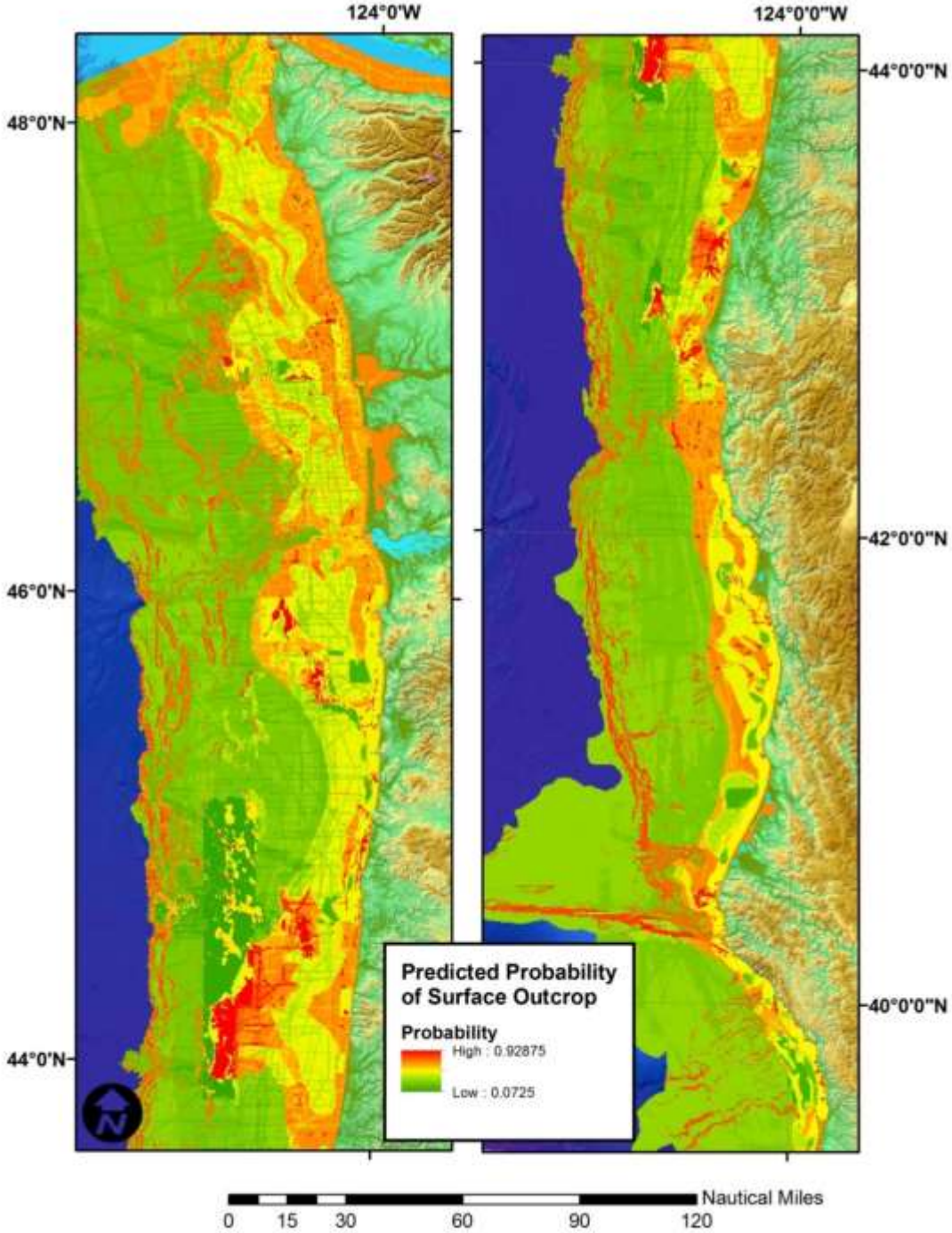
The minimum isochore map developed from seismic reflection profiles.



