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Massive Mountain Planation of the Eastern Canadian Seaboard

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Abstract

Large planation surfaces have been documented around the world. Secular geologists are hard pressed to explain them, while diluvial explanations appear reasonable. Such a large-scale planation surface is documented on the Canadian seaboard. It appears to be a dissected planation surface covering over 800 km in Nova Scotia, Newfoundland, and Labrador. Of the possible explanations for its origin, only one appears to fit the facts of the field: a large, fast-flowing sheet of water eroding the rocks of the area. It has yet to be determined if erosion happened at today's elevations or whether there has been subsequent uplift. It is possible that many identified unconformities are simply planation surfaces distorted during uplift.

Introduction

Planation surfaces up to regional scale have been documented by both secular and diluvial geologists. These features are interesting because of their size, the uniformity of erosion across varying lithologies, and their present elevation. Together, these features present a profound puzzle for conventional geology, because the most likely explanation for their origin is the action of large-scale, fast-flowing sheets of water, flowing at high elevations in many cases.

I have examined a number of these surfaces, including the Cypress Hills in Alberta/Saskatchewan, the Hand Hills in Alberta, Joggins in Nova Scotia, and other minor surfaces along the Eastern Seaboard. However, none of these match the regional extent of another surface on the east coast of Canada. While it is possible that the planation surface at Joggins, Nova Scotia, is part of this surface, I will treat it as a separate entity, separated by the Cobequid Highlands to the east of Joggins. However, this East Coast planation surface is still a massive feature. Having been unable to find a name for this planation surface in the existing literature, I will tentatively call it the Newfoundland Planation Surface (NPS), named after the island on which the surface is most prominent.

Figure 1 shows waypoints where position and/or elevation was marked using GPS or documented as an outcrop of the planation surface. The southern terminus of the NPS is in Nova Scotia, in Guysborough and Antigonish counties ("X" in Figure 1). Although the planation surface itself is clearly present, its boundary is not entirely clear because of breaks, undulations, and further erosion to the west and south. The elevation in this area is around 160 m (all elevations given relative to mean sea level), but the surface gains elevation to the east and north, where it reaches approximately 400 m at the northern tip of the Cape Breton Highlands (Figures 2 and 3; points 3 and 4 in Figure 1).

North of the Cape Breton Highlands lies the Cabot Strait, and the NPS is again visible north of that water body in Newfoundland. Here it reaches an elevation of around 550 m (Figure 4; Figure 1, point 5). The NPS continues to rise, peaking at 814 m at "The Cabox" mountain, west of Corner Brook, Newfoundland (Figure 1, point 6). The NPS then begins descending north and west into Labrador. The surface is especially

