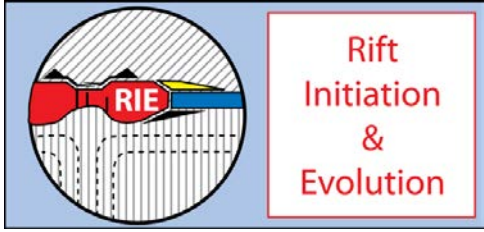

Offshore Active Processes and Hazards

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B. Dugan (Rice University), M. Hornbach (SMU)

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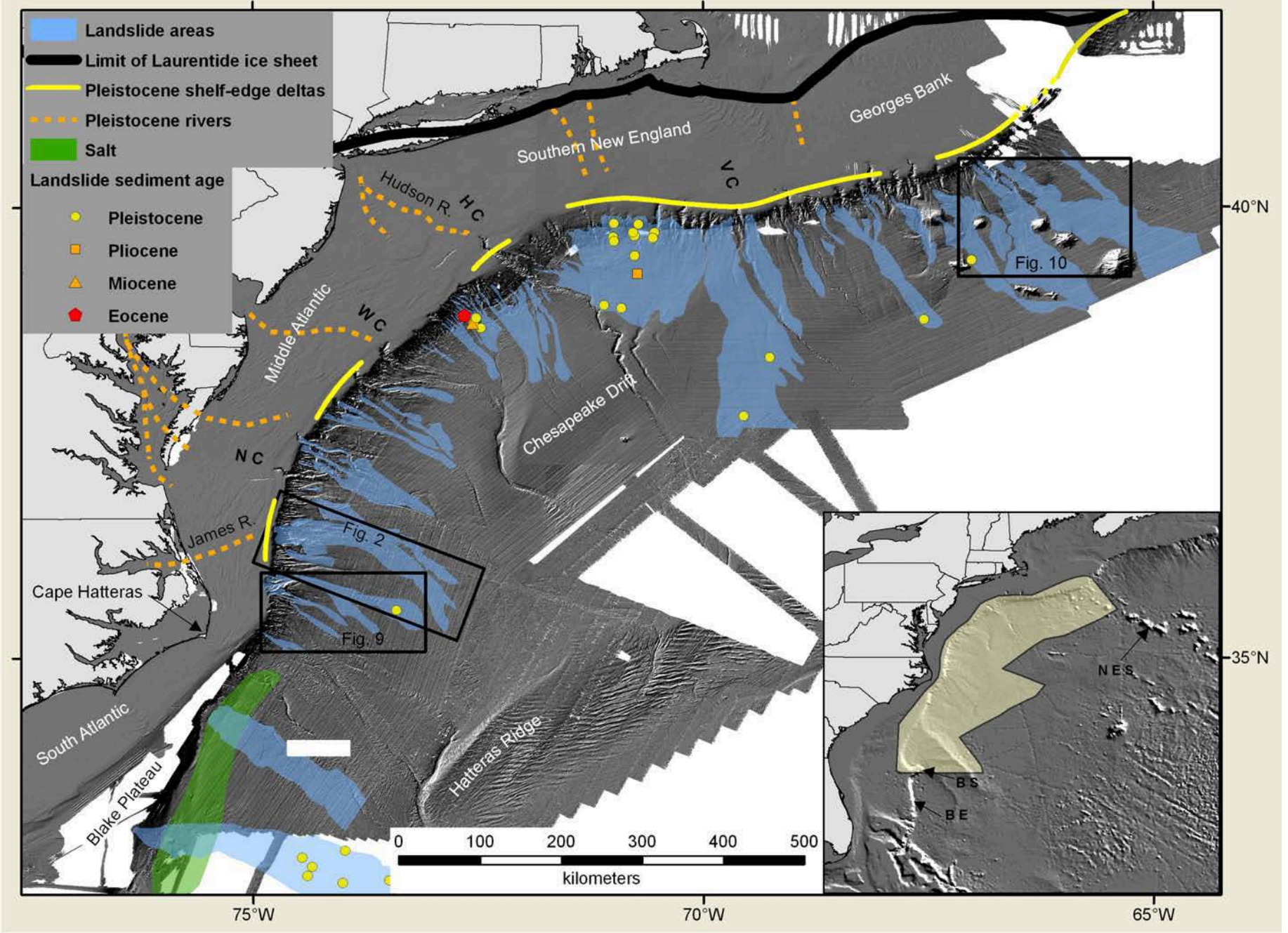
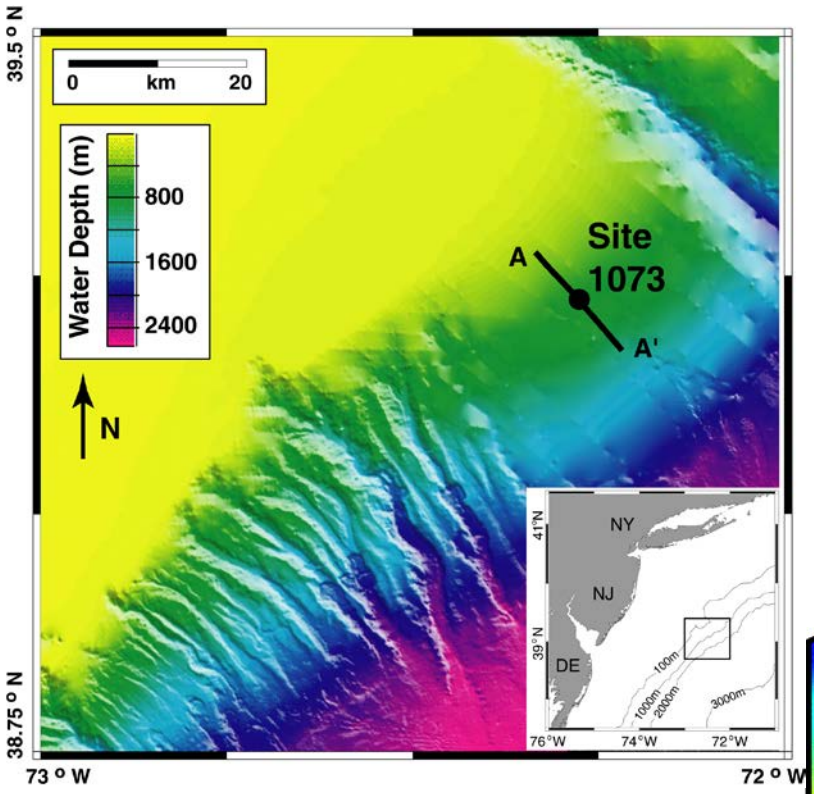
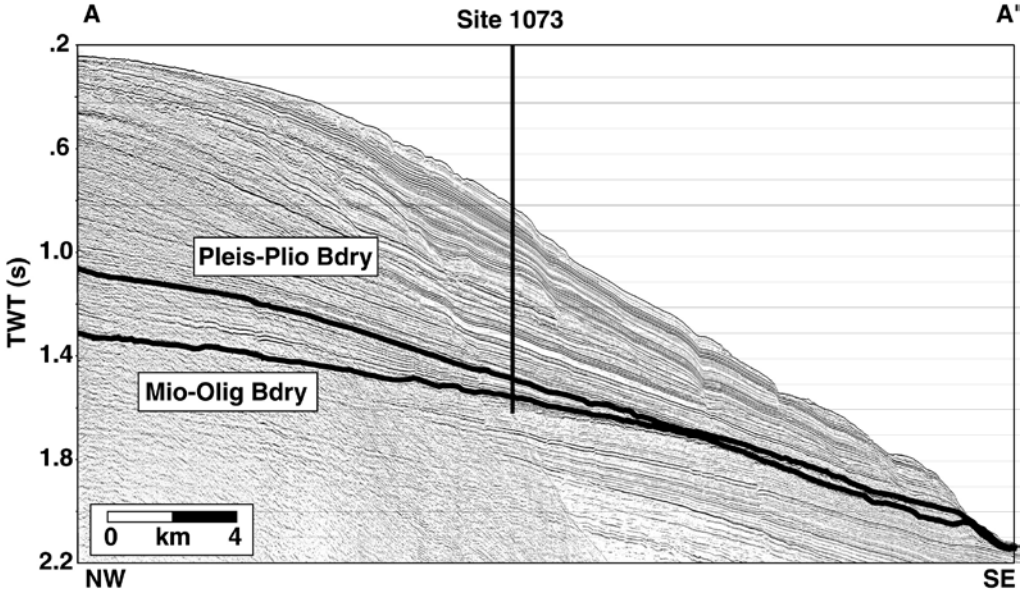
Key Points

- Landslides and Sea Floor Venting
  –Geohazards, Carbon Cycle
- Impact ‘architecture of continental margins’ and ‘fluids and volatiles’
- Developing a process-understanding
- Understanding can be tested through direct observation

