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Author Biography:
Denis St-Onge joined the Geographical Branch of the Department of Mines and Technical Surveys in 1958 and was a member of the original group of the Polar Continental Shelf Project which took him to Ellef Ringnes Island to conduct geomorphological surveys. In 1965 he joined the Geological Survey of Canada and later spent a period at the University of Ottawa where he was Chair of the Department of Geography and Vice-Dean of the School of Graduate Studies and Research. He was appointed Director, Terrain Sciences Division, GSC in October 1987 and since his retirement he has been an Emeritus Scientist. He was inducted as an Officer of the Order of Canada in May 1996 in recognition of his long and distinguished career, and in 2005 the Royal Canadian Geographical Society awarded him the Camsell Medal for exceptional service to the Society.

Glacier Ice Preserved for more than 10 000 years

Denis A. St-Onge, Emeritus Scientist Geological Survey of Canada

One of the great pleasures of working as a geologist is "going in the field", that is going to an area of Canada to study the rocks and sediments to determine their age and origin. No matter which region is to be studied one thing is absolutely certain, you will come to understand some aspect of the local history of the Earth and explain it better than anyone before. In some remote parts of Canada you may be the first human to leave footsteps and to see the particular beauty of that part of our great country. These are some of the reasons why geologists are so passionate about their work.

The following example may give you some idea of the pleasure and satisfaction in understanding what nobody else before has figured out.

In 1986 the Geological Survey of Canada gave me the responsibility of mapping the landforms and deposits resulting from the last glaciation in the area south of Dolphin and Union Strait which is now part of Nunavut. The area lies north of 68°N and west of Coronation Gulf.

In order to carry out this project which would require three summers of fieldwork, I hired several students to assist me. Besides getting valuable experience by participating in a field geology project, these students could use the results of their work for undergraduate or graduate theses. There were five students, two undergraduates (I. McMartin from Université Laval and M. Potschin a volunteer from Germany) and three graduate students (D. Kerr and H. Beaudet from Ottawa University, and R. Avery from Queen`s University). Rather than live in tents as was normally the case, we were able to refurbish part of an abandoned building of the Distant Early Warning (DEW) complex of radar and radio stations built during the Cold War period in the early 1950's. With heating from two small oil furnaces, this proved to be a remarkably comfortable camp with the added benefits that we had two landing strips and a road network still in excellent conditions in spite of having been abandoned for over 30 years.

Geological mapping involves a lot of walking, usually in pairs, but often alone; this is called "doing a traverse". After a detailed study of air photographs the "party chief" decides where traverses will be done in order to gather the maximum amount of information. Then the traverses are assigned to members of the party. A typical day would unfold as follows. Wake up around 7 am; breakfast prepared by the person whose turn it is to do the cooking and radio contact with Yellowknife to pass and receive messages, if any; prepare lunches to be carried in back packs; "set outs" i.e.; flown by fixed plane or helicopter to starting point of traverse; walk the 12 to 20 km of traverse using air photos as a guide; and make observations on the nature and distribution of surficial materials, and any other feature which might help explain the geological history of the area; collect samples of material and fossils where appropriate; stop for lunch, preferably in a particularly beautiful spot protected from mosquitoes; pick up for return to camp between 5 and 6 p.m. with possible

stop at a promising fishing spot (Arctic Char!!); dinner; sort out samples and notes; general discussion on what was learned during the day; contact Yellowknife between 9 and 9:30 PM; bed around 11:00 p.m.

After three weeks of traversing the area we realized that the belt of ridges and hills skirting the east side of Bluenose Lake was a massive "end moraine" (called the Bluenose Lake Moraine) was part of the frontal position of the Last Glacial Maximum. In other words, during the last time glacial ice covered most of Canada, the ice stopped in the Bluenose Lake area because it could not override the upland (the Brock Inlier) west of the lake. We later determined that this occurred tens of thousands of years ago and lasted until 12 000 years ago. From the study of air photos, there was one aspect of this moraine that was intriguing. Numerous scars were visible on the slopes of the hills and ridges in sediments composed of a mixture of boulders, gravel, sand, silt and clay. In order to understand this puzzle, I outlined a traverse on air photos and asked Isabelle McMartin, who has a degree in Engineering Geology, to try and find out what the explanation was. When she came back at the end of the day, she told the rest of us that the scars were slumps resulting from material sliding on buried ice. This raised the more difficult problem of "What is the origin of the ice?". We knew that buried ice can grow in the ground as it freezes following the melting of the glacial ice cover; this type of "ground ice" is common in the Mackenzie River delta region where the material is sand and silt and the relief is flat. We did not think that this explanation was suitable for the buried ice in the Bluenose Lake Moraine but the amount of ice visible was too limited to provide convincing arguments for an alternate explanation. So, in 1986, the problem remained.

