Undersea Feature Names Project Team

and

Detection Project

SCUFN 33
November 2020

Content

- Update on Undersea Feature Name Project Team
- Update on Undersea Feature Detection Project (UFDP)
  - GIS analysis from raster data
  - Contour pattern feature detection

Work Plan 2019-2020

Work Item (SCUFN 32)	Priority H-High M-Medium	Start Date	End Date	Status O-Ongoing C-Completed	Contact (s) *Indicat
Hold an online workshop, to discuss the steps to continue the development of the product specification. - Assign a Minute Taker - As per the recommendation of HSSC11, we need to assess the practical consequences of the implementation of an S-100 compatible specification for UFN. - Consider, with the Generic Term Working Group, the progress of the Undersea Feature Discovery Project, presented by Canada, and its applicability for interoperability and standardizing UFN - Explore within existing product specifications in S-100, the expansion of textual description to include - Associated Features - Reason for choice of name - Discovery facts - Survey Data information - Set project milestones and project plan	H	November 2020	August 2020	Completed	UFNPT* a Generic Te
Prepare minutes of the online meeting and send them to the participants for approval	M	January 2020	August 2020	Completed	Minute Ta
Proceed with the project according to the plan discussed during the online workshop	H	February 2020	October 2020	Ongoing	UFNPT* a Generic Te
As per the recommendation of HSSC11, we need to consolidate into one report for HSSC12 (May 2020), the status of work of the UFNPT, including the results of the online meeting, the approved work plan for the year 2019-20 (this table), and a new request for a product specification number that should include the new project milestones and project plan.	M	March 2020	June 2020	Completed	UFNPT
Prepare update report and presentation for SCUFN33	M	August 2020	October 2020	Completed	Canada*, Generic Te

Drafting the UFN data model

- S-101 ENC Feature type – Sea area/named water

IHO Definition: **SEA AREA/NAMED WATER AREA**. A geographically defined part of the sea or other navigable waters. It may be specified within its limits by its proper name. (S-57 Edition 3.1, Appendix A – Chapter 1, Page 1.151, November 2000).
S-101 Geo Feature: Sea Area/Named Water Area (SEAARE)
Primitives: Point, Surface

feature name			C	0,*
display name			(S) BO	0,1
language		ISO 639-2/T	(S) TE	0,1
name	*(OBJNAM)* *(NOBJNM)*		(S) TE	1,1
scale minimum	(SCAMIN)	See clause 2.5.9	IN	0,1

(CATSEA)	2 : gat 3 : bank 4 : deep 5 : bay 6 : trench 7 : basin 8 : mud flats 9 : reef 10 : ledge 11 : canyon 12 : narrows 13 : shoal 14 : knoll 15 : ridge 16 : seamount 17 : pinnacle 18 : abyssal plain 19 : plateau 20 : spur 21 : shelf 22 : trough 23 : saddle 24 : abyssal hills 25 : apron 26 : archipelagic apron 27 : borderland 28 : continental margin 29 : continental rise 30 : escarpment 31 : fan 32 : fracture zone 33 : gap	34 : guyot 35 : hill 36 : hole 37 : levee 38 : median valley 39 : moat 40 : mountains 41 : peak 42 : province 43 : rise 44 : sea channel 45 : seamount chain	46 : shelf-edge 47 : sill 48 : slope 49 : terrace 50 : valley 51 : canal 52 : lake 53 : river 54 : reach 55 : intertidal cay 56 : submarine volcano	EN	0,1

Specific to Individual Generic Terms

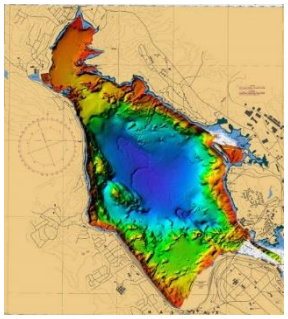
Work Plan 2020-2021

Task	Work Item	Priority H-High M-Medium	Start Date	End Date	Status O-Ongoing C-Completed	Contact Person (s) *Indicates leader
1	Request from the Intergovernmental Oceanographic Commission (IOC), support and/or approval to use one of their S-3XX specification numbers under which to develop the standard for undersea features.	H	June 2021	September 2021		UFNPT* and Chair of SCUFN
2	Expand UFN data model from Korea to show which scientific attributes would be applicable to each undersea feature	M	May 2021	September 2021		UFNPT* and Chair of Generic Terms WG
3	Request from the HSSC, support and/or approval to use a specification number under which to develop the standard for undersea features.	H	October 2021	October 2021		UFNPT and Chair of SCUFN
4	Prepare update report and presentation for SCUFN34	M	August 2020	October 2020		UFNPT and Generic Terms WG

