Quaternary Newsletter
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REVIEW OF FOUR 1:25,000 GEOLOGICAL MAPS/MEMOIRS OF SWITZERLAND PUBLISHED BY THE BUNDESAMT FUR LANDESTOPOGRAPHIE SWISSTOPO

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75 Ibergeregg (sheet 1152)[1]
170-1 Beatenberg und Brienz (sheets 1208-1209)[2]
167 Innertkirchen (sheet 1210)[3]
174 Guttannen (sheet 1230)[4]
1:25,000 Landesgeologie (Geologischer Atlas der Schweiz, Atlas géologique de la Suisse, Atlante geologico della Svizzera). Published by: Bundesamt für Landestopografie swisstopo 2020[3] 2022[1, 2, 4]

30 CHf each for folded map with explanatory memoir (Erläuterungen) in plastic wallet with enclosures, and 40 CHf for pair. Bundesamt für Landestopografie, CH-3084 Wabern.

This selection of 1:25,000 geological maps are in German (Nowell 2022). Extracts of text from the pdf versions can be copied and loosely translated online, plus the Lithostratigraphic Lexicon of Switzerland provides entries for mapped units in up to four languages, including some useful English terminology. The swisstopo online data viewer (Nowell 2021) allows the mapping to be enlarged and used to identify individual units with a simple click. The geological viewer also includes other areas in less detail, until the remaining sheets are completed. So far 175 maps have been published, with a planned series of 220 maps, combining some adjacent sheets coving border areas into single editions.

Each slightly too tight wallet includes a 210 by 148 mm memoir, folded map and plates in three neat pockets. On their covers the maps have a simplified

1 ISBN 978 3 302 40111 9 memoir, 1:25,000 geological map and plates
2 ISBN 978 3 302 40098 3 memoir, 1:25,000 geological map and plates
3 ISBN 978 3 302 40102 1 memoir, 1:25,000 geological map and plates
4 ISBN 978 3 302 40104 1 memoir, 1:25,000 geological map and plates

coloured geological map draped over synthetic topography, including lakes, rivers and peaks. Opened out the margins include detailed keys, and definitions of the symbols and lines on these sheets, usually covering 17½ km E-W by 12 km N-S, based on their topographic series. They also have accession numbers starting with the first geological map published in 1930. In areas covered by superficial deposits the underlying bedrock geology is not shown apart from projecting significant fault and thrust lines beneath such areas. Various colour coded series of distinctive dots and dashes are used to mark some superficial deposits, along with relatively easy to comprehend symbols. Neatly marked features include: boreholes; erratics; dolines; former channels; edges of features; quarries and peat cuttings.

The Ibergeregg sheet ranges from 441 m in the southwest to peaks including the Gschwändstock 1,616 m, Gross Mythen 1,898 m (Fig 1) and Druesberg 2,282 m. The bedrock consists of sedimentary sequences thrust into place forming Nappe structures, which when they consist of clay rich flysch were affected by extensive swamp and peat bog formation. Heavily weathered Middle Pleistocene tills are mapped, without the memoir giving any description of their rock types. This flaw extends the notes on till and moraines associated with the last glacial maximum, which would have benefited from a figure showing the different ice flow directions across the district. This came from the Reuss glacier in the high Alps, consisting of granites, metamorphic sediments and volcanics, migmatites and gneiss. On the flanks of the Mythen two local glaciers developed. Many erratic blocks are marked on the map, and some of their compositions and likely origins described.

Glacial gravels are detailed alongside debris cones, and lake bottom sediments, including those under the Sihlsee reservoir. Holocene deposits are quite varied

Fig. 1. View of the Klein and Gross Mythen from the northwest, with in the foreground southern end of the Lauerzersee, Ibergeregg Fig. 44. *Photo A. Pfiffner*, Copyright © swisstopo, All rights reserved

with scree slopes, significant landslides including one still moving at around 20 cm a year, areas covered by permafrost thawed rock falls. Given their extent peat bogs, wetlands and moorlands are given extensive coverage. Unspoiled and often impassable mountain pine raised bogs, with swamps, reeds and peat moors extend above the tree line. There was a complex history of fluctuations in the level of lake Ägerisee, including former lakes to its south which became peat bogs drained for intensive farming. This consumes the organic soils, emitting very large amounts of CO_2. Hydrology provides further details, as superficial deposits are used for water supplies and so it has three detailed cross sections as figures showing sequences over 100 m thick in places.

