Alberta RESEARCH

LEGEND

RECENT

EROSIONAL FEATURES

- 20 — Gully, creek valley, scarp: *thin colluvial cover on valley slopes; thin alluvial materials along streams; mixed glacial and bedrock materials in slump areas*

ALLUVIAL DEPOSITS AND FEATURES

- 19 — Beach: *mainly sand, sand and silt*
- 18 — Lake and slough deposits: *silt, clay, organic muck and marl*
- 17 — River terrace: *alluvial gravel, sand and silt, along North Saskatchewan River*
- 16 — Stream alluvium: *silt, clay and sand, along small streams*

AEOLIAN DEPOSITS

- 15 — Loess: *fine-grained to very fine-grained sand, and silt*
- 14 — Sand, dunes: *medium- to fine-grained sand, in sheet and dune form; 10 to 50 feet thick in dunes, thin in sheet sand*

PLEISTOCENE

GLACIOLACUSTRINE DEPOSITS

- 13 — Silt and clay: *bedded silt and clay, with minor sand; varved in places*
- 12 — Silt, sand and clay: *bedded silt and fine- to medium-grained sand; minor clay*
- 11 — Sand, silty sand: *mainly sand, with minor silt and clay; minor pockets of coarse sand and gravel*
- 10 — Mixed: *bedded silt, sand and clay, with pebbles, till pockets and till-like layers; overlying till*

GLACIOFLUVIAL DEPOSITS AND FEATURES

- 9 — Pitted delta: *fluvial sand, silt and sand, minor clay, with occasional till pockets; topography hummocky to gently rolling*
- 8 — Eroded lacustrine plain: *thin, fine- to medium-grained sand deposits overlying lacustrine deposits, till and bedrock; local gravelly lenses*
- 7 — Eroded till plain: *thin, fine- to medium-grained sand and gravelly lenses overlying till, and locally bedrock; lag deposit*
- 6 — Outwash sand: *coarse- to medium-grained sand with pebbles and small gravel lenses; thickness variable, 2 to 20 feet; topography level to gently undulating*
- 5 — Outwash sand and gravel: *coarse- to medium-grained sand, with up to 50 per cent gravel; quartzite and granite pebbles and boulders; thickness variable, 2 to 20 feet; topography level to gently undulating*
- 4 — Outwash gravel: *quartzite and granite pebbles and boulders, with less than 50 per cent sand; occasional very large granite erratics; thickness variable, 2 to 20 feet; topography gently undulating to level*
- 3 — Kame, esker: *sand and gravel, commonly silty, with inclusions of till; forming local hills and ridges*

GLACIAL DEPOSITS

- 2 — Hummocky moraine: *till composed of mixed clay, silt and sand, with pebbles and boulders; lenses of sand, gravel and local bedrock; generally more than 40 feet thick; topography undulating to gently rolling*
- 1 — Ground moraine: *till composed of clay, silt and sand, with pebbles and boulders; variable in thickness, but generally less than 40 feet; topography level to undulating*

