

Abstract

GIS and Google Earth were used to interpret the surface morphology of rock glaciers in the Mount Sneffels Range of Ouray County, Colorado. Measurements were collected for furrows and ridges of each rock glacier studied. The data that was collected was used to detect and present a trend in size, surface morphology, and deposition.

Introduction

- Sneffels Range is located in Ouray County ~10 km west of Ouray, CO (figure 1)
- Mount Sneffels is the highest summit in the Sneffels Range (14,138 ft.)
- Sneffels Range hosts more than 15 rock glaciers though the study area only contained 6 rock glaciers (Figure 4)
- Rock Glaciers are lobate or tongue-shaped bodies of frozen debris that are separated from the surrounding terrain by a steep front and side slopes and that have a surface expression of furrows, and ridges which are generally perpendicular to the direction of flow.

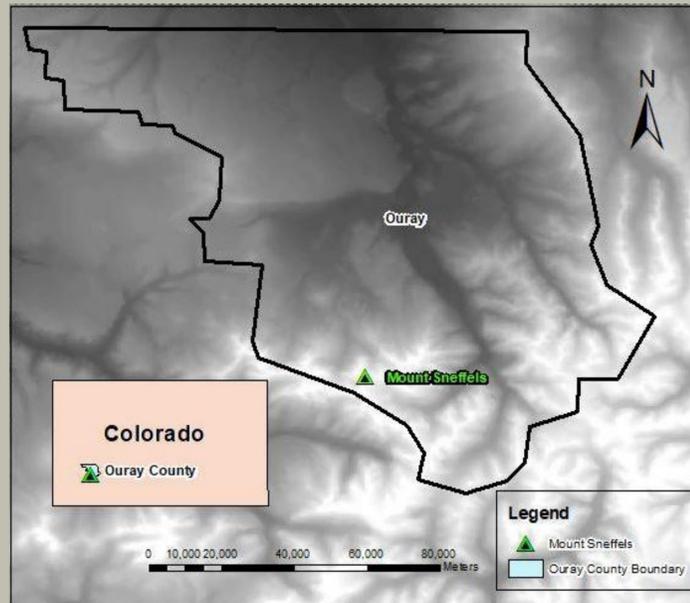


Figure 1. This is a GIS generated map that includes a location map showing where in Colorado Mount Sneffels is located and a DEM background to show varying elevation.

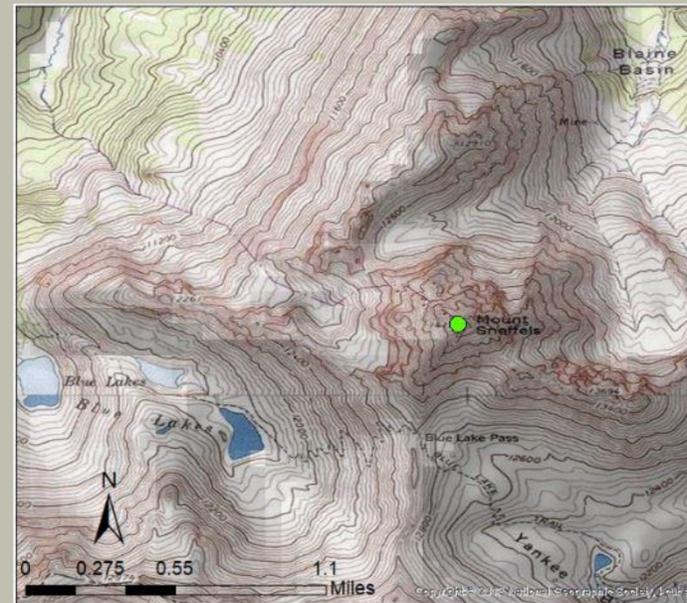


Figure 2. This is an ArcGIS online generated topographic basemap of the USA. There is a hillshade beneath the slightly transparent basemap.

