

# **DIGITAL MAPPING TECHNIQUES 2020**

**The following was presented at DMT'20  
(June 8 - 10, 2020 - A Virtual Event)**

**The contents of this document are provisional**

**See Presentations and Proceedings  
from the DMT Meetings (1997-2020)**

**<http://ngmdb.usgs.gov/info/dmt/>**



# Large Submarine Canyons of the Outer Continental Shelf

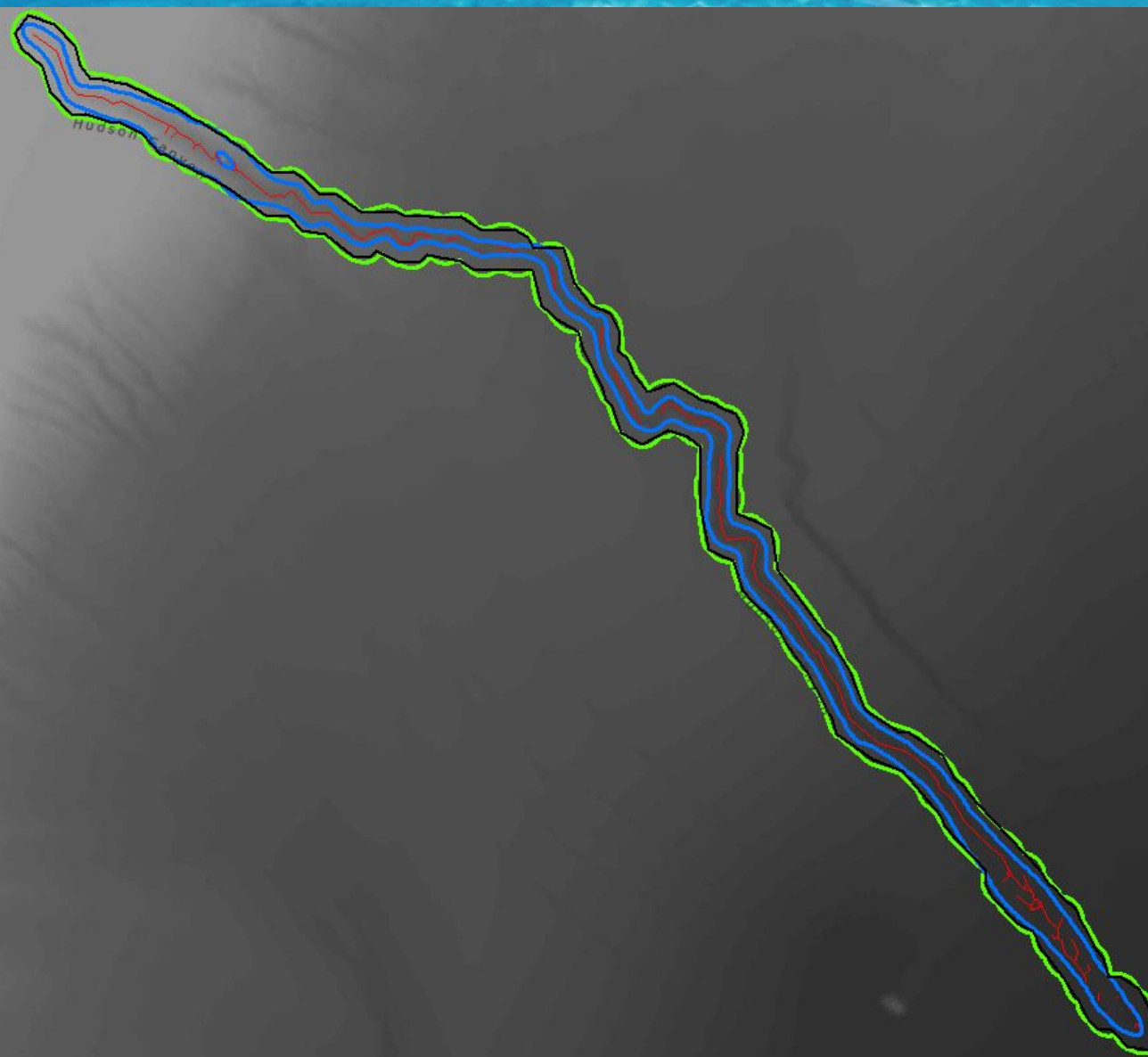
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An aid to stewardship of federal marine oil and gas,  
renewable energy, and mineral resources

