BOEM
Bureau of Ocean Energy
Management

Shallow Water Flow Mapping Project Executive Summary

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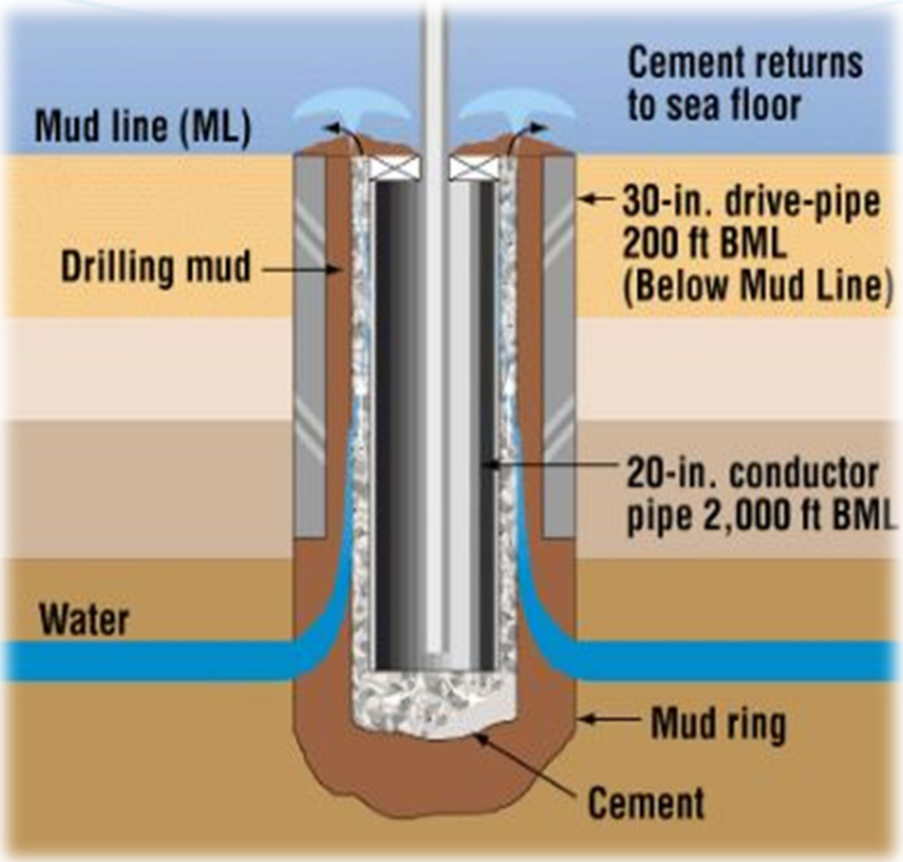
What is a Shallow Water Flow?

- Shallow water flows result from unbalanced pressure regimes between mud weight and the formation.

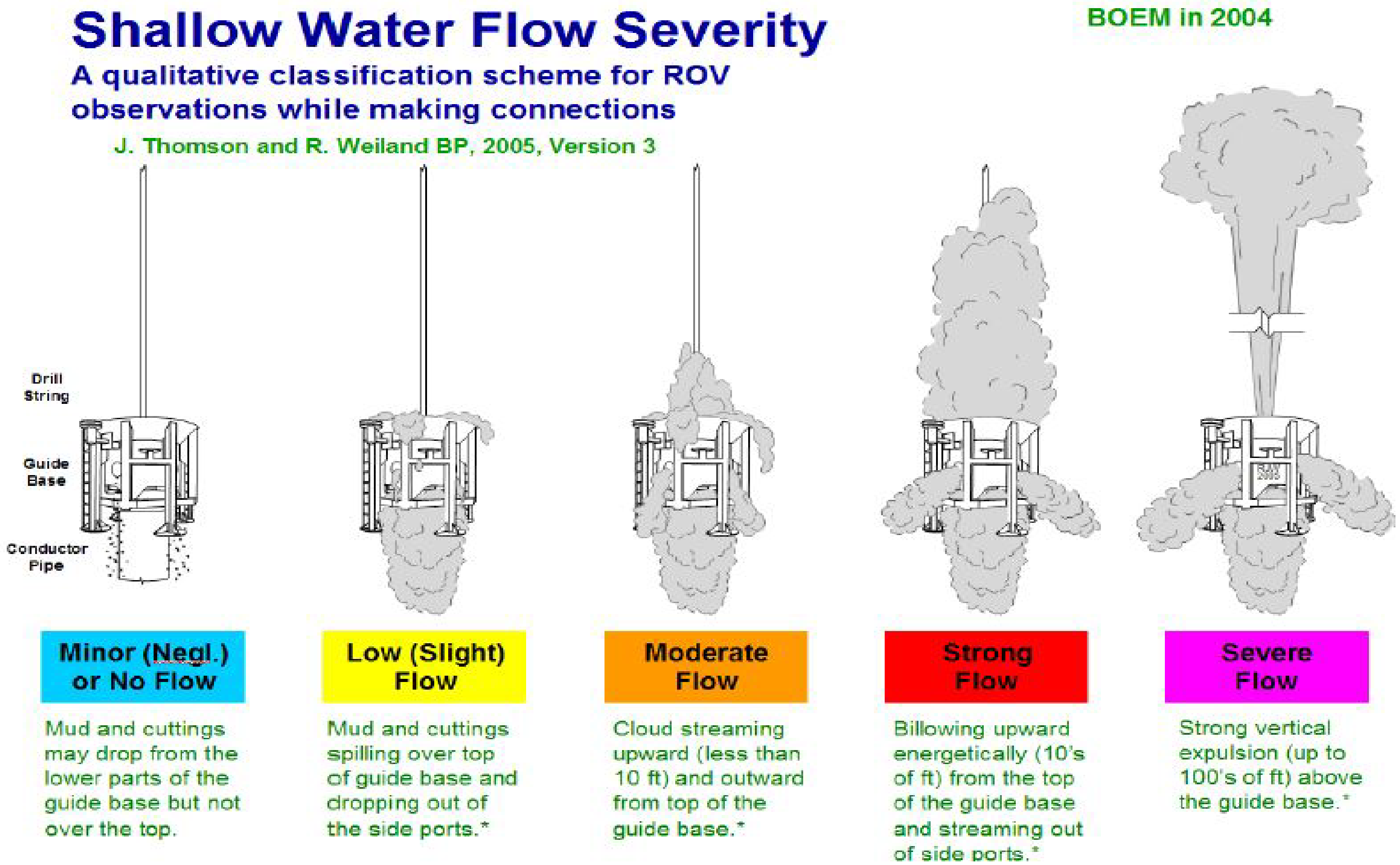
- Rapidly deposited sand and mud can dewater and compact differentially.



