GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRELIMINARY SERIES

SHEET 82H (West Half)

LEGEND

QUATERNARY

RECENT

- 17 Alluvium, coarse, modern stream deposits: gravel, sand
- 16 Alluvium, fine, modern stream deposits: silt, sand, clay, local gravel; minor till and bedrock exposures
- 15 Wind deposits, including areas of blow-outs: sand, silt

PLEISTOCENE AND RECENT

- 14 Lake deposits, coarse: sand, silt
- 13 Lake deposits, fine: silt, minor clay; locally varved
- 12 Alluvium, coarse, glacial and early post-glacial stream deposits: gravel, sand
- 11 Alluvium, fine, glacial and early post-glacial stream deposits: silt, sand, clay, local gravel; minor till and bedrock exposures

CENOZOIC

PLEISTOCENE

- 9 | 10 WISCONSIN (AND ILLINOIAN?) Outwash, kame, and esker deposits: 9. Laurentide; gravel, sand, silt 10. Cordilleran; gravel, sand, silt
- 7 | 8 Hummocky moraine: 7. Laurentide; till, minor gravel, sand, silt; 7a, largely gravel 8. Cordilleran; till, minor gravel, sand, silt
- 5 | 6 Ground moraine: 5. Laurentide; till; 5a, modified by stream and lake erosion or deposition 6. Cordilleran; till
- 4 NEBRASKAN OR (AND) KANSAN ? Hummocky moraine: Cordilleran; till, minor tillite, gravel, sand, silt
- 3 Ground moraine, includes much associated outwash: Cordilleran; till, tillite, local gravel, sand, conglomerate

TERTIARY AND EARLY QUATERNARY

- 2 Alluvium: pre-glacial gravel and sand; includes 'Saskatchewan gravel and sand'

PROTEROZOIC TO CENOZOIC

- 1 Bedrock; 1a, exposed in non-glaciated areas; 1b, exposed in areas eroded by valley glaciers and cirques (never drift covered); 1c, exposed by post-glacial removal of drift (mostly in stream valleys); 1d, exposed, or thinly covered by till or scattered erratics

Geological boundary (defined, approximate)

Ice-flow features: drumlins, drumlinoid ridges, furrows, flutings, gouges; individual features or groups of features defining direction of ice-movement; (symbol represents actual length of feature)

Esker ridge: gravel, sand, silt, clay, till; (direction of stream flow assumed)

Southern and western limits of Laurentide erratics (stones brought from the Precambrian Shield by ice); (boundary defined, approximate)

Limit of quartzose conglomerate boulder train

Geology by A. MacS. Stalker, 1956 and 1957

Main highway

Other roads

International boundary

Township boundary

Indian Reserve boundary

Intermittent lake and stream

Irrigation canal or ditch

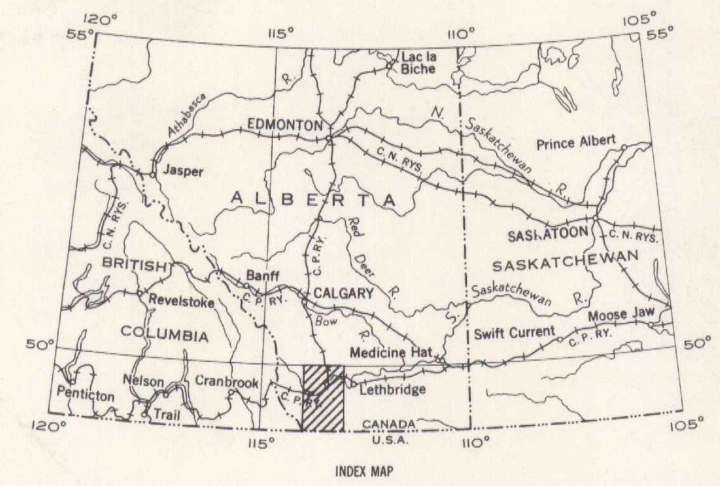
Contours (interval 200 feet)

Approximate magnetic declination, 20° 49' East

Cartography by the Geological Cartography Unit, 1958

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



Adjoins Map 14-1957, "High River"

PUBLISHED, 1959
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MAP 21-1958

SURFICIAL GEOLOGY

FORT MACLEOD

WEST OF FOURTH MERIDIAN

ALBERTA

Scale: One Inch to Four Miles $= \frac{1}{253,440}$

Miles

4 2 0 4 8 12

21-1958

DESCRIPTIVE NOTES

Three districts in the map-area were never covered by moving or glacier ice. These undoubtedly had thick covers of stagnant ice and snow that left no trace upon melting. The small non-glaciated district in the southeast is the westernmost part of the Del Bonita non-glaciated area east of the map-area. This is typically a flat, well-drained area floored by preglacial gravel, and has thick soil. Part of this district is below 4,300 feet altitude, which is higher than the surrounding country but well below altitudes reached by Laurentide glaciers a short distance to the west. The lack of glaciation in the Del Bonita district may have been caused partly by strong drawdown of ice to low land farther east. The other non-glaciated districts, in the Porcupine Hills and in the mountains near Waterton Park, are high areas that remained above the glacier surface. In them bedrock is generally exposed or covered only by thin soil.

The southern and western limit of Laurentide erratics represents the extreme limit reached by Laurentide ice. It lies at about 4,300 feet in the southeast but rises to between 4,700 and 5,100 feet in southwest (the lower figure where the Laurentide glacier was fended off by Cordilleran ice), and to above 5,500 feet in the Porcupine Hills.

