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PAPER 50-25

ILE-A-LA-CROSSE MAP-AREA, SASKATCHEWAN

(REPORT AND MAP)

By

M. J. Frarey

OTTAWA

1950

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ILE-À-LA-CROSSE MAP-AREA, SASKATCHEWAN

(Summary Account)

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CONTENTS

Illustration

ILE-À-LA-CROSSE MAP-AREA, SASKATCHEWAN

INTRODUCTION

Ile-à-la-Crosse map-area, comprising about 5,400 square miles, lies in west-central Saskatchewan, between latitudes 55 to 56 degrees north, and longitudes 106 to 108 degrees west. The centre of the area is about 160 air miles north of Prince Albert, Saskatchewan; 190 air miles southeast of Waterways and Fort McMurray, Alberta; and 75 air miles northwest of the terminus of the highway from Prince Albert at Lac La Ronge.

The area is accessible by the Churchill River route from points up or down stream; by Beaver River, a large tributary of the Churchill; and by road and barge from Green Lake and other points to the south. Beaver River flows into the south end of Lac Ile-à-la-Crosse. A regular air service crosses the area diagonally, with landings at Snake Lake, Patuanak, and Ile-à-la-Crosse.

The Churchill River system provides relatively easy passage through the area, but its tributaries, with few exceptions, are small and are navigable by canoe for only short distances. Large parts of the area are thus difficult of access, and geological information correspondingly difficult to obtain.

The field work was done in 1949, with the writer in charge of three units operating from separate camps. Information was obtained chiefly by shoreline mapping and pace and compass traverses. Air photographs were only of general and limited use; low-level reconnaissance flights served to confirm the lack of outcrop in large drift-covered tracts.

Previous work in the map-area consisted of a reconnaissance survey along Churchill River by J. B. Tyrrell in 1892. Tyrrell's mapping, which included a much larger region, was confined to the waterways, and although the principal rock types were recognized no details of their extent and distribution could be described. Pertinent information was included in the single report and map published.[1]

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[1] Tyrrell, J. B.: Geol. Surv., Canada, Ann. Rept. (New Series), vol. VIII, pt. D, 1896.

The geology of adjoining map-areas to the east[1] and north[2] has been mapped

[1] McLarty, D. M. E.: Lac La Ronge Sheet (West Half), Saskatchewan; Geol. Surv., Canada, Map 357A, 1935.

[2] Alcock, F. J., Sproule, J. C., and Downie, D. L.: Haultain River and Porter Lake, Northern Saskatchewan; Geol. Surv., Canada, Maps 579A and 580A, 1940.

on a scale of 1 inch to 4 miles, and the results obtained there afforded some guidance to the writer in the Ile-à-la-Crosse area.

Messrs. R. C. Oulton, R. L. Butler, M. G. Atkinson, J. E. Howell, and J. R. Day served capably as field assistants.

PHYSICAL FEATURES

The elevation of the drainage system in the map-area decreases from 1,382 feet above sea-level on Lac Ile-à-la-Crosse on the west to 1,260 feet on Sandfly Lake at the eastern boundary. Maximum local relief is about 400 feet, and is attained by granite hills in the northeast part of the area.

Bedrock is well exposed only north and east of Churchill River from Dipper Lake eastward. Elsewhere it is almost completely covered by heavy drift, or by large areas of swamp and muskeg. Relief in this part of the map-area is less than 100 feet.

This contrast in surface is strikingly reflected in the drainage patterns of the two parts of the area. Where bedrock is well exposed, lakes and rivers are controlled as to shape and trend by the foliation of the formations, as is well instanced east of Snake Lake. South of Besnard, Snake, Sandy, and Knee Lakes, the relief is very slight, and the drainage is dendritic. Interior drainage is a local feature west of Snake Lake. East and west of Lac Ile-à-la-Crosse, however, a definite northwest trend is established, as shown by the bays of the lake, by the courses of the rivers and streams flowing into it, and by the linear muskegs in the vicinity. In this district, relief is slightly greater, and sand and gravel ridges, parallel with the drainage trend, rise to heights of 100 to 200 feet above stream level. Several of these are mapped west of the north end of Lac Ile-à-la-Crosse. They are probably small, discontinuous, terminal moraines, representing fluctuations in position of the ice-fronts, and are evidently responsible for the drainage pattern in their vicinity. Elsewhere, the glacial mantle forms a gently rolling drift plain, probably deposited as ground moraine. A few small boulder trains were observed. Eskers and drumlins are lacking. Several kame-like hills, up to 200 feet high, lie about 4 miles north of the mouth of Belanger River, in a relatively small, drift-covered area within the bedrock terrain.

