Geomorphology and Land Units of the St. Walburg Area, Saskatchewan

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The study of the geomorphic features of this area was undertaken to aid in the determination of the distribution of landforms (soil material and slope pattern). Areas dominated by certain landform patterns were later evaluated for their significance for the growth of natural woody vegetation.

GLACIAL HISTORY

The surficial deposits were examined to indicate the history of deglaciation and to aid in the understanding of the distribution of surface materials.

This area was covered by continental ice sheets during the Pleistocene epoch, perhaps repeatedly. During the final deglaciation, glacial ice became stagnant and formed a high relief hummocky moraine in the Battle Creek area and south of the map sheet. Following further melting of glacier ice, active ice invaded the area from the northwest, covering much of the present North Saskatchewan River valley.

Later this ice began to stagnate under a blanket of drift. Then, renewed glacial activity saw ice readvancing from the north-northeast to the Greenstreet-Jackfish Lake area, building an impressive hummocky moraine. This readvance must have blocked the North Saskatchewan River southeast of the map area and a lake was ponded in the deepest part of the present river basin. The ancestral North Saskatchewan River emptied into this lake through the Big Gully Creek valley, building a large delta and spreading fine grained sediments on its floor.

As this ice began to stagnate, a super-glacial lake was formed in the Turtleford area, draining to the south. The drainageway was formed on till in the north, but the water flowed under the ice in the south, building a large esker. As the outlet was eroded into the till, the lake was drained, but the channel still carried meltwaters from the ice front farther north.

Renewed glacial activity resulted in a well defined ice border, stretching from Onion Lake through Spruce Lake toward Medstead in the east. Large outwash plains were formed in the west and the meltwaters drained into the North Saskatchewan River which found its present course after temporarily flowing through the Rex-Greenstreet area. The river was no longer blocked in the southeast and the lake that covered much of its basin was drained.

Some time later the ice melted from its previous frontal position and became stagnant some distance to the north. Meltwaters issuing from the stagnant ice dissected the previously exposed areas in the western part of the map area. The final disappearance of the ice followed which was marked by the presence of small lakes that depended on meltwater. The lake in the northeastern corner of the map may have been part of a larger lake to the east.

During the final disappearance of the ice, the North Saskatchewan River eroded deeply into its present bed, after some minor adjustments of its course. Sandy lacustrine, deltaic and outwash deposits were reworked by wind, often spreading into neighbouring areas.

LANDFORMS

1. Materials

The most commonly occurring material is till. It is generally a loam, with variable amount of stones. The carbonate content is generally between 15% and 7%, with a modal value at about 10%, with pH values varying between 9 and 8. The pH values higher than 8.3 are probably due to bicarbonates rather than salts, as the soluble salt content of the material is low.

Lacustrine sediments range from very fine to medium-coarse sands. The coarser lacustrine sediments were frequently reworked by wind, but the material is the same. The fine textured lacustrine material in this area consists of very fine sand and silt. Mineralogically it appears to be identical to the till from which it was derived. The lacustrine medium sands have lower carbonate and pH values than the finer sediments. The finer lacustrine materials are characteristically stone free, except in the Turtleford area, where a few stones may be found in the sediments of the super-glacial lake.

Sands of deltaic, fluvial, outwash, esker or eolian origin are similar to lacustrine sands. In the stone free medium sands the carbonate levels are low, generally less than 1% in the rooted zone and pH is near neutral. In gravelly deposits the carbonate levels average about 10% and the pH is near 8.

Organic matter consists mainly of moderately to poorly decomposed remains of sedges and grasses, but mosses are becoming important in the north. The pH of the material is near neutral or slightly acid.

2. Form of land

The landforms were identified on the basis of their genesis and were further subdivided by characteristic and particular slope pattern.

Knob-and-kettle complex, identified by subscript 'k' on the geomorphological map, refers to a rolling, hummocky till plain. The hummocks may be strongly expressed in the high relief areas, or can be barely noticeable on the ground. In either case, high and low ground alternate with great frequency.

