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Discussion on Deglacial History of Northern St. George's Bay

Current Research, Report 2000-1, 2000, pages 33-47

I.A. Brookes writes:

Following three seasons of work in the 1960s studying the glaciation of the St. George's Bay area, during which I had vacillated in my interpretation of the meaning of striae for the sequence of ice-flow directions, in 1968, I happened upon a partly till-mantled bedrock exposure at Campbells Creek, on the south shore of Port au Port Peninsula, where the reason for my previous indecision was clear. MacClintock and Twenhofel (1940) had interpreted crossing striae on bedrock along the north shore of St. George's Bay as produced in the "Wisconsin" glaciation, first by southward flow of Labrador ice, succeeded by westward flow of Newfoundland ice following retreat of the former. At Campbells Creek (NTS map area 12B/10 - Stephenville, UTM 3627/53763), only stronger, deeper, westward striae appeared to me at first to "cross" northerly ones, suggesting younger inscription. Yet, on detailed examination, it became clear that southerly striae appeared to have been "crossed" by westerly ones because they had failed to register across the westerly striae, where the latter were the more deeply inscribed. Therefore, I concluded that the earliest late Wisconsinan ice flow had been from the Newfoundland ice cap, westward across Port au Port Peninsula, and was followed by southwesterly and southerly flow in the same ice-cap as its margin was indented by a calving bay, having a northern edge, parallel to the south shore of the peninsula (Brookes, 1970). I have found since, that a similar explanation, where glacial striae failed to inscribe the floor of a depression left by removal of a small bedrock chip, was called upon by Dawson (1875, Plate X, facing p. 207) in his examination of rare striae about the Missouri Coteau, during his survey with H.M. Boundary Commission 1873-74. At Campbells Creek and other localities along the southern shore of Port au Port Peninsula, the stronger striae are always the more westerly, and are more encompassing of bedrock relief, whereas more southerly striae are both weaker and more restricted to the tops of bedrock rises, which are commonly stromatoliths.

Batterson and Sheppard (2000) made a radical return to MacClintock and Twenhofel's (1940) interpretation of ice-flow sequence in the northern St. George's Bay area. They stated that the earliest ice-flow was from the north, citing what they saw as widespread evidence of southerly striae in central west Newfoundland. The second movement was stated as westerly to southwesterly, producing striae seen as crosscutting the southerly ones. The third flow was stated to be to the west and northwest. These authors did not refer to the paper of Brookes (1970) on this subject and the crucial figures it contains, nor did they present field evidence for their conclusions on ice-flow sequence.

I made a repeat visit to Campbells Creek in 2005, 37 years after the original one, conscious of interpretive bias and thus making every effort to counteract it. I did not change may mind as a result of an hour's detailed examination of about 20 m of glacially eroded limestone. I present 2 photos here that I consider crucial to the argument, where (i) stronger striae are oriented more westward (actually southwest, 225°), and (ii) weaker southerly striae (180°) cross from proximal to distal edges of the deeper westward striae without descending into them. Details of striae in the photos (Plates 2 and 3) are described in the captions. Plate 1 is included as a locational aid. Magnetic declination in 2005 was 20°W, which was set in the Silva compass pictured.

Other evidence that generally westward ice-flow over northern St. George's Bay was stronger comes from the distribution of striae on Port au Port Peninsula. Only the westerly ones continue almost to Cape St. George (to Marches Point, *see* Brookes, 1970, and Map 15-1973, Brookes, 1974). If northerly flow had preceeded this, it surely would have left its mark on the western part of the peninsula. Erratics tell the same story. Brookes (1970) showed a peridotite

Plate 1. *View southeast at Campbells Creek, Port au Port Peninsula, showing till eroded from glacially eroded surface of limestone, striated as in Plates 2 and 3.*