Geological boundary: defined, approximate, assumed

Glacial fluting

Meltwater channel, large

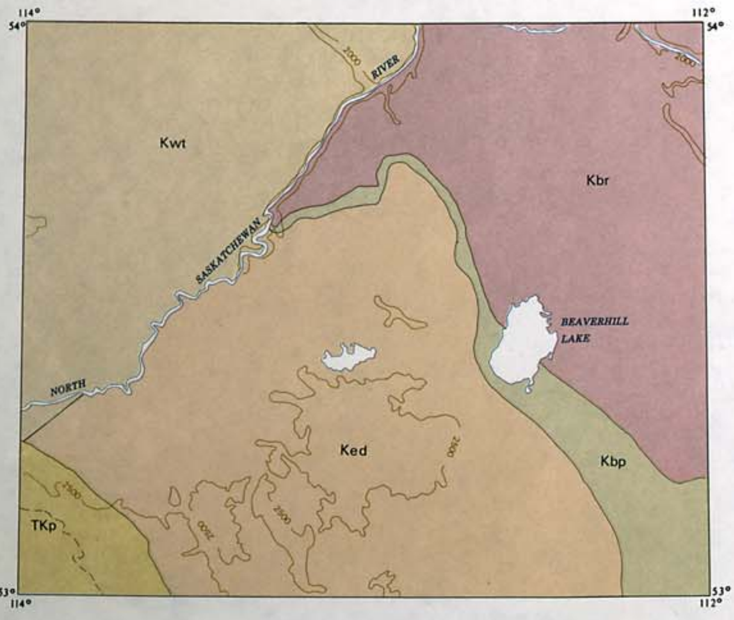
Meltwater channel, small

Geology by L. A. Bayrock, 1958, 1959, 1960, 1967, 1968, 1969

BEDROCK GEOLOGY

from R. Green, 1972

Scale 1:1,000,000



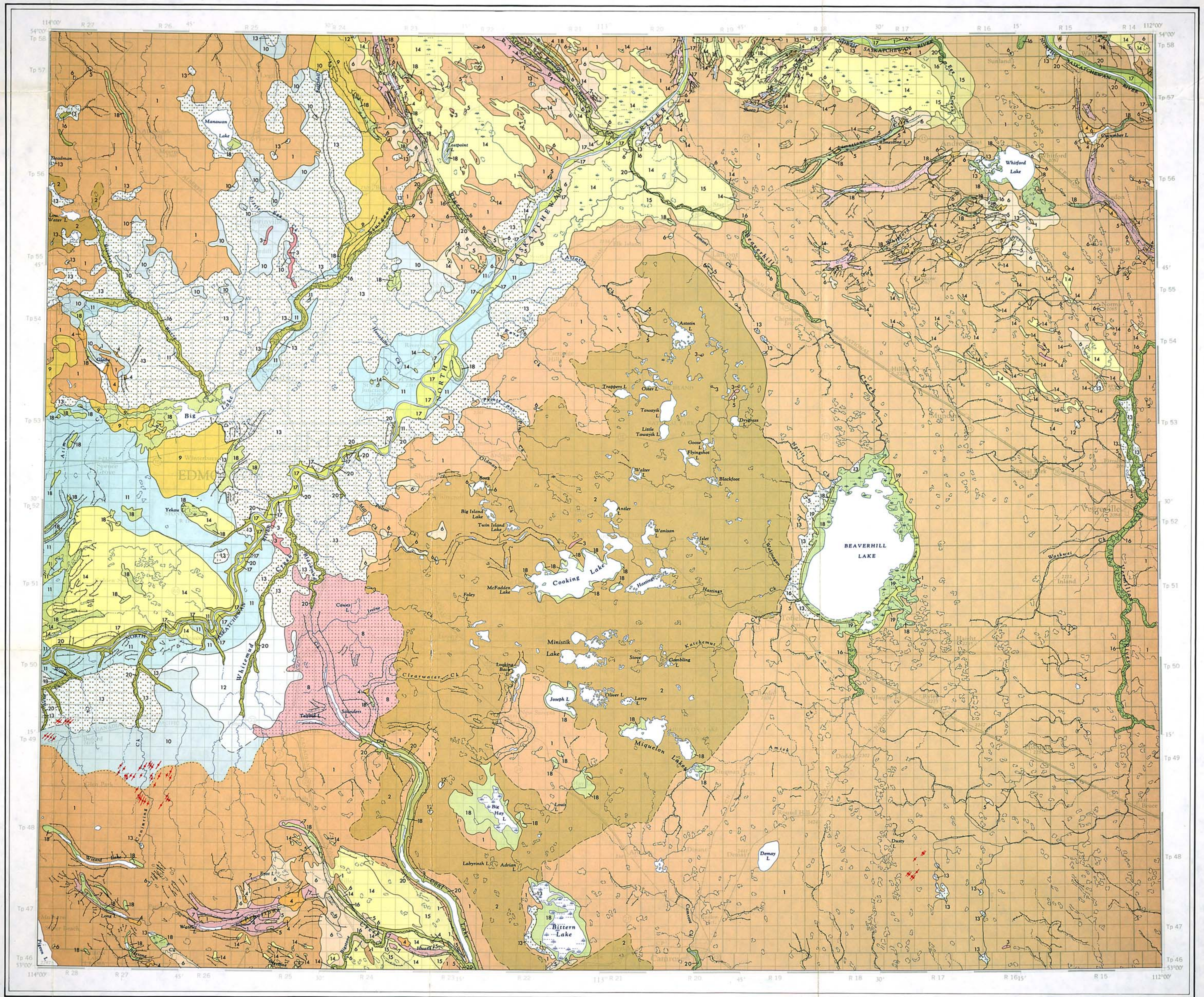
LEGEND

CRETACEOUS

- TKp — Paskapoo Formation: *sandstone, siltstone; coal and tuff beds*
- Kwt — Wapiti Formation: *sandstone, mudstone and shale; ironstone and coal beds*
- Ked — Edmonton Group: *sandstone, mudstone, shale; ironstone and coal beds*
- Kbp — Bearpaw Formation: *silty shale, minor clayey sandstone*
- Kbr — Belly River Formation: *sandstone, siltstone and mudstone; ironstone beds*

Geological boundary

Surface contour (contour interval 500 feet)



Base map provided by Surveys and Mapping Branch, Department of Energy, Mines and Resources; modified by Surveys Branch, Alberta Department of Highways and Transport

Cartographic editing by J. D. Root

Drawn by D. E. Jacobs

Published 1972

LEGEND

River or stream

Intermittent river or stream

Lake

Intermittent lake

Road, hard surface, all weather

Railway

Township boundary

Section line

SCALE 1:250,000

1 Inch to 4 Miles Approximately

Miles 5 0 5 10 15 20

Kilometres 5 0 5 10 15 20 25 30

SURFICIAL GEOLOGY
EDMONTON
NTS 83H

DESCRIPTIVE NOTES

BEDROCK GEOLOGY

The near-surface bedrock in the Edmonton area is mainly of Late Cretaceous age; the beds dip gently southwestward, so that the oldest rocks occur in the northeast and the youngest, of early Tertiary age, are present in the southwest corner. All are nonmarine except for a thin tongue of marine strata present in the southeast.

The oldest beds belong to the Belly River Formation—grey to greenish-grey sandstones, clayey siltstones and mudstones with local ironstone beds. These are overlain by thin brownish and dark grey shales and siltstones of the Bearpaw Formation, containing marine microfossils. The overlying Edmonton Group consists of grey clayey sandstones and mudstones, dark carbonaceous shales, volcanic tuff and ironstone beds, and commercial coal seams. Dinosaur bones and petrified wood can sometimes be found on outcrops, as in the North Saskatchewan River valley between Edmonton and Devon. North of the North Saskatchewan River, the Bearpaw Formation thins to zero, and the Belly River and Edmonton strata are grouped together as Wapiti Formation. In the southwest, the Paskapoo Formation is the youngest rock unit, containing the thick Ardley coal zone near the base, and consisting of similar beds to the Edmonton Group, but with no ironstone, less coal, and generally more sandstone.