Paul O. Knorr, DMT '20



# Submarine Canyon Delineation Method



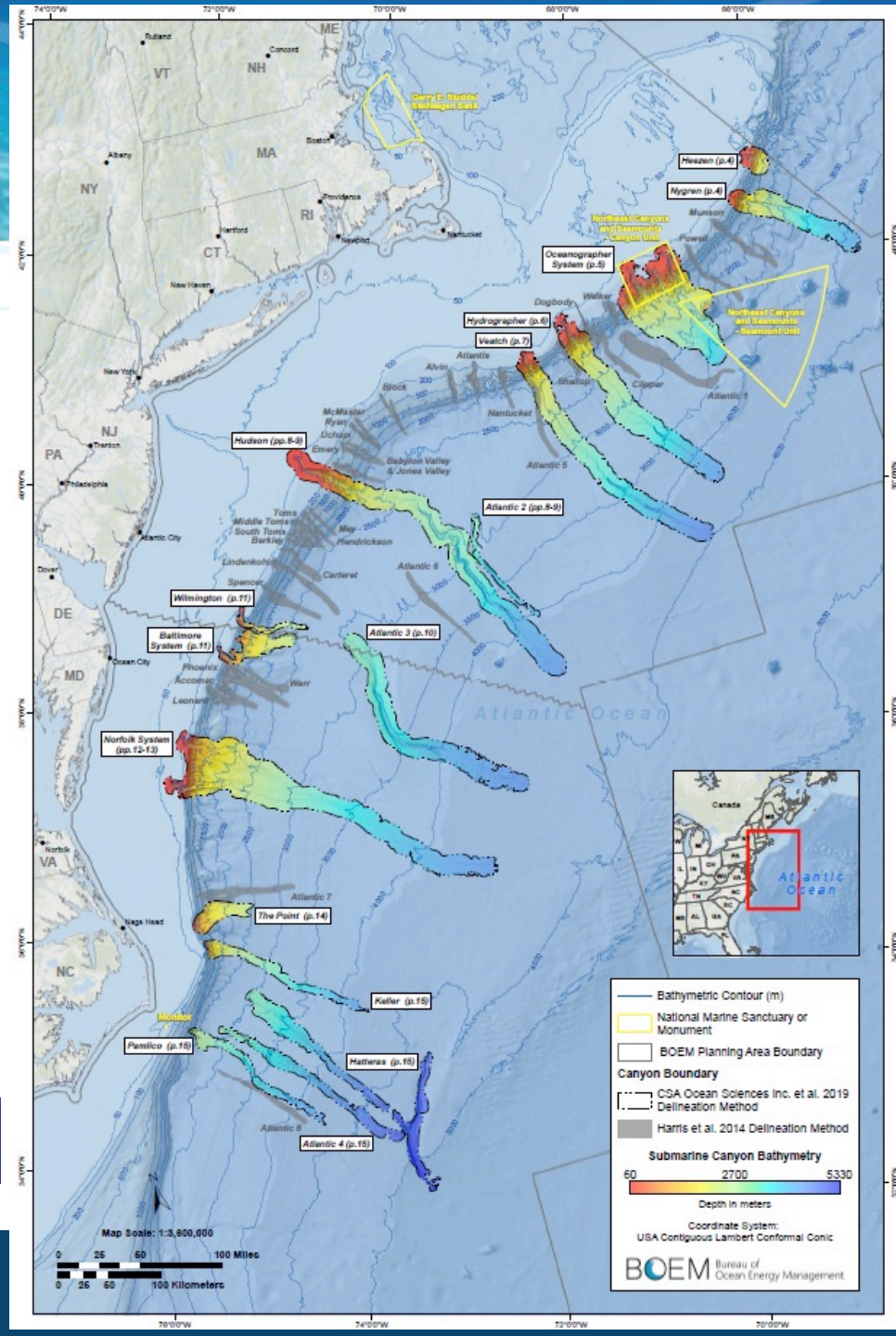
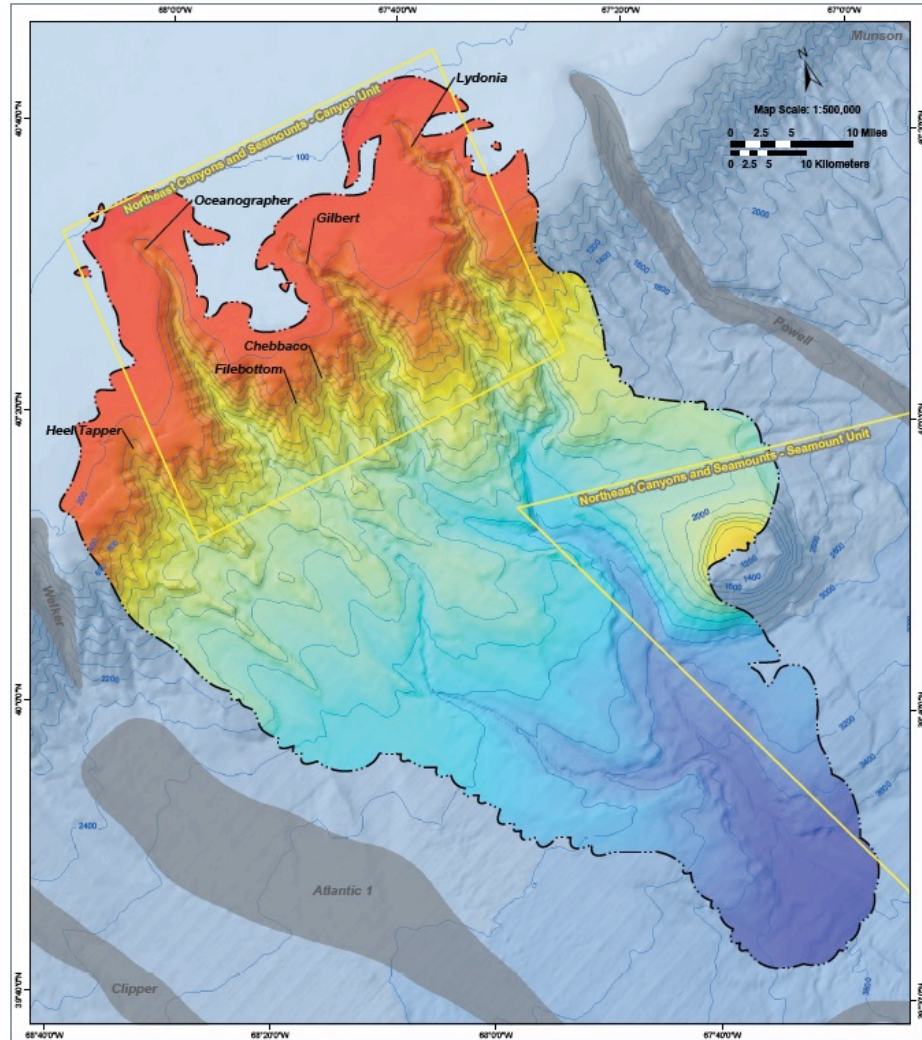
- SRTM bathy data with superimposed Hudson Canyon boundaries.
- Central **red** line is canyon thalweg from stream order computations.
- **Blue** line is the Harris et al. (2014) boundary.
- Outermost **Green** line is 5 km buffer.
- **Black** line is the effect of removing the lowest 4.6% (2 Standard Deviations) of slopes from within the 5-km buffer area.