Furlow (1998)

Qualitative Description of SWF Severity

Adopted by the BOEM in 2004



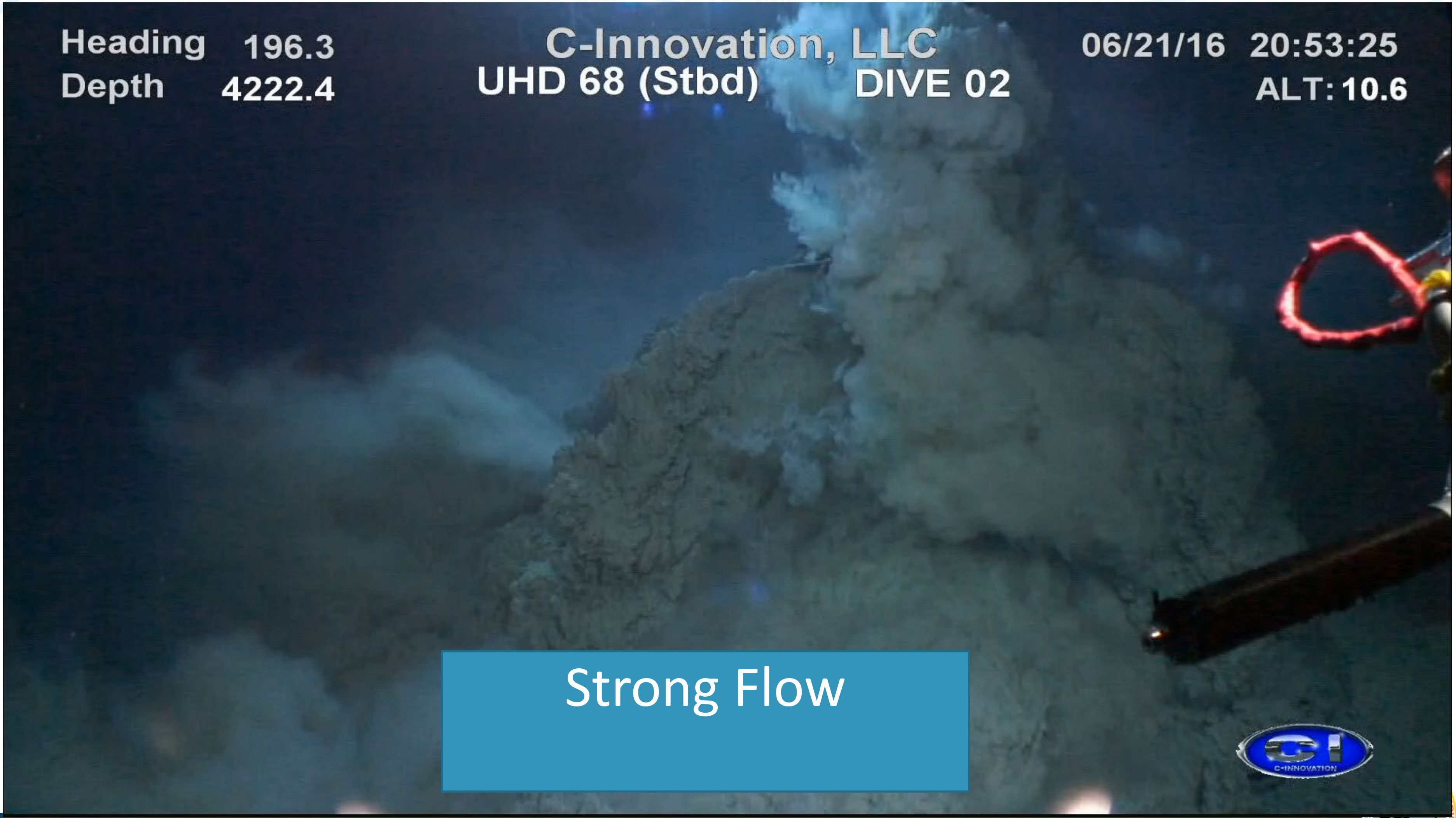
Shallow Water Flow Severity

A qualitative classification scheme for ROV observations while making connections

J. Thomson and R. Weiland BP, 2005, Version 3

Minor (Negl.) or No Flow	Low (Slight) Flow	Moderate Flow	Strong Flow	Severe Flow
Mud and cuttings may drop from the lower parts of the guide base but not over the top.	Mud and cuttings spilling over top of guide base and dropping out of the side ports.*	Cloud streaming upward (less than 10 ft) and outward from top of the guide base.*	Billowing upward energetically (10's of ft) from the top of the guide base and streaming out of side ports.*	Strong vertical expulsion (up to 100's of ft) above the guide base.*

