OFFSHORE SAFETY DIRECTIVE: FORWARD PARADIGMS OF RISK AND SAFETY

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What effects Risk/Liability/Compensation?

- Novel Activities
  - New Benefits
  - New Risks
- New players and stakeholders
- Change in Scale of Events
- New Location of Events, in what Jurisdiction(s)

- The more factors, above, engaged the more the need to rethink liability, compensation, and financial security

Looking Ahead on Liability, Compensation, and Financial Security

- Directive reflects a body of knowledge, built on previous experiences and events in the offshore industry
- There are on-going events in the offshore industry that might provide insight into the present functioning of the Directive
- Some of these are **paradigm changing**; which also raises a question of how well the Directive functions to raise safety standards for novel and incoming changes in operational activities
- These changes will materially impact on policy and planning for **liability**, **compensation**, and **financial security** in advance of operations

Changes Impacting Offshore Safety

- Possibilities for Smaller Actors to have Larger Impacts
- New Offshore Possibilities – From Elephants to Cows, from Blue Whales to Dolphins
- New Resource Risks – Offshore Methane Hydrates, from Deep Rocks to Shallow Mudlines
- Improving on Safety Case Implementation

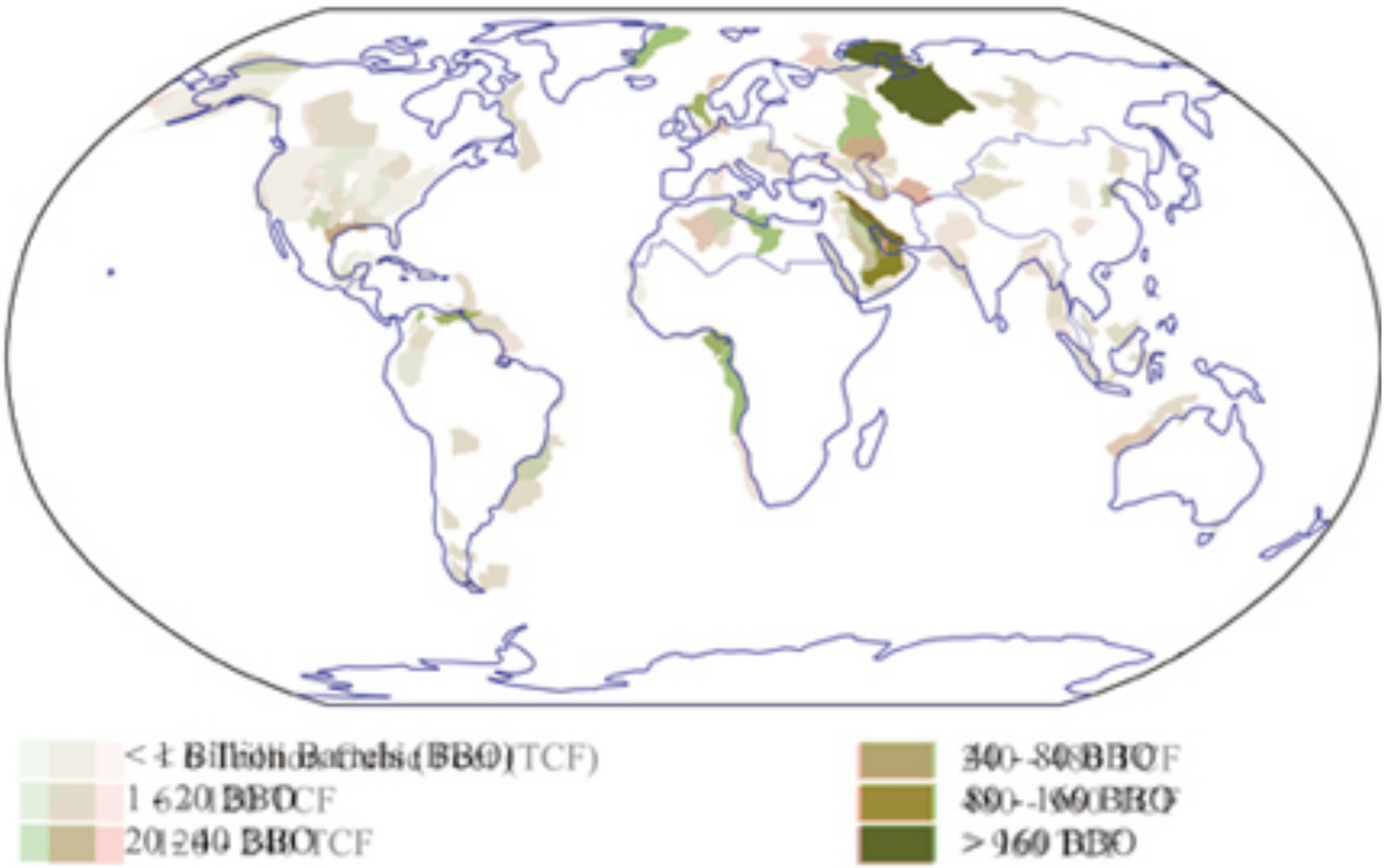
New Offshore Possibilities -- From Elephants to Cows, from Blue Whales to Dolphins