# Atlantic

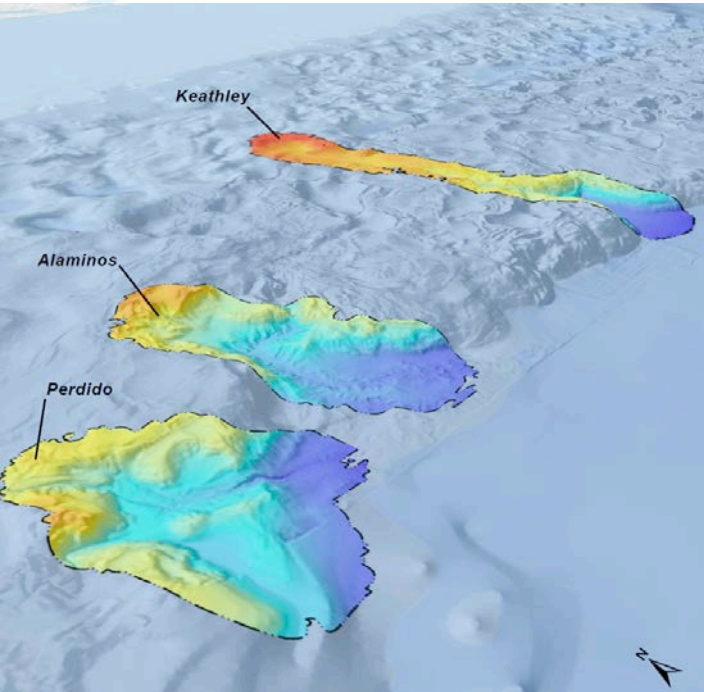
Detailed views of each canyon

## OCEANOGRAPHER CANYON SYSTEM

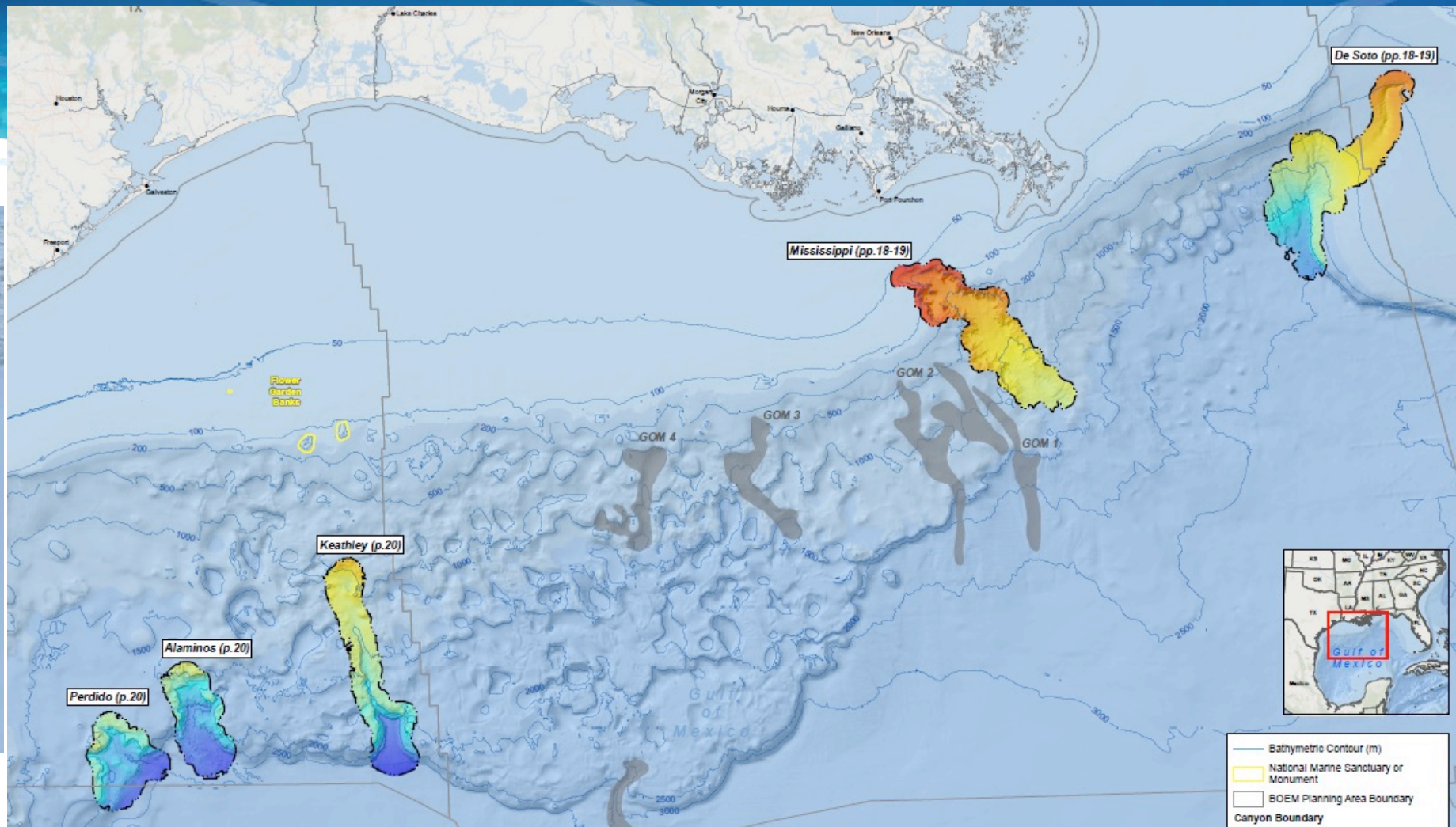


Region	<i>n</i>	Avg Area (km <sup>2</sup> )	Avg Depth -min (m)	Avg Depth -max (m)	Avg Length (km)	Notes
Atlantic	16	3,306	877	3,936	180	Longer, deeper canyons

# Gulf of Mexico



3-D view of each canyon



Region	<i>n</i>	Avg Area (km <sup>2</sup> )	Avg Depth -min (m)	Avg Depth -max (m)	Avg Length (km)	Notes
Gulf of Mexico	5	3,072	717	2,687	109	Fewest canyons

# Pacific

Useful scientific facts for analysts, fully-referenced

## NOTABLE FACTS



Juan de Fuca Canyon has been identified as the most important source for the net upwelling of nitrate onto the Washington shelf (Hickey and Banas 2008). The canyon is also known to have high krill biomass concentration (Santora et al. 2018).



