

# VOLUME OF SEDIMENT IN DEPOSITED IN GLACIAL LAKE NARRAGANSETT DURING LATE WISCONSINAN DEGLACIATION: IMPLICATIONS ON SEDIMENT SOURCE?

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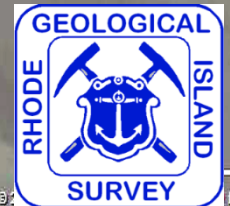
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***Northeast meeting of the Geological Society of America***

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*Bretton Woods, New Hampshire*

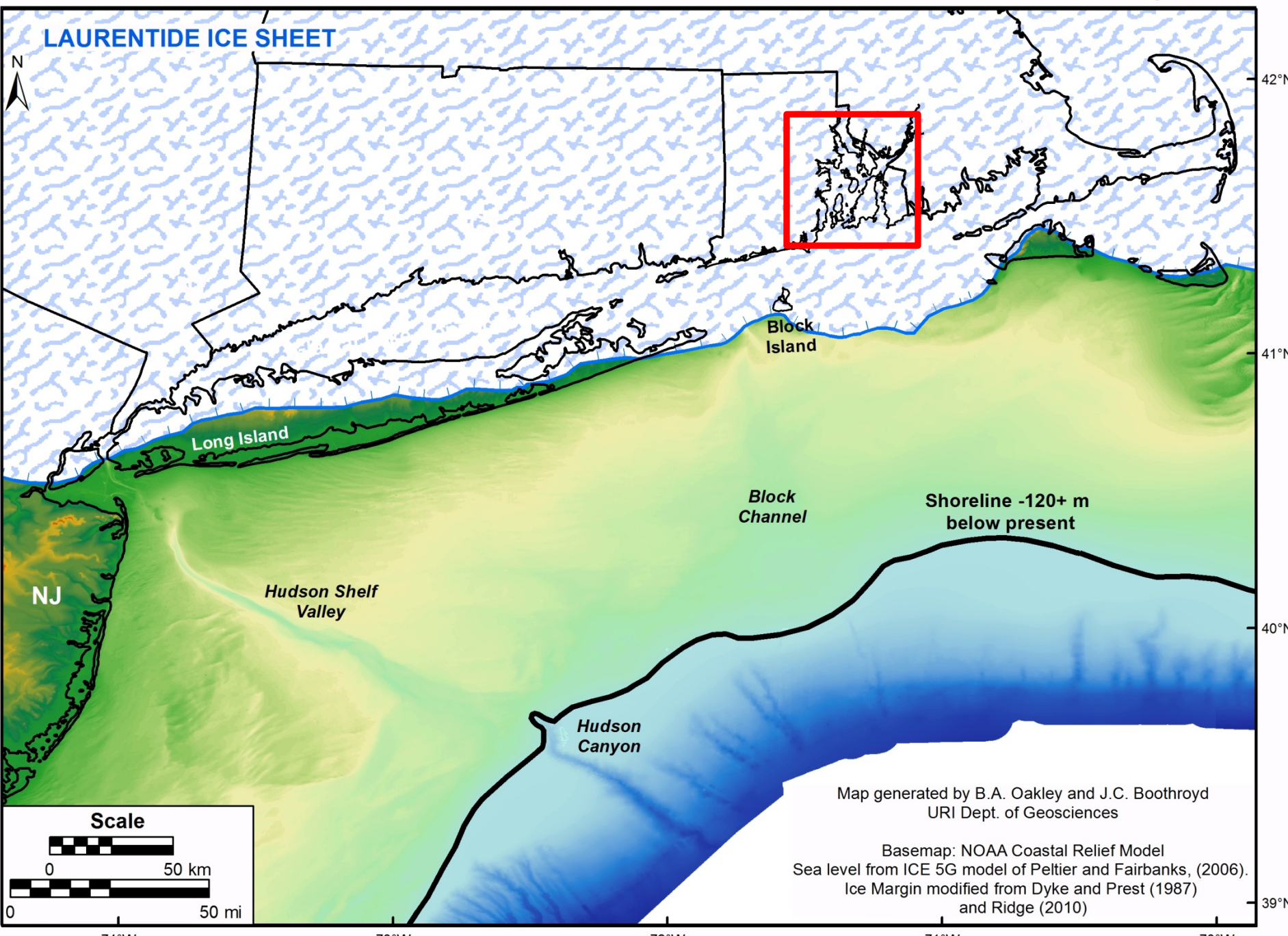


# OUTLINE

1. Determine sediment volume for Glacial Lake Narragansett
2. Where did all of that sediment come from anyways?

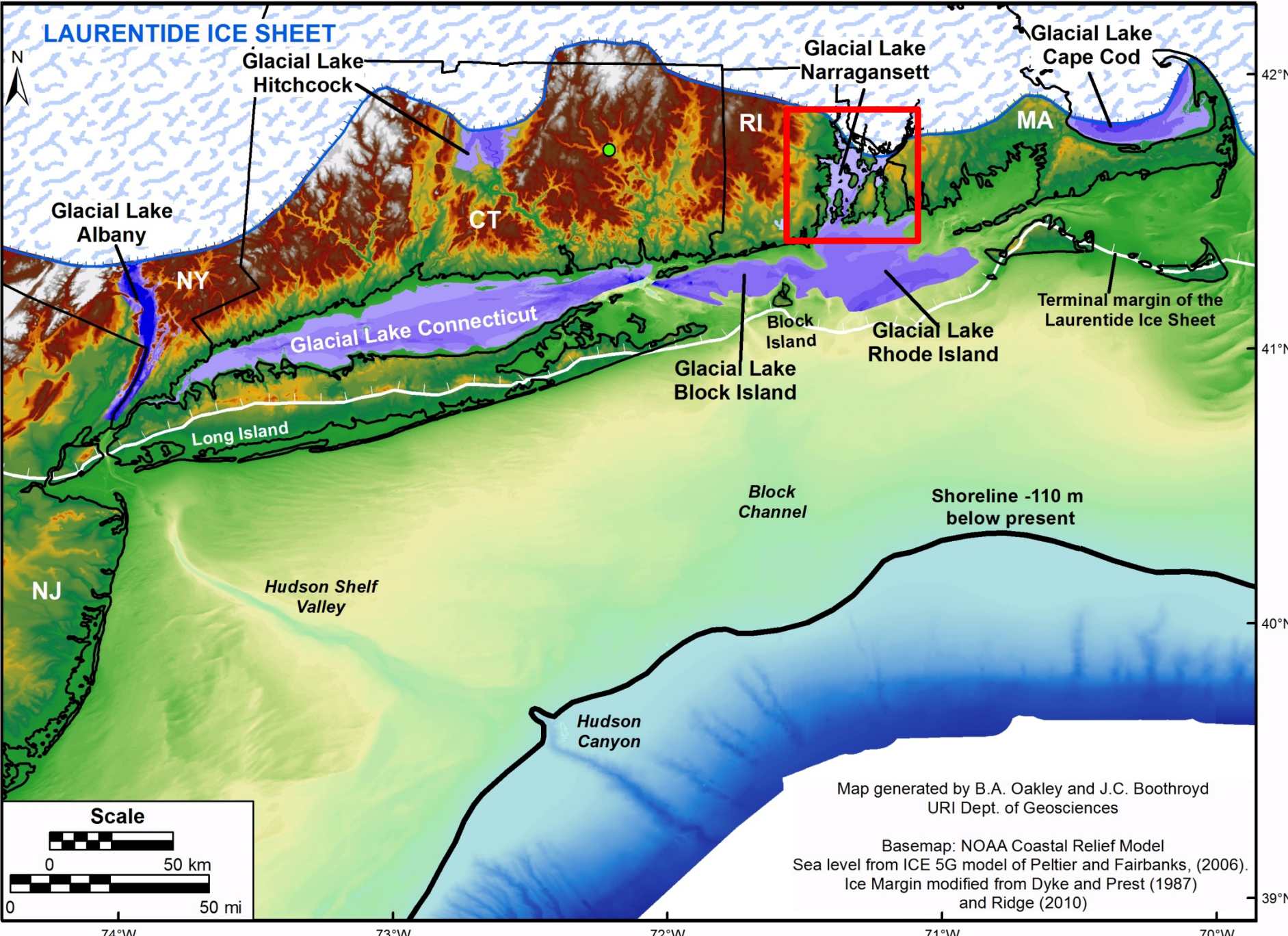


SOUTHERN NEW ENGLAND AND EASTERN NEW YORK AT THE LAST GLACIAL MAXIMUM: 26,000 yBP



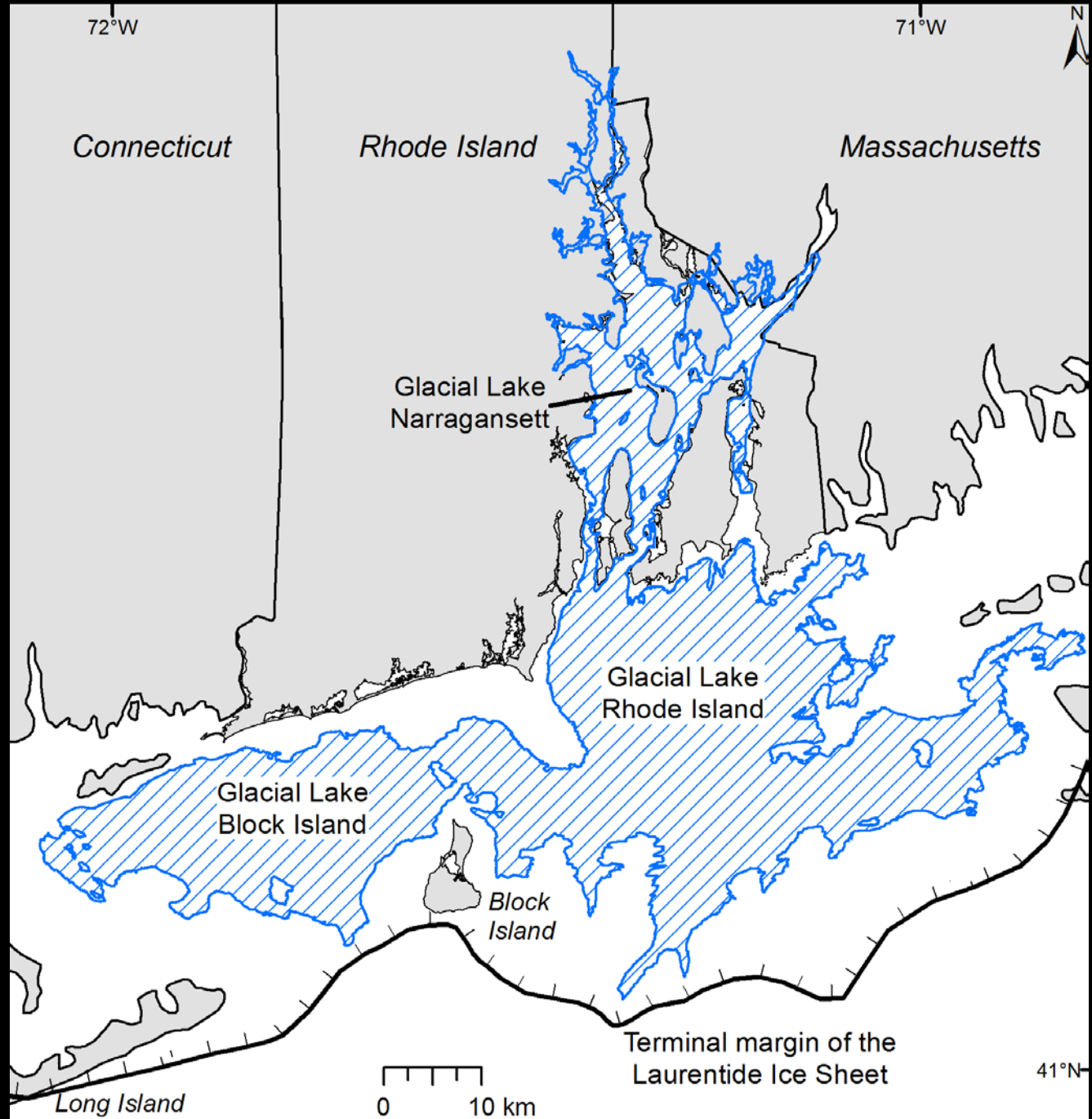


GLACIAL LAKES OF SOUTHERN NEW ENGLAND AND EASTERN NEW YORK