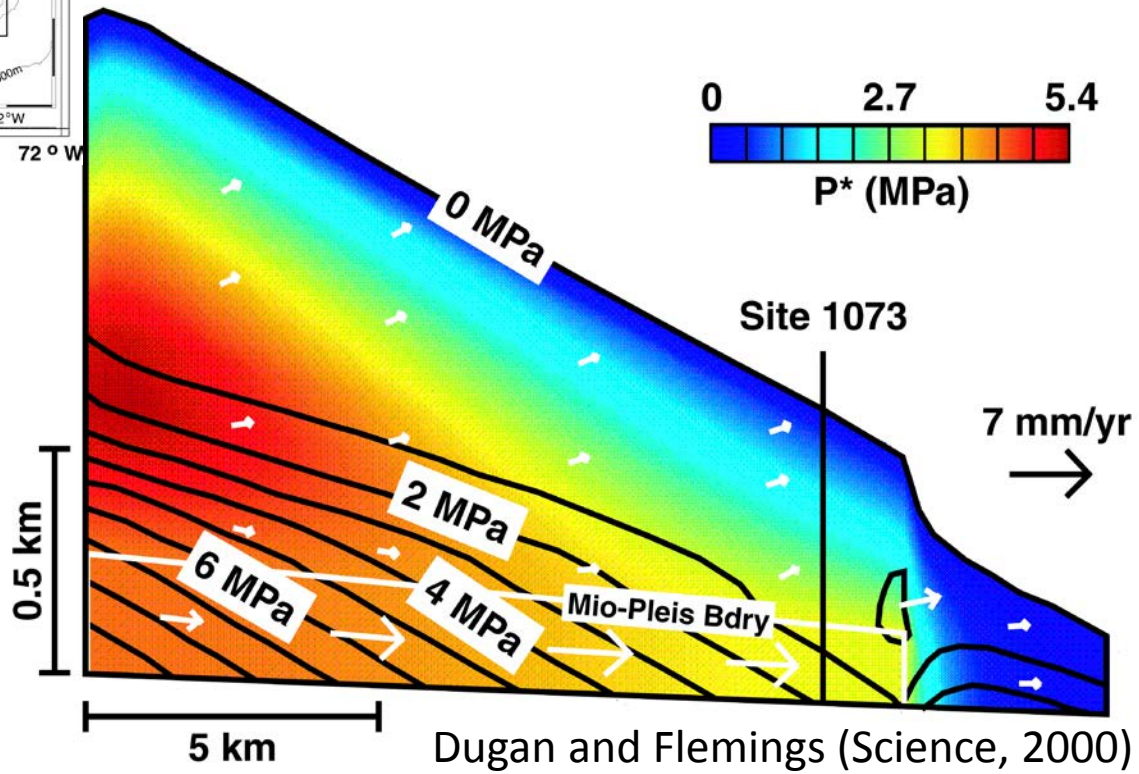


Twichell et al., (2009)

