MEASURING THE RETREAT VELOCITY OF THE LAURENTIDE ICE SHEET BY COSMOGENIC NUCLIDES? ^{10}BE DATING OF GLACIAL FEATURES IN THE LOWER HUDSON VALLEY

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Motivation

The Laurentide Ice Sheet (LIS) was the earth's dominant continental ice sheet during the Last Glacial Maximum (LGM). The retreat of the eastern margin of the LIS released enormous amounts of fresh water into the Atlantic Ocean, potentially slowing down North Atlantic Deep Water formation, thus affecting thermohaline circulation and global climate. To evaluate the impact of this fresh-water signal, it is important to know the timing and rate of the LIS in New York and New England.

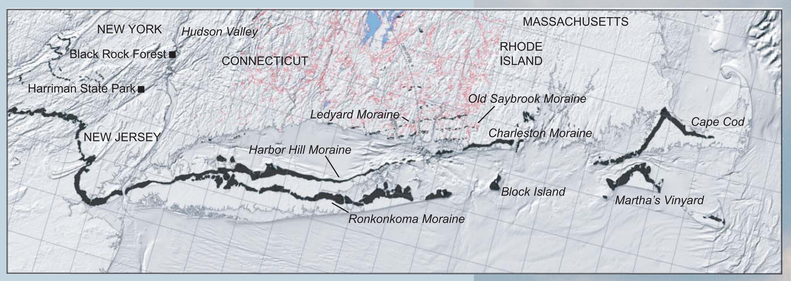

Fig. 1. Map of terminal moraines deposited by the LIS on the New York and New England coast

Introduction

Glacial geologic features in the lower Hudson Valley are evidence of the advance of the LIS to its LGM terminus at Long Island and subsequent ice recession. Surface exposure dating (SED) using the cosmogenic nuclide ^{10}Be is applied to date glacially transported boulders and scoured bedrock in two areas in the lower Hudson Valley: Black Rock Forest and Harriman State Park.

Previous work - *See Fig. 2 for ^{14}C and ^{10}Be dates and locations*

Initial estimates of the age of LIS deglaciation are based on ^{14}C dating of lake and bog bottom sediments.

The New England (NE) Varve Chronology, origionally established by Antevs (1922, 1928) and recently improved by Ridge and Larsen (1990) and Ridge (2003, 2004) provides a robust estimate of the timing and rates of deglaciation in New England.

SED has also been used to date LIS terminal moraines on Long Island, NY (Edwards et al., 2004) and in New Jersey (Clark, 1995) and scoured bedrock surfaces in Central Park, NY.

Table 1. List of dates for LIS deglaciation near the Huson Valley

Location	Reference	Cal. yr BP
(^{14}C dates from lake and bog bottom organics)		
Spruce Pond, Harriman State Park	Maenza-Gmelch 1996	14,200-14,610
Sutherland Pond, Black Rock Forest	Donnelly et al. 2005	13,050-13,190
Allamuchy Pond, NJ	Pettet et al. 1993	13,900-14,620
Tappan Zee Bridge core, NY	Donnelly et al. 2005	12,040-11,960
Eagle Hill Camp Bog, NY (Red Hook Moraine)	Connally and Sirkin 1986	15,980-16,550
Poughkeepsie Moraine, NY	Connally and Sirkin 1986	20,120-20,520
Pellets Island Moraine	Connally and Sirkin 1986	20,900-21,540
New Hampton Bog, (New Hampton Moraine)	Connally and Sirkin 1986	20,120-20,520
Wallkill Moraine	Connally and Sirkin 1986	20,120-20,520
(NE varve chronology)		
Lake Quinnipiac	Ridge 2003, 2004	>18,900
Surface exposure dates		
Harbor Hill Moraine	Edwards et al. 2004	18,300±1500
Cental Park, NY	Edwards et al. 2004	19,200±1200

