Is eastern Lake Erie a Famennian non-depositional feature?

Raymond C. Vaughan, Ph.D., P.G.
Professional Geologist/Environmental Scientist
Buffalo, NY

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Eastern part of Lake Erie –

Was the lakebed scooped out by erosion?

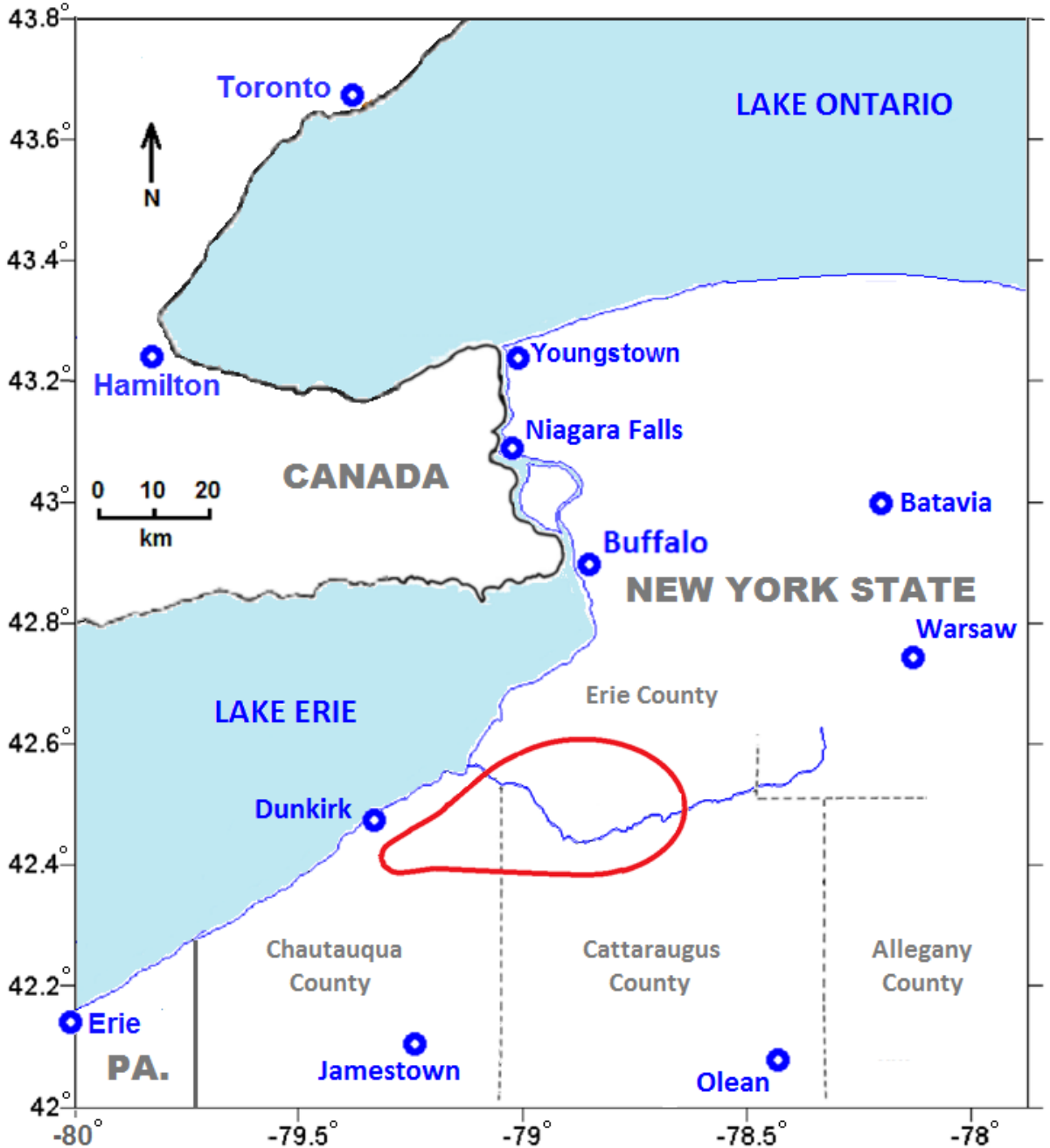
Or does the lake occupy a bedrock low (a bedrock depression) formed mainly by non-deposition during the Famennian?

Primary study area in red:

- Dissected Allegheny Plateau
- Catskill Delta shale, siltstones
- Upper Devonian/Famennian
- Dunkirk & other Formations within the Canadaway Group

Topic of this presentation

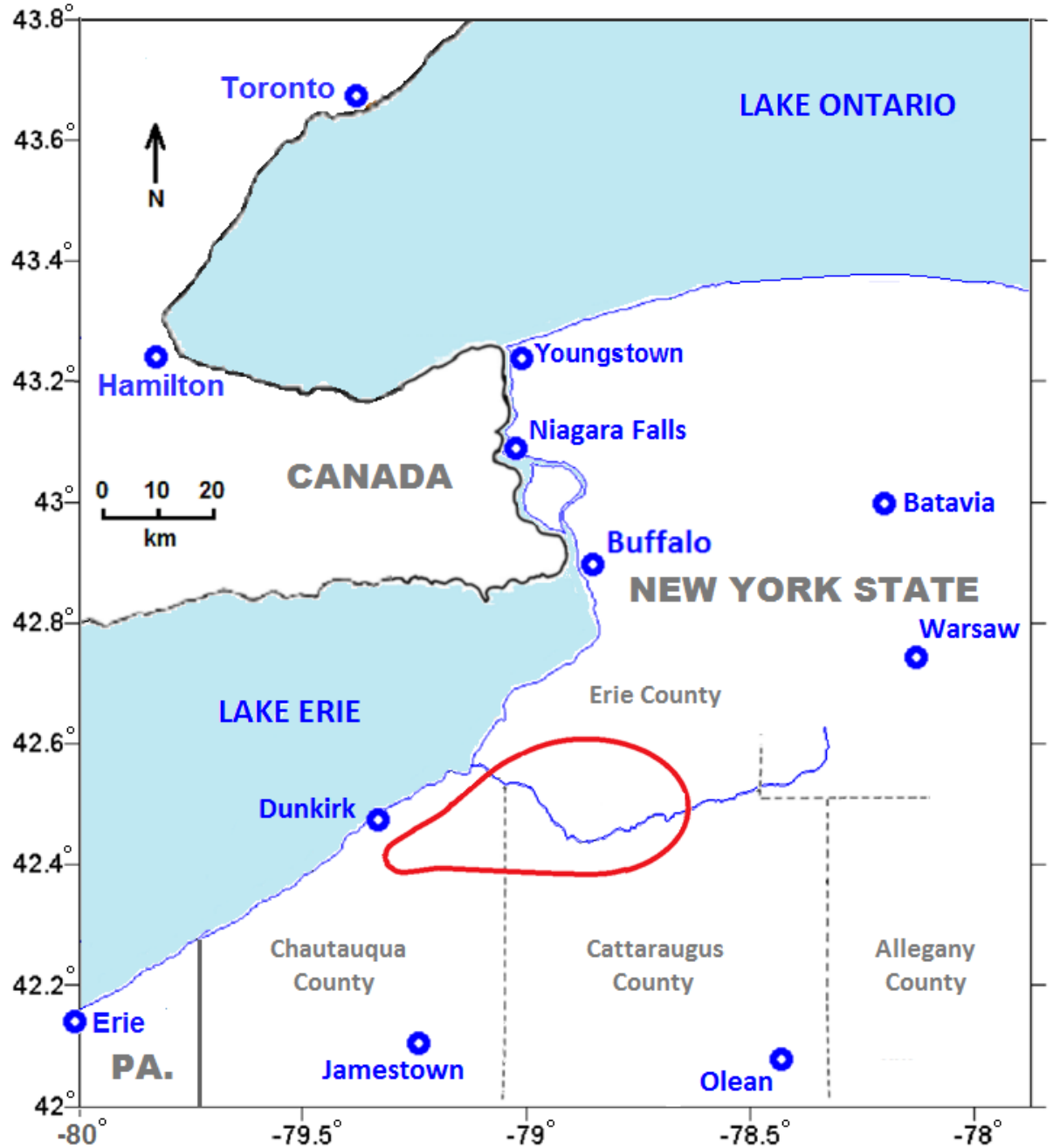
Results from the inland study area (outcrop & well logs) and what they show for Lake Erie



The Great Lakes of North America are often assumed to occupy depressions carved by erosion (flowing water and glacial action)

Lake Ontario is an example

Was the eastern basin of Lake Erie similarly formed?



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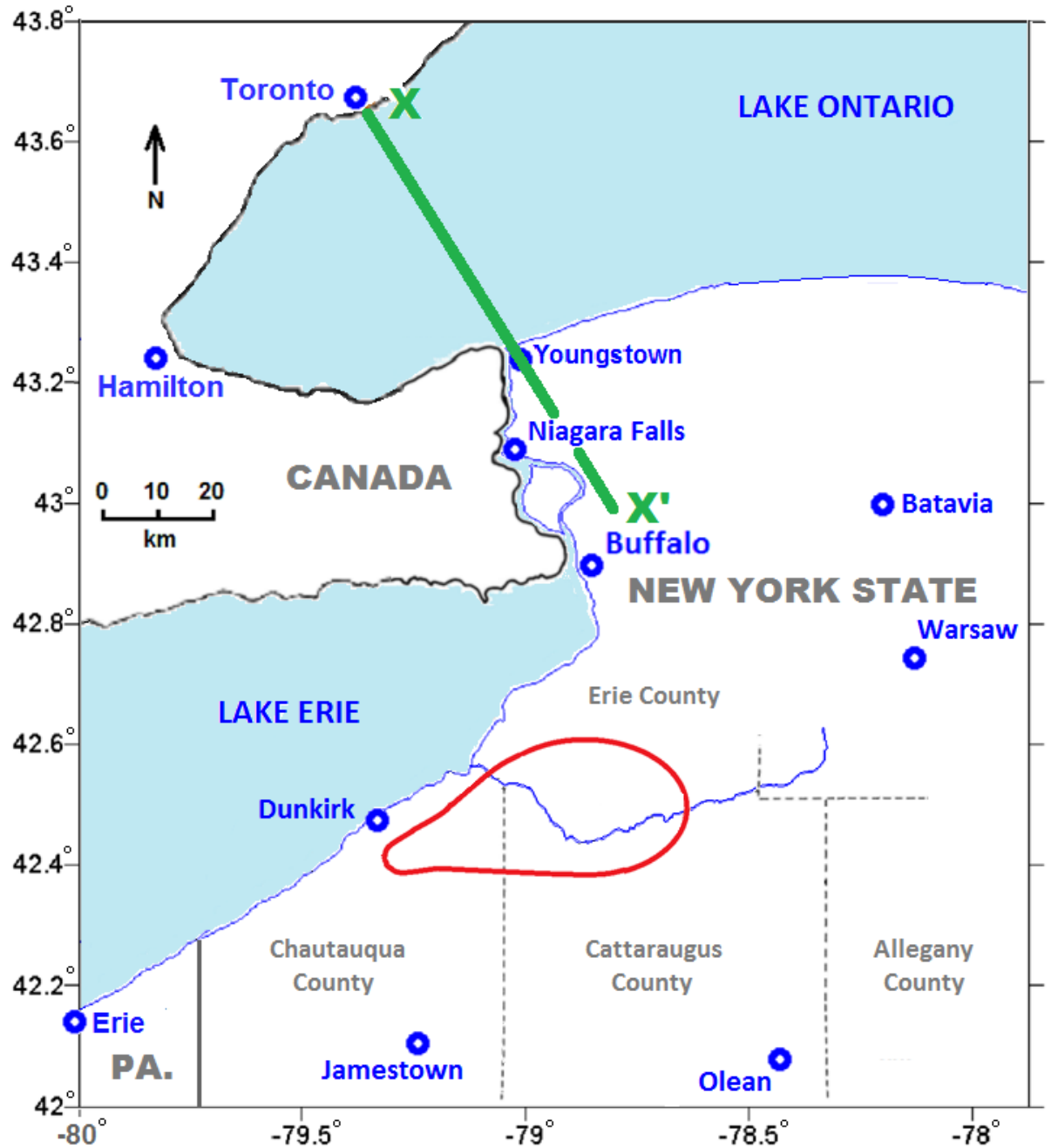
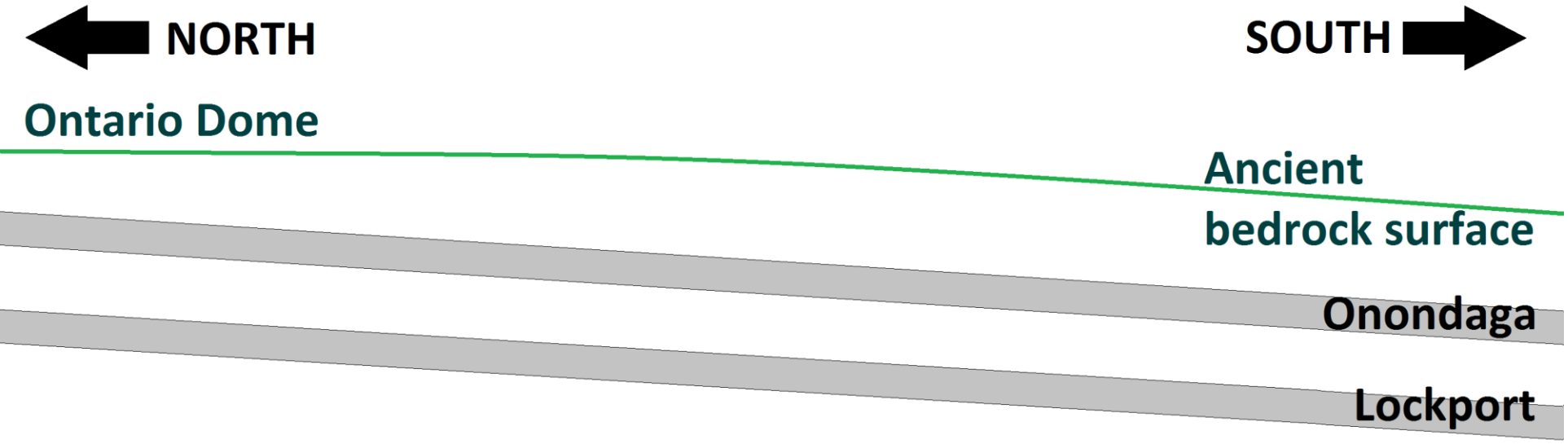
See line of section X – X’