Linear ridges, identified by subscript 'r' on the map, modify a ground moraine where a considerable number of elongated till ridges occur. The ridges are generally low, 5 to 20 feet high, occasionally with steep slopes. In the study area they always occur in otherwise smooth ground moraine areas or in combination with knob-and-kettle complex. The ridges seldom occur singly and show a general trend of orientation, although they may be cut by other ridges at right angles or at more acute angles.

Circular dimpled knobs, identified by the subscript 'c' on the map, refers to an area where these 'doughnut' shaped landforms occur. They are generally low, less than 10 ft. high. Although there is a central depression, it is seldom deep enough to hold a pond or bog. The diameter of these landforms is generally less than 50 feet, but may be larger. These landforms are usually readily recognized on aerial photographs, but are not conspicuous on the ground. They occur mainly in ground moraine, and less frequently, in lacustrine plains. Some of these forms in lacustrine materials may reflect the landforms of the underlying till sheet.

Flutings, identified by the subscript 'f' on the map, shows areas where elongated, low, broad ridges occur parallel to one another.

Morainic hills, identified on the map by the subscript 'm' refer to areas where elongated till ridges are found at right angles to the movement of the ice sheet. The height and extent of these hills is variable.

Dissected ground moraines are identified on the map by the subscript 'd'. These areas are generally low to moderate relief ground moraine plains cut by steep gullies. The depth of the gullies varies from about 20 feet to over 100 feet. Many gullies are occupied by underfit streams and by bogs.

Wave-washed ground moraine, shown on the map by the subscript 'w', identifies areas that were modified by lake erosion, or by sheet erosion through shifting streams. In former lake beds the relief tends to be low or very low, but can be moderate in stream-eroded areas.

Pitted surfaces, shown on the map by the subscript 'p', occur in essentially level areas where deep, steep-sided hollows occur. The density of hollows in the only pitted area on the map sheet is high, and the area resembles a knob-and-kettle topography. The pits are 50 to 200 feet in diameter and may be as much as 30 feet deep.

VEGETATION

Three broad belts of vegetation are recognized within the area. These are, from south to north (Fig. 1): 1. Aspen - grassland; 2. Aspen - spruce forest; 3. Boreal forest.