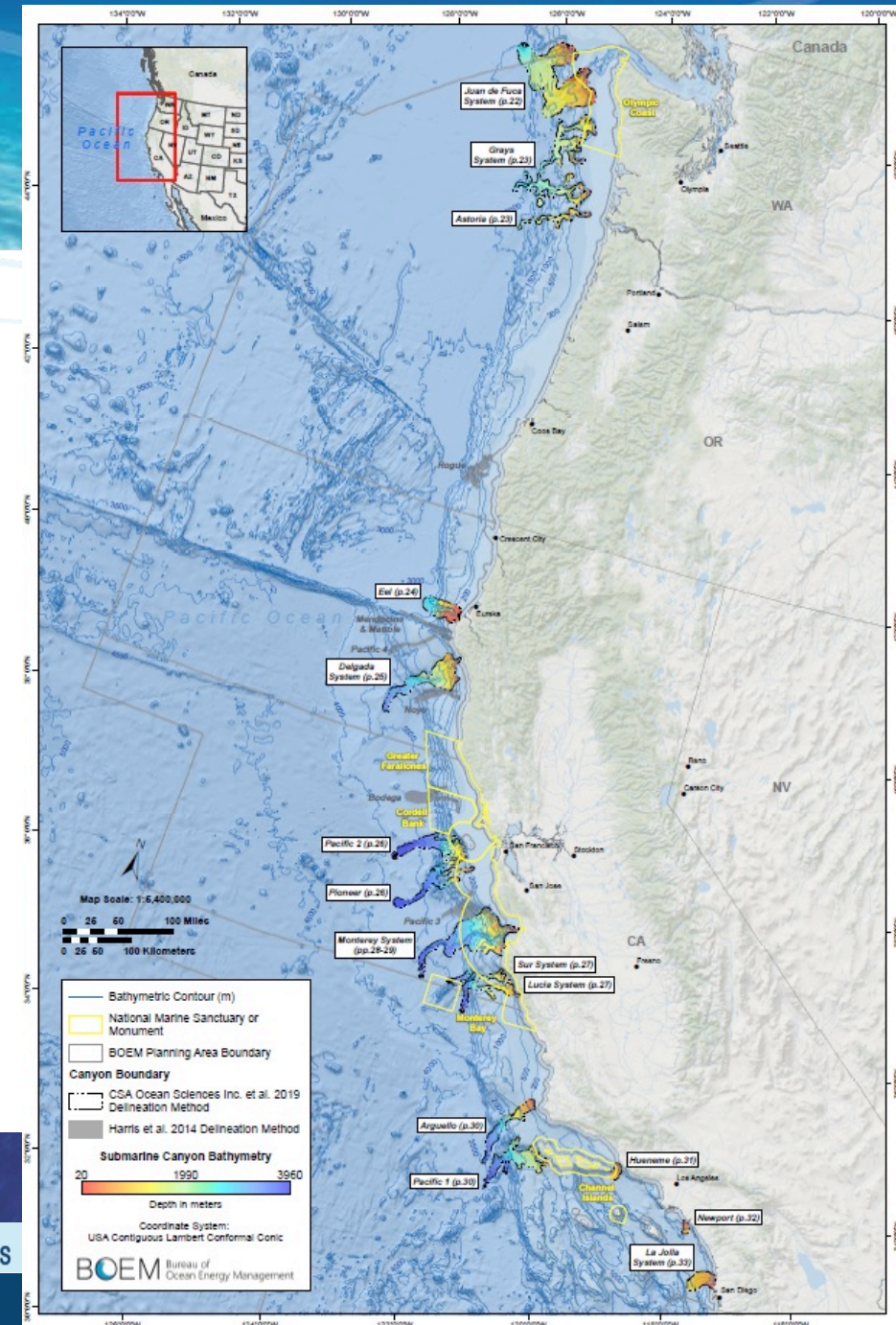
Large deep-sea communities were discovered in Juan De Fuca Canyon in 2017, including long-lived species of coral and sponges (Raineault et al. 2018).



The trawling fleet in Washington focuses their efforts around the Juan de Fuca Canyon to catch rockfish, Pacific hake, arrowtooth flounder, and Dover sole (Tagart 1997).