Interlaken, lies in between the Thunersee 558 m and Brienzersee 563 m, on the edge of the Beatenerg sheet. Brienzersee extends onto the Brienz sheet sold together with a combined memoir. Furggegütsch 2,197 m and Schwarzhoren 2,927 m are notable peaks. The bedrock consists of a series of Helvetic and Penninic sedimentary sequences thrust northwest towards the Miocene Subalpine Molasse. Apart from the 1·87 ± 0·21 Ma Wagenmoos-Moräne, superficial deposits date from the Last Glacial Maximum onwards. The Aare glacier buried the landscape (Fig 2), and glacial tills are not as extensive as might be supposed. A moraine complex has been seismically profiled beneath the Thunersee, filling the top of a hollow down to ~200 m below sea level. Tills and numerous erratics are characterized by a high content of granitic rocks from the Aar massif. Local tills are identified because they don't contain crystalline erratics, and lateral moraines are denoted using red dots. Because of rapid bedrock weathering few places retain any glacial striations. Glacial gravels and terrace gravels were also deposited along with glacialfluvial silts, and some of these deposits were overridden by the Lombach Glacier.

Fossil scree slopes are also mapped. Patches of unstable postglacial ground are common and various rock falls, landslides, and unconsolidated deposits have been surveyed in great detail throughout these maps. The Ralligen landslide has a notable failure scar mapped alongside debris flows mantling the hillsides for 2½km down into the Thunersee. These were deposited as three separate events within the last 2,800 years, demonstrating that another slope failure