Erosion of the bedrock surface during later Tertiary time established a pattern of drainage towards the northeast, as indicated by the centrelines of preglacial valleys shown on the side map. Stream and terrace deposits are commonly quartzite-rich gravel in the main valleys (and are extensively used for aggregate), and sandy in the smaller valleys. The deposits are classed as Saskatchewan Gravels and Sands.

SURFICIAL DEPOSITS AND LANDFORMS

Glacial History

During the Pleistocene epoch, a continental ice sheet originating on the Precambrian Shield in Keewatin advanced from the northeast and covered the region at least twice. The last ice advance took place some 25,000 to 30,000 years ago, in late Wisconsin time; this ice sheet extended southward into Montana, and westward to beyond Edson to coalesce with mountain ice sheets. Melting of this glacier, which was essentially complete about 9000 years ago, left all of the area covered by surficial deposits of various types.

Glacial Deposits

Till is unsorted sediment deposited directly from a glacier and is composed of varying proportions of all materials eroded by the glacier upstream from any point of deposition. Till forms the surface deposits over the greater part of the map area and, in addition, underlies much of the area covered by younger lacustrine and aeolian sand deposits. Till deposits are divisible on the basis of topography into two types: *ground moraine*, with local relief of less than 15 feet, and *hummocky moraine*, with local relief of more than 15 feet. Ground moraine, which has a wide distribution, is generally thin (10 to 40 feet) and fairly uniform in composition. Hummocky moraine is confined mainly to the central part of the area, underlying the hilly terrain which extends from Elk Island Park in the north to the southern boundary of the map area west of Camrose. The till in hummocky moraine is generally thick (40 to 150 feet) and contains many lenses of gravel, sand, and silt.

