Ice movement and structural characteristics of the Cathedral Glacier system, Atlin Provincial Park, British Columbia
by Ronald Frederick Johnson

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Earth Sciences
Montana State University

Abstract:
The Cathedral Glacier is a receding double cirque glacier system located in northwestern British Columbia. The purpose of this study was to use ice movement data and structural characteristics to determine which cirque's flow unit is presently the most active.

Results of a horizontal ice surface movement survey show that the average rate of ice movement per year for 1979-1981 was approximately 5.meters in the upper reaches of the upper cirque compared to only 2.5 m in the lower cirque. There is a slight increase to 3 meters midway down-glacier in the lower cirque flow unit.

The arcuate patterns of primary stratification on the glacier's surface delineate the two flow units. Up-glacier dips of the primary stratification indicate that rotational slippage has occurred. However, the presence of secondary structures indicate that englacial shear deformation has also occurred.

Crevasses are best developed in the upper reaches of the upper cirque. They are the result of extending flow put of the accumulation zone. Crevasses are also present midway down-glacier in the lower cirque approximately in the area where the rate of ice movement increases slightly. These crevasses indicate extending flow over an extrapolated convex bedrock surface which exists beneath the glacier.

Longitudinal tectonic foliation was observed near the glacier margins and in the area between the two flow units and was noted to parallel the primary stratification. This foliation results from the lateral shear strain between the ice and cirque walls or between the different layers of primary stratification. Transverse foliation associated with and parallel to stepped "overthrust" structures indicates compressive shearing strain has occurred near the terminus of the glacier.

Movement data show that the rate of horizontal surface movement is approximately twice as great in the upper cirque as it is in the lower cirque. In addition, crevasses and foliation were found to be more numerous and better developed in the upper cirque. The conclusion drawn from these data is that the upper cirque flow unit is presently the most active in the Cathedral Glacier.

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APPROVAL

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Ronald Frederick Johnson

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies

April 22, 1983
Date

John Montague
Chairperson, Graduate Committee

Approved for the Major Department

April 22, 1983
Date

Head, Major Department

Approved for the College of Graduate Studies

5-13-83
Date

Graduate Dean

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Date April 27 1983

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CHAPTER 1

INTRODUCTION

Research on the Cathedral Glacier began in 1972 with the establishment of Camp 29, which is located on a bedrock berm near the terminus of the glacier. This camp serves as a research base for work conducted under the auspices of the Foundation for Glacier and Environmental Research at the Pacific Science Center, Seattle, Washington and its affiliated Juneau Icefield Research Program (JIRP).

Since 1972, three major studies have been conducted that have a direct relationship to this particular study. The first investigation was a field mapping project conducted by JIRP under the direction of Dr. G. Konecny, then of the Division of Survey Engineering at the University of New Brunswick. This project resulted in a topographic map published in 1976 and used in all subsequent field work on the Cathedral Glacier. The second study was by V. K. Jones in 1975, resulting in a Master's thesis in geology at Michigan State University. His work is best described by the title of his thesis: "Contributions to the Geomorphology and Neoglacial Chronology of the Cathedral Glacier System". The other major study is presently being completed as a Master's thesis by J. B. Price at the University of Arizona. His research concerns the 1979-80 mass balance and glacio-hydrological characteristics of the Cathedral Glacier. These works, which will be

discussed later, led to the present study involving the movement characteristics of the Cathedral Glacier.

Physical Setting of the Cathedral Glacier

The Cathedral Glacier is in the northwestern corner of British Columbia at 59° 20' N latitude, 134° 5' W longitude (Figure 1). As such it lies within the confines of the newly established Atlin Provincial Wilderness Park. The glacier is within the Cathedral Massif, a rugged bedrock highland on the southwestern end of Atlin Lake. The massif is located just north and east of the Juneau Icefield, North America's fifth largest continuous icefield which in turn is located in the Northern Boundary Range of the Alaska-British Columbia border region.

The climate of the Cathedral Massif is characterized by cold, dry conditions and hence may be termed a periglacial environment. These conditions are in contrast with the maritime climate found in the southern and western regions of the Juneau Icefield. Because of this contrast, the acquisition of meteorological data from the Cathedral Glacier area is an important scientific function of Camp 29. Meteorological data obtained at Camp 29 can be compared with data from other research stations located across the Juneau Icefield. With these data is is possible to obtain a better understanding of the climate of the Juneau Icefield itself. The data are also a key to understanding the relationship between climate and glacial activity at both the Cathedral Glacier site and on the main Juneau Icefield.