Certain physical features of rivers and lakes are noteworthy. Churchill River commonly forms depositional fans or deltas where it widens into lake expansions, as well illustrated on Dipper Lake. Overloading, resulting from the transportation of large amounts of material into the Churchill by Haultain River, has formed braided stream channels downstream from the junction of these rivers. Meanders, cut-offs, oxbow lakes, and related features are all strikingly exhibited along Haultain River. Braiding is also a distinctive feature of Beaver River between the southern limit of the map-area and the mouth of Pine River. In general, the streams of Ile-à-la-Crosse area are characteristically shallow and boulder-strewn. The only notable waterfall, on Haultain River near the northern limit of the area, has a total drop of about 20 feet, the aggregate of several individual falls.

Remnants of former lake beaches were observed at scattered localities, but are best preserved north of the map-area, between $5\frac{1}{2}$ and $8\frac{1}{2}$ miles north of the northern end of Lac Ile-à-la-Crosse.

GENERAL GEOLOGY

Rock Types

The rocks of the map-area consist chiefly of acidic intrusions containing widely separate bands of older, metamorphosed rocks that lie parallel with the foliation of the granitic rocks. In a relatively small area, southeast of Sandfly Lake, however, intrusive rocks are subordinate, and metamorphism less intense. The metamorphic rocks include hornblende-plagioclase and quartz-biotite gneisses, in part intimately associated with granite, and greenstone, quartzite, and mica schist.

An undifferentiated assemblage(1)[1] of acidic and basic volcanic

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[1] Numbers, in parentheses, are those of map-units on accompanying map.

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rocks, feldspar porphyry, and minor quartzite and mica schist occupies one principal belt in the map-area. The basic volcanic rocks are andesitic in character, and resemble rocks commonly termed greenstones; the acidic bands are rhyolitic. Both types exhibit flow banding, but lack other volcanic structures. The basic type is represented by fine-grained, equigranular, green to dark grey rocks composed chiefly of amphibole, chlorite, and plagioclase. Biotite, magnetite, and pyrite are plentiful. The acidic types are dense, reddish to grey rocks of uniform appearance and composed chiefly of quartz and feldspar. The feldspar porphyry is in many places associated with the basic bands, and is probably in part of volcanic origin; in such places it consists of pink potash feldspar crystals up to 1½ inches long in a dense, dark-coloured groundmass. At other localities, greyish porphyry, with smaller phenocrysts and a paler groundmass, was found to be intrusive, and may be related to the granitic rocks of the area.

The quartzite(2) is a light-coloured rock, of medium to fine grain, and exhibits good banding in most places. Close folding can be traced locally. Besides quartz, microcline is plentiful, and sericite is locally abundant. Biotite is scarce. Interbands of quartz-biotite gneiss, and thin, very fine-grained, slaty layers are common. The associated mica schist is a soft, fine-grained, grey or greenish rock, exposed across widths of as much as 1,000 feet. It is composed mainly of sericite and quartz; biotite is concentrated into ovoid masses, some of which have sericitic centres. Numerous small grains of magnetite are accessory.

The hornblende and the biotite gneisses(3) are closely associated, and in places could not be mapped separately. The hornblende gneiss(3a) is typically an equigranular, mottled or dark-coloured rock, medium to fine grained, and composed dominantly of green hornblende and plagioclase. Pyroxene and quartz are prominent in some outcrops. Under the microscope, apatite, titanite, zircon, and magnetite are seen to be common accessory minerals. The plagioclase is andesine (An_{30-50}). Numerous small inclusions of quartz and plagioclase give amphibole and magnetite grains a characteristic sieve texture.

The quartz-biotite gneiss(3b) is a grey, well-foliated rock, commonly of sugary texture, consisting mainly of quartz, plagioclase, and biotite. Sericite, zircon, apatite, magnetite, garnet, and titanite are minor constituents in many localities. Cordierite and sillimanite are of restricted occurrence. The biotite is characterized by many distinct pleochroic haloes, which surround included zircon grains.

The relative age of the rocks of sedimentary and volcanic origin is unknown, but the sequence is probably the same as that assumed in the adjoining Lac la Ronge map-area. The metamorphosed volcanic rocks(1) resemble those that McLarty included in the Wokusko group, and may be correlated provisionally with the Amisk volcanic group of Archaean age, which has a wide distribution farther east in Saskatchewan and in adjoining regions of Manitoba. The quartz-biotite gneisses are evidently of sedimentary origin, but original bedding features, which might have indicated age relationships, have been obliterated by metamorphism; similarly, any features originally present in the volcanic rocks from which the hornblende-plagioclase gneiss was probably derived have likewise disappeared.

