# A STUDY OF CERTAIN ROCKS OF THE CALIFORNIA LAKE MAP AREA, NORTHERN MANITOBA

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# A STUDY OF CERTAIN ROCKS OF THE CALIFORNIA LAKE MAP AREA, NORTHERN MANITOBA


## Abstract

The geology of the Precambrian rocks of the California Lake Area was mapped in 1953. The area is mainly of granitic Rocks which surround a northern and a southern volcanic-sedimentary belt. The metamorphism of the northern belt (Bigstone Lake group) has been studied and it is found that regional metamorphism of the grade of the garnet zone is general throughout. The Merritt formation which in the main part was probably a greywacke, is the most highly metamorphosed, reaching the grade of the sillimanite zone in part. The volcanic rocks (Greenstone formation) are in the amphibolite facies. The argillite and impure quartz-feldspar sandstone on Utik Lake (Utik Lake formation) has reached the grade of the garnet zone. Cordierite is present in part of the Merritt and Utik Lake formations. The area is characterized by deficient shearing stress during the regional metamorphism.

CHAPTER 1

# INTRODUCTION

## Forward

The material for this thesis was gathered during the summer of 1953. The writer was co-chief with M. D. Moorhouse of a geological field party engaged in mapping the California Lake Area in Northern Manitoba for the Manitoba Mines Branch. The results of this survey will be published as the Manitoba Mines Branch Report 53-3 (1954) with the title "Geology of the California Lake Area, Northern Manitoba."

This thesis is a study of the northern volcanic-sedimentary belt. M. D. Moorhouse's thesis is a study of the southern volcanic-sedimentary belt and the granitic rocks.

## Location and Access

The California Lake Area lies across the east-west boundary between the Cross Lake and Oxford Lake Mining Divisions. The map-area comprises approximately 230 square miles, and lies between 55° 00' and 55° 20' north latitude and between 95° 30' and 95° 45' west longitude.

The most convenient mode of entry into the area is by air from Norway House (approximately 120 miles), or Ilford on the Hudson's Bay Railway (approximately 60 miles).

The best canoe route originates at Oxford House. From Semple (Sucker) Bay on Oxford Lake, the route follows the Semple River with three short portages to Semple Lake, in the extreme southern portion of the area. Continuing into the central portion, from the north shore of Semple Lake the route follows a stream with two short portages to Powstick Lake, a one mile portage leads to California Lake, and from the north shore of California Lake a three-quarter mile portage terminates at the south shore of Bear Lake. Access to the northern part of the area is gained by following the Bigstone River from its point of origin on the north shore of Bear Lake over one short portage to Bigstone Lake. Utik Lake, in the extreme northwest corner of the map-area, may be reached by a one-half mile portage from the north shore of Bigstone Lake.

## General Character of the Area

The topography of the area is dominated by monotonous stretches of muskeg and swamp which are separated by broad gently sloping belts of glacial clays whose long axes lie in a northeasterly direction.

Throughout the area to the east of Bear Lake, and from there south to Semple Lake, there are many glacial ridges of greater height composed of sand and boulders. These ridges are thickly covered with second-growth jack pine and in some places spruce. They differ from the lower ground which, where previously burned, is sparsely dotted with spruce. In general, good rock exposures are not associated with this sort of topography. Over most of the area outcrops are concentrated on the shores of the larger lakes. The area of most extensive outcrops and also of greatest relief (up to 100 feet), lies between the Bigstone River and the eastern portion of Bear Lake.

In the past, fires have destroyed much of the timber in the area. Many of the burned trees still stand in a tangle of second-growth spruce and jack pine. The most recent burn is located on the south shore of Bear Lake at the mouth of the creek flowing from Dobbs Lake. The average diameter of the living trees is from four to six inches and only rarely were any found having a diameter over ten inches. Timber for mining operations or extensive construction can not be found in quantity in the area.

## Previous Geological Work

Prior to 1951, little work had been done in the area. Wright (1925) examined the Oxford and Knee Lakes area, and in the same year, Merritt made a track survey of the Bigstone and Fox rivers. The latter survey crossed the present map-area from south to north.

## Present Geological Work

Field mapping was conducted in the California Lake area during the summer of 1953. Traverses were run, where feasible, at intervals of 1500 to 2000 feet. Outcrops were located by pace and compass and on vertical aerial photographs. A base map on a scale of two inches to one mile was compiled by the Manitoba Surveys Branch from vertical aerial photographs, using slotted template and sketchmaster.

