



Static debris-covered glaciers and rock glaciers in Tröllaskagi Peninsula (northern Iceland): The cases of Hóladalur and Fremri-Grjótárdalur.

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The glacial and periglacial environment – linked to the extensive presence of permafrost- which predominates in the Tröllaskagi Peninsula (NE Iceland), has been conducive to the development of numerous glaciers, covered glaciers and rock glaciers located at most of its valley headwalls. This is the case in the Vidinesdalur valley, north of Hólar, where there is a debris-covered glacier (65°42'N-65°44'N and 18°56'W-19°00'W) at the bottom of the Hóladalur valley, one of its tributary valleys, and an extensive rock glacier at the bottom of the Fremri-Grjótárdalur, another tributary valley to the west. These two valleys have been monitored using digital photogrammetry to evaluate their activity in relation to displacement and velocity rates.

As a detailed aerial photo from 1946 and also two orthophotos dated 2000 and 2013 were available, our aim was to study the advance rate of the two glaciers from the changes observed in their morphology at these three dates. The methodological approach adopted consisted of a combination of a geomorphological field survey 2012-2014 and photogrammetric analysis of the available material from these three years. The 1946 photograms were scanned in high resolution and georeferenced in the GIS ArcMap 10.1 (ESRI ArcGIS), using the Georeferencing module, with the 2000-2013 orthophotos as support. Between 49 and 63 control points were used for each photo, located along the outer edges of the glaciers. The transformation, applying a third degree polynomial function, obtained an RMS error of 16.10480 m and 9.42038 m respectively. The geomorphological traits were then digitized and observation of the images was carried out in a CAD environment (Bentley MicroStation V8i), which also allowed us to overlay a grid and work simultaneously with various views, facilitating the detection of possible changes in the surface of the rock glacier. During the 2014 fieldwork the limits and main geomorphological units of the two glaciers were delineated with GPS.

The analysis and interpretation of the morphological characteristics clearly show the almost complete absence of changes in the superficial structure of both the Fremri-Grjótárdalur rock glacier and the Hóladalur debris-covered glacier during the time interval studied, detecting the same flow structures (transversal crests and grooves and flow lines) located in the same position. Similarly, the external limit or shape shows hardly any variations. The rock glacier may be considered to have remained practically stable from 1946 to the present. This assertion contrasts with the observations made by Wangensteen et al., 2006, who also used photogrammetric techniques and detected displacements in the interior of the rock glacier during the 9 year period from 1985 to 1994.

In conclusion, the geomorphological survey of the 1946 aerial photograph and of the 2000- 2013 orthophotos, and their comparison using photogrammetric techniques has allowed us to detect the total stability of both the rock glacier and the debris-covered glacier over the last 50 years.

Reference.-

Wangensteen, B., Gudmundsson, A., Eiken, T., Käab, A., Farbrot, H., Etzelmüller, B., 2006, Surface displacements and surface age estimates for creeping slope landforms in northern and eastern Iceland using digital photogrammetry. *Geomorphology* 80:59-79.

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