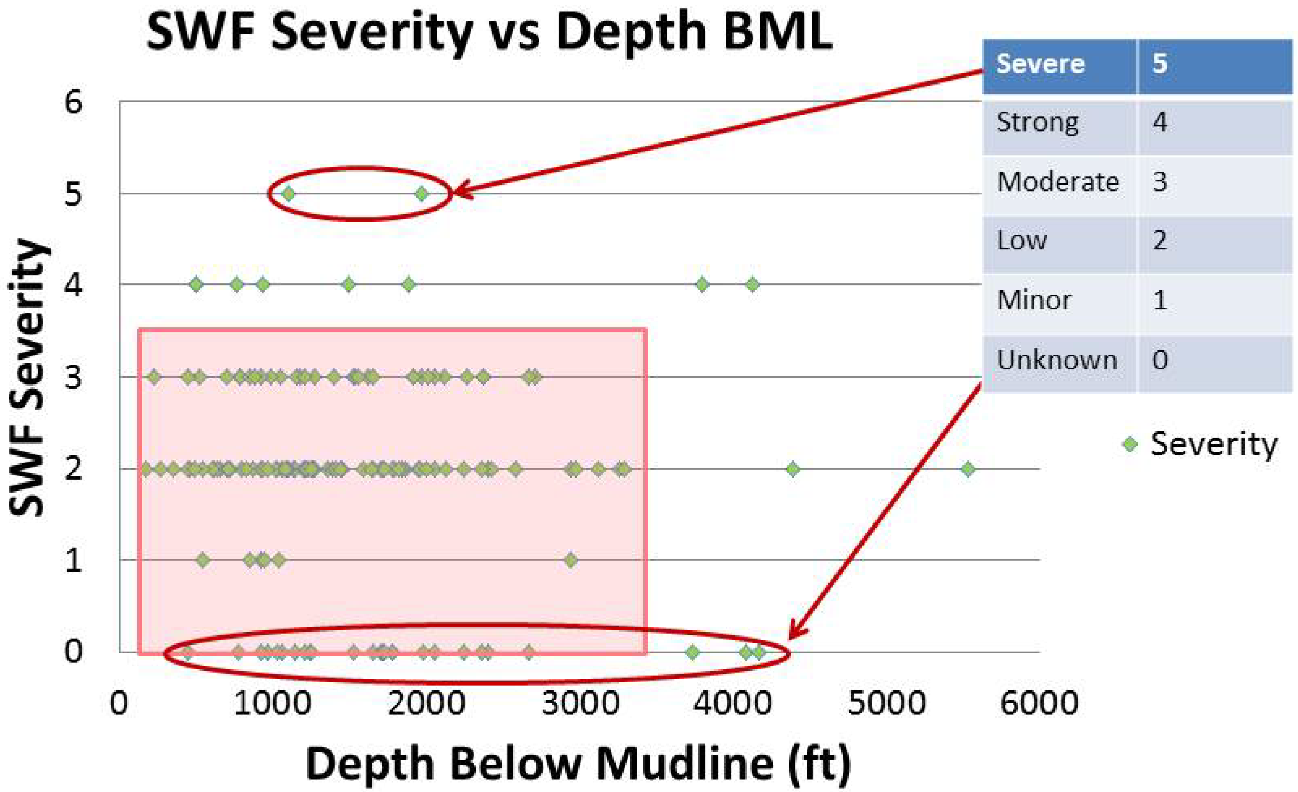
2016 SWF in Green Canyon



Strong Flow

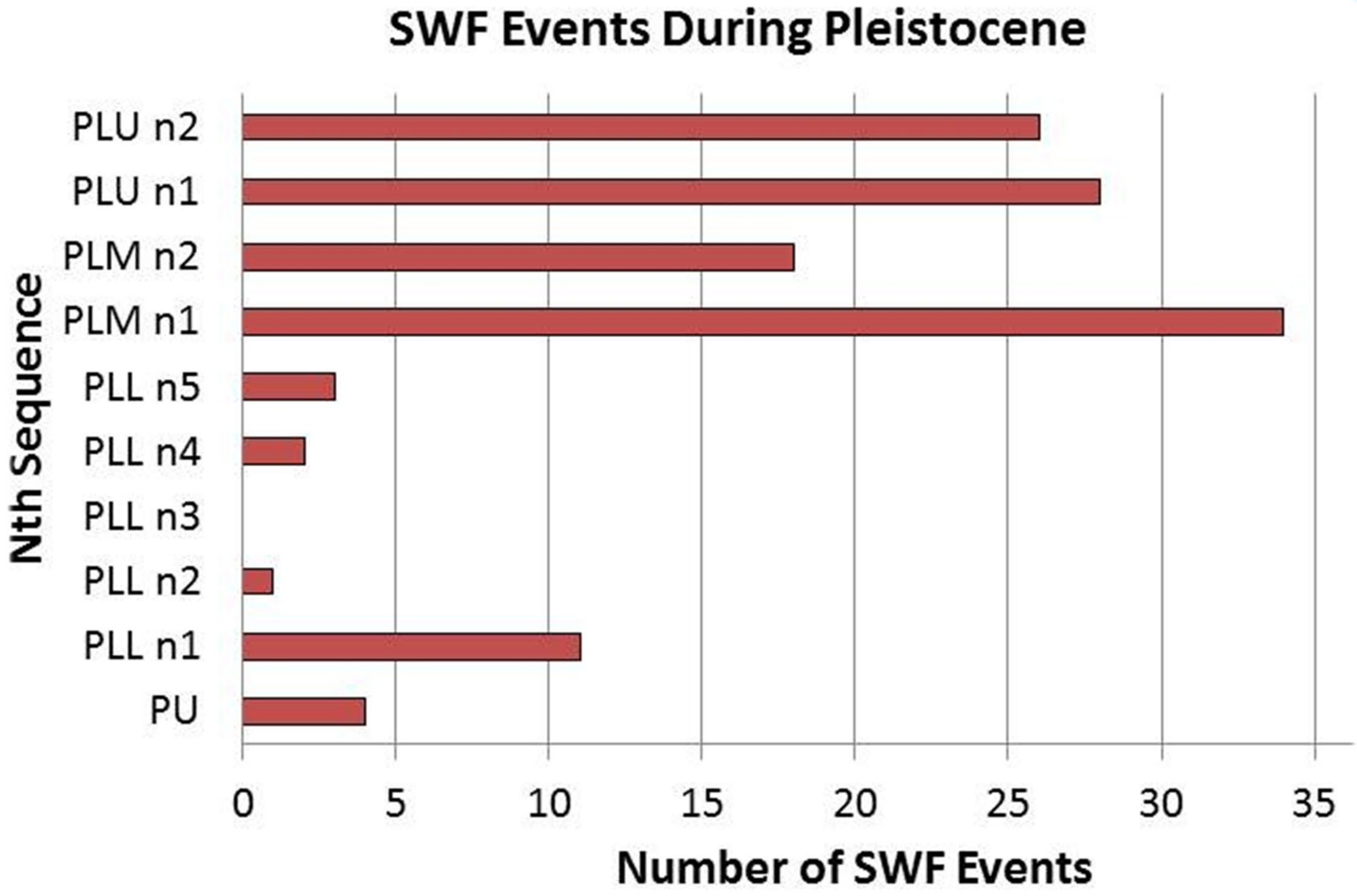
Where do SWFs occur?

- In GOM SWFs occur in water deeper than 600 ft (200 m) and depths below mudline between 300 ft (91 m) and 3,500 ft (1,066 m).
- Two SWF hot spots in GOM are in southwest MC and northeast GC.