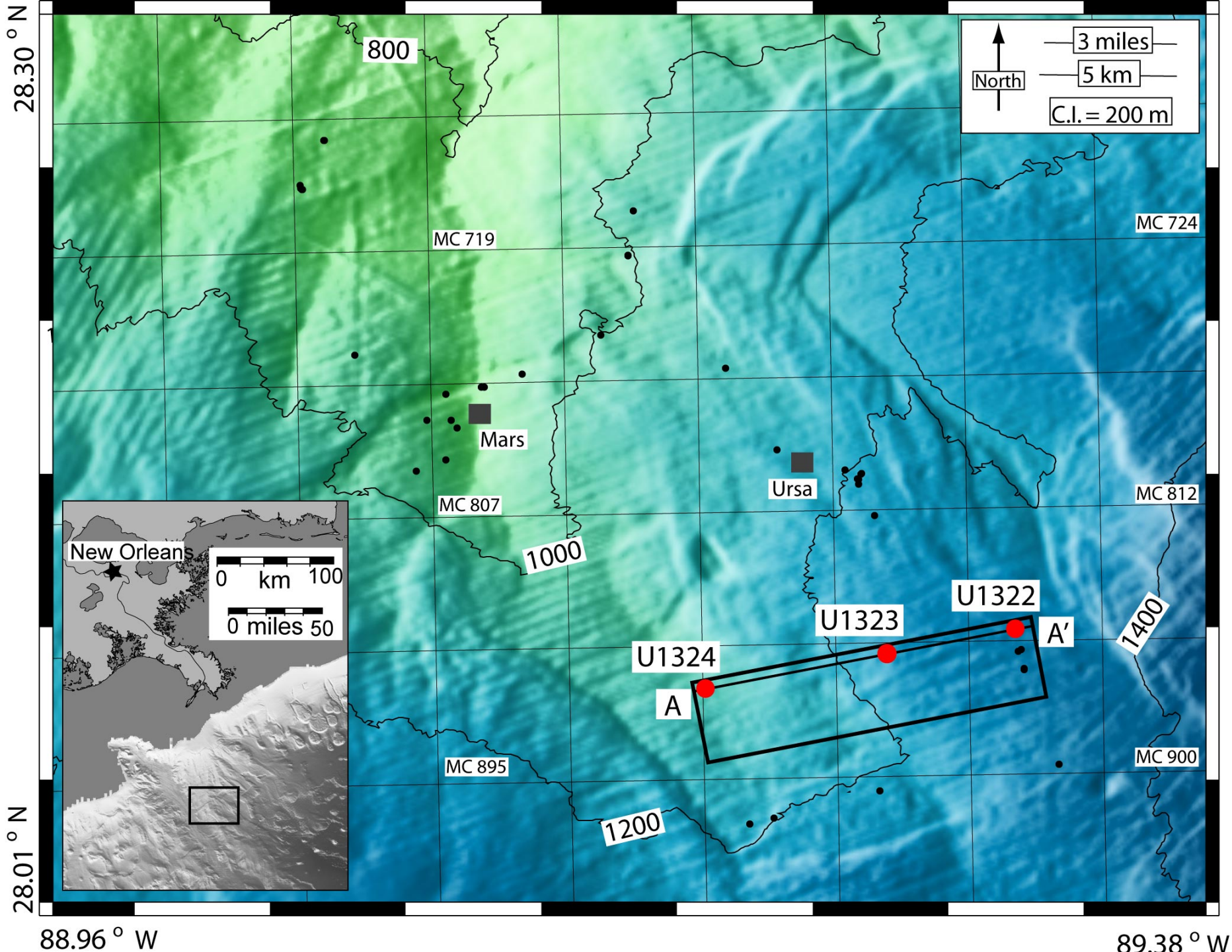


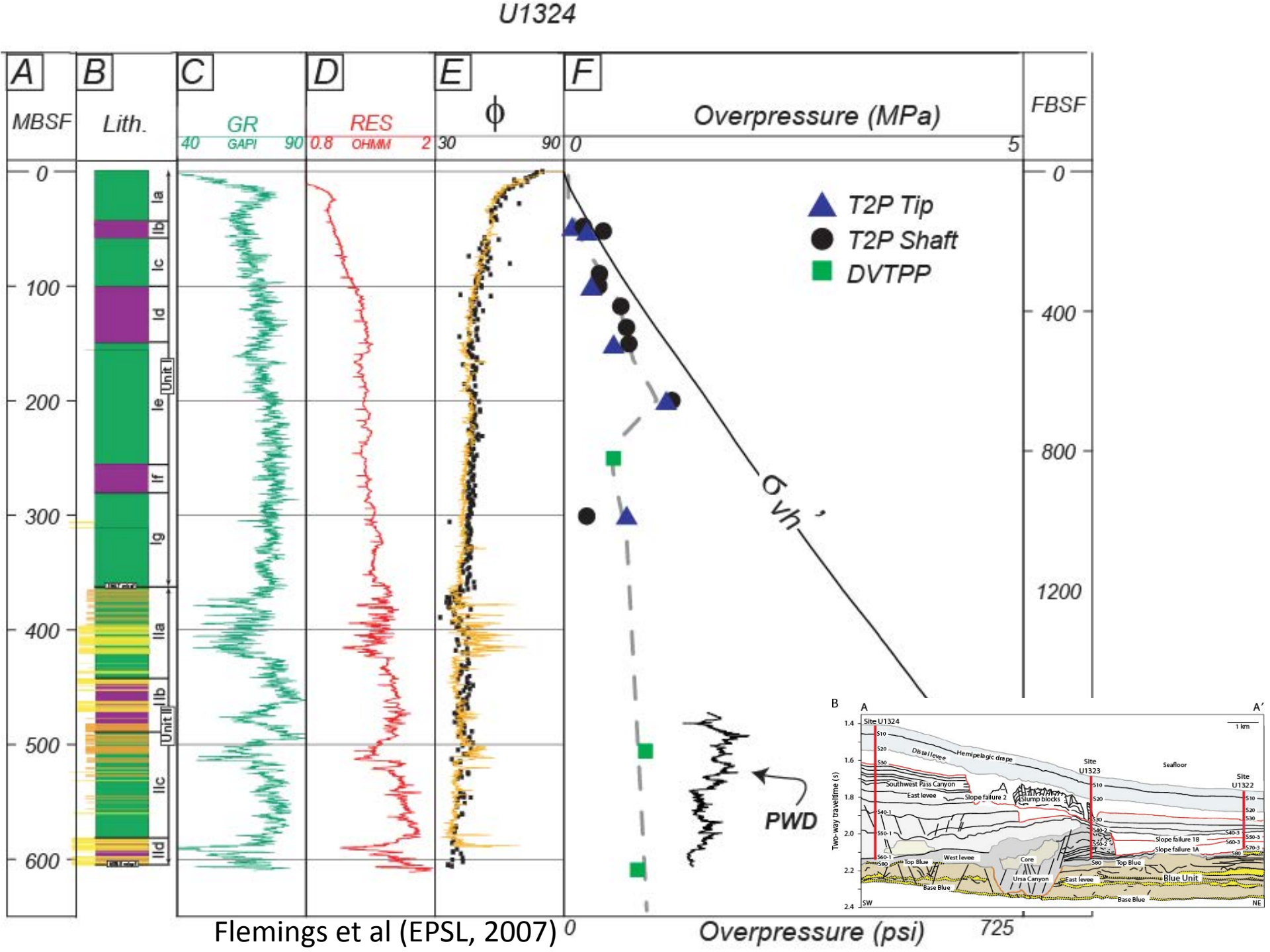


Sedimentation>
Lateral Flow>
Slope Failure

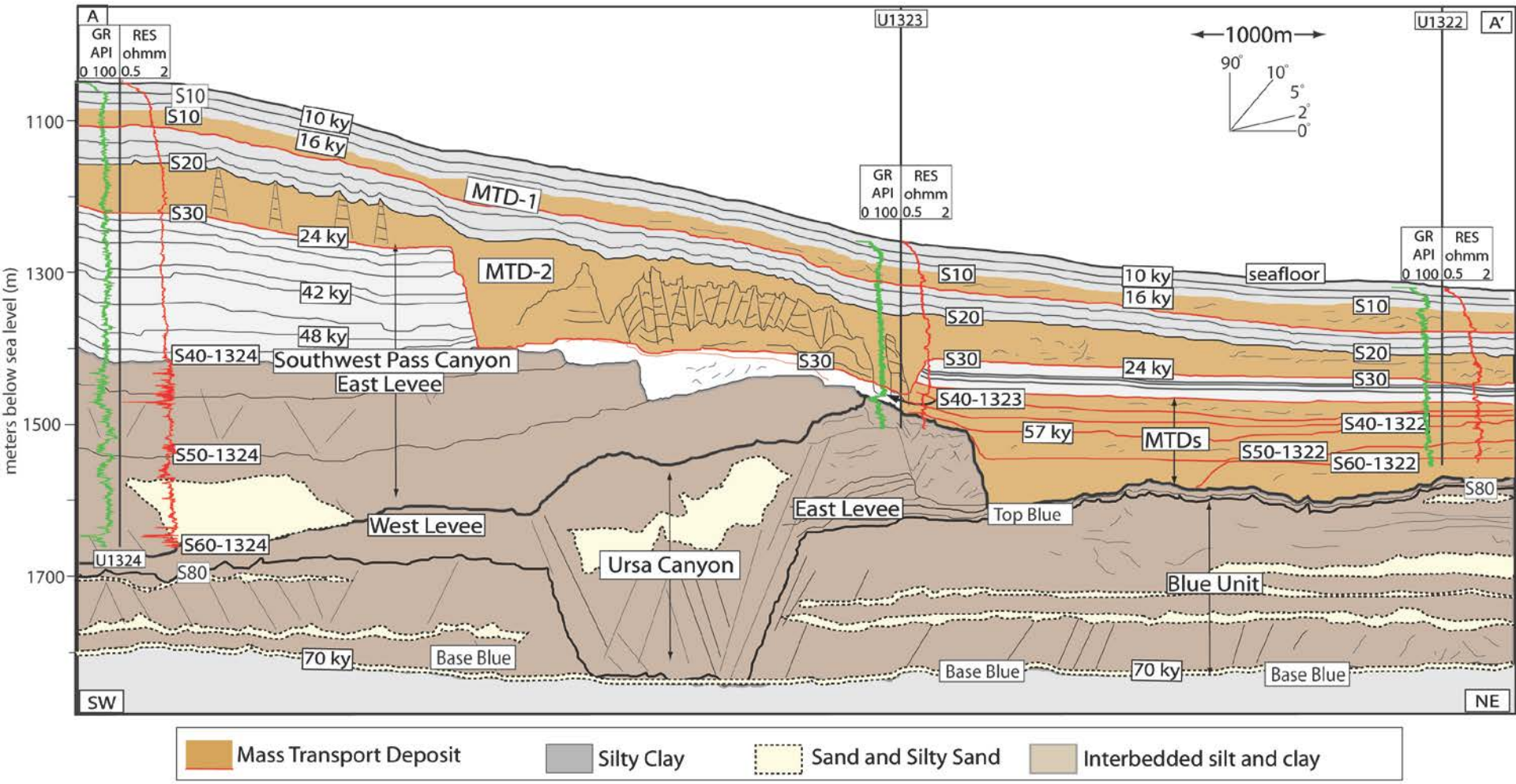


Dugan and Flemings (Science, 2000)

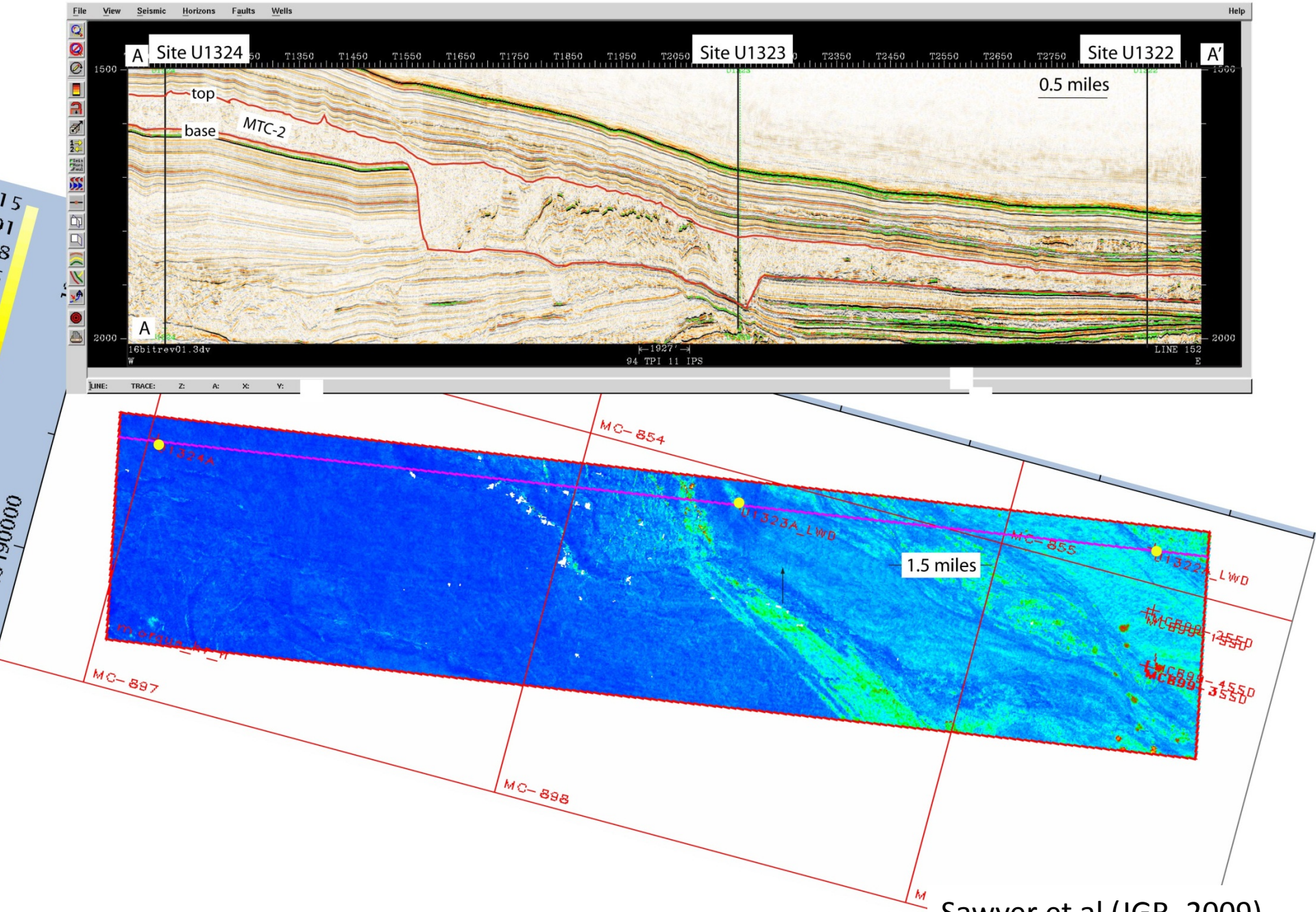

28.30 ° N
28.01 ° N
88.96 ° W
89.38 ° W
North
3 miles
5 km
C.I. = 200 m
800
MC 719
MC 724
Mars
Ursa
MC 807
MC 812
1000
1400
U1322
U1323
U1324
A
A′
MC 895
MC 900
1200
New Orleans
0 km 100
0 miles 50



Flemings et al (EPSL, 2007)



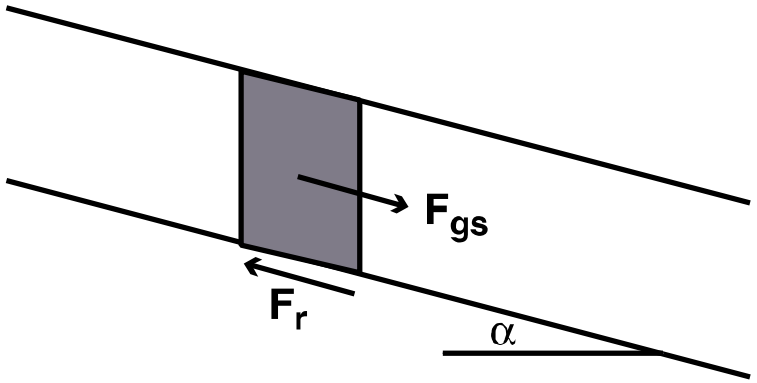
Sawyer et al (JGR, 2009)