This work is part of a mapping project which covers a volcanic-sedimentary belt extending from near the Nelson River to the present map-area.

## General Geology of the California Lake Area

All consolidated rocks in the area are of Precambrian age. The oldest rocks consist of two belts of metamorphosed sediments and volcanics. The northern belt is called the Bigstone Lake group and the southern belt is called the Semple Lake series. The Bigstone Lake group is more highly metamorphosed than the Semple Lake series. Andesites and basalts are the dominant rocks of these belts. Some sedimentary and minor acid volcanic rocks are associated with the intermediate and basic lavas. Granitic rocks, which extend over the major part of the area, include alaskite, a northern granodiorite, pink massive quartz monzonite, porphyritic granodiorite, and grey to buff quartz monzonites, granodiorites, and quartz diorites. The age relationships of these granitic rocks are not clearly established.

A persistent diabase dyke, the youngest rock type in the region, extends for several miles in a northeasterly direction across the northern part of the area.

Faulting is common throughout the area. One major fault extending across the southwest part of the map-area is believed to be an extension of the Bear Lake fault mapped by Milligan (1954) to the west. Most of the faulting is on a small scale. Some of these faults are recent enough to have displaced the diabase dykes.

## Table of Formations

The rock types of the map-area and their postulated relative ages are summarized in the following table of formations.

TABLE OF FORMATIONS

| | |
|---|---|
| Recent and Pleistocene | Swamp and muskeg<br><br>Glacial deposits: clay, sand, gravel, and boulders |
| PRECAMBRIAN | Basic dykes |
| | Alaskite<br><br>Northern granodiorite and quartz monzonite and gneissic marginal phase<br><br>Porphyritic granodiorite<br><br>Pink massive quartz monzonite<br><br>Grey and buff quartz monzonite, granodiorite, and quartz diorite |
| | Intrusive contact |
| | Bigstone Lake group and Semple Lake Series<br><br>Greywacke, impure quartzite, and conglomerate. Derived schists and gneisses<br><br>Plagioclase amphibolite derived from andesites and basalts; acidic volcanics and tuffs. Derived schists |

## Geology of the Bigstone Lake Group

The Bigstone Lake group is made up of three distinct formations, two of them being sedimentary and the third volcanic. Structural criteria show that the top of these formations is to the south and therefore the oldest formation is the most northerly one. The oldest formation is a small area of sediment which will be called the Utik Lake formation for the purpose of description. A belt of lavas called the Greenstone formation overlies the Utik Lake formation. The lavas are approximately one mile thick. The youngest formation is a band of sediments outcropping on Bigstone Lake south of the Greenstone. This band of sediments will be called the Merritt formation. The Calcareous member forms one small part of the Merritt formation.

CHAPTER 11

# SEDIMENTARY ROCKS

## Introduction

The sedimentary rocks have been studied with the object of determining their metamorphic history and original composition. Samples were collected wherever possible and thin sections were made so that any variation along or across strike could be detected.

The Merritt formation constitutes the main bulk of the sedimentary rocks so is discussed first. The Calcareous member is excluded from the discussion of the Merritt formation and is described next. The Utik Lake formation is described last.

## A. MERRITT FORMATION

The Merritt formation is highly metamorphosed so that original textures and much of the original mineral content is changed. The best exposures are on the shoreline of the islands and south shore of Bigstone Lake at its western end.

### Character

In all areas the Merritt formation has been intruded by large amounts of grey granodiorite. Some outcrops consist mainly of granodiorite containing large contorted xenoliths of the sediment. Fine and coarse lit-par-lit injections are present. The intrusions greatly increase the width of the sedimentary band.

The unweathered sedimentary outcrops are dark colored, and where fine grained resemble the fine part of the Greenstone formation. However most outcrops are weathered to a rusty brown so that the sedimentary character is apparent even though the grains are 1 mm. or less in diameter.

## Composition

Quartz, plagioclase, and biotite are the predominant minerals together making up 95 to 99 per cent of the volume. The sediments do not contain potash feldspar as shown by the staining and miscroscopic examination of four of the thin sections. The metamorphic minerals, cordierite, sillimanite, and garnet, are present in certain areas in amounts less than 5 per cent. Hornblende makes up 13 per cent of one sample. The accessory minerals, not present in every sample, are magnetite, apatite, zircon, sphene, and rutile.

