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Laurentide ice sheet meltwater routing along the Iro-Mohawk River, eastern New York, USA

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ABSTRACT

The rerouting of meltwater as the configuration of ice sheets evolved during the last deglaciation is thought to have led to some of the most significant perturbations to the climate system in the late Quaternary. However, the complex pattern of ice sheet meltwater drainage off the continents, and the timing of rerouting events, remains to be fully resolved. As the Laurentide Ice Sheet (LIS) retreated north of the Adirondack Uplands of northeastern New York State during the last deglaciation, a large proglacial lake, Lake Iroquois, found a lower outlet that resulted in a significant flood event. This meltwater rerouting event, from outflow via the Iro-Mohawk River valley (southern Adirondack Mountains) to the spillway at Covey Hill (northeastern Adirondack Mountains), is hypothesized to have taken place ~13.2 ka and disturbed meridional circulation in the North Atlantic Ocean. However, the timing of the rerouting event is not certain because the event has not been directly dated. With improving the history of Lake Iroquois drainage in mind, we obtained cosmogenic ^{10}Be exposure ages on a strath terrace on Moss Island, along the Iro-Mohawk River spillway. We hypothesize that Moss Island's strath terrace became abandoned during the rerouting event. Six ^{10}Be ages from the strath surface average 14.8 ± 1.3 ka, which predates the previously published bracketing radiocarbon ages of ~13.2 ka. Several possibilities for the discrepancy exist: (1) the ^{10}Be age accurately represents the timing of a decrease in discharge through the Iro-Mohawk River spillway; (2) the age is influenced by inheritance. The ^{10}Be ages from glacially sculpted surfaces on Moss Island above the strath terrace predate the deglaciation of the site by 5 to 35 ky; and (3) the abandonment of the Moss Island strath terrace relates to knickpoint migration and not the final abandonment of the Iro-Mohawk River as the Lake Iroquois spillway. Further study and application of cosmogenic ^{10}Be exposure dating in the region may lead to tighter chronologic constraints of meltwater history of the LIS.

1. Introduction

The Laurentide Ice Sheet (LIS) reached mid-latitude North America multiple times during Quaternary glaciations (e.g., Young and Burr, 2006; Balco and Rovey, 2010). While there, the time-transgressive LIS margin impounded various phases of proglacial lakes and led to significant meltwater rerouting (Muller and Prest, 1985; Muller and Calkin, 1993; Kehew et al., 2009). During the last deglaciation, meltwater routing events spilling into the North Atlantic Ocean have been proposed to be the cause of significant regional and global abrupt climate change (Rayburn et al., 2011; Carlson and Clark, 2012).

One region where meltwater flowed to the North Atlantic was across New York State, carving channels that document the complex interplay between the ice margin, the routing of its meltwater, and the spillover of former proglacial lakes (Fairchild, 1909; Muller and Prest, 1985). One such lake, Glacial Lake Iroquois (GLI), which occupied the present-day Lake Ontario basin and the adjacent low-lying areas (Fairchild, 1909; Muller and Prest, 1985; Pair and Rodrigues, 1993; Bird and Kozlowski, 2016), was involved in a major flood as its meltwater was re-routed (Franzi et al., 2016). Prior to the LIS retreating north of the Adirondack Uplands, the Lake Iroquois outflow was routed through a spillway near Rome, NY, and along the Mohawk River valley in central-eastern New York. The spillway subsequently reaches the Hudson River valley and eventually the North Atlantic Ocean (Pair and Rodrigues, 1993; Rayburn et al., 2005; Fig. 1). However, as the LIS retreated north of the Adirondack Uplands, a lower spillway of Lake Iroquois was uncovered at the Covey Hill col. This event prompted a significant flood event through the glacial Lake Vermont basin and eventually down the Hudson River Valley (Pair and Rodrigues, 1993; Rayburn, 2004; Rayburn et al., 2005; Franzi et al., 2007, 2016; Fig. 1). Rayburn et al. (2005) estimated a meltwater flux to the North Atlantic of 30–60 km^3/s (0.03–0.06 Sv) for this event. They credit this event with the drop of Lake Iroquois from its main level (Mohawk River valley spillway) to its Frontenac level (Covey Hill spillway) and estimated a volume change of 570 ± 85 km^3. Pair and Rodrigues (1993) determined that the lake level dropped ~120 m in total (though incrementally) as

