

GURGLER FERNER, AUSTRIA, 1:10,000

(Aerial photogrammetric map)

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The map of Gurgler Ferner (Ferner means glacier) was prepared with the aims: (1) to document with the greatest possible detail the present state of the glacier, (2) to form the basis for glaciological studies such as measurements of ice thickness or calculations of mass changes, and (3) to attempt to reflect the continuity of the glacial and periglacial landscape by representing the surrounding area with its characteristic features in a suitable way (Patzelt 1986). In addition, the glacier mapping programme in the Oetztal Alps is being continued (cf. the maps of Kesselwandferner 1971 in Vol. III and of Gepatsch Ferner 1971, Hintereisferner 1979, Vernagtferner 1979 and Langtaler Ferner 1971 in Vol. IV of the "Fluctuations of Glaciers"). Note that the map is oriented towards the east, north being to the left.

The glacier was specially flown on 7 September 1981. The photos taken allowed photogrammetrical analysis to be done at a scale of 1:5,000 with high precision and a great amount of detail. Morphological details and boundaries between bedrock and scree surfaces were mapped in the field in the summers of 1984 and 1985. At the same time, the topographic representation was also completed in the field. Reduction to the scale of 1:10,000 was possible without loss of information and gave the sheet a more handy format. Cartographic processing followed the common standards for glacierized areas (cf. Brunner 1977). Crevasses and morainic surface cover containing individual blocks have been mapped in actual position. Perennial patches of snow/firn/ice are marked with dashed contours. All such firn patches - including very small ones - have been shown because they are good indicators of periglacial permafrost distribution.

Special emphasis was given to the representation of the terrain outside the snow and ice surfaces. The grey tone of bedrock surfaces was chosen to reflect the contrast in brightness with respect to snow and ice. Differences between the sharp cornered crests and summits, for instance at Schwärzenkamm or Mitterkamm, and the smooth and rounded shapes of bedrock in formerly glaciated areas were modelled using corresponding

rock signatures. Forms of scree and debris are marked with various sizes and densities of point-screens with edges marked separately. This combination made it possible to represent - as an important periglacial phenomenon - rock glaciers with their fluid surface structure and their steep margins. The existence of active rock glaciers in the "Aeusseres Hochebenkar" (Haeberli and Patzelt 1983) as well as near the Hochwildehut are a striking testimony of the occurrence of discontinuous periglacial permafrost above the timberline in the region. Due to the fact that only few debris-producing rock walls surround the glacier, the concentration of loose sediments in the glacier forefield of Gurgler Ferner is rather unimportant. The morainic deposits are correspondingly limited in extent and thickness.

Morainic ridges indicate the limits of former glacier positions at the end of advance periods and, hence, manifest the history of glacier fluctuations. All morainic ridges still preserved within the considered region were mapped and marked using heavy black lines. Red lines indicate the reconstructed maximum extent which the glaciers reached around the middle of the 19th century in the Alps. At Gurgler Ferner, the end of this advance period is known to be the year 1856. The few remains of moraines outside the limits of the 1856-stage have variable ages and could date from pre-neoglacial times. The systems of morainic ridges within the 1856-stage were deposited during short readvance periods between 1895 and 1920. During stages of increased glacier extent, the tongue of Gurgler Ferner repeatedly dammed up the meltwater runoff from the neighbouring Langtaler Ferner, forming a lake with floating icebergs; this was a popular tourist attraction in the 19th century. The maximum lake level reached is indicated by a blue chain, and corresponds to a lake volume of about 11.7 million cubic meters. The terraces still preserved within the former lake basin are also shown.

The cartometric analysis of the glacier map involved the hypsometric distribution of the glacier surface in 1981 as well as changes in glacier volume between 1969 and 1981. The calculated values of volume change can be found in Table D of the present volume. In 1981, Gurgler Ferner plus its tributary glaciers covered a surface of 11.2 square kilometers, making it the fourth-largest glacier in the Eastern Alps. Volume changes were calculated for 20m-altitudinal intervals. Total volume loss from 1969 to 1981 amounts to 30.6 million cubic meters.

Taking the density differences between firn, ice and water into account, this corresponds to a loss of 25 million cubic meters of water or to a mean annual balance of -17cm of water equivalent. The latter value agrees well with the directly-measured annual mass balances of Hintereisferner; for the same period, the mean annual balance at Hintereisferner was -16cm of water equivalent (Kuhn et al. 1985).