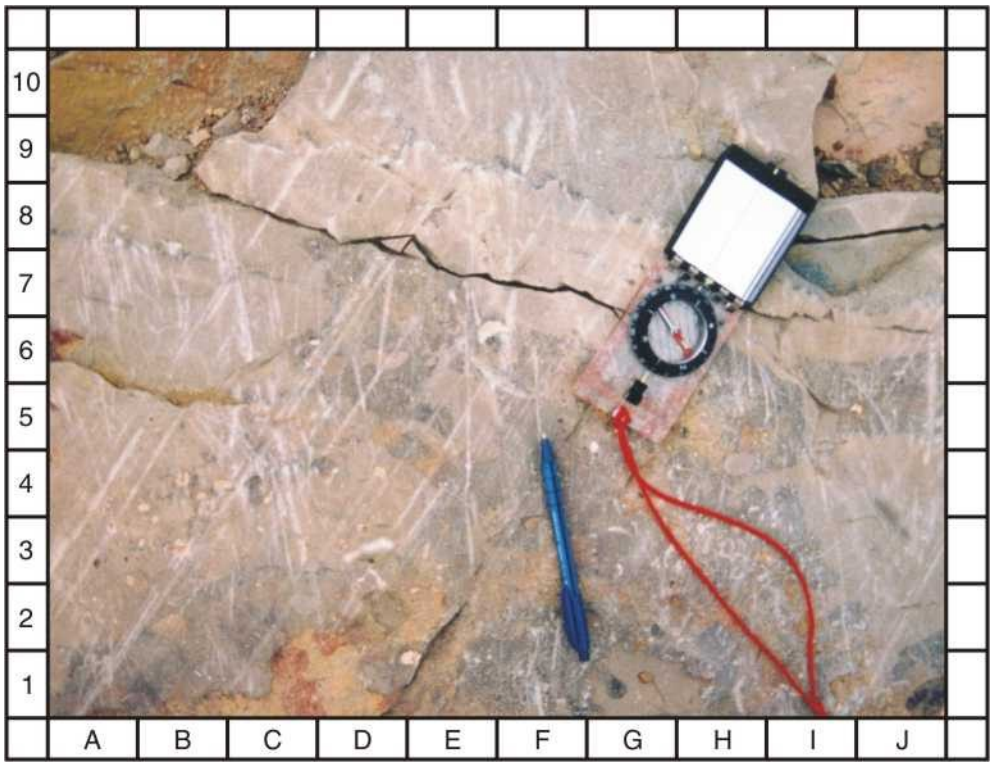

Plate 2. *Campbells Creek: striae at 225°T (parallel to compass) crossed by striae at 180°T (parallel to pen). Crossing relationship seen at A8, C7, D5, E5.*

("dunite") erratic near the west end of Port au Port Peninsula and its closest source in the Lewis Hills, which later experience would lead me to conclude was most likely derived from that massif southward down the valley of Fox Island River, and deflected southwestward by the main flow. Peridotite ("dunite") erratics shown in the same figure atop Table Mountain, Port au Port would also have been derived from Fox Island River valley. The ice carrying these erratics was deflected southward by the Lewis Hills themselves, although some higher ice might have passed through the col north of their 811 m summit, where an amphibolite knob at 600 m elevation, is striated westward, but striae are of unknown age (although the fact that they are visible at all suggests that they are late Wisconsinan). Thus, the assertion of Batterson and Sheppard (2000) that peridotite boulders in diamictons at Abrahams Cove, 4 km west of Campbells Creek, can be used as evidence for earlier southward ice-flow is weakened, particularly considering that they viewed this ice as either "occupying the Gulf of St. Lawrence" or deflected south by "Laurentide ice that impinged on the coastal fringe of Newfoundland" (Batterson and Sheppard 2000, p. 37). The strong grooving of the lower west flank of Table Mountain near Port au Port (shown on Map 15-1973, Brookes, 1974) could be interpreted as produced either by the earlier deflected southerly flow down Fox Island valley, or by more extensive southerly flow toward the margin of a calving bay.

Along the north shore of St. George's Bay west of Stephenville, the late Wisconsinan till is loaded with large erratics (</= 1.5 m diameter) of two distinctive anorthosites, one eroded from the southern Indian Head Range, immediately to the east, on the crest of which strong striae are oriented westward (270°), and the other from the massif east of St. George's, farther southeast (Riley, 1962). Both types of erratics occur in the till at least as far west as Abrahams Cove. Large boulders of red granite derived from the Long Range Mountains (probably Hare Hill, Riley, 1962) are strewn across the western end of Port au Port Peninsula at ca. 300 m elevation, which also indicates strong westerly flow within ice which must have terminated tens of kilometres to the west in Gulf of St. Lawrence.