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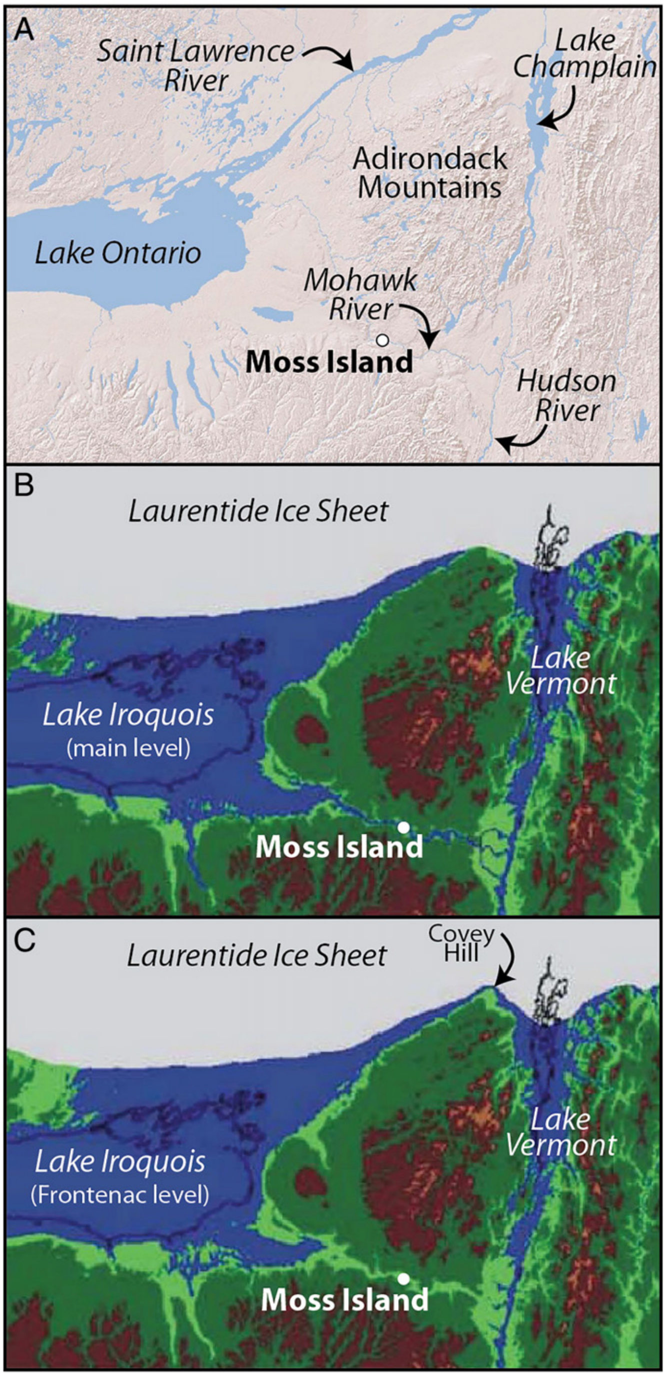

Fig. 1. The region surrounding Moss Island, New York. (A) Shaded relief map showing important place names in the region. (B) Lake Iroquois at its most extensive (main phase) level, when the lake drained into the Mohawk River valley. (C) Lake Iroquois at the Frontenac level, when a lower spillway was reached north of the Adirondack Mountains and into Lake Vermont. (B) and (C) modified from Rayburn et al. (2005).

the LIS retreated north of the Adirondack Uplands; and the largest drop, ~80 m, occurred when the Covey Hill spillway was initiated.

The age of the drainage event is constrained by maximum and minimum radiocarbon ages, and the flood history is described in detail in Donnelly et al. (2005), Rayburn et al. (2005), and Franzi et al. (2007). Balco et al. (2009) used ^{10}Be measurements from the boulder bar formed during the event as one of several ^{10}Be production rate calibration sites in the formulation of the northeastern North America production rate value. The flood event postdates radiocarbon-dated material from Lake Iroquois maximum highstand sediments, which is 13,730–14,230 cal YBP (Karrow, 1981). The flood also postdates a radiocarbon-dated musk-ox bone associated with a preflood ice margin position that is 13,440–13,020 cal YBP (Rayburn et al., 2007). The flood predates a drop in the level of glacial Lake Vermont, which took place prior to 12,995–12,793 cal YBP (Rayburn et al., 2007). In addition, the flood event pre-dates the eventual drainage of Lake Vermont and the establishment of marine conditions in the Champlain Sea that has been dated at 13,187–12,872 cal YBP (Richard and Occhietti, 2005) and 13,124–12,853 cal YBP (Franzi et al., 2007). Taken together, the best estimate for the flood age based on the above radiocarbon constraints calculated by Balco et al. (2009) was 13,180 ± 130 cal YBP.

To improve our understanding of the characteristics and chronology of this meltwater rerouting event, we have applied cosmogenic ^{10}Be exposure dating to a strath terrace within the Mohawk River valley that we hypothesize was abandoned during the meltwater-rerouting event (Fig. 2). The Mohawk River valley spillway was the initial drainage route from Lake Iroquois to the Hudson River valley (Brigham, 1897; Fullerton, 1980; Pair and Rodrigues, 1993). If the strath terrace was abandoned during the rerouting event, we might expect an age of around 13,200 cal YBP.

