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# Revisiting Late Pleistocene glacier dynamics north-west of the Feldberg, southern Black Forest, Germany

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Table S1: Ice-marginal positions in Sankt Wilhelmer Tal

| Ice-marginal position (this study) | Location of terminal moraines (m a.s.l.) | Original reference | Description | Interpretation or comment (this study) |
|---|---|---|---|---|
| 1 | 1030 | - | ESE-WNW oriented sediment ridge on the eastern headwall of the Napf cirque | Terminal moraine |
| - | 985 | Zienert (1973) | Ridge on the eastern headwall of the cirque | Not identified in this study |
| 2 & 3 | 910 | Schreiner (1977b) | Two-crested sediment ridge with a steep northern flank and a gently sloping southern side; on the valley floor | Terminal moraine |
| - | 850 | Klute (1911) | Terrace-shaped accumulation of partly rounded boulders on the valley floor | Rockslide deposit |
| 4 | 820 | - | E-W oriented, subdued sediment ridge on the northern valley side | Terminal moraine |
| 5 | 820 | - | E-W oriented, subdued sediment ridge on the northern valley side | Terminal moraine |
| 6 | 820 | - | SE-NW oriented ridge composed of boulders on the southern valley side | Terminal moraine |
| 7 | 780 | Schreiner (1977b) | NE-SW oriented sediment ridge (oriented perpendicular to the orientation of the valley); on the valley floor | Terminal moraine |

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| 8 | 780 | Schreiner (1977b) | NE-SW oriented sediment ridge (oriented perpendicular to the orientation of the valley); on the valley floor | Terminal moraine |
| 9 | 780 | - | Arc-shaped sediment ridge on the valley floor | Terminal moraine |
| 10 | 780 | - | Arc-shaped sediment ridge on the valley floor | Terminal moraine |
| 11 & 12 | 700-760 | Schreiner (1977b) | Two-crested sediment ridge with a SE-NW orientation on the valley floor | Terminal moraine |
| 13 | 700 | Klute (1911) | SW-NE oriented sediment ridge with a steep NW side and a gently sloping SE flank; on the valley floor | Terminal moraine |
| 14 | 900 | - | Arc-shaped sediment ridge with a strongly asymmetric cross-section (steep NE flank and gently sloping SW side); separated from the surrounding slope by a depression; on the southern valley side | Terminal moraine |
| 15 | 910 | - | NW-SE oriented sediment ridge with a steep NE side; separated from the surrounding slope by a depression; on the southern valley side | Terminal moraine |

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| 16 | 920 | - | NW-SE oriented sediment ridge with a steep NE side; separated from the surrounding slope by a depression; on the southern valley side | Terminal moraine |
| 17 | 930 | - | NW-SE oriented sediment ridge with a steep NE side; separated from the surrounding slope by a depression; on the southern valley side | Terminal moraine |
| 18 | 650 | Hüttner (1967) | Terrace-shaped accumulation of partly rounded boulders on the valley floor | Medial moraine |

Table S2: Ice-marginal positions in the Wittenbach cirque

| Ice-marginal position (this study) | Location of terminal moraines (m a.s.l.) | Original reference | Description | Interpretation or comment (this study) |
|---|---|---|---|---|
| 1 | 1210 | - | N-S oriented, arc shaped sediment ridge in the SE corner of the cirque | Terminal moraine |
| 2 | 1170 | - | SW-NE oriented, arc shaped sediment ridge at the margin of the uppermost cirque floor | Terminal moraine |
| - | 1120 | Schreiner (1977b) | Arc shaped ridge at the northern end of the intermediate cirque floor | Not identified in this study |
| 3 | 1100 | - | N-S oriented sediment ridge NE of the intermediate cirque floor | Terminal moraine |
| 4 | 1100 | - | Sediment ridges NE and NW of the intermediate cirque floor | Terminal moraine |
| 5 | 990 | Schreiner (1977b) | Arc shaped sediment ridge with a smooth crest on the lowermost cirque floor | Overprinted terminal moraine |
| 6 | 980 | Schreiner (1977b) | Arc shaped sediment ridge with a smooth crest on the lowermost cirque floor | Overprinted terminal moraine |
| 7 | 950 | Schreiner (1977b) | Arc shaped sediment ridge with a smooth crest on the lowermost cirque floor | Overprinted terminal moraine |