Rosiwal analysis of several thin sections were made to obtain the amounts of quartz, plagioclase, and biotite. In the garnetiferous bearing area these minerals are present in close to equal amounts, a typical analysis showing 30 per cent quartz, 35 per cent plagioclase, and 30 per cent biotite. The more highly metamorphosed rocks containing cordierite and sillimanite have quartz and plagioclase present in roughly equal amounts though the biotite is lower. A typical analysis has 45 per cent quartz, 35 per cent plagioclase, and 15 per cent biotite. The rosiwal analyses of the sample containing hornblende shows it to be quite different from the rest. It contains 14 per cent quartz, 58 per cent plagioclase, 14 per cent biotite, and 13 per cent hornblende.

The minerals have a similar appearance in each thin section. The quartz grains are clear and rounded. A few grains occur that are up to 3 mm. in diameter but most of them are .5 mm. or less. The plagioclase grains are rarely twinned and as they are only slightly sericitized they closely resemble the quartz grains unless stained in the laboratory. Biotite is a very strongly pleochroic brown variety. Cordierite forms irregular grains 1.5 mm. or less in diameter and contains small quartz inclusions. Sparcely distributed sillimanite forms tiny patches of needles in the cordierite, quartz, and biotite.

## Metamorphism

The metamorphism is a regional type ranging from medium to high grade. The stress factor has been much reduced in part by the lubricating action of the abundant magma injections. The metamorphism is shown by:-

(1) Structure. This sediment has been intruded by large amounts of granodiorite in the form of pods or dykes usually parallel to the regional schistosity. Fine lit-par-lit injections are also present (Fig. 1). The foliation, or possibly relic bedding, is highly con-

torted. Harker (1939, p.303), concerning lit-par-lit injections, says,

> "Injection of so intimate a kind demands suitbale conditions, including high pressure as well as high temperature. It may be found locally as part of an aureole of purely thermal metamorphism bordering a granite batholith but such effects are possible upon an extensive scale only when the country rocks invaded had already been raised to a high temperature prior to the intrusion. It is then an incident of regional metamorphism; and, as already remarked, the igneous intrusion, while closely related to the metamorphism, is not to be regarded as its sole and sufficient cause."

(2) Texture. The common texture is a granoblastic aggregate of quartz, plagioclase and biotite (Fig.2) with the biotite flakes neither especially elongated nor aligned. Where the metamorphism has been less intense the biotite flakes are aligned in one plane (Fig. 3). The granoblastic texture is formed in high grade regionally metamorphosed rocks.

(3) Metamorphic Minerals. (a) The western portion of this sediment contains numerous, very small garnets (Fig. 4). Garnets can occur in sedimentary rocks under conditions of thermal metamorphism but such a sediment must contain manganese or abundant lime. The minerals associated with garnet in the Merritt formation show that lime is not abundant. A qualitative test for manganese in the garnets showed this element was not present and therefore the garnets are not due to thermal metamorphism. Manganese garnets can form before biotite in regional metamorphism but when the biotite develops the garnet loses its manganese and becomes almandine. The garnet in the Bigstone Lake must therefore be the normal garnet formed during regional metamorphism. This is almandine, which has a strong preponderance of iron in the

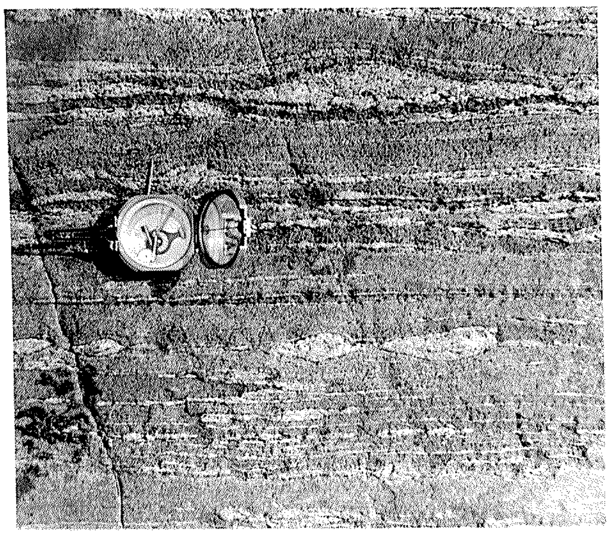

Fig. 1

Lit-par-lit gneiss