In the north the Porcupine Hills prevented Cordilleran ice from advancing eastward. Farther south Cordilleran drift is present below Laurentide drift in the banks of the Oldman River to 5 miles northeast of Brocket, and Cordilleran ice probably advanced some miles farther eastward down this valley. Similarly Cordilleran drift occurs below Laurentide drift in the Waterton and Belly Valleys to near Hill Spring. Elsewhere the areas overrun by Laurentide and Cordilleran glaciers overlap some 15 or 20 miles, and the extent of the Cordilleran advance is represented by scattered large boulders brought from the mountains to the west and south. These are found particularly on the higher Foothills where they are intermingled with Laurentide boulders.

The maximum advance of both Laurentide and Cordilleran glaciers apparently took place during either the first or second regional glaciation of the area, and hence probably in Nebraskan or Kansan time. The last (Wisconsin) Laurentide and Cordilleran glaciers were not so strong as the earlier ones and had only limited contact in the southwestern part of the area. Even in this region they did not overrun some areas that had been glaciated earlier in Illinoian or early Wisconsin time (?). The last Laurentide glacier reached altitudes of about 4,500 feet, or 500 to 1,000 feet lower than the upper limits of Laurentide erratics to the west. Similarly, in the Waterton district, erosional breaks on valley walls marking the upper limits of late Pleistocene glaciation are 500 to 1,000 feet lower than those formed by earlier glaciers. Thus the early valley glaciers were 500 to 1,000 feet thicker than the later ones.

Good sections through the Pleistocene and Recent deposits occur in all the river valleys. They commonly include the preglacial gravels, two or more tills, and in some instances thick post-glacial deposits. The most complete exposure (the Brocket cut, sec. 34, tp. 7, rge. 28) shows, from the bottom up: bedrock, preglacial gravels, Cordilleran till, four distinct Laurentide tills, outwash, and non-glacial deposits. Where both Cordilleran and Laurentide drifts are present the Cordilleran is the lower, and mountain ice perhaps was already retreating before the Laurentide glacier arrived. The four Laurentide tills present in the Brocket cut indicate that four Laurentide glaciers reached the region. These glacial stages or substages cannot be correlated or dated with the general Pleistocene section, but it is assumed that the top till is of Wisconsin age, and it is likely that the bottom Laurentide till and the Cordilleran till are Nebraskan in age.

The general movement of the last Laurentide glacier in this region was south-southeastward, but the flow was strongly affected by local topography, which diverted it locally to flow up the Oldman Valley and into low land near Cardston. During its retreat wastage along the ice margin induced westward movement in the marginal zone of the ice-sheet, particularly along the front of the Porcupine Hills. Movement of the Cordilleran ice was directly down the various valleys out of the mountains.

Buried preglacial and interglacial valleys are present in the area, and drift in them is up to 300 feet thick. On the plains there was a preglacial valley to correspond to each of the present river valleys, and the present rivers generally follow long sections of these earlier valleys. The two apparent exceptions are the Oldman River north of Pincher Creek, which at one time flowed closer to the present position of the town; and the preglacial St. Mary River, which flowed southeast of the St. Mary reservoir to join the present valley north of Spring Coulee. In the Foothills the buried valley system is more complicated, and there are deep, buried preglacial or interglacial valleys between most of the bedrock ridges.

The preglacial alluvium (2) includes the best gravel in the area. Surface exposures of this gravel are small, but buried deposits are extensive and form good aquifers. The gravel overlies the bedrock, to a depth of 5 to 25 feet, along most of the courses of the preglacial buried valleys. In addition such gravel is present on many hills, where it was laid down by former rivers. These gravel beds, being more resistant than the nearby bedrock, form a protective cover and remain as hills whereas the surrounding area has been eroded. In general the northeastward-trending ridges have a protective gravel cover and represent former river channels; southeastward-trending ridges represent structural control by resistant bedrock layers.

The Nebraskan or Kansan ground moraine (3) found east of Belly River in township 1 covers broad, flat buttes to a general depth of 50 to 100 feet. The soil there is much thicker than on the normal ground moraine and the basic boulders on the surface show much more weathering (to depths of 1/4 to 3/4 inch). This area lies at an elevation of about 6,000 feet, and the resistant till, tillite, and outwash may have protected it while the surrounding land was eroded down several hundred feet.

Nebraskan or Kansan hummocky moraine (4) occurs only where its altitude has protected it from later glacial erosion.

Most of the ground moraine (5) consists of a clayey and silty till, which normally contains few stones, and which is grey to buff in colour. The till of the ground moraine (6) is silty and sandy, with numerous stones, many of them striated. It is generally pink.

Most of the hummocky moraine (7) is of the dead-ice type, and does not necessarily represent former ice margins.

The chief outwash and esker deposits of the Cordilleran glacier (10) are in township 2, north of the Waterton Lakes, and these supply much good gravel. Most of the Laurentide outwash (9) occurs along the Oldman River from west of Brocket to near Fort Macleod. There it forms a remarkable series of outwash plains, each with a scarp on the east representing the former ice-contact, and grading westward from coarse gravel near the scarp through sand to stony silt.

Most of the glacial and early post-glacial stream deposits (11, 12) were laid down while the glacier was near, and before the present drainage pattern had developed. These deposits generally are higher than the modern stream deposits (16, 17) found in the flood plains and deltas of the present streams. The coarse deposits (12, 17) normally are thin, but locally they contain much good gravel.

The quartzose conglomerate boulder train consists of numerous large, angular, distinctive erratics, brought from the north. It is part of a much larger boulder train that extends northwestward along the Foothills to at least the latitude of Edmonton. In this area there are several expansions of this normally narrow train, one in the Oldman Valley and another north of Cardston. Distribution of the local branches of this train, one trending northward on the Blood Indian Reserve and the other, trending southwestward, north of Glenwoodville, apparently was controlled by elevation.

MAP 21-1958
FORT MACLEOD
ALBERTA
SHEET 82H (West Half)