QUATERNARY GLACIATION OF MT. HARRISON CASSIA COUNTY, IDAHO

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INTRODUCTION

The Albion Range has two prominent summits, Cache Peak to the south and Mt. Harrison to the north. Both mountains reveal evidence for alpine glaciation. Based on relative dating, Mt. Harrison experienced at least two glaciations in this region, one considerably more extensive than the other. These glaciations were most likely the Pinedale (last retreat dated from 20,000-40,000 yrs. Before present) and the Bull Lake (last retreat dated from 140,000-150,000 yrs. before present) glaciations (Berry, 1987).

Mt. Harrison is dominated by both glacial and periglacial geomorphic features that include cirques, tarns, moraines, solifluction lobes, block fields and a rock glacier. Within the area of interest, a large glacial valley exists to the northeast, which is encompassed by a compound cirque system to the west and southwest. A smaller cirque is present to the south, neighbored by a sequence of solifluction lobes and block fields above. The prominent moraines are aligned north-south, and are present northeast of the summit.

The purpose of this study is to distinguish the events that produced the geomorphic features present within Mt. Harrison, and organize them chronologically by applying relative dating techniques. The chronologic sequence of events will lead to a better understanding of the glacial geologic history of this area.

Methods

Two glacial systems were studied: the southeastern cirque and the valley that includes Lake Cleveland. Surface boulder frequency was measured on all interpreted moraines by counting the number of boulders greater than 22.4 cm (10 in.) in an area of $25m^2$. Soil descriptions were also recorded at each of the sites where boulder frequency was measured. Differences in soils (organic content, horizon development, and grain size distribution) help to determine relative age. In addition, the slope of each moraine was measured; older moraines should have gentler slopes near their crests.

The clay mineralogy of two samples thought to be from different glacial systems was determined using X-Ray Diffraction. Oriented clay slides were prepared, placed in the X-Ray diffractometer, and X-Rayed from 2º 2Ø to 32º 2Ø at a scan rate of 1º per minute for 30 minutes. This procedure was repeated three times, the second time after each of the two samples sat in ethylene for 12 hours, and the third time after they were heated for 1 hour at 500º C.

RESULTS AND DISCUSSION

Based on the erosion of till and weathering of moraines, two glacial events are reflected in the geomorphology of this region. The younger moraines contain soil that has less organic matter and contains more sand (though not much was present). In general, thicker soil horizons were present within the Bull Lake system, and the composition was finer-grained than the Pinedale soil.

The overall morphology of the region provides little evidence related to the active movement of the Bull Lake Glaciation. Moraines presumably of Bull Lake age are found

predominantly north of Mt. Harrison. Pinedale moraines are present southeast of the southern cirque and northeast of the Lake Cleveland glacial valley, suggesting that the Pinedale glaciation was extensive enough to overrides Bull Lake features in these areas. It also seems plausible that the Pinedale glaciation did not extend as far north as the Bull Lake at Mt. Harrison.

Striations appear on the surface of Elba quartzite outcrops on the northeastern side of Mt. Harrison. The maximum elevation at which they appear is 2700 meter, suggesting that the glacier did not advance above this. Since the grooves themselves are well preserved, they are most likely Pinedale in age.

The slopes of the Bull Lake moraines (mean slope of 15˚) are gentler, while the Pinedale moraine slopes (mean slope of 25˚) are significantly steeper, and contain more angular, less weathered boulders. While boulders occur less frequently on Bull Lake moraines, they are more rounded due to weathering. The average number of boulders found within a given Bull Lake moraine is 9 per 25 m^2, while the average number for a Pinedale moraine is 36 per 25 m^2. While the frequency of boulders is not necessarily indicative of the relative age of the Bull Lake moraines, the weathering and slope properties within the system support the idea that the Bull Lake moraines are older.

Rock Glaciers are another glacial feature that occurs near both the southern cirque and the Lake Cleveland cirque (Figure 2.). Their position relative to the cirque suggests that they are perhaps a result of less severe climatic conditions, where melting ice and topoclimatic factors would have favored a high intensity of rockfall (Morris, 1981). While the primary glacial ice was concentrated within the cirque, freeze-thaw action could have been taking place nearby, in an area that could sustain periglacial activity. This allowed for the formation of rock glaciers, where glacial ice was buried rapidly by the accumulation of boulders.