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| 8 | 860 | Klute (1911) | Sediment ridge at the entrance to the cirque extending up to the eastern headwall of the cirque | Terminal moraine |

Table S3: Ice-marginal positions in the Katzensteig cirque

| Ice-marginal position (this study) | Location of terminal moraines (m a.s.l.) | Original reference | Description | Interpretation or comment (this study) |
|---|---|---|---|---|
| 1 | 1040; 1080 | Schreiner (1977b) | W-E oriented, asymmetric sediment ridges | Terminal moraine |
| 2 | 1020; 1030 | Klute (1911) | SW-NE to W-E oriented, asymmetric sediment ridges; partly separated from the surrounding slope | Terminal moraine |
| 3 | 1020 | Klute (1911) | W-E oriented, asymmetric sediment ridges; partly separated from the surrounding slope | Terminal moraine |
| 4 | 900; 980; 1030 | Schreiner (1977b) | SW-NE and N-S oriented, asymmetric sediment ridges; separated from the surrounding slope | Terminal moraine |
| 5 | 890; 980; 1060 | Schreiner (1977b) | N-S and SW-NE oriented, asymmetric sediment ridges; not separated from the surrounding slope | Terminal moraine |
| 6 | 890; 1110 | - | Arc-shaped, asymmetric sediment ridge on the eastern headwall of the cirque and SW-NE oriented sediment ridge north of the entrance to the cirque | Terminal moraine |

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| 7 | 1110 | - | Arc-shaped, asymmetric sediment ridge on the eastern headwall of the cirque | Terminal moraine |

Table S4: Ice-marginal positions in Zastler Tal

| Ice-marginal position (this study) | Location of terminal moraines (m a.s.l.) | Original reference | Description | Interpretation or comment (this study) |
|---|---|---|---|---|
| 1 | 1400-1420 | - | Set of short sediment ridges on the uppermost cirque floor | Terminal moraine |
| | 1340-1360 | Zienert (1973) | Set of sediment ridges in the SE corner of the cirque | Terminal moraine |
| 2 | 1400-1430 | - | Arcuate sediment ridge at the NW margin of the uppermost cirque floor | Terminal moraine |
| | 1320-1340 | Zienert (1973) | Set of sediment ridges in the SE corner of the cirque | Terminal moraine |
| 3 | 1340-1350 | - | Sediment ridges with a SW-NE and a SE-NW orientation in the SE corner of the cirque | Terminal moraine |
| 4 | 1260 | Steinmann (1902) | Arcuate sediment ridge separated from the eastern headwall of the cirque by a depression; at the margin of the lowermost cirque floor | Terminal moraine |
| 5 | 1270 | Schreiner (1981) | Arcuate sediment ridge on the eastern headwall of the cirque | Terminal moraine |

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| 6 | 1200-1290 | Schreiner (1981) | Two SE-NE oriented sediment ridges on the eastern headwall of the cirque, a S-N oriented sediment ridge on the centre of the valley and a S-N oriented sediment ridge on the western headwall of the cirque | Terminal moraine |
| 7 | 1200 | Schreiner (1981) | S-N oriented sediment ridge on the eastern headwall of the cirque | Terminal moraine |
| 8 & 9 | 1030 | Steinmann (1902) | Two-crested, arcuate sediment ridge on the centre of the valley floor | Terminal moraine |
| 10 | 980 | - | Short sediment ridge on the centre of the valley floor | Terminal moraine |
| 11 | 970 | - | Short sediment ridge on the centre of the valley floor | Terminal moraine |
| 12 | 970 | - | SE-NE oriented sediment ridge on the western valley side | Terminal moraine |
| 13 | 980 | - | SE-NE oriented sediment ridge on the western valley side | Terminal moraine |
| - | 860 | Zienert (1973) | Ridge on the centre of the valley floor | Not identified in this study |
| 14 | 720 | - | Small sediment ridge on the centre of the valley floor | Terminal moraine |
| - | 720 | Steinmann (1910) | Prominent ridge oriented perpendicular to the valley floor | *Riegel* |
| 15 | 640 | Schreiner (1977a) | Arcuate sediment ridge on the valley floor | Terminal moraine |