The Apollo 13 method: predicting substrate probability

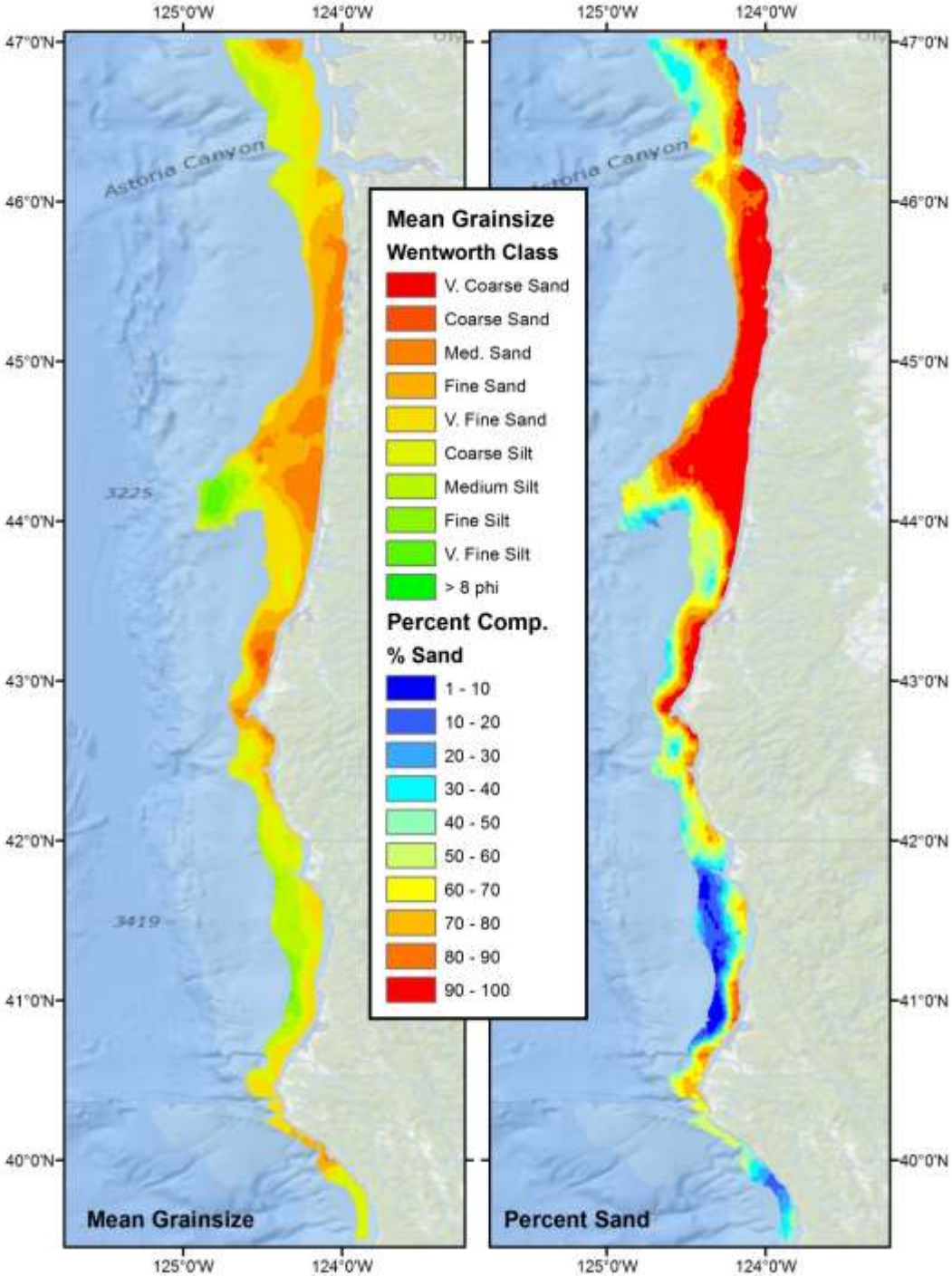


The mark 1.0 Bayes model.



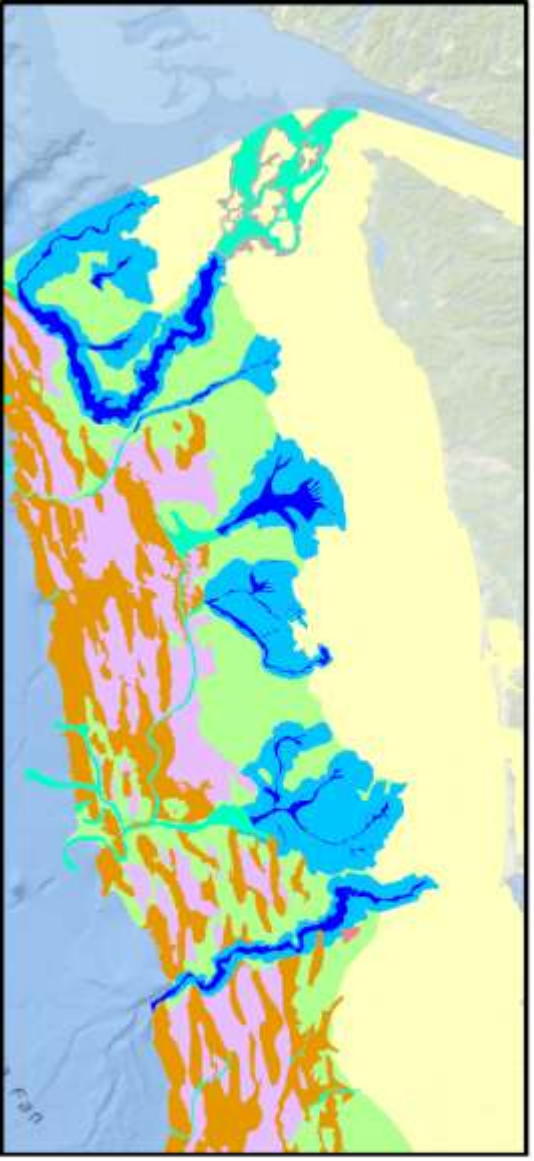
Predictive model output of probability of surface outcrop.