The clay mineralogy of the two samples reveals a consistency between the relative age of the soil samples and their clay composition. Data for the presumably older, Bull Lake soil samples shows a higher concentration of mixed layered illite-vermiculite than the Pinedale sample, where peaks indicating a presence of vermiculite are more subtle In addition, mineralogical data shows that Bull Lake soil is more fine-grained

Four tree cores were collected from trees within the compound cirque system and the smaller, southern cirque. The set of cores from each locality consisted of one Limber pine and one sub-alpine fir. Cores LCA and LCD are from Lake Cleveland trees within the compound cirque, while MHA1 and MHA 2 are from the southern cirque.

Annual rings were measured for 120 years on each core, and then graphed thickness vs. time. In addition, absolute thickness was subtracted out in order to view relative thickness changes. Though the tree cores are not relevant to glacial or periglacial studies of the area, they show both more recent seasonal trends and the way that seasons could have affected different areas of the mountain differently. Climate variations affected the trees differently. For LCD 1, there appears to have been more wet seasons (more conducive to tree growth) more recently. On the contrary, LCA 1 shows a more fluctuating seasonal pattern. Further back in time, more wet seasons seem to have occurred more randomly.

Figure 1. Glacial valley at Lake Cleveland: located directly northeast of the large compound cirque.

According to the southeastern tree core data, MHA 1 exhibits more inconsistent seasonal trends. In contrast, peak seasons (higher levels of precipitation) for the other core, MHA 2

appear to have occurred more often. The overall consistent conclusion is that the tree growth patterns for each of the trees were affected differently, according to climate variations.

SEQUENCE OF EVENTS

The relative dating techniques applied to this study serve the purpose of constructing a generalized sequence of events. The oldest glaciation to have geomorphically transformed Mt. Harrison was the Bull Lake glaciation. Since the ice for both Pinedale and Bull Lake glaciations originated in the same cirque (Evenson et al, 1982), then the more extensive Bull Lake ice is most likely responsible for the initial glacial erosion of the Albion Range. The Bull Lake glacial ice last retreated 140,000 years ago, after which the climate on and around the summit of Mt. Harrison was cold enough to support freeze-thaw activity and the preservation of post-glacial, periglacial features. At the same time, warmer temperatures were required in the cirques to account for the gradual melting of the glacial ice.

According to findings in this study, the Pinedale glaciation was less extensive than the Bull Lake. In areas where the Pinedale overrode Bull Lake features it eroded much of the morphology. As the temperature dropped once again 40,000 years ago and became supportive of an alpine glacial environment (Pinedale), frigid conditions allowed the advancement of glacial ice within both the southern and the compound cirque. The glacial ice in the southern cirque was not as thick as that which was present in the Lake Cleveland compound cirque system. The southern cirque here is primarily composed of quartzite bedrock that has not been eroded and there are no striations present. The lateral moraines both in the lake (see Figure 1.) and northeast of the glacial lake suggest a pause in the ice retreat. The last retreat of the Pinedale glacier occurred no at least 10,000 yrs. ago (Luckman & Osborn, 1979), and perhaps can be referred to as the last major melting event to have taken place on Mt. Harrison. The most obvious evidence to support this is the appearance of consecutive moraines (Figure 2. not available), the inner of which is the youngest, encompassing the southeastern cirque.

CONCLUSIONS

The proposed sequence of events covers a period of time of approximately 120,000 years. The evidence found in this study supports the suggested hypothesis that two glacial events shaped the alpine region of the Albion Range.

Field work and mapping contributed most to the conclusions drawn in this study. The production of a map, using GIS, most accurately summarizes the extent of glacial features discussed in this abstract.

While the mineralogical analysis was incomplete due to mechanical failure, and the trends within the tree rings from all four trees vary too much to depend on for precise conclusions on recent climate changes, the supporting evidence is substantial enough to accurately describe the sequence of events in the manner in which they are told.

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