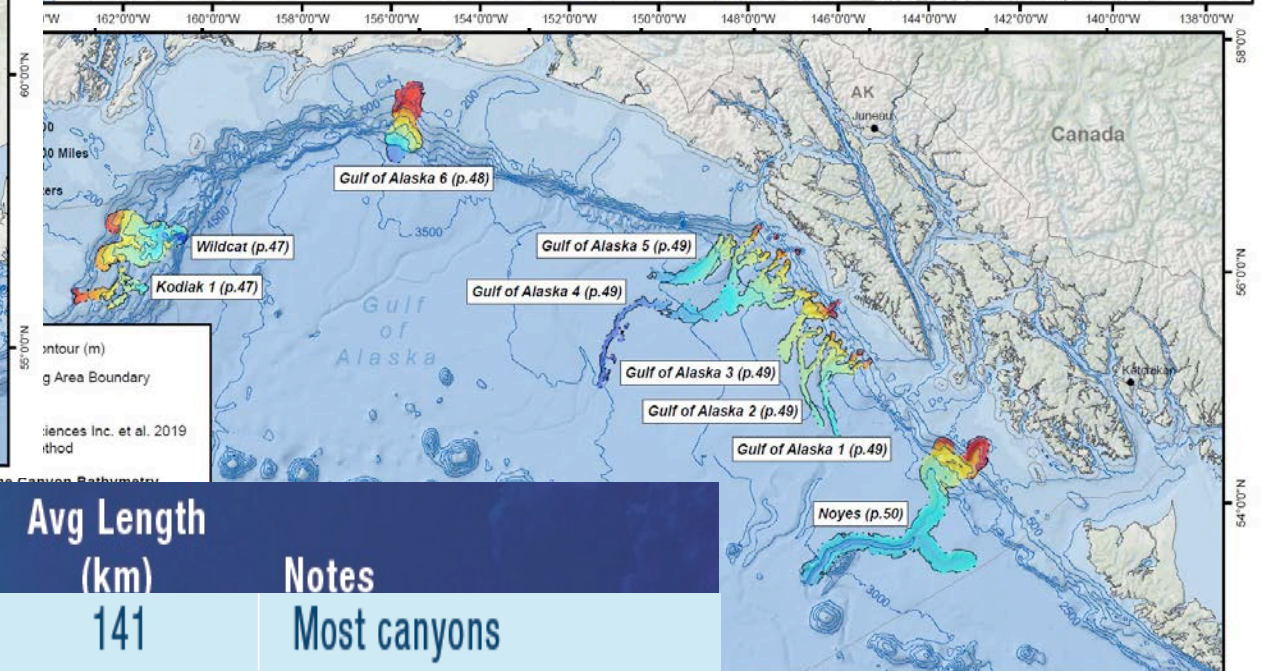
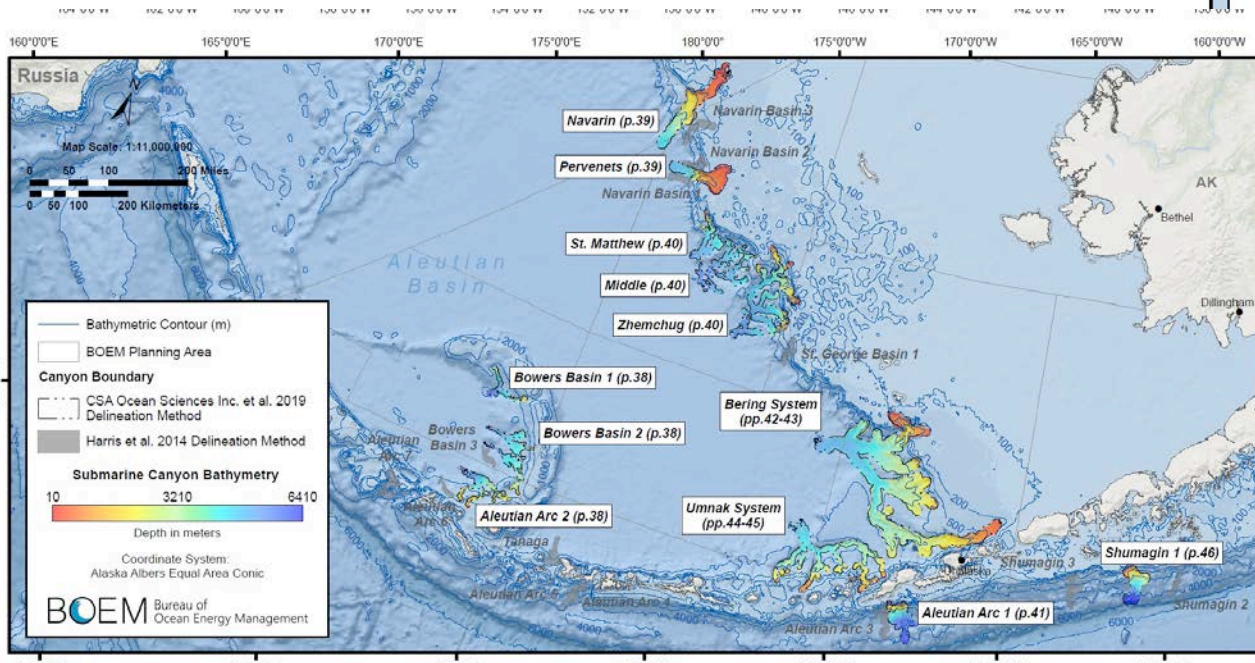
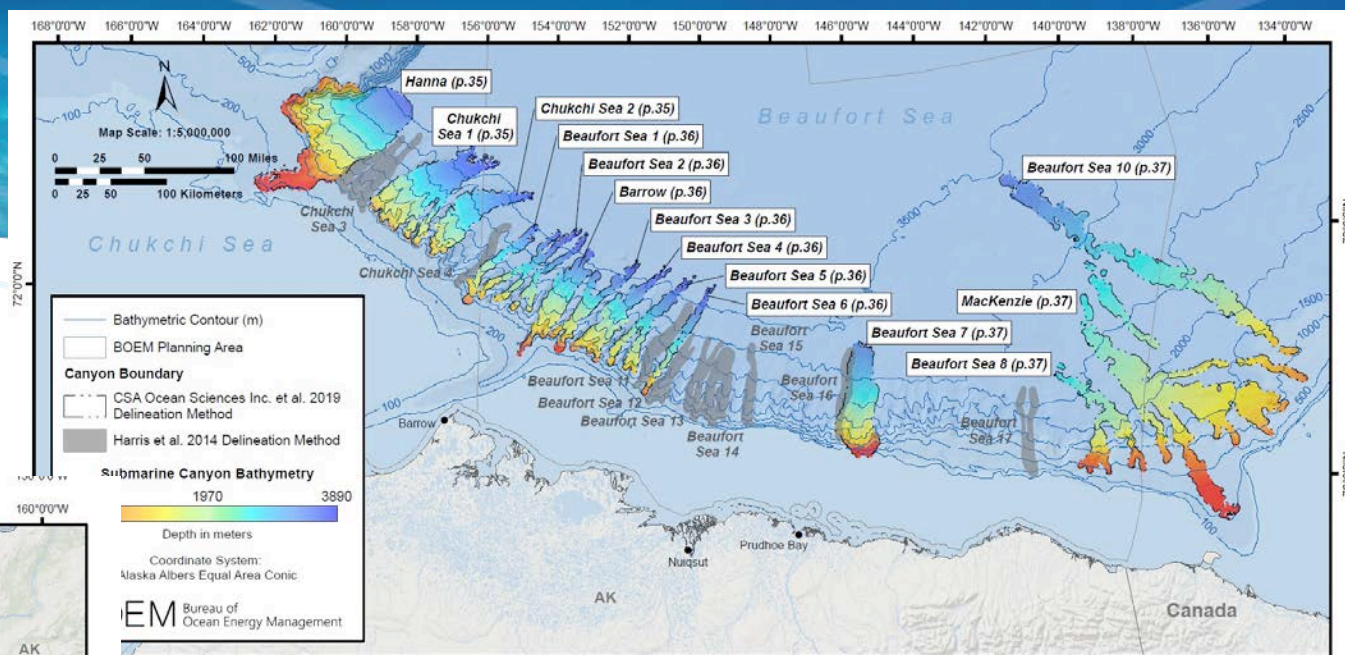
The *Coast Trader* was sunk in 1942 by a Japanese submarine, and the shipwreck lies at the head of Juan de Fuca Canyon (NOAA 2019).



