

Context:

Gabriola ice-age geology

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This is Version 2.3, the final version.

Later file:

There is a file with additional data at www.nickdoe.ca/pdfs/Webp541.pdf posted May 17, 2014.

Gabriola's glacial drift—Glaciation from Vancouver Island?

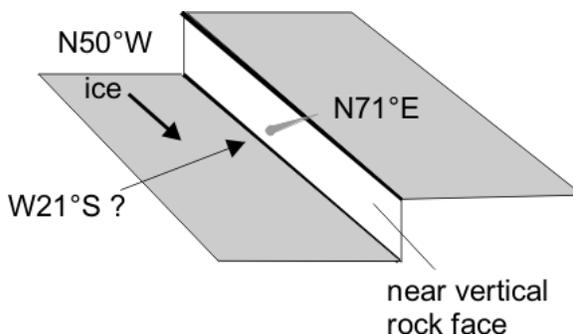
Nick Doe

Fortunately, when [looking at striae](#) left by glaciers in Gabriola's sandstone bedrock, it was pretty obvious which way the ice must have been flowing, but there was one set of striae that did pose a problem. These striae run roughly west-to-east (W21°S - N69°E). The striae left by this movement were found at only three sites.

The striae on horizontal faces gave little or no indication of direction that I could rely on, but there was evidence for direction in some bedrock markings at two other locations, both of which, it is important to note, were, until recently, buried in overburden, which would explain their good state of preservation.

Site 6

At this site, ice from the northwest has exploited pre-existing fractures in the sandstone¹ to remove a substantial slice of rock, thereby creating a small valley flanked by Malaspina Drive and McConvey Road. The valley runs inland from the Galiano Gallery (Malaspina Galleries) (*formerly* Fosters Bay).



A stria at site 6 (ignore the fracture on the *right*) moving up the face of a 2-metre-high wall. It appears to have been created by ice moving from the west. There are more striae of different widths and some scarcely-visible crescentic gouges further along the face.

Striae can be seen moving up and over the top of the southwest facing wall. It is difficult to see how ice from either northwest or northeast could have created these deflection striae, but their orientation makes perfect sense if ice had moved from south of west, pressed against the by-then-existing wall, and proceeded up and over the top of the step where the pressure was relieved. I should add however that I am far from 100% confident about this interpretation as the number of striae at this site in this direction is low.

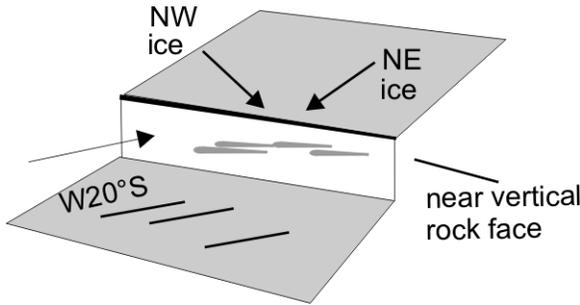
¹ These are C1 fractures (N56°W, ±15°), which run parallel to the axis of the island's syncline. Doe, *ibid*, 2009.

