Université d'Ottawa • University of Ottawa
Faculté des sciences Faculty of Science
Sciences de la Terre Earth Sciences

GEO 2334 – GEG 3306
Quaternary Geology and Climate Change

Field Trip # 3, Deglaciation and Subaqueous Outwash
September 30 – 31, 2008

Following the glacial maximum (ca 21,500 yr B.P.) a global warming trend began and the Laurentide Ice Sheet commenced its retreat from the Great Lakes Basin and the St. Lawrence Lowlands. However, it was not until after 11,500 that deglaciation reached the Ottawa area. The pro-glacial lake that existed in the St. Lawrence valley was expanding into the Ottawa valley by calving at the glacier front. Around this time, the ice dam at Québec City opened and the proglacial lake drained, becoming the Champlain Sea - an arm of the Atlantic Ocean stretching up the St. Lawrence lowands and the Ottawa Valley. Sediment was deposited in sub-aquous pro-glacial fans that remain as ridges of sand and gravel in the region.

The South Gloucester Sand and Gravel Pit

The South Gloucester pit, NE of Johnson Corners on Highway 31, exploits sands and gravels of a ridge of subglacial outwash. The ridge represents a subaqueous pro-glacial fan created as deglaciation proceded from southeast to northwest throught the site of the City of Ottawa. The core of the ridge comprises many of the sedimentary features from the formation of the outwash fan, while the crest of the ridge is truncated by wave action at about 10,500 years B.P., during regression of the Champlain Sea.

The Exercise:

You are an esteemed Quaternary geologist assigned to unravel the late Quaternary sedimentary record at this site. You begin by examining representative sections at this site and make an interpretation of the processes at work here some 11,500 to 10,000 years ago. In your report include the following components:

1. Draw a map of the sand pit, including the general location of the dig sites and other important features.

2. Describe and sketch the sedimentation at the sites we visited. In particular, indicate the types of sediments, grain sizes, bedding, sorting and current directions.

3. Describe the sedimentary environment, including the position of the ice sheet, water level, and sediment source. Where do the events at this site fit with general deglaciation in the Ottawa region during the late Quaternary period.

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References:

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EXCURSION A

SUBAQUEOUS OUTWASH OF THE OTTAWA AREA

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This excursion visits exposures in three gravel ridges in the immediate vicinity of Ottawa (A, B and C of Fig. 2). The prime objective is to look at the stratigraphy and sedimentary structures in these ridges and see if a consensus can be reached on the mode of formation of these features. Figure A.1 shows the planned route and location of stops, Figure A.2 a general model of subaqueous outwash deposition and Figure A.3 is a cross-section showing the general sequence of events.

Stop A-1: Spratt's Sand and Gravel Pit, South Gloucester

Gravel pit operated by Spratt Sand and Gravel, on the west side of Highway 31, 0.5 km north of South Gloucester (jct. of Hwy. 31 and Regional Rd. 8); elevation at top 112 m; Figures A.1 to A.3; map 31 G/5, G.R. 548 143; Richard (1982a).

The pit is located in a ridge of sand and gravel that extends southeastward from Ottawa Airport, turning southward at Greely. The ridge is flat-topped due to truncation by wave action during the littoral phase of the Champlain Sea (Harrison, 1977). Descriptions of pits in this area are included in papers by Rust (1977) and Rust and Romanelli (1975). The purpose of this stop is to examine subaqueous outwash.

In this pit typical facies of subaqueous outwash are overlain unconformably by littoral gravel of the Champlain Sea. The uppermost part of the sequence that underlies the unconformity is downwarped by faults and associated folds. It contains abundant *Hiatella* with minor *Balanus* that lived below wave base in the Champlain Sea, at some distance from the retreating ice front. A radiocarbon date of 11 100 ± 130 BP (GSC-4166) was obtained for *Hiatella arctica* shells collected from the base of one of the folds. The lower part of the section is coarser and unfossiliferous, and is attributed to deposition close to the ice front as subaqueous outwash. The facies present are: (1) Massive to faintly parallel-stratified sand and pebbly sand in sheets and steep-walled channels. This facies is transitional laterally and vertically (in both coarsening-up and fining-up sequences) to faintly stratified cobble/pebble gravel (Fig. A.2, cut 2). (2) Climbing ripple sequences of silty fine sand in which the angle of climb commonly steepens upwards, indicative of decelerating bottom flow in a quiet-water basin (Fig. A.2, cut 4). (3) Coarse pebbly sand with large scale trough cross-bedding (Fig. A.2, cut 4). (4) Imbricate boulder gravel. This facies is seen on the left of the minor track on entering the pit. It represents the most proximal facies of subaqueous outwash, probably deposited within or at the mouth of the subglacial conduit system (Fig. A.2, cut 1). Paleocurrents measured from boulder imbrication, channel orientation, trough cross-strata and ripple cross-lamination all indicate general southward flow.