# Glacial Lake Narragansett



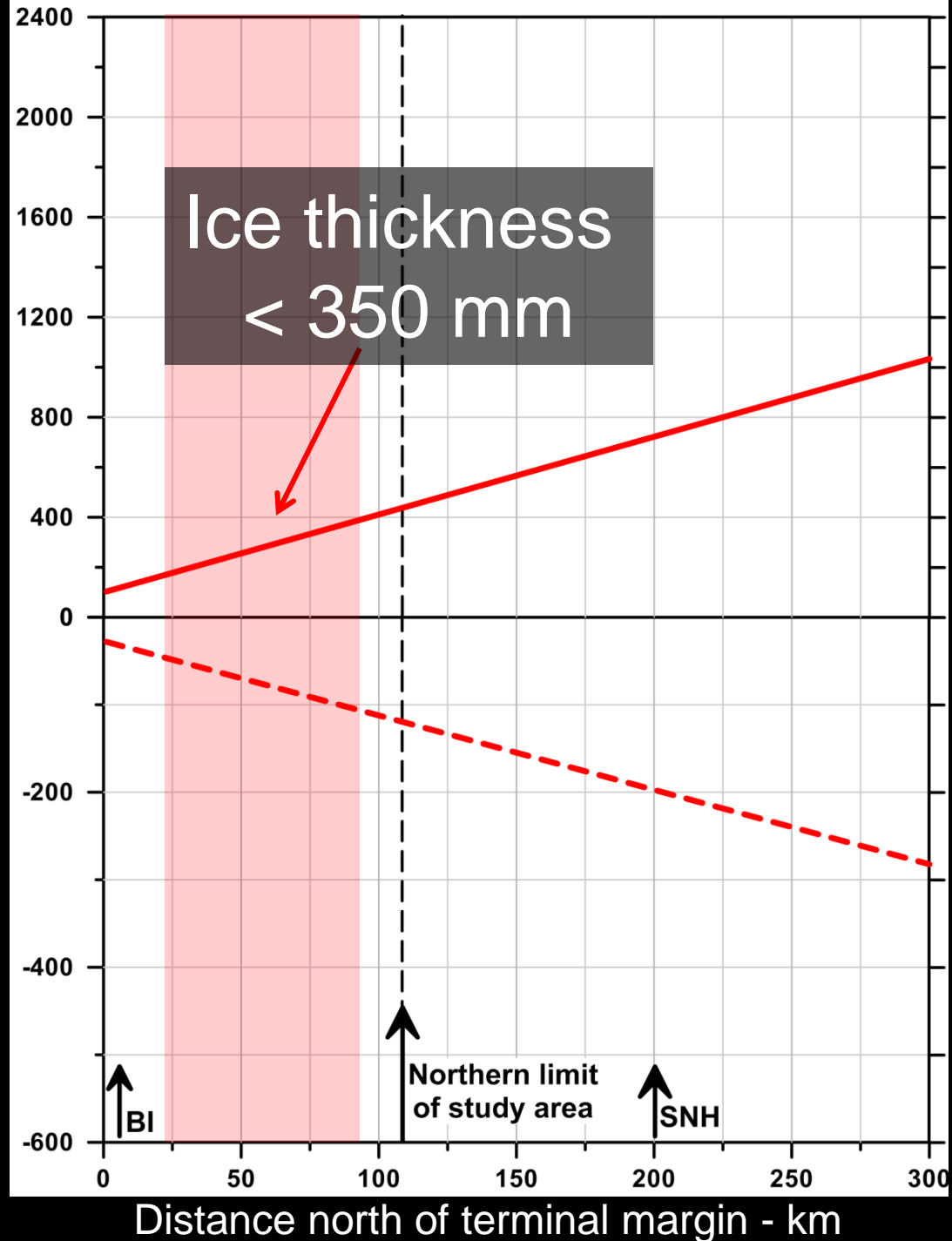
Oakley and  
Boothroyd, 2013



# Ice sheet profiles and resultant isostatic depression

Ice  
thickness - m

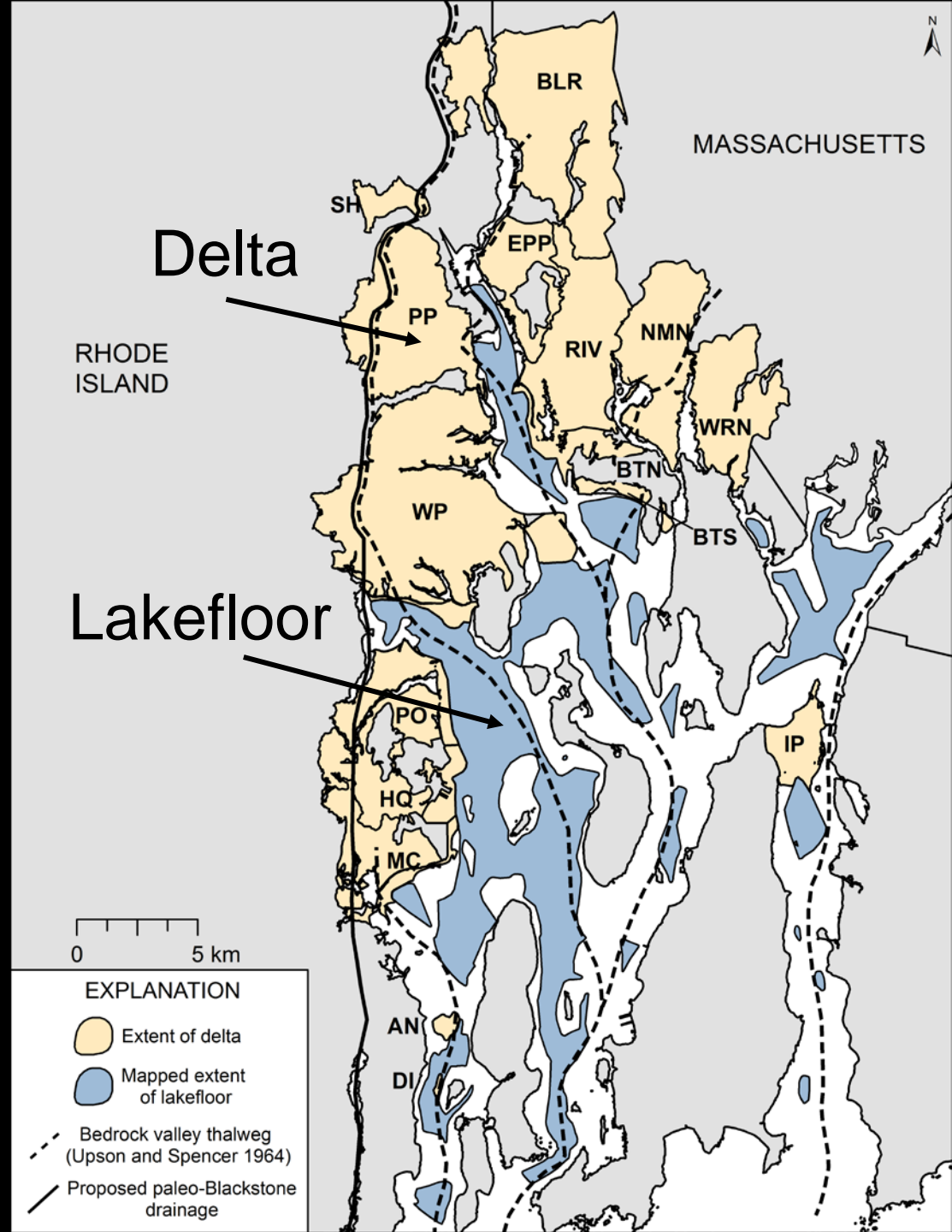
Isostatic  
depression - m



Oakley and Boothroyd,  
QR, 2012



# Stratified Deposits: Glacial Lake Narragansett



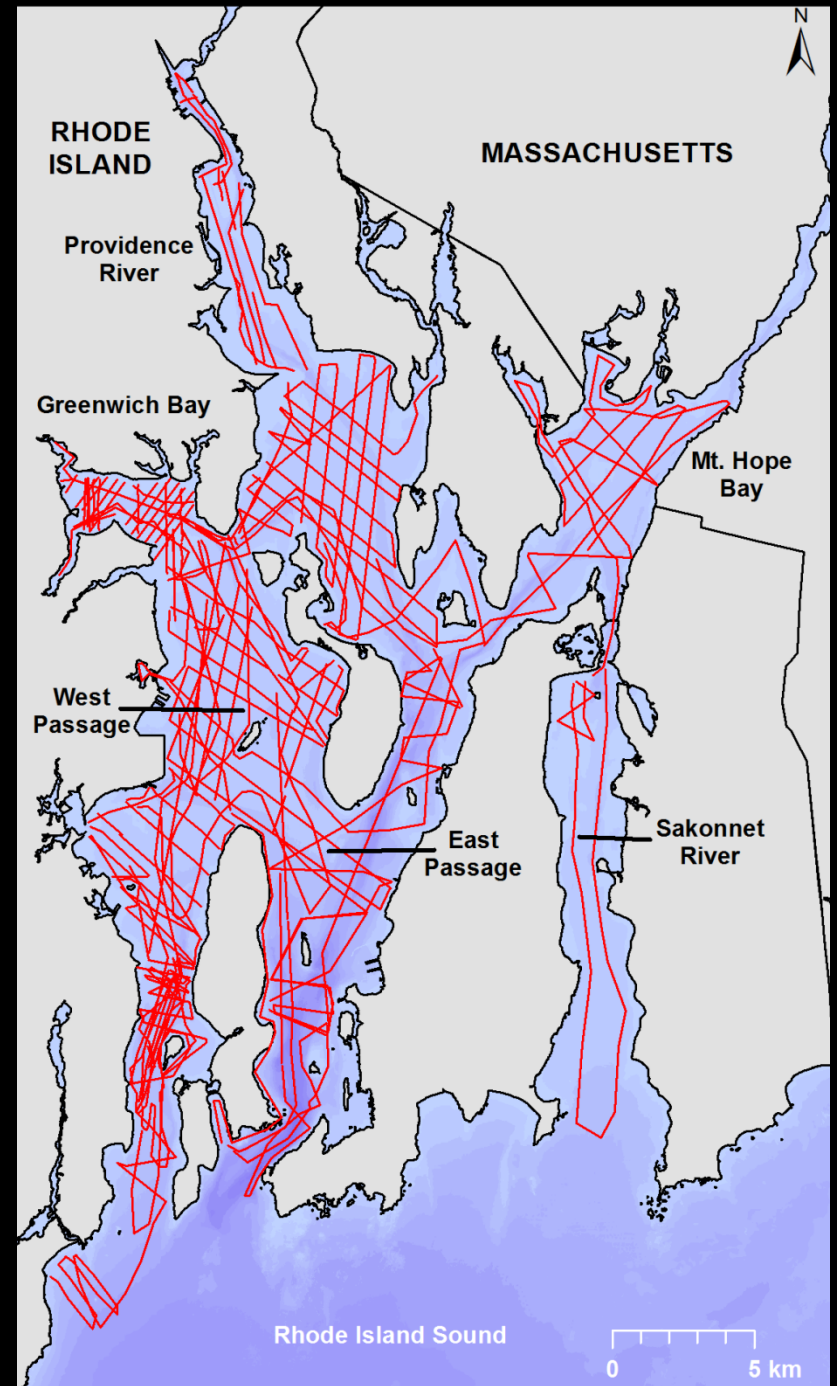
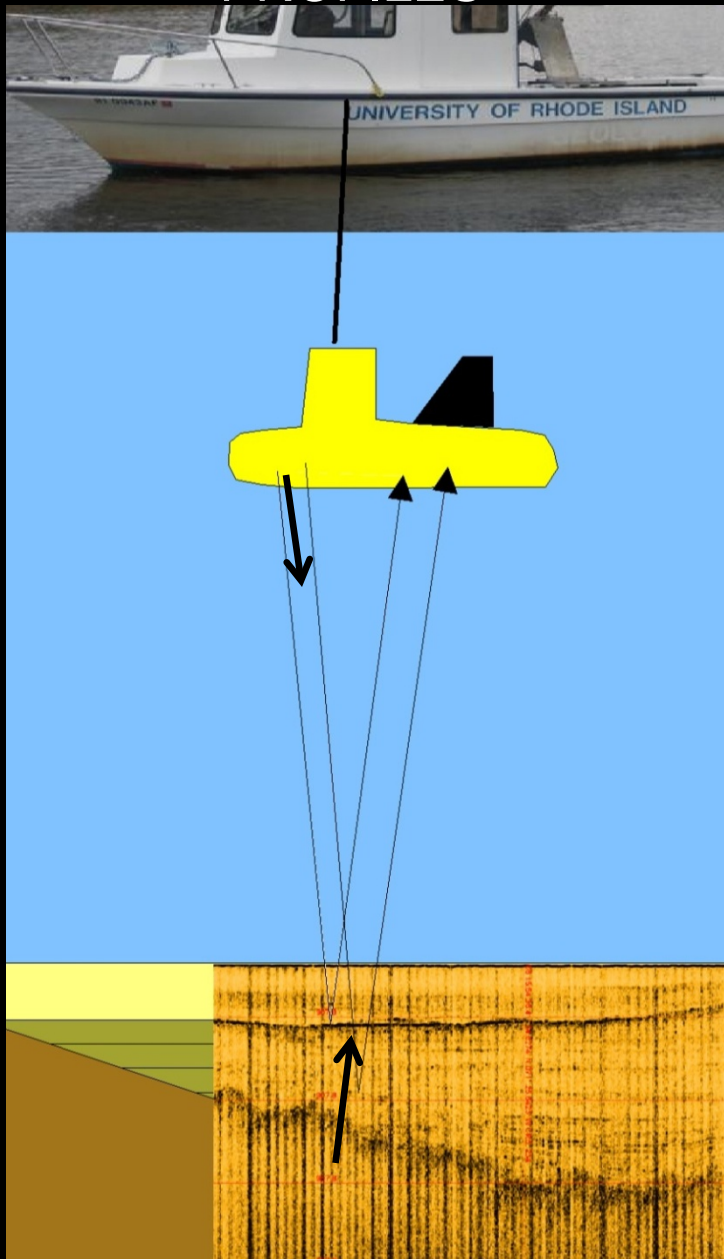
Oakley and  
Boothroyd; in prep



