Glaciation and Geomorphology of Lodgepole and Trail Creeks, Park County, Wyoming

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INTRODUCTION

During the late Pleistocene, northwestern Wyoming was covered by the Yellowstone mountain ice sheet (Pierce, 1979). The Clarks Fork lobe of the Yellowstone ice sheet entered Lodgepole Creek and Oliver Gulch from the north and traveled up both drainages until it crossed the divide into Trail Creek, depositing a large moraine near the mouth of Trail Creek (Parsons, 1939). Erb (1995) concluded that granitic erratics near the mouth of Trail Creek were deposited by ice rafting in glacial Lake Sunlight. The purpose of this study is to determine the extent of glaciation along these creeks and to describe both glacial and post-glacial features.

PLEISTOCENE GEOLOGY OF LODGEPOLE CREEK

Lodgepole Creek was invaded by the Clarks Fork lobe from the north and possibly by the Crandall valley glacier from the northwest. There is considerable data to indicate that the upper limit of ice in the Lodgepole drainage basin was at approximately 2,743 m (9,000 ft). The Clarks Fork lobe covered the surrounding area to such an extent that erratics are found on top of Hunter Peak 2,741 m (8,994 ft) to the north, and up to 2,731 m (8,960 ft) on Cathedral Cliffs to the east. The lowest point on the divide between Lodgepole and Crandall Creeks that was not glaciated is a 2,777 m (9,111 ft) peak that displays patterned ground at its summit. This patterned ground consists of sorted circles, stones, and stripes formed from clasts of decaying volcanic bedrock (Stephen Dornbos and Jonathan Payne, personal communication, 1995). On the divide between Oliver Gulch and Lodgepole Creek, granitic erratics are present to an elevation of 2,743 m (9,000 ft).

Granitic erratics indicate the presence of Clarks Fork ice, because the granite was transported from the Beartooth Plateau or the Clarks Fork valley by this lobe of ice. Absaroka rocks can be transported by either Crandall ice or Clarks Fork ice because both lobes traveled over Absaroka bedrock. Exposures of a unique Absaroka intrusive rock are located in Crandall Creek to the northwest of Lodgepole Creek, and therefore, their presence along Lodgepole Creek indicates the presence of Crandall ice.

Along the divide between Lodgepole and Crandall Creeks, there are more Absaroka intrusive erratics in the till than in the till near the mouth of Lodgepole Creek. There is also a decrease in the number of boulder-sized granitic erratics along the divide. For these reasons we believe that Crandall ice was present in this area. However, there are no Absaroka intrusive erratics on the divide between Lodgepole Creek and Oliver Gulch, or upstream from the junction between the west and main forks of Lodgepole Creek. Therefore, although some ice from the Crandall valley glacier may have joined the Clarks Fork lobe in Lodgepole valley, we believe that the Crandall glacier itself did not travel up Lodgepole Creek farther than the west fork.

Glaciolacustrine sediments are exposed in stream cuts along the west fork of Lodgepole Creek, at some sites interbedded with till or outwash, indicating fluctuation of the ice margin. Deltaic sediments are also present in stream cuts along the west fork of Lodgepole Creek. Most of the deltaic sediments are located near tributaries to the west fork, and foreset beds dip more or less toward the center of the valley. Therefore, we believe that tributaries to the west fork deposited the deltas into an ice-dammed lake.

In the upper west fork of Lodgepole Creek, there is a possible moraine complex, with till overlying the glaciolacutrine and deltaic sediments. This area has been altered by extensive landsliding along the stream channel, and by erosion by the west fork and its tributaries.

The presence of lake beds here indicates that the west fork was dammed by Clarks Fork ice, creating glacial Lake Cinderella. The lacustrine deposits of this lake are compact and deformed in places, indicating that the ice overrode them after their deposition. Also, the presence of till above and below the glaciolacustrine sediments indicates that there was a period of ice advance and retreat before the possible moraine complex was deposited.

The last evidence of Clarks Fork ice in the Lodgepole Creek area is a series of moraines near the mouth of Lodgepole Creek. These moraines are rich in limestone clasts; their Clarks Fork lobe origin is indicated by the presence of many granitic boulders at the surface.