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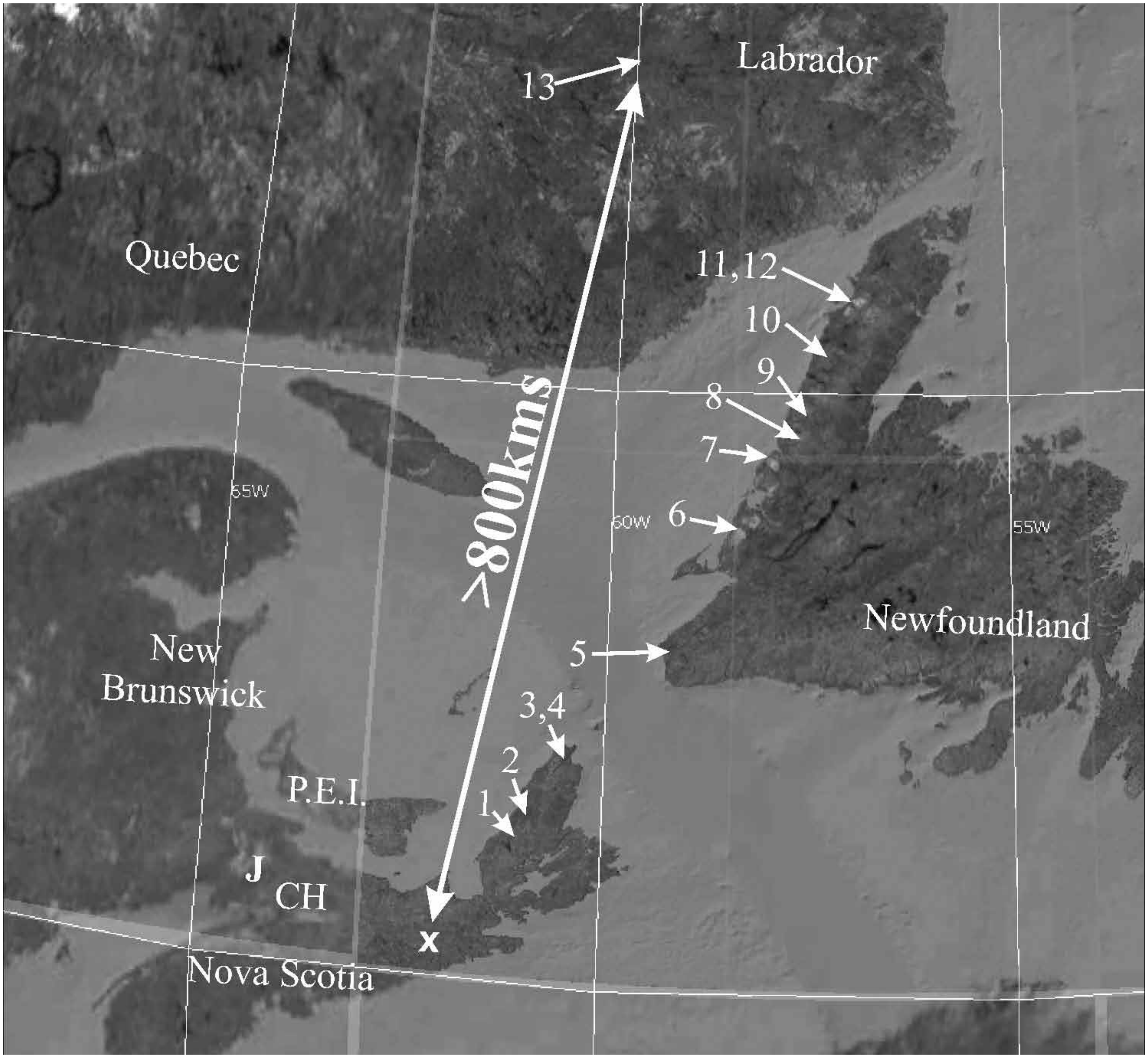

Figure 1. Map of significant points of interest along the Newfoundland Planation Surface.

prominent in Gros Morne National Park, where the mountains have all been planed flat as far as the eye can see (Figure 5; Figure 1, point 7).

The NPS has been eroded at the northern tip of the Northern Peninsula, with the last outcrop near the town of Castor River, at 600 m (Figure 6; Figure 1, point 12). Across the Strait of Belle Isle, the NPS is again visible inland, around the 500 m mark (Figure 7; Figure 1, point 13). The NPS apparently has been scoured away near the Strait of Belle Isle and been broken up by heavy erosion and uplifting to the north of point 13 in Figure 1. This would appear to be the end of the NPS.

Going by road, following the NPS takes a drive in excess of 1,200 km, although the distance is only about 800 km as the crow flies. Later erosion has obscured the exact boundaries of the NPS, and it is difficult to pinpoint specific starting and stopping locations.

Because the NPS covers such a wide swath, the geology of the mountains cut by the NPS is wildly varied and fascinating. They range from Carboniferous sedimentary rocks and basement gneiss in Nova Scotia (Figure 1, points 1–4) to

Figure 2. Planation surface at Cape Breton Highlands, taken from Sugarloaf Mountain, looking south.

Figure 3. Planation surface at Cape Breton Highlands, taken from Sugarloaf Mountain, looking north toward Newfoundland across the Cabot Strait.

Figure 4. View from atop Table Mountain, near Port Aux Basques, Newfoundland, looking north toward the other planed mountaintops.

Figure 5. Looking southeast from about 50 m below the planation surface on the Tablelands. This was as high as I could climb due to snow and ice.

Figure 6. Last view of the planation surface at the northern tip of the Northern Peninsula.