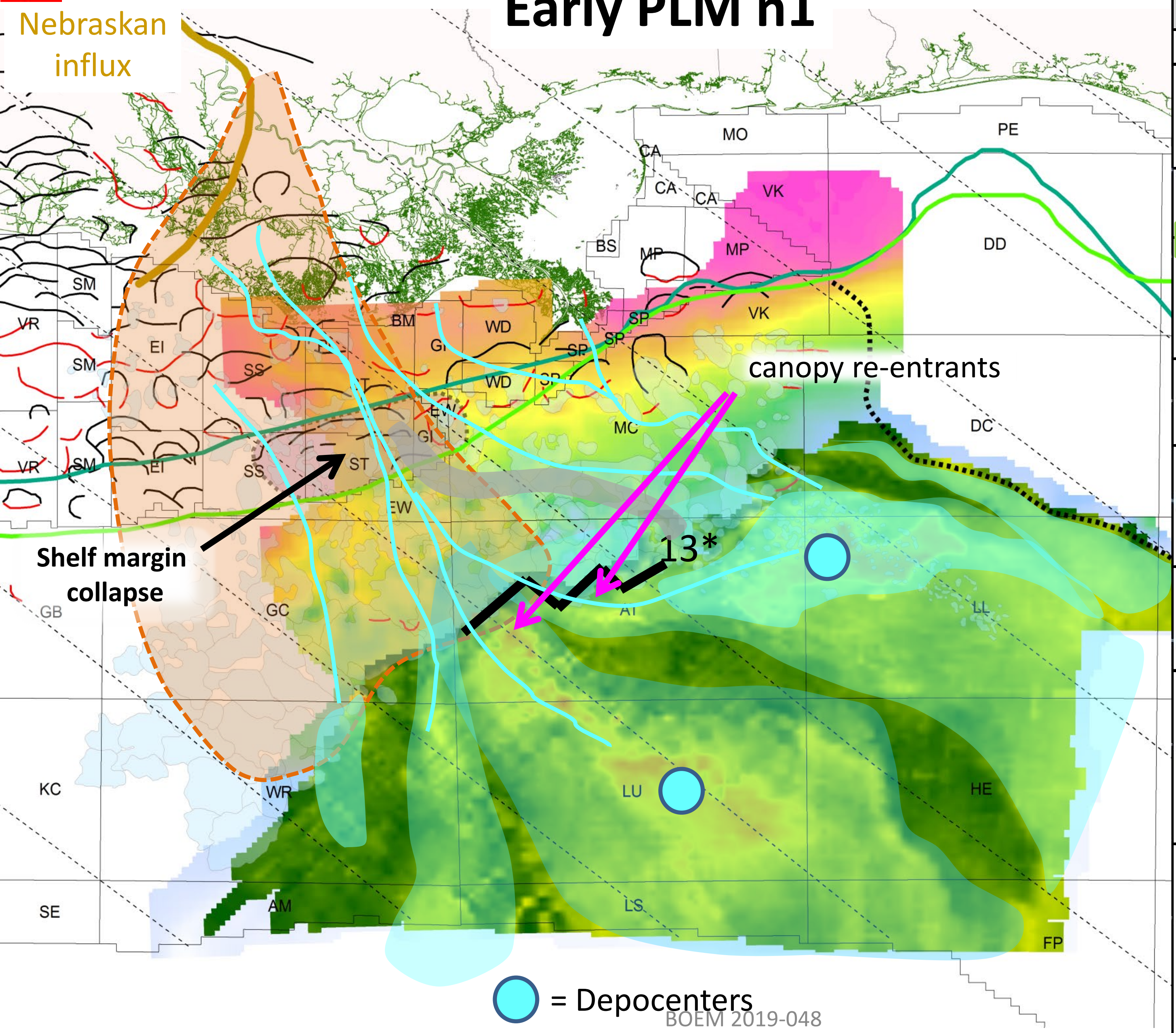


Severe	5
Strong	4
Moderate	3
Low	2
Minor	1
Unknown	0

Temporal Distribution of SWFs



Early PLM n1