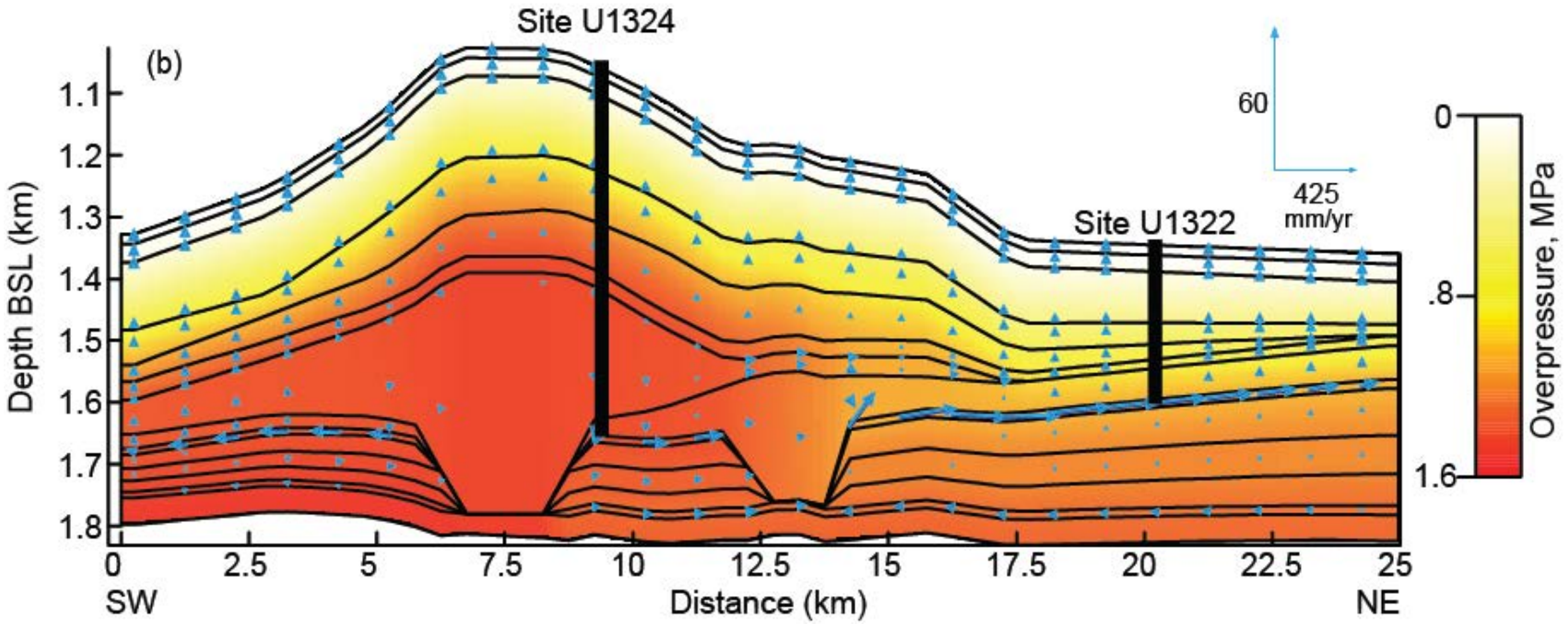


Sawyer et al (IGR, 2009)

$$FS = \frac{C + [(\sigma'_{vh} cos^2\theta) - P^*)] \tan \emptyset}{\sigma'_{vh} \cos\theta \sin\theta + F_{eq}}$$

Infinite Slope Analysis





Stigall and Dugan (JGR, 2009)

Earthquake stability map for MTD-2 at 27 k.y.

$$k_{crit} = \frac{c + [(\sigma'_{vh} cos^2\theta) - P^*)] \tan \emptyset_f - \sigma'_{vh} cos\theta sin\theta}{\sigma_v cos^2\theta}$$

Critical horizontal eq. acceleration

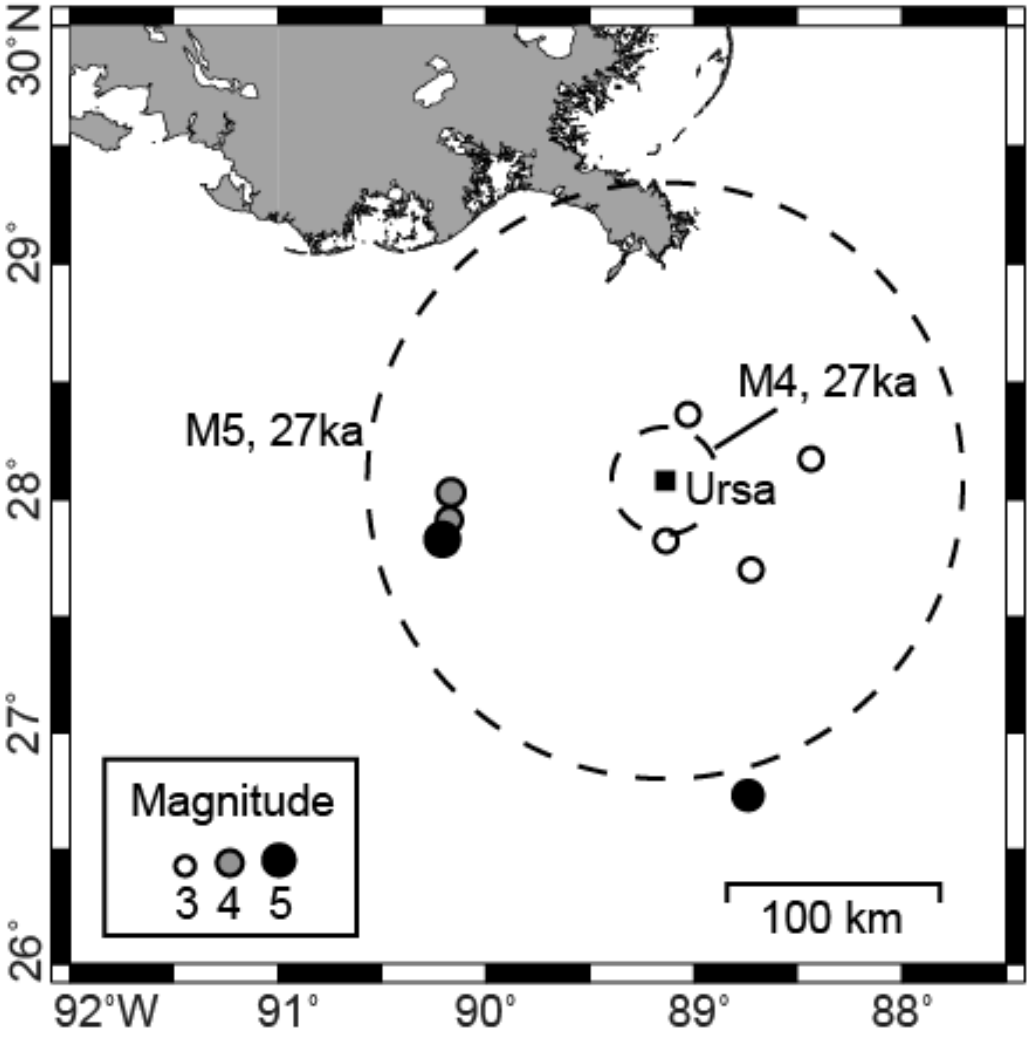
$$k_{psa} = \frac{k_{crit}}{0.15 * 3.5}$$

Peak spectral acceleration

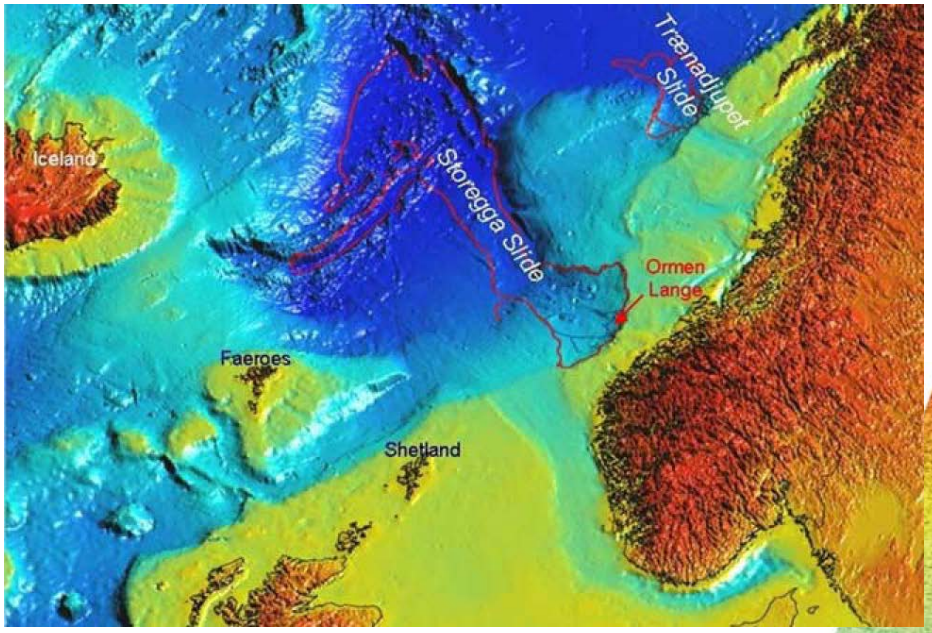
$$ln(k_{psa}) = c_1 + f_1(M) + f_2(M, r) + f_3(r)$$