GENERALIZED CROSS-SECTION X – X’



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. . . . . L A K E O N T A R I O . . . . .

Original depositional bedrock surface caps the generally parallel beds such as the Onondaga & Lockport Formations that now dip southward less than 1°

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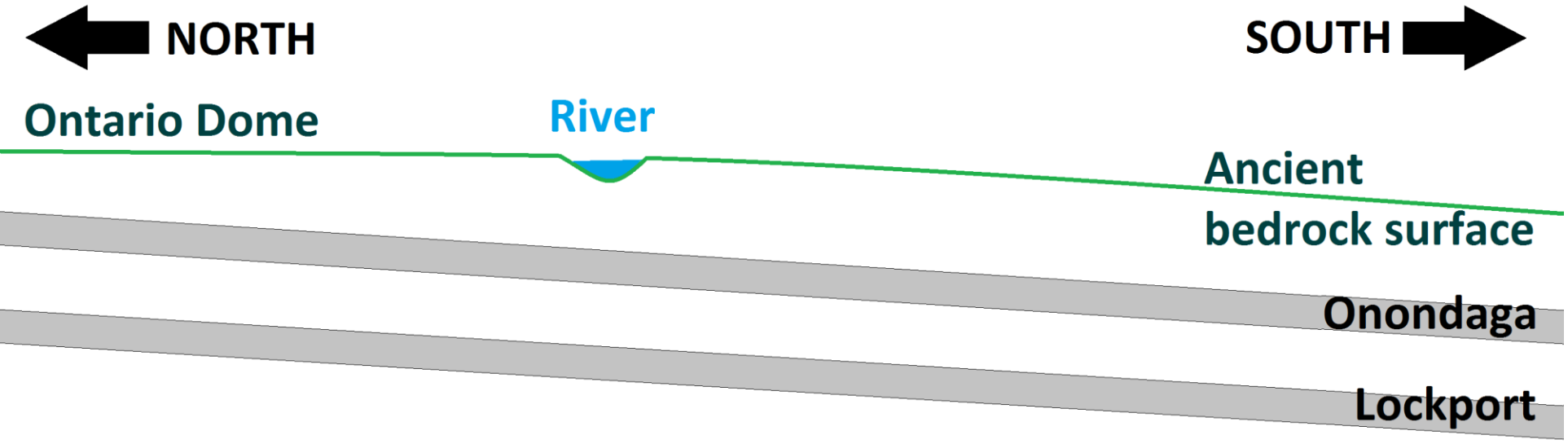

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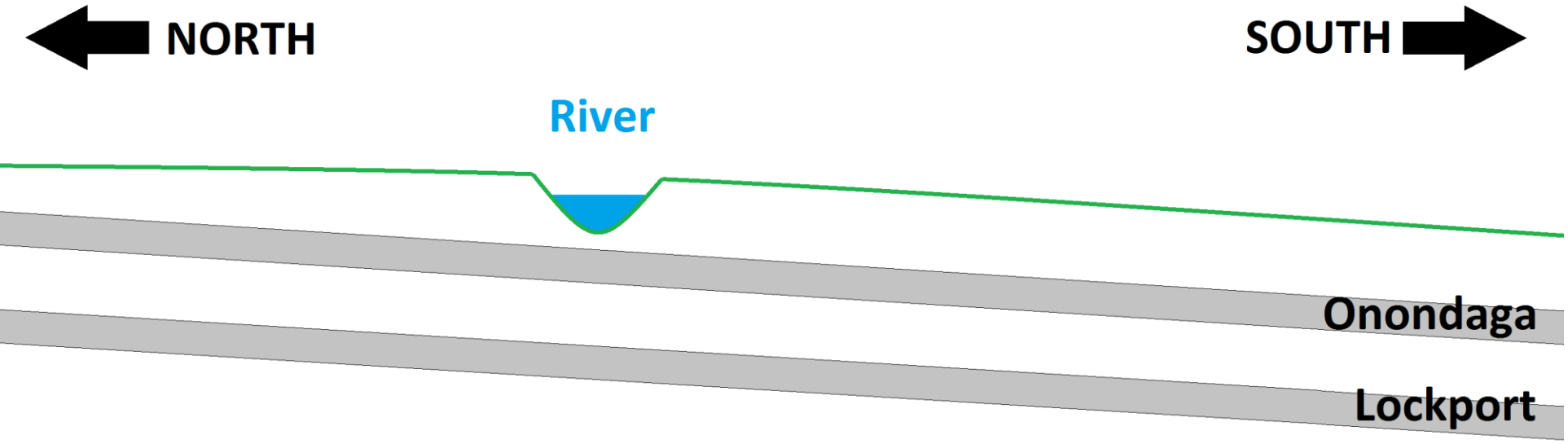

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.....LAKE ONTARIO.....

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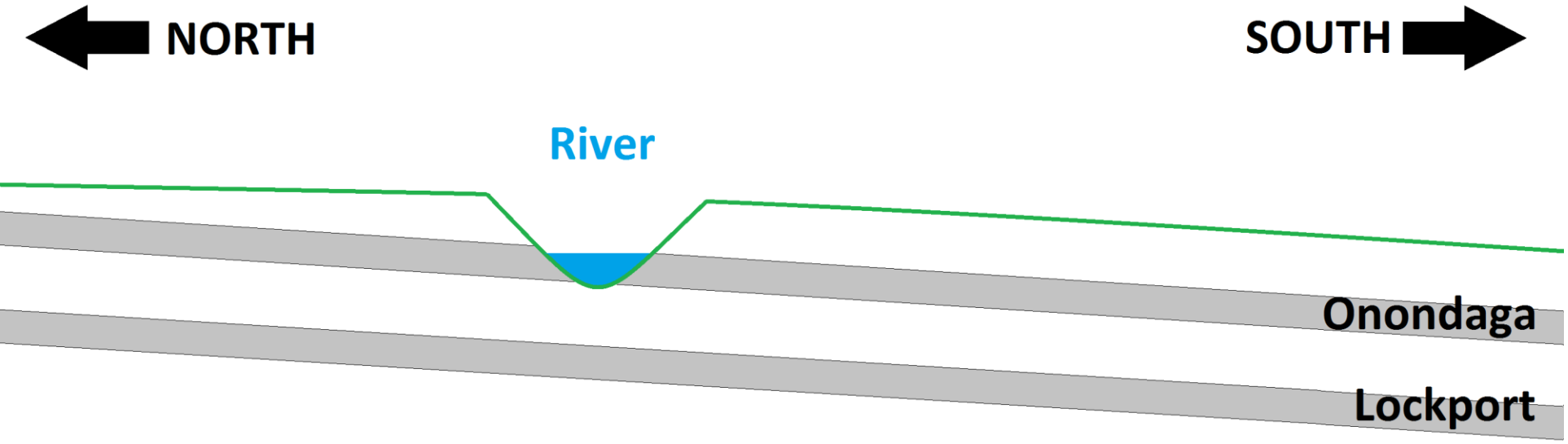

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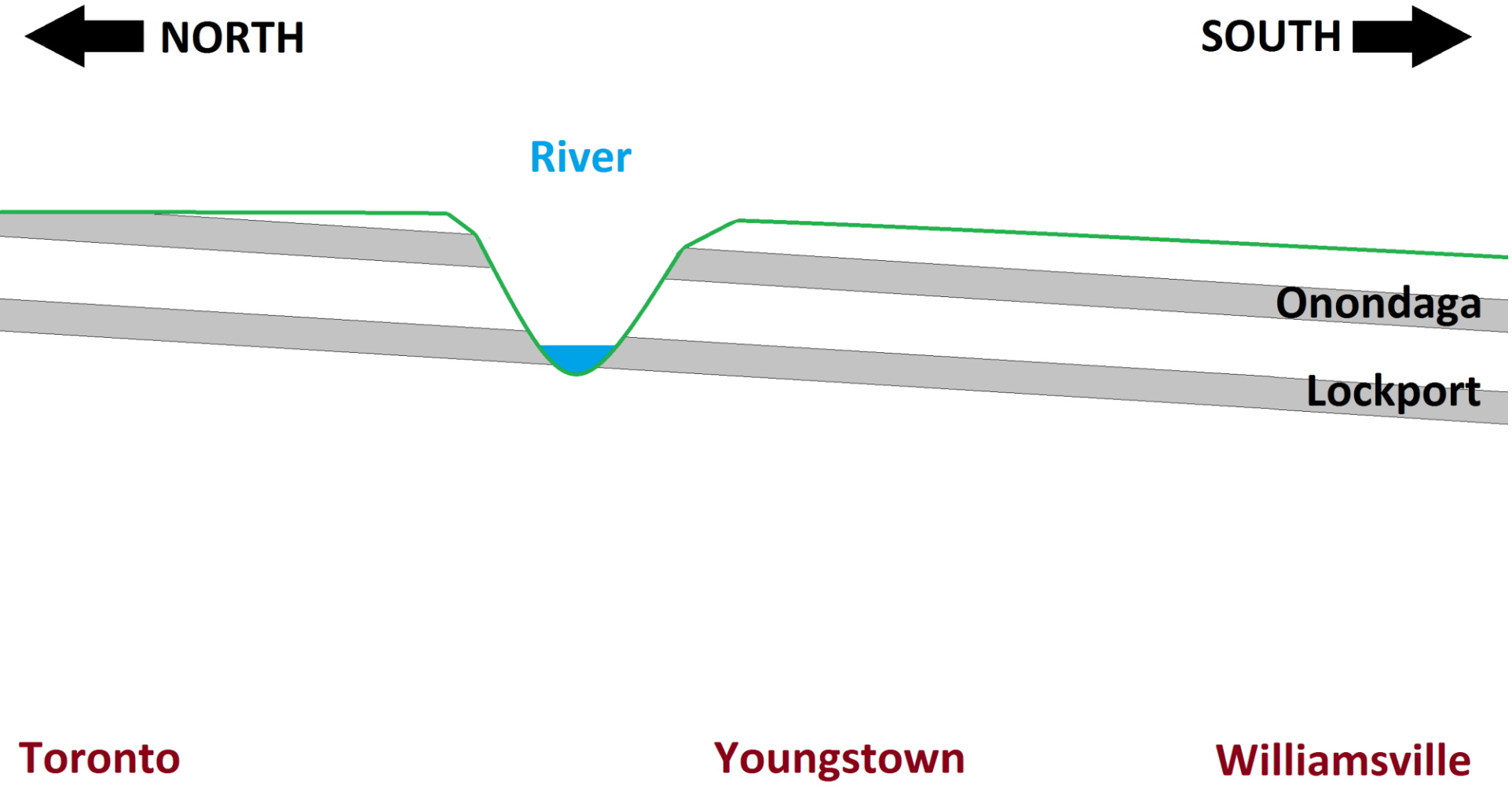