● = Depocenters

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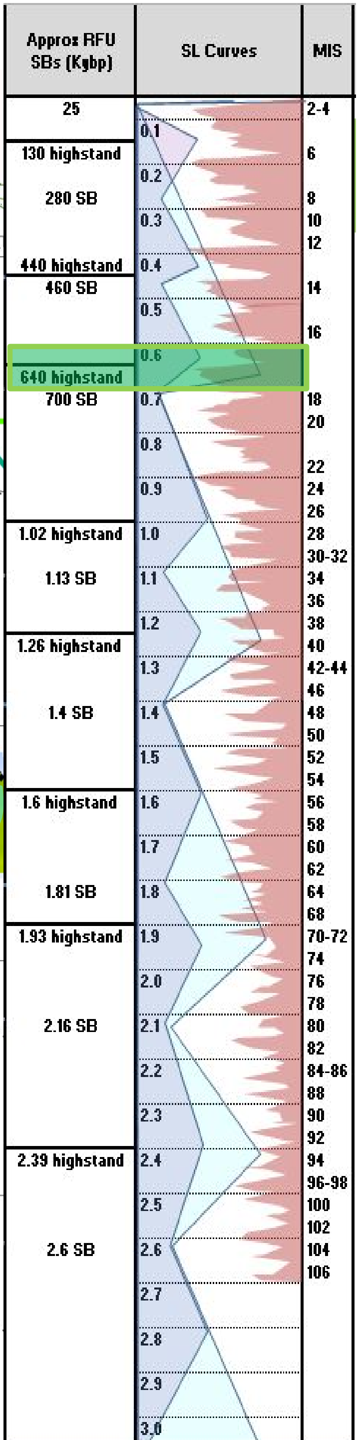
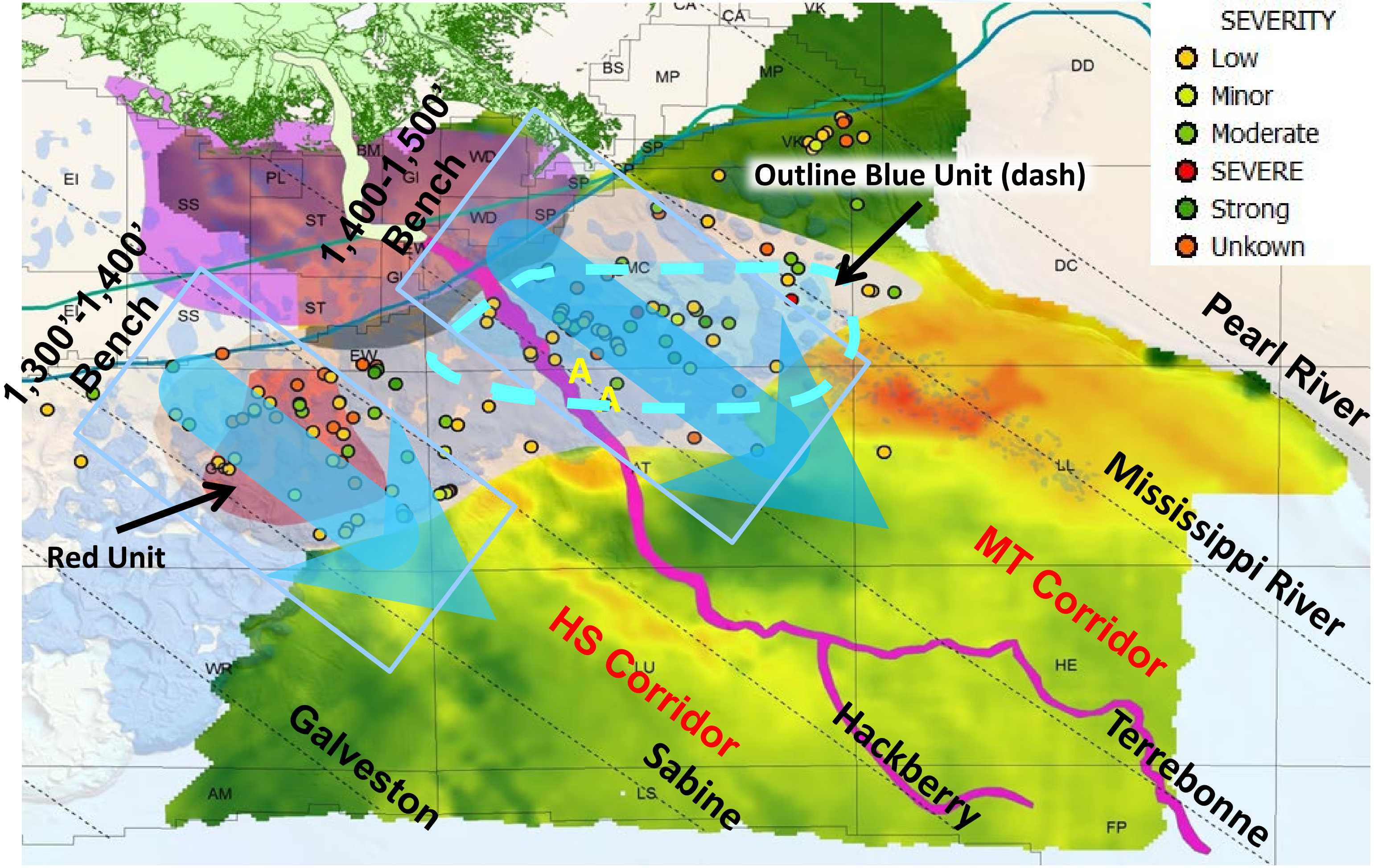


