



The ground moraine (1) is composed of buff to grey clay till. It is generally thick, possibly as much as 100 feet. In most places it is overlain by a layer, commonly 18 inches thick, of sandy silty clay. In places a water-worked residual layer of gravelly material separates this fine material from the till, and grades into the latter.

The hummocky moraine (2) is also composed of clay till, and contains pockets of sand and gravel. It occurs mostly as irregular masses of knobs and kettles, oriented at random, with relief up to 40 feet. The western and southern margins of the main mass consist of low ridges, circular or 'doughnut' shaped in plan, about 300 feet across and 3 to 5 feet high.

The ice-contact deposits (3) consist of isolated hills or ridges, or features combining both, composed of stratified sediments. They have steep ice-contact slopes. The deposits composed of silt (3a) are from 30 to 115 feet high, linear in outline, and roughly normal to ice-flow direction. On some the surface is marked by minor ridges parallel with the direction of elongation. The silt is finely laminated to medium. It has a buff colour and a floury texture. The deposits composed of sand and gravel (3b) occur as isolated hills (kames), elongate ridges (kame moraines), or as irregular, steep-sided, hummocky masses.

The outwash (4) consists of sand and gravel deposits, in many places with a pitted surface. These deposits have a generally low relief and a surface that resembles that of ground moraine or hummocky moraine.

The lake deposits (5) consist of sand (5a), silt (5b), clay (5c), or a mixture of all three. They occur mostly in two large basins, in the North Saskatchewan River lowland below the Eagle Hills Escarpment, and in the southern part of the map.

The modified till (6) is the till of ground moraine or hummocky moraine reworked by water. It consists largely of lag gravels formed of the coarser part of the pre-existing till, in places intermixed with alluvium. The colluvium (7) consists of material on steep slopes, that has been moved mainly by gravity. It is found in series of narrow, elongate, step-like slump blocks. Little or no change has occurred in this transported material.

The alluvium (8) consists of sand, silt, and gravel deposited in channels carrying water derived directly or indirectly from melting ice. It is of various ages and represents all such deposits not laid down by modern streams.

The windblown sand (9) represents reworked lake deposits. It is medium grained and uniform. It occurs both as gently to moderately undulating areas of sand and as sharp-crested dunes and blowouts with a relief of up to 35 feet.

The pond deposits (10) include those materials generally referred to as 'alkali'. Most of them are silt and clay. They contain a large amount of precipitated salt, mostly sodium and magnesium sulphates. A poorly defined, intermittent band of thin gravel deposits extends northwesterly from Denholm to the North Saskatchewan River. These deposits represent an eroded remnant of a band of alluvium laid down by a stage of the North Saskatchewan River that predated the last ice advance.

Just south of Phippen, a pit nearly a mile long has been excavated in sandy gravel about 40 feet thick of unknown origin. This gravel is overlain by 2 to 3 feet of till.

Ice-flow features range from easily discerned fluting to isolated ridges and to aligned knobs in the ground moraine. Most are composed of till, except for some gravel ridges found in the band of alluvium near Brada, northwest of Denholm.

Eskers are defined on the basis of their forms. Those in tps. 41 and 42, rgs. 18 and tp. 45, rgs. 7 are composed in part at least of gravel; those in tp. 39, rgs. 16 and tp. 41, rgs. 15 are of till.

Crevasse fillings occur along a broad ridge that parallels the direction of ice movement. Although they may be related to the minor moraines the crevasse fillings differ from them generally by being less regular and in many cases longer, more branching, and higher. Some till ridges were found whose origin is unknown.

Sequence of Events

The area was covered by Laurentide glaciers. Evidence of more than one major glaciation is both tentative and scarce, but two superposed tills occur in road cuts in secs. 10 and 16, tp. 42, rgs. 16; a lower, light-buff, sandy till and an upper, darker clay till. The buried gravel south of Phippen also may be the result of an early glaciation.

Ice-flow and ice-marginal features indicate that the last glacial movement in the area occurred in two phases, accompanied by minor oscillations during retreat. The general direction was for the most part slightly west of south, followed by a later restricted movement to the southeast.

Evidence of the first phase is visible south of the Eagle Hills Escarpment on our west side of the map-area and farther west, and on the upland north of the map-area. Ice-flow features south and southeast of Whiteshore Lake indicate a fanning out of the glacier into the low land in the southeast corner of the map-area.