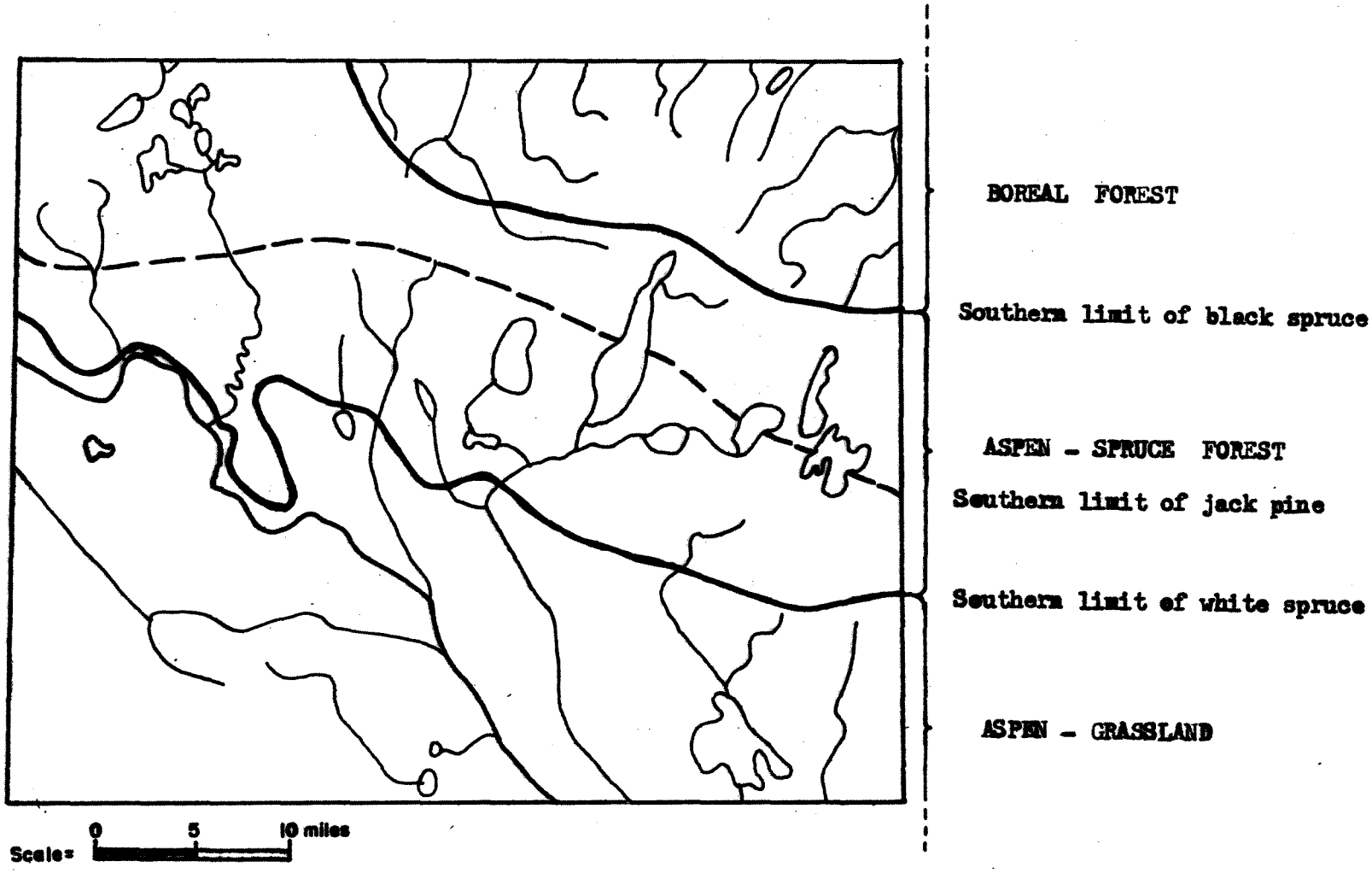

Fig. 1. Vegetational zones

1. Aspen - grassland

Grasslands dominate the natural vegetation of this area, with aspen bluffs of several acres in size but the extent of woodlands increases toward the north. Grasses grow mainly where moisture is deficient in heavier soils, such as on hills, and slopes. Trees occur in slight depressions, or on the northern side of hills where they are not exposed to direct sunshine. The tree species growing in these environments are mainly trembling aspen, with some balsam poplar in the moist areas. The height of trees seldom exceeds 40 feet. Open aspen stands grow on dry sandy sites, which also show poor height growth. Wet sites in depressions are occupied by sedges and by some willows, or by salt tolerant plants. Scattered white spruce and white birch may occur on favourable sites, as on gully slopes near rivers.

2. Aspen - spruce forest

Areas of adequate soil moisture are covered with a dense, continuous canopy of trembling aspen. When left undisturbed, white spruce will form nearly pure stands. Open aspen-white spruce stands occur on dry sandy soils, and the dry sites on heavier soils are covered by aspen of poor height growth. In the northern half of this zone, jack pine is present, and may cover large areas following fires. White spruce, together with tamarack or balsam poplar occur on some wet sites. Mesic or fibric peat may accumulate in poorly drained areas under a sedge or willow cover.

3. Boreal forest

This vegetational zone is characterized by boreal tree species. Jack pine grows on dry sands and on dry to fresh loamy soils; trembling aspen occurs on most fresh and moist sites. White spruce is an occasional component of the stands on fresh to moist sites. Black spruce and tamarack grow on poorly drained areas. Fibrous to mesic peat occurs frequently in depressions under open sedge, or under sphagnum moss and black spruce cover.

LAND UNITS

The areas delineated on the geomorphological map were evaluated according to the significance of various factors for the growth of vegetation in each broad vegetation zone. The factors judged important for plants were: soil material, including texture and nutrient status (Table I); broad relief pattern (Table II); and soil moisture (Table III). This information was put on the land unit map and the boundaries of geomorphic units changed when necessary.