# DETERMINING SEDIMENT VOLUME

1. Measure thickness of stratified deposits below present-day Narragansett Bay using seismic reflection profiles
2. Calculate thickness of stratified deposits graded to Glacial Lake Narragansett using published borehole records and mapped extents

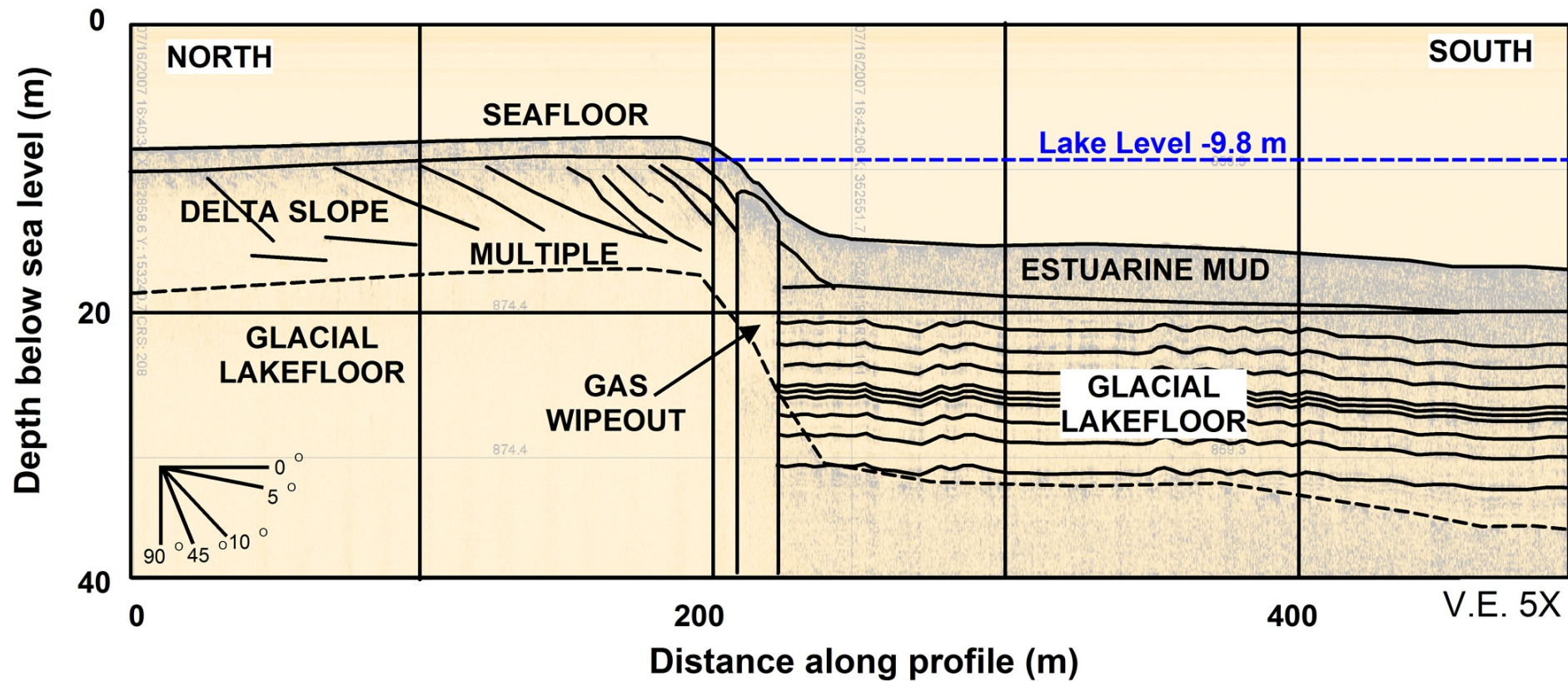
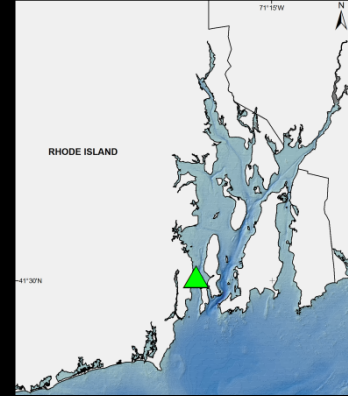
# SEISMIC REFLECTION PROFILES