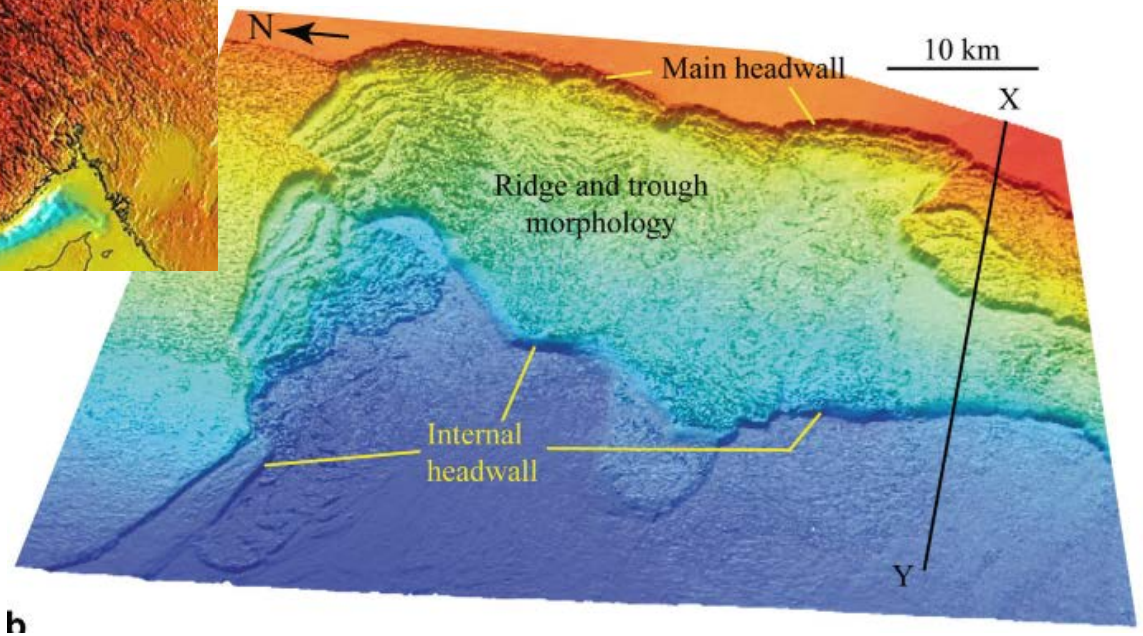
Seismicity (1973-2009) plotted as circles, (NEIC) database

Stigall and Dugan (JGR, 2009)