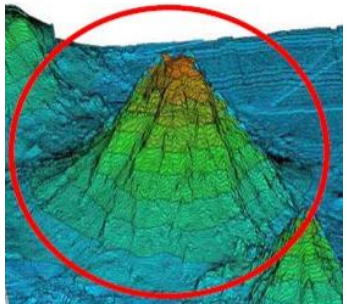
Undersea Feature Discovery Project

- GIS analysis from raster data
- Contour pattern feature detection

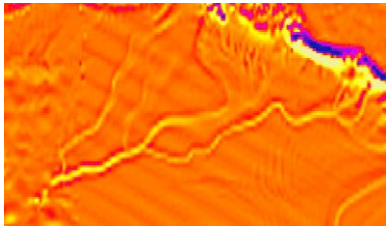
GIS Analysis with Raster Data



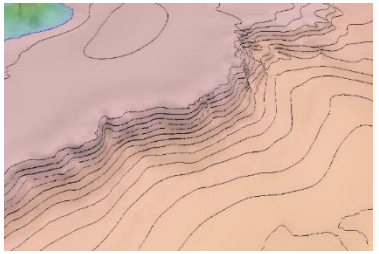
Basin



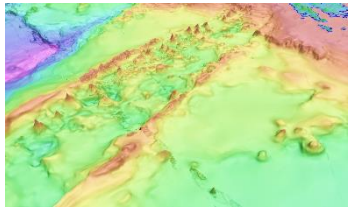
Seamount



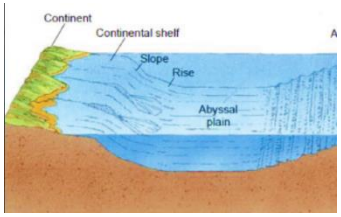
Sea Channel



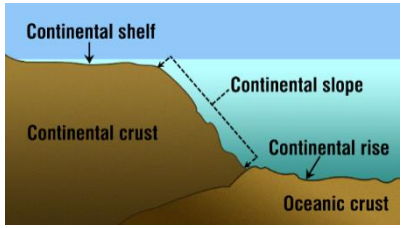
Shelf



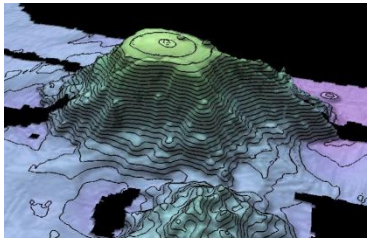
Ridge



Abyssal Plain



Slope



Guyot

SEA CHANNEL

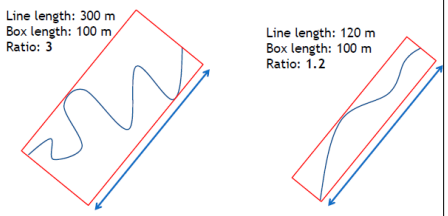
An elongated, meandering depression, usually occurring on a gently sloping plain or FAN.

1. Elongated
   - How long is elongated?
2. Meandering
   - How curved/bendy is meandering?
3. Depression
   - How depressed it has to be?
4. Gently sloping plain
   1. How flat is gently sloping?

How do you calculate:

GENTLE slope??

Criteria Analysis NO.1: Meandering



Confidence Level: Very High

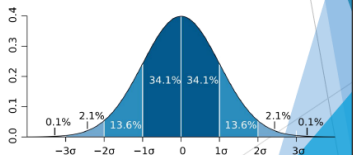
Criteria Analysis NO.3: Gently Sloping

Potential Ways to Define Flatness:

- Slope value
- Standard deviation of slope
- Standard deviation of elevation
- Local relief
- Contour line density

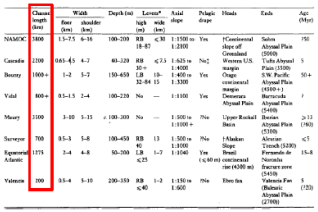
Lack of literature and/or data for descriptions of flatness.

Value we used is chosen based on observation and statistics, certain level of **arbitrariness** still exist

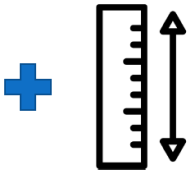


Confidence Level: Medium

Criteria Analysis NO.2: Elongated



Summary of physical characteristics of deep-sea channels described in the literature. (Carter, 1981.)