Site 5

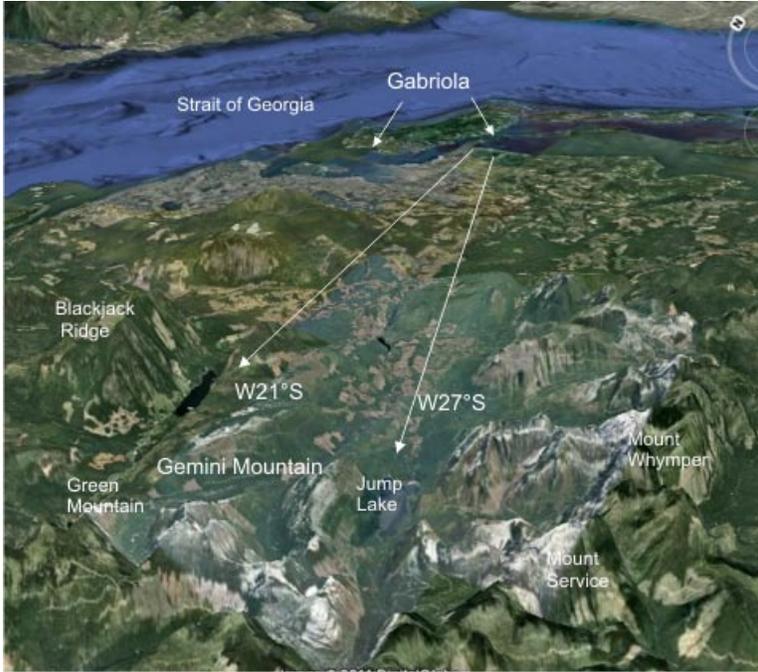
Vertical faces that run more or less east-west are rare on Gabriola, but at this site there is one that faces almost due south. This means that the step was downward both for ice moving from the northwest and from the northeast; yet, striae across its face run obliquely moving up as they move east, suggesting movement of ice from a little south of west. The striae are near the top of the wall, but there are many striae on the horizontal floor of the step indicating ice movement from W20°S.



Striae at site 5 (top of the picture) on the near-vertical wall of the borrow pit; the compass is lodged on a small fracture. Although hard to photograph, there were quite a few of these. They run across the face, most moving slightly upward. Some are deeper at the western end (left in the photo; ignore the fractures). The striae are most common at the top of the wall, or close to it. The wall is around 2-3 metres high.



Many striae at site 5 on the floor of the borrow pit run close to west-east (horizontal in the picture). These appear to be genuine glacial striae despite being hard to photograph. They might be deflection striae and their orientation might be of no regional significance, but the same floor also has striae created by ice movement from the northwest, and their orientation is normal.

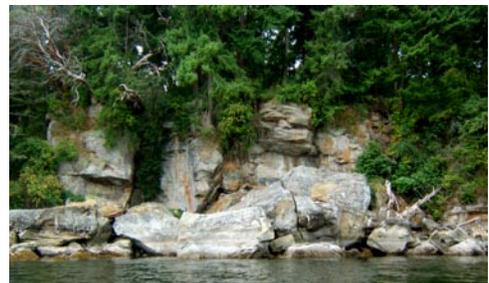


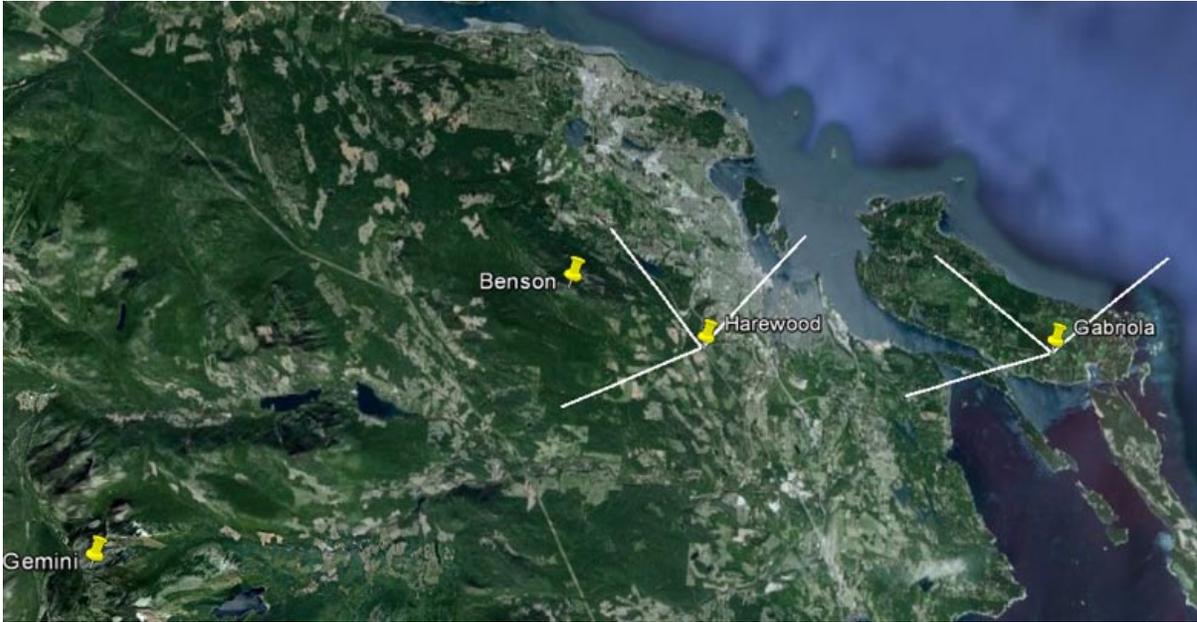
Left. The notion that at some time ice moved off Vancouver Island across Gabriola makes perfect sense when you look at the topography of Vancouver Island. The ice clearly would have originated in the Nanaimo Lakes area at the headwaters of the Nanaimo River about 35 km away. The mountains there are up to 1500 m above sea level.