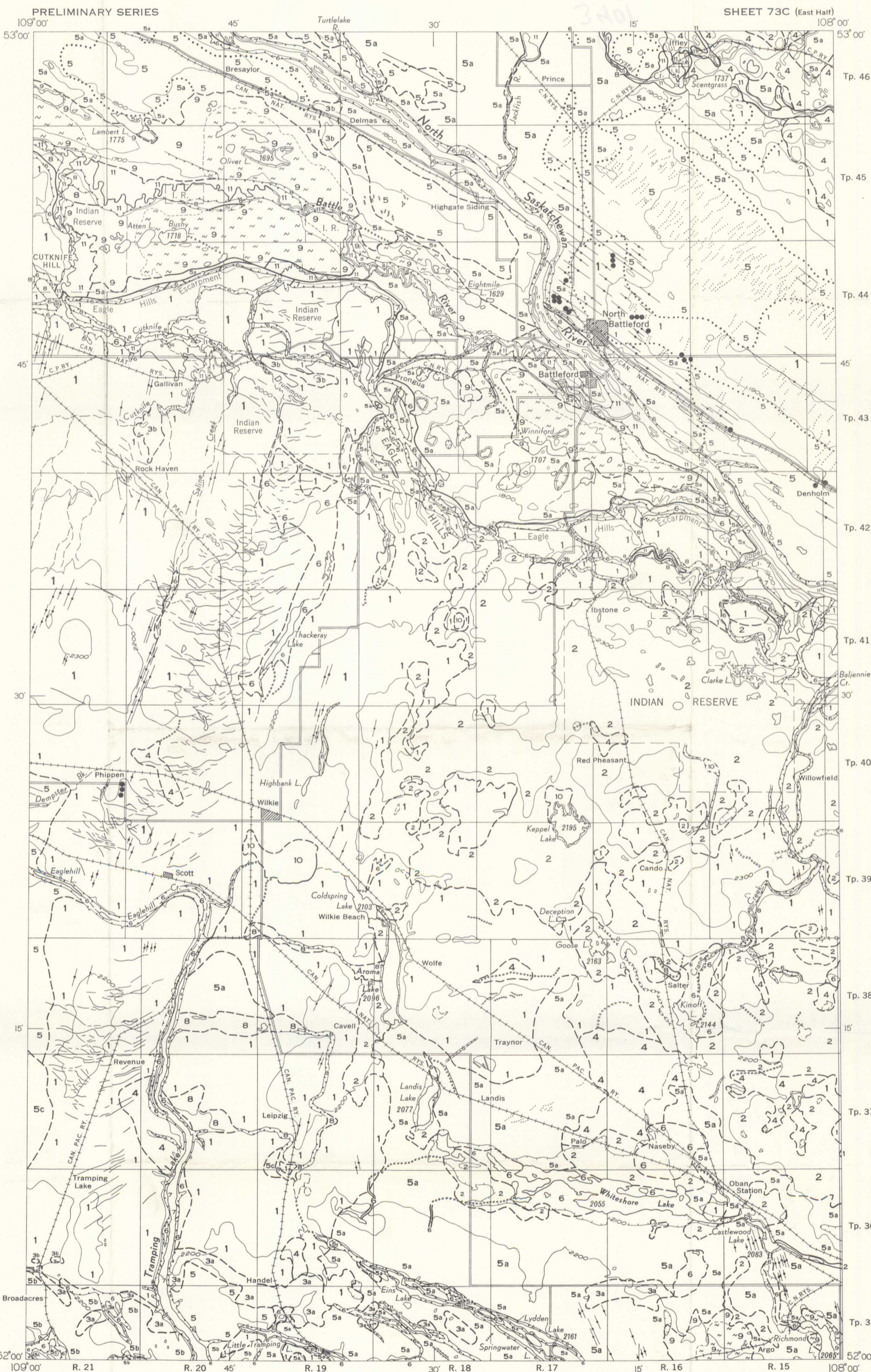
As the ice-front retreated into the area from the south the most rapid forward movement of the ice took place along Tramping Lake valley and resulted in a salient along the valley and reentrants on either side. Debris was deposited in some places during temporary halts in the retreat and, as this retreat was downslope to the northeast, successively lower ice-marginal valleys were carved, such as secs. 35 and 36, rgs. 17 to 19. The position of one well-marked ice-front is indicated along the north side of the lake deposits and ice-contact material in tp. 35, rgs. 19 to 21, and along the edge of the Eins Lake-Lydden Lake valley.

Water was impounded in the basin formed between the retreating ice-front and the high land to the south. This water escaped to the south through the Tramping Lake valley which cuts through a ridge that forms the southern rim of the basin a few miles south of the map-area. Retreat continued intermittently downslope and successively lower lake levels were established. When downcutting in the outlet valley was deep enough to allow the lakes to be drained the ice-marginal channels were carved. Slight advances occurred that partly filled some of the channels. Some water probably flowed eastward and southward through the southeast corner of the map-area but the main spillway remained through Tramping Lake.

North of the valley containing Coldspring, Aroma, Landis, and Whiteshore Lakes, which predates the last glacier advance, the land slopes downward to the south and meltwater did not accumulate after the ice-front had retreated this far.

At about this stage the glacier had thinned so that complete stagnation took place south of the Escarpment. North of there in the North Saskatchewan lowland the ice was still thick enough to flow. A strong south-east movement is indicated by the striking ice-flow features immediately north of the river. Along the edge of the upland an intricate network of meltwater channels was formed as the margin of the active ice fluctuated. Many of these channels have been overridden and in places partly filled. Terraces mark fluctuations in the amount of water that was discharged. This tongue of ice retreated to the northwest. Blockage of the valley east of the map-area caused the formation of a lake that inundated nearly the whole valley.