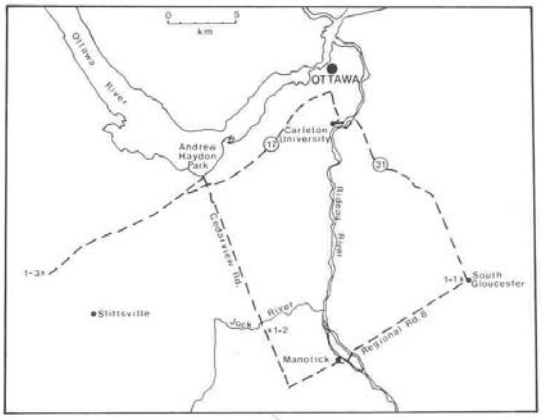

Figure A.1: Location of stops and route map for Excursion A

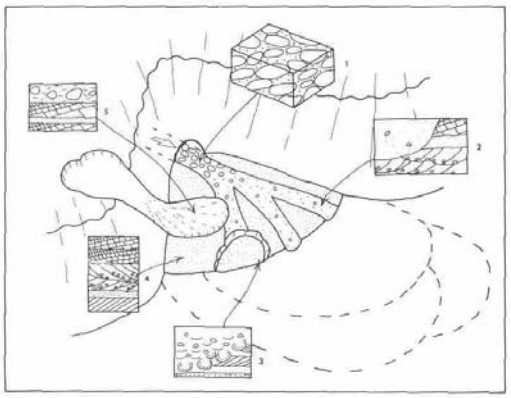

Figure A.2: Model for deposition of subaqueous outwash as applied to stops A-l, A-2 and A-3

The littoral Champlain Sea gravel above the unconformity contains scattered *Hiatella* that are distinctly smaller than those below the unconformity. Shells from just above the unconformity have been radiocarbon dated at 10 500 ± 120 BP (GSC-4173).

At the junction of Highway 16 and Regional Road 8 another ridge of sand and gravel is crossed. This is part of a ridge of stratified sand and gravel (subaqueous outwash) that extends from the Jock River (near the site of stop A-2) southeastward to Kars.

Stop A-2: Brazeau Pit

Active gravel pit located on the east side of Cedarview Road 2 km south of the Jock River; Figures A.1 to A.3; map 31 G/4, G.R. 430 108; Richard (1982b).

The purpose of this stop is to look at a succession of subaqueous outwash in a different ridge. See also Rust and Romanelli (1975) for further discussion of pits in this area.

The facies in Brazeau Pit are similar to those at South Gloucester except that diamicton is present, and channel forms are largely absent. The diamicton occurs as sheets conformable to the stratified subaqueous outwash, and is attributed to debris flows that originated on the glacier surface as meltout tills, and slid onto the sea floor close to the ice margin (Fig. A.2, cut 5). Deformation in Brazeau Pit is locally more intense than that seen at South Gloucester, and the relationship between proximal unfossiliferous subaqueous outwash and more distal fossiliferous strata is unclear. Littoral Champlain Sea deposits were formerly present over the top of the ridge, but have been removed from this area by pit operations.

Stop A-3: Rump's Pit

Entrance to Rump's Pit is on the south side of Regional Road 5 (Stittsville-Carp Road) about 200 m west of Highway 417; Figures A.1 to A.3; map 31 G/5, G.R. 343 145; Richard (1982a).

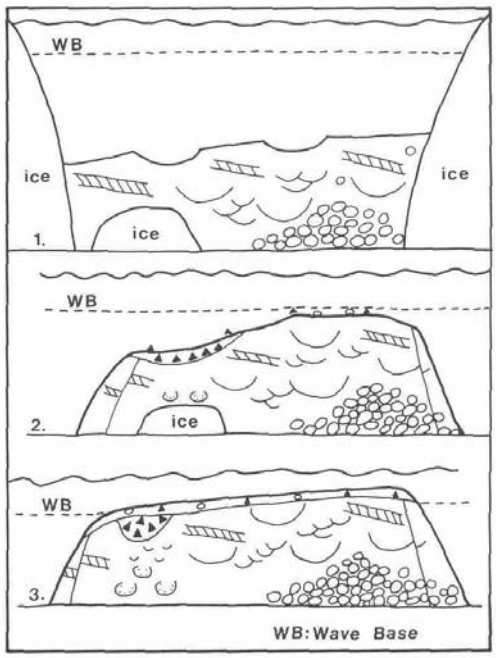

Figure A.3: Schematic representation of subaqueous outwash deposition and subsequent deformation in ridges south of Ottawa

Rump's Pit is located in a third ridge of sand and gravel that is parallel to and essentially similar to those seen at stops A-1 and A-2. The purpose of this stop is to look at some slightly different structures that are common in subaqueous outwash in the Ottawa area. Rust (1977), Rust and Romanelli (1975) and Cheel (1982) also discuss this location.

Pits on the northeast side of Regional Road 5 formerly worked proximal boulder gravel and coarse sand facies, but these are no longer exposed. Rump's Pit now predominantly shows medium to fine and silty sand in a variety of rippled facies. Isolated larger clasts "floating" in the sand were probably emplaced by ice rafting. Deformation structures are abundant and consist predominantly of pillow structures of varied size (Fig. A.2, cut 3). In some cases diapirs intervene between pillows, and pillow size decreases upwards, with transition to dish structures at the top of the section. As at the other localities, littoral deposits of the Champlain Sea formerly existed as an unconformable lag on the top of the ridge, but they have been removed by pit operations.