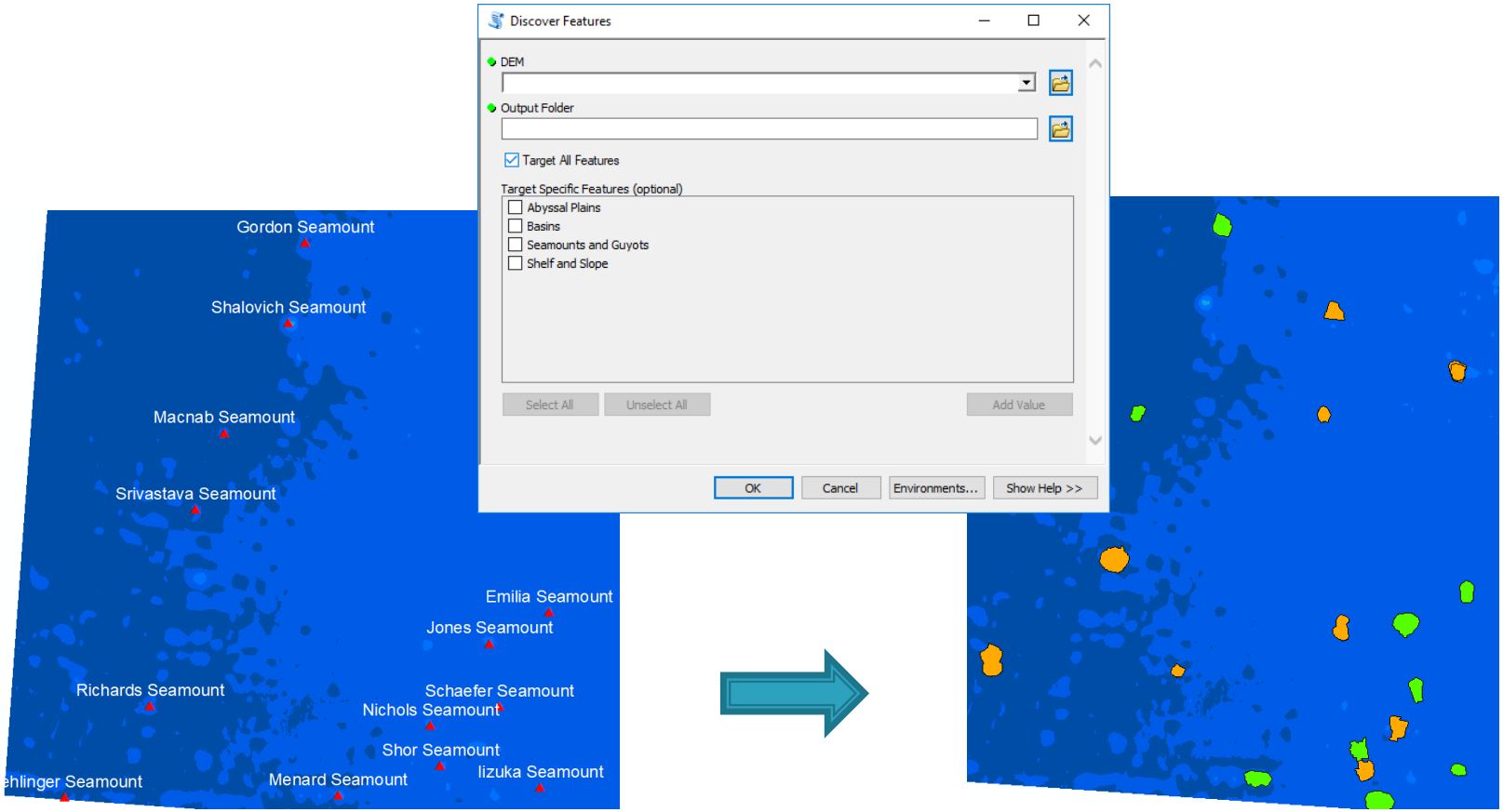


Confidence Level: High

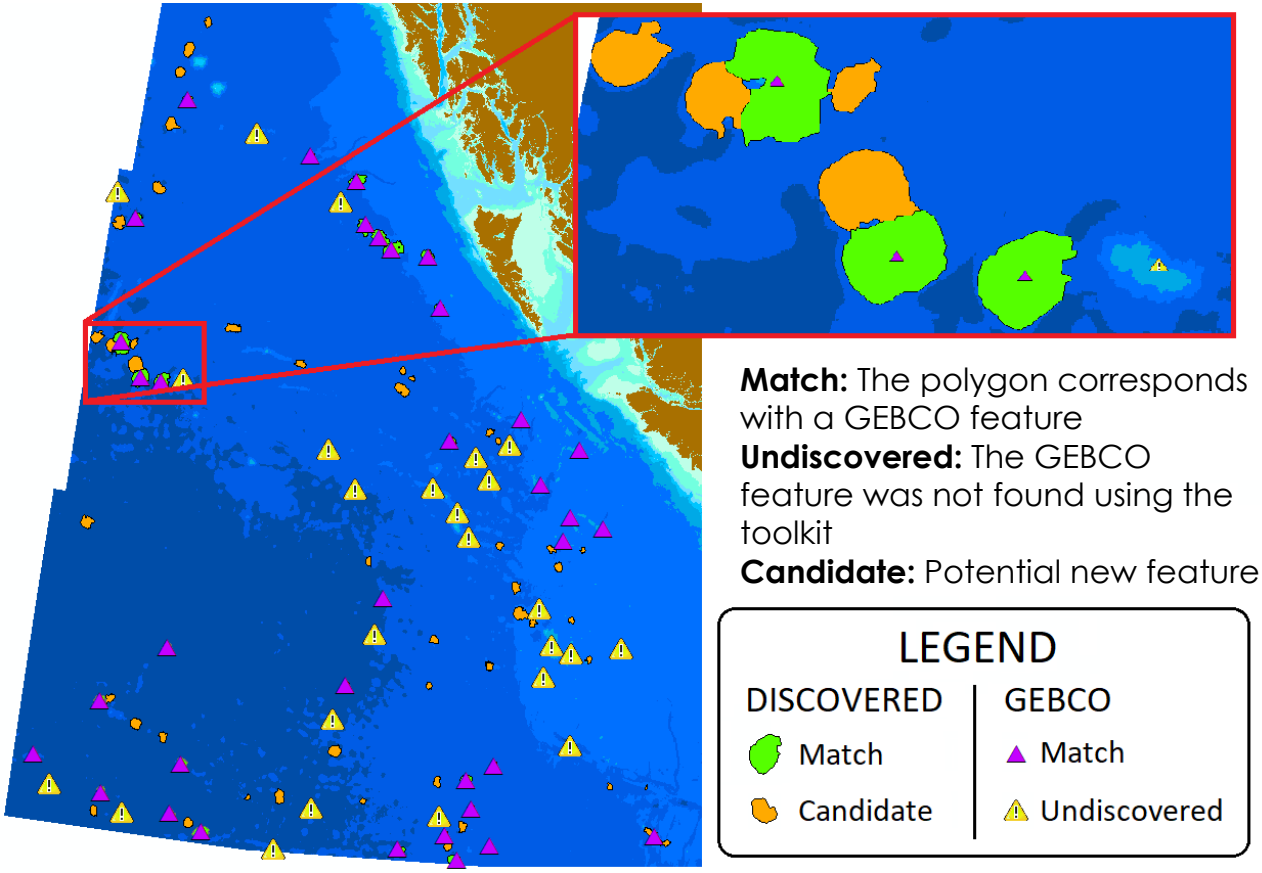
SEA CHANNEL

A meandering linear depression with sinuosity typically greater than 1.3, at least no less than 1.15. Feature need to be no shorter than 150 km, usually occurring on a gently sloping plain or FAN where local slope standard deviation is typically less than 0.5 degree, at least no more than 0.65 degree.

UFD Toolkit


Discover Features
DEM
Output Folder
Target All Features
Target Specific Features (optional)