Beta version.



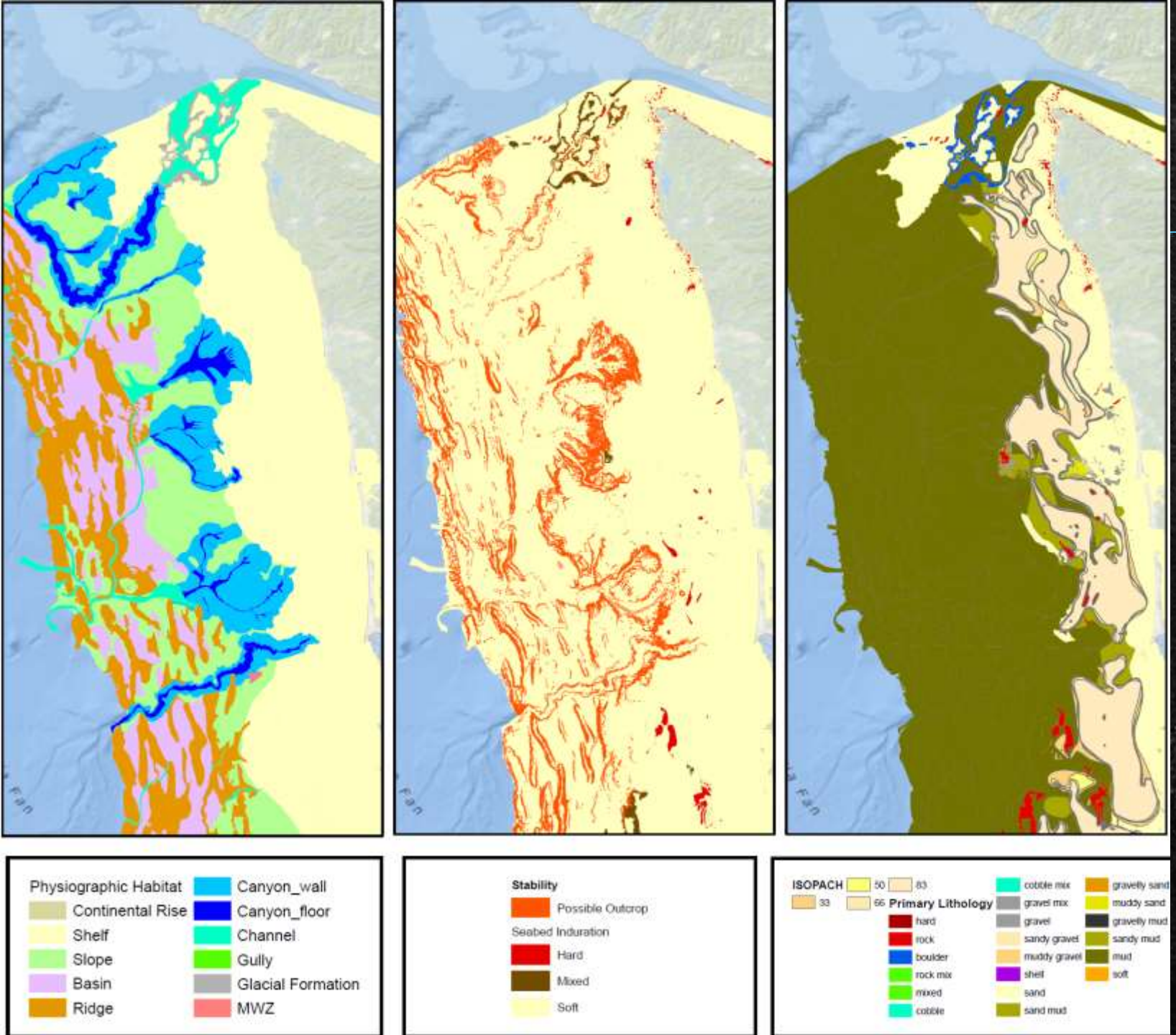
Another useful derivative of the sample data is a regional gain size map.

This can be used as an input to HSP models, renewable energy suitability and other things.