DISCUSSION

If the land unit map and the geomorphological map are compared, it becomes evident that they are similar, but not identical. The reason for this being that on the geomorphological map those features were shown which are important for understanding the geomorphology of the area. On the other hand, the land unit map stresses the ecological features that are of importance to the growth of woody plants.

An example is the linear ridges till pattern occurring in the south-western part of the area. The ridged pattern distinguishes this from other ground morainic areas and suggests certain conditions during deglaciation. The knob-and-kettle ground moraine in the same area is distinct from the ridged pattern and implies different conditions during the stagnation of the glacier. Yet, as far as the plants are concerned, these areas are very similar. The material is the same, the moisture distribution is similar, the broad relief pattern is similar. From the ecological point of view, these areas are sufficiently homogeneous to be presented as a single unit at this scale of mapping.

In other instances, more information is necessary for the ecological land units than for geomorphology. The till on the study area appears to be rather uniform in mineral composition. Yet, the till is classed as highly calcareous in the south and only moderately calcareous in the north, due to pedological processes rather than to mineralogical differences. The level of carbonates is very important for perennial woody species, as concentrations near the surface may severely reduce their growth. This information, however, has no value for the geomorphologist.

It is always necessary to be aware of the purpose for which the map was intended. It would be a serious mistake to take a map prepared for a certain purpose and use it for an entirely different purpose. Thus, while it is recognized that a geomorphological approach is an excellent means for the initial delineation of ecologically significant areas, its indiscriminate use is not advocated.

TABLE I. Soil material classes

Symbol	Description
LH	Loam (silt loam, sandy clay loam, sandy loam, very fine sand). Highly calcareous: free carbonates within 6-30 inches of surface.
LM	Loam (silt loam, sandy clay loam, sandy loam, very fine sand). Moderately calcareous: free carbonates within 30-48 inches of surface.
FH	Fine sand (loamy sand, silty sand, fine sand). Highly calcareous: free carbonates within 9-30 inches of the surface.
FM	Fine sand (loamy sand, silty sand, fine sand). Moderately calcareous: free carbonates within 30-48 inches of the surface.
GH	Sand (coarse sand, medium sand, gravelly sand, gravel). Highly calcareous: free carbonates within 9-30 inches of surface.
GM	Sand (coarse sand, medium sand, gravelly sand, gravel). Moderately calcareous: free carbonates within 30-48 inches of surface.
GL	Sand (coarse sand, medium sand, gravelly sand, gravel). Somewhat calcareous: free carbonates below 48 inches of surface.
OM	Mesic organic matter: moderately decomposed organic matter: fiber content 1/3 to 2/3 of total mass before rubbing, or 10-40% after rubbing.
OF	Fibric organic matter: poorly decomposed organic matter: fiber content 2/3 of total maps before rubbing, or over 40% after rubbing.
WA	Bedrock, weakly resistant to weathering (poorly cemented). Very low in bases: very low in mineral nutrients.

TABLE II. Broad relief classes

Very low relief	Essentially level area, less than 10% of the area occupied by low relief features, the magnitude of which is less than 25 ft.
Low relief	Area of long gentle slopes, or very short steep slopes. Differences in elevation generally less than 75 ft.
Moderate relief	Area of long moderate slopes or of short steep slopes. Differences in elevation less than 200 feet.
High relief	Area of moderately steep long slopes or of short very steep slopes. Difference in elevation frequently in excess of 200 feet.

TABLE III. Soil moisture classes

Dry (rapidly drained)	Plants suffer from lack of moisture during part of the growing season.
Fresh (well drained)	Adequate moisture is available to plants through the growing season.
Moist (imperfectly drained)	Plants suffer from excess moisture from an intermittent water table during part of the growing season.
Wet (poorly drained)	Plants suffer from excess moisture from a fluctuating permanent water table.
Saturated (very poorly drained)	Plants suffer from excess moisture from a high, permanent water table.