Abyssal Plains
Basins
Seamounts and Guyots
Shelf and Slope
Select All
Unselect All
Add Value
OK
Cancel
Environments...
Show Help >>
Gordon Seamount
Shalovich Seamount
Macnab Seamount
Srivastava Seamount
Emilia Seamount
Jones Seamount
Richards Seamount
Schaefer Seamount
Nichols Seamount
Shor Seamount
Iizuka Seamount
Menard Seamount

Validation OUTPUT



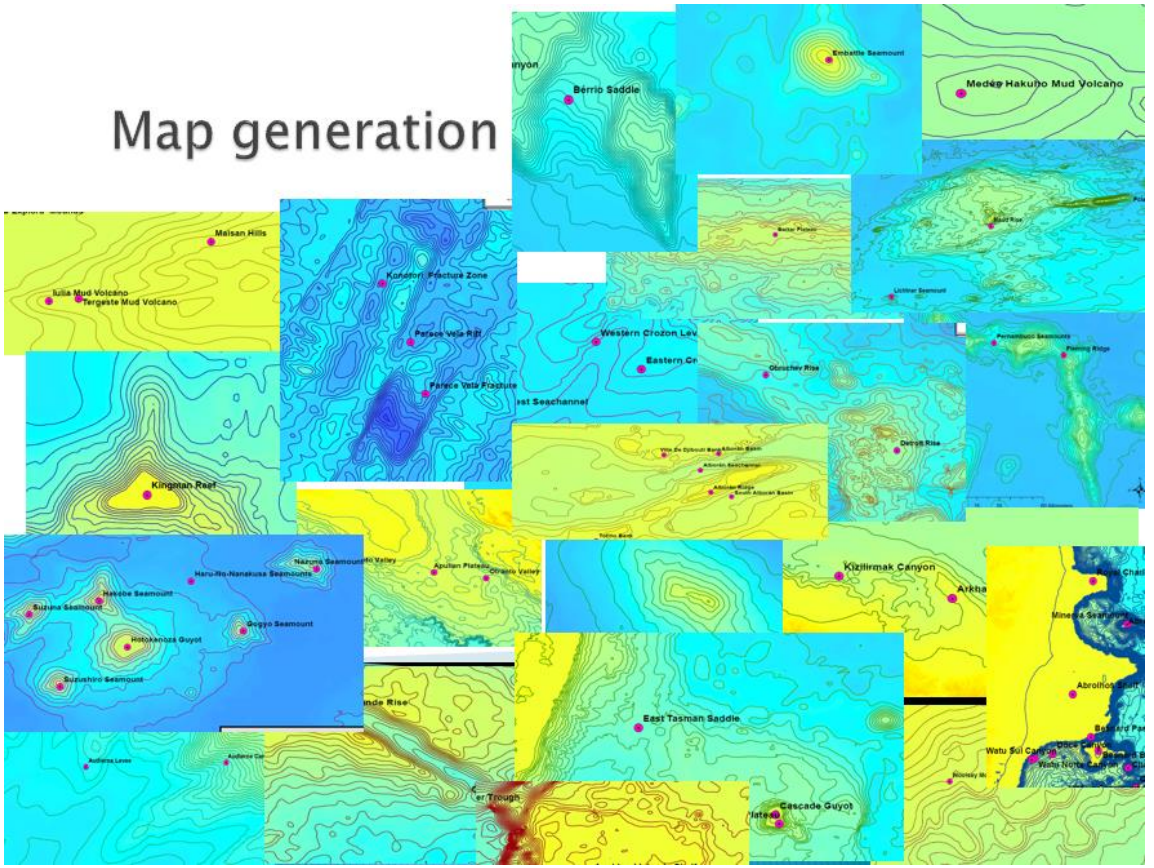
Match: The polygon corresponds with a GEBCO feature
Undiscovered: The GEBCO feature was not found using the toolkit
Candidate: Potential new feature