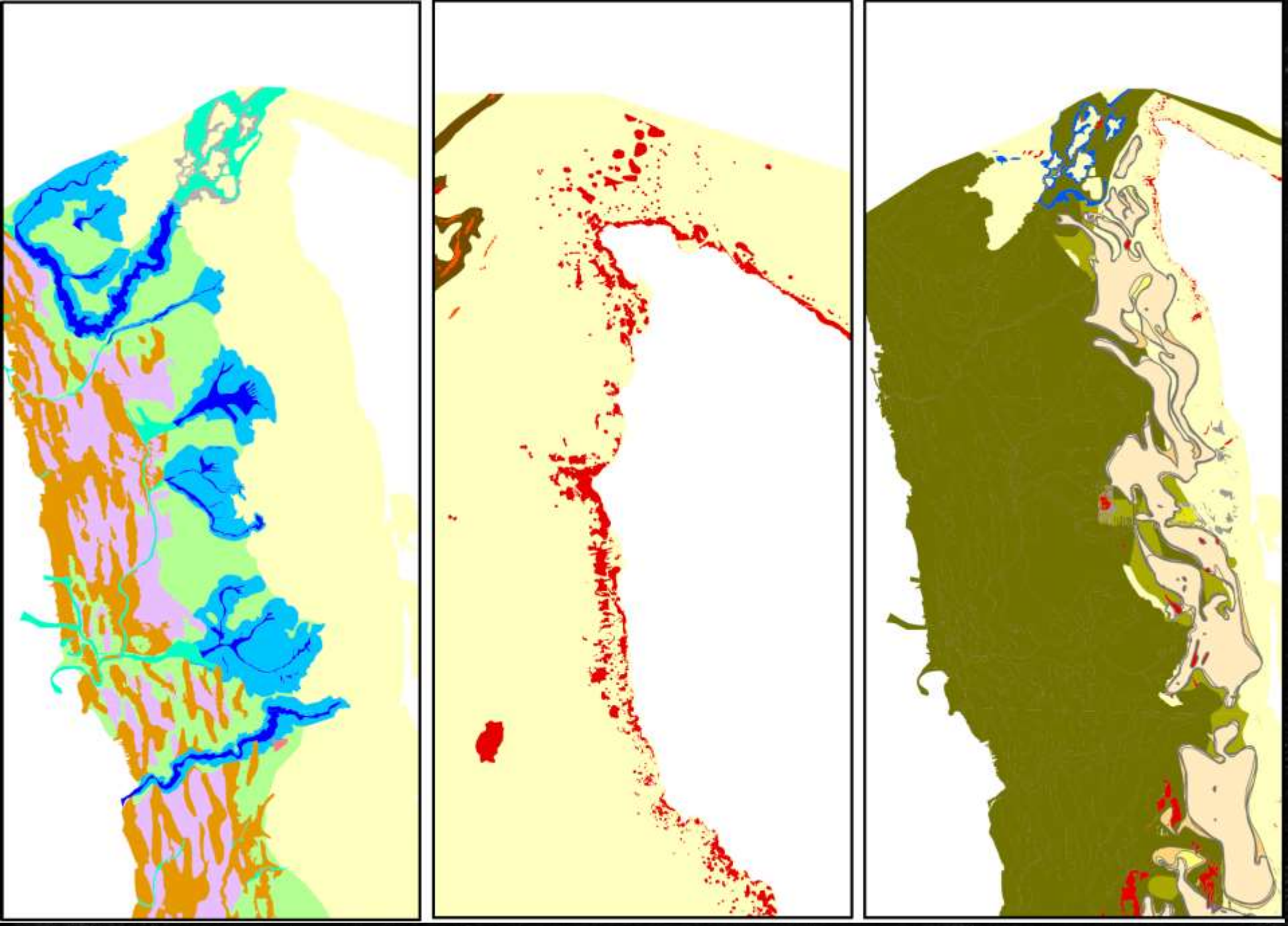

Physiographic Habitat
Continental Rise
Shelf
Slope
Basin
Ridge
Canyon_wall
Canyon_floor
Channel
Gully
Glacial Formation
MWZ