2. Moss Island, NY

Moss Island sits adjacent to the present-day Mohawk River in Little Falls, NY (Fig. 2). It is an island in the sense that it lies between the New York State Canal System (successor to the Erie Canal and other canals within NY) and the Mohawk River. The main body of Moss Island is ~500 m long and ~200 m wide. The Moss Island/Little Falls area is unique among locations along the Mohawk River because it flows across a fault-bounded, upthrown block of basement crystalline rocks consisting of charnockitic, granitic, and syenitic gneisses; whereas elsewhere the river flows across Paleozoic sedimentary rocks that are significantly more erodible than the crystalline lithologies (Fisher et al., 1970; Agle et al., 2005). The lithologies in the upthrown block are variably leucocratic (containing varying amounts of biotite, hornblende, and pyroxenes) and may contain interlayered amphiboles, metasedimentary gneisses, and migmatites. The lithologies at Moss Island itself consist of syenite with common quartz veins ranging in width from <1 cm up to a few decimeters.

The elevation of Moss Island ranges between river level [~98 m above sea level (asl)] and a crest of ~136 m asl. The southern slope of the island was blasted for the Erie Canal and Lock E-17, the tallest lock in New York (12.3 m lift) and one of the largest of its kind in the world (Bowers and McNulty-Bowers, 2010). Along Moss Island's northern margin, and parallel to the course of the Mohawk River, is an uneven surface notable for its large potholes that is ~5–20 m above river level. Above this surface is the upper portion of the island, which exhibits glacially sculpted and smoothed bedrock with glacial polish on quartz vein surfaces.

The glacial history of Moss Island is not completely known. However, despite a lack of chronological information from the Moss Island region, we can generally outline the timing of the last glaciation by drawing on regional studies. The timing of when the LIS advanced to the region during the LGM is not known with precision, but some data constrain the advance phase of the Hudson-Champlain lobe toward its maximum position to ~28–26 cal ka BP (e.g., Fullerton, 1986; Stone and Borns, 1986; Rayburn, 2015). Corbett et al. (2017) dated the terminal moraine in northern New Jersey, roughly due south of Moss Island, to 25.2 ± 2.1 ka using cosmogenic ^{10}Be exposure dating. This age is similar to ^{10}Be ages from the terminal moraine in southern New England of 27.5 ± 2.2 ka (Balco et al., 2002; Corbett et al., 2017).

In terms of deglaciation, the classical works by Fairchild (1909, 1912) outlined a history of ice lobes, proglacial lakes, and meltwater routing in New York State. Despite a lack of chronology, Fairchild (1909, 1912) depicted the overall pattern of the ice sheet configuration during the deglaciation of New York. Later work, summarized by Muller

Fig. 2. (A) Landsat image of Moss Island acquired in 2015. The Mohawk River enters from the west side of the image and flows eastward, skirting Moss Island to the north. The New York State Canal System lies on the southern margin of Moss Island. (B) and (C) Photographs of potholes on Moss Island.

and Calkin (1993), added a chronological framework to events across New York, which continues to be updated (e.g., Kozlowski et al. in press). Following the maximum ice advance (Nissouri Stade), deglaciation of the Finger Lakes region in central New York — where more work has been done than near Moss Island — involved periods of recession (Erie Interstade at ~20 ka) and readvances (the Port Bruce stade at ~18–17 ka and the Port Huron stade at ~16–14.3 ka). In the Mohawk River valley, Ridge (2004) described an advance associated with the outer Valley Heads ice limit referred to as the Hinckley-St. Johnsville Readvance, which took place ~17 ca ka. Ridge (2004) also described an advance associated with the inner Valley Heads ice limit as the Barnevald-Little Falls Readvance, which took place ~16.2 ka.

How the Finger Lakes' glacial history relates to the Moss Island site is not well constrained. Moss Island lies in a region of convergence of three major ice lobes: the Adirondack Lobe from due north, the Ontario Lobe (that formed the Valley Heads ice limits) from the west, and the Mohawk Lobe (sometimes referred to as the Mohawk-Hudson Lobe) from the east. Fairchild (1912) depicted the Ontario and Mohawk lobes as contemporaneous, resulting from downwasting ice around the Adirondack Lobe (and later, the Adirondack Nunatak). Muller and Calkin (1993) described drainage through the Mohawk and Hudson valleys during the Erie Interstade, as the LIS temporarily withdrew from the uplands of central New York (Mörner and Dreimanis, 1973). Ridge et al. (1991) recognized the Erie Interstade in the Mohawk Valley as an erosional interval named the Shed Brook Discontinuity, which produced the Little Falls Gravel. The events of this time period have been further described by Ridge (1997) and Stanford (2010). However, recent investigations in central New York shed doubt on ice recession significant enough to allow drainage through the Mohawk at this time (Karig, 2015).