RESULTS

Feature	Accuracy
Abyssal Pain	23.2%
Basin	0%
Guyot	6.3%
Seamount	42.3%
Shelf	70.6%

Ground Truth Dataset

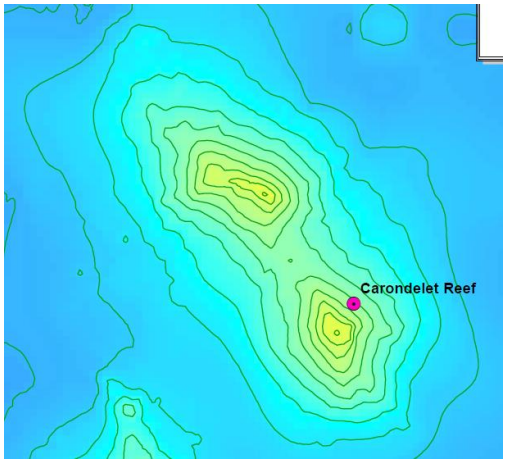
Image potential to be used to train a machine to recognize similar features

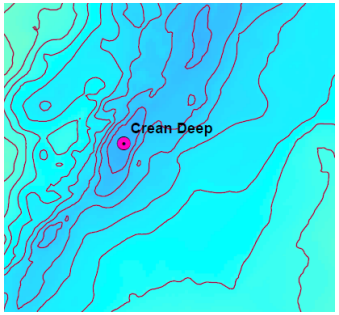


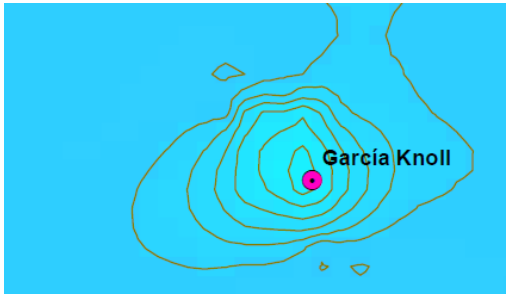
Closed Loop Featured

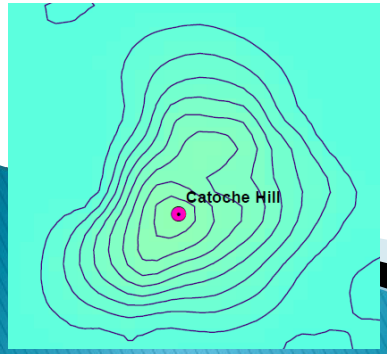
Elevations & Depressions

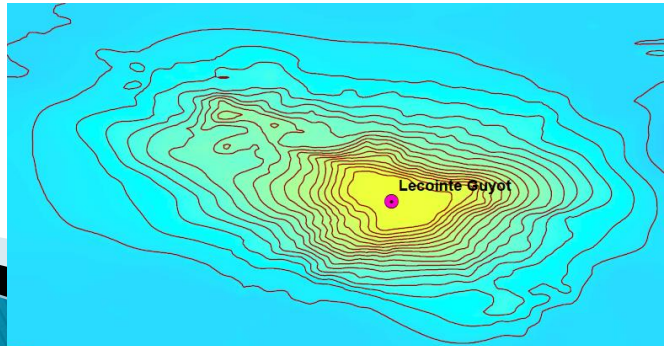
These features are often defined by a bounding isobath that surrounds most or all of the feature. At least one isobath should surround the entire feature.