Acknowledgments

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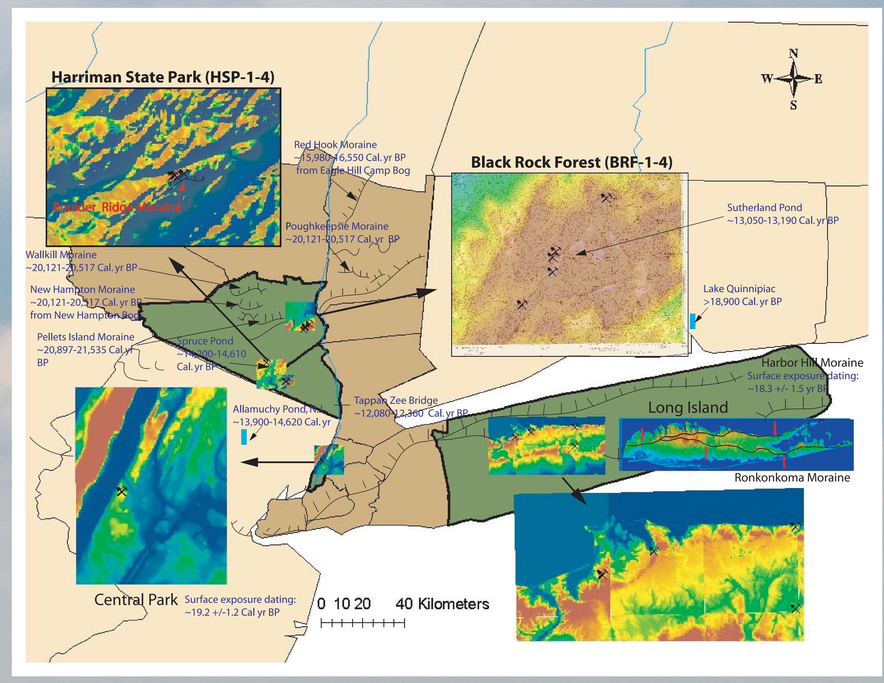
Fig. 2. Map of the lower Hudson Valley showing previous work and ^{10}Be sample locations at Harriman State Park and Black Rock Forest



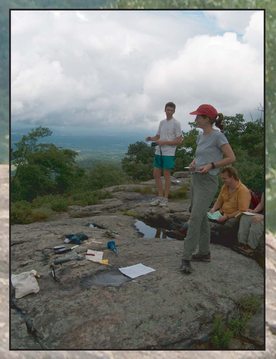
Photos showing sample locations

Harriman State Park

HSP-1

HSP-2

Black Rock Forest



BRF-1

BRF-2

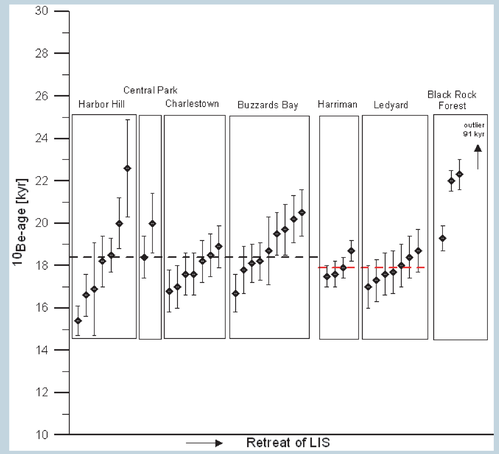
BRF-3

Results

Table 2. List of sample locations and results

Sample	Coordinates	^{10}Be age (kyr)	Comment
Black Rock Forest			
BRF-1	41.408 N/74.022 W 381 m a.s.l.	22.02 ± 0.46	Scoured bedrock
BRF-2	41.395 N/74.038 W 432 m a.s.l.	91.06 ± 2.09	Quartz vein in scoured bedrock
BRF-3	41.396 N/74.0369 W 441 m a.s.l.	19.34 ± 0.64	Boulder
BRF-4	41.384 N/74.047 W 360 m a.s.l.	22.30 ± 0.66	Boulder, perched on bedrock
Harriman State Park			
HSP-1	41.160 N/74.121 W 380 m a.s.l.	17.85 ± 0.53	Quartz vein in boulder
HSP-2a	41.159 N/ 74.124 W 346 m a.s.l.	17.49 ± 0.51	Quartz vein in perched boulder
HSP-3	41.159 N/74.124 W 357 m a.s.l.	18.66 ± 0.50	Quartz vein in boulder
HSP-4	41.159 N/ 74.123 W 357 m a.s.l.	17.59 ± 0.60	Quartz vein in boulder

Fig. 3. Results from the lower Hudson Valley and from Connecticut and Massachusetts



Conclusions and outlook

^{10}Be dates from New York show good consistency with the NE Varve Chronology

^{10}Be and varve-chronology ages are between 2-3 kyr older than ^{14}C dates from lake and bog bottom sediments

Boulderly moraines are highly appropriate for SED as shown by the consistency of ^{10}Be dates from such deposits

Measurement of the retreat speed of the LIS by SED is possible if bouldery moraines are used for sample locations

No significant delay is shown between the latest stage LGM moraines (Harbor Hill, Charlestown moraines) and recessional moraines (Ledyard and Harriman State Park moraines)

GOING NORTH! - future work will focus on locations further north, such as the "Littleton-Bethlehem readvance"