# SEISMIC REFLECTION PROFILE

## Dutch Island Delta



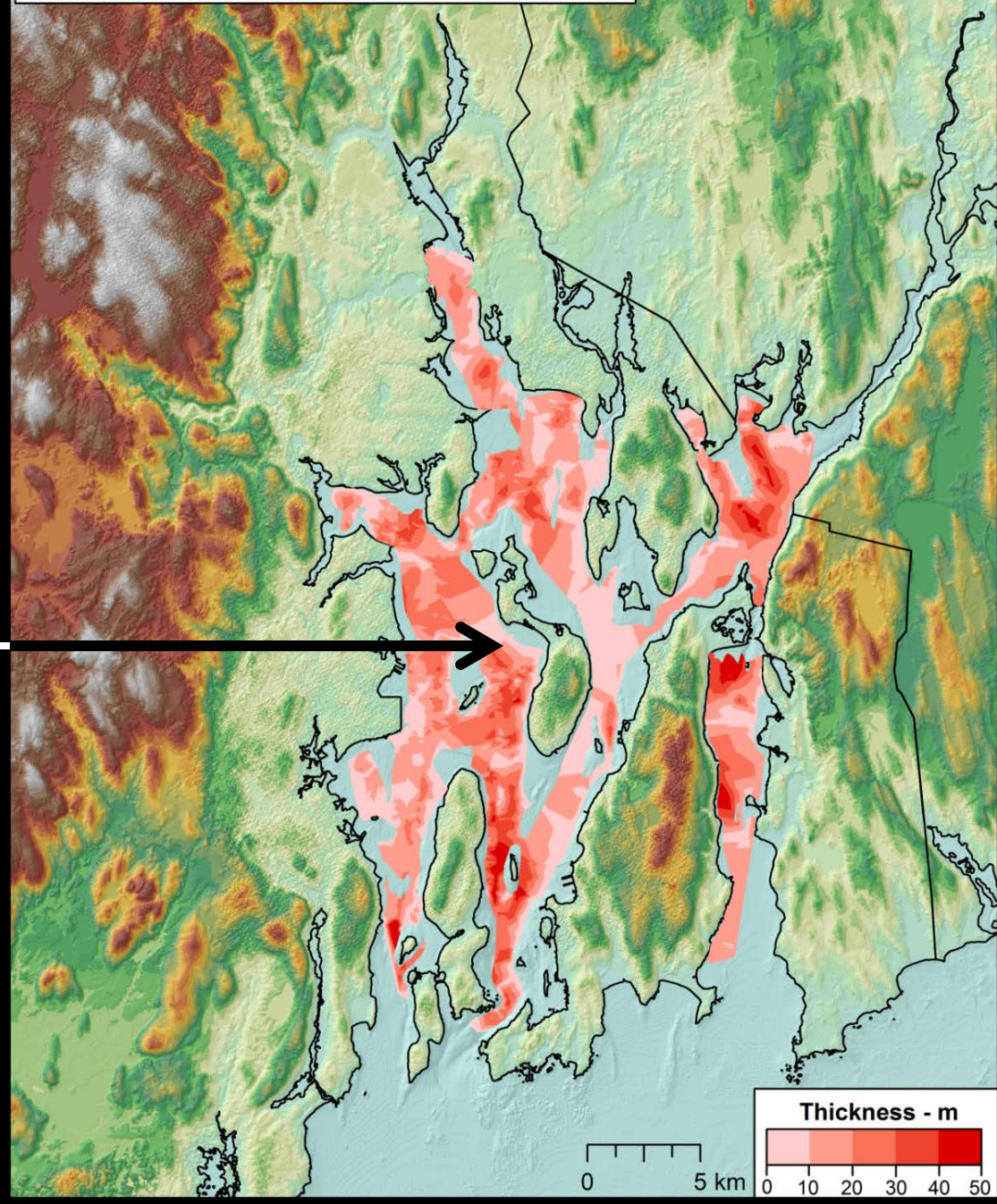


# INTERPOLATED THICKNESS OF STRATIFIED DEPOSITS (Lakefloor, Deltas, Lacustrine Fans)

Previous Slide

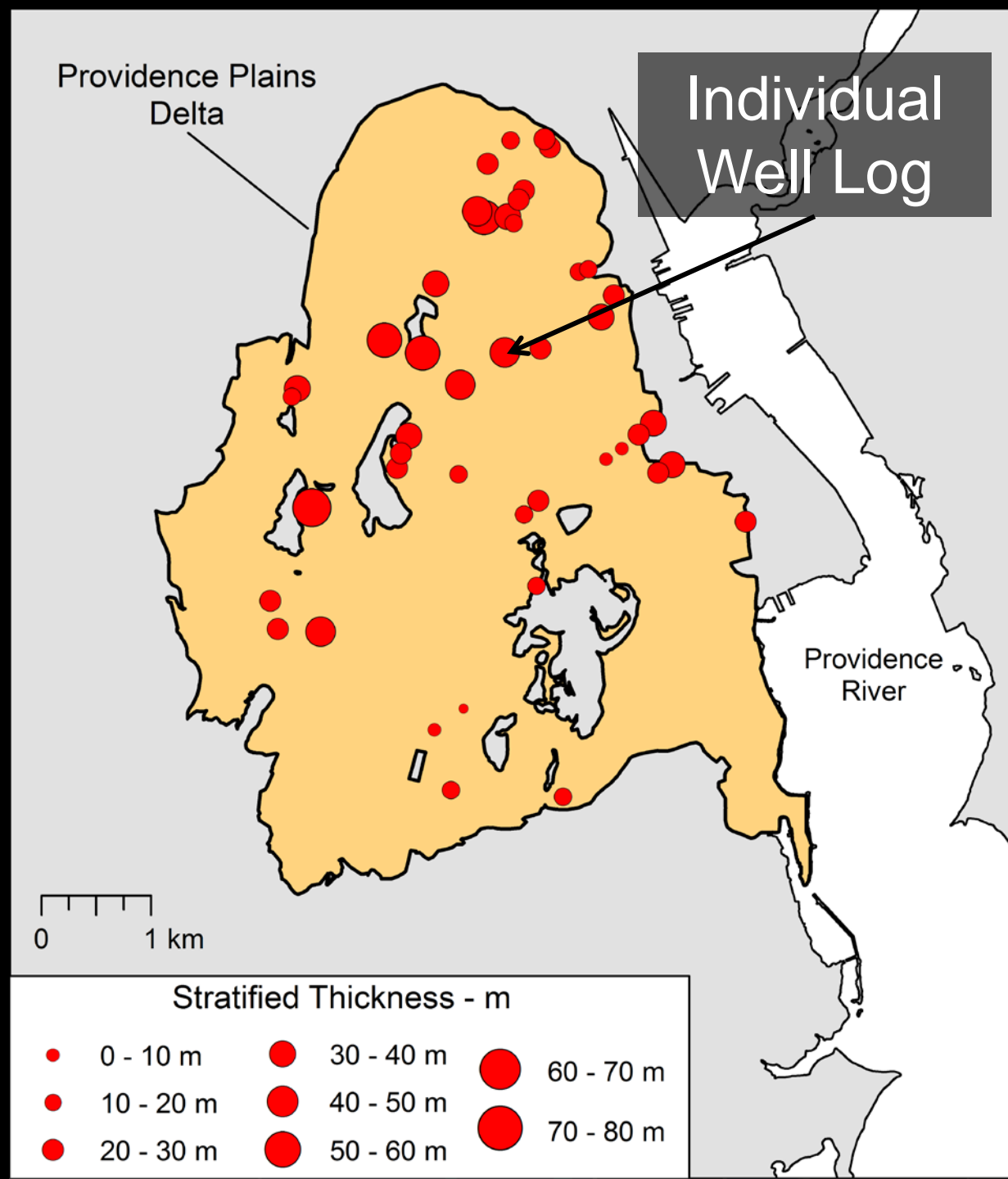


THICKNESS OF STRATIFIED DEPOSITS:  
GLACIAL LAKE NARRAGANSETT





# STRATIFIED DEPOSIT THICKNESS



Delta Extent from:  
Boothroyd and  
McCandless, 2002

# VOLUME OF SEDIMENT DEPOSITED: GLACIAL LAKE NARRAGANSETT

Delta	Area - km <sup>2</sup>	Average Thickness - m	Number of wells	Volume - m <sup>3</sup>
Narragansett Bay - lakefloor	200	Varies	Seismic profiles	3,500,000,000
Warwick Plains	51	25	20	1,275,000,000
Providence Plains	26	34	68	894,200,000
Blackstone	43	19	36	765,000,000
Riverside / Barrington North	27	19	31	513,000,000
New Meadow Neck	19	17	11	317,900,000
Potowomut	16	20	16	316,000,000
Island park	5	60	2	300,000,000
East Providence	10	21	18	210,000,000
Mill Creek	12	17	5	204,000,000
Warren River	17	10	12	170,000,000
Smith Hill	3	33	7	108,900,000
Hunt-Quonset	9	> 10	0	85,000,000
Barrington	2	30	2	45,000,000
Ten Mile River	1.5	25	3	37,500,000
Annaquatucket	0.8	15	Seismic profiles	12,000,000
Dutch Island	0.2	15	Seismic profiles	3,000,000
<b>Total</b>	<b>428</b>			<b>8,756,500,000</b>



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**Total Volume =  $\sim 10 \times 10^9 \text{ m}^3$**



