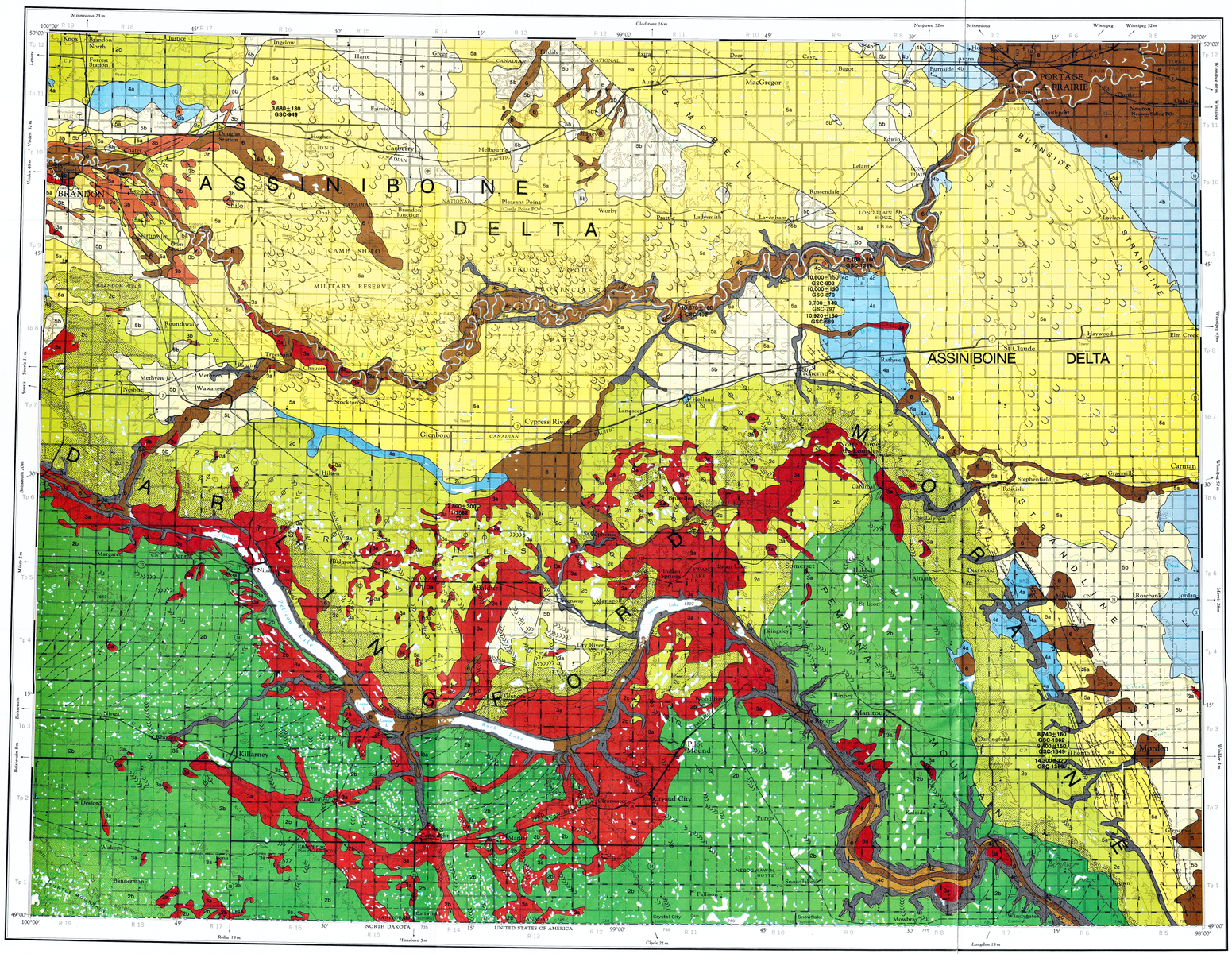
MANITOBA
DEPARTMENT OF ENERGY AND MINES
MINERAL RESOURCES DIVISION

QUATERNARY GEOLOGY MAP: SOUTHERN MANITOBA 62 G BRANDON



LEGEND

HOLOCENE WISCONSINAN

- 8 — Swamp: peat and peripheral mud with some alluvium
- 7 — Colluvial slumps, slope wash and some ice push deposits
- 6 — Alluvial silt, sand and clay, including alluvial fans along the escarpment and present day alluvial deposits
- 5b — Offshore silt, locally interbedded with sand or clay
- 5a — Littoral and nearshore gravel, sand and silt including minor deltaic deposits
- 4c — Fluvio-lacustrine clay and silt, deposited as alluvial fill in major river valleys
- 4b — Lacustrine silt and clay deposited in deep basins of Lake Agassiz
- 4a — Lacustrine silt and clay deposited in basins peripheral to the main Lake Agassiz basin
- 3b — Deltaic coarse gravel and sand, deposited primarily as the Assiniboine delta deposits
- 3a — Glaciofluvial and outwash sand and gravel, with minor silt, clay and till; includes eskers, kame deltas, outwash terraces and outwash plains
- 2c — Till: grey calcareous silty till derived primarily from Paleozoic carbonate rocks
- 2b — Till: brown clay till, deposited in part as hummocky stagnation moraine: includes wave washed till and minor clay basins
- 2a — Till: sandy till derived primarily from Precambrian bedrock: includes minor amounts of clay till
- 1c — Mesozoic bedrock :primarily shales
- 1b — Paleozoic bedrock :primarily carbonates
- 1a — Precambrian bedrock :primarily crystallines

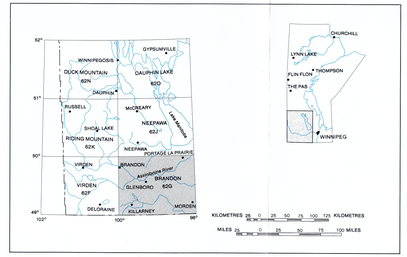
SYMBOLS

- Sand dunes, wind direction inferred
- 14,300 ± 320 GSC-1369 — Significant stratigraphic section (Radiocarbon Date)
- Flutings, ice advance direction inferred
- Minor till ridges
- End moraine , hummocky stagnation moraine
- Beach ridges — strandlines
- Esker (direction unknown ,direction known)
- C — Elbow of capture
- Spillway
- Buried Valley

Scale 1:250 000

KILOMETRES 0 5 10 15 20 25 30 KILOMETRES
MILES 0 5 10 15 20 MILES

Geological Map Q80- 7
Compiled by Aggregate Resources Section
Mineral Resources Division
Winnipeg 1980



CLASSIFICATION OF DEPOSITS

The preglacial topography in the Brandon map sheet was not extensively modified by glacial erosion. Till is common throughout the escarpment zone above 397m, and lacustrine deposits prevalent below this altitude.

TILL