- The improving ability to 4D scan for resources will lead to reduced risk of dry holes while also increasing reliability on volumes in reservoirs.
- Improvements in drilling technology have led to reduced costs thereof, as seen occurring in the onshore shale fracturing developments
- While this combination of changes has mostly been onshore so far, it is foreseeable that these trends, to commercially develop smaller assets, will extend to the offshore
- This reduction in capital mass per well could also led to new circumstances in offshore safety planning – same as it did onshore
  - Smaller Assets in Play
  - Smaller Capital Pools Required
  - Space for Smaller Investors/Operators

New Discoveries – Offshore Methane Hydrates, from Deep Rocks to Shallow Mudlines

- Present Offshore Directive presumes conventional petroleum assets, those laying deeply under rock and other geological structures
- New offshore actors are moving to develop offshore methane hydrates (OMH):
  - OMH are a methane resource that lays under the mud in the benthic offshore
  - Methane hydrates casually appear as accumulated snow, with the methane molecules locked in molecular-scale ice cages — **85% H_2O** and **15% CH_4**
- The risks shift from "Exxon Valdez" or "BP Macondo" crude oil hazard paradigms to more novel risks of offshore landslides, tsunami, and massive/continuous methane leaking and venting, both into the water column and into the atmosphere, with the associated risks to climate change and loss of oceanic biota
- There is also an increased risk of international/transboundary loss of human life
- Need to develop awareness of these novel environmental and safety risks, and implement within framework of Offshore Directive, for OMH production will likely arrive in a surprising manner, much as shale fracturing did a decade or so ago
- **Needs for liability, compensation, and financial security might resemble the early nuclear industry more than the traditional oil and gas paradigms**