Although the Mohawk River lowland held eastward-flowing meltwater during many separate intervals between ice margin fluctuations throughout the last glaciation and deglaciation (Fairchild, 1909, 1912; Muller and Prest, 1985), the timing of final ice retreat is most relevant for ^{10}Be ages from Moss Island. Retreat from the Little Falls-Berneveld advance would have been the final deglaciation of Moss Island (~16 ka; Ridge and Franzi, 1992; Ridge, 2003, 2004). It is unclear, however, if the Moss Island site would have been covered by ice-dammed lakes and sediments for a period of time prior to the existence of Lake Iroquois and the Iro-Mohawk spillway (Ridge and Franzi, 1992; Franzi et al., 2007). In any case, at some time following deglaciation, the Iro-Mohawk River became the spillway of Lake Iroquois until the LIS retreated north of the Adirondack Mountains and a lower spillway became available (Pair and Rodrigues, 1993; Rayburn, 2004).

3. Methods

We surveyed the position of potholes across Moss Island using handheld and Trimble differential GPS devices. For pothole locations, elevations were obtained using light detection and ranging (LiDAR) data provided by the New York Geologic Survey of the New York State Museum (3 m resolution) to determine precise elevations for pothole locations. LiDAR data were also used to generate digital elevation models (DEMs).

Twelve samples weighing about 1 kg each were collected from quartz veins found within syenitic bedrock at a variety of elevations across Moss Island (Fig. 4) for cosmogenic ^{10}Be exposure dating. Samples were collected with a hammer and chisel and a battery-powered angle grinder with a diamond blade. Geographic location data were collected using a Garmin Colorado 400 t handheld GPS/DGPS device. The Garmin Colorado 400 t has a GPS accuracy of <10 m. The elevations of sample locations were recorded using LiDAR data provided by the NYS Museum. The LiDAR data were used preferentially over the handheld GPS data because of higher vertical accuracy (<1 m). LiDAR elevation data are reported in Table 1 using Universal Transverse Mercator (UTM), Zone 18 N, North American Datum (NAD) 1983 coordinates.

After field collection, samples were processed in the rock crushing and cosmogenic laboratories at the University at Buffalo. Samples were crushed then sieved to a grain size of 500–250 μm. Quartz was isolated and purified using heavy liquid separation and repeated etching in dilute hydrofluoric (HF) acid. Subsequently, ^{10}Be was extracted and purified from clean quartz samples following protocols outlined in Corbett

Table 1
^{10}Be ages of sampled quartz veins from Moss Island[a].

Sample	Latitude (°)	Longitude (°)	Elevation (m)	Thickness (cm)	Shielding correction	Quartz (g)	^{9}Be carrier (μg)	^{10}Be (atoms g-1)	^{10}Be uncertainty (atoms g-1)	^{10}Be age (ka) (*NENA Lm*)	^{10}Be age (ka) (*NENA LSDn*)
73-15MI-1	43.03967	−74.84906	124.4	2.0	0.992201	40.0720	225.69775	2.09E + 05	3.89E + 03	49.0 ± 0.9	49.3 ± 0.9
73-15MI-2	43.03985	−74.84917	125.8	1.0	0.992201	40.0686	227.74650	1.03E + 05	2.59E + 03	24.0 ± 0.6	24.2 ± 0.6
73-15MI-3	43.03899	−74.84788	126.3	1.0	0.991663	40.1481	228.97575	1.09E + 05	1.81E + 03	25.5 ± 0.4	25.7 ± 0.4
73-15MI-4	43.03896	−74.84753	124.0	2.0	0.991663	40.1347	224.35675	8.78E + 04	2.01E + 03	20.7 ± 0.5	20.9 ± 0.5
73-15MI-5	43.03909	−74.84657	118.4	1.5	0.994938	35.0237	223.12750	1.66E + 05	2.72E + 03	38.9 ± 0.6	39.1 ± 0.6
74-15MI-6	43.03955	−74.84720	120.5	1.0	0.994938	40.3490	225.36250	1.03E + 05	1.93E + 03	24.0 ± 0.5	24.3 ± 0.5
74-15MI-7	43.04027	−74.84746	102.7	1.0	0.993484	40.2142	226.03300	5.98E + 04	1.14E + 03	14.5 ± 0.3	14.8 ± 0.3
74-15MI-8	43.04050	−74.84764	101.9	1.0	0.996895	40.2031	226.88975	6.80E + 04	1.30E + 03	16.3 ± 0.3	16.7 ± 0.3
80-16MI-1	43.04075	−74.84870	102.1	1.5	0.986143	20.5184	245.92450	5.92E + 04	1.27E + 03	14.4 ± 0.3	14.7 ± 0.3
80-16MI-2	43.04067	−74.84845	101.9	1.0	0.992413	23.3884	246.89300	5.30E + 04	1.10E + 03	12.7 ± 0.3	13.0 ± 0.3
80-16MI-3	43.04068	−74.84870	104.4	1.5	0.498908	22.4499	246.11075	3.09E + 04	1.05E + 03	14.5 ± 0.5	14.8 ± 0.5
80-16MI-4	43.03938	−74.84622	99.1	1.0	0.878495	19.8354	246.33425	5.95E + 04	1.25E + 03	16.1 ± 0.3	16.4 ± 0.3