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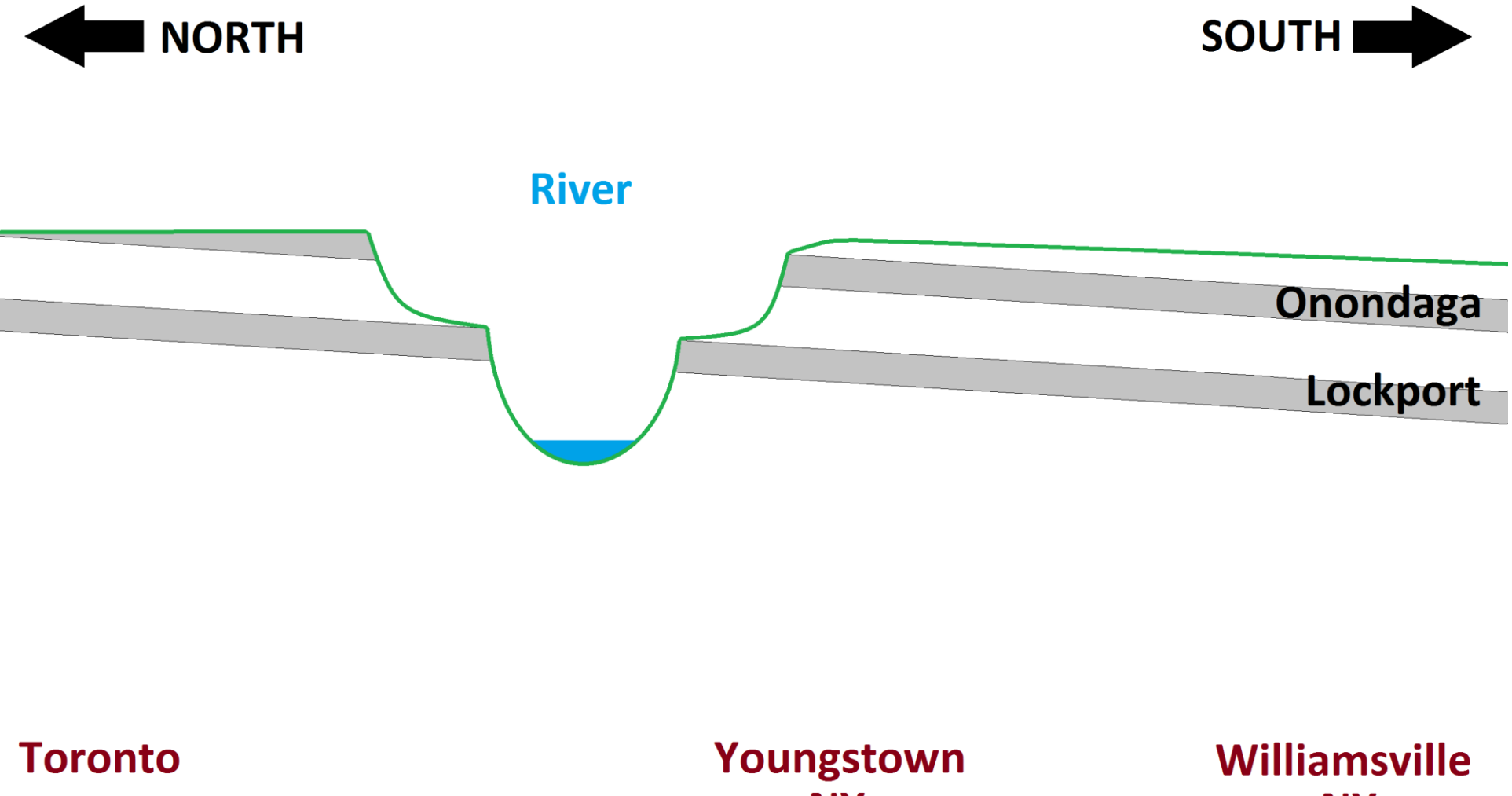

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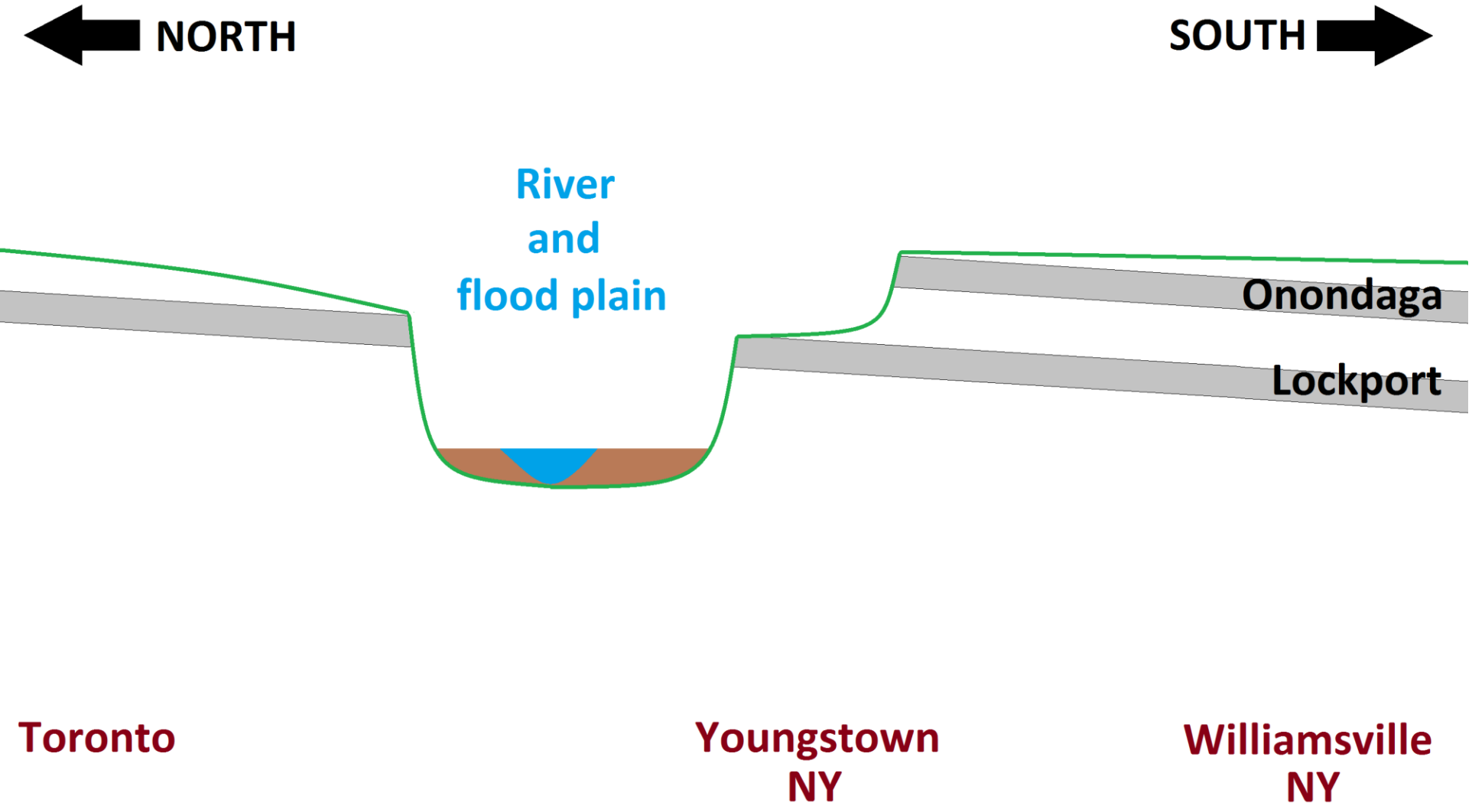

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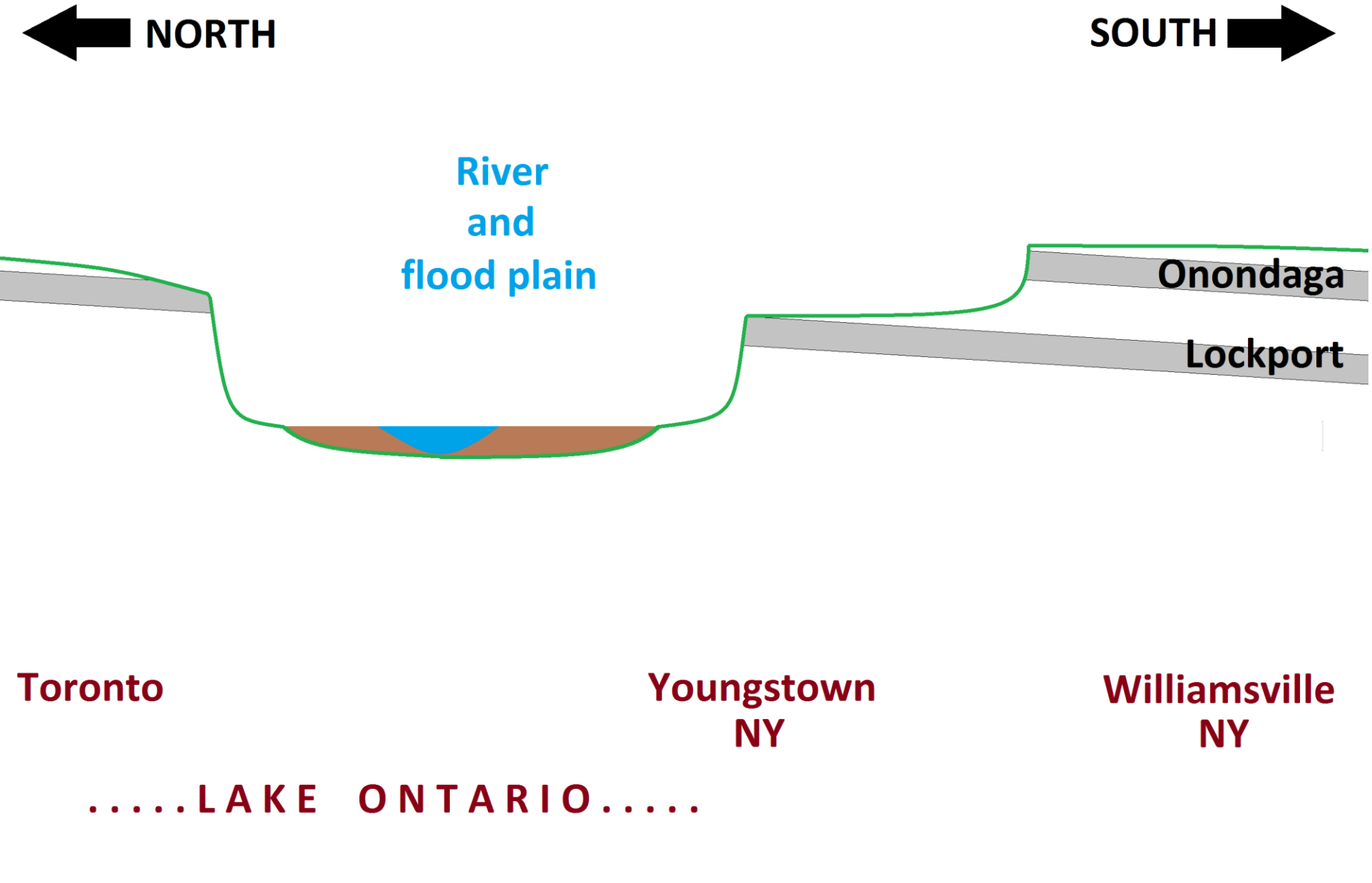