Map of Conventional Petroleum Assets… vs



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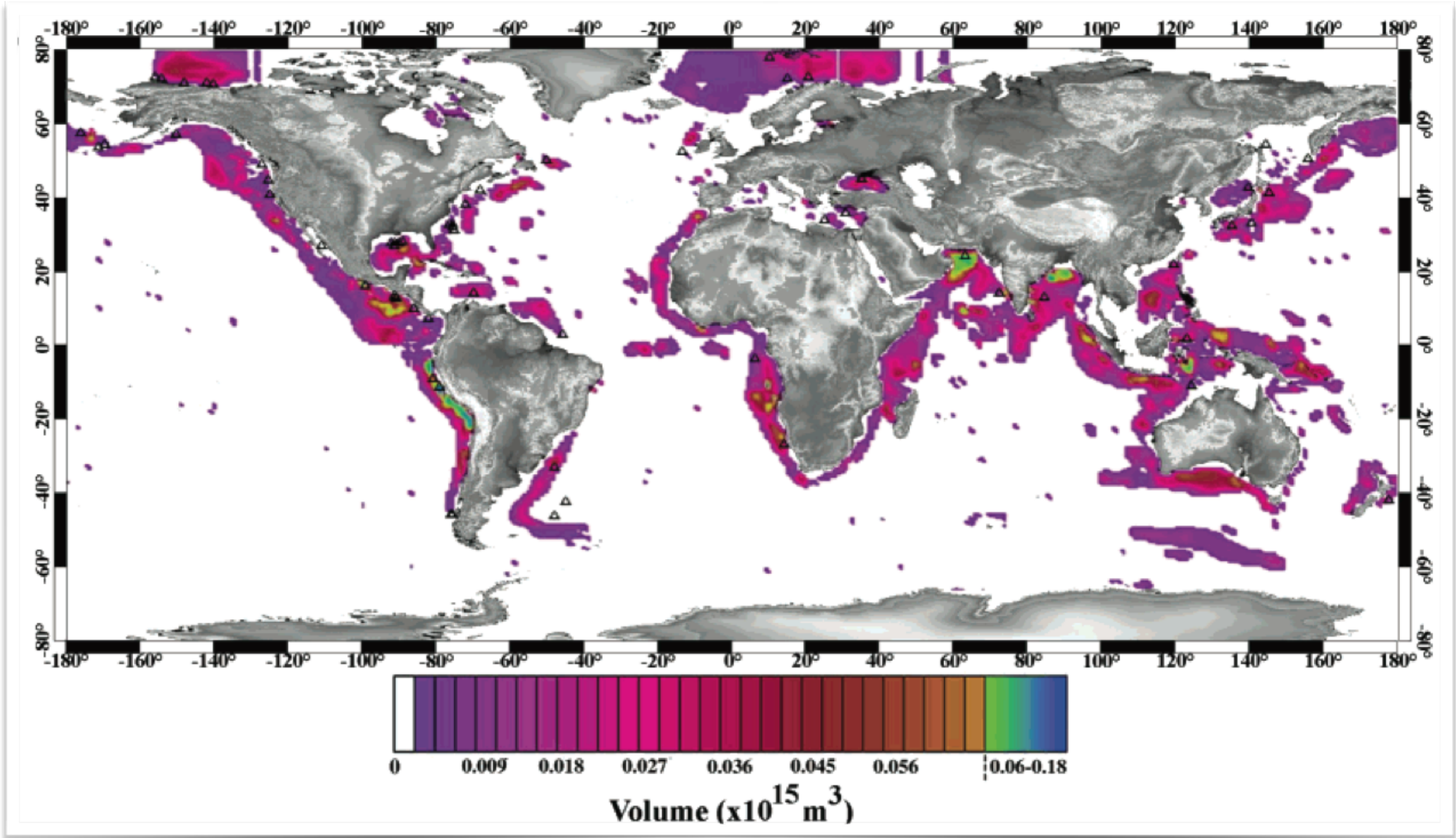
. . . where the OMH are found.