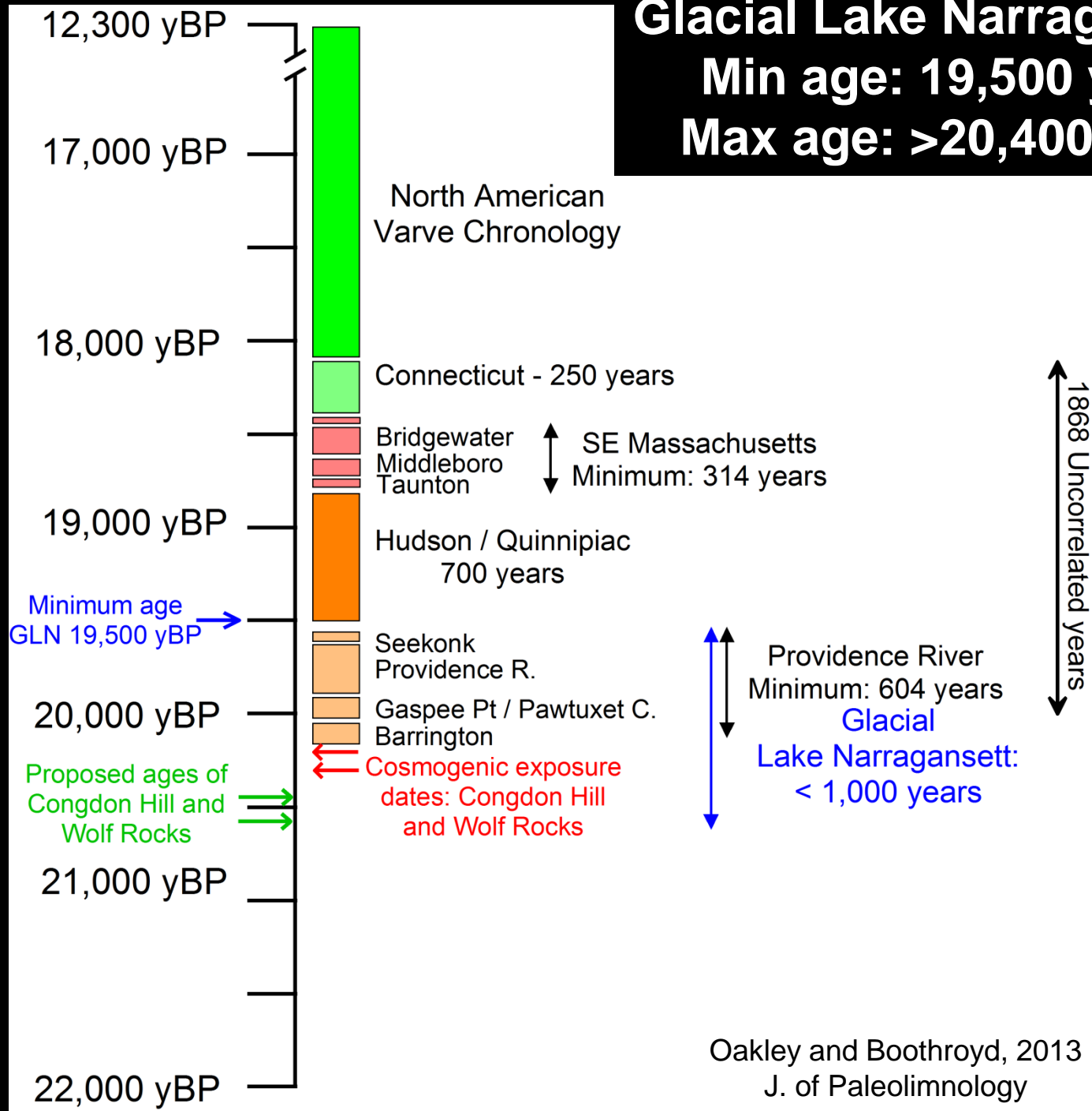
# CONCLUSION I

- Glacial Lakefloor deposits below Narragansett Bay  $> 4 \times 10^9 \text{ m}^3$
- The volume of stratified deposits (deltas) around GLN  $> 5 \times 10^9 \text{ m}^3$
- Total volume  $> \sim 10 \times 10^9 \text{ m}^3$

# Glacial Lake Narragansett

Min age: 19,500 yBP

Max age: >20,400 yBP



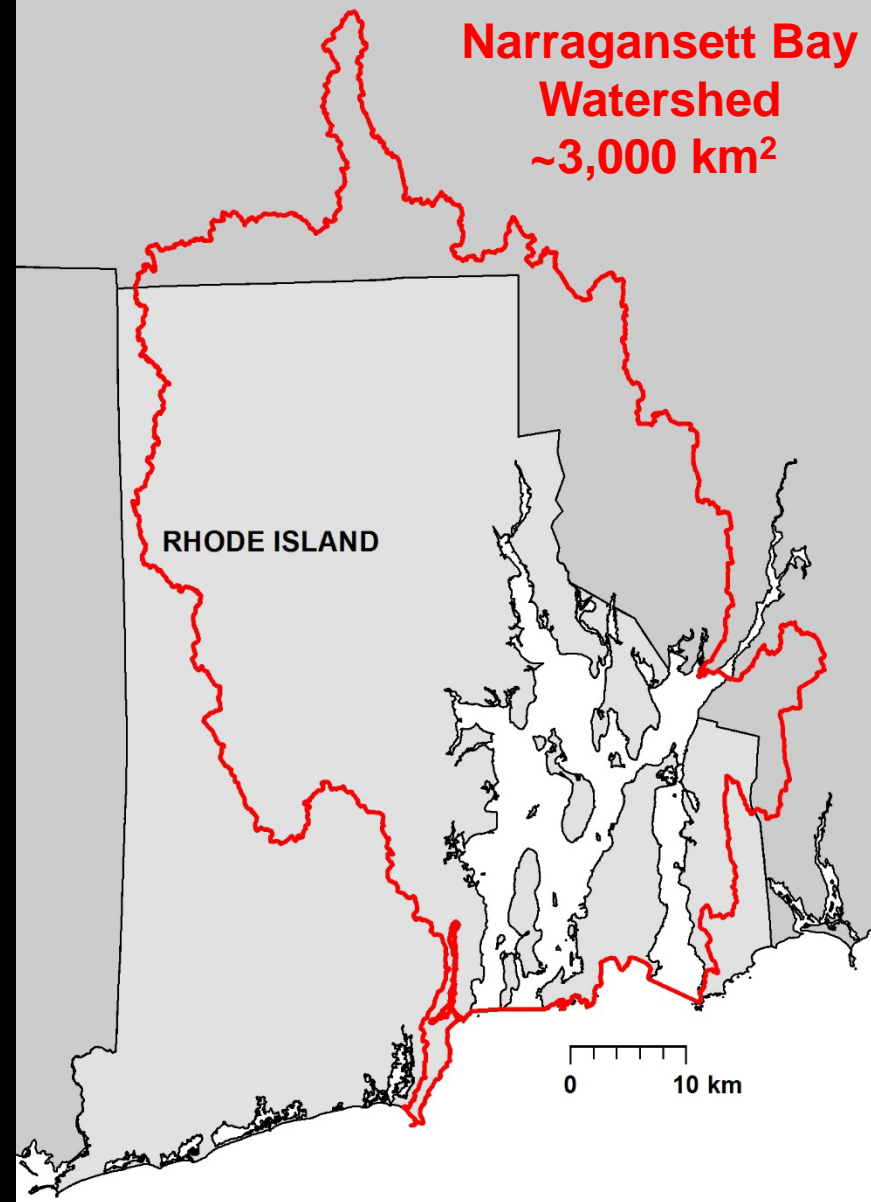
# Possible Sources of Sediment

- IF all older deposits removed during advance (transported to shelf?), ALL sediment deposited must either be:
  - Erosion of bedrock
  - Mobilized subglacial till
  - Transported from 'up ice'



Equivalent excavation of  
>3 m · m<sup>-2</sup> of  
sediment/bedrock erosion

(Assuming it ALL went to  
GL Narragansett)