Spatial Distribution of SWFs

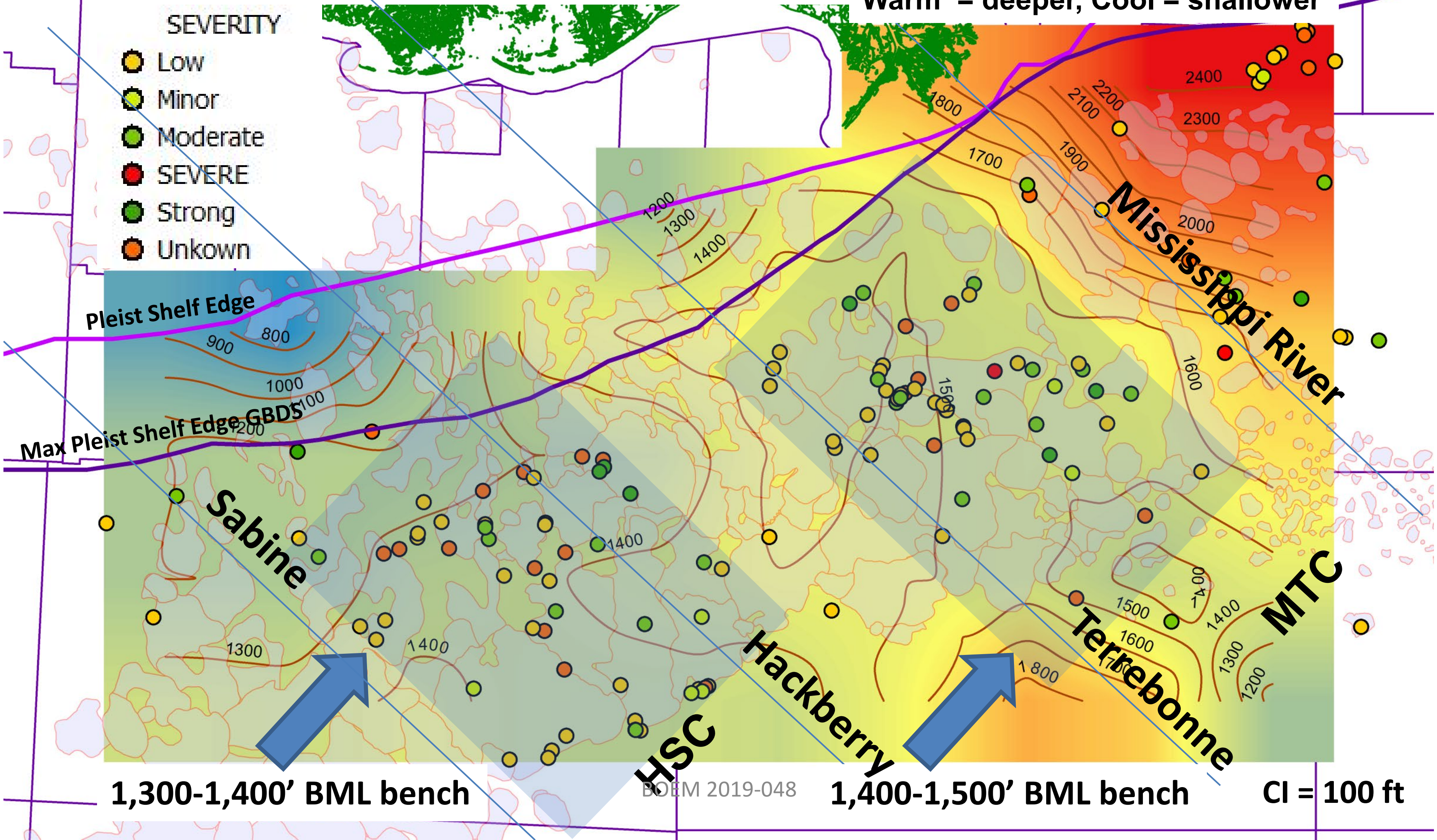
MC and GC SWFs conform to guidance by transfer fault-bounded structural corridors



Depth of Shallow Water Flows BML (ft)

- Spatially, MC and GC populations occur in two benches ~1,300-1,500 ft (400-460 m) BML.
- Stratigraphically, each population ~100 to 150-ft-thick (30-45 m), separated vertically by ~100 ft (30 m).