In accounting for the earlier southward flow, Batterson and Sheppard (2000) leave open the question of deflection of Newfoundland ice by "ice occupying the Gulf of St. Lawrence, or [by] Laurentide ice that impinged on the coastal fringe of Newfoundland" (p. 37). The difference between the descriptors of these ice masses eludes me, but some evidence exists for the latter. I have previously drawn Batterson's attention (personal communications, 2001, 2002) to a north–south moraine on a structural bench at 400 m elevation on the western face of the North Summit of Highlands of St. John, containing solely quartzite clasts (50°.833N, 57°.016W; NTS map area 12I/14, UTM E498700 / N561200). This moraine can only have formed if ice flowing westward around the northern edge of that quartzite massif was deflected south by impinging ice in the Gulf (which can only have been Labradorean ice, and the moraine therefore 'interlobate' in position). Grant (1994) did not recognize this moraine, but his Figure 28 (p. 30) shows the late Wisconsinan glacial limit on North Summit at 380 m. Grant (1994, Figure 44, p. 48), did, however, show that southwest deflection of Newfoundland ice, so much in evidence at the coast from at least St. John Bay to Western Brook, could have resulted from development of a calving bay between it and Labradorean ice.

To return to Port au Port Peninsula, I have not seen evidence south of Bonne Bay of Labradorean (or "Gulf") ice

deflecting Newfoundland ice. Late Wisconsinan ice tongues emerging from the fiords of Bonne Bay and Bay of Islands were undeflected (Grant, 1989; Grant, *in* Berger *et al*., 1992). Strong southerly ice flow south of York Harbour and Lark Harbour, at the southwest entrance to Bay of Islands, resulted from topographic deflection by coastal hills into easily accessible lowlands, and, as stated above, around Lewis Hills, westerly flow was deflected south to escape via Fox Island River valley to Port au Port.

In conclusion, my previous interpretation of late Wisconsinan ice-flow sequence over northern St. George's Bay (Brookes, 1970) was not addressed or critically evaluated by Batterson and Sheppard (2000), whose case for southerly late Wisconsinan ice flow there, followed by westerly flow, is both weakly argued and erroneous in its conclusion. My earlier conclusion stands, that, over northern St. George's Bay, westward ice flow within the late Wisconsinan Newfoundland ice-cap preceded local southerly flow toward a calving bay.

