SECTION B, GEOLOGY

Geology of the Lemon-Ptarmigan Area, Alaska

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INTRODUCTION

Juneau Icefield (Naff, 1968) is a vast glaciated area which offers access to supplies in Juneau and communications with the outside world through this port. Lemon and Ptarmigan glaciers are on the west edge of the icefield, only about 4,000 ft above Juneau and can be reached by helicopter at almost any time of year. Two trails, the Lemon Creek Trail and the Salmon Creek Trail, permit investigators to walk to and from the glaciers during the summer months. Salmon Creek Trail is, however, dangerous, and Lemon Creek Trail requires a walk-up of 8 to 12 hr through thick, tangled rain forest, so the exacting needs of field parties dictate the use of helicopters to transport men and equipment to the site.

TOPOGRAPHY

Camp 17 of Juneau Icefield Research Program is located at 4,185 ft on an arète separating Lemon and Ptarmigan glaciers. The arète, known as Ptarmigan Ridge, is about 3¼ miles long, trending almost due north-south. At the south end, 5,642-ft Cairn Peak drops off abruptly to Salmon Creek Valley. This eroded horn peak has cirques on the north face in which lie the upper nèvès of Ptarmigan and Lemon glaciers. Vesper Peak, 5,642-ft, forms the north end of the principal arète. A long, sloping cleaver-ridge extends northward from Vesper Peak, separating the lower reaches of Lemon and Ptarmigan valleys. The entire area is above timberline, exhibiting broad expanses of barren bedrock and a few patches of thin tundra cover.

BEDROCK GEOLOGY

Bedrock of Ptarmigan Ridge is predominantly metaclastic. Metamorphism is of very low degree except in a few places where pegmatite dikes have intruded, and many primary structures of the sediments are visible. Original bedding planes are preserved in nearly all localities; planes of foliation and schistosity lie parallel to the bedding planes. Rocks are not complexly folded, showing a strike of N. 18° W. and a dip of about 42° eastward. Graywackes and hematitic gritstones are commonplace on the arète. These rocks show low-degree cementation and realignment of quartz grains although some bedding planes are surfaced with thin veneers of sericite mica. Locally thin, tabular quartz veins have been injected parallel to the bedding planes, occasionally cutting across them as microdikes.

Pegmatite dikes and sills crop out at several localities on the arète. Adjacent to these intrusives, metamorphism of the country rock has been increased. Ptygmatic folding of quartz veins and boudin structures of veinlets in schistose rocks characterize the highly metamorphosed areas. A few feet away from the dikes, the clastic rocks are practically in their original state, preserving relict bedding planes and some ripple marks.

About three miles east of Ptarmigan Ridge, across Lemon Glacier, the western fringe of the Coast Range Batholith is exposed (Buddington, 1927). In the contact-metamorphic zone of this batholith degree of metamorphism is substantially higher, and rocks are principally schists with amphibolite bands parallel to the foliation. Some actinolite and epidote are present in the contact zone. The pegmatites in Ptarmigan Ridge probably are related to aplite and quartz-latite dikes in the granodiorite of the batholith. These pegmatites consist almost entirely of quartz and potassic feldspar, with little mica or accessory minerals.

Glacial Features

Ptarmigan Glacier is a separate drainage system, having no connection with the main body of Juneau Icefield. It is about 2¾ miles long. Lemon Glacier, about 3½ miles long, is much wider than Ptarmigan, and is continuous with upper snowfields of the main mass of Juneau Icefield, though actual nourishment of its stream is from the limited area of its own valley. Both glaciers extend northward along each side of Ptarmigan Ridge, the smaller glacier having no tributaries. Ptarmigan Glacier is very steep, having an average surface gradient of about 900 ft/mile. Slopes as steep as 50° are encountered in the central part of the stream. This steep gradient, the limited area of accumulation, the low elevation, and the high wind velocities all serve to expose large patches of blue glacial ice in mid- and late summer. Despite the small size and slow movement of this glacier, large crevasses constitute major surface features. In the upper and middle reaches crevasses are concave downstream. In the lower reaches crevasses are straight across or convex downstream, demonstrating the stream-flow movement of Ptarmigan Glacier (Nye, 1952).

Snow occupies the lower portion of Ptarmigan Valley only during winter and early spring. A well-developed valley train extends for 3,000 ft in front of the terminus, giving way at the lower end to a steep, snow-filled couloir dropping 600 ft to the confluence with the lowermost Lemon. Boulders and cobbles in the valley train are sub-angular owing to short distance of transportation and stratified or foliated nature of the rock. Where ice still occupies Ptarmigan Valley, the steep valley walls rise nearly perpendicularly from the glacier, but below the terminus several levels of lateral moraines and fragments of kame terraces can be seen along the lower flanks of the rise.

Lemon Glacier has a more gentle gradient than Ptarmigan along its principal reaches, but near the terminus it turns abruptly westward and tumbles in an 800-ft ice-fall. Terminus is about 1,200 ft downstream from the base of the icefall. Lower glacier features consist of radiate crevasses, moulins, dust wells, seracs, and closely meandering streams superimposed from the winter snow cover.

Lemon Glacier is the principal headwater source of Lemon Creek, and mass-budget figures are being gathered on this glacier. It has been found that bore holes 12 ft deep maintain a continuous summer temperature of 0 C. at their bottoms. Any change in depth of these holes is the result of accumulation or ablation at the surface of the glacier (Sharp, 1951). A network of such study bores near the terminus of Lemon Glacier is facilitating the U. S. Forest Service investigation of mass-budget problems.

Movement of Lemon Glacier upstream from the icefall is predominately by stream flow, but some indication of block-schollen movement (Finsterwalder, 1950) is observed in the middle reaches of the upper glacier. Near the upper limit of Lemon Glacier is a subglacial bedrock divide permits a very short sector of the ice to move southward. In former periods of nèvè maxima this movement has built a lobed terminal moraine at the southernmost extremity.

Several erratic boulders of granodiorite from the Coast Range Batholith now rest upon the upper ridges and in the cols of the arête. The transportation of these boulders dates back to maximum advances during Wisconsinan or post-Wisconsinan time (Kerr, 1936; Lawrence, 1950).

Both glacial valleys follow major joint lineations and cols and some tributary cirques are developed where joints have weakened the rocks.

One set of major joints strikes about N. 15° W., containing the glaciers themselves, whereas the arète is serrated by erosion along a set of joints which strikes about N. 45° E. (Miller, 1963).

SUMMARY

Accessibility throughout most of the year, development of typical features of alpine glaciation, and limited area combine to make Lemon and Ptarmigan Glaciers ideal field research models. Diversified lithologic and structural problems open many avenues of approach to future research. A continuing research effort such as Juneau Icefield Research Program will have long-term opportunities to make major contributions to fields of glacial and periglacial sciences.

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