Seabed Induration
Hard
Mixed
Soft

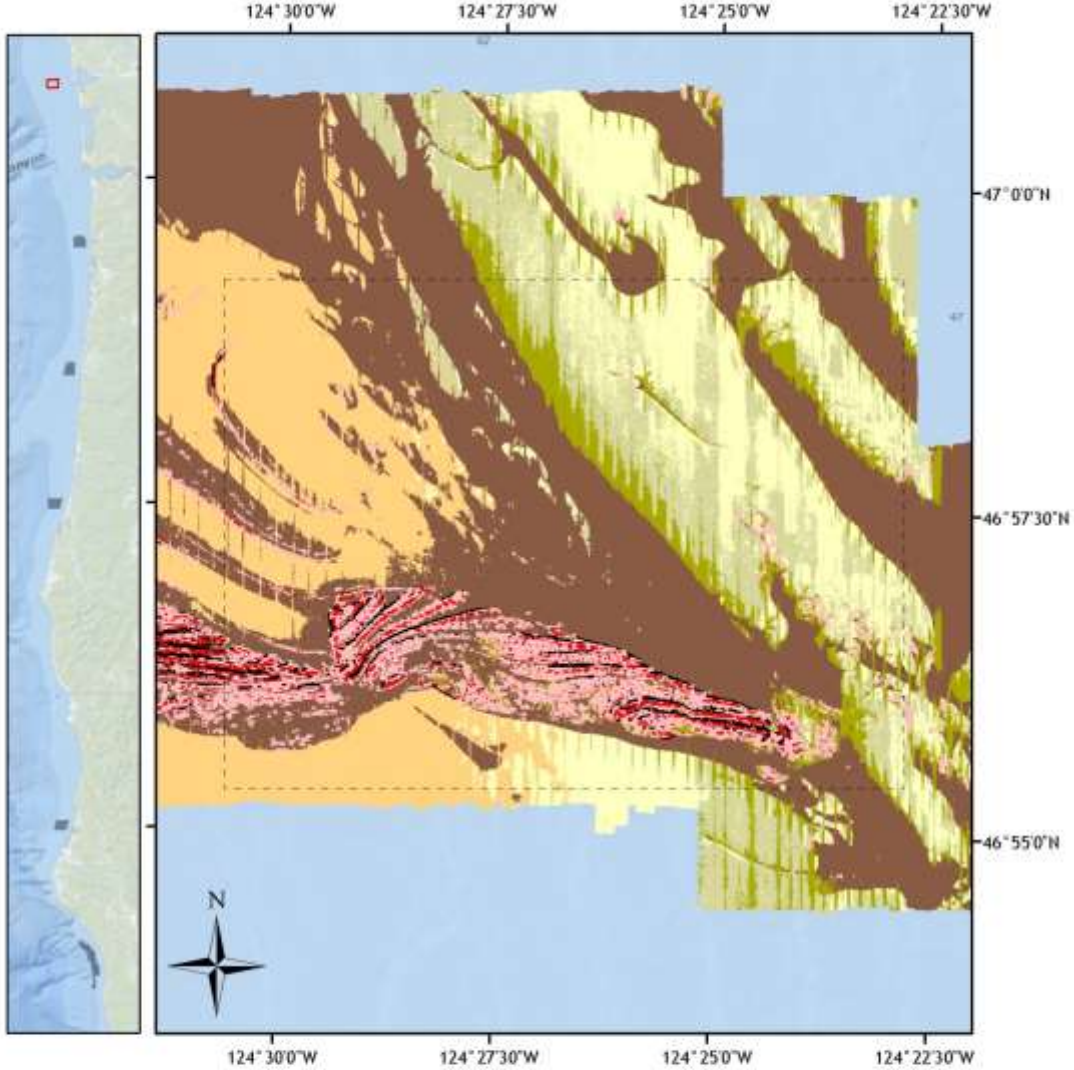
Primary Lithology
hard
rock
boulder
rock mix
mixed
cobble
cobble mix
gravel mix
gravel
sandy gravel
muddy gravel
shell
sand
sand mud
gravelly sand
muddy sand
gravelly mud
sandy mud
mud
soft



With isopach and slope predictor



Supervised Classification of Seabed Samples and Seabed Imagery at:
Grays Bank, WA



