STRUCTURAL GEOLOGY OF A SICKLE OUTLIER

NEAR NOTIGI LAKE, MANITOBA

A Thesis

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by

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ABSTRACT

The area of study is located thirty-five miles northwest of Nelson House, Manitoba, and is underlain by a meta-arkose to diatexite gneiss outlier, of Sickle-type rocks, approximately 25 square miles in area. The Sickle rocks differ considerably from the underlying Wasekwan-type gneisses which constitute the predominant rock type around the Sickle outlier.

The deformational history of the outlier is based on ground attitude measurements backed up by detailed air-photo interpretation, and interpreted stratigraphy. The rocks have undergone at least three, and probably four, folding events, plus two periods of brittle deformation: folding of original sediments into isoclinal folds (f_1); weak open folds developed perpendicular to f_1 axial planes (f_2); refolding of f_1 and f_2 axial planes by f_3 isoclinal folding; refolding of f_1, f_2 and f_3 axial planes about a north-south axial plane (f_4) to produce the present configuration of the Sickle outlier. Extensive amphibolite grade metamorphism accompanied f_3 folding, resulting in partial anatexis and flow in less competent layers.

Late brittle deformation consisted of early jointing (D_5), along which pegmatite later intruded. This was followed by a period of jointing (D_6). Two periods of post-f_4 faulting occurred with the earlier northeast striking faults offset by a north-south striking late period of faults.

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

TABLE OF CONTENTS (cont'd)

LIST OF TABLES

LIST OF MAPS

(in pocket in back)

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Statement of Problem

The purpose of this study is to analyse the structure and delineate the deformational history of an outlier of Sickle-type rocks in the Churchill Province of the Precambrian of northern Manitoba.

Location and Access

The area studied encompasses approximately twenty-four square miles of Township 80, ranges 13W and 14W. The area is located sixty-five miles west-north-west of Thompson, Manitoba (Figure 1).

Access is restricted to float-equipped aircraft which may land on any one of four lakes bordering the area. The area is characterized primarily by dense bush and tree-covered outcrops which restrict helicopter landing sites to large pegmatite outcrops in the northern part of the area. The Lynn Lake-Thompson power line, trending northwest, passes within one mile of the southwest corner of the area.

Previous Work

In 1953, H. A. Quinn of the Geological Survey of Canada included the present area of study in his Nelson House map sheet, which was published at a scale of one inch = four miles. This work was revised largely by T. G. Frohlinger of the Manitoba Mines Branch in the