Figure 7. The new Trans-Labrador highway crosses over the top of the planation surface.

the granite, gneiss, and quartzite of Gros Morne Mountain (Figure 1, point 8) to the unique peridotite of the Tablelands Mountain (Figure 1, point 7). The rocks then transition to various sedimentary formations in the Northern Peninsula, southern Quebec, and Labrador before returning to basement gneiss throughout Labrador. The Cape Breton highlands are capped with dense trees, scrub brush, and bogs, which make it very difficult to traverse (Figure 8). The NPS in southern Newfoundland is quite similar to the Cape Breton Highlands and is capped with less dense scrub brush and bogs (Figure 9) and what appears to be felsenmeer—fields of rock broken by freeze-thaw cycles. In Gros Morne National Park, the Tablelands Mountain is barren of plant life and capped with *in situ* felsenmeer (Figure 10). These rocks appear to have formed in place; in numerous field excursions, I have found only one rock that was even possibly an exotic. Gros Morne Mountain is also denuded and covered with *in situ* felsenmeer (Figure 11). The hiking trail crosses over the top of the mountain from the southwest to the northeast, and as the mountain geology transitions from quartzite to gneiss, so does the felsenmeer. Clearly the breakup of the surface rocks was *in situ*.

The sedimentary rocks of the Northern Peninsula and southeastern Quebec/southern Labrador are predominantly horizontal and lay parallel to the planation surface (Figure 12).

My primary point is that whatever cut, the planation surface was not influenced by rock hardness. From very soft sedimentary rocks to extremely hard quartzites, the mountaintops were planed equally flat.

Formation of Planation Surfaces

Oard and Klevberg have discussed the formation of planation surfaces (Klevberg and Oard, 1998; Oard and Klevberg,

Figure 8. On top of the planation surface on the Cape Breton Highlands. This particular spot affords a good view; most of the surface is covered with dense scrub brush and deep bogs, making for extremely difficult hiking.

Figure 9. On top of Table Mountain, near Port Aux Basques. The planation surface here is also covered in scrub brush and bog, with some occasional felsenmeer exposed through the bogs.

Figure 10. On top of Tablelands Mountain, Gros Morne National Park. The mountain here is composed of peridotite and capped with *in situ* felsenmeer.

Figure 11. On top of Gros Morne Mountain, looking west. The mountains are all planed flat as far as the eye can see. The mountains here are capped with *in situ* felsenmeer.

Figure 12. Horizontal sedimentary formations at the northern tip of the Northern Peninsula. The planation surface can be difficult to see when one is standing below the planation surface.

Figure 13. The cliffs of Joggins, Nova Scotia. Differential erosion caused by the tides stands in stark contrast to the planation of the very same layers at the top of the cliff.

1998; Oard et al., 2005; Oard 2000, 2008, 2011b), and have built a compelling case for planation surfaces being cut by fast-moving water. Their findings are supported by my observations at the Joggins Fossil Cliffs. Figure 13 shows the "reefs" in the Bay of Fundy, which are being eroded by the significant tidal action of the bay. The southward twenty-degree dip of the local strata can be seen in the cliffs. In the water, the softer rocks are eroded first. The harder rocks resist erosion and form the "reefs" jutting out of the water. However, the planation acted in a different manner. At the top of the cliffs, the exact same rocks have been sheared and are now flat and level, regardless of the hardness of the eroded rock. This is in stark contrast to the observable, present-day erosion process, which has produced the expected textbook example of differential erosion. Clearly these processes are *not* what cut the planation surface at the top of the cliffs. There are only three possible planing (*peneplain* is an outdated term, referring to Davis's outdated cycle of erosion theory) processes that could do so: glacial action, fast-flowing water carrying abundant sediments and rocks that acted as cutting agents, or a high-velocity sheet flow of water flowing well above cavitation thresholds.

Glaciers, by definition, flow downhill. Essentially, there is no "downhill" on the NPS. The steepest slope is from Gros Morne Mountain to the Topsails (isolated, sharp mountain peaks inland that preserve remnants of the NPS on their planed tops) 104 km to the east, having a downslope of 0.15 degrees. Such shallow slopes would greatly restrict the action of glaciers. However, glaciers carve gouges (not flat surfaces) and leave behind telltale features such as moraines. None of these typical glacial remnants has been observed in association with the NPS. Such moraines would be huge if there were any.