[a] Note: Blank-corrected ratios are reported relative to the 07KNSTD standard of 2.85×10^{-12} (Nishiizumi et al., 2007; Rood et al., 2010). Process blanks for batches 73, 74, and 80 are 2.755×10^{-15}, 3.075×10^{-15}, and 3.835×10^{-15} respectively. We used 0.6071, 0.6073, and 0.6594 g of 372.5 ppm Be carrier for batches 73,74, and 80 respectively.

et al. (2016). Isotope ratios were measured using accelerator mass spectrometry at the Center for Accelerator Mass Spectrometry at the Lawrence Livermore National Laboratory in Livermore, CA.

Beryllium-10 exposure ages were calculated using the regional ^{10}Be production rate for northeastern North America (NENA; Balco et al., 2009) and the CRONUS-Earth online exposure age calculator v. 3 (Balco et al., 2008; http://hess.ess.washington.edu/math/index_dev.html) using the 'Lm' and 'LSDn' scaling schemes. All interpretations and discussion of ^{10}Be ages presented in the text are based on Lm scaling using the internal error (AMS analytical uncertainty only).

4. Results

A total of 264 potholes were recorded in the syenitic-gneiss across Moss Island (Fig. 3). Most potholes are concentrated along the northern margin on what we interpret as a strath terrace 5–10 m above and adjacent to the present-day Mohawk River. We interpret this surface as a strath terrace because, although undulatory, it is a bedrock surface that forms a step between the river and the uppermost level of Moss Island. Potholes range in elevation from ~100 to ~116 m asl (Fig. 3). The potholes themselves are diverse in terms of size range. Pothole

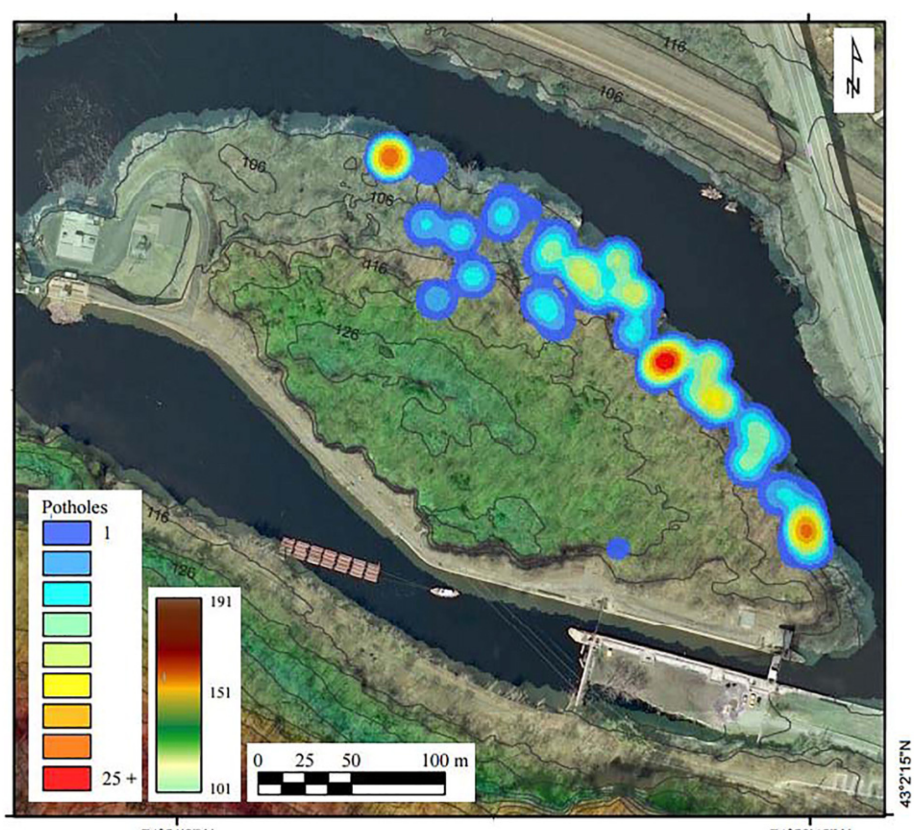

Fig. 3. Pothole density distribution on Moss Island. The pothole density layer was created using the kernel density tool in ArcMap10.2.2. Input for kernel density came from pothole location data recorded during the pothole survey of Moss Island. The kernel density output cell size was 0.89 m with a 0.5 m search radius and area units in km^2. The base layer of the map consists of aerial orthoimagery obtained from Earth Explorer, overlain by a hillshade elevation map created from a LiDAR DEM obtained from the New York State Museum. The contour interval is 5 m.