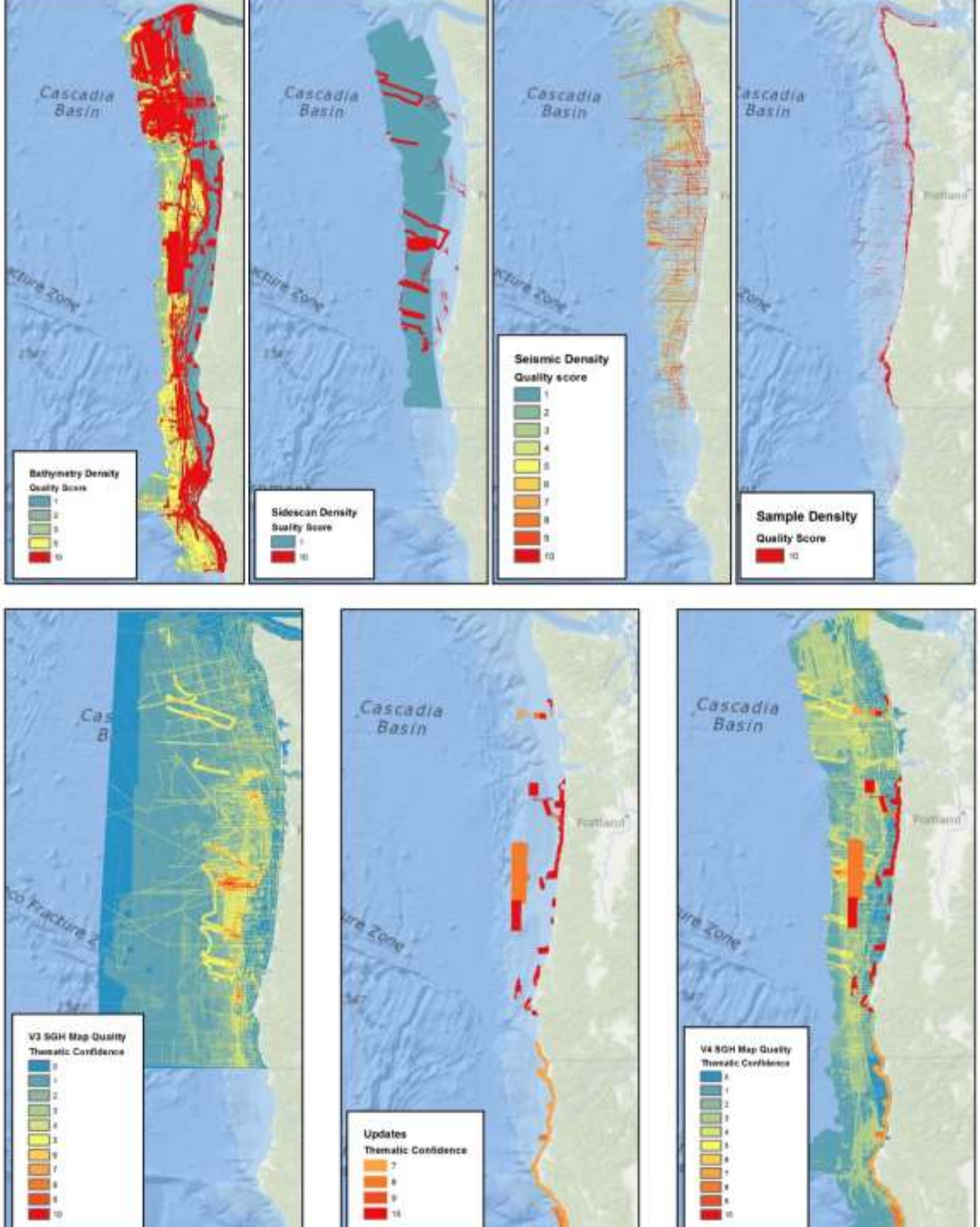
Map Scale: 1:75,000

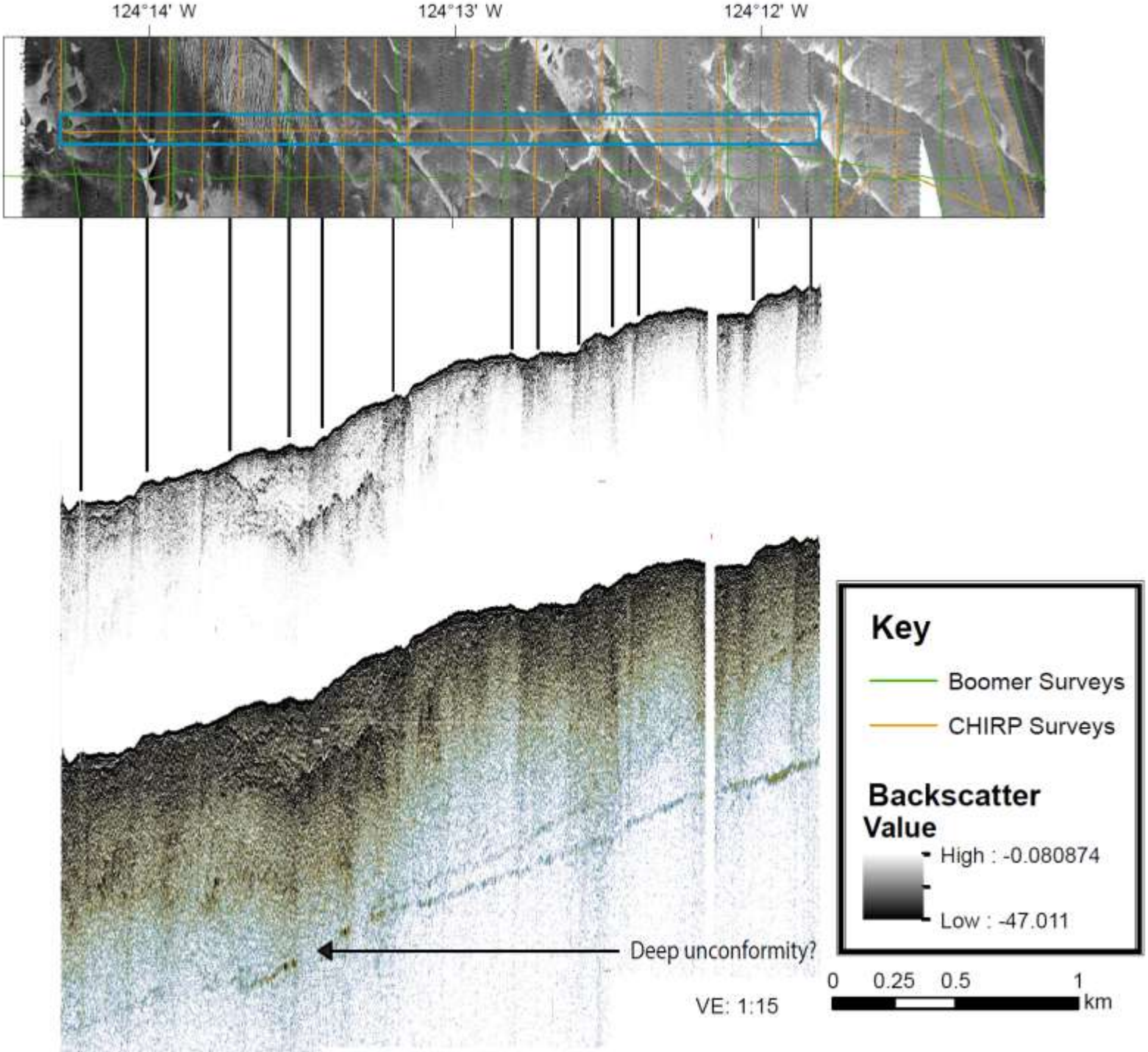
0 0.425 0.85 1.7 2.55 3.4 Nautical Miles