Remember, OMH are both methane and freshwater resources

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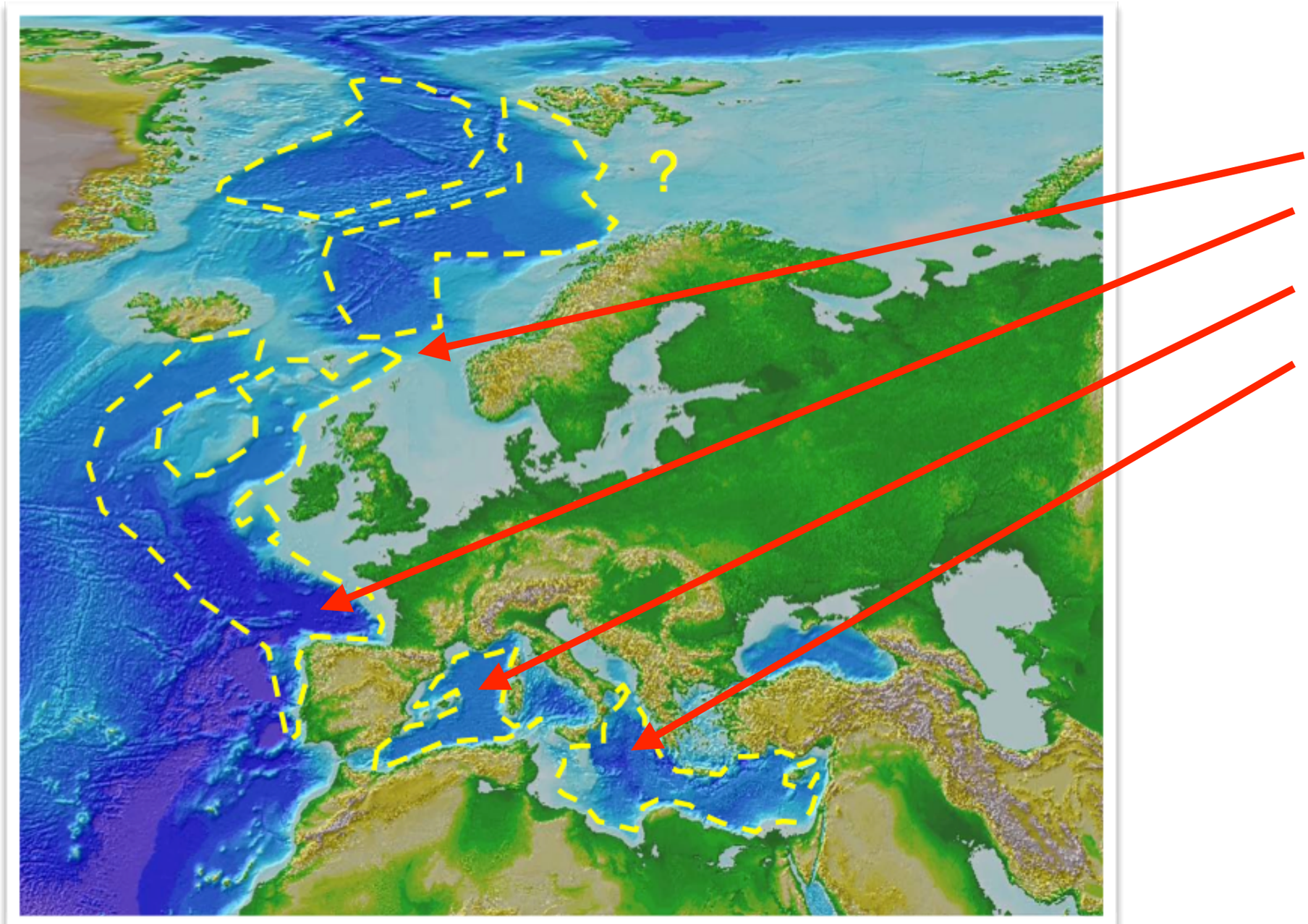
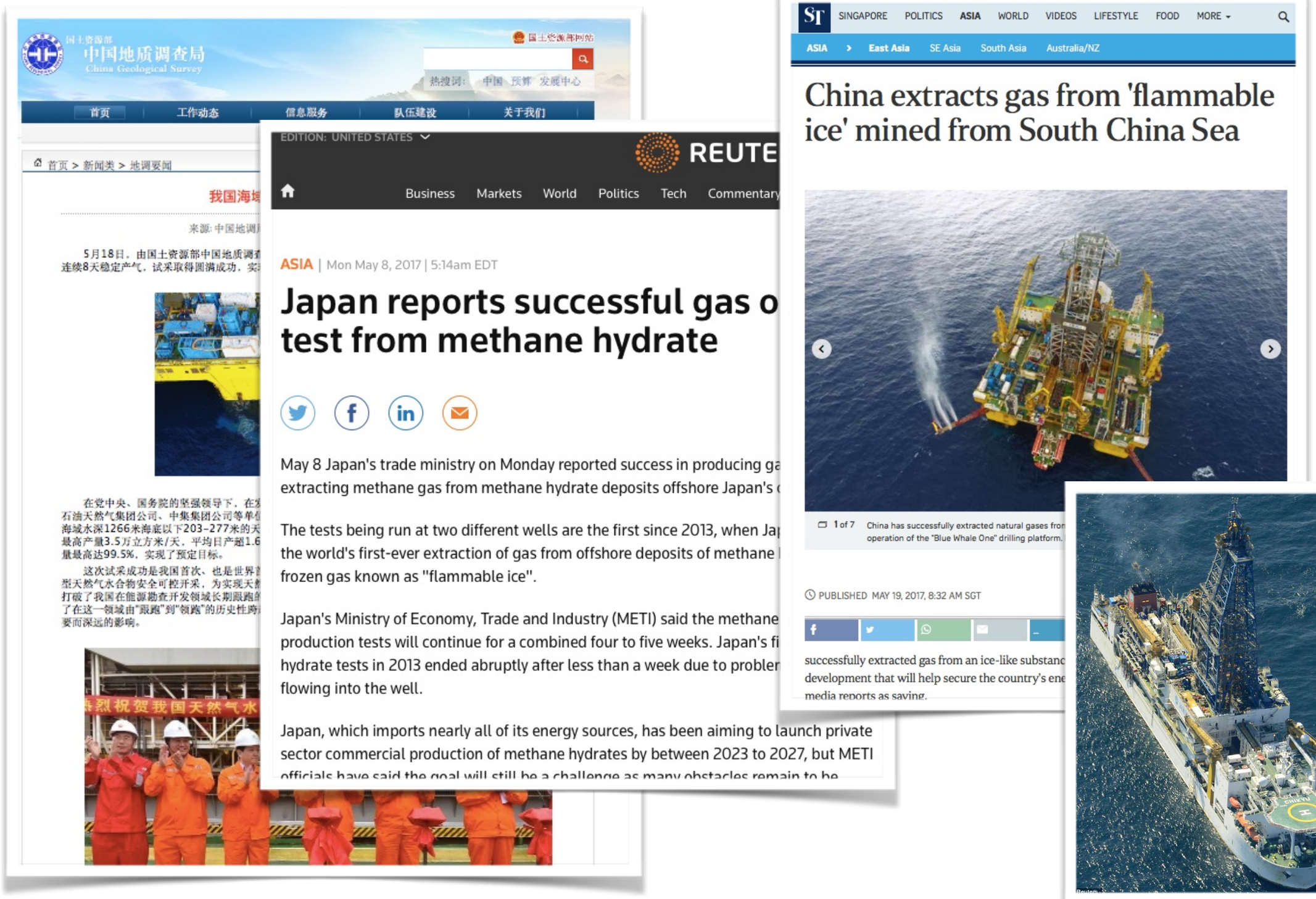