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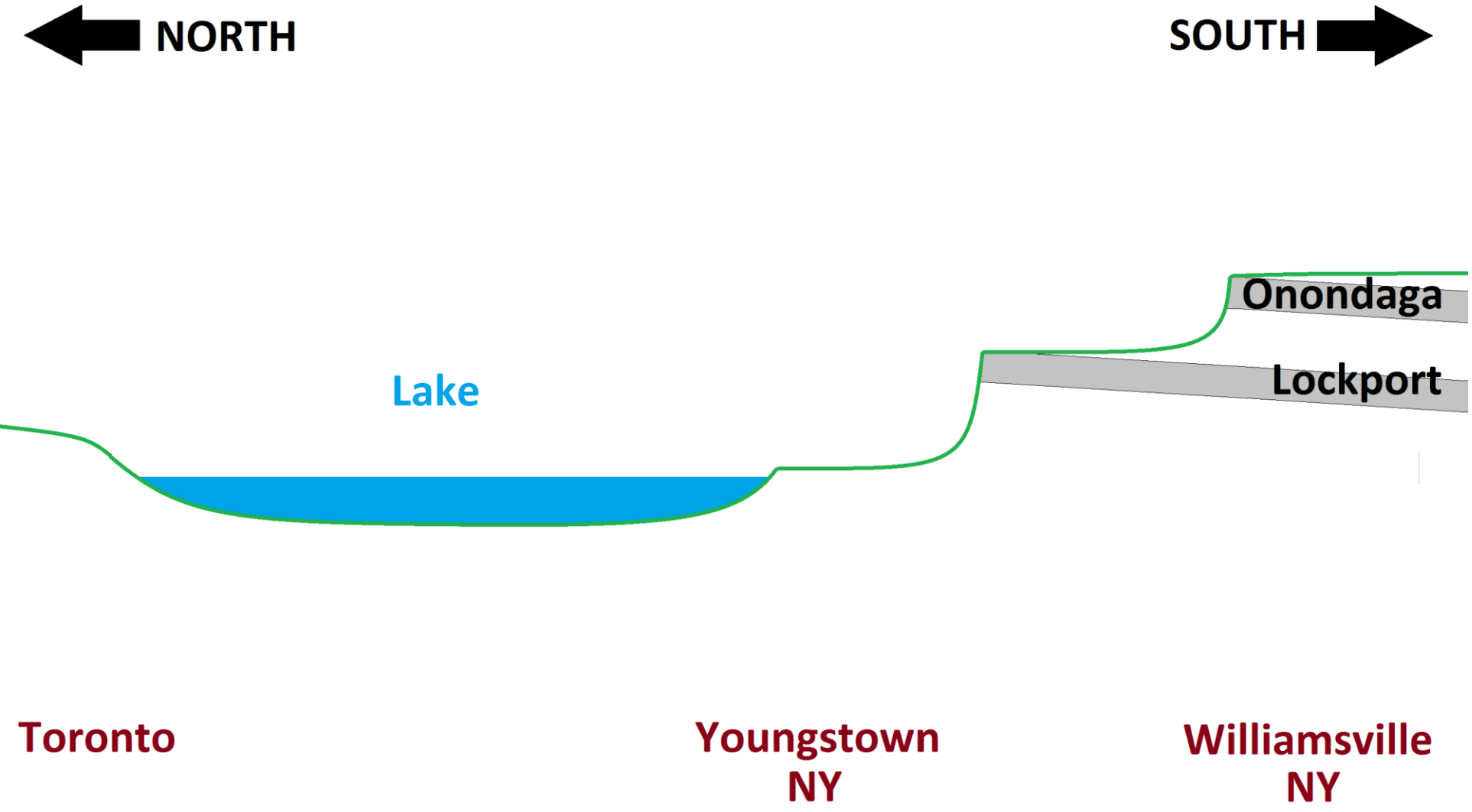

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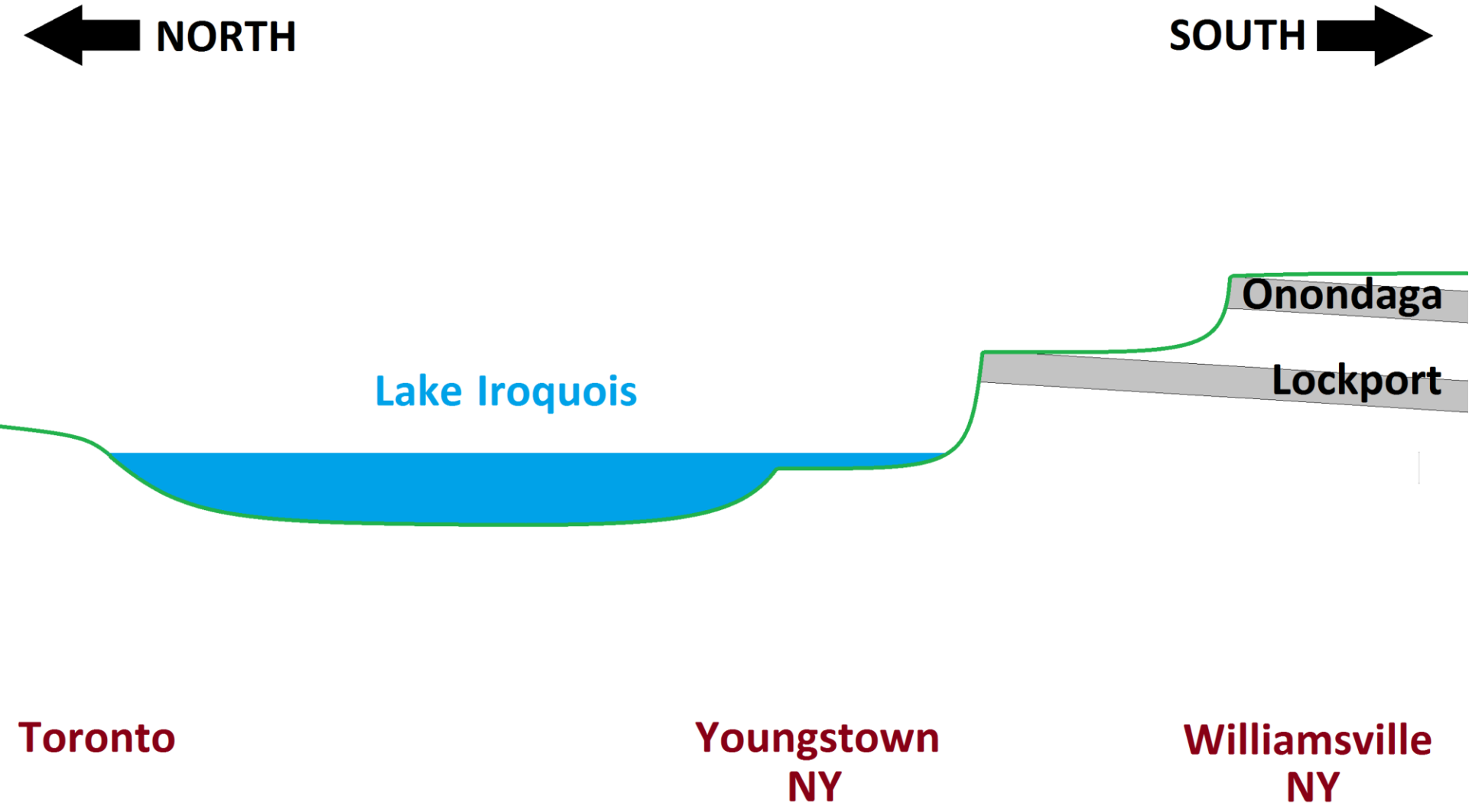

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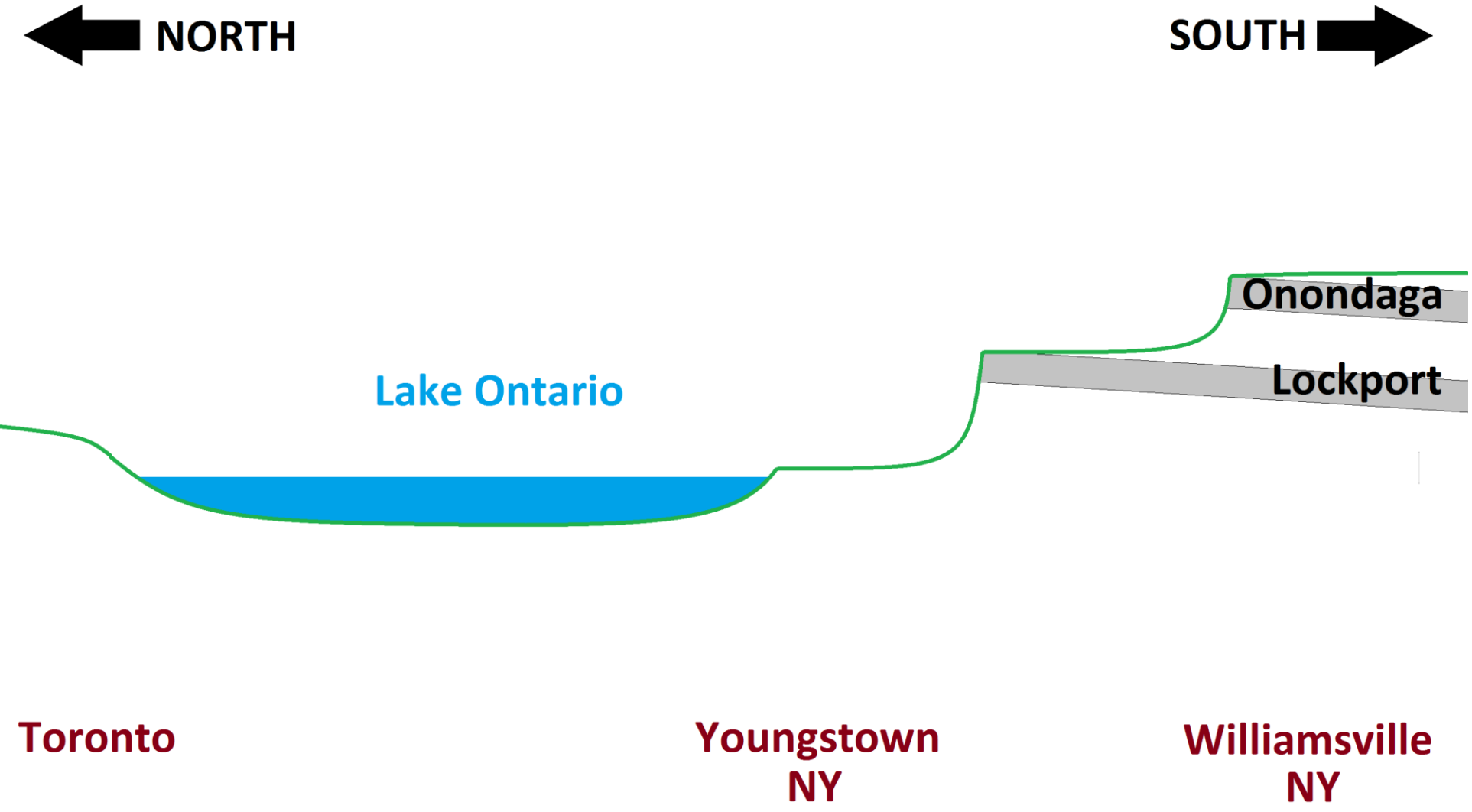