Region	n	Avg Area (km <sup>2</sup> )	Avg Depth -min (m)	Avg Depth -max (m)	Avg Length (km)	Notes
Pacific	15	2,002	93	2,848	98	Shorter, shallower canyons

# Alaska

## Alaska needs three overview maps

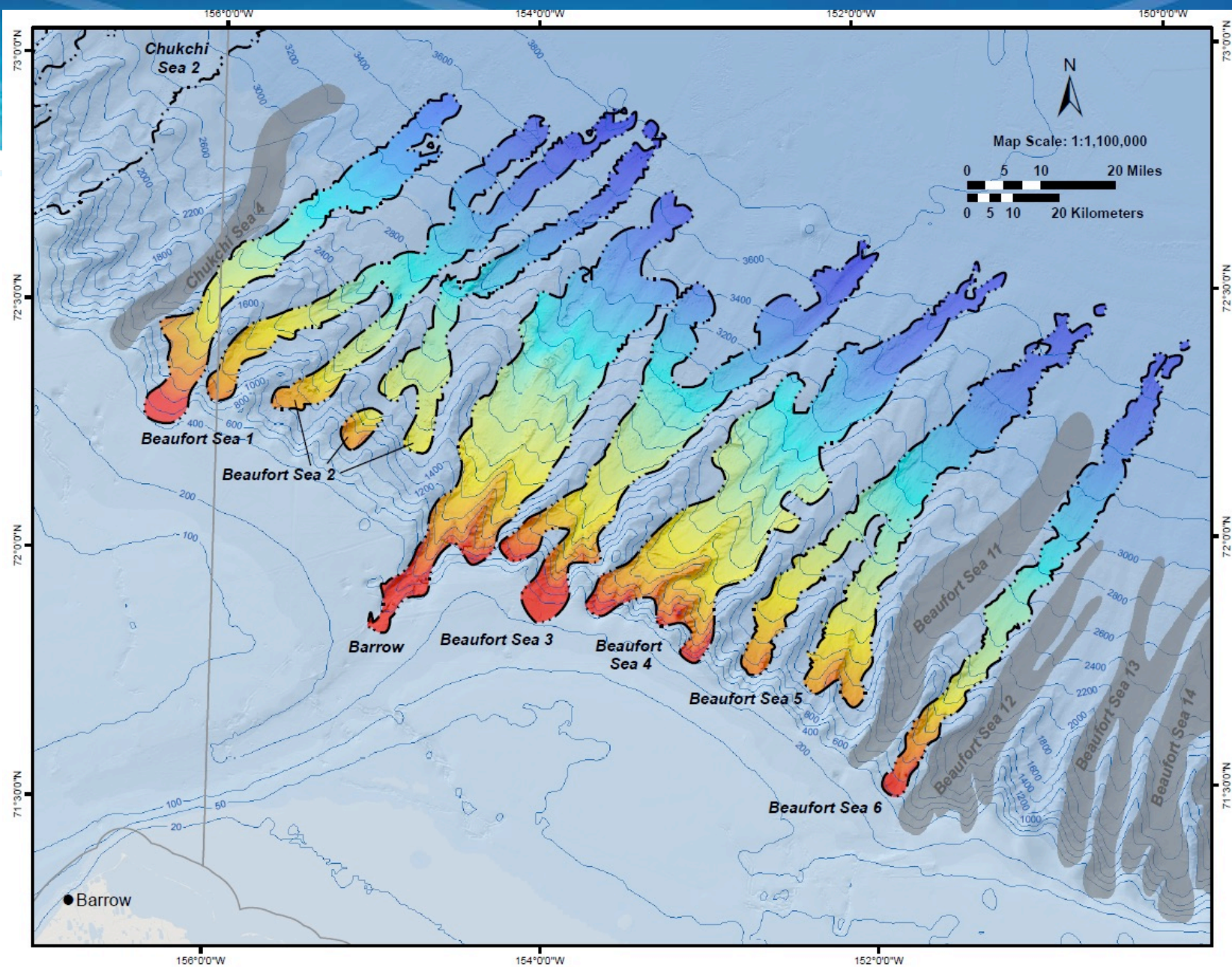


Region	n	Avg Area (km <sup>2</sup> )	Avg Depth -min (m)	Avg Depth -max (m)	Avg Length (km)	Notes
Alaska	35	3,902	444	3,588	141	Most canyons