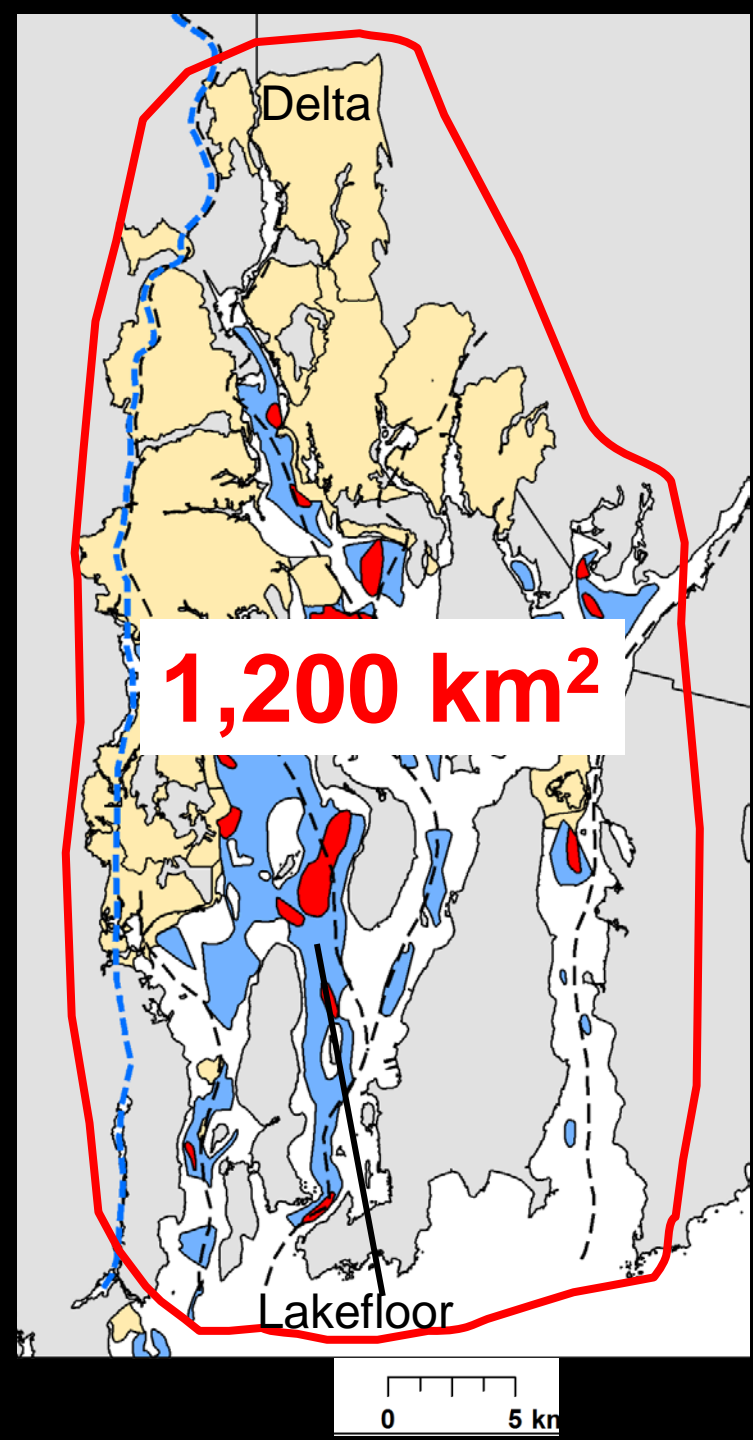


Equivalent excavation of  
 $>7.5 \text{ m} \cdot \text{m}^{-2}$  of  
sediment/bedrock erosion

Bedrock erosion near LIS margin  
 $\sim 0.4 - 0.9 \text{ m}$  (Colgan et al. 2002)

Bedrock ages in NJ 'about right'  
(Biermen et al., 1998)

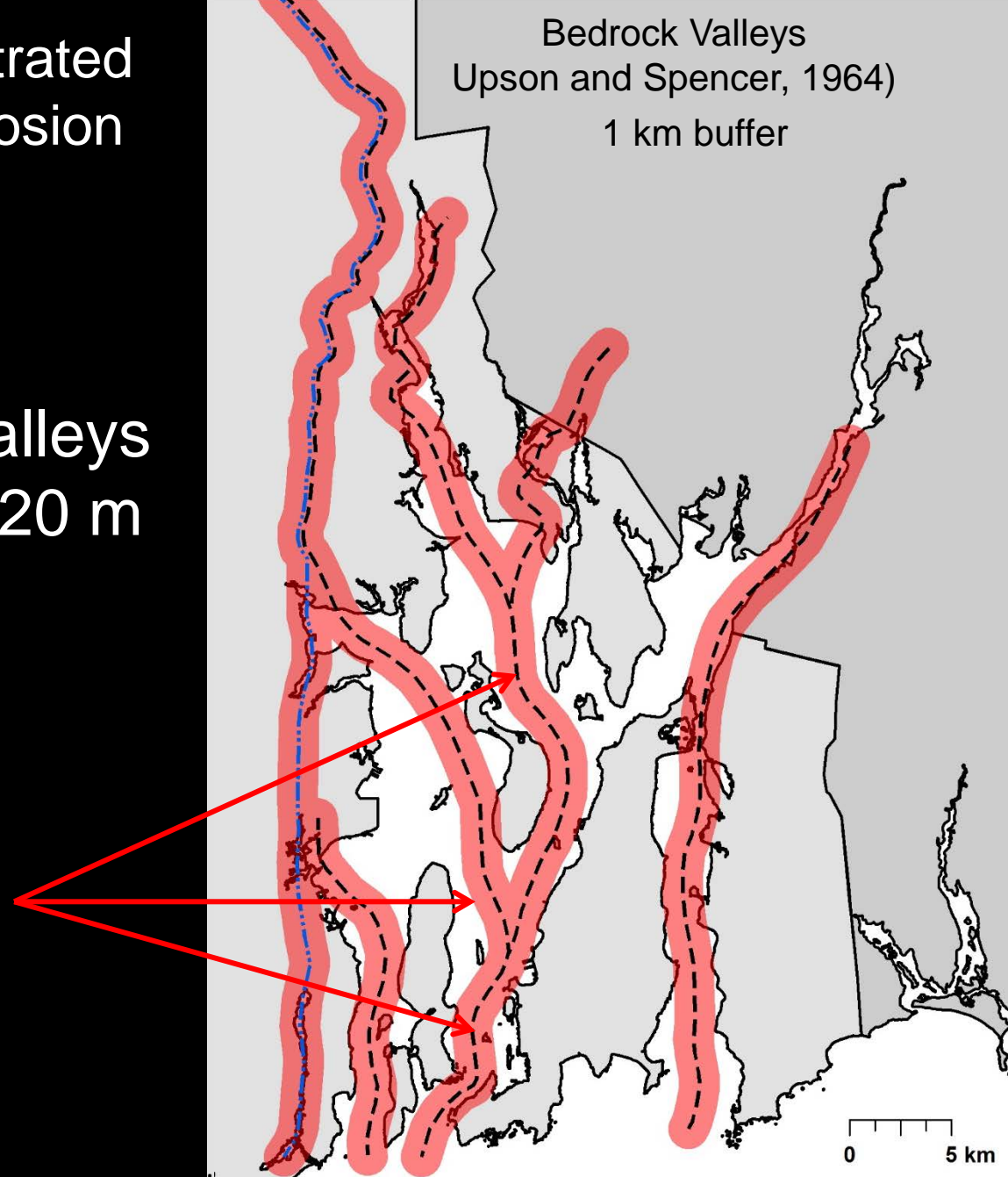
Variable; erosion in valleys, less  
on uplands (Briner et al., 2006)