Original depositional bedrock surface **caps the generally parallel beds such as the Onondaga & Lockport Formations that now dip southward less than 1°**

Such erosional excavation can explain not only Lake Ontario but most of the other Great Lakes as well

However, the process by which Lake Erie formed appears different

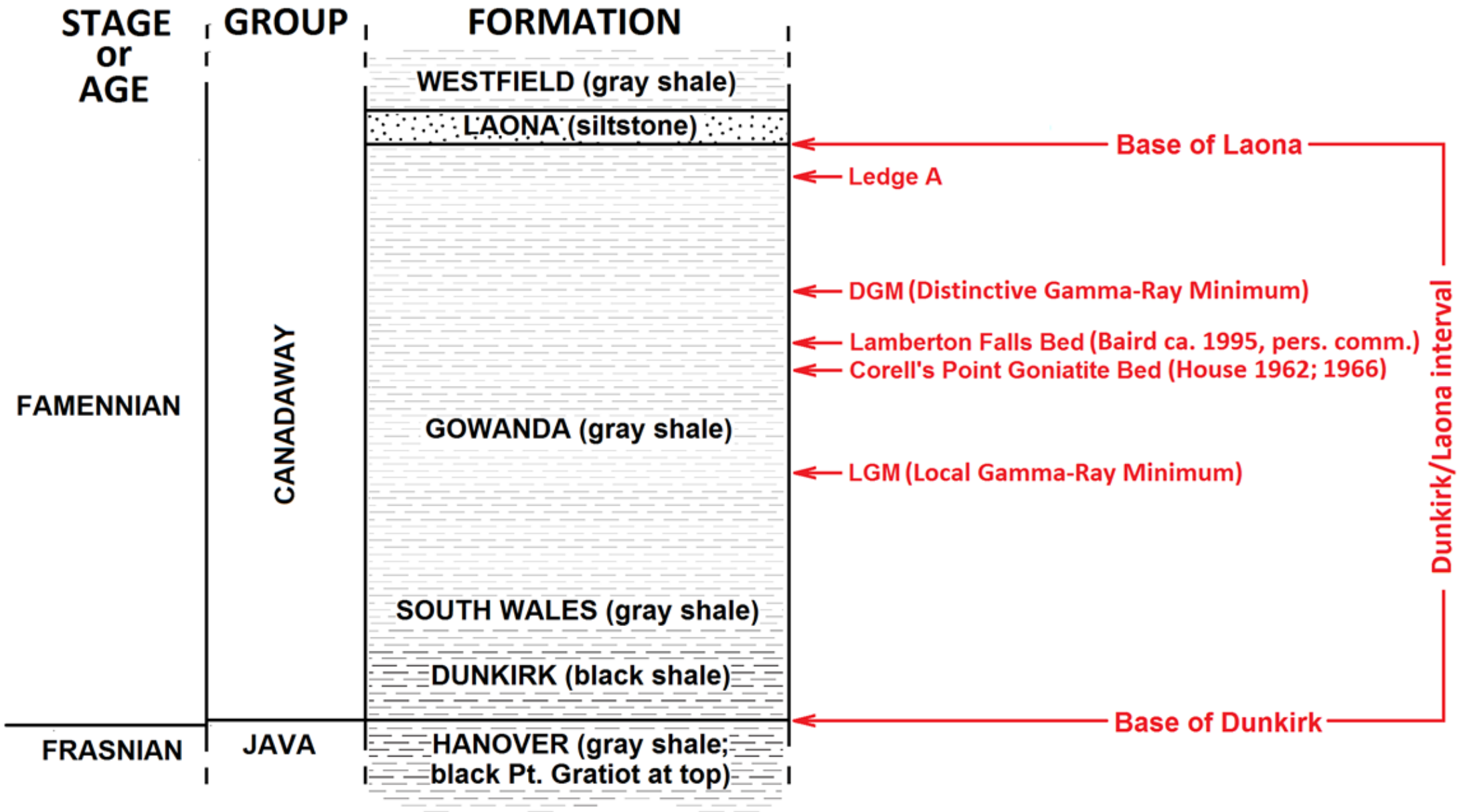
For at least the eastern part of the lake, the evidence points to non-deposition rather than erosional removal as the main agent that formed the bedrock depression occupied by the lake

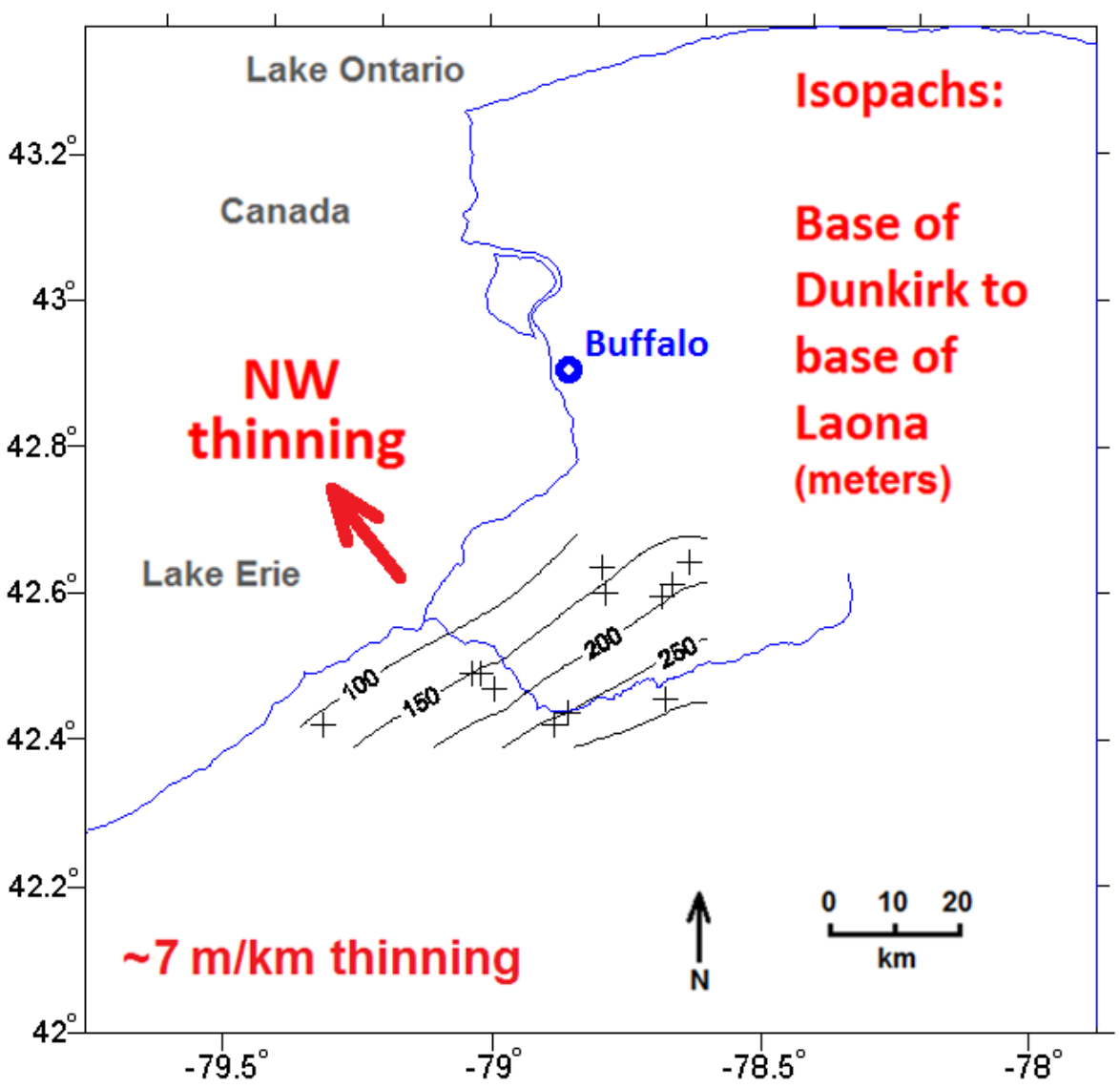
Key evidence, based on outcrop & well logs, as set forth in Vaughan paper in *Bulletins of American Paleontology*, No. 411 (2025):

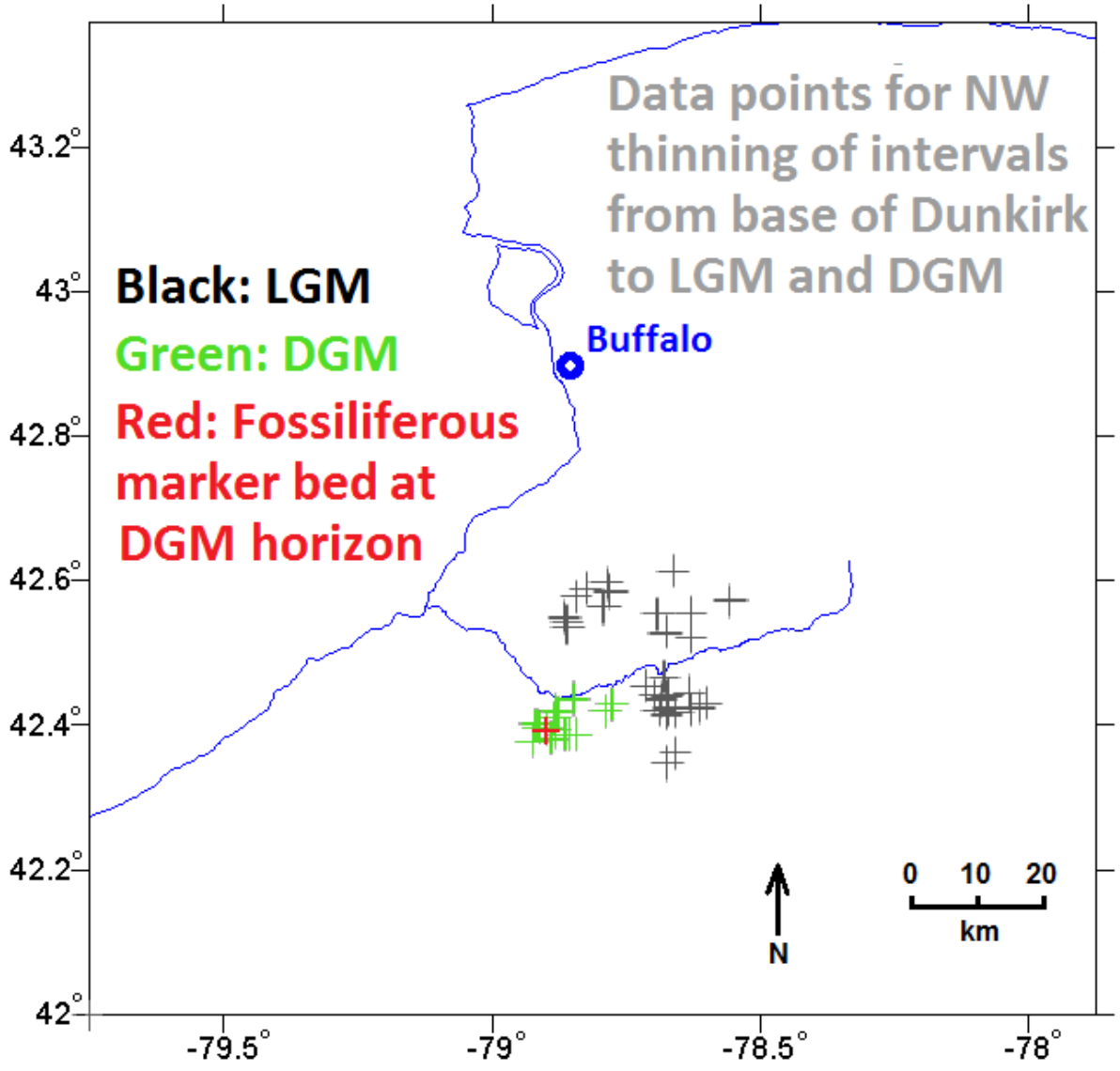
- The Famennian beds in and near the study area thin to the northwest – in other words, toward the lake
- These beds, when projected or extrapolated northwestward beyond the study area, pinch out within the footprint of the lake
- Thinning and pinchout are seen in the interval between the base of the Dunkirk Formation and base of the Laona Fm.
- Similar thinning and pinchout are seen independently in two subintervals, termed Dunkirk/LGM and Dunkirk/DGM, that are seen on gamma logs within the Dunkirk/Laona interval*