0 0.75 1.5 3 4.5 6 Kilometers

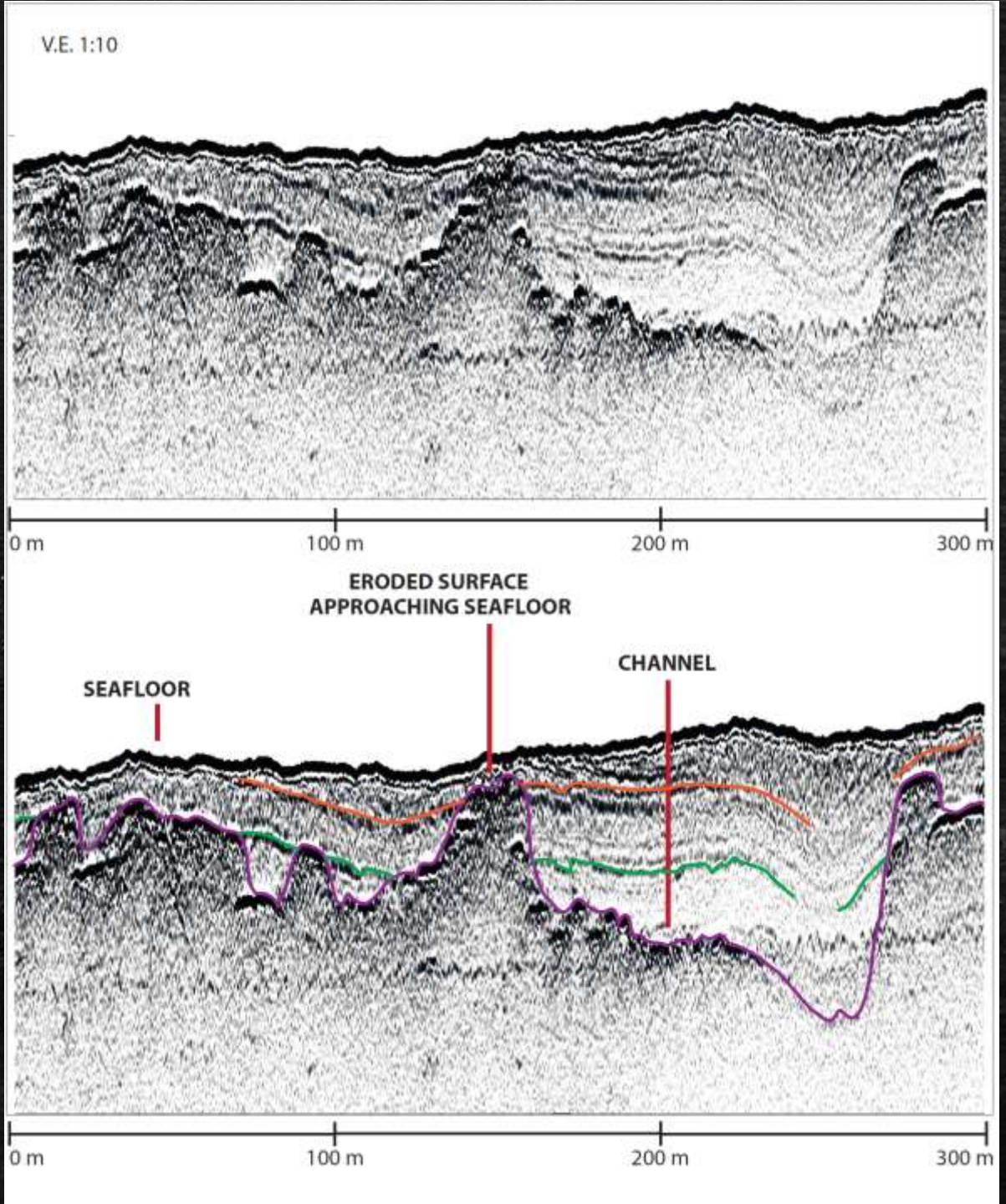
Date Saved: 6/28/2013 6:08:33 PM

Sediment Classes	Rocky Relief Classes
muddy sand	crest
fine sand	mid relief
medium sand	depression
coarse sand	
gravel mix	Site Bounds

