Identification and Mapping of Periglacial Features near Snowdon Peak, CO

Broaddus, C.M. , Lancaster, V.M. and Morgan, T.F. (Advised by Kenny, R.)

Geosciences Department, Fort Lewis College, Durango, CO

Abstract

Ground surveys of a 0.27 km² area at the western base of Snowdon Peak near Silverton, CO resulted in the identification of a variety of periglacial features, including stone stripes, nivation hollows, debris islands, nonsorted steps, solifluction lobes, sorted and nonsorted circles, and nonsorted nets.

Introduction

Periglacial features are developed through the action of intense freeze-thaw processes in cold climates that lack glacial coverage. The features described in this report are located at the base of Snowdon Peak near Molas Pass outside of Silverton, Colorado.

- **Distribution of Periglacial features in the Southern Rocky Mountains has been well defined in terms of elevation and latitude (Marker, 1990).**
- **There is a gap in the existing research regarding the types of features observed at specific locations.**
- **The purpose of this research project was to help fill that gap by answering the question: "What periglacial features exist in the area near Snowdon Peak?"**

Background

Research Area

- **Deglaciation of the Southern San Juan Mountains (SSJM) dated at 12.4 +/- 1ka using Cosmogenic Nuclides (Guido, 2007).**
- **Permafrost locations in the SSJM show a strong spatial correlation with rock glaciers (Irham, 2016) and appear to be controlled by aspect and elevation.**
- **Elevation of study area ranges from 11,748ft-12,421ft (3,581-3,786 m). Slope of the study area ranges from 0-42 degrees. Dominant aspects are N, NW, and NE facing.**
- **Study area has a close proximity to two ice-cored rock glaciers.**

Periglacial Features and Patterned Ground

- **Washburn (1956) identifies 5 principle forms of patterned ground, including stripes, circles, nets, polygons, and steps. These forms can be further classified as sorted or nonsorted and can be gradational with respect to slope.**
- **Processes involved in the formation of patterned ground (Washburn, 1956) include:**
  - **Cryostatic movement (frost heave, frost thrust, aided by gelifluction)**
  - **Contraction (due to drying, thawing and temperature fluctuations)**
- **Small-scale (<1m) periglacial features can develop through intense freeze-thaw in the absence of permafrost. Large-scale features are thought to require the presence of permafrost.**

Figure A. Needle ice found at the base of the toe of a solifluction lobe.

Figure B. Nivation hollows, highlighted by lack of vegetation, lack of infilling snow.

Figure C. Nivation hollow filled with snow.