Warm = deeper, Cool = shallower



1,300-1,400’ BML bench

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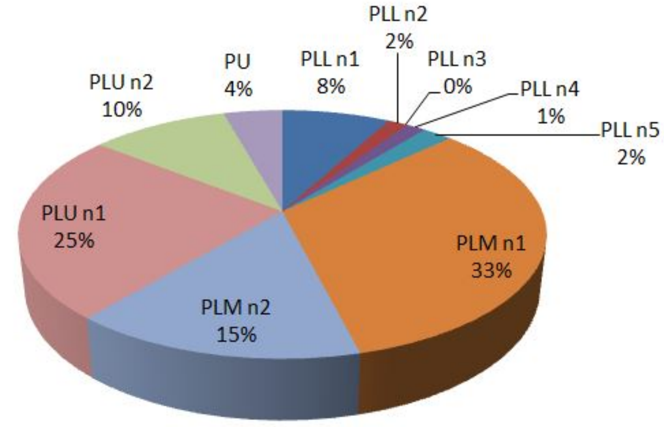
1,400-1,500’ BML bench

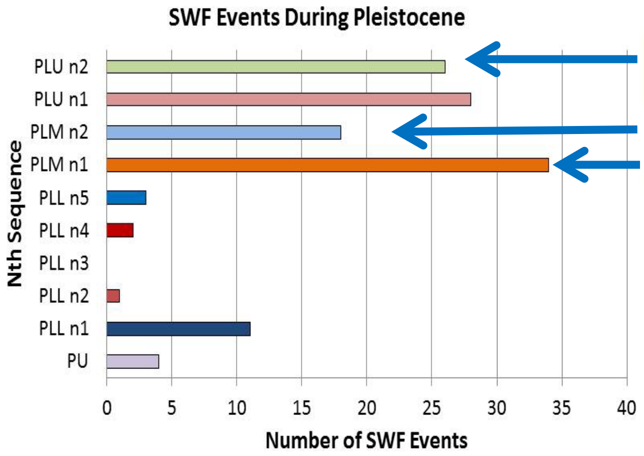
CI = 100 ft

Conclusions

1. About half of the SWF events are Middle Pleistocene (PLM n1 & PLM n2) and a third are Late Pleistocene (PLU n1 & PLU n2).



Percent SWFs per Nth Order Sequence

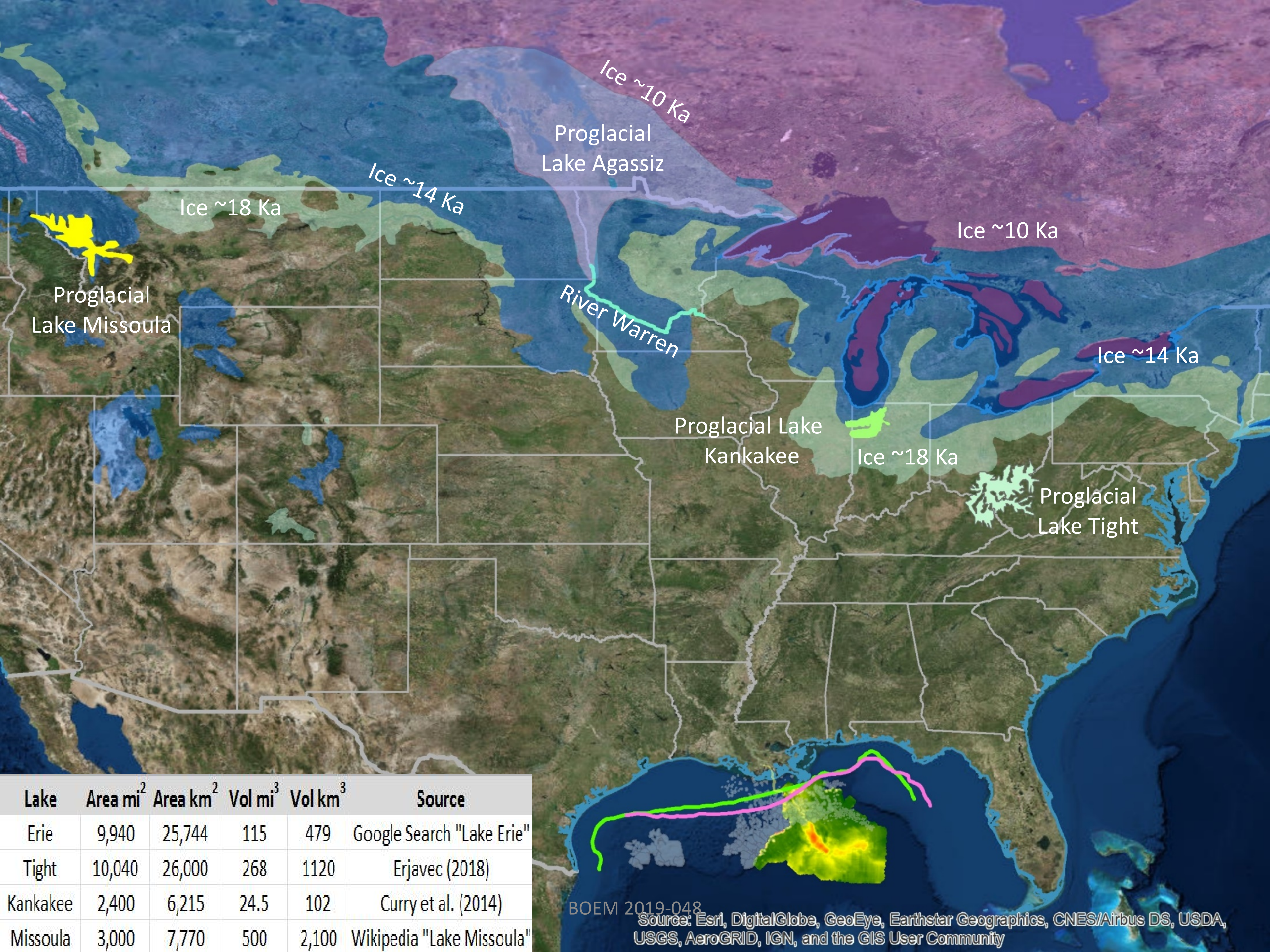


~ 19-11 Ka Lakes Kankakee and Agassiz

~ 440-400 Ka Blue Unit

~ 780-460 Ka Lake Tight

2. Destabilization of the Pleistocene shelf margin ~700 Ka and influx by proglacial Lake Tight set conditions for Middle Pleistocene SWFs.
3. The PLU n1 high follows unification of Missouri-Mississippi catchments.
4. Proglacial lakes Kankakee and Agassiz set conditions for the Latest Pleistocene SWFs.