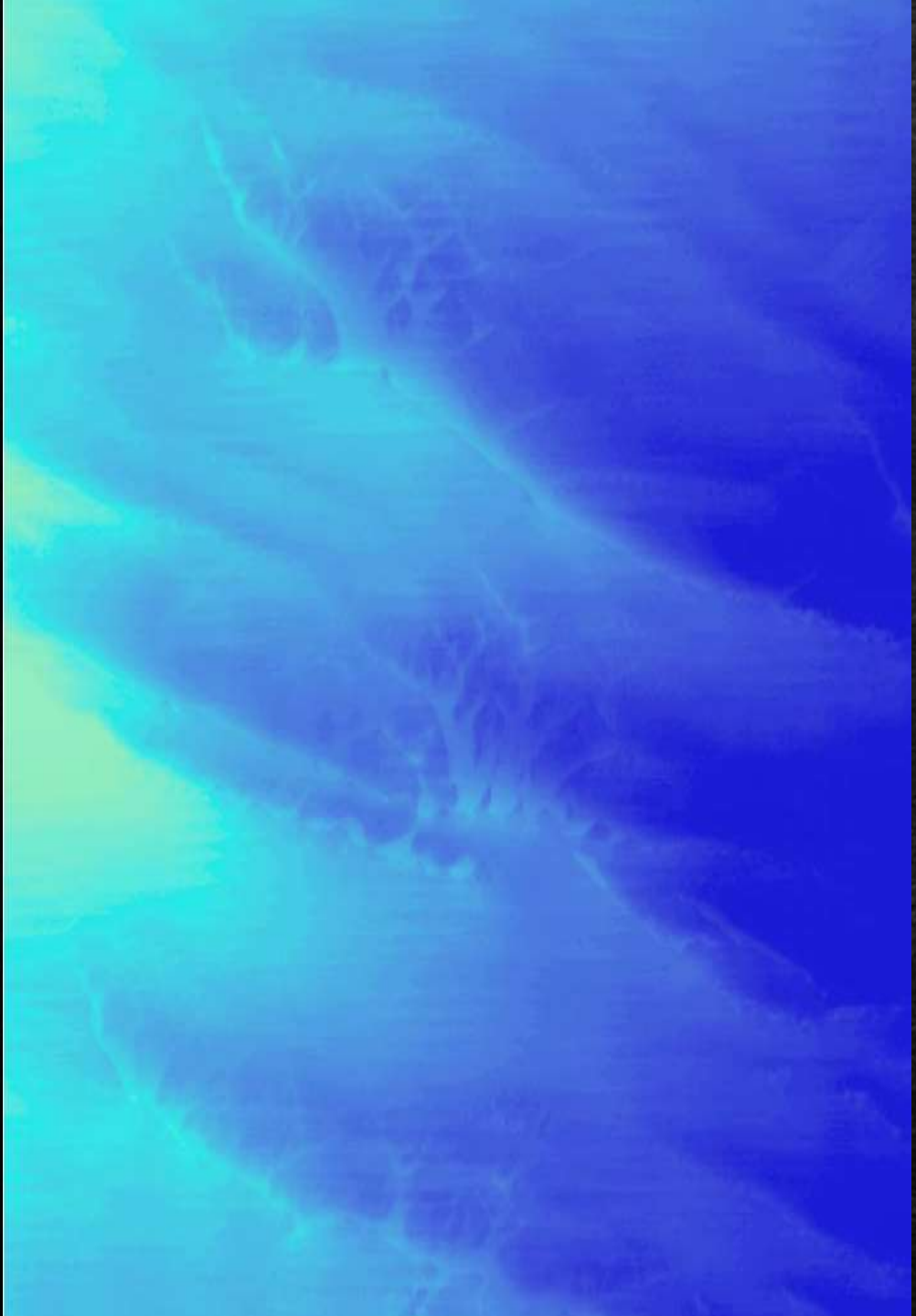

Cascadia Basin
Bathymetry Density
Quality Score
Cascadia Basin
Sidescan Density
Quality Score
Cascadia Basin
Seismic Density
Quality score
Cascadia Basin
Sample Density
Quality Score
V3 SGH Map Quality
Thematic Confidence
Cascadia Basin
Updates
Thematic Confidence
Cascadia Basin
V4 SGH Map Quality
Thematic Confidence



The closer you look, the more you see.



Pleistocene topography overlain by transgressive sands on much of the Oregon and Washington shelves.



Relict, eroding Pleistocene dunes leftover from the last sea-level lowstand.

Conclusions

- Mapping of the Washington slope ~ 80% complete with a mix of systems and resolutions.
- The Washington shelf is only ~ 20-30% complete with s similar mix of systems
- Core and sample groundtruth on the shelf not as abundant as Oregon or Canada, reducing confidence in habitat maps.
- Few surveys in State waters, where for most areas the smooth sheet maps are all that is available.
- Broad areas of the shelf are underlain by relict topography that comes to or near the surface in many areas.
- Bayesian models can help quantify and merge disparate datasets to predict probability of substrate types in areas poorly covered by geophysical and sample data.

Thanks for your attention!

Questions?