PLEISTOCENE GEOLOGY OF TRAIL CREEK

On the divide between Oliver Gulch, Trail Creek, and Lodgepole Creek, the highest erratics can be found at 2,743 m (9,000 ft). These erratics are granitic in composition, indicating that the Clarks Fork ice crossed this divide. As the lowest point on this divide is 2500 m (8,200 ft), the maximum ice thickness crossing the divide was approximately 243 m. Ice spilled across the entire divide between the pass at the headwaters of Lodgepole Creek and the saddle at the head of Oliver Gulch. Most of the Lodgepole Creek ice spilled toward the west fork of Trail Creek, whereas most of the Oliver Gulch ice descended into the main fork of Trail Creek. The steep slopes at the head of Trail Creek and its west fork probably resulted in an ice fall as the ice crossed the divide and descended down the valleys.

Once past the ice fall, the glacier flowed down Trail Creek to its mouth, bulding a moraine with a crest at 2,194 m (7,200 ft). Few erratics were found between the ice divide and the moraine; therefore, we can only estimate the extent of ice in the Trail Creek drainage. Although the majority of the erratics are granitic, there are erratics of limestone and Absaroka intrusive lithology. The Lodgepole ice could have picked up the intrusive erratics at the divide into Trail Creek which contains an Absaroka intrusive exposure. There are no erratics at the top of the divide between Trail Creek and Painter Gulch, indicating that ice did not flow east into Painter Gulch. The large terminal moraine near the mouth of Trail Creek is composed of mostly granitic and Absaroka clasts (Parsons, 1939).

The size of this moraine indicates that the ice was in equilibrium for a long time. Further downvalley, there are ice rafted erratics at approximately the same elevation as the top of the moraine (Erb, 1995). It does not appear that glacial Lake Sunlight and the building of the Trail Creek terminal moraine were synchronous because of the steepness of the front of this moraine in comparison to other moraines in Sunlight Basin.

HOLOCENE COLLUVIUM AND ALLUVIUM

The stream channel of Lodgepole Creek is characterized by small landslides throughout its extent. On a larger scale, many slumps occurred at the base of the Pilgrim Limestone; these are most likely the result of failure of the underlying Cambrian shales. Along the west fork of Lodgepole Creek, there is also extensive landsliding, mostly of drift from the valley sides. The landslide activity in this area is most likely due to a combination of three factors: erosion by the west fork which decreases lateral support to the valley sides, high water content indicated by the presence of many springs, and the lacustrine sediments which underlie the deltaic deposits and till.

There is a large landslide which covers approximately 2 sq km on the southwestern side of Trail Creek. Most of the landslide consists of hummocky terrain composed of volcanic-rich colluvium; however, in at least two places, there are granitic and limestone erratics. It is possible that this landslide blocked the course of Trail Creek.

In the Lodgepole and Trail Creeks area, in addition to widespread landslides, there is a variable thickness of colluvium on most slopes, particularly at the bases of cliffs of volcanic and limestone rocks.

There is alluvium along much of Lodgepole Creek. Below the Pilgrim Limestone, the flood plain/alluvial fan deposits contain charcoal that has been dated at 4,300 years before present (Grant Meyer, personal communication, 1995). Throughout this region, during a period of time 4,000 to 4,500 years ago, there was extensive fluvial activity including debris flows that were fire and/or climate related (Grant Meyer, personal communication, 1995). The most recent large scale alluvial activity took place in the form of a flood and debris torrent that had its origins in the west fork of Lodgepole Creek. The flood traveled the length of Lodgepole Creek, eventually destroying a dam at a ranch near its mouth . The flood left natural levees along lower Lodgepole Creek, and log jams near the mouth of the west fork.

Most of the Trail Creek valley is covered with alluvium that has been reworked by periodic flooding. The most recent episode of flooding was due to the increase in discharge and sediment after the Yellowstone fires of 1988. Small alluvial fans line much of the valley sides of Trail Creek.