Final retreat of the ice to the northwest and north and removal of the ice-dam downstream allowed through-flowing streams to be established. Terraces were formed along the Battle and North Saskatchewan Rivers. The final event was the reworking by wind of some of the lake sediments.



- RECENT
11 Alluvium: gravel, sand, silt, clay; modern stream deposits
10 Pond deposits: chiefly silt and clay; commonly very alkaline
PLEISTOCENE AND RECENT
9 Wind deposits: medium-grained sand
8 Alluvium: gravel, sand, silt; spillway and run-off channel deposits, delta deposits; includes patches of 6
7 Colluvium: mostly slumped till
6 Modified till: commonly till of ground or hummocky moraine reworked by current or wave action; includes patches of 8; occurs on modern valley slopes, in meltwater channels, and on terraces
PLEISTOCENE
5 Lake deposits: 5, undifferentiated, generally silt, some sand and clay, commonly less than 4 feet thick; 5a, mostly sand; 5b, mostly silt; 5c, mostly clay
4 Outwash: mainly sand and gravel; some till
3 Ice-contact deposits: silt, sand, gravel; stratified sediments in ridges and steep-sided mounds; 3a, silt; 3b, sand and gravel
2 Hummocky moraine: till; minor sand and gravel; in places dominantly silt
1 Ground moraine: till, commonly capped by lag gravel and 1 foot to 2 feet of lake (?) deposits

- Geological boundary (defined, approximate, assumed)
Ice-flow features (drumlins, drumlinoid ridges, fluting); individual features or groups of parallel features
Esker ridge (direction of ice movement unknown)
Crevasse fillings; till ridges; generally transverse to direction of glacier flow
Minor moraines; mainly till, some stratified sand and gravel; transverse to direction of glacier flow
Till ridges, origin unknown
Area of sharp-crested dunes and blowouts
Indistinct drainage lines; commonly occur as series of small ponds in indistinct valleys; marking courses of buried valleys and short-lived meltwater channels
Scarp (symbol marks upper edge; fresh and well-defined, eroded and indistinct)
Erosion remnant, probably with bedrock core
Gravel occurrence; deposited before last glaciation

Geology by B.G. Craig, 1952

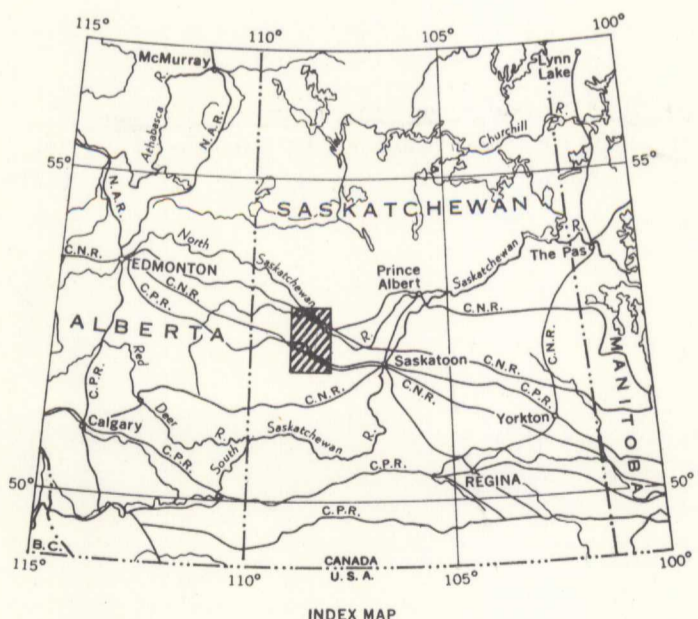
- Roads
Township boundary
Indian Reserve boundary
Intermittent lake and stream
Contours (interval 100 feet)
Depression contour
Height in feet above mean sea-level

Cartography by the Geological Survey of Canada, 1959

Approximate magnetic declination, 20° 22' East

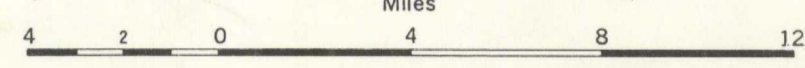
In response to public demand for earlier publication, Preliminary Series maps are now being issued in this simplified form, thereby effecting a substantial saving in time. There is no loss of information, but the maps will be clearer to read if all or some of the map-units are hand-coloured.

Air photographs covering this area may be obtained through the National Air Photographic Library, Topographical Survey, Ottawa, Ontario



MAP 15-1959
SURFICIAL GEOLOGY
BATTLEFORD
WEST OF THIRD MERIDIAN
SASKATCHEWAN

Scale: One Inch to Four Miles = 1/253,440 Miles



5.1.10
A, Geol. Battleford, Sask.
15-1959