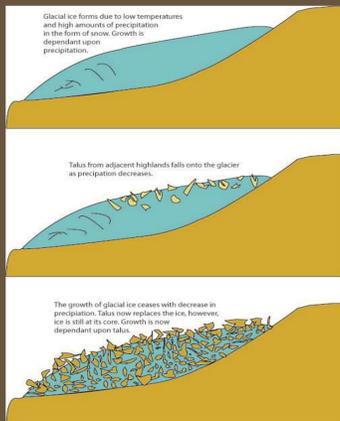


Figure 3. Diagram of a rock glacier

Background Information

- GIS is a geographical information system that is used to analyze, manage and interpret spatial and non-spatial data.
- Mt. Sneffels is located in the Uncompahgre National Forest of Ouray County, Colorado about 6 and a half miles southwest of the city of Ouray.
- This range covers 16,587 acres of national forest.
- Rock glaciers provide a great source for water, aquifers, drilling sites, tunnels, portals, and dam abutment.
- Rock glaciers consists of furrows and ridges. Where furrows are like the trough and ridges are the higher and usually rounded portion.
- Predominantly massive ice type rock glaciers contain plugs of ice that are covered by ice-saturated talus or landslide rock debris.
- The talus cone is the highest elevation point as well as the source of sedimentation for each rock glacier.
- Lakes and streams near the terminus tell us that freeze thaw cycles are occurring.
- These features generally occur in dry, continental areas rather than humid regions, perhaps because thin to absent snow cover favors their persistence.
- Morphology of rock glaciers is controlled by lithology, location, aspect, and microclimate.
- Most findings indicate that movement is the result of plastic deformation of ice contained within the structure.
- Can be classified as moraine rock glaciers, talus derived rock glaciers, avalanche rock glaciers and protalus rock glaciers.
- Rock glaciers of periglacial origin are generally considered to have an ice content of 50% - 70% by volume.
- Active rock glaciers are steep and at an angle of repose while inactive rock glaciers are rounded and rise ~20-35 degrees

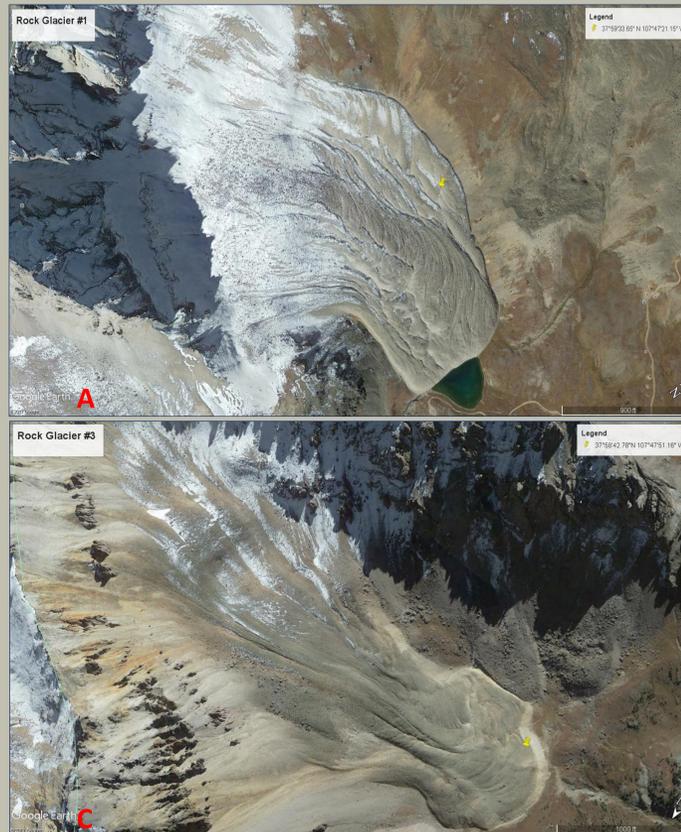
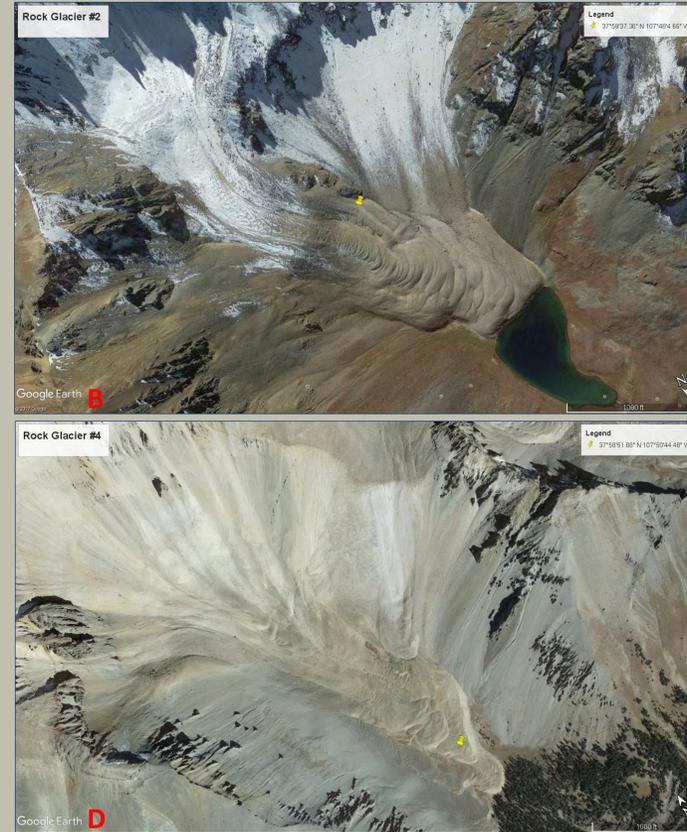