Mike Oard (personal communication, November 2012) suggested that the most likely explanation for the NPS was a slurry of sediment and rock carried in a large current, cutting into the rock. That mechanism is supported in other study areas such as the Cypress Hills, which are capped by cobble-to-boulder-size exotic rocks from hundreds of kms to the southwest. However, with the exception of the Cape Breton Highlands and the most southerly mountaintops in Newfoundland, which were covered in bogs and scrub brush, none of the mountains cut by the NPS exhibit these types of exotic rocks, and all of the observed broken rock capping the planation surface is felsenmeer. Observations of hundreds of square km of the NPS (which included a low-level flight over the NPS covering over 1,600 square km in Gros Morne National Park alone, and multiple ascents to multiple mountaintops) showed *no* exotics of any kind—no rounded rocks, no gravels, not even sand. It all appeared to be in-situ felsenmeer.

This indicates that the most viable explanation for the origin of the NPS was a large sheet flow, moving at velocities exceeding the cavitation threshold, if the water depth was shallow enough. However, the velocity was sufficient to shear the rocks, even if the water depth was too deep for cavitation to occur. (The current would have to be shallow for cavitation and was likely fairly deep, but no matter, just the shear velocity of the current is enough to flatten the terrain without cavitation.) This explanation is also compatible with the receding Floodwaters of the Noachian deluge.

At present, there are too many unknowns to actually calculate the flow parameters of velocity, water depth, and duration of the flow. It seems clear that cavitation was involved in shearing the various lithologies, and that provides a basis for estimation, depending on the depth. Oard (2011a) and Klevberg and Oard (1998) used clast size and slope to estimate velocity in the western United States. Holroyd (1990a) discussed problems with determining paleoflow conditions, and Barnhart (2011, 2012) derived flow parameters from bedforms and sediment size, based on similar work by Lalomov (2007).

Holroyd (1990b) suggested minimum speeds of 30 m/s as a threshold for substantial cavitational erosion. Klevberg and Oard (1998) and Oard, et al. (2005) derived velocities of around 30 m/s, or 110 km/hr, based on percussion marks and rounding in quartzite boulders. Having seen rounded quartzite boulders with percussion marks in British Columbia and Alberta that are larger than those used in the Oard and Klevberg calculations, and since their study derived minimum estimates of current velocity, it is likely that their estimates actually underestimate current velocity.

Oard and Klevberg (1998) attributed flow to the recession of Floodwaters off the continents. However, Baumgardner and Barnette (1994) made a profound serendipitous discovery while trying to build a computer model of the Tethys Sea during a worldwide flood. They found that the total submersion of the land produced continent-scale, high-speed vortices in response to the Coriolis effect. The patterns showed velocities on the order of 40–80m/s! The NPS is certainly far enough north to fall within the affected areas shown by their model. However, that would place the timing of the NPS earlier during the Flood, rather than at the end, as suggested by the absence of further large-scale geological work atop the NPS. But it is clear that either cause would produce velocities sufficiently large to generate massive sheet erosion.

Discussion

Observation of various planation surfaces leads to the question of their original elevation at the time of their formation. Were they cut at the elevations observed today or at a lower elevation, followed by subsequent uplift? Ollier and Pain (2000, p. 302, italics mine) made their opinions known, writing:

> The remarkable thing is that plains of great perfection are ever made, despite all the obvious possibilities of complication. But they are real, and planation surfaces were widespread *before the uplift* of the many mountains of Plio-Pleistocene age.

Their conclusion is understandable. The Beartooth Mountains of Montana and Wyoming exhibit a planation surface at elevations in excess of 3,000 m. Furthermore, there are multiple planation surfaces at different elevations in these mountains, indicating tectonic uplift between episodes of planation. But the NPS shows different features. If the NPS was cut at a lower elevation and then elevated by continental collision or vertical tectonics, then the resulting model would have to explain how the NPS remained both flat and level. This problem is multiplied by the size of the NPS; the absence of deformation would have been on a large scale, just as the scale of uplift would have been quite large. The significance of this particular planation surface is not just that it is incredibly flat, but also that it covers incredible distances.