Figure 1

Figure 2

However when we returned in 1988 (there was no fieldwork in 1987 because of an international congress in Ottawa), the situation was significantly different. When Isabelle and I went back by helicopter on Saturday July 23rd, one of the small slumps seen in 1986 had grown to a large amphitheatre over one kilometre in length and over twenty metres in height (Photo Figure 1). In this well exposed section, sediment-rich ice was overlain by a bouldery till (debris carried at the base of glacier), more than 3 m thick, with a sandy to sandy silt matrix, columnar jointing and prismatic fissility.

The icy sediments exhibited banding, folding and complex deformations, and included numerous boulders, cobbles, and pebbles (Photo Figure 2).

The upper contact of the icy sediments and the bouldery material (diamicton) above was sharp and subhorizontal. We now had all the information necessary, pending some laboratory analysis, to formulate the following hypothesis: the massive icy sediments represent basal glacier ice buried by the stacking of debris, mostly till, carried at the base of an ice sheet. Because the active ice was being pushed up slope, it rode over or, more precisely thrusted over stagnant ice near the ice front. As a result some of the glacier ice was buried by material carried at the base of the ice sheet as illustrated in figure 3. This buried ice has been preserved for the past 12 000 years. Although the climate became warm enough to melt the exposed glacier ice, it never got warm enough in this northern part of Canada to melt the ice below the till cover as shown in figure 4.

It is postulated that if the regional climate was to warm to the point of melting the icy sediments, which form the bulk of the Bluenose Lake Moraine, the resulting landscape would be hummocky terrain similar to that which covers extensive regions in more southerly parts of Central Canada.

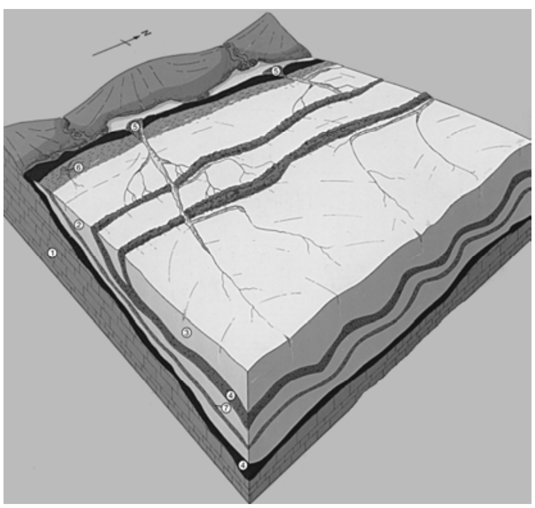

Figure 3

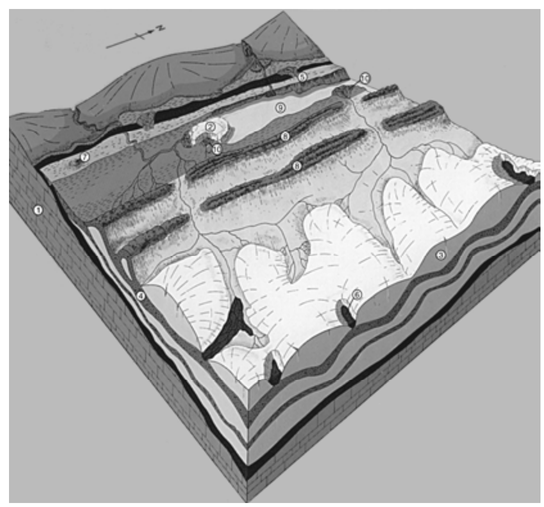

Figure 4

The Bluenose Lake Moraine is part of a proposed national Park and it illustrates the joy of discovery and of sharing it with others.