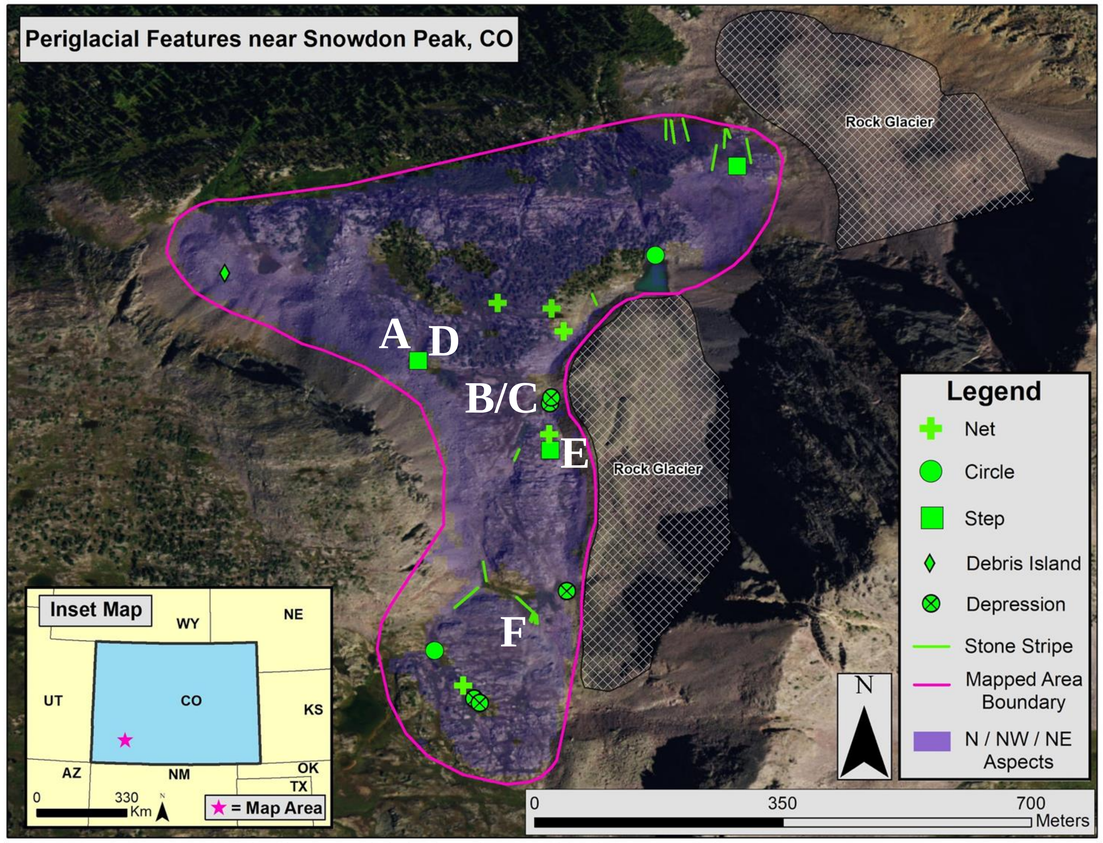

Figure 1. Feature map, sorted and nonsorted circles have been combined.

Figure D. Sorted step (Tape length 80 cm)

Figure E. Netted pattern ground highlighted by raised vegetated areas. (Tape length 2 m)

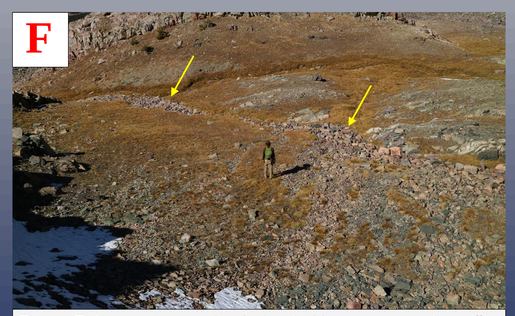

Figure F. Large stone stripe being fed by a system of smaller stripes.

Key Results

- **~85% of the study area has either a NW, NE, or N facing aspect**
- **Water-saturated soil due to large volumes of seasonal snowmelt, evidenced by abundant bogs & fens.**
- **Presence of needle ice observed at the base of vegetated soil lobes.**
- **The absence of lichen was noted on almost all features and at all scales.**
- **These features exhibit a variety of dimensions.**
  - **Stripes range from 5m to 20m long and 0.4m to 2m wide, with slopes of 6-29°. Clast size ranges from 0.02m up to 1.4m.**
  - **Circles have a diameter range of 0.8m to 9m, on slopes of 0-2° ground**
  - **Debris islands average diameter 2.7m**
  - **Depressions range from 0.5m to 3m in diameter.**

Discussion

Based on field observations and GIS analyses we suggest these features to be of periglacial origin.

- **Meanders of small stream channels contrast with the linear nature of the observed stone stripes. Fluvial processes don't explain circles or debris islands.**
- **Slopes, dimensions of observed features match descriptions in the literature (Washburn, 1956).**
- **Vegetation separates talus fields from features, suggesting genetic differences between the two.**
- **Presence of needle ice indicates intensive freeze-thaw, mechanism necessary for the ongoing formation of small-scale patterned ground features.**
- **Lack of lichen suggests features are far younger than LGM and thus not of glacial origin**
- **Climate cold enough to preserve regolith-insulated ice for long periods of time. This suggests that the climatic conditions required for the development of periglacial features are present.**

Conclusion

On the southwest base of Snowdon Peak small scale pattern ground is present, in the form of stone stripes, circles, nets, steps, nivation benches and debris islands. A lack of lichen on features of all scales suggests that they are either still developing or only stopped developing fairly recently. Elevation, aspect, slope, proximity to rock glaciers, and field observations suggest that permafrost may present be at this location.

References

Guido, Z.S., Ward, D.J., Anderson, R.S., 2007, Pacing the Post-Last Glacial Maximum Demise of the Animas Valley Glacier and the San Juan Mountain Ice Cap, Colorado, Geology, v. 35, no. 8, p. 739-742.

Irham, Muhammad (2016). The Impact of Temperature, Elevation, and Aspect on the Potential Distribution of Permafrost in San Juan Mountains

Marker, Margaret E. "Minimum Altitudes for Former Periglacial Landforms Adjacent to Longitude 106°W in Colorado and New Mexico, USA, between Latitudes 33°N and 40°N." Arctic and Alpine Research, vol. 22, no. 4, 1990, pp. 366–374.

Washburn, A.L., 1956, Classification of Patterned Ground and Review of Suggested Origins, Bulletin of the Geological Society of America, Volume 67, p. 823-866.