*Local Gamma-ray Minimum (LGM); Distinctive Gamma-ray Minimum (DGM)

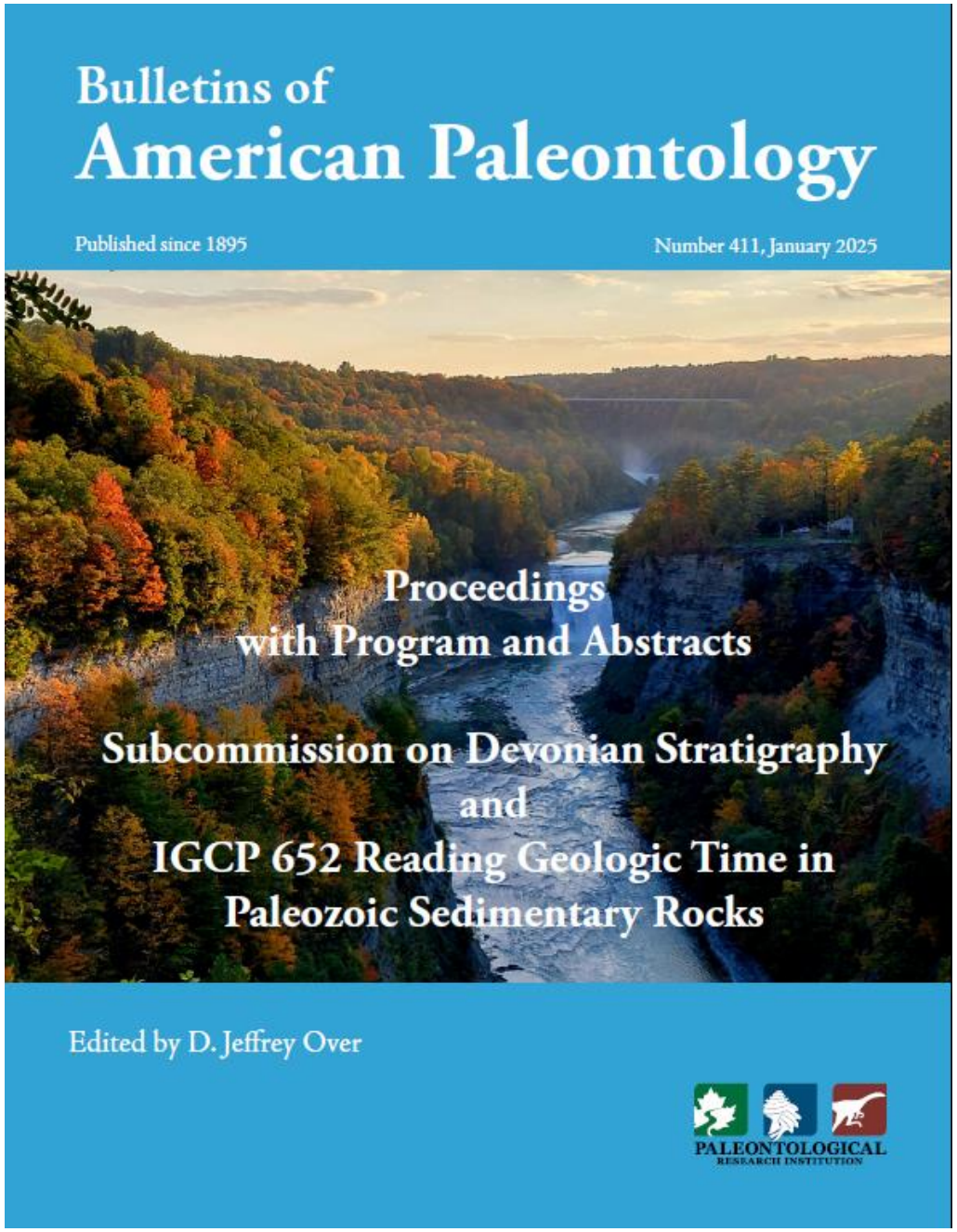
GENERALIZED STRATIGRAPHIC COLUMN

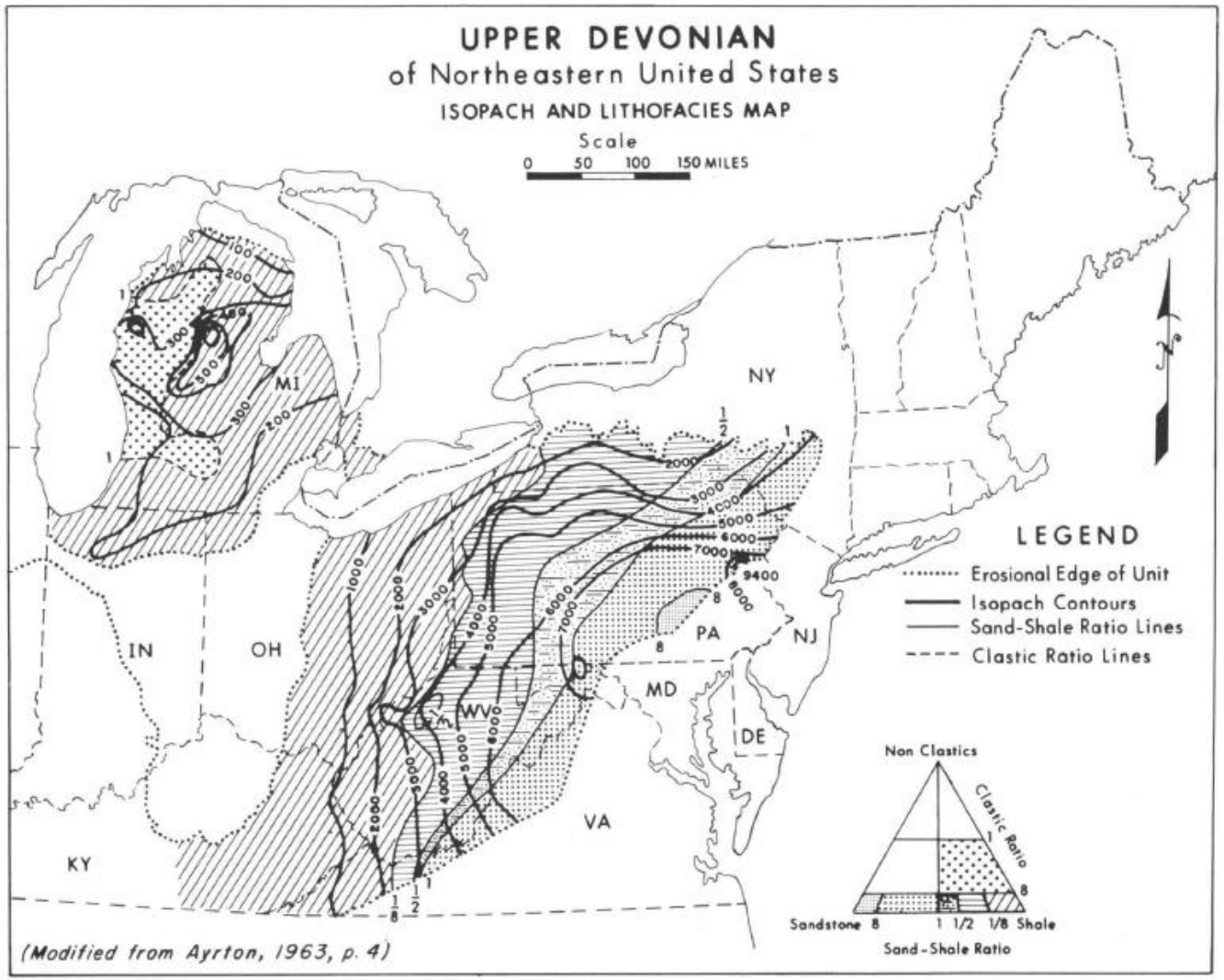




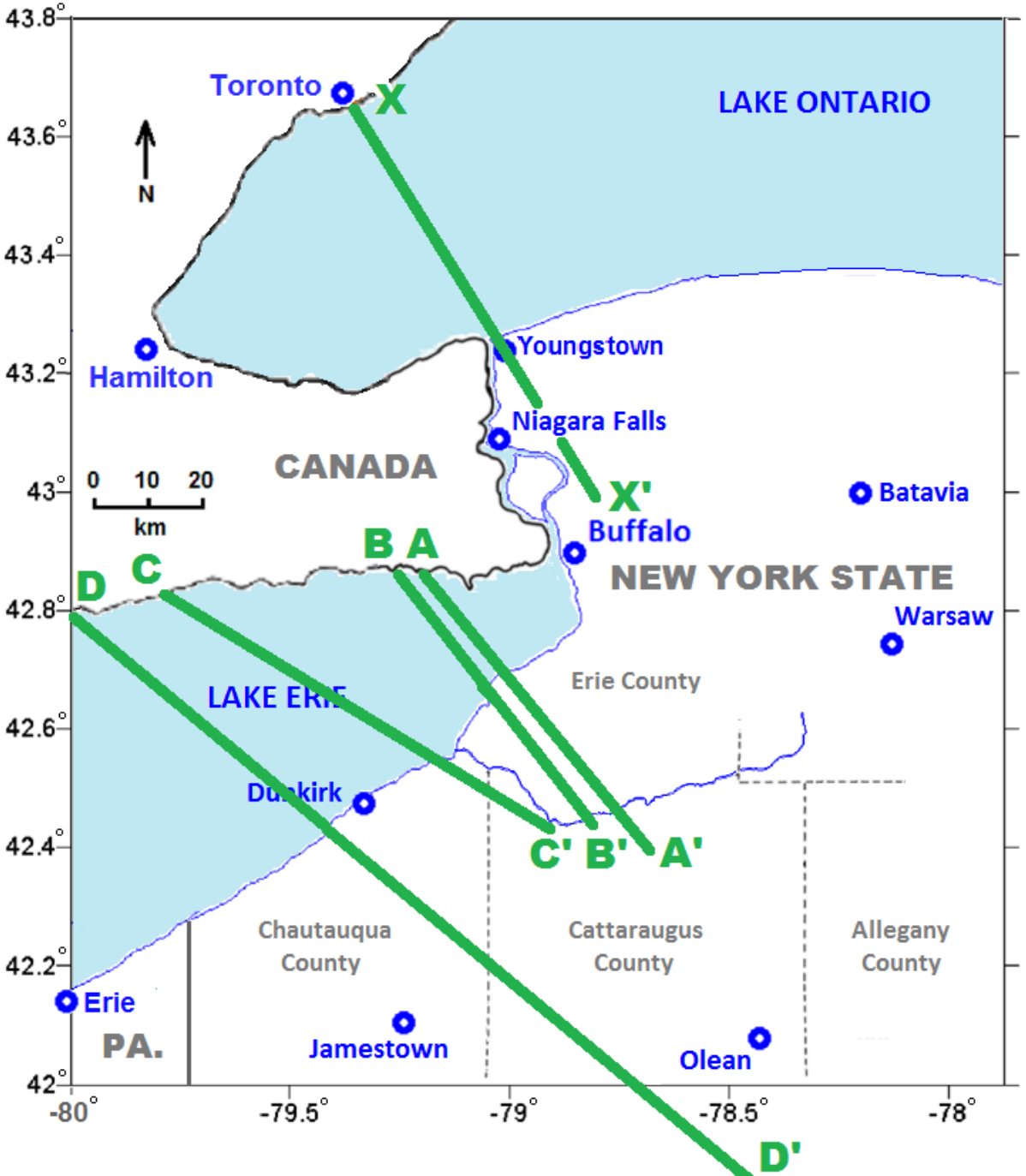


Data coverage for <u>Dunkirk/Laona</u> interval and <u>Dunkirk/LGM</u> & <u>Dunkirk/DGM</u> subintervals





See BAP 411 (cover at left) for Vaughan data and details; also Tesmer (1975) for part of the data for section C-C'. Map from Ayrton (1963) & Sevon (1985) is source of data for section D-D'. Lake Erie bathymetric data is from Holcombe et al.