radii range from ~0.25 to 6 m, and the average radius of surveyed potholes is ~1 m. Pothole depth to sediment (or the Mohawk River) was also recorded. These depths range from ~0.5 to 6 m, and the average pothole depth is ~2 m. The potholes are mostly circular, although some are more elongate. In some places, potholes have coalesced into one another to form larger (elongate) features. Potholes are largely clustered together in groups of up to ~25 within a relatively small area (Fig. 3).

The ^{10}Be ages of the 12 quartz vein surfaces sampled from Moss Island range from 12.7 ± 0.3 to 50.0 ± 0.9 ka (Table 1; Fig. 4). Six ^{10}Be ages were obtained from the strath terrace, which range from 12.7 ± 0.3 to 16.3 ± 0.3 ka and average 14.8 ± 1.3 ka. The six ^{10}Be ages from the upper surface of Moss Island range from 20.7 ± 0.5 to 50.0 ± 0.9 ka (Fig. 5).

5. Interpretation and discussion

The distribution of potholes on Moss Island indicates turbulent meltwater outflow, presumably from Lake Iroquois rising high enough, at least at times, to cover the flanks of Moss Island but not its upper elevations (Fig. 3). Potholes are mainly distributed on the island's undulating strath terrace, from ~100 to ~116 m asl. A channel where the present-day Erie Canal and Lock 17 lie may also have existed, flowing onto Moss Island from the southern side, as evidenced by the lone pothole surveyed on that side of the island (Fig. 3). The upper surface of Moss Island is pothole free, with the exception of the lone pothole on the south side that is higher in elevation that most other potholes. The elevations >116 m asl up to the island's crest at 136 m asl lie above the strath terrace. Some surfaces, mainly quartz veins, on this level display fine striations and polish.

The ^{10}Be ages fall into two groups. The ^{10}Be ages from the strath surface form a relatively tight cluster averaging 14.7 ± 1.3 ka (Fig. 4).

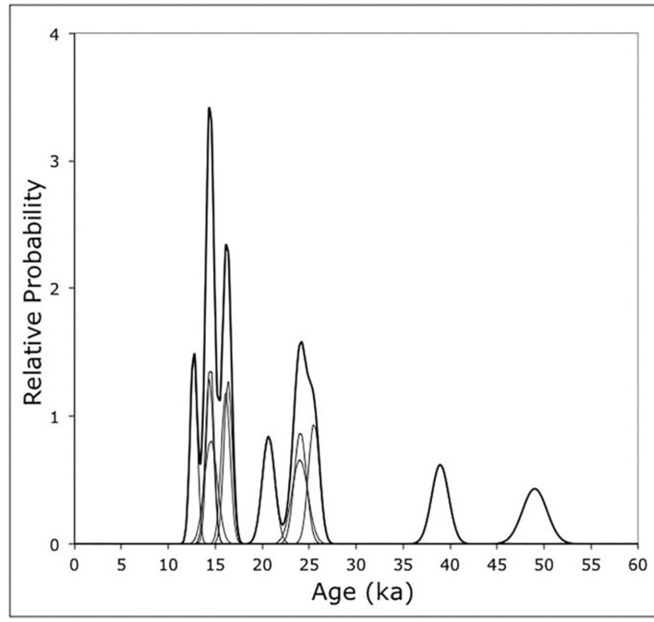

Fig. 5. Relative probability distribution of all 12 ^{10}Be ages from Moss Island. Thin blue line is the relative probability of each individual age; the thicker black line is the summed probability of all the ages.