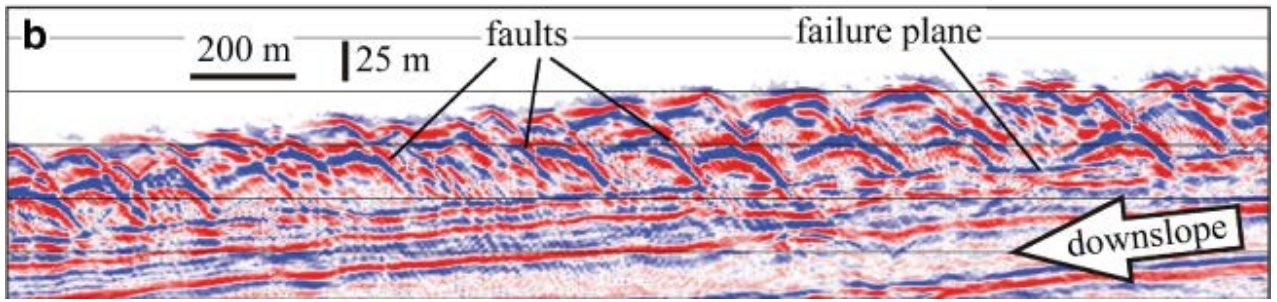


Storegga Slide

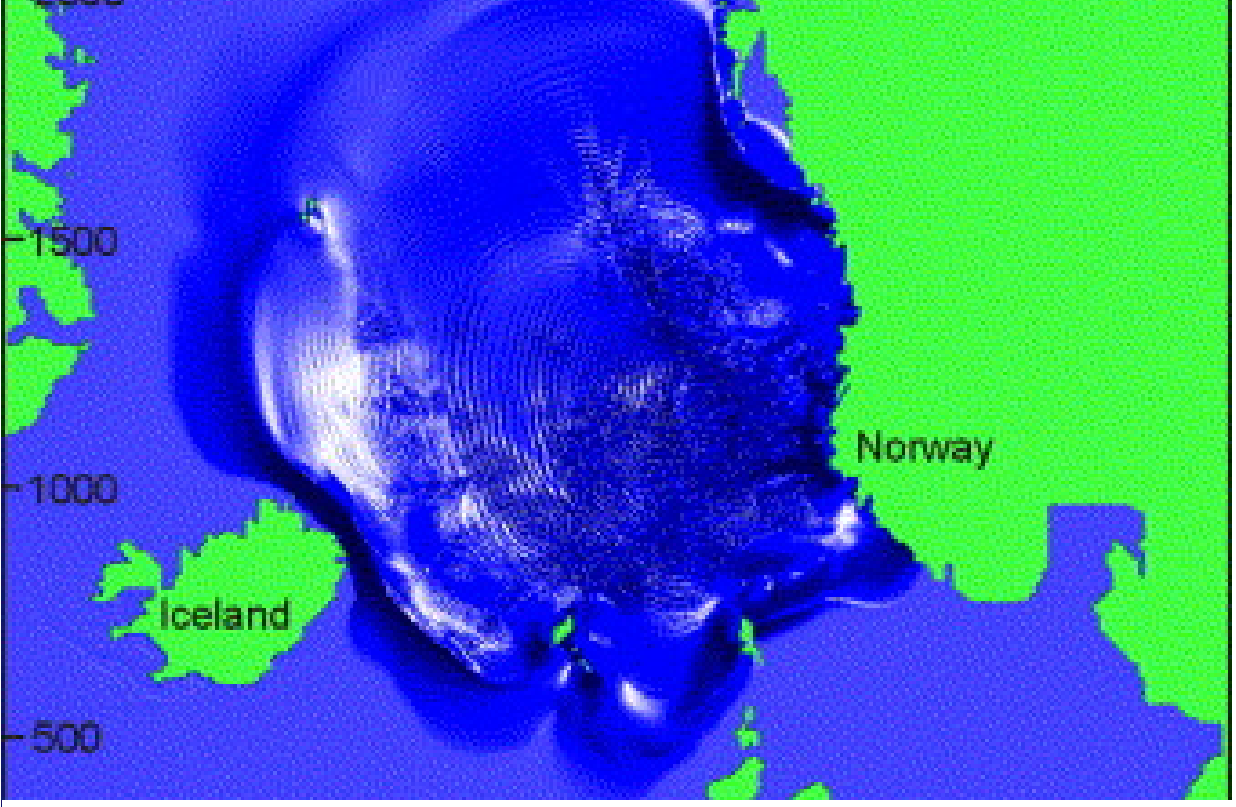


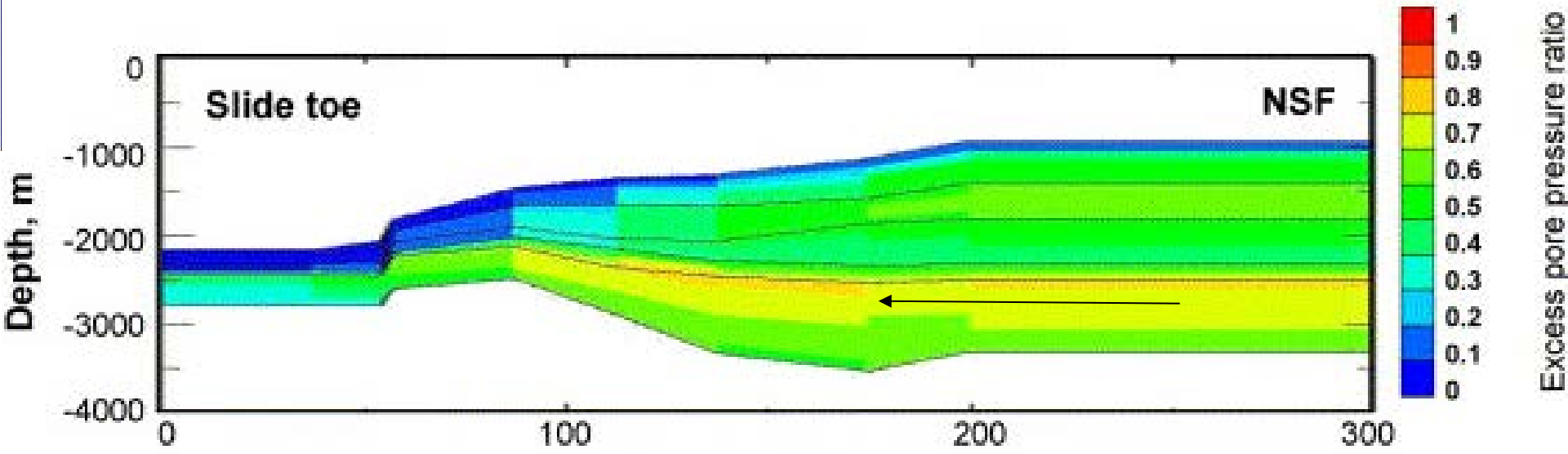


b



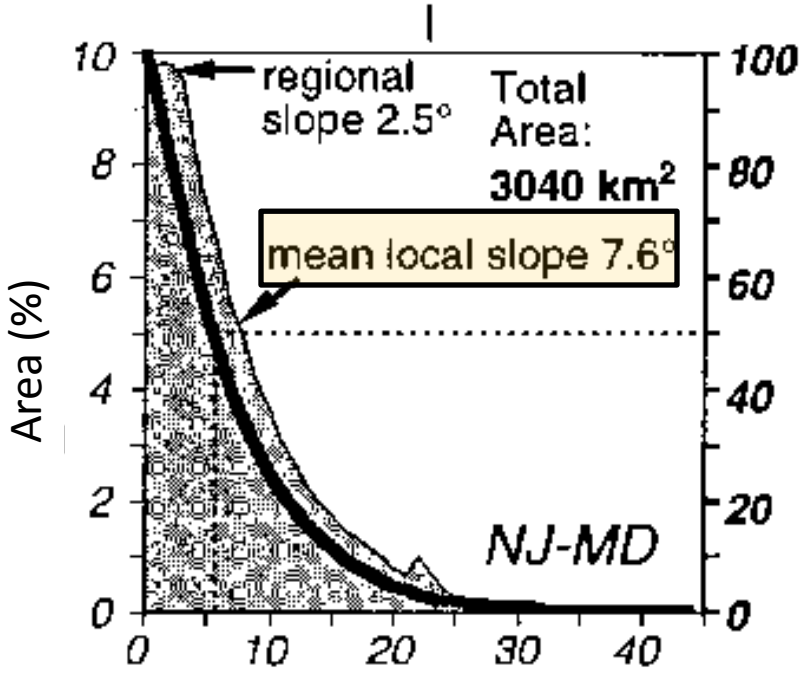
Kvalstad et al., 2005
Masson et al., 2010



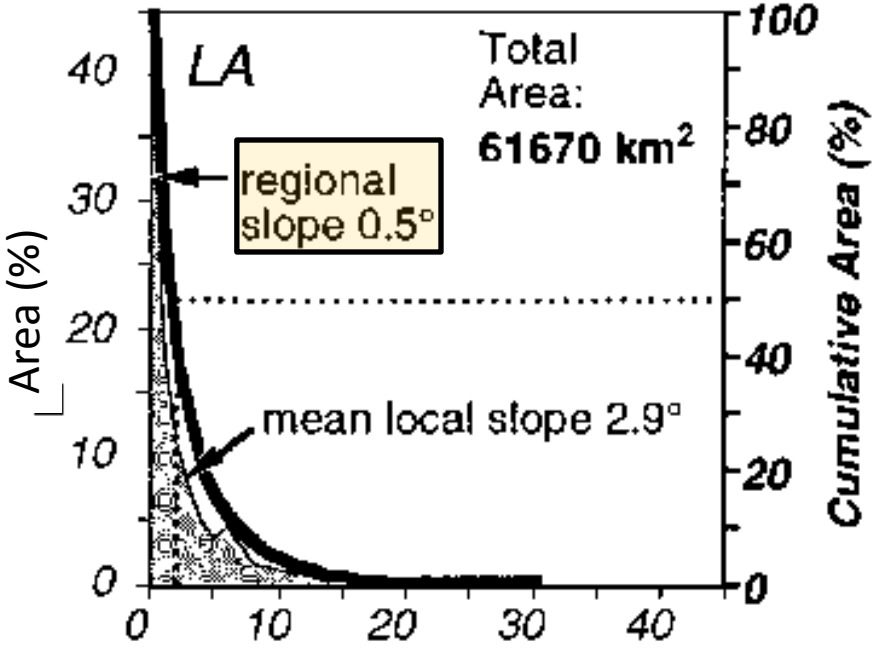


Kvalstad et al., 2005

Overpressure > Failure > Large-scale form of Continental Margins?



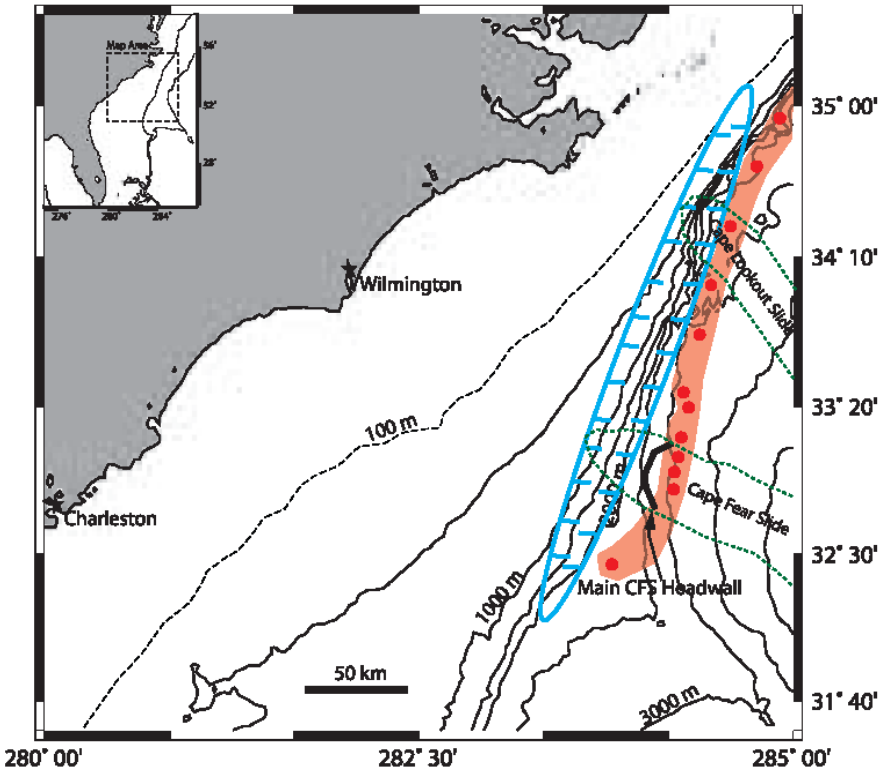
Atlantic Margin

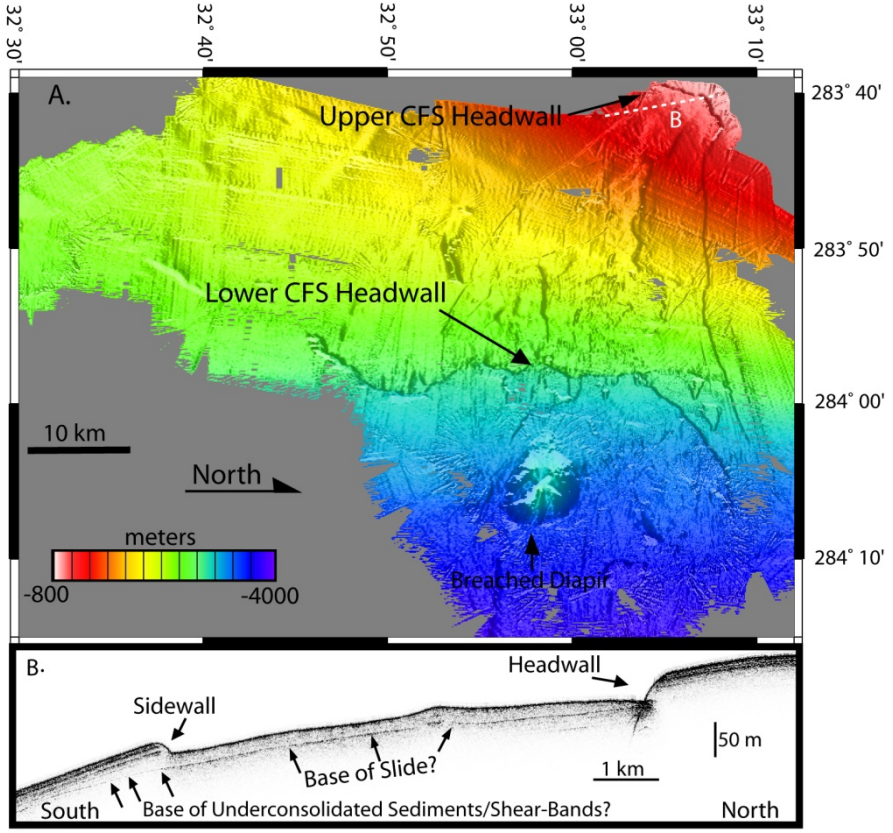


Gulf Coast Louisiana

(Pratson and Haxby, 1996)

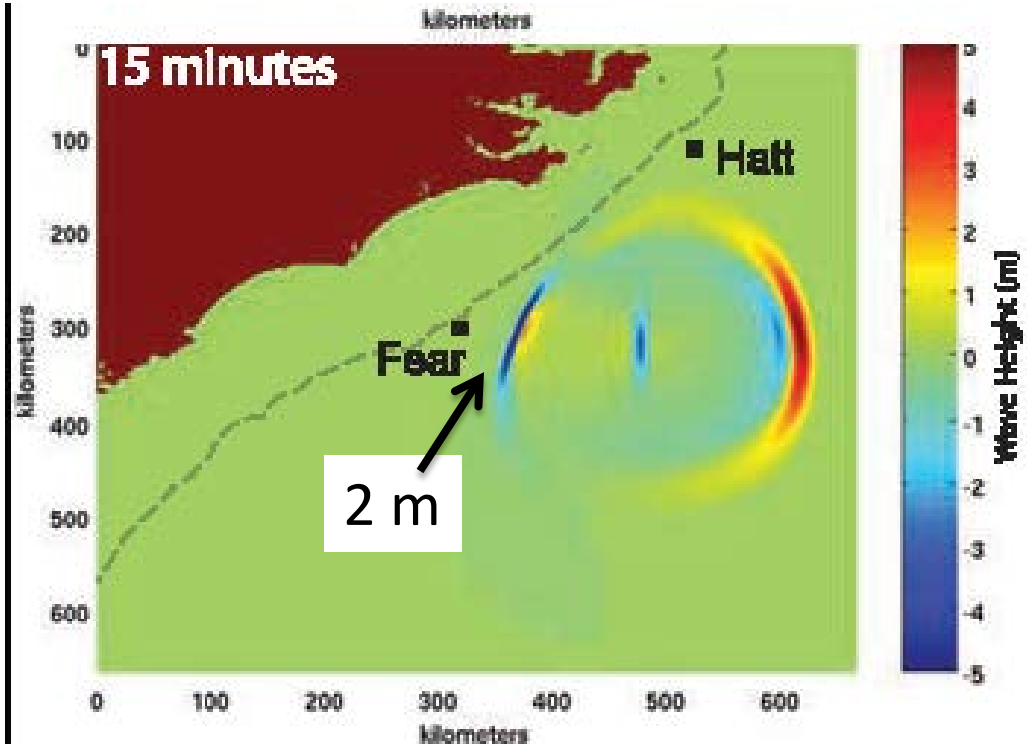
Cape Fear Slide complex, U.S. Atlantic margin