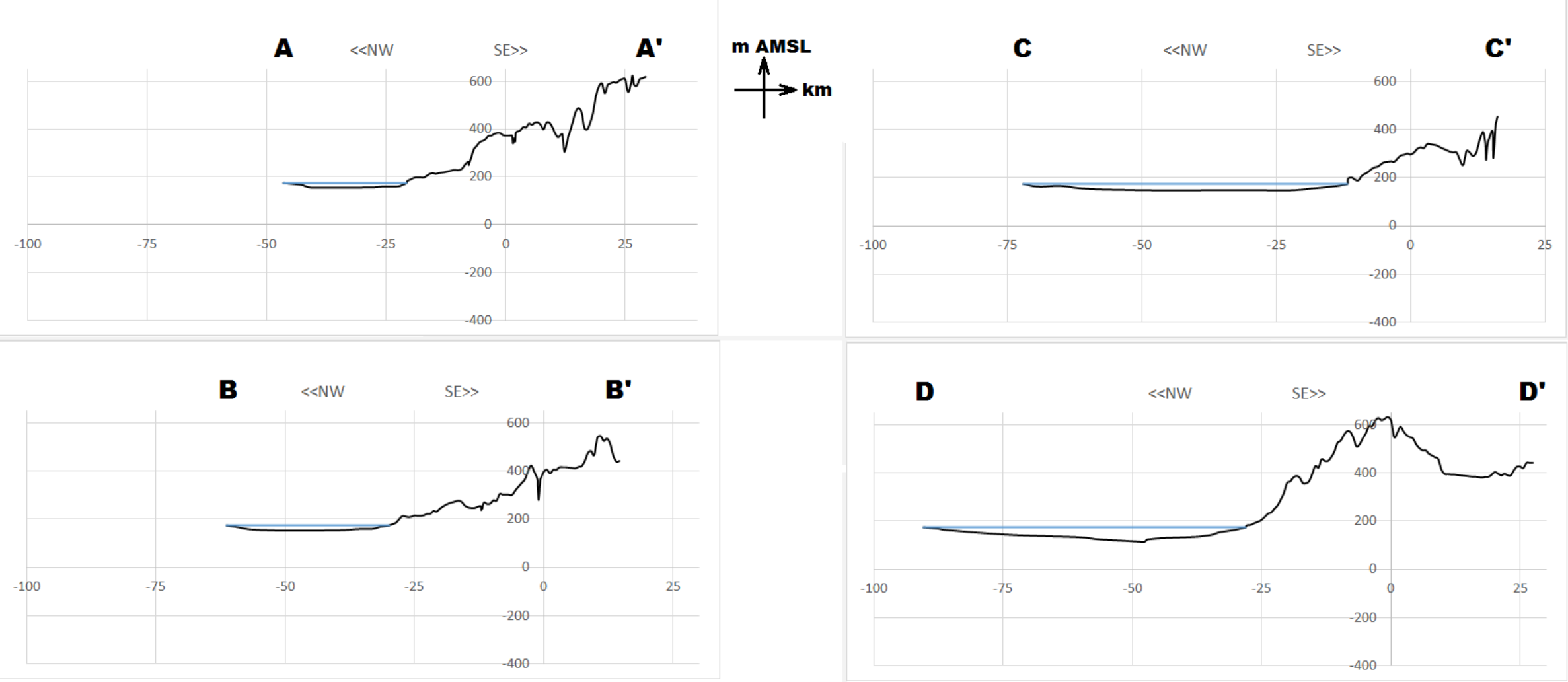
Lines of section across Lake Erie:

A – A’: Base of Dunkirk to LGM subinterval

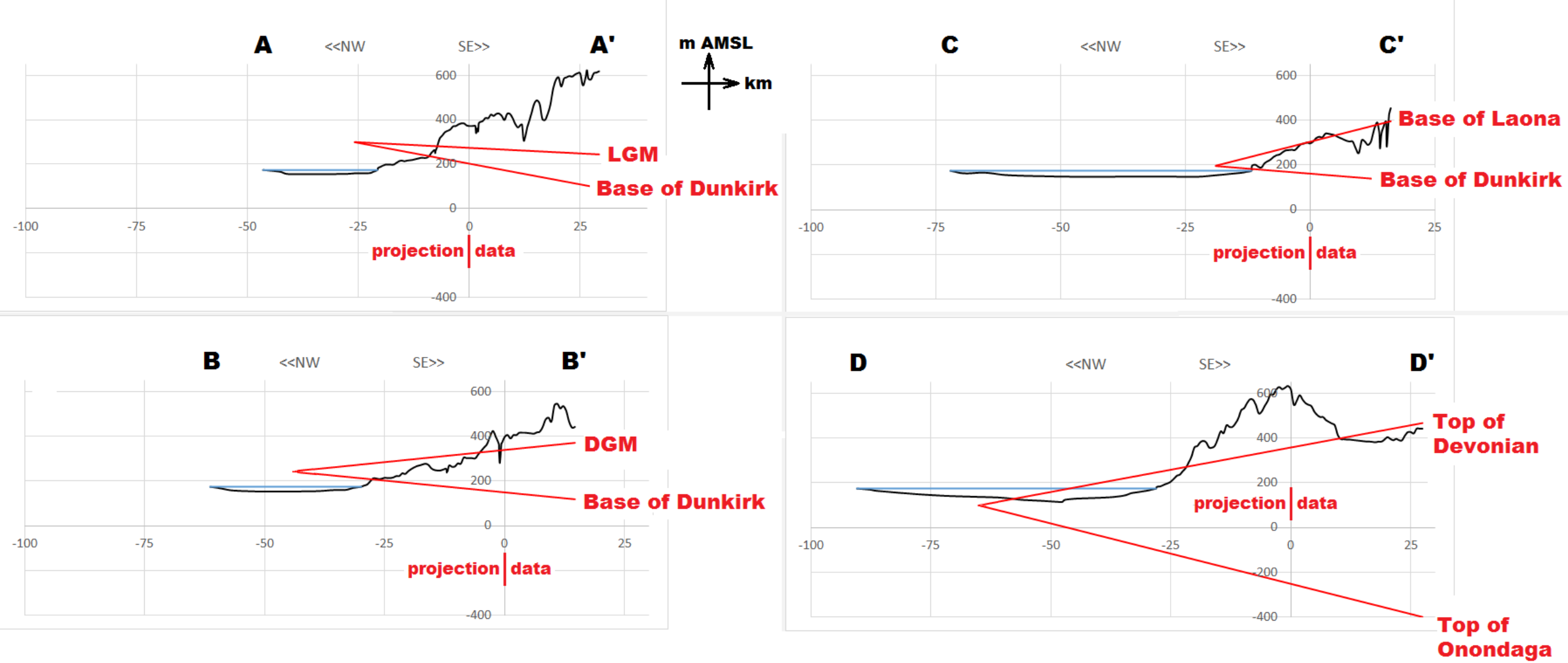
B – B’: Base of Dunkirk to DGM subinterval

C – C’: Base of Dunkirk to base of Laona interval

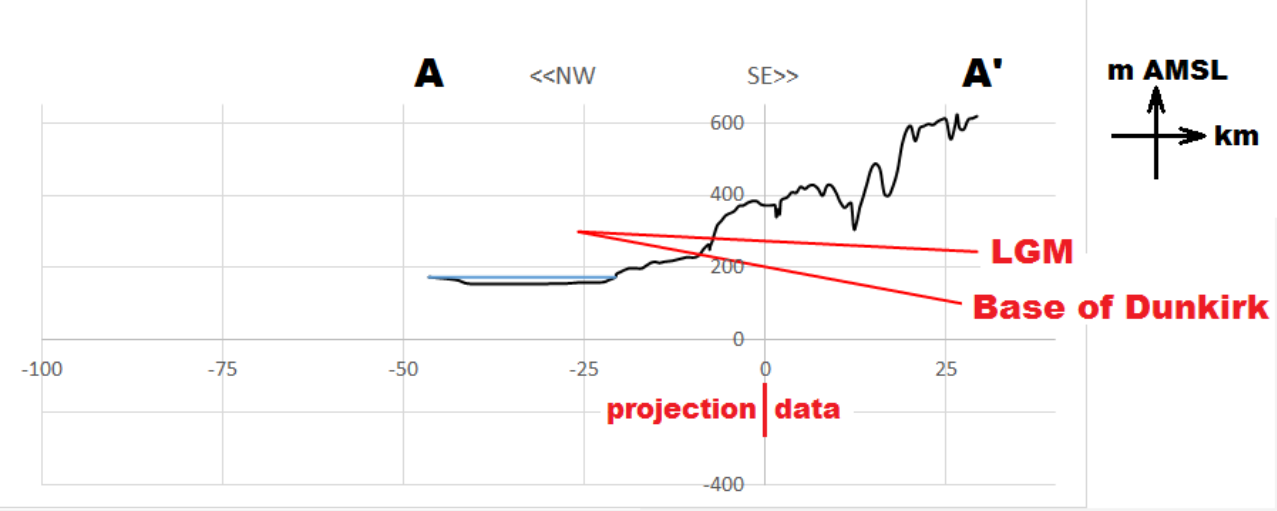
D – D’: Upper Devonian interval, from top of Onondaga upward, adapted from Ayrton (1963) and Sevon (1985); line continues southeast into Pennsylvania