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| | 940 | Schreiner (1977a) | Ridge-shaped accumulation of boulders parallel to the valley floor; on the southern valley side south of Schweizerhof | Terminal moraine |
| 16 | 620 | Zienert (1973) | Arcuate sediment ridge on the valley floor and both valley sides | Terminal moraine |
| | 770-780 | Hüttner (1967) | Ridge-shaped accumulation of boulders parallel to the valley floor; on the southern valley side between the entrance to Stollenbach and Angelsbach | Terminal moraine |
| 17 | 560 | Erb (1948) | Short sediment ridge on the southern and the northern valley side near Jockelehof | Terminal moraine |
| 18 | 550 | Erb (1948) | Short sediment ridge on the southern and the northern valley side near Jockelehof | Terminal moraine |

### Establishment of the digital surface model of the upper Katzensteig

Due to the presence of well-preserved terminal moraines, the rugged terrain and the lack of vegetation, an additional drone survey was conducted in the Katzensteig valley to derive a more precise digital surface model (DSM) based on structure-from motion photogrammetry (Westoby et al., 2012). 470 photos of the unforested area in the upper Katzensteig were obtained using a DJI Mavic quadrocopter equipped with a FC220 camera (12 megapixel). The internal GPS of the quadrocopter enabled the coordinates of the locations from which the photos were taken to be recorded. The photos were subsequently imported in Agisoft Photoscan. The photos were first aligned using the highest quality setting. The application of the 'dense point cloud' command resulted in the identification of c. 540,000,000 points, whereby the ultra-high-quality setting was chosen. A mesh was subsequently created from the dense point cloud using the 'height field' mode. Lastly, an orthomosaic and a DSM were derived from the mesh and dense point cloud, respectively. The orthophoto has a x- and y-cell size of 5.4 and 3.7 cm, respectively, whereas the DSM has a pixel size of 3.7 cm. Due to the sheltered location of Katzensteig, the total error of the georeferencing was 2.67 m. Due to this high error with respect to the pixel size of the DSM, the DSM and an existing DTM of the area were compared. Since the DSM and the DTM agreed well, the georeferencing error of the DSM was deemed acceptable. To correct the DSM for trees, trees were digitised in ArcMap. The resulting shapefile was then substracted from the DEM using the 'clip' tool. The application of the 'Elevation void fill function' enabled the substracted areas to be filled.