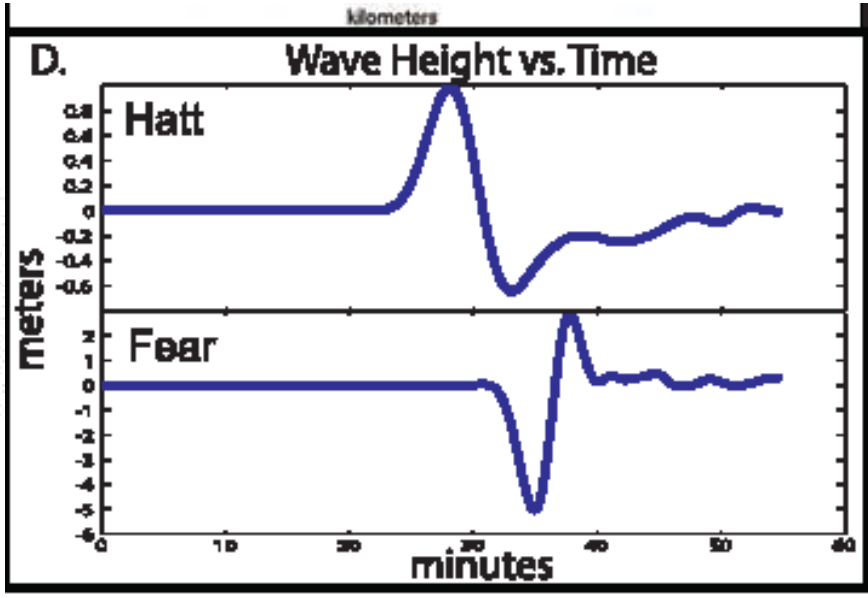




Hornbach et al. (G3, 2007)

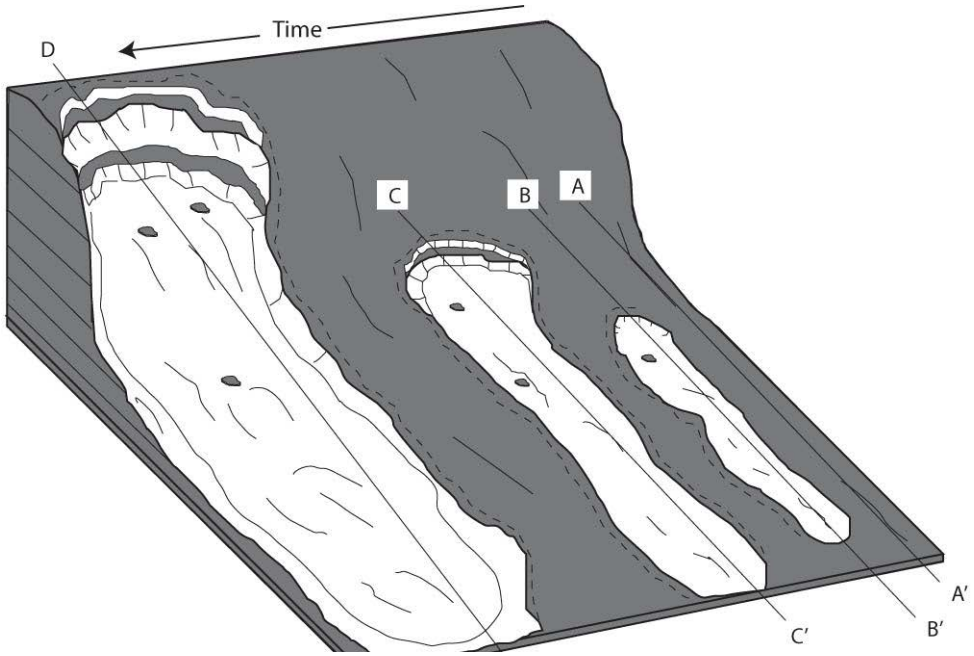
Simulated Cape Fear Tsunami (S4 event)



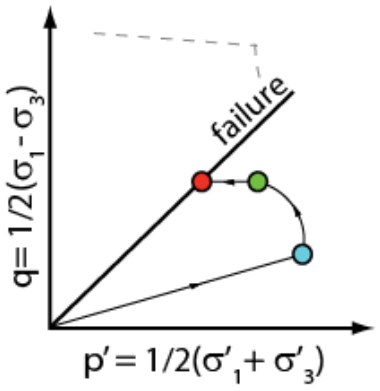


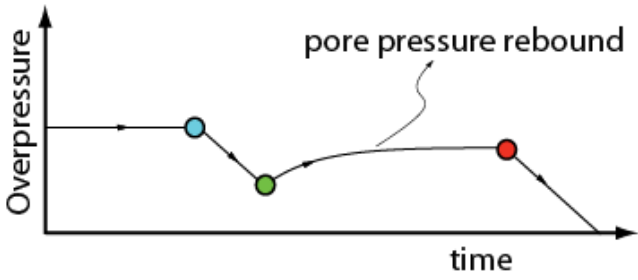
Hornbach et al. (G3, 2007)

Landslides



1) How initiated?
2) Many small or few big releases?
3) Rate?
4) How does record reflect seismic frequency prediction