Granite, and granite-gneiss(4) and quartz diorite(4a) vary in character from place to place in the map-area. Along the southeast shore of Knee Lake, a porphyritic phase of the granite-gneiss was observed in which phenocrysts of potash feldspar an inch or more in length lie in a highly sheared matrix containing abundant coarse biotite.

The principal mineral constituents of the granitic rocks are quartz, microcline, plagioclase, and biotite, and textures are normally equigranular and uniform. Near Dipper and Shagwenaw Lakes, and at many other localities, the granite is contaminated by numerous inclusions and schlieren; small blocks and irregular wisps of gneiss are numerous, and coarse biotite forms streaks and lenses. The plagioclase seems to be mainly oligoclase (An_{20-29}); potash feldspar is mainly microcline; and microperthitic and myrmekitic intergrowths are numerous. Magnetite, zircon, apatite, and sericite are common accessory minerals. Pleochroic haloes are common in the biotite and most of them can be seen to surround zircon inclusions.

North of Sandfly Lake, and east of Haultain River, hornblende gneiss(3a) appears to grade into a hornblende-bearing granite; elsewhere this gradation was not observed, and no contacts were seen between the hornblende granite and the more normal biotite granite.

Pegmatite dykes, veins, and patches occur in the metamorphic and granitic rocks. Only the common rock-forming minerals were observed in them. The pegmatite commonly shows gradational contacts with granite.

Quartz diorite(4a) is a coarse, dark-coloured rock, and was observed only in Besnard Lake. It is composed chiefly of hornblende, plagioclase (An_{50}), and quartz; locally, the hornblende constitutes most of the rock.

The quartz bodies(5) are interesting features from the point of view of size and origin. The main occurrence, west of the south end of Sandfly Lake, is about 3½ miles long and as much as 2,500 feet wide. It trends parallel with the foliation of the enclosing granite-gneiss and with nearby small remnants of quartzite and hornblende gneiss. It is roughly lenticular, with steep sides, and carries a talus slope along the east side. Contacts with other rocks were not observed. The quartz mass is white, and is easily visible from the air and from many points on Sandfly Lake and farther north. Megascopically, the rock is typically coarse grained and glassy, and weathers to a pebbly, rough surface. Rose quartz is dominant in places. Locally, flakes of biotite or white mica, or grains of feldspar are prominent. No metallic constituents were observed. At many points in this body, a well-defined foliation is apparent, and a strong shear zone was observed along the eastern edge. At least one remnant of biotite gneiss is included in the mass. In the case of the smaller occurrence in the north bay of Knee Lake, the quartz is very coarse, and at its eastern edge can be seen in contact with quartzite, which is much finer in texture and more foliated. Here, as at Sandfly Lake, feldspar and mica are minor constituents, and no metallic minerals were seen. Toward the west edge, this quartz mass had a banded appearance resulting from numerous, narrow, hair-like cracks, in which small biotite flakes are numerous, and on either side of which for as much as 1 inch the quartz is darker in colour. The biotite content in the quartz near the fractures is higher than normal, though not prominent. Under the microscope, the quartz grains of this rock appear distorted and strained.

The evidence indicates that these unique bodies of quartz represent magmatic differentiation products, possibly closely related to the quartz veins and pegmatite bodies of the area, and emplaced, at least in part, as a result of metasomatic processes. An origin through recrystallization of quartzite is improbable because of the size of the masses, the presence of quartzite of distinctly contrasting character in direct contact with the quartz, and the occurrence of included biotite gneiss. The Snake Lake body may have entered and occupied a great shear zone, as suggested by the pronounced shearing along its eastern margin. No normal pegmatite dykes or veins were seen cutting the quartz.

Structure

The outstanding structural feature of Ile-à-la-Crosse area is the regular northeast trend of foliation in the granitic rocks and in most of the gneisses. Although there are many marked deviations locally, the general direction of trend is north 10 to 25 degrees east. Dips are commonly steeply inclined; near Snake and Sandfly Lakes, foliation planes dip mostly northwest; elsewhere they may dip in this or other directions. The gneisses of sedimentary and volcanic origin lie in long, relatively straight bands in the granite, and no folds could be identified in these rocks. Many small-scale, close crenulations characterize the sedimentary gneiss, and are generally accentuated by narrow lit-par-lit granite stringers.