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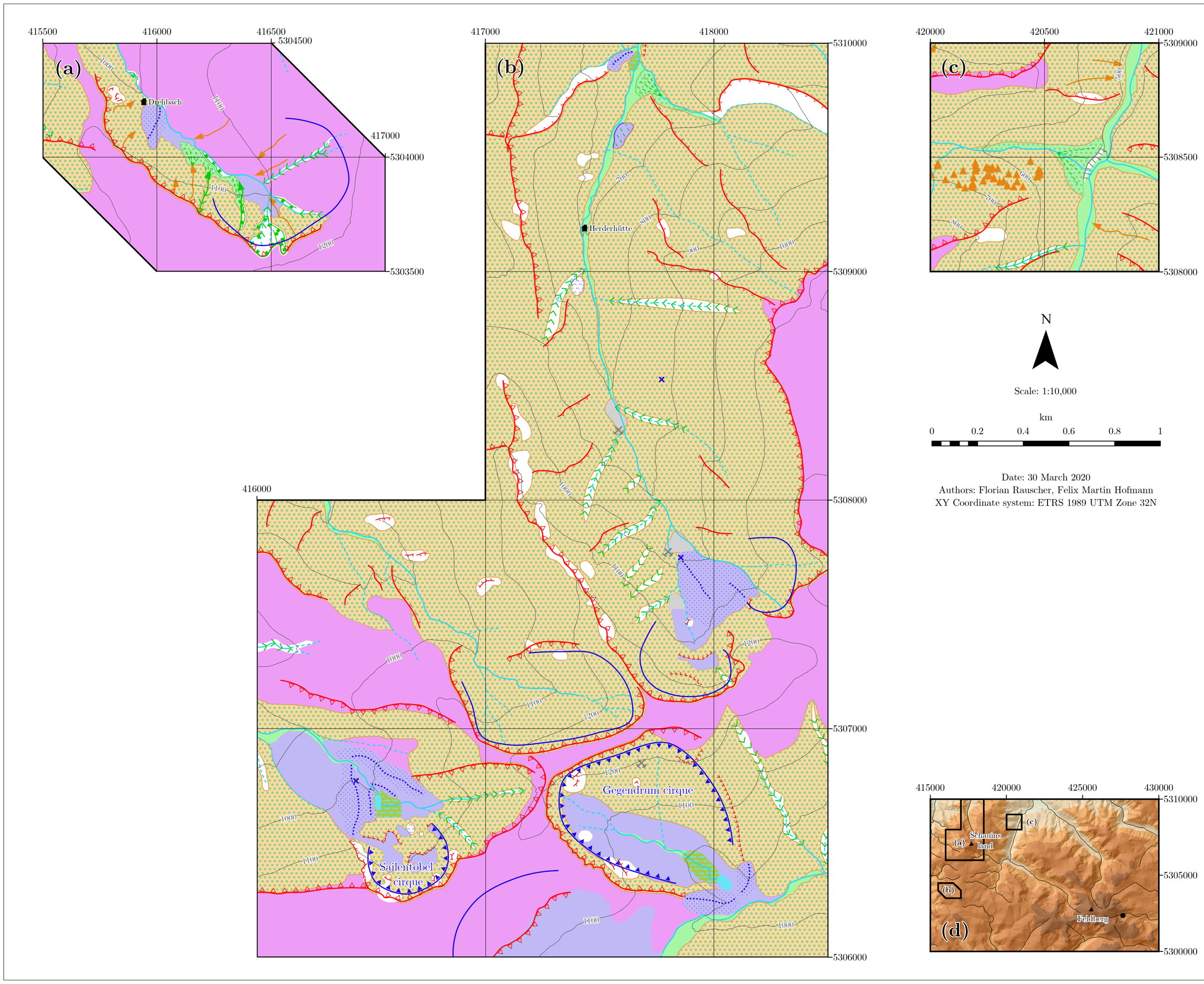


Figure S1. Geomorphological map of (a) Drehbach, (b) Kappeler Tal, the Sailendobel cirque and the Gegendrum cirque and of the entrance to (c) Hörnegrund. The legend of the geomorphological maps is given in Figure S4. The location of the mapped areas is shown in (d). The legend for (d) is given in Figure 2.