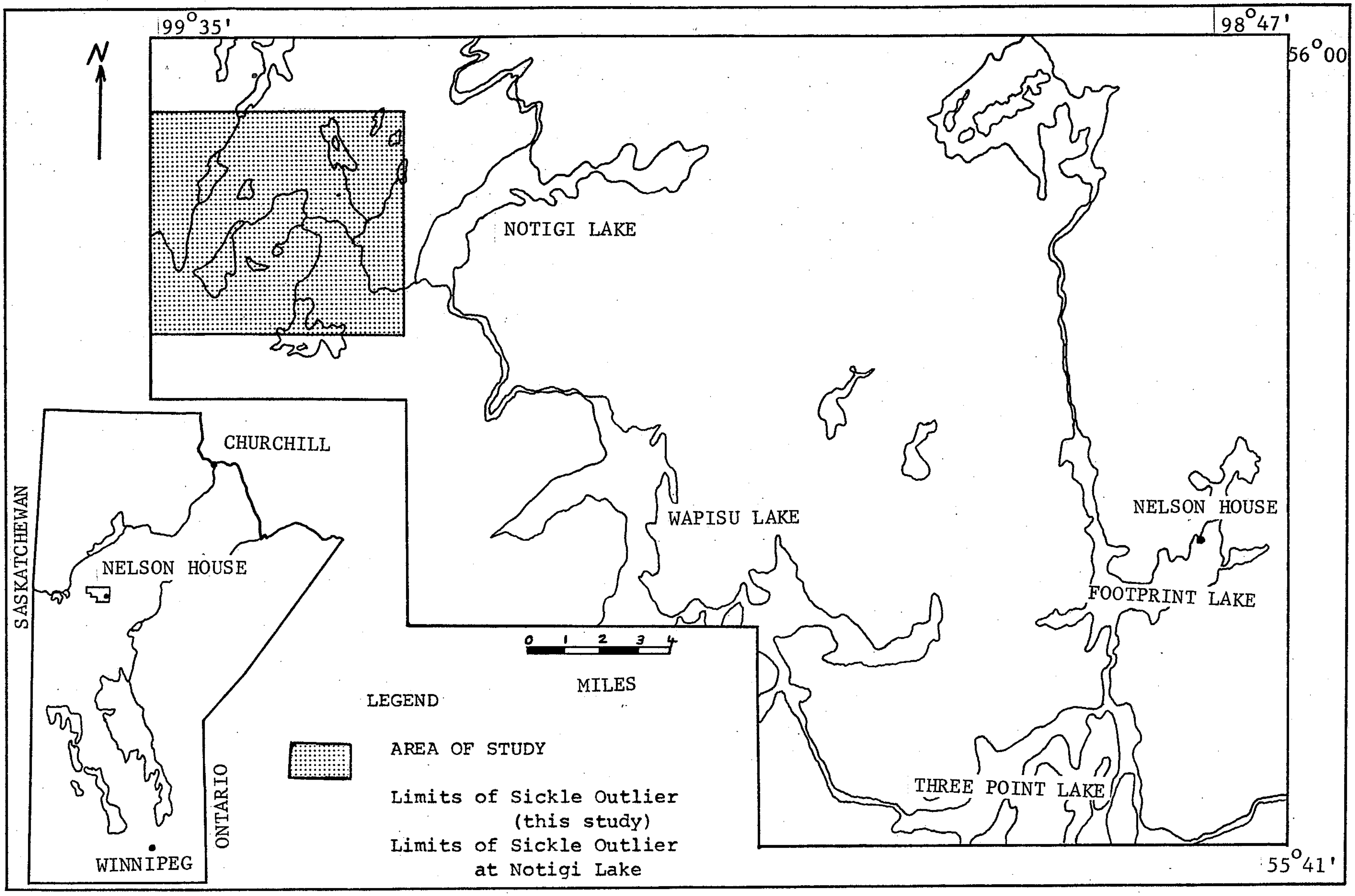

FIGURE 1 Area of Study

1971 field season, mapping at a scale of one inch = one-half mile.

Present Work

Field work in the area of study was conducted during the 1971 field season while in the employ of the Manitoba Mines Branch, working with T. G. Frohlinger. The pace and compass method of traversing was utilized, in conjunction with air-photos and air-photo mosaics. Although outcrop comprises approximately twenty per cent of the area, much of the outcrop is moss and lichen covered, restricting observations in much of the area.

Acknowledgements

The writer wishes to thank Dr. W. C. Brisbin for supervision of this work. T. G. Frohlinger was very helpful in discussing problems arising during the field mapping and in making time available for the work during a very busy field season. J. S. Roper, Director of the Mines Branch, Manitoba Department of Resources and Environmental Management, kindly released the data necessary for this study. L. Dykowski, L. Evenson and G. Smith acted as very able assistants during field mapping.

CHAPTER II

GENERAL GEOLOGY

Introduction

The area of study is composed of rocks similar in lithology and mineralogy to the Sickle Group, named by Norman (1933) from occurrences at Sickle Lake. Similar rocks were recognized and classified as Sickle-type by Schledewitz (1969) at Rat Lake to the northwest, and by Elphick (1970) in the Mynarski-Notigi Lake area to the east and northeast of the area of present study (Figure 1).

In the area of study the Sickle-type rocks are surrounded and underlain by rocks classified as belonging to the Wasekwan Group (Frohlinger, 1971, personal communication). The Sickle rocks in the area of this study are referred to as a Sickle outlier; there is some evidence to interpret that they were joined to the Sickle rocks to the north and west at Rat Lake and are now separated by erosion. Similarly, another larger body of Sickle-type rock around Notigi Lake to the east is herein called the Notigi outlier (Figure 1), for it is surrounded by Wasekwan-type rocks and separated by erosion from the large body of Sickle-type rocks to the north (Elphick, 1971, personal communication).

General Statement

The study of deformational history is restricted to the

Sickle outlier referred to above (Figure 1). This outlier is composed largely of light tan-coloured meta-arkosic paragneisses and migmatites.

Underlying the surrounding Sickle outlier is a thick sequence of pelitic gneisses. These rocks, believed to be the oldest in the area (Table 1), differ in composition and appearance from the Sickle-type rocks. They are similar in lithology and mineralogy to the Wasekwan Group (Frohlinger, 1971, personal communication), named by Bateman (1945) for rocks in the McVeigh Lake area, although no definite correlation has been made up to this time.

At the southern extent of the hook-shaped Sickle outlier (Map 1), there are two bodies of intrusive rocks. Immediately south of the Sickle rocks there is a body two miles long and one and one-half miles wide, consisting of foliated granodiorite. The composition of this unit is similar to that of the Sickle-type rocks of the outlier; however, the granodiorite is believed to be intrusive in origin.

