

UNIL legend for geomorphological mapping

Instructions for use in QGIS 3.40 and later

2025-10-01

1 History and principles of the legend¹

The geomorphological mapping legend of the University of Lausanne has been used for more than 30 years for detailed mapping especially in high and middle mountain regions. It is a morphogenetic mapping system built on the following principles:

- Colours represent process categories;
- Symbols have a genetic significance and are drawn in the colour of the related process;
- Morphodynamic differentiation of erosion and accumulation areas is achieved by white and coloured surfaces, respectively;
- Morphography, slope gradient and lithology are not represented.

The legend was initially developed for manual mapping in the field. It has since been adapted to ArcGIS and QGIS, and its symbology has been expanded to include aeolian, marine, lacustrine and anthropogenic processes.

2 QGIS implementation

In QGIS, the UNIL geomorphological legend is distributed directly inside a GeoPackage, as an independent style database, as QML files and as SLD files (Styled layer descriptor in XML).

The QGIS symbology is rule-based: each object has three attributes **FORM**, **PROCESS** and **ANGLE** used to define the symbology.

- **FORM**: drop-down menu. Always used, stores the name of the landform. Several options may correspond to the same symbology, but are proposed separately for clarity;
- **PROCESS**: drop-down menu. Only necessary to distinguish between two processes producing similar landforms, e.g. scars (gravitational erosion edges) and fluvial erosion edges. Can also be useful to extract statistics about the dominant processes in the study area;
- **ANGLE**: integer. Used to rotate directional symbols (points and polygons). Usually corresponds to the slope direction.

3 Load data structure and styles

Chose reference scale (bottom of the window) (1:5'000 or 1:10'000) and lock the scale.

Load **geomorpho_mapping.gpkg** (3 tables) in a group.

Styles are included in the geopackage and should load automatically. Check by opening layer *Properties* > *Symbology*. See the appendices of this document for the complete list of symbols and rules.

¹See Lambiel C., Maillard B., Martin S., Pellitero Ondicol R., Schoeneich P., Reynard E. (2013). Adaptation of the geomorphological mapping system of the University of Lausanne for ArcGIS. *8th International Conference on Geomorphology (IAG)*, Paris, 27-31 Aug. 2013.

4 Mapping

4.1 Setup

View / Toolbars: activate *Digitizing toolbar*, *Advanced digitizing tools* and *Snapping toolbar*.

Enable *Snapping* to avoid overlapping features.

Select the layers and toggle *Editing* on. Then select the layer where you want to create a feature and start mapping.

If you are not familiar with editing with QGIS, first have a look at the manual: https://docs.qgis.org/2.18/en/docs/user_manual/working_with_vector/editing_geometry_attributes.html

Note: Some lines and polygons are *directional*, i.e. they must be drawn in a particular direction to represent the feature correctly (e.g. terrace edges and scarps). If you have drawn the line the wrong way around, you can simply flip it by selecting *Reverse line* in the *Advanced digitizing toolbar* and clicking on the object.

4.2 Attribute form

A form opens upon completion of an object. You can directly fill in all the attributes, or only **FORM** by selecting the appropriate name in the dropdown menu. If you are mapping several of the same landforms, you can also digitize a series of forms without using the form (leave all blank) and then use the *Field calculator* to populate the attributes all at once.

For directional symbols that cannot be determined by drawing direction (such as landslides, ploughed ground, or solifluction), the azimuth of the displacement must be provided in the **ANGLE** attribute. You can manually change a symbol's orientation by editing the **ANGLE** field in the attribute table.

Some symbols depend not only on the **FORM** attribute, but also on **PROCESS** to differentiate between similar landforms originating from different morphogenetic processes. Please refer to the symbology rules in the appendix to find which symbols require supplying **PROCESS**. In these cases, select the corresponding process domain from the dropdown menu.

Note: As the dropdown menu for the **FORM** attribute cannot be filtered or searched, landforms are alphabetically sorted by the most relevant term, i.e. "ephemeral lake" is registered as "lake, ephemeral", but "kettle lake" is registered as is.

5 Export map

First, in the layer list, uncheck all layers that you do not want to show on your map.

Secondly, for readability, your map has to include topographic information. You can use e.g.:

- a mix of hillshade and vector layers for hydrography, main summits, buildings and roads;
- a black and white map in the background.

In both cases, you have to adapt the transparency of your geomorphological map layers to make the base layer visible. Create your layout with *Project / New print layout*.

6 Appendices

Appendix I: Symbology

Line features

Note: Indicated attribute values are those that appear in the dropdown menu interface. For the internal values assigned to these terms in the symbology rules, refer to the Attribute Form section of the layer properties.

Symbol	Legend label	Dropdown menu value(s)
	fault	FORM = 'fault'
	supposed fault	FORM = 'fault, supposed'
	rock scarp (> 20 m)	FORM = 'rock scarp, large'
	rock scarp (5 - 20 m)	FORM = 'rock scarp, small'
	covered scarp (> 20 m)	FORM = 'covered scarp, large'
	covered scarp (5 - 20 m)	FORM = 'covered scarp, small'
	rock step (< 5 m)	FORM = 'rock step'
	covered rock step (< 5 m)	FORM = 'rock step, covered'
	fault escarpment	FORM = 'fault escarpment'
	stream	FORM = 'stream'
	intermittent stream	FORM = 'stream, intermittent'
	crevasse, serac	FORM = 'crevasse' OR FORM = 'serac'
	ice fall	FORM = 'ice fall'
	rimaye	FORM = 'rimaye'
	gorge	FORM = 'gorge'
	fluvial erosion edge (< 5 m)	FORM = 'edge/scar' AND PROCESS = 'fluvial'
	fluvial erosion edge (> 5 m)	FORM = 'edge/scar, large' AND PROCESS = 'fluvial'
	fluvial terrace edge	FORM = 'terrace' AND PROCESS = 'fluvial'
	debris flow channel	FORM = 'channel' AND PROCESS = 'fluvial'
	paleochannel	FORM = 'paleochannel'
	alluvial fan direction	FORM = 'direction, alluvial fan'
	gully	FORM = 'gully'
	scar	FORM = 'edge/scar' AND PROCESS = 'gravitational'
	debris channel	FORM = 'channel' AND PROCESS = 'gravitational'
	glacial corrie, glacial edge	FORM = 'edge/scar' AND PROCESS = 'glacial'
	trimline	FORM = 'trimline'
	rock sill	FORM = 'rock sill'
	striae direction	FORM = 'direction, striae'
	moraine crest (main