In contrast, the ^{10}Be ages from the upper surface of Moss Island form the second group of ages and are significantly older than those from the strath surface (Fig. 6). Also, more scatter in ages is seen in the upper surface than from the strath surface. Some of the ages form a cluster around 24 ka, but there are also ages of 39.7 and 48.5 ka (Fig. 6). The

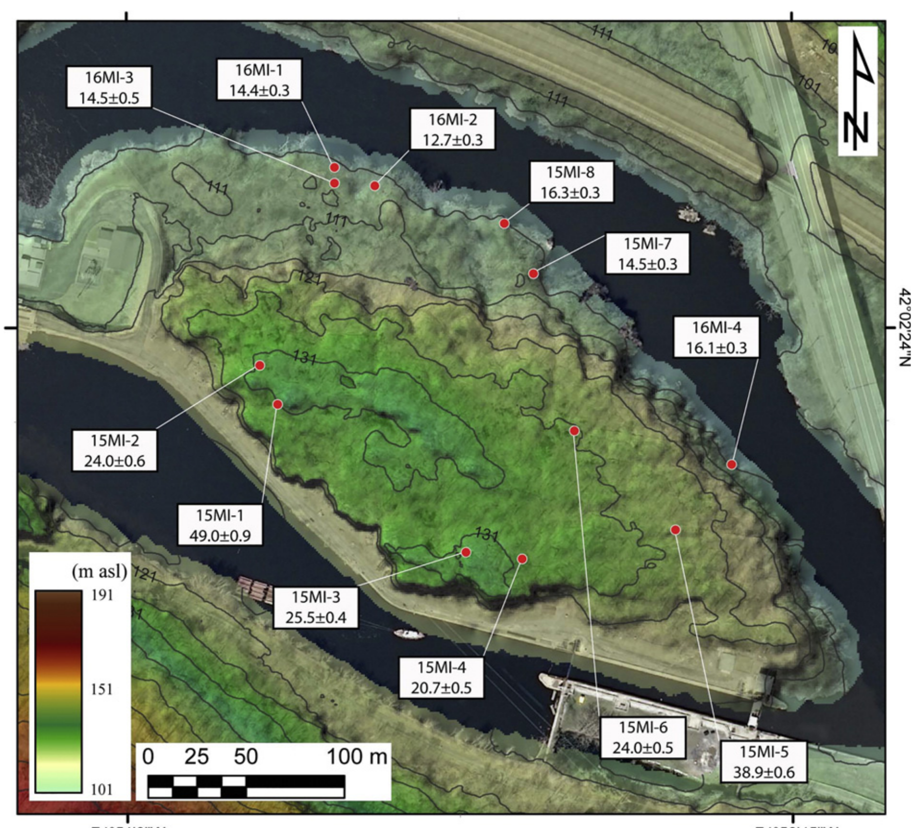

Fig. 4. Map of Moss Island showing the 12 sample collection sites and ^{10}Be ages. Contour interval is 5 m. The base layer of the map consists of aerial orthoimagery acquired in 2013 and obtained from Earth Explorer in March of 2016. The base layer imagery is overlain by a hillshade elevation map created from a LiDAR DEM obtained from the New York State Museum.

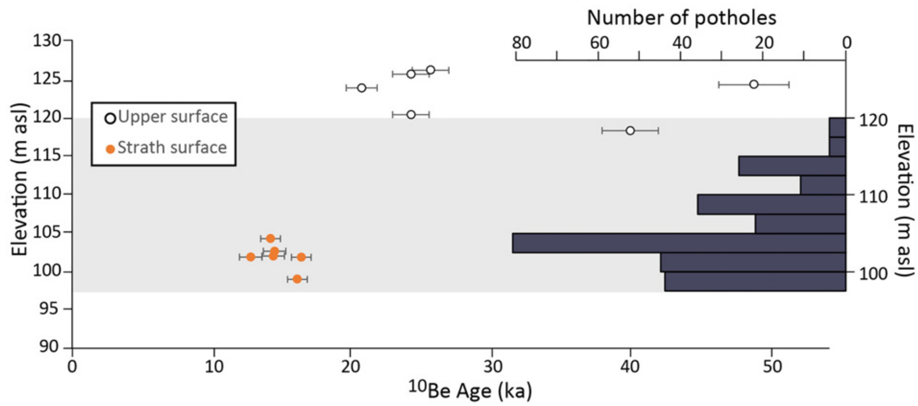

Fig. 6. ^{10}Be ages and pothole distribution vs. elevation. The gray zone marks the elevation range of the strath surface, revealed by the abundance of potholes. The potholes histogram is binned in 2.5 m.

^{10}Be ages combined with the geomorphic characteristics of Moss Island's surfaces help us to interpret its history. The heavily potholed strath surface likely was submerged by the Iro-Mohawk River following deglaciation of the site. Although the upper level of Moss Island lacks potholes, contains primary glacial surfaces, and has ^{10}Be ages that suggest it was never significantly impacted by the Mohawk River, we cannot eliminate the possibility that it was.