Lake	Area mi^2	Area km^2	Vol mi^3	Vol km^3	Source
Erie	9,940	25,744	115	479	Google Search "Lake Erie"
Tight	10,040	26,000	268	1120	Erjavec (2018)
Kankakee	2,400	6,215	24.5	102	Curry et al. (2014)
Missoula	3,000	7,770	500	2,100	Wikipedia "Lake Missoula"

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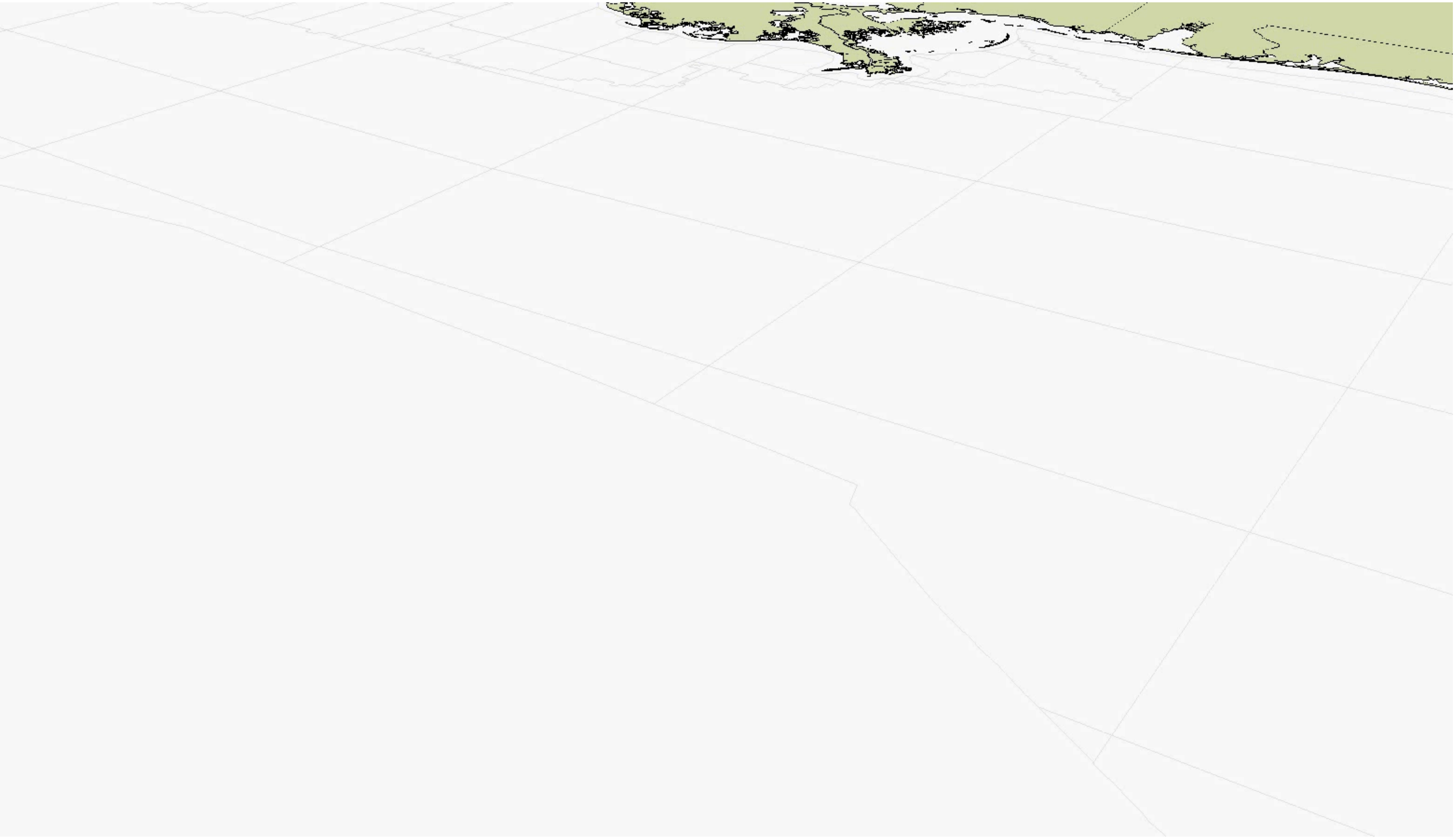
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- 1st Surface is Structure on base of PLM n1, approx 700 Ka
- Overlying this surface are isopach rasters of early, middle, and late PML n1
- Note MTDs in the Eastern Fan, warmer = thicker



- **Surface is time structure on base of PLM n1, approx 700 Ka, overlain by isopach color raster of PML n1 units; warmer = thicker**
- **Animation tracks up the Eastern Mississippi Fan to the NW toward the collapsed Pleistocene margin**
- **Cloud of SWF events are roughly in stratigraphic relationship with PLM n1 surface**

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