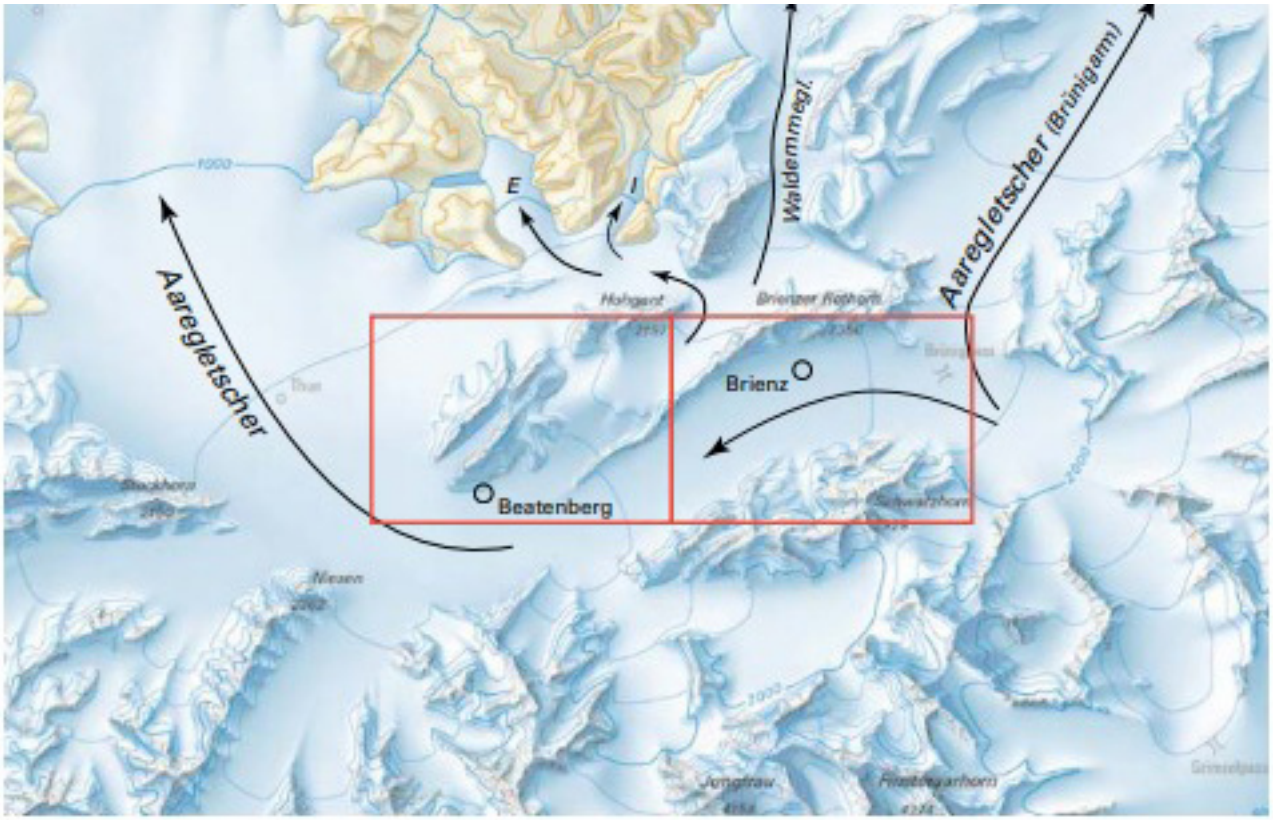

Fig. 2. Ice cover during the last glacial maximum - LGM, E=Emme and I=Ilfis branches of the Emme glacier. Beatenberg-Brienz Fig 34 Copyright © swisstopo, All rights reserved

could trigger an extremely destructive wave. Alluvial fans are also included within this geomorphological coverage, along with swamps and raised peat bogs. Alluvial deposits are identified according to their dominant lithologies and areas of made ground delineated.

Innerkirchen along with the Guttannen sheet to its south, encompass the Haaslital right up the river Aare towards its source, flooded by the Grimselsee, 1,908 m hydroelectric dam. This includes the Mährenhorn, 2,924 m, Diechterhoren 3,388 m, Ewigschneehoren 3,330 m, and Ritzlihoren 3277 m. The Innerkirchen sheet, has a marked diagonal boundary across the northern edge of the Aar Massif, mainly consisting of complex pre-Alpine crystalline rocks. Subglacial channels have been mapped and described in some detail, including three bypassing the current up to 180 m deep Aareschlucht gorge. Glaciers started to reform in the mid Holocene, reaching a maximum at the end of the Little Ice Age in 1850, and these tills are mapped separately. Since then, larger glaciers have lost up to 30% in area and many smaller ones have almost disappeared. Their retreat is often documented by maps and photographs, including a series showing how the Trift glacier has receded by more than 4 km between 1948 and 2019 (Nowell 2021). These two memoirs describe the many different types of debris flow and subsidence.

Even in the Guttannen district, glaciation buried the landscape so only peaks and ridges protruded from the ice as nunataks. This memoir, includes a carefully annotated landscape photograph of the Brünberg ridge (Fig 3). This is similar to the starkly glaciated relief on the Elm (Blatt 1174) sheet 173 (Nowell 2023). All three memoirs include passages about karstification and formation of extensive cave systems, including the 30 km long Bettenhöhle. The Innertkirchen memoir also has a geotechnical section about hydroelectric schemes and tunnels dating back to 1898. This section also notes the use of safely blasts to reduce the risk of rockfalls. The Guttannen memoir details the impact of melting permafrost causing rockfalls and mudslides. These four maps are adjacent to Grindelwald (Blatt 1229) sheet 13 published in 1938, so the geological mapping can be directly compared. Clearly this historic surveying lacks finer detail and includes extensive areas of ice which have since melted. Thus, once the series is completed there would be a strong case for resurveying older sheets, especially those which have already been impacted by climate change revealing fresh outcrops and superficial deposits.