Below. The Nanaimo River valley as seen from the west side of Link Island. The broad dish-shaped valley provides a vision of how big the glacier that carved it must have been. And at the time, it was probably a “small” one.



Left. The south end of Round Island (between Mudge and Cedar). It runs W15°S. The west side (*bottom left*) is smooth, but the east side (*below*) is strewn with boulders, as you might expect if this were a *roche moutonnée* created by a glacier from Vancouver Island.

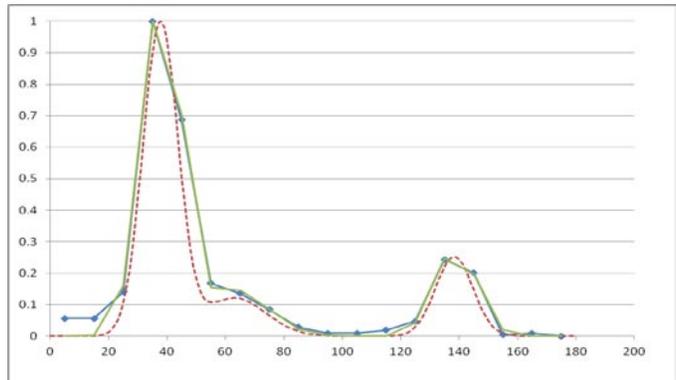




Harewood plain

Additional data supporting the notion that Gabriola was once glaciated from a source on Vancouver Island comes from a study by Vancouver Island University students. As part of their Quaternary Geology course, they made observations of the orientation of striae up on Harewood Plain. Their results were, as shown on the map above, almost identical to those made on Gabriola, after allowing for the differences that Mount Benson must have made.

The striae from the south of west were shallow and were not numerous, and it was only after a statistical analysis of their results that its presence was suspected.

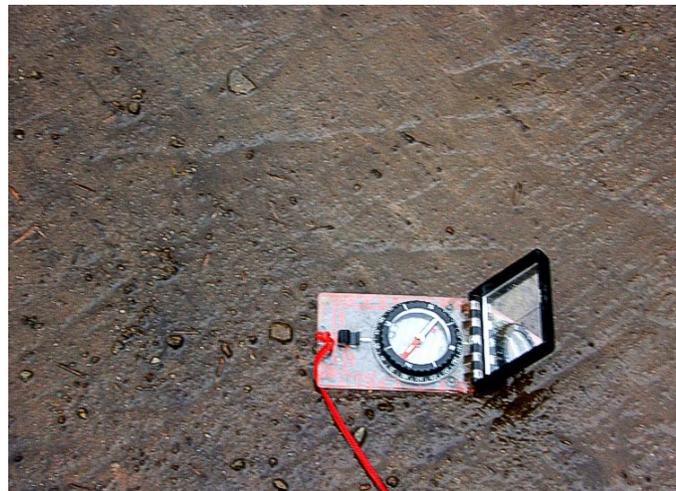


Above: Analysis of 620 measurements of striae orientation on Harewood Plain. The dotted red line is a bell-curve match to the data assuming three sets of striae. Those from the SW are at 63° (W27°S).