Two types of till are found on the escarpment. The earlier grey till, composed largely of locally derived comminuted shale and a later carbonate rich till with a clast content of carbonate, crystalline and shale pebbles. Most of the till on the escarpment comprises hummocky stagnation moraine.In the Darlingford moraine till knolls and kames have an amplitude of 2-25m. Further west and south the till surface is more subdued. A series of discontinuous parallel ridges occur in the moraine and subdued till portions of the map.These stand 1-10m high, 1-2km long and have formed either parallel or perpendicular to the ice margin. The features south of Pelican Lake and Rock Lake are mapped by Elson (1959) as washboard moraines whereas the features north of Windygates are regarded as streamline flutings resulting from the advance southwestwards over the Darlingford moraine (Ringrose 1980).

ICE CONTACT STRATIFIED DRIFT

Kames, eskers and pitted outwash deposits are found mainly on the escarpment and as irregular, isolated hills in the nearshore and offshore zone. Kames accumulated as small deltas, and eskers in glacial tunnels within the stagnating ice. These provide sources of sand and gravel. Outwash comprises gravel, sand and silt washed out of the debris on the ice margin by meltwater.

LAKE DEPOSITS

Beach deposits are composed of well sorted sand and gravel ridges 1.0-3.0m thick, 15m to 70m wide and many kilometres long, with minor gaps. These are concentrated on the eastern slope of the escarpment and are particularly well developed in the vicinity of Morden. The best developed ridge stands at the upper Campbell strandline at about 317m.

DELTA AND FAN DEPOSITS

The Assiniboine river flowed eastwards into an early stage of Lake Agassiz depositing coarse apex gravel immediately east of Brandon , and finer sand and silt eastwards towards Portage La Prairie. The delta sand is medium to fine grained and has been reworked partially into dunes, well developed in the vicinity of Spruce Woods. South of Portage La Prairie, along the escarpment, the apex becomes progressively finer forming yellow offshore silt and clay. Alluvial fans are common along the east side of the escarpment and composed mainly of silt and clay. An alluvial fan also developed around Portage La Prairie, resulting from late stage deposition of the Assiniboine River. The Portage fan is discontinuous and includes sand deposits, silt in natural levees and backswamps. The alluvial fan built by the Cypress River is composed of shale, gravel, sand and silt and is crossed by several channels up to 4.0m deep.

The Pembina Valley comprises upper outwash terraces and lower recent terraces for most of its course. Ten kilometres downstream from La Riviere valley fill deposits form intermediate terrace levels. The upper terraces result from outwash deposition in an ice marginal environment. The intermediate terraces result from fluvio-lacustrine deposition occurring when the Pembina River flowed into Lake Agassiz, through its delta at Walhalla, North Dakota.