Tills of the Edmonton area consist mainly of local bedrock materials (disintegrated Cretaceous sandstones and bentonitic shales with coal and sideritic ironstone fragments) with significant amounts of igneous and metamorphic rocks derived from the Canadian Shield to the northeast. The presence of rocks and minerals from the Shield (e.g., granite, schist, green hornblende) readily distinguishes the glacial deposits of the area from preglacial sands and gravels and local bedrock materials. The tills also contain Devonian carbonate rocks from outcrops along the Shield margin; hence, although the local Cretaceous bedrock formations tend to be low in calcium carbonate, the tills are calcareous owing to the presence of Devonian limestones. The tills contain approximately equal proportions of sand, silt, and clay, but have low gravel contents—less than 10 per cent. Montmorillonite forms a significant fraction of the total clays—between 10 and 20 per cent. Near the surface the tills are oxidized and brown in color, but deeper than 10 to 20 feet from the surface they are typically unoxidized and grey to dark grey in color. In groundwater discharge areas till near the surface may contain significant amounts of sulfate salts.

Glaciofluvial Deposits and Features

Ice-contact deposits in the form of *kames and eskers* are very rare in the area. Four small moulin-type kames have been found in Elk Island Park. A large kame partly covered by glaciolacustrine (Lake Edmonton) sediments and supporting small beaches forms Rabbit Hill south of Edmonton. Two eskers, also covered partly by Lake Edmonton sediments, are located near the town of Morinville, north of Edmonton. Other kames are very small. Generally, the kames and eskers are composed of impure sand and gravel with large inclusions of till and silt and are not suited for use as aggregate.

Outwash deposits are deposits of sand and gravel laid down by glacial meltwater, usually on ice-free terrain, either along meltwater channels or as sheet deposits. On the basis of composition, outwash deposits in the Edmonton area are subdivided into three categories: *outwash gravel, outwash sand and gravel,* and *outwash sand. Outwash gravel* is found mainly in association with glacial meltwater channels, mostly as terraces along the channels, but rarely (as near Millet and Andrew) as channel floor deposits. Most outwash gravel in the area is of good commercial grade and is mined for aggregate. *Outwash sand and gravel* also is associated with former glacial meltwater channels but, in addition, occurs as sheet deposits, as in the Fort Saskatchewan-Redwater and Millet areas. These deposits contain a significant proportion of coarse sand in addition to fine sand and large layers and pockets of gravel. Many are mined for aggregate. *Outwash sand* is found mainly as sheet deposits. Generally the sand is fine to medium grained with a very small proportion of gravel; the fine grain-size precludes its use for aggregate. Most outwash sand deposits have had their surface modified by aeolian action and support sand dunes stabilized by vegetation.

The *eroded plains* outlined on the map are areas from which some or all of the surficial deposits have been removed by running water. Two types of eroded plains are present: *eroded till plains* and *eroded lacustrine plains*. On *eroded till plains,* which cover small areas in the Redwater and Millet regions, the ground moraine has been wholly or partially removed by glacial meltwater, leaving a thin cover of fluvial material on the bedrock surface. Lag gravel deposits 1 to 2 feet thick are common and contain numerous large boulders. A thin sand or fine gravel layer is present in many places, and bedrock exposures are common. A few small gravel pockets of commercial size are found in these areas. The *eroded lacustrine plain* is associated with glaciolacustrine sediments along the southeast margin of former Lake Edmonton. It is an area near the lake outlet from which lacustrine deposits and the underlying till have been partially or completely removed by discharging Lake Edmonton waters (see below). Lag gravel is found only where the till has been partially or completely eroded after removal of the lacustrine material. Bedrock exposures are found only along the major channels.