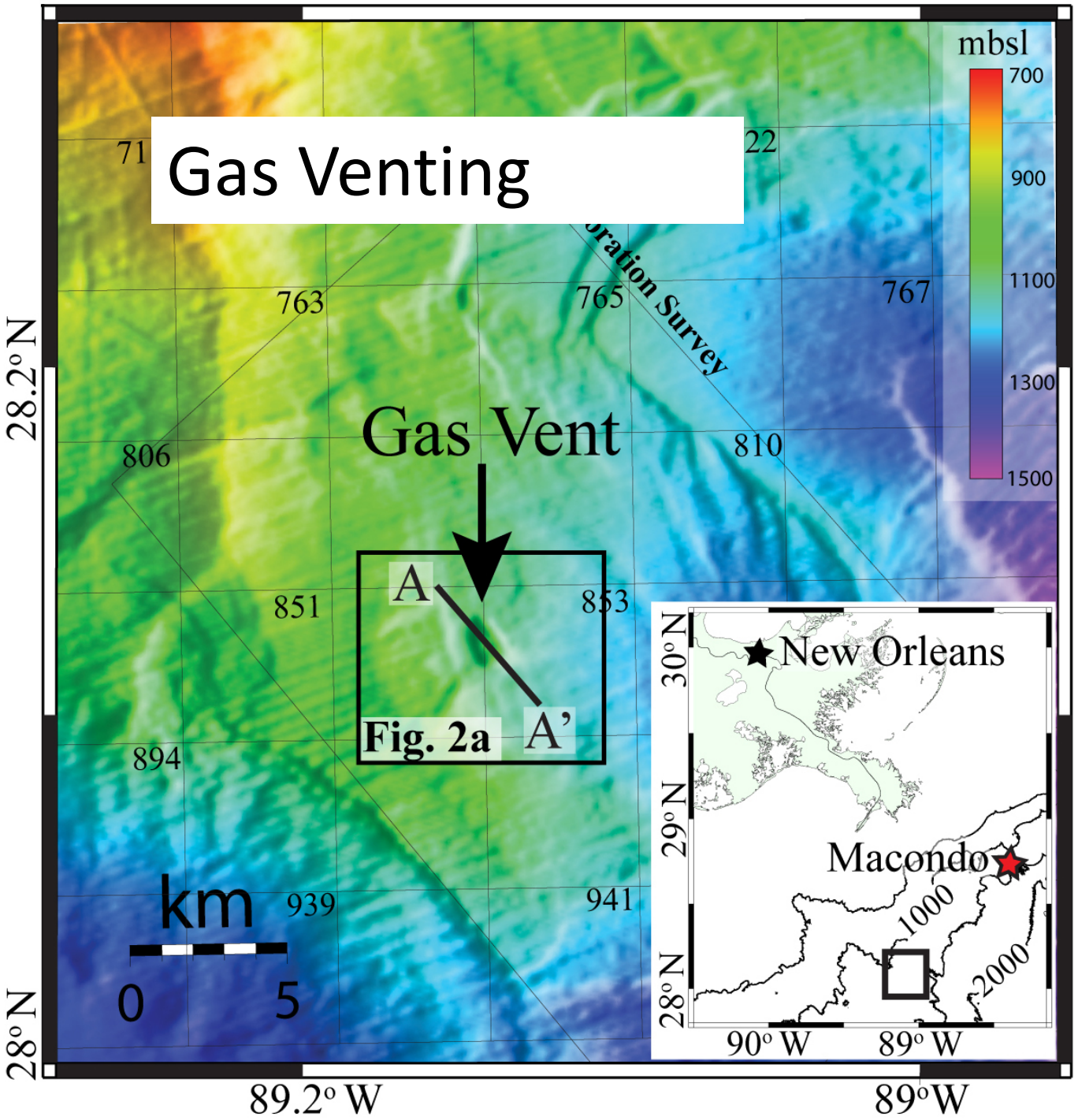
Understanding Submarine Landslides

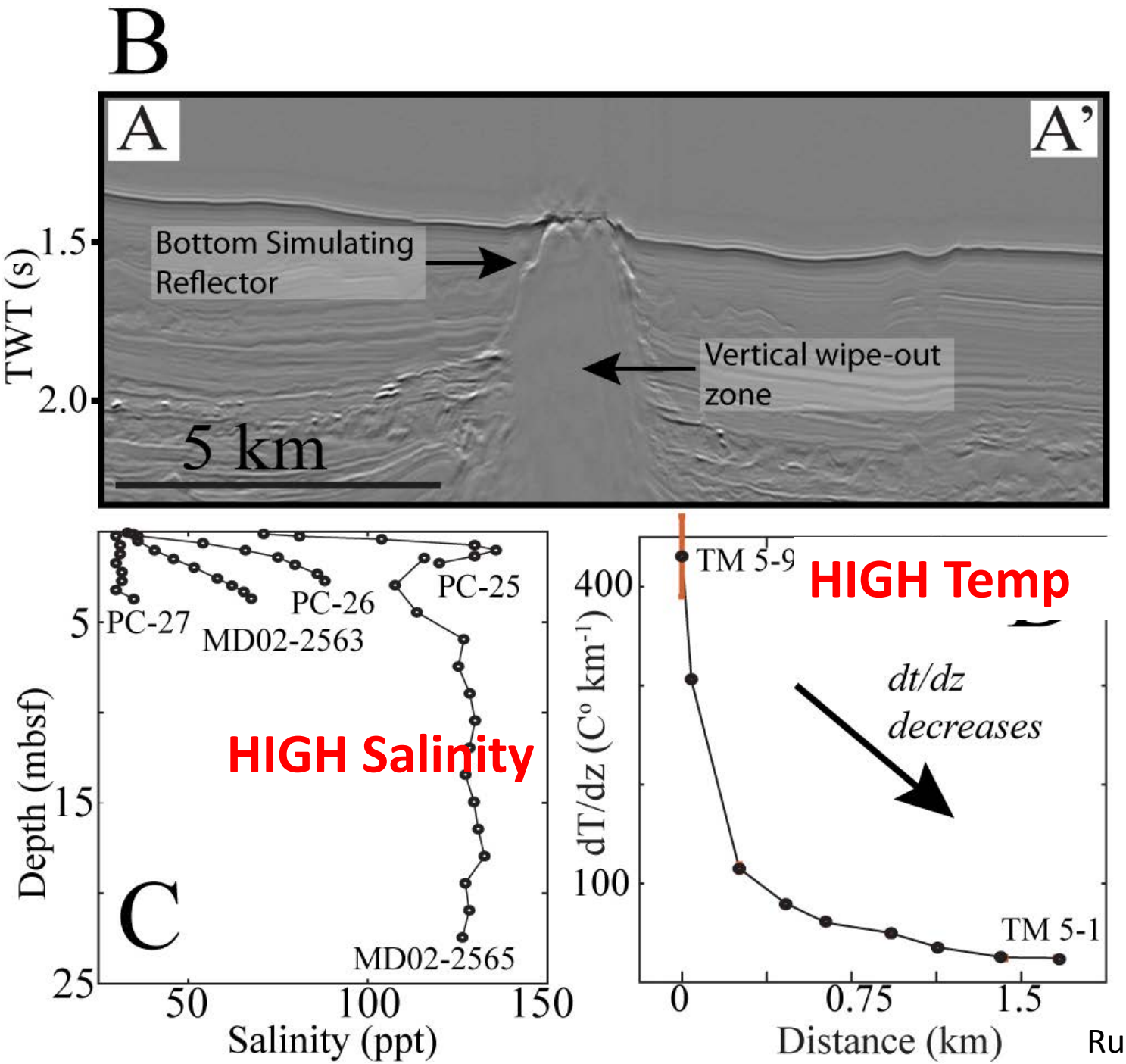
1) Short recorded history -- one slide generated event (1929 off Newfoundland)-- geohazard threat is real.

(2) Tsunami magnitude dependent on mechanics, magnitude, motion, and depth of the slide. Rough constraints on magnitude (size & depth); not the mechanics or motion.)

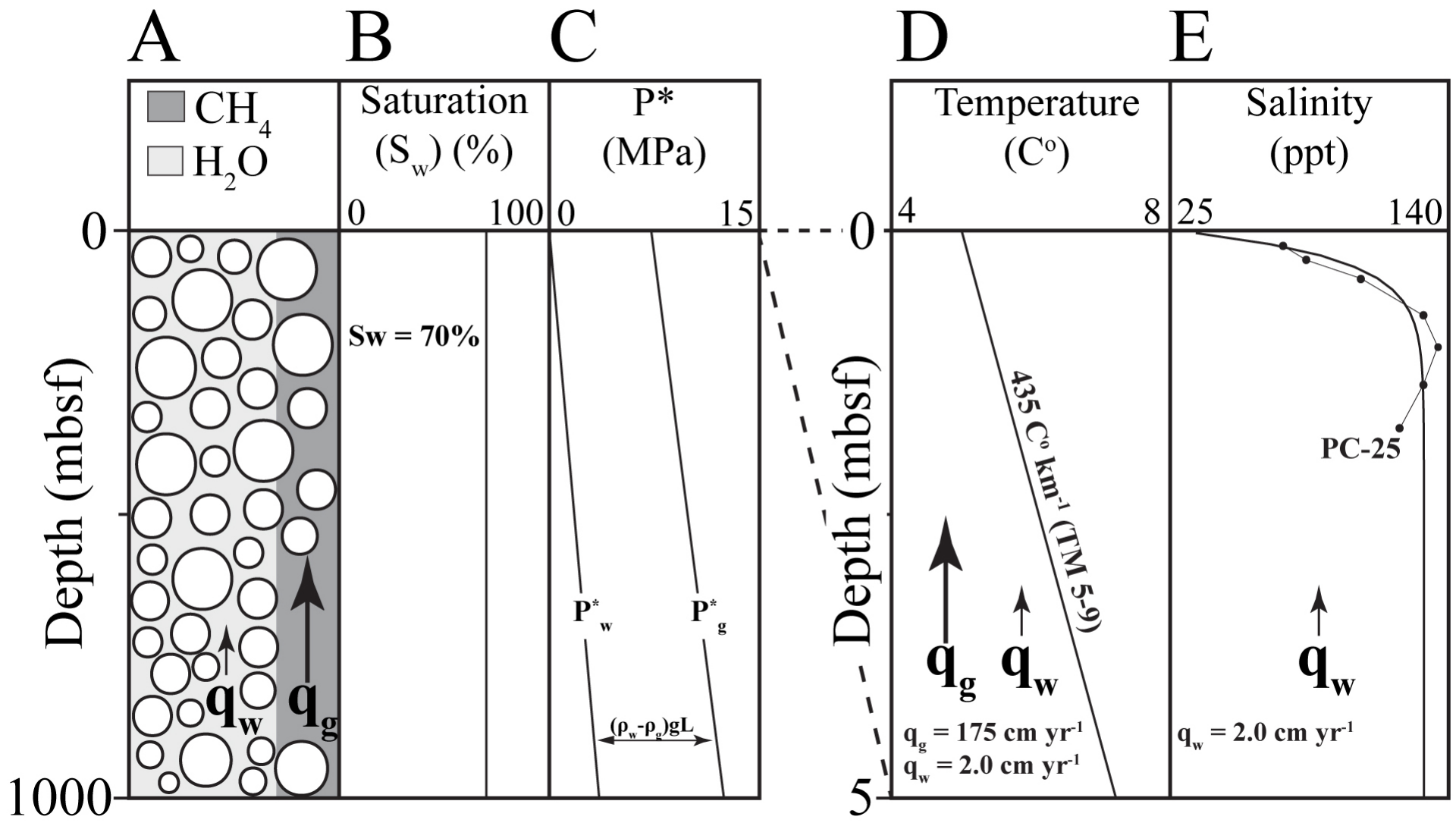
(3) We need to know (a) stress state, material properties (areas pre-conditioned to failure?) and (b) the style of failure (creep, or catastrophic)?

(4) Insight from in-situ measurements, mechanical testing, seismic analysis, monitoring.


Gas Venting
mbsl
700
900
1100
1300
1500
71
22
763
765
767
806
810
851
853
894
939
941
Gas Vent
A
A'
Fig. 2a
km
0
5
28.2° N
28° N
89.2° W
89° W
New Orleans
Macondo
1000
2000
30° N
29° N
28° N
90° W
89° W



Ruppel et al 2005 (GRL



Each year 25% of the carbon expelled from Macondo is vented into the ocean.....from a single vent

Key Points

- Submarine Landslides and Sea Floor Venting
  - –Geohazards, Carbon Cycle
- Address ‘architecture of continental margins’ and ‘fluids and volatiles’
- Developing a process-understanding of behavior
- Models can be tested and constrained through direct measurements