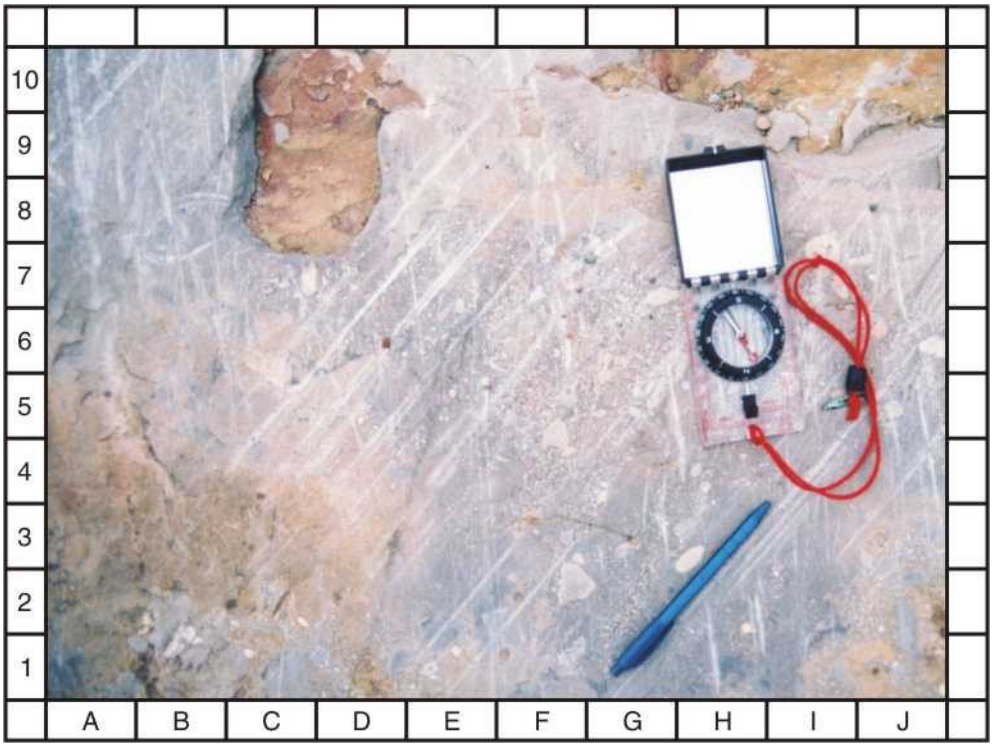

Plate 3. *Campbells Creek: striae at 225°T (parallel to pen) crossed by striae at 180°T (compass). Crossing relationship seen at A9, E6, E-F1. Examples of 180° striae interrupted across deeper 225° striae seen at E7, E-F2, I3-4, J4.*

M. Batterson and K. Sheppard reply:

Although we commonly disagree on the interpretation of evidence for late-glacial events on the west coast of Newfoundland (Batterson and Catto, 2001, 2005; Batterson *et al*., 1993, 1995; Bell *et al*., 2001, 2002; Brookes, 1995, 2002, 2005), we are nonetheless pleased that Dr. Brookes maintains his interest in the area.

The coastal bedrock exposure at Campbells Cove shows unequivocal evidence of an early westward to southwestward ice flow crossed by a later southward flow. The site was originally described by Brookes (1970) and has been discussed subsequently by Liverman *et al*. (2001). Grant (1991) shows a similar pattern at Felix Cove to the east.

The sequence of events interpreted at Campbells Cove is interesting because it is the reverse of that described from that near Romaines Brook, 12 km to the east (Batterson and Sheppard, 2000; Grant, 1991) (Plate 4), and from several other sites on the Port au Port Peninsula (Taylor, 2001). At these sites, evidence for the southward flow is preserved on facetted surfaces in the lee of the more recent westward flow.

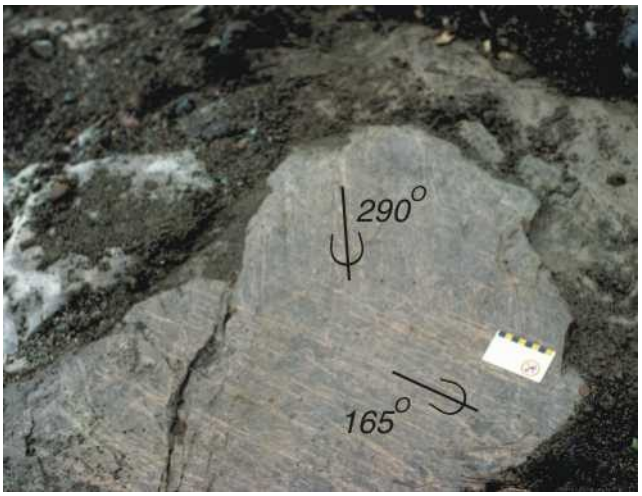

Plate 4. *Striated outcrop found on the coast 2 km west of Romaines Brook, showing striations from an early southward flow (165°) preserved in the lee of those from a later westward flow (290°).*

The interpretation of striations has been well documented (Chamberlin, 1888; Batterson and Liverman, 2001; Iverson, 1991). Striations represent ice flow at an individual site and therefore may not be representative of regional trends. Regional ice-flow patterns may only be assessed based on numerous striation sites. The sequence described by Batterson and Sheppard (2000) of an early southward flow followed by a later westward flow has been recorded at over 20 sites between Stephenville and Corner Brook (e.g., Batterson *et al*., 1993, 1995; Bell *et al.*, 2001, 2002), including several on the Port au Port Peninsula. Although we concur with Brookes' interpretation of the striation record from Campbells Cove, we remain convinced of the regional ice-flow history on the northern coast of St. George's Bay indicates an early southward ice flow followed by a later westward ice flow.

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