Examination of air photographs disclosed curving trend lines in rocks that mapping showed to be granitic. These lines could represent primary foliation, or a structure in the older formations that controlled the trend of the invading granite bodies, thereby suggesting gradual replacement of the original material by 'granitization' processes. Illustrations of these curving trend lines are shown on the map north of the northeastern arm of Sandfly Lake, and south of Sandy Lake.

No faults were definitely located, and only a few shear zones were observed. The latter are mostly narrow, although the shear zone in granite west of the north end of Sandfly Lake is at least 200 feet across. Neither the amount nor the direction of movement in such shear zones is known. Sericite is characteristically abundant in the sheared granite. North of the northeastern arm of Sandfly Lake, and again near the northern limit of the map-area west of Belanger River, inspection of air photographs indicates the possible existence of faults; both places are marked by strong lineaments, and at Sandfly Lake the lineament separates two distinct systems of trend lines.

Lineation was measured on biotite streaks in granite, but observations were too few and scattered to permit of drawing any conclusions.

Metamorphism

As a result of regional metamorphism the pre-granitic rocks of the map-area have been transformed to aggregates of medium- and high-grade metamorphic minerals. Quartz-biotite gneiss of sedimentary origin(3b) is in many places characterized by pink garnet crystals commonly 1/8 to

1/4 inch in diameter; in some outcrop areas, as north of Snake Lake, and in the band of sedimentary gneiss west of Belanger River, garnet crystals form distinctive aggregates about 1 inch in diameter, in which are included numerous quartz and feldspar grains. Garnet is also found in impure granite-gneiss, where assimilation of older rock has taken place. Of local extent, and in close association with the garnet-biotite gneiss are layers in which sillimanite and cordierite are additional constituents. Restriction of these minerals to definite narrow layers, bordered on both sides by bands lacking sillimanite and cordierite, suggests that they represent original beds of somewhat different chemical composition rather than products of more intense metamorphic agencies than those that produced the garnet-biotite gneiss. Crenulation is equally severe in both types, and no zoning is apparent. The cordierite is distinctively twinned, microscopically, and contains zircon grains about which chloritic aureoles are developed.

The hornblende-plagioclase gneisses(3a), which in places are characterized by a considerable amount of pyroxene, biotite, or quartz, are similar to those of the Kisseynew gneisses in the Sherridon district of Manitoba, and are generally considered to be metamorphosed, intermediate to basic, volcanic rocks or sills. Typical remnants of these occur, in association with granite, along the south shore of Sandfly Lake. The hornblende gneiss becomes more dioritic in texture, and less mixed with granitic material, toward the east end of the lake, and is probably related to the volcanic types of lower metamorphic grade (greenstone) exposed in that vicinity.

The widespread introduction of granitic material into the gneisses (3a, 3b) has added to the metamorphic effects. All types of introduced material were observed, from well-defined pegmatite, granite, and rare aplite dykes and stringers to evenly disseminated quartz and feldspar grains in inclusions of gneiss. 'Soaking' or permeation by granitic fluids is suggested in the latter case. Intimate mixtures of gneiss and granite are commonly coarse textured, as illustrated particularly by the size of the biotite flakes in these more highly metamorphosed rocks.

Boundary of the Canadian Shield

At no point in the map-area were rocks younger than Precambrian observed; consequently, the position of the southwestern limit of the Canadian Shield is uncertain. However, the discovery of a small outcrop of granite and sedimentary gneiss in the southwest bay of Snake Lake probably extends the boundary of known Precambrian rocks about 5 miles farther southwest than previously surmised. As this isolated outcrop lies well within the broad area of glacial drift, too much emphasis should not be placed on lack of outcrop as a criterion for defining the boundary of the Shield.

Boulders of limestone, some petroliferous, are found on the shores of the southern part of Lac Ile-à-la-Crosse; these were described by Tyrrell as of Devonian age. As none was noted in the northern part of this lake, or in Shagwenaw Lake, the Precambrian-Palaeozoic contact may be assumed to lie somewhere in the intervening area, between Aubichon Arm and the latitude of the south end of Shagwenaw Lake.

Economic Notes

Field work indicated a lack of deposits of economic interest in this area. Metallic minerals were observed in only a few localities, and consisted of pyrite, with minor chalcopyrite and arsenopyrite. A shear zone in sedimentary gneiss along the east shore of Snake Lake, toward the north end, is mineralized by pyrite, with some arsenopyrite. The sulphides are most conspicuous at the south end of the zone, but are nowhere abundant; they occur as disseminated grains in the sheared gneiss.

Such quartz veins as were observed in the area are typically short, narrow, and irregular, and carry no metallic minerals.

No unusual or strategic minerals were observed in the pegmatitic rocks of the map-area.