Figure 4. (average furrow length)
 A. avg. length-10.21m, relief-333.76m, lake located at the terminus.
 C. avg. length-8.10m relief-314.55m, stream at the terminus.



B. avg. length-9.65m relief-391.67m, lake located at the terminus.
 D. avg. length-13.31m relief-306.33m, abandoned stream at the terminus.



Figure 5. West to east vertical elevation profile of the Mount Sneffels Range

Methods

- Google Earth was utilized to zoom in as close as possible and measure six individual rock glaciers.
- The length of the rock glacier was calculated by measuring from talus cone to terminus.
- The width was calculated by taking three measurements (one near the terminus, one near the middle, and one near the talus).
- The elevation of the talus cone and terminus were found by hovering the cursor over the area in Google Earth.
- Furrow advancements were measured by lines between each ridge that was visible to the eye.
- Four digital elevation models were mosaicked together and then a boundary of Ouray County, Colorado was put on top with a symbol for Mt. Sneffels summit (Figure 1).
- Average elevation, relief, and average furrow length were calculated using an excel spreadsheet.
- A hillshade was derived from the downloaded digital elevation models and is underlying the basemap (Figure 2).
- The path tool on Google Earth was used to create a vertical elevation profile (Figure 6).

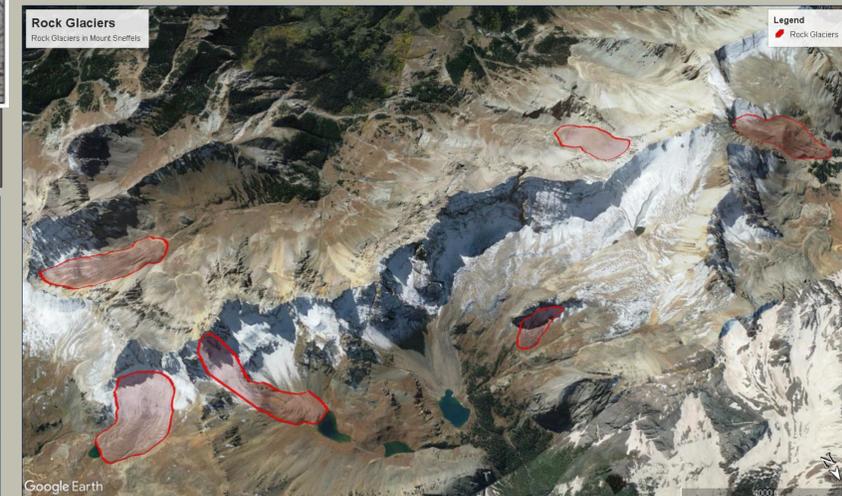


Figure 6. Rock glaciers shown in red outline in Mount Sneffels Range

Conclusions

From the data gathered, it was revealed that all of the rock glaciers measured were found at elevations greater than 3500 meters and lower than 4100 meters. Over half of the rock glaciers had either a lake or stream at the toe which furthers our belief that these rock glaciers are indeed active. There was a bimodal distribution between the measured furrow distances of each rock glacier. The first 3 rock glaciers measured all had advancing terminus measurements near 9 meters with a standard deviation of 1 meter. The second set of rock glaciers measured recorded lengths near 15 meters. The last one measured had the greatest average furrow length of 20 meters. With the exception of one, all rock glaciers observed had a change in elevation between 300 and 400 meters from where the rock glacier started to the farthest advanced furrow. The similar structures in these rock glaciers can be attributed to the conditions in which undergo.

Acknowledgments

Esri Inc. (basemap), WebGIS.com (DEM), USGS (DEM), Google Earth (Rock glacier photos), ArcGIS Online (Topographic basemap), summitpost.org (rock glacier diagram)

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