LAKE BOTTOM DEPOSITS

Nearshore zone: nearshore deposits comprise silt, with some sand and clay, occupying the shallower margins of Lake Agassiz in backswamp zones of the Assiniboine delta and along the Agassiz coast, south of Tobacco Creek. Included in this zone are yellow silt and clay found in the vicinity of Winkler.

Offshore zone: Brown to grey mainly homogeneous silty clay, 5 to 30m deep characterises the deeper water sediment of the Lake Agassiz basin.

GLACIAL HISTORY

Stagnation on the escarpment took place as the Red River Ice Lobe was advancing southwards into Iowa and Minnesota, about 12,000 years B.P.* An early lake developed between the active ice margin and the escarpment west of Morden. This has been dated at 14,300± 320 years B.P. (GSC-1369) from organic detritus in a terrace deposit (Lowden and Blake, 1976). A second small lake may have developed later around Rathwell. A date of 12,100± 160 (GSC-1319) was obtained from wood in clay below Assiniboine River alluvial deposits (Lowden, Robertson and Blake, 1971). During this period ice marginal drainage took place through the Pembina Valley, east of Ninette depositing extensive outwash over stagnation till, and higher level terraces of the Pembina system.

By 12,600 years B.P. ice stagnation on the escarpment had virtually ceased as kettle lakes were becoming filled with organic detritus (I-1682, 12,800± 350, Ritchie and Litchti-Federovich, 1968) and the Assiniboine River began to flow between the east-west trending portion of the escarpment zone and the ice margin. A tributary of the Assiniboine cut back and captured the Souris River, thus diverting all meltwater into the Assiniboine system. The upper Assiniboine delta began to form about 11,000 years B.P., which coincides with the higher levels of Lake Agassiz. Continued ice recession beyond the map area, allowed the level of Lake Agassiz to drop to the Campbell strandline (about 317m). Ponded water backed up into the Assiniboine River valley above the Campbell strandline level into which up to 20m of silt, clay and plant detritus were deposited. Dates from the alluvial till sediments range from about 10,000 to 10,600 years B.P. in the Rossendale gullley section (GSC-902, GSC-870, GSC-797, GSC-889). The dates record fluctuations in the level of Lake Agassiz at this time (Lowden and Blake, 1970). Further ice recession caused the level of Lake Agassiz to drop to about the level of the Burnside strandline. The Assiniboine River therefore extended to Portage la Prairie across the lower Assiniboine delta. A subsequent readvance of ice, caused the second major ponding of water in the Agassiz basin, with levels attaining the lower Campbell strandline level. After this period, a series of lower level strandlines, particularly well developed along the escarpment zone represent sequential drops in lake level, until about 8,500 years ago (Ringrose, 1976). During this period, longshore drift caused the deposition of yellow silt and clay in the basin east of Morden, and later the Assiniboine deposited its alluvial fan also containing some yellow sediment, in the vicinity of Portage la Prairie.

Subsequent activity increased the redistribution of sand in the Assiniboine delta in the form of dunes. Dune activity, dated from paleosols suggest periods of stabilization alternately with sand transportation. The first period of stabilization is dated at 3,680±180 (GSC-949, David, 1971). Portions of the dunes are currently active, while others are stabilized by vegetation.

* B.P.=before present

REFERENCES

David, P. P. 1971 The Brookdale Road Section and its significance in the chronological studies of dune activities in the Brandon Sand Hills of Manitoba. Geological Association of Canada, Special Paper Number 9. 1971. p. 293-299.

** Elson, J. A. 1959 Map 1067A .Surficial Geology, Brandon: Ground water resources of the Brandon map area, Manitoba, by G. C. Halstead. Geological Survey Canada Memoir 300. 67p.

Lowden, J. A. and Blake, W. Jr. 1970 Geological Survey of Canada Radio carbon Dates 1X Paper 70-2 Part B. p. 65.

Lowden, J. A., Robertson, I. M. and Blake, W. Jr. 1971 Geological Survey of Canada Radiocarbon Dates X1 Paper 71-7 p. 282.

Lowden, J. A. and Blake, W. Jr. 1976 Geological Survey of Canada Radio carbon Dates XV1 Paper 76-7, p. 8.

Ringrose, S. 1975 A re-evaluation of late Lake Agassiz Shoreline data from North Carman, Manitoba, The Alberta Geographer No. 11, p. 33-41.

Ringrose, S. M. 1980 Quaternary Geology and Gravel Resources of the Portage-Winkler area, Manitoba Mineral Resources Division. In preparation.

Ritchie, J. C. and Lichti-Federovich, S. 1968, Holocene pollen assemblages from the Tiger Hills, Manitoba. Can. Jour. Earth Science. V. 5 p. 873-880.

** Much of the map information was derived from this source.