Although there is no direct evidence, we believe that the valley floor of Trail Creek was at one time covered by outwash and till deposited by the glacier as it was advancing and retreating. However, these sediments have been reworked by fluvial systems. The floodplain and alluvial fan sediment in this valley may be covering the Pleistocene drift.

CONCLUSIONS

Ice originating on the Beartooth Plateau and vicinity flowed down Clarks Fork valley and eventually pushed against the Absaroka Mountains and up into several valleys, including Lodgepole Creek and Oliver Gulch. This ice continued up these valleys, spilling into the Trail Creek drainage basin and depositing a large moraine near the mouth of Trail Creek. In addition, there was a valley glacier which began at the headwaters of Crandall Creek and probably crossed the divide between Crandall and Lodgepole Creeks, joining the Clarks Fork lobe. After the ice receded, the area was affected by mass wasting and fluvial erosion and deposition. Alluvial fans, flood plains, gorges, and landslides were some of the landforms created by post-glacial processes. The most recent geologic activity occurred after the 1988 fires in Yellowstone National Park and vicinity; these fires indirectly increased the volume of runoff and sediment in the Trail Creek and Lodgepole Creek drainage basins, in some areas promoting aggradation of sediments while elsewhere eroding previous deposits.

REFERENCES CITED

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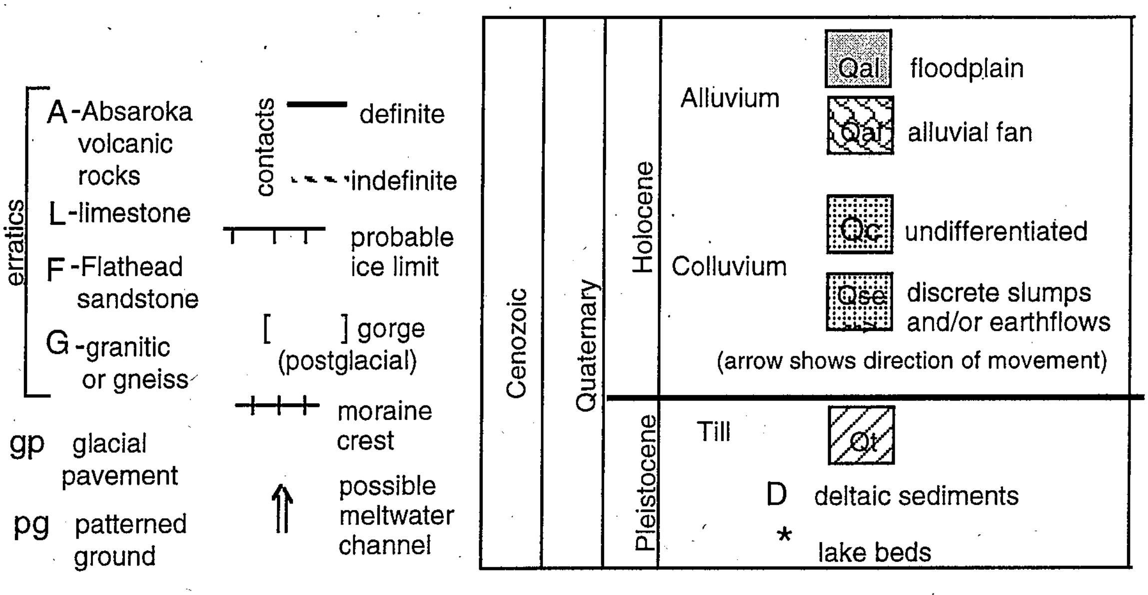
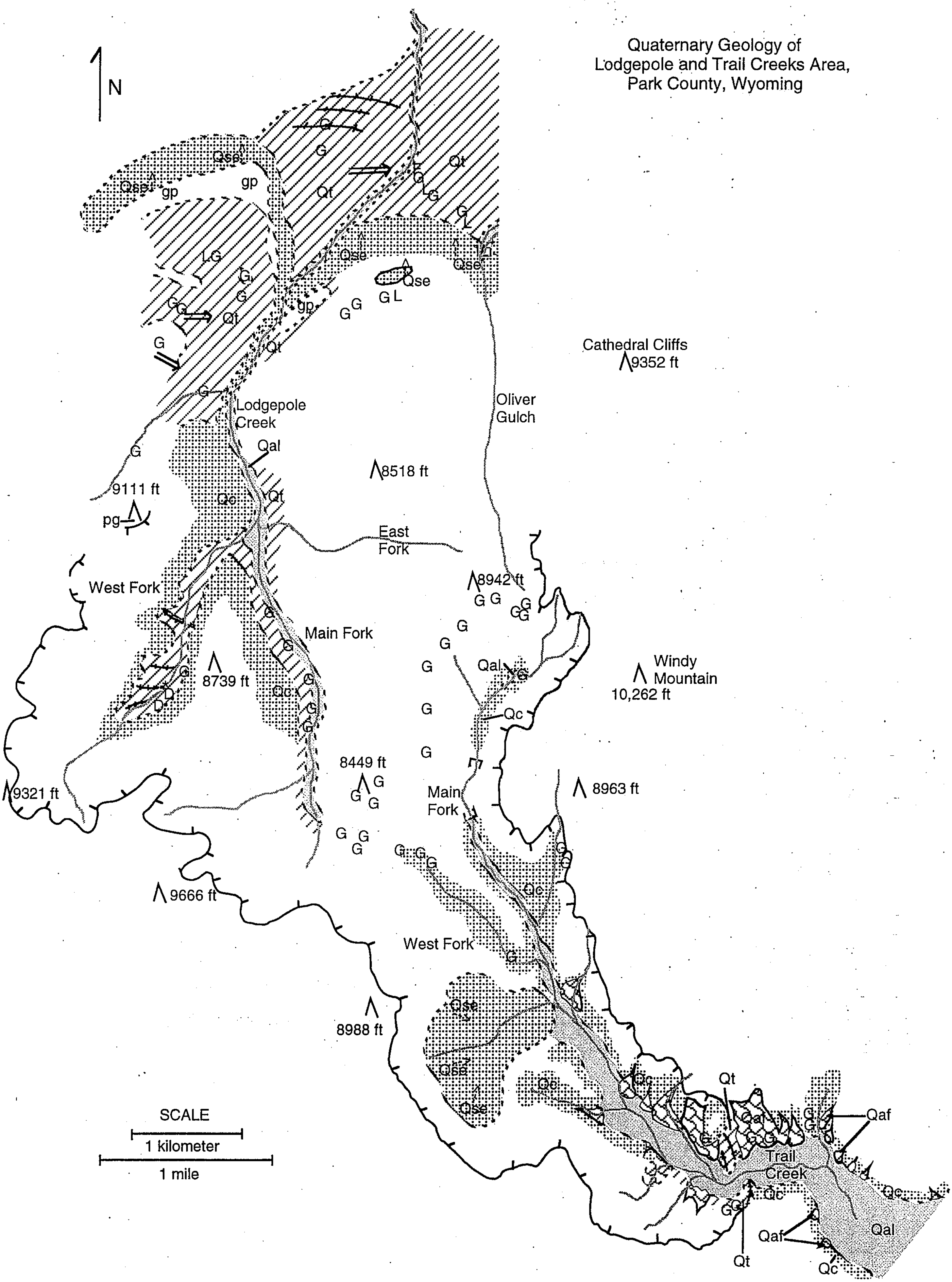
LEGEND




Quaternary Geology of
Lodgepole and Trail Creeks Area,
Park County, Wyoming
N
Cathedral Cliffs
9352 ft
Oliver
Gulch
Lodgepole
Creek
Qal
8518 ft
9111 ft
Qc
Qt
pg
East
Fork
West Fork
8942 ft
Main Fork
Windy
Mountain
10,262 ft
8739 ft
Qc
Qal
Qc
8449 ft
8963 ft
9321 ft
Main
Fork
9666 ft
Qc
West Fork
Qse
8988 ft
Qse
Qse
Qc
Qt
Qaf
Trail
Creek
Qc
Qaf
Qal
Qt
Qc
SCALE
1 kilometer
1 mile