Glaciolacustrine Deposits

Much of the west-central part of the area, adjacent to and including the City of Edmonton, is underlain by glaciolacustrine sediments of various types deposited in a large proglacial lake called Lake Edmonton. Lake Edmonton formed during the recession of the ice sheet in Late Pleistocene time, when a minor readvance of the glacier from the northeast blocked the regional drainage along the North Saskatchewan River valley. The readvancing ice reached the Bruderheim region northeast of Edmonton, and an ice lobe apparently also moved into the Stony Plain region just west of the map area. The low-lying area between the two ice lobes was filled by glacial meltwater, which eventually overflowed and escaped through the Gwynne Outlet, a large channel southeast of Edmonton in which Saunders and Coal Lakes now are situated. Most of the lacustrine sediment was derived from the Stony Plain lobe on the west, but some is from the Bruderheim lobe. Deltas were built into the lake by meltwater streams from the glacier, and in places stranded icebergs and blocks of ice were surrounded and covered by the sediments. On subsequent melting depressions were left in the delta; thus *pitted deltas*, a hummocky terrain made of fine sand and silt of fluvial origin, were formed.

Near the pitted deltas, lake sediments are mainly sandy, whereas farther out they become silt and sand, then silt and clay which is varved at depth. Along other lake margins clay was deposited; these clay areas are grouped together with the silt and clay deposits. In many places along the margin of former Lake Edmonton, the lacustrine deposits contain large amounts of material deposited from melting icebergs; thus, the lacustrine deposits locally may approach till in composition. "Glir" deposits (glaciolacustrine ice-rafted deposits) cover a large area south of Calmar and another near Morinville. On the map, lacustrine deposits containing a large proportion of "glir" materials are designated as *mixed lacustrine deposits.*

Aeolian Deposits

Aeolian sand deposits in the area are derived from glacial outwash sand, except those southwest of Edmonton which have been formed partly from glaciolacustrine sand. After the recession of the glacier, but before vegetation stabilized the land surface, strong winds reworked the sands forming large dunes up to 50 feet in height. Most sand dunes are U-shaped, showing the dune-forming wind direction to have been from the northwest. Between the sand dunes in the dune fields are aeolian sheet sand deposits. Most sand dunes directly overlie the source sand, but in the Redwater and the Andrew areas northeast of Edmonton some dunes have migrated beyond the source area onto ground moraine. The dunes are composed of fine- to medium-grained sand, except those southwest of Edmonton which are made of fine-grained sand. All sand dunes at present are stabilized by vegetation.

Loess is aeolian-deposited silt and very fine sand. Three areas of loess are present in the Edmonton district: near Millet south of Edmonton, and near Bruderheim and Andrew northeast of Edmonton. The loess is composed of silt except near sand dunes where it consists of very fine sand. The deposits vary in thickness from 10 feet near dunes to zero at the outer margins of the deposits.

Alluvial Deposits and Features

Recent alluvial deposits are found along most streams in the area. *Small stream alluvium* is composed of silt and clay with a small proportion of sand, but small streams flowing through dune areas contain alluvium made entirely of sand. *Alluvial deposits associated with the North Saskatchewan River* contain a large proportion of gravel. In the floodplain the gravel is buried by flood-deposited silts from 2 to 10 feet in thickness. From Fort Saskatchewan eastward, the North Saskatchewan River alluvium is composed predominantly of sand. All *terraces of the North Saskatchewan River* situated higher than 40 feet above the present river level contain gravel.

Recent lacustrine deposits (lake and slough deposits) are predominantly silt and clay, although locally marl deposits are found. Many of these deposits are too small to be shown on the map. Lake deposits in sand areas are predominantly sand or organic material (muskeg).

Postglacial beaches are well developed around Beaverhill Lake east of Edmonton, and are composed of sand with minor amounts of silt.

Erosional Features

Recent erosional features are limited to valley walls of rivers and streams. Generally, these are covered with a thin veneer of colluvium—a mixture of glacial materials and bedrock. Only very small alluvial deposits are found in the gullies. Slumping of valley walls is essentially limited to the North Saskatchewan River and mainly to areas where active river bank erosion is in progress.

Glacial flutings are poorly developed. A few flutings are present south of Calmar, near Kavanagh, and east of Camrose, all south of Edmonton.

Glacial meltwater channels are common. Large channels such as the Gwynne Outlet near Millet are up to one mile wide; through this channel Lake Edmonton drained. Large impressive channels are present also in the Redwater and Willingdon-Andrew areas, the former carrying meltwaters into the North Saskatchewan River system from the northwest. Most of the channels are incised into bedrock.

REFERENCES:

Bayrock, L. A. and G. M. Hughes (1962): Surficial geology of the Edmonton district, Alberta; Res. Coun. Alberta Rept. 62-6, 40 pages.

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