# Barrow / Alaska


Unexpected concentration of canyons along Alaska's northern slope






# Submarine Canyons - Application

- Aid to research & assessment
- 52 pages
- 11x17
- Printed and pdf
- References
- GIS files

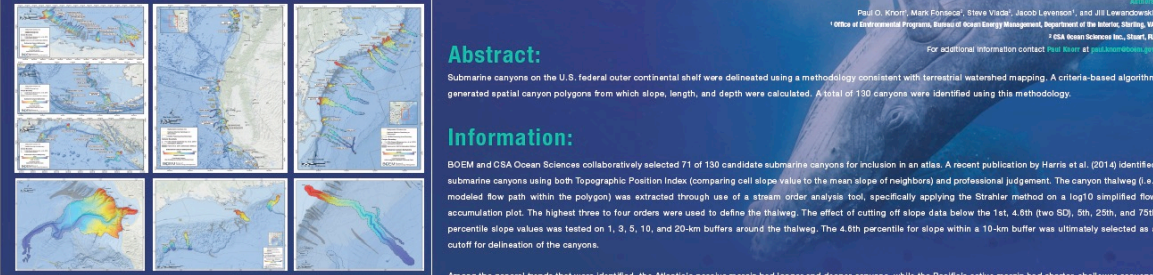


BOEM  
Bureau of Ocean Energy Management

## Application of Federal Submarine Canyon Morphometrics to Environmental Management of Marine Mammals



CSA  
Ocean Sciences Inc.



**Abstract:**  
Submarine canyons on the U.S. federal outer continental shelf were delineated using a methodology consistent with terrestrial watershed mapping. A criteria-based algorithm generated spatial canyon polygons from which slope, length, and depth were calculated. A total of 130 canyons were identified using this methodology.

**Information:**  
BOEM and CSA Ocean Sciences collaboratively selected 71 of 130 candidate submarine canyons for inclusion in an atlas. A recent publication by Herrie et al. (2014) identified submarine canyons using both Topographic Position Index (comparing cell slope value to the mean slope of neighbors) and professional judgement. The canyon thalweg (i.e., modeled flow path within the polygon) was extracted through use of a stream order analysis tool, specifically applying the Strahler method on a log10 simplified flow accumulation plot. The highest three to four orders were used to define the thalweg. The effect of cutting off slope data below the 1st, 4.6th (two SD), 5th, 25th, and 75th percentile slope values was tested on 1, 3, 5, 10, and 20-km buffers around the thalweg. The 4.6th percentile for slope within a 10-km buffer was ultimately selected as a cutoff for delineation of the canyons.

Among the general trends that were identified, the Atlantic's passive margin had longer and deeper canyons, while the Pacific's active margin had shorter, shallower canyons. Alaska, which contains ~53% of the US shoreline, had almost as many canyons as the rest of the U.S. The Gulf of Mexico had the fewest canyons, perhaps a consequence of the sprawling Mississippi River deltaic deposits.

**Application and Results:**  
As a trial of application, the inventory was used to support an analysis of cetacean population density of Atlantic deep-feeding toothed and surface-feeding baleen taxa to identify preferential presence within the delineated submarine canyon polygons. CETMAP density models (Roberts et al., 2016) were annualized, and statistics were calculated at regional and canyon scales. The accompanying maps show distribution of the deep-diving genera *Physalis* and *Meagropodius* (i.e., sperm whales and beaked whales, typically feeding on aphotic-zone squid) and the shallow-dwelling genera *Eubalaena* and *Megaptera* (i.e., North Atlantic right whales and humpback whales, feeding photic-zone zooplankton).

- Deep-diving taxa (i.e., *Physalis*, *Meagropodius*) had a significantly higher density of individual animals within the perimeter of the delineated canyon polygons: 1-sample Z test of density compared to the regional average produced a  $p < 0.01$  for both genera.
- Shallow-feeding taxa (i.e., *Eubalaena*, *Megaptera*) did not have a significantly different density of individual animals within delineated canyons compared to outside of canyons: 1-sample Z test of density for both genera gave a  $p > 0.05$ .

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All U.S. Canyons	71	3,308	487	3,447	138	All canyons

Atlas available at [https://espis.boem.gov/final%20reports/BOEM\\_2019-066.pdf](https://espis.boem.gov/final%20reports/BOEM_2019-066.pdf)



OCS EIS/EA  
BOEM 2016-001

## Outer Continental Shelf Oil and Gas Leasing Program: 2017-2022 Draft Programmatic Environmental Impact Statement

March 2016

Volume I: Chapters 1-6



U.S. Department of the Interior  
Bureau of Ocean Energy Management  
[www.boem.gov](http://www.boem.gov)



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[https://epis.boem.gov/final%20reports/BOEM\\_2019-066.pdf](https://epis.boem.gov/final%20reports/BOEM_2019-066.pdf)



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