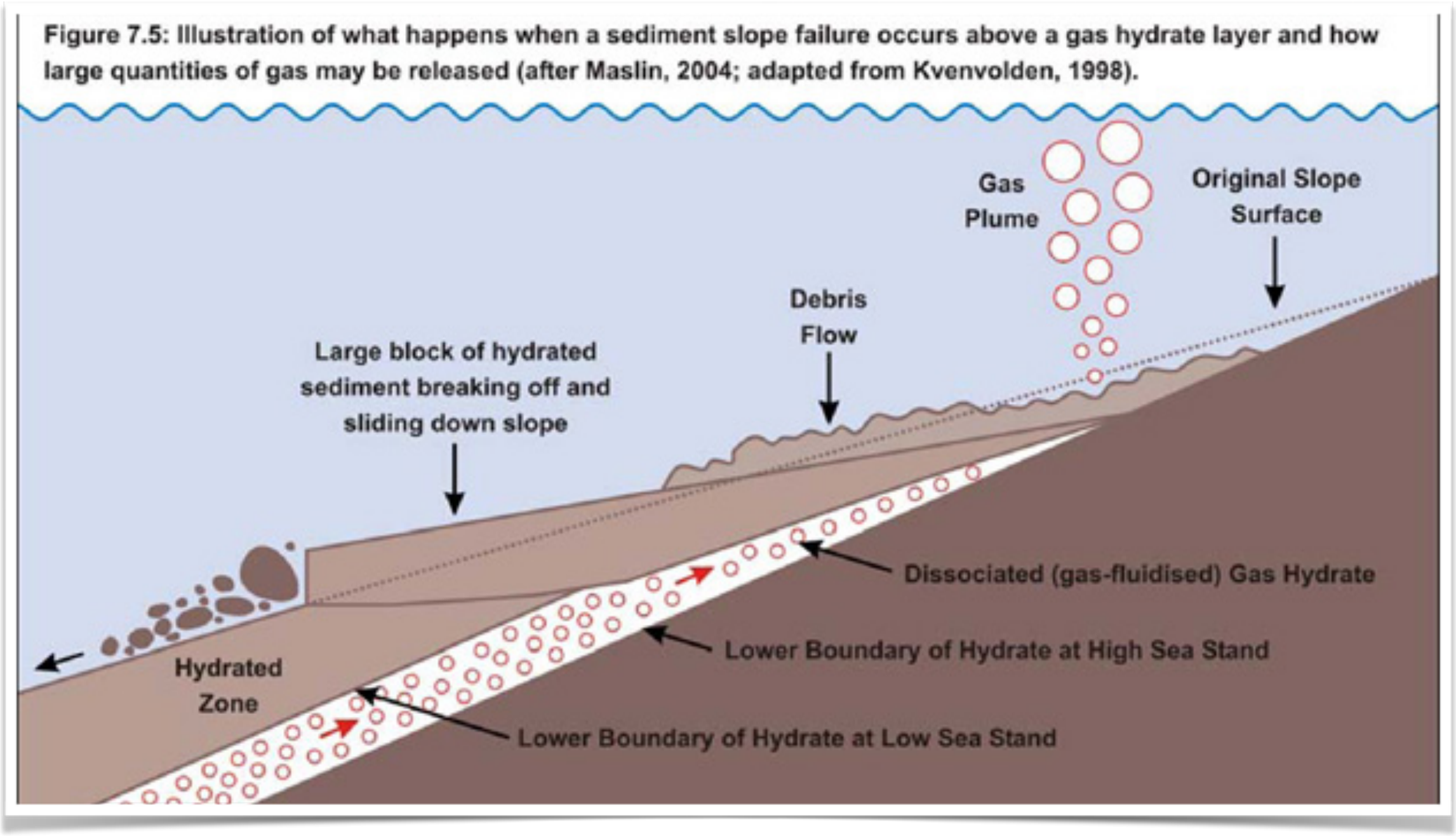
Forecasted OMH in EU Waters