The ^{10}Be ages from the upper surface of Moss Island predate the last deglaciation of the site. Because the best-known age of deglaciation in the region is ~16 cal ka BP (Ridge, 2004), Moss Island's upper surface likely contains isotopic inheritance. This implies that the 2–3 m of glacier erosion (Gosse and Phillips, 2001) required to remove previously accumulated ^{10}Be (for example, from exposure prior to the Last Glacial Maximum) were not achieved on Moss Island during the last glacial overriding. This may be in part because of Moss Island's location being at the bottom of a canyon-like river valley that was perpendicular to regional ice flow for much of the last glaciation. There are occurrences elsewhere where bedrock surfaces composed of well-indurated crystalline lithologies were eroded <2 m during the last glacial cycle (e.g., Briner and Swanson, 1998; Heyman et al., 2011).

Although no direct age control exists for deglaciation at Moss Island, the regional retreat chronology suggests that the ^{10}Be ages from the strath surface may post-date the last deglaciation by centuries or a millennium. Given the pothole evidence that the strath surface was eroded by the Mohawk River for some amount of time, we next investigate whether the strath surface ages reflect the abandonment of the Lake Iroquois outflow through the Mohawk River valley.

The average ages from the strath terrace at Moss Island (14.7 ± 1.3 ka) are older than existing constraints on the meltwater rerouting event from the Mohawk River valley to the Champlain-Hudson route (13.2 ka). There are several possibilities for the age discrepancy. The existing radiocarbon constraints on the rerouting event may be too poorly constrained to rule out an earlier age. A secure age for a glacial Lake Iroquois main phase comes from two radiocarbon ages come from the same wood sample from Lake Iroquois sediments that range from ca. 15,580–13,830 cal YBP (Calkin and Brett, 1978). Another important age comes from an *Ovibos moschatus* (musk ox) fossil recovered from glacial Lake Vermont sediments near Elizabethtown, New York that dates to ca. 13,140–13,420 cal YBP (Franzi, 1992; Rayburn et al., 2007). The musk ox fossil provides a minimum age estimate for the Coveville Level of Glacial Lake Vermont, which existed prior to the Lake Iroquois meltwater rerouting event. The existing chronology is fairly robust; nevertheless, it is based on few radiocarbon age constraints.

A second possible explanation is that the strath terrace age cluster is older than the meltwater rerouting event because of isotopic inheritance in the strath surface bedrock. Like the upper surface of Moss Island, erosion required to reset the cosmogenic clock was perhaps not fully achieved on the strath terrace either, even with the addition of fluvial erosion from Lake Iroquois outflow. Inheritance would yield exposure ages older than the true exposure age. Despite the strath surface being riddled with large potholes, our samples are from surfaces between the potholes themselves; thus, conceivably post-glacial fluvial abrasion may not have completely removed inherited ^{10}Be that existed upon deglaciation. The individual ages range from ~16.3 to 12.7 ka; hence, they span older and younger events than the radiocarbon estimate for the hypothesized rerouting event of ~13.2 ka.

An additional interpretation for the ^{10}Be ages from the strath surface is that they relate to migration of the Little Falls knickpoint rather than to the rerouting event. In this scenario, the following might have occurred: (i) following regional deglaciation, the position of the Little Falls knickpoint was located east of Moss Island, perhaps at the crystalline/Paleozoic rock contact along the NE-SW oriented fault where the present canyon widens (Agle et al., 2005); (ii) Lake Iroquois outflow (with much higher discharge than today) along the Mohawk River channel initiated knickpoint migration westward through the crystalline basement rocks, passing by Moss Island, leading to the abandonment of the Moss Island strath terrace at ~14.8 ± 1.3 ka; (iii) the Little Falls knickpoint continued to migrate westward (upstream) until the rerouting event at ~13.2 ka, at which time the Little Falls knickpoint became 'frozen' near its current location. The knickpoint migration hypothesis may be another explanation for the exposure age of Moss Island's strath terrace pre-dating the radiocarbon ages for the rerouting event. This hypothesis could be tested if strath terraces at equivalent elevations could be found and dated upstream and downstream of Moss Island.

6. Conclusions

This study yields two groups of ^{10}Be ages from Moss Island, NY. The island's upper surface, which retains glacial polish and striations, yields apparent ^{10}Be ages that pre-date the best-estimated age for deglaciation of the site ~16 ka. The northern flank of Moss Island contains an undulating surface riddled with potholes that we interpret as a strath terrace. The ^{10}Be ages from this surface average 14.8 ± 1.3 ka. The upper surface of the island likely was more prone to cosmogenic inheritance in the absence of significant (if any) fluvial erosion. The average ^{10}Be age from the strath terrace may be related to the rerouting event of Lake Iroquois from the Mohawk River spillway to the Covey Hill col. However, the meltwater rerouting event is currently estimated to have taken place ~13.2 ka. The ^{10}Be ages may be influenced by cosmogenic nuclide inheritance on a surface that was not completely reset or perhaps relates to the migration of the Little Falls knickpoint. Future work, including samples collected closer to the knickpoint location, may help add to this data set.

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