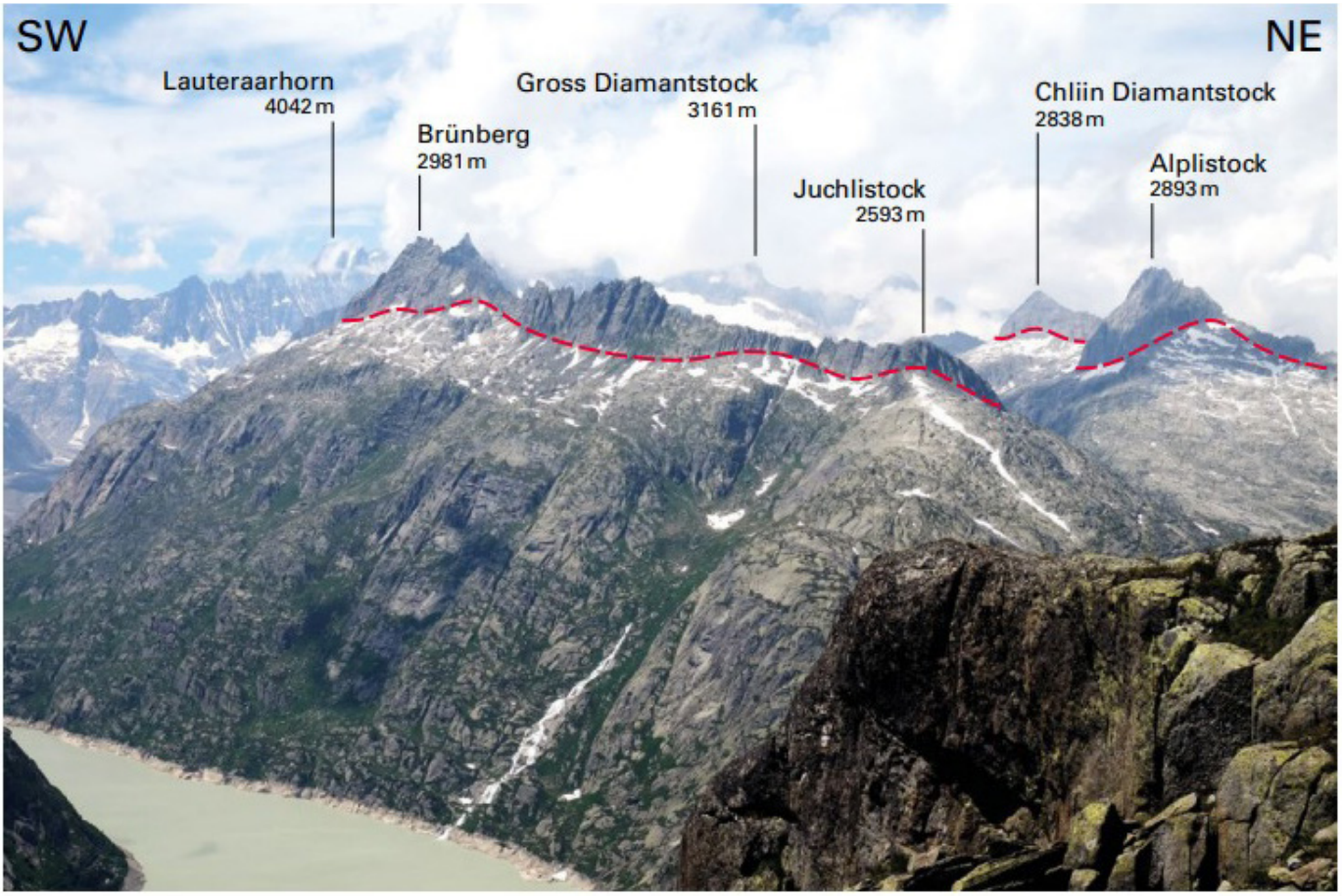

Fig. 3. Upper limit of LGM ice cover (red dashed line) on the Juchlistock–Brünberg ridge, and behind this the Alplistock and Chliin Diamantstock. View to the west over the Grimselsee from Nagelisgrätli watershead, Guttannen Fig 38. *Photo J. Arech*, Copyright © swisstopo, All rights reserved

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