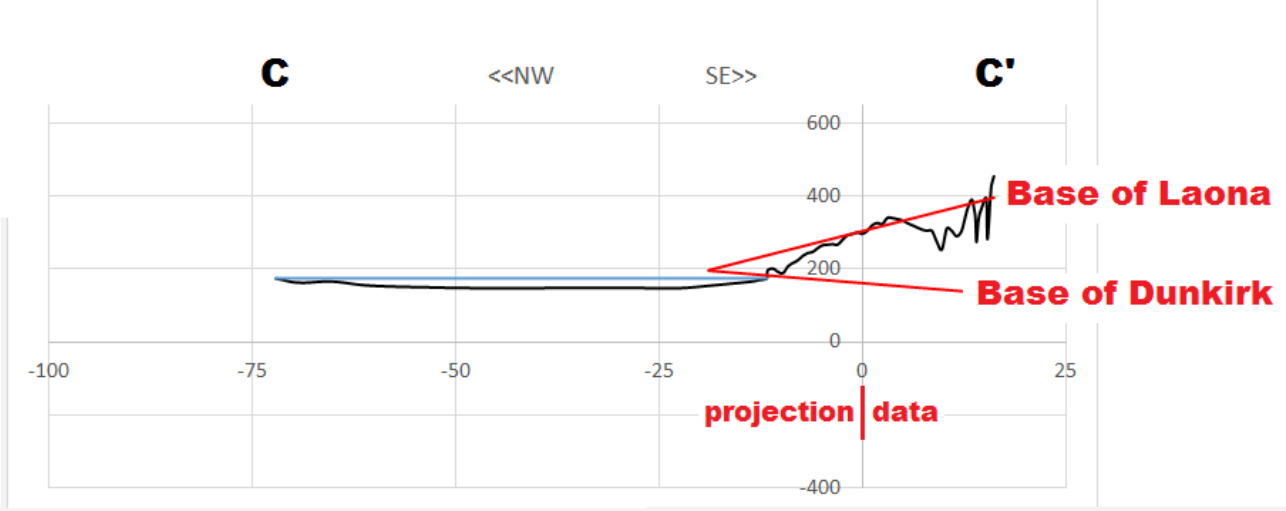


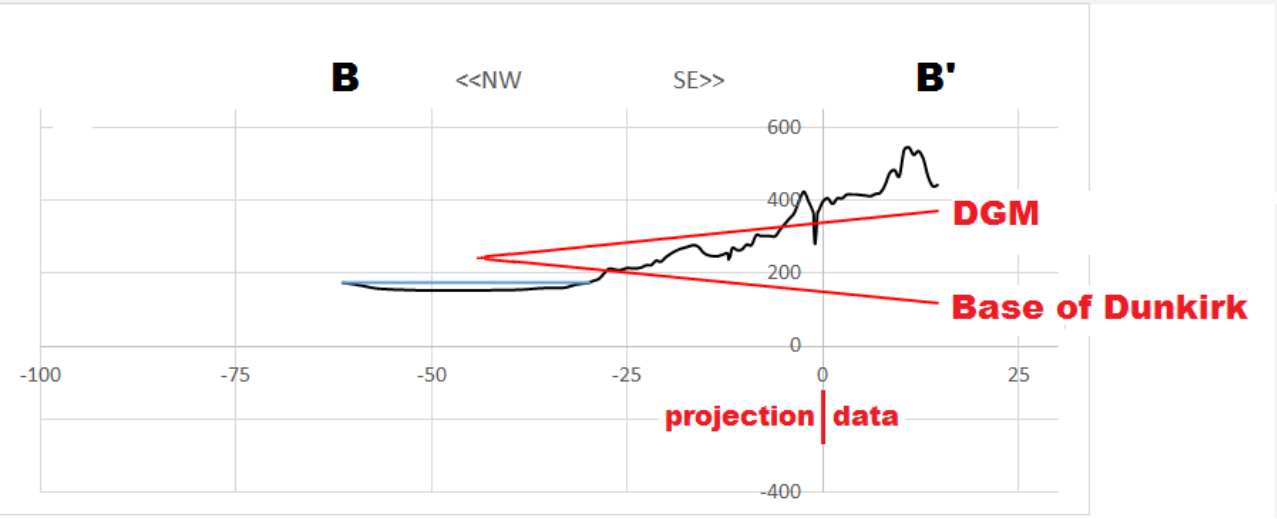
These four cross-sections are all about the same scale. Lake Erie is at left, with Canadian shore at far left. The New York shore and the incised onshore topography, including the study area, are at right.

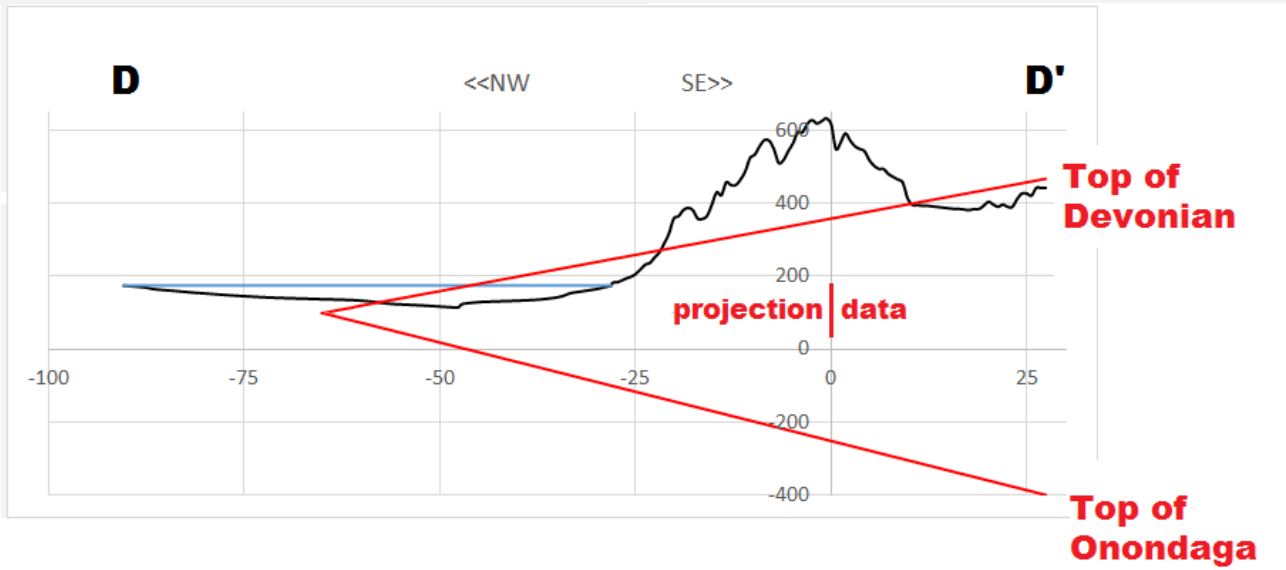


Contacts drawn in red show the NW-thinning (sub)intervals. These are identified by data where data coverage exists and projected northwestward to pinchout. Thinning on line D-D' adapted from Ayrton (1963) & Sevon (1985).



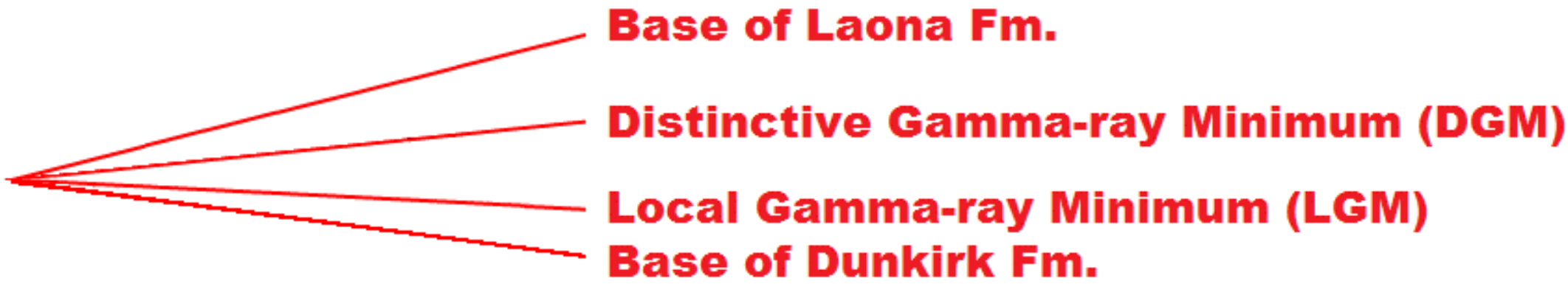






- Black lines are erosional (current limit of erosional truncation)
- Red lines are depositional contacts. They all converge to pinchout within the footprint of modern Lake Erie.

The projected depositional contacts on cross-sections A-A', B-B', and C-C' can be superimposed (with pinchout locations adjusted slightly within the footprint of the lake):



Each of the three cross-sections shows, independently, Famennian non-deposition within the footprint of the modern lake. The combined evidence is strong.

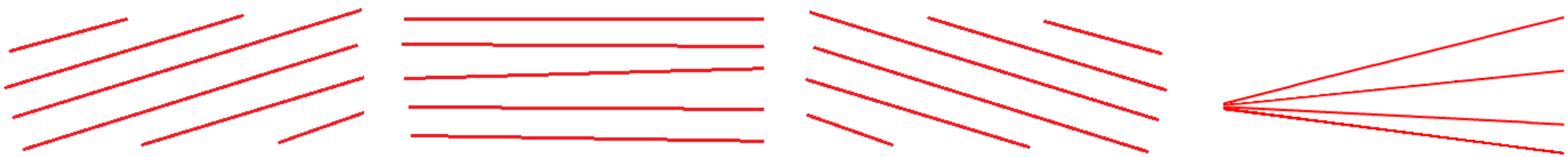
The data from Ayrton and Sevon points to a similar result.

But taking a step back, we don't actually see pinchout due to the erosional truncation shown on previous slides. What survives today along the 3 cross-sections looks more like this:

This still provides good evidence of pinchout, meaning Famennian non-deposition within the footprint of the modern lake. While the combined evidence remains strong, an additional supporting step is needed.

What sedimentary bedding would evolve to this?

? ? ? ?



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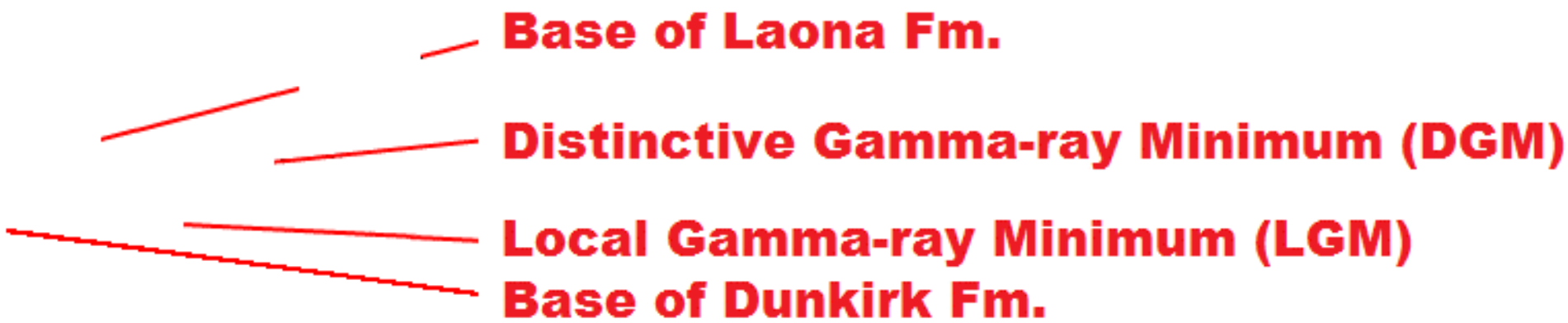

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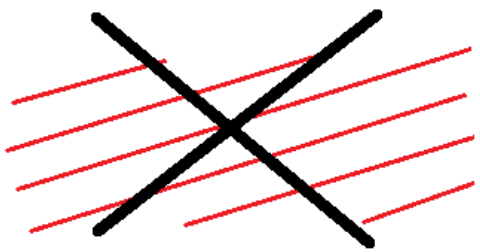

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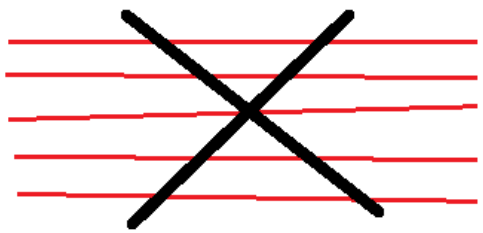

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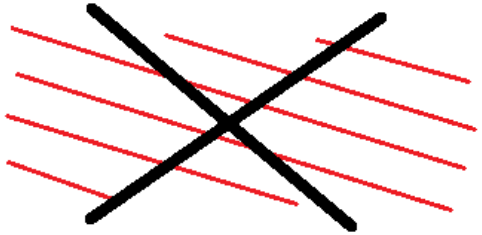

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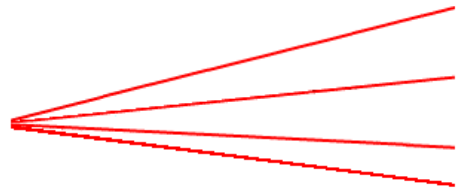

In summary, each of the cross-sections reviewed here shows, independently, Famennian non-deposition within the footprint of the modern lake. The combined evidence is strong but not dispositive.

While additional work would of course be useful, the currently available evidence indicates that eastern Lake Erie occupies a bedrock low hundreds of millions of years old, subsequently deepened by glacial action but originally a Famennian non-depositional feature.