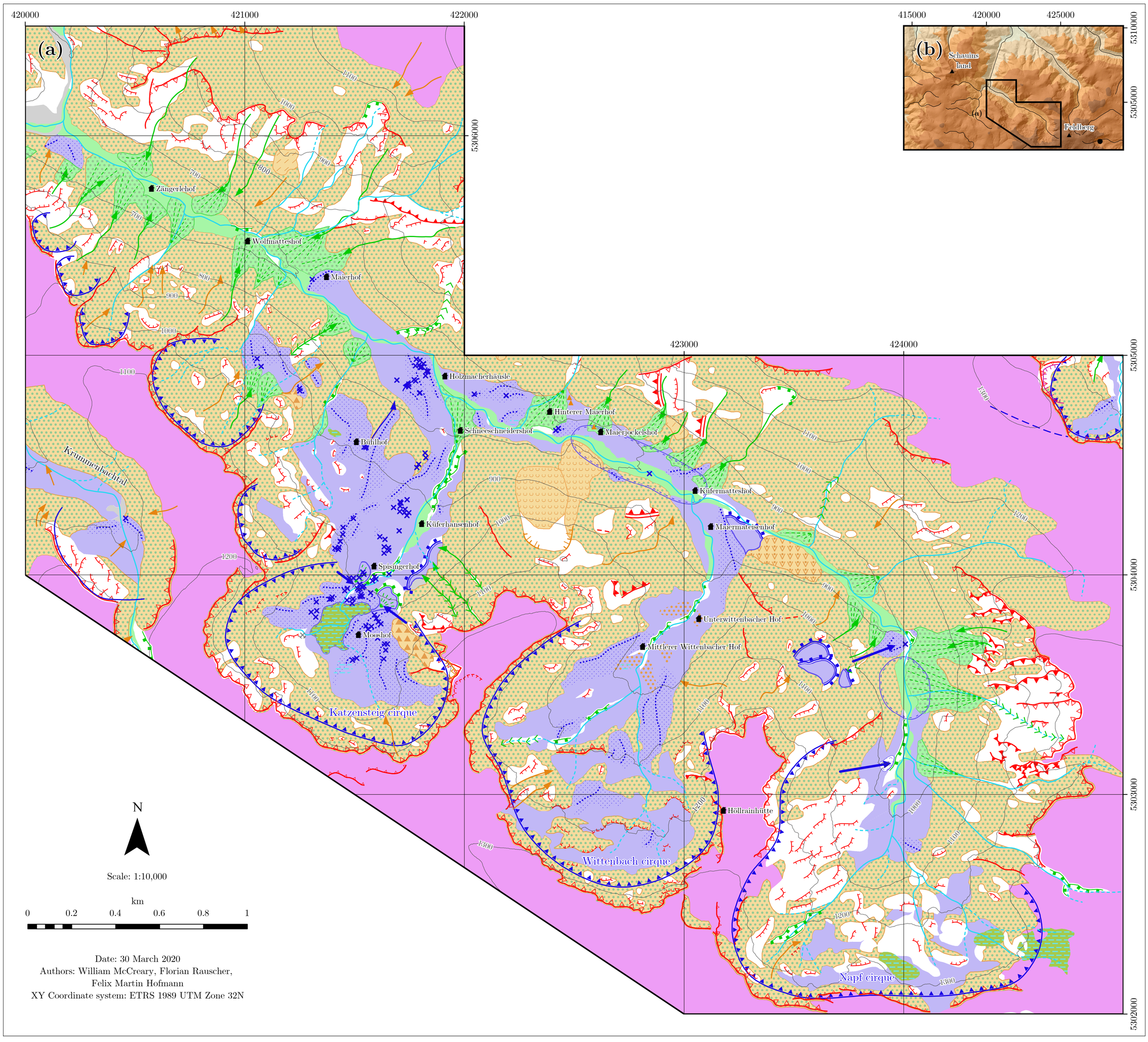


Fig. S2: Geomorphological map of (a) Sankt Wilhelmer Tal including the Katzensteig, Wittenbach and Napf cirques as well as of Krummenbachtal. The legend of the geomorphological maps is given in Figure S4. See (b) for the location of the mapped area. The legend for (b) is given in Figure 2.