Assume: Erosion concentrated  
in valleys with minimal erosion  
on uplands

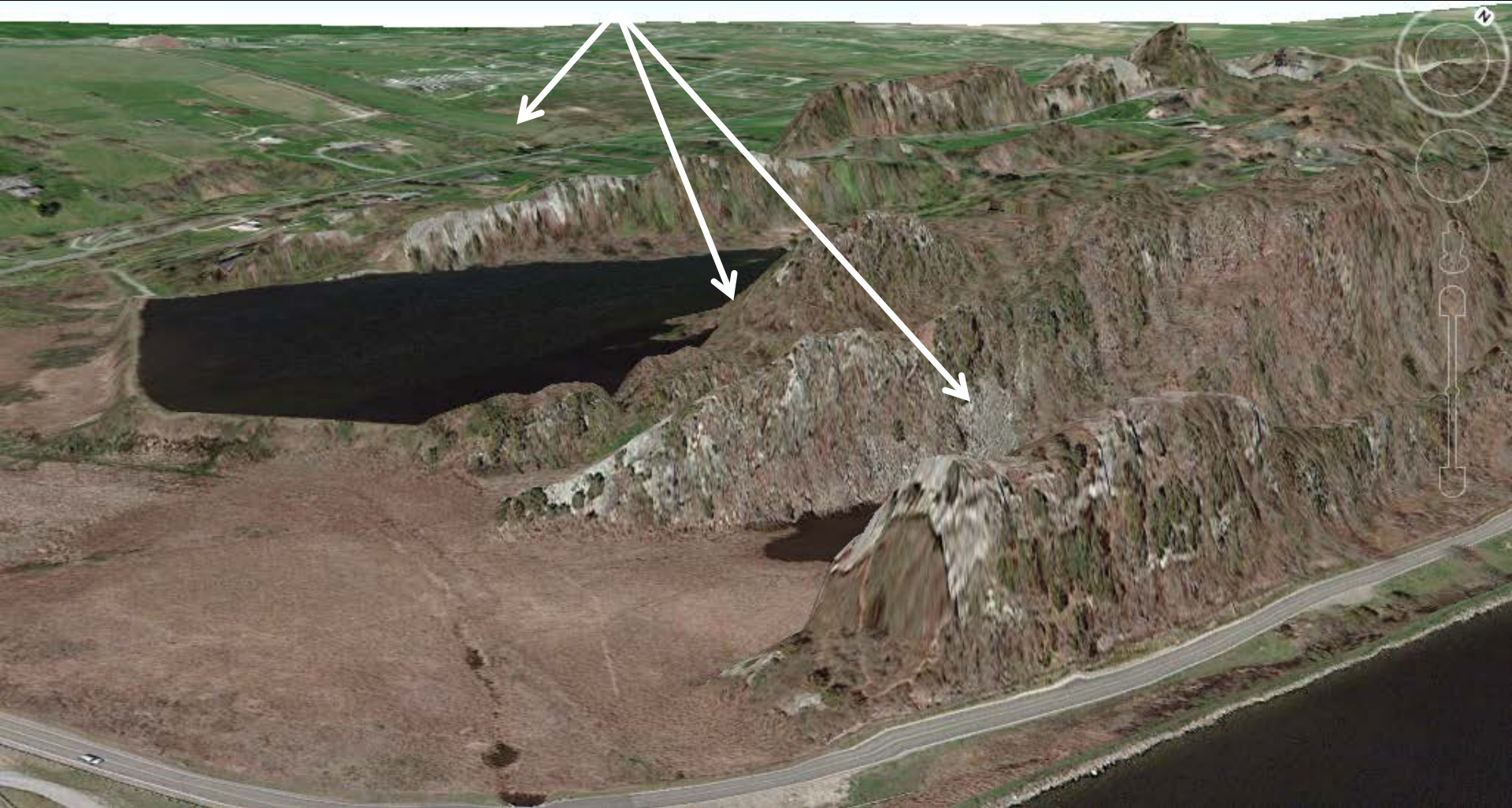
Area = 500 km<sup>2</sup> for valleys  
requires incision of ~20 m

Closed  
depressions  
> 50 m VERY  
localized



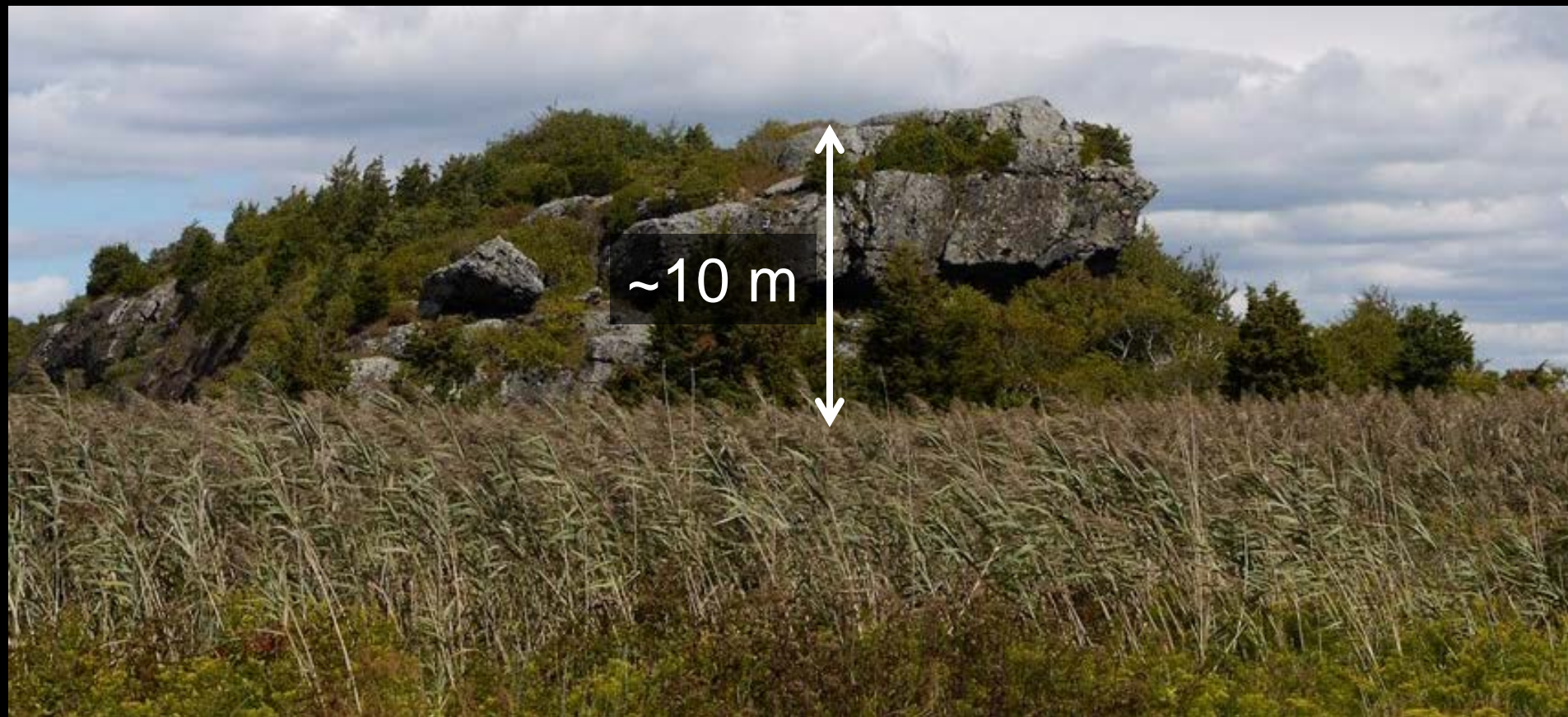


# Outcrops of Rhode Island Formation (Quartzite (conglomerate))





Would a deglacial age represent  
bedrock erosion or just L. Wisconsinan  
uncovering?



~10 m

# CONCLUSIONS II

- Bedrock erosion probably doesn't account for **all** of the sediment deposited in GLN
  - How much?
  - < 25%?
- Some older (Illinoian and/or L. Wisconsinan *advance* deposits probably survived the advance of the LIS and were mobilized during retreat



# Older Stratified Deposits: “Lower Drift” Illinoian/Early Wisconsinan Block Island, RI



(For more on Block Island, see S2: Posters – booth 36 and 37 Monday 1:30-5:30p)

# CONCLUSIONS II

- This implies, at least *near the terminal margin* in S. New England, removal of older deposits and erosion down to bedrock during *advance* of the Laurentide Ice Sheet was likely not as complete as often portrayed.



An aerial photograph of a river delta, showing a complex network of channels and distributaries. The water is a light tan color, contrasting with the darker, vegetated land. A large, dark gray rectangular box is centered over the image, containing the word "QUESTIONS?" in white, bold, sans-serif capital letters.

# QUESTIONS?

250 feet

100 m