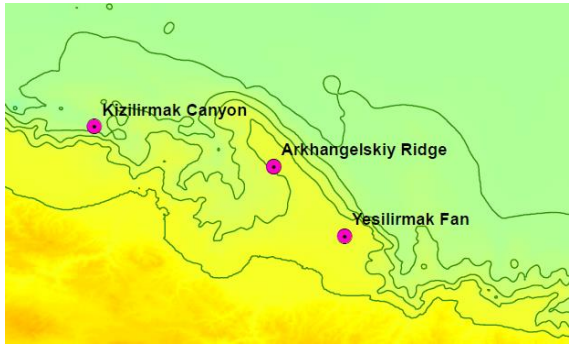


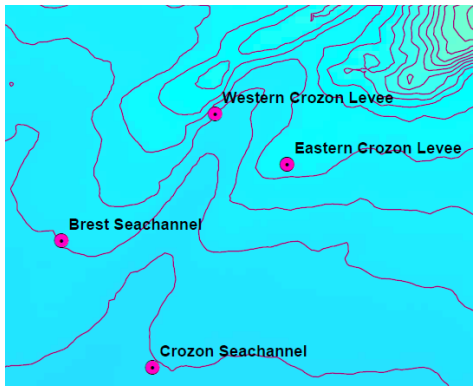


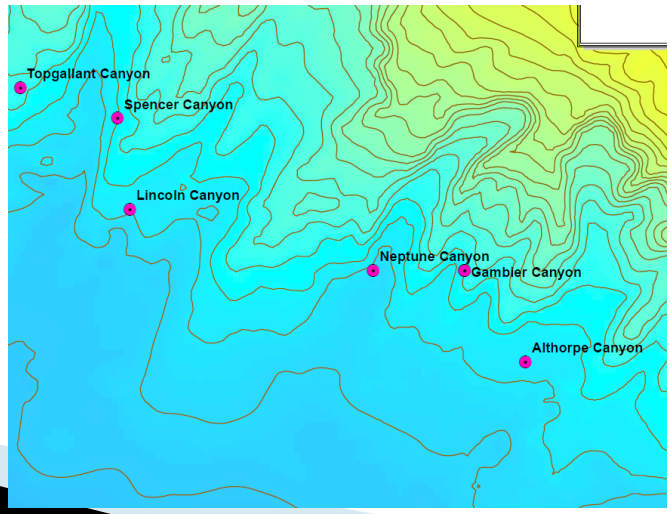


Trend Variation Features
Recesses and Protrusions

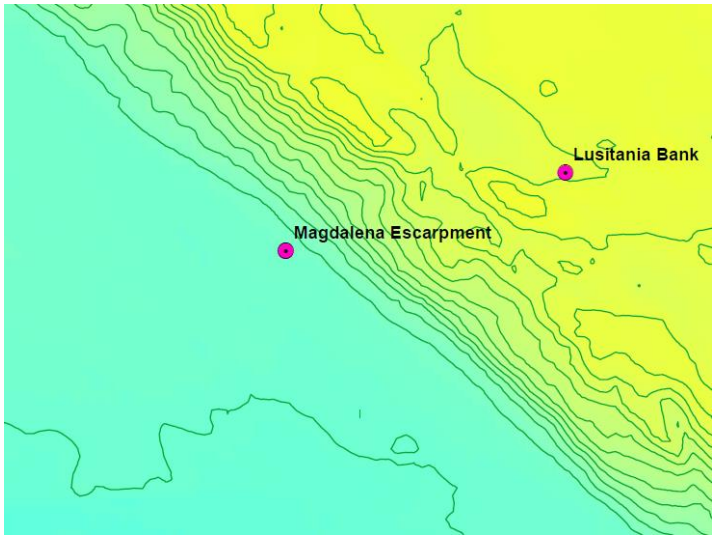
These features are defined by a change in the regional trend of an isobath, often with at least one relatively steep angle.