This assumes that the NPS was originally one large surface, later dissected by gaps, like the Cabot and Belle Isle straits. If it was a single feature, then it extended more than 800 km from north to south and at least 120 km wide. Drawing a straight line between the start and end points of the NPS and measuring from that line to the Topsails measures about 350 km wide. While a large portion of the western part apparently was eroded away during the formation of the Gulf of St. Lawrence, it would seem reasonable to assume the NPS was originally 350 km wide or more. Could this large of an area have been uplifted without any evidence of deformation? The presence of mountains to the west of Gros Morne and to the north of the last outcrop of the NPS in Labrador suggests that uplift occurred, but that it was local and did not affect the NPS in a regional manner. Thus, the current elevation of the NPS is likely that at which it was cut.

Walker (1994) noted that the recession of the Floodwaters occurred in two stages: (1) a sheet-flow stage and (2) a channelized-flow stage. The successive episodes of distinct types of erosion are seen at the NPS, where the planation surface was cut by sheet flow and later dissected by channelized flow, forming the seaboard edges of the mountains and the associated deep canyons. Two geological/geographical models at the park visitors' center of Western Brook Pond show canyons with the suggested glacial action (Figure 14) and the present-day canyons (Figure 15).

Note the virtual absence of moraines. Significant amount of rock was removed in the carving of these canyons, which undoubtedly wound up in the ocean. But could glacial action cut canyons in that way? Western Brook Pond (the center canyon in the model of Figure 15) is one of several steep-walled box canyons cut into the mountains of Gros Morne National Park (Figure 16). Western Brook Canyon has very steep, 700-m-high walls. Another example is Ten Mile Pond Canyon (Figure 17), with walls in excess of 780 m and virtually nonexistent moraines at the canyon mouth. The small moraines cannot account for a fraction of the sediments removed during canyon formation. The lack of talus and large river delta suggests the canyons best match the erosion of a receding waterfall–like the Niagara Gorge. Yet there appears to have been no sufficient water source (no reservoir large enough to account for the volume of water that would have been needed) to feed such a waterfall to cut the canyon. However, the Flood scenario, with broad sheet flows being constricted to powerful channelized currents, would explain both the planation surface and the numerous canyons.

Figure 14. National Park model of the Western Brook Pond area with proposed glaciers. There is no doubt there were glaciers in the canyons, but did the glaciers cut the canyons? Notice that the glaciers are absent from the top of the planation surface.

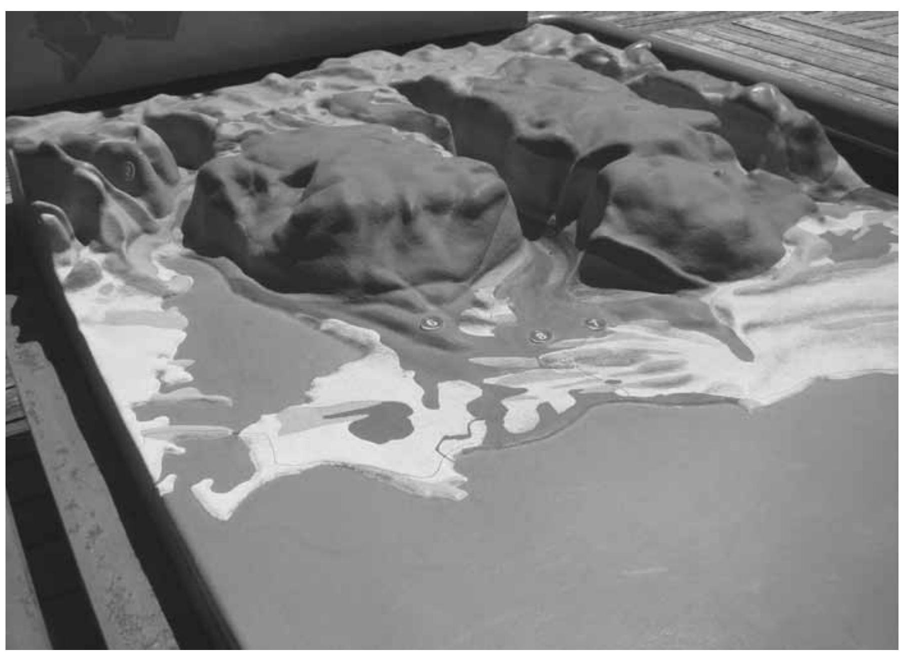

Figure 15. National Park model of the present-day Western Brook Pond area. Note the virtual absence of moraines and, even more importantly, the box-end that would best match the erosion of a waterfall cutting a canyon, rather than glaciers.