Technology is there now – Commercial terms developing



Novel Safety Risks from OMH Extraction



Forecasted Area of Subsea Instability (Landslides, Tsunami)

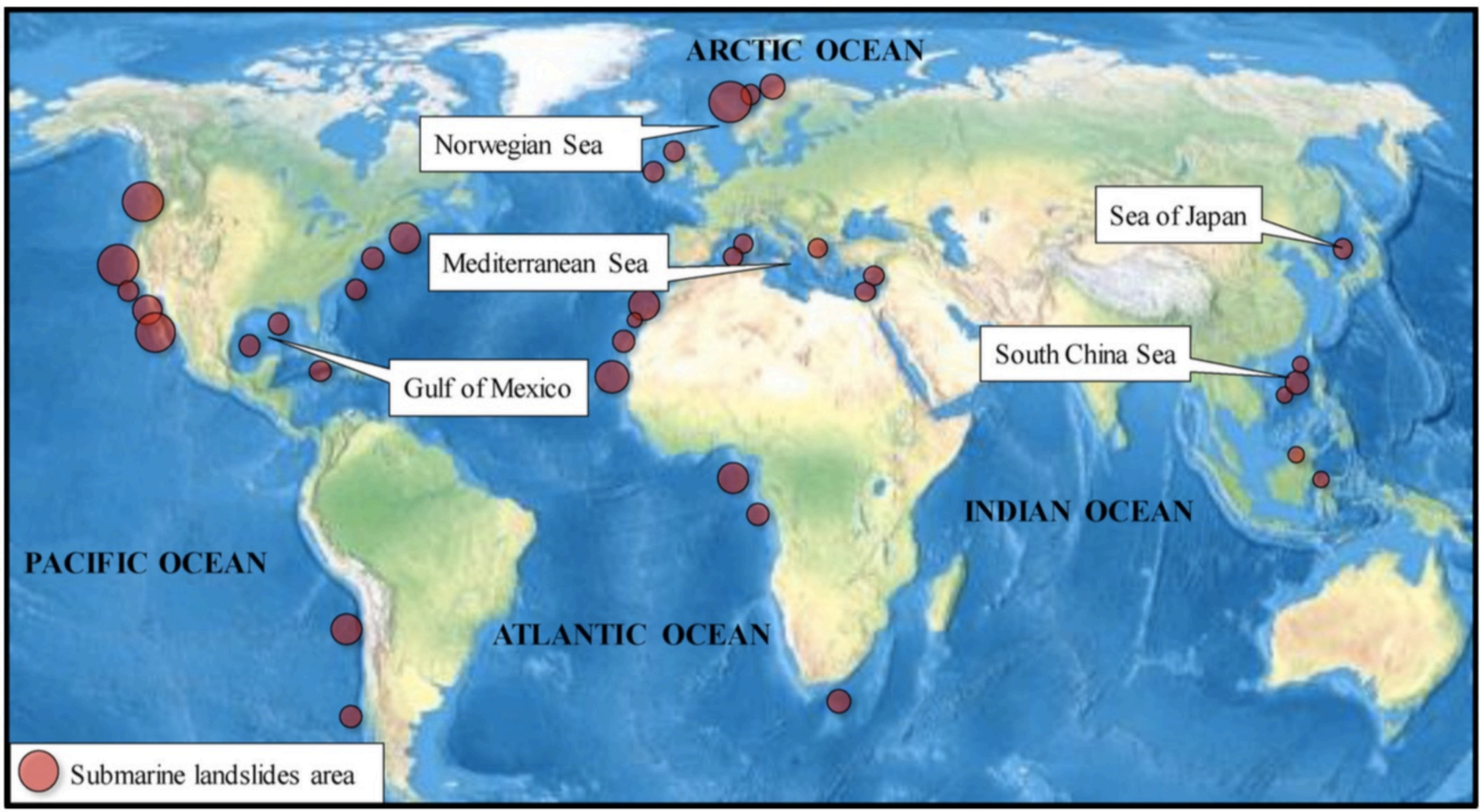
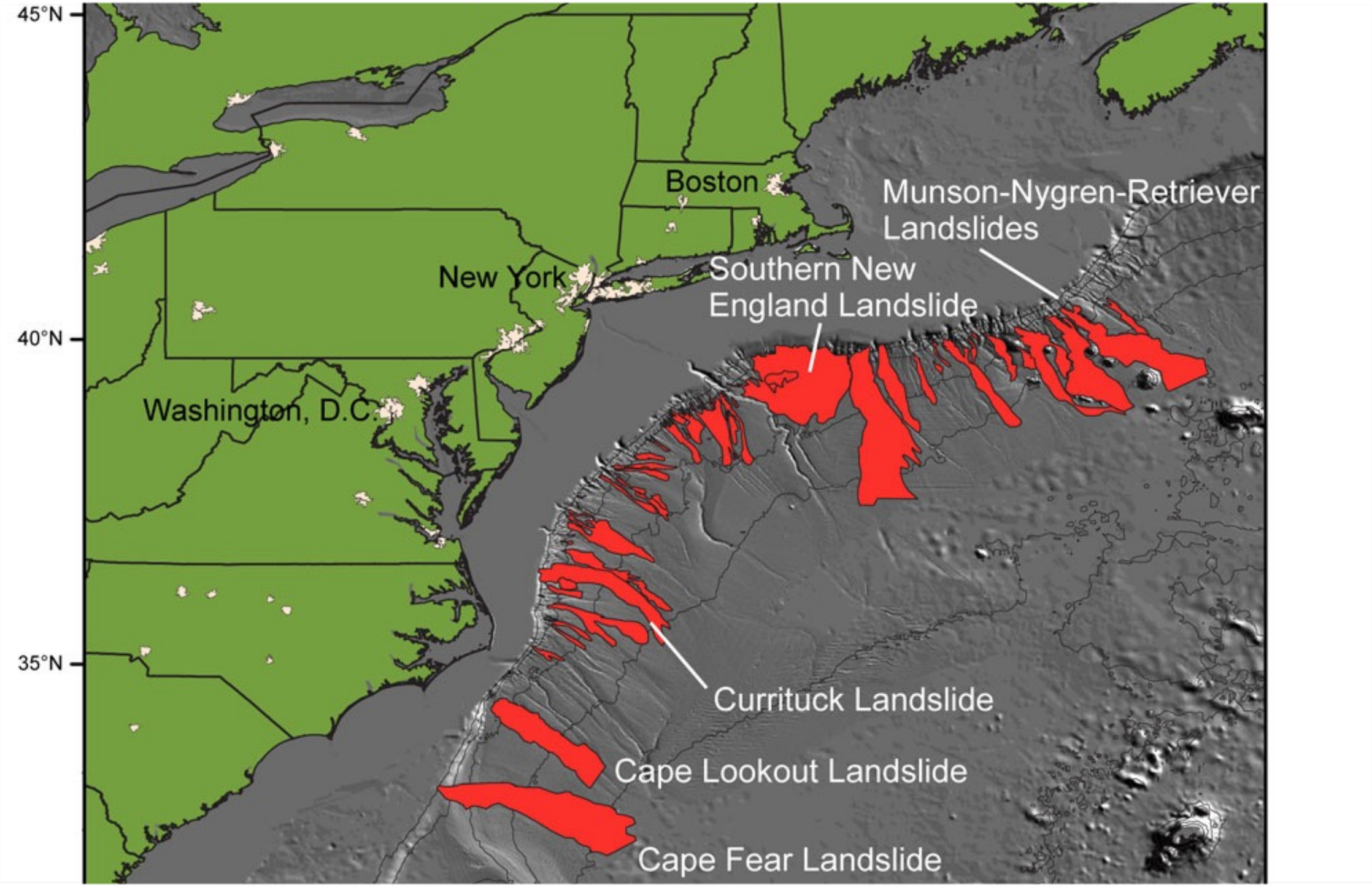


Fig. 2. Regional distribution of main areas for submarine landslides.

Bin Zhu, Huafu Pei, & Qing Yang, Probability analysis of submarine landslides based on the Response Surface Method: A case study from the South China Sea , 78 Applied Ocean Research 167 (2018)

Evidence of Ancient Landslides



Improving on Safety Case Implementation

- It is difficult to prove that the "paper" exercise of the safety case/major hazard report actually translates into meaningful action on the ground.
- In particular, to what extent is the key concept of the safety case/MHR being a living document actually implemented in practice?
- Does industry remains reactive, rather than proactive in the way that the idea of the living document would imply - do blind spots remain?
- **'*Borrowing*' from the Banks?**
  - Might hypothetical scenario "stress testing" be a method of interest
  - Team of diverse stakeholders could design hazard scenarios, which the operators could simulate across their systems to learn of capacity to respond to events
  - Discovery of preparedness, or lack thereof, could enable parties to engage in robust prevention planning

Thank You

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