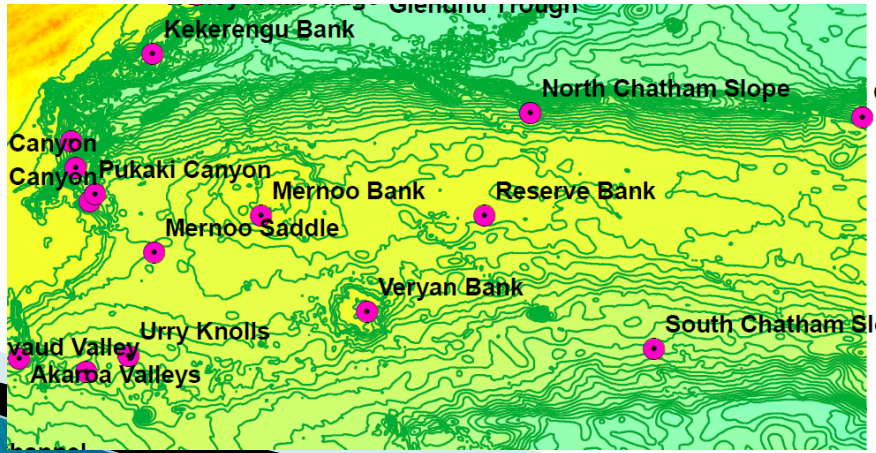


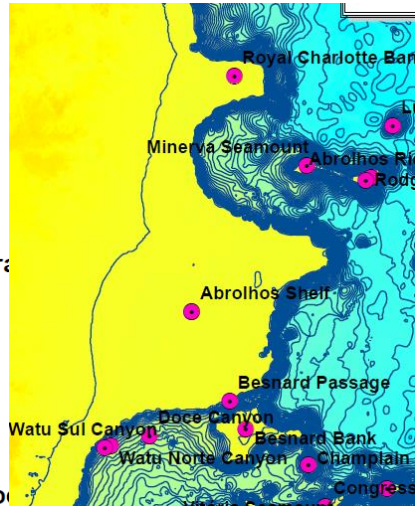


Slope Variation Features
Tightly Spaced Isobaths



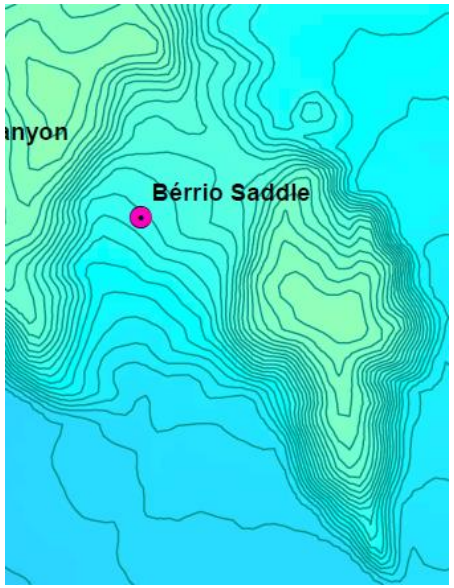
These features are typically defined by a certain amount of distance between isobaths (which directly translates to average slope) that is consistent over a section of the isobaths.

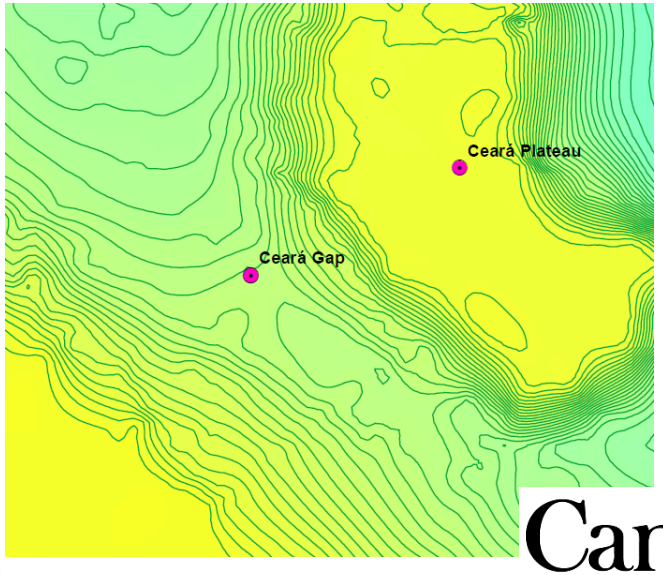




"Negative Space"

These features typically involve two isobaths of the same depth (or two greatly distant parts of the same isobath) that narrow significantly and may include some protrusions or recesses in isobaths as well.





Shape classification of undersea features

	Elevations		Depressions	
Closed	Bank Guyot Hill Knoll Mound* (?) Mud Volcano*	Plateau Reef* Shoal* Ridge Seamount	Abyssal Plains Basins Deeps Hole	Rifts* (?) Trench* Trough (?)
Trend	Fan Levee* Mound* (?) Mud Volcano* (?) Plateau Ridges		Canyons Spur Rifts*	Sea Channel Trough Valley
Negative	Sill		Gap Passage Saddle	

Slope	Steep	Gentle	Flat
	Slope Escarpment	Rise	Shelf Terrace

* - These features require geological knowledge of the processes or materials involved

The results of the classification are presented here.

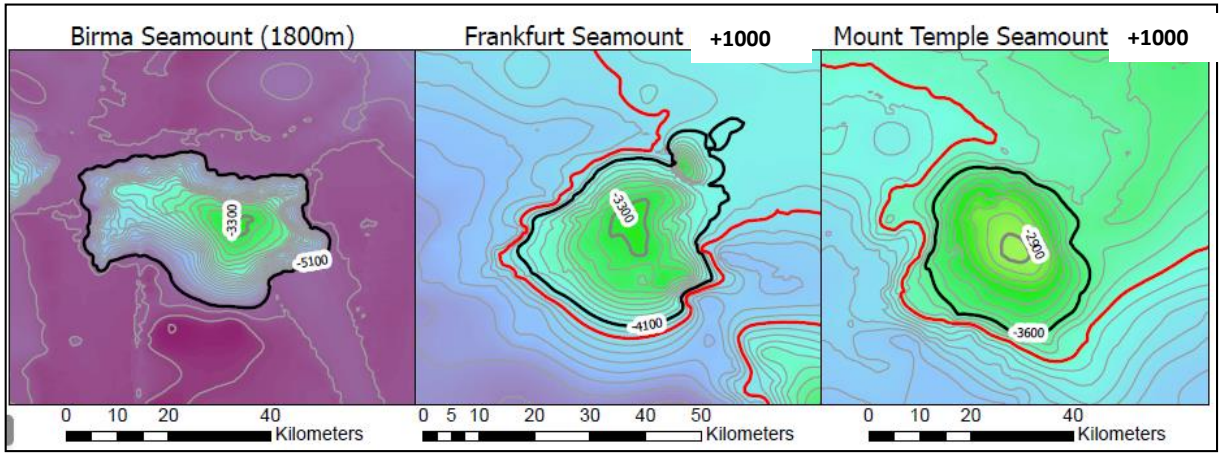
Not classified are:

- Aprons
- Calderas
- Fracture zones
- Peaks
- Pinnacles

Closed – Seamount

B6 description:

- Equidimensional in shape, rises 1000 m from the deepest isobaths **surrounding most** of the feature