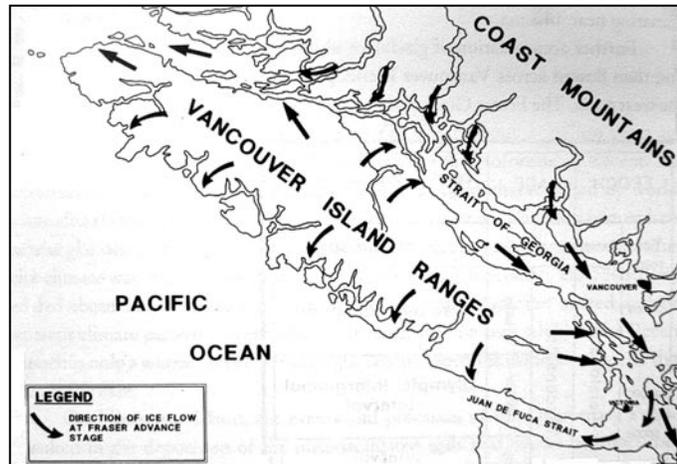
Data courtesy Steve Earle, Vancouver Island University

Striae on Harewood Plain. The compass is set for W20°S (west on the *right*). Two striae running from this direction can be seen above the compass.

The numerous other striae running from *bottom left* to *top right* are the 38° set (N38°E).



That ice moved from Vancouver Island across Gabriola at some time during the Pleistocene is obvious from the topography of Vancouver Island to the west. The ice would have moved down the Nanaimo River valley from the high mountains that form the thrust fault on the north side of the Cowichan valley. The question is, did it also move that way during the last ice age? And the answer appears to be, yes. Although my observations suggest that this happened at the end of the last ice age, there is no supporting evidence for this timing (post-Vashon) in the published literature. The glacier responsible was large and not likely to have been overlooked by researchers, so it makes more sense to suppose that the glaciation was at the beginning of the last ice age, before ice moving from the north had filled the strait.



Another map, the third, of the movement of ice during the last ice age. This one shows movement during the initial phases of the glaciation. Ice is shown moving down the strait from the NW, but just south of Gabriola, ice is also shown (2 arrows) moving off Vancouver Island from the west. I think we can safely add a third arrow pointing at Gabriola.

From Chris Yorath, *The Geology of Southern Vancouver Island*, p.44, Revised 2005 edition.

The supposed sequence of glaciation and deglaciation on Gabriola then becomes: (1) valley glaciers from the west descended from Vancouver Island into the strait including one from the Nanaimo Lakes area; (2) later, this and many others like it, became dominated by one large glacier moving down the strait from the northwest. This glacier left lots of till because it was a collection of valley glaciers, and the lodgement till it created protected the bedrock from subsequent glaciations; and (3) later, a continental glacier from the mainland mountains in the northeast spread ice across the area, moving directly to the west coast of Vancouver Island, essentially unaffected by the topography of the strait.

De-glaciation was rapid, and the ice just wasted away without resuming earlier patterns of movement and without creating any new striae. ◇



Striae from the NW at site 2. There are hints of striae also from the NE, but the evidence was not strong enough for them to be recorded as such. There has to be more than just a few scratches; the striae can't be parallel to fractures in the bedrock; orientations have to be consistent; the sandstone has to be recently exposed or otherwise protected from salt accumulation; and striae with the same orientation should be seen on neighboring outcrops. Only the NW striae passed the test here.

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