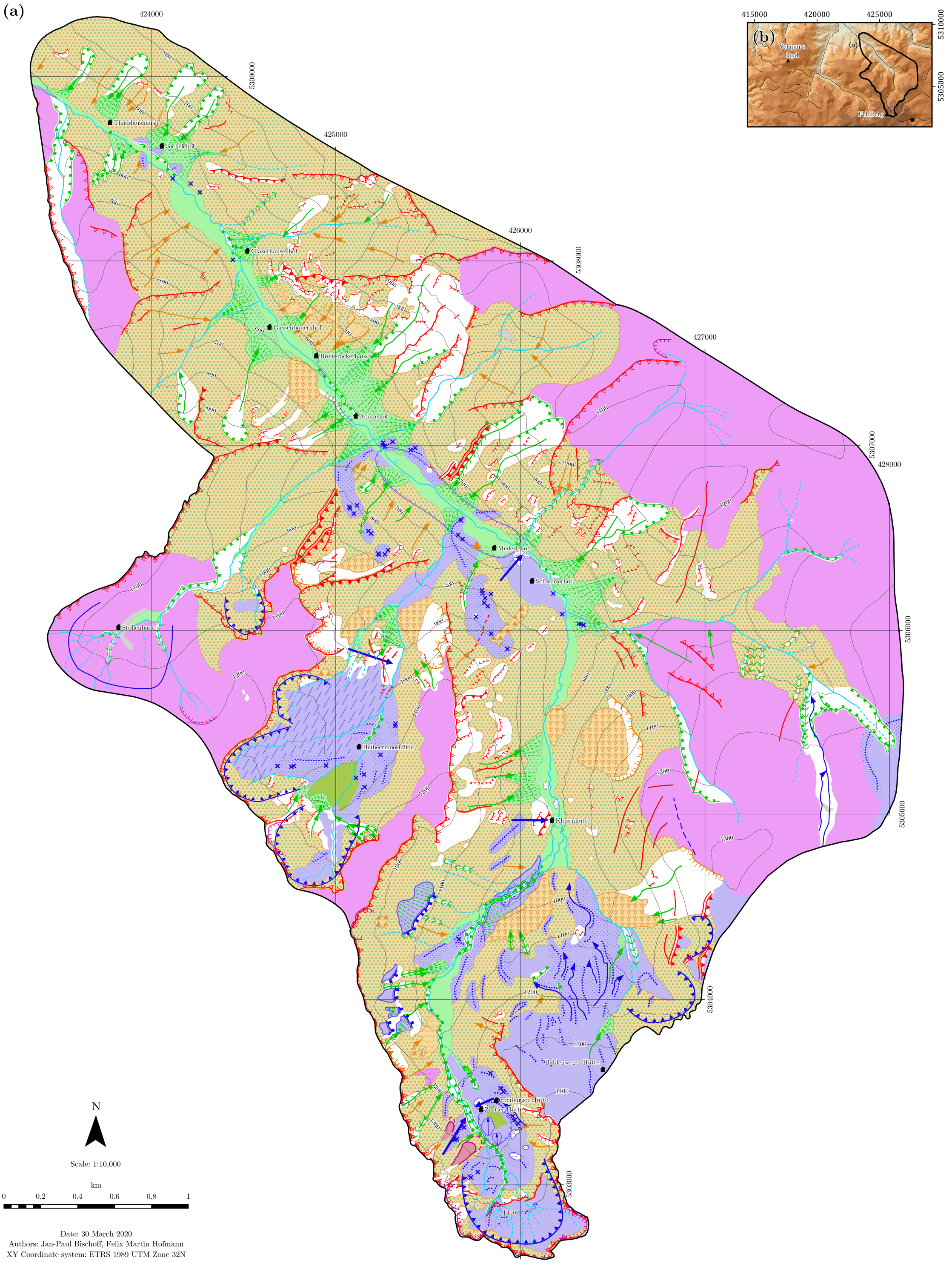


Fig. S3: Geomorphological map of (a) Zastler Tal and its tributary valleys. See (b) for the location of the mapped area. See Figure S4 for the legend of the geomorphological maps. The legend for (b) is given in Figure 2.

**Structural landforms**

- Covered scarp (5-20 m)
- Covered scarp
- Covered step
- Fault
- Fault escarpment
- Rock scarp
- Rock scarp(5-20 m)
- Rock step
- Supposed fault

**Hydrography**

- Intermittent stream
- Stream
- Marsh
- Lake

**Fluvial landforms**

- Alluvial fan (direction)
- Debris flow
- Erosion or terrace edge >5 m
- Glaciofluvial terrace (direction)
- Gully
- Fluvial accumulation area
- Vegetation-covered alluvial fan

**Gravitational landforms**

- Fallen boulder
- Debris channel
- Scar
- Screes lope/talus slope
- Rockfall deposit
- Landslide
- Rockslide with dislocation
- Vegetation-covered scree

**Glacial landforms**

- Errratic boulder
- Glacial cirque (poorly developed)
- Glacial cirque
- Kame terrace (edge)
- Glacial meltwater channel
- Moraine crest
- Riegel
- Trimline
- Drumlin
- Overprinted moraine
- Glacial basin
- Glacial deposition area/till plain
- Glaciofluvial deposition area
- Moraine
- Roches moutonnées
- Streamlined till plain

**Periglacial landforms**

- Periglacial deposition area (periglacial cover beds)
- Solifluction lobe

**Nival landforms**

- Avalanche deposit
- Avalanche impact zone
- Nivation hole
- Avalanche erosion zone
- Nival deposition area

**Other landforms**

- Mine
- Slope (backfilled or excavated)
- Anthropic deposition area
- Mire

**Other objects**

- Hamlet, farm or hut
- Contour line (m a.s.l.), interval: 100 m

Figure S4. Legend of the geomorphological maps of the Schauinsland area (Fig. S1), Sankt Wilhelmer Tal (Fig. S2) and of Zastler Tal (Fig. S3).