Possible clarification:

- Equidimensional in shape, rises 1000 m from the deepest isobaths **surrounding at least 45%** of the feature

Results
Initial Mehtodology

Feature	Accuracy
Abyssal Pain	23.2%
Basin	0%
Guyot	6.3%
Seamount	42.3%
Shelf	70.6%

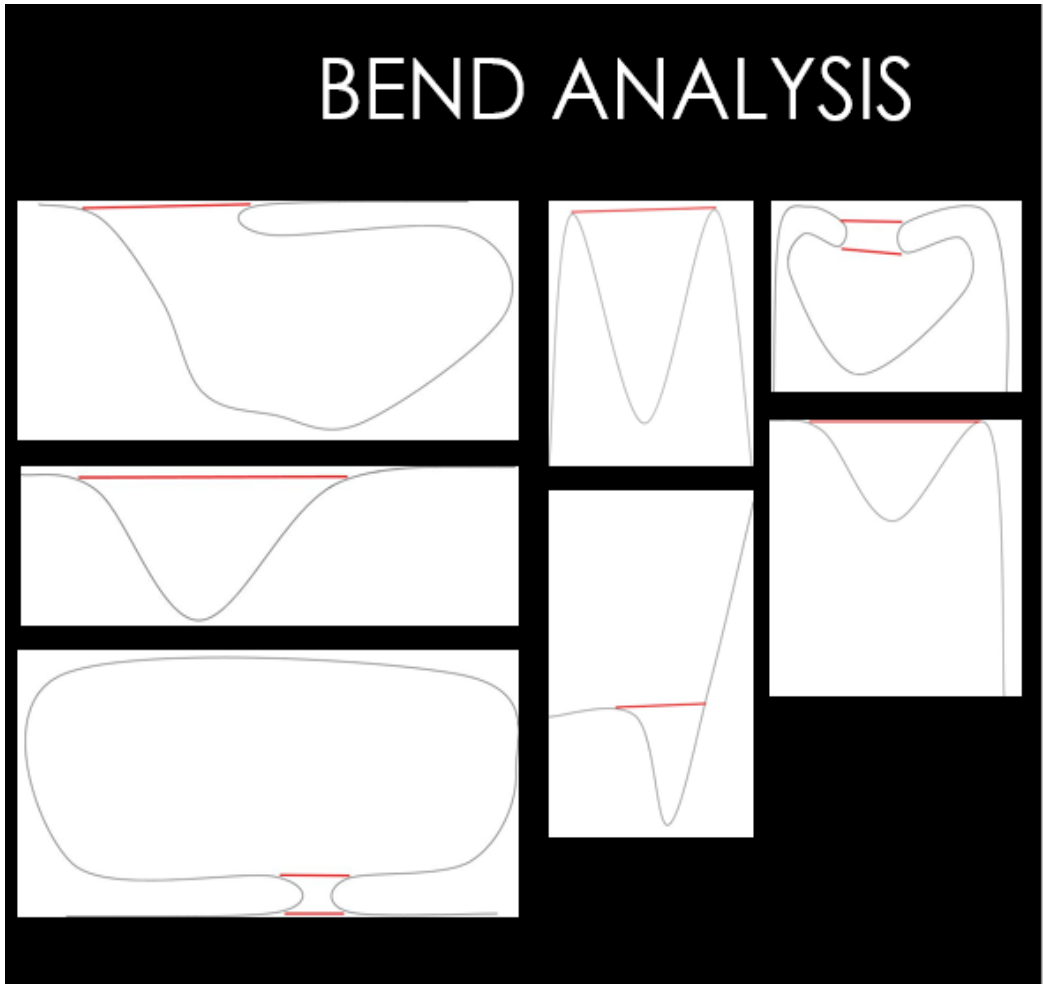
Results
Pattern Recognition

Feature	Accuracy
Seamount	96%
Knoll	64%
Guyots	98%
Banks	80%
Hills	64%

Trend Variation

Variations in trend should

- Consist of at least one sufficiently sharp bend in the isobaths
- Find an appropriate connecting point to close off all or part of the isobaths
- Ensure the enclosed feature makes sense
- And treat it as a new feature.



Challenges

- Unknown proper intervals for isobaths
- Simplify the number of vertices in the isobaths
- How and when can significant bends be joined.
- Identify overlapping V shapes (for example for canyons)
- What constitutes a sufficiently close isobath
- Are there other options to simplify our object hierarchy? (e.g. topographic prominence)
- Other statistics of interest for classification?

Next Steps

- Automate the detection of more “closed” features
- Expand study of “trend-based” features (bend analysis)
- Begin study of “slope based” features
- And of “Negative space” features

- Sharing, cooperate
- Learning more about how to teach a machine to detect Undersea Features at a global scale and
- Standardize an acceptable process of UF detection.

Action Required of SCUFN33

- Note reports
- Approve the proposed UFNPT work plan for 2020-2021
- Take any other actions that SCUFN would deem necessary to advance the UFNPT work plan
- Encourage support and feedback from earth science experts
- and those who are investigating machine learning methods.

Thank You

Questions?