Figure 16. Western Brook Pond Canyon, looking down the canyon to the ocean, has extremely steep, 600-meter walls. It is highly unlikely that glacial action carved this and many other canyons in the mountain ranges here in Gros Morne National Park.

Figure 17. Ten Mile Pond Canyon, beside Gros Morne Mountain, is another example of some of the dramatic, steep-walled canyons that were cut into the planation surface. In this case, the walls are in excess of 700 meters high.

This model also argues against the possibility that the planation surface was cut at a lower elevation and later exhumed. The box canyons were cut to what is presently below sea level. If the planation surface was originally cut at sea level, then sea level must have later decreased by over 700 m to account for the canyon cutting. The Flood model also accounts for this problem, since base level was rapidly changing during the recession of the waters off North America.

There are also problems for this model. The canyons in Newfoundland face west, toward the straits—the opposite direction of the presumed receding Floodwaters. Furthermore, the straits between Newfoundland and the mainland are also products of erosion, but how does that episode fit in with the formation of the planation surface and the canyons?

The Tablelands Mountain in Gros Morne Park presents an especially interesting case. It is one of the more famous outcrops of peridotite in the world. Geologists travel from all over the world to study this outcrop, as they believe it to be a remnant of mantle forced up during plate collision. Since the Tablelands Mountain also was planed flat, the sequence would have to account for a plate collision prior to planation.

Also of interest are the mountains at Western Brook Pond. They are composed of basement gneiss dated at 1,250 Ma and resting on top of 400 Ma Devonian limestones. This implies significant thrusting at this location. Having had the privilege of examining seven "overthrusts" in North America now, and having found essentially no evidence for the alleged thrusting, I will remain skeptical about the Western Brook Pond thrust fault for the present. There may be other areas that do show such evidence, and judgment should be suspended pending further investigation. If this thrust is genuine, it implies an orogenic event that thrust the Canadian Shield basement gneiss over the Devonian limestone. All of this was followed by planation, again suggesting that the elevation of the planation surface has not significantly changed.

The planation surface at Joggins (Figure 1, "J") may be part of the NPS, but it has been separated from the rest of the surface by the uplifting of the Cobequid Highlands (Figure 1, "CH"). Many geologists believe that many unconformities are planation surfaces that were tilted, buckled, and distorted by later tectonic activity. Tilted layers visible in the Cobequid Pass also have been sheared, like a planation surface, but the cut surface is no longer flat and level. This may also be true of Prince Edward Island.

If the Cobequid Highlands are a distorted planation surface, it would seem to add credence to the idea that present flat and level planation surfaces were cut *in situ*, and that continued tectonic activity would distort planation surfaces instead of simply elevating them.

Likewise, the Joggins strata were also tilted prior to planation. The most likely cause of the tilting of these 5,486 vertical m of sedimentary layers was the East Coast orogeny. Thus the tilting, buckling, and elevation of the sedimentary layers occurred first, then the receding floodwaters eroded the planation surface. It is possible that the East Coast mountains were among those raised during the Flood, when the continents were elevated relative to the newly forming deep ocean basins.

Conclusion

The Newfoundland Planation Surface is a regional-scale planation surface that extends from Nova Scotia to Labrador. Its formation is difficult to explain by conventional geology but fits well within the late Flood recession, which included sheet flow followed by channelized flow on a massive scale. That flow most likely would have been from west to east, off North America, but more study is needed to provide details of the water's path, depth, and velocity. It would have been at least 800 km wide and flowing at a minimum of 30 m/s. Because the planation surface was probably cut near its present elevation, which reaches 800 m, the only reasonable explanation is the recession of the Flood.

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