To the south of the granodiorite there is a body of pink quartz monzonite which is in contact with the Wasekwan-type pelitic gneisses to the south.

At least two ages of intrusive pegmatite occur in the map-area. Early K-feldspar-plagioclase pegmatite occurs as an *in situ* metamorphic derivative of the Sickle-type arkosic gneisses. In addition, a late stage intrusive, granitic to quartz monzonitic pegmatite occurs often along the contact between the Sickle-type

TABLE I

TABLE OF FORMATIONS

Age	Group	Unit	Map Unit Number	Unit Description
PRECAMBRIAN		Pegmatite	8	coarse-grained to pegmatitic pink to white, K-feldspar-plagioclase pegmatite
	Post-Sickle Intrusives	Granodiorite	7	medium-grained, tan-coloured, hornblende-magnetite granodiorite, with penetrative foliation
		Quartz Monzonite-Granite	6	fine-to-medium-grained, light pink, biotite-magnetite bearing quartz monzonite-granite, with penetrative foliation
		Diatexite-Anatexite	5	light grey, medium-to-coarse-grained granodiorite; highly mobilized equivalent of Unit 4
		Metatexite	4	tan to grey, medium-grained equivalent of Unit 3; metamorphic layering with 20-65% leucocratic _lit-par-lit_
	Sickle Group	Meta-Arkose-Paragneiss	3	light brown to tan, fine-to-medium-grained, K-feldspar-plagioclase-quartz-magnetite-hornblende rich rock, bedded, with less than 20% _lit-par-lit_ leucocratic injections
		Amphibolite	2	black to greenish black, medium to coarse-grained, hornblende-plagioclase-biotite amphibolite, with minor disseminated sulfides
	Wasekwan Group	Hybrid Gneisses and Migmatites	1	light grey, fine to medium-grained, plagioclase-K-feldspar-quartz-biotite-garnet gneisses with varying amounts of cordierite, sillimanite and diopside; rocks are bedded to highly migmatized

arkosic gneisses of the Sickle outlier and the pelitic Wasekwan-type gneisses. A large portion of the northern and central parts of the Sickle outlier is also comprised of this late stage intrusive pegmatite (Map 1).

Aeromagnetic Relationships

The aeromagnetic map of the area studied bears a close relationship to the geology (Figure 2), clearly outlining the distribution of the Sickle outlier. The Sickle-type rocks are outlined by the 2800 gammas contour and are characterized by magnetic values in excess of 2800 gammas. The underlying Wasekwan-type rocks exhibit magnetic values below 2800 gammas. This relationship is due largely to the high magnetite content of the Sickle-type rocks, as opposed to the lack of magnetite in the Wasekwan-type rocks. The granodiorite and quartz monzonite intrusions, south of the Sickle outlier, also have a high magnetic signature due largely to the presence of magnetite.

The 2800 gamma contour reveals the shape of the Sickle outlier and the fact that the Sickle outlier is clearly separated from the Notigi outlier (Figure 2).

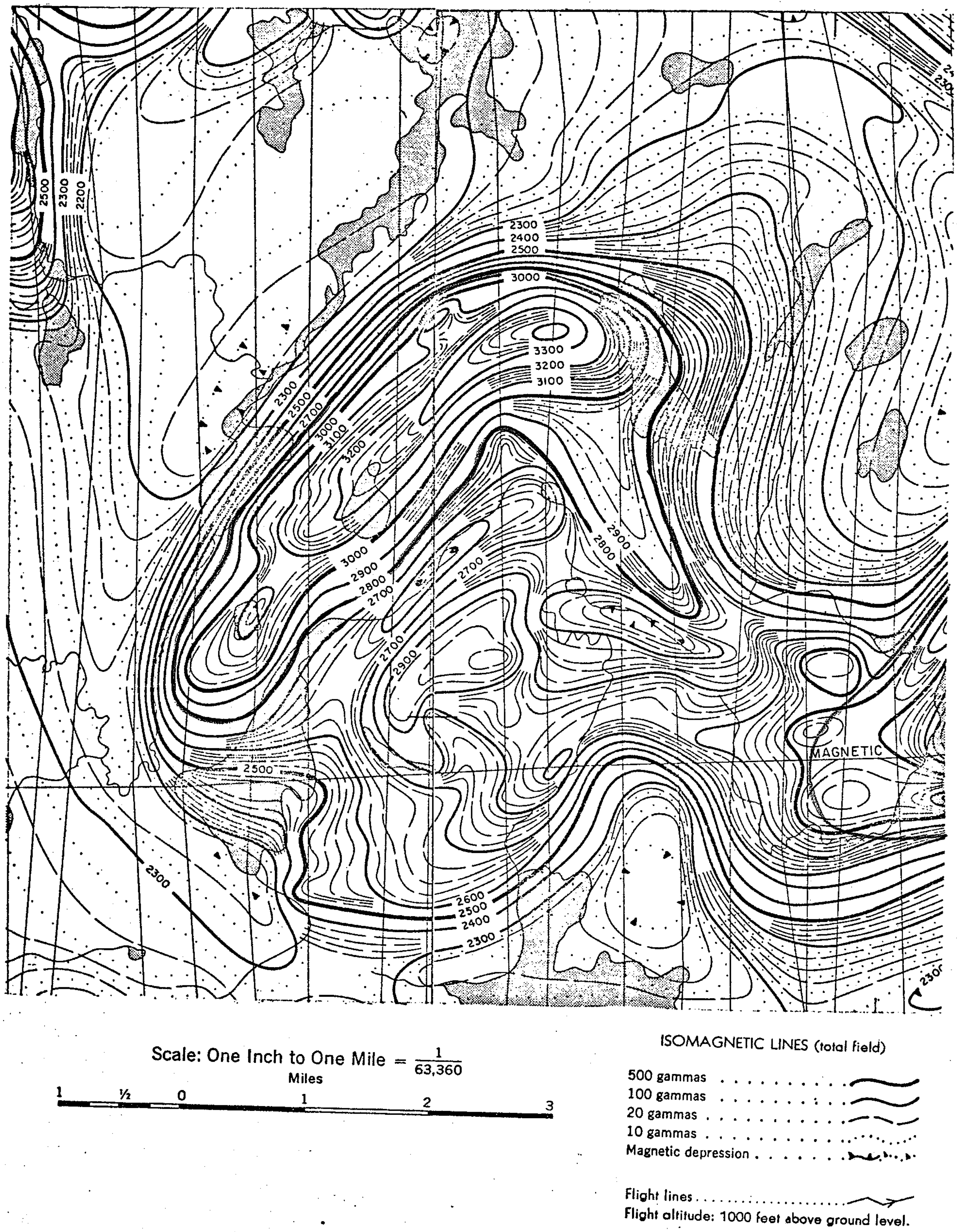

FIGURE 2 Aeromagnetic map of the area of study (2800 gamma contour outlined in red). The SW corner of the Notigi Lake outlier outlined in green

CHAPTER III

DESCRIPTIVE PETROLOGY OF ROCK TYPES

Introduction

This chapter describes the different rock types occurring in the area and their relationships to one another.

Wasekwan Group

The Sickle outlier is surrounded and underlain by light to medium grey gneisses composed predominantly of plagioclase, quartz, biotite and garnet with or without varying amounts of K-feldspar cordierite, sillimanite and diopside. These rocks vary from well bedded meta-greywackes, to interlayered paragneisses with granitic and leucocratic lit-par-lit material, to highly mobilized diatexite-anatexite migmatites with more than seventy-five per cent pegmatitic mobilizate and very little evidence of layering.

Structural evidence indicates a long and complex tectonic history within the Wasekwan Group. At least three periods of folding and at least three periods of faulting have been established by others (Frohlinger, 1971). The presence of two ages of development of cordierite, garnet and sillimanite indicates at least two stages of metamorphism of upper amphibolite grade, under high temperature and low pressure conditions (Frohlinger, 1971).

Wasekwan tectonic history will not be discussed in further detail, for this thesis deals only with deformation within the Sickle-type rocks.

Sickle Group

Distribution

The area of structural study, the Sickle outlier, is manifest on the surface by a topographic form which outlines a large hook-shaped fold (Figure 3). The outlier is visible on air-photos and measures five miles in an east-west direction from limb to limb, and two and one-half miles in a north-south direction. The rocks within the outlier are Sickle-type arkosic gneisses and migmatites, some late stage intrusive pegmatites, and minor amphibolite. The form of the outlier initially drew the attention of the author to this area as one in which studies of the deformational history of Sickle rocks within the Churchill Province might prove enlightening.

Stratigraphy

The homogeneity of what appear to have been predominantly arkosic sediments, coupled with high grade amphibolite facies metamorphism, create problems in establishing the stratigraphy within the outlier. Bedding is visible in some outcrops; however, correlation of beds between outcrops is not possible. The primary features have been obliterated by recrystallization and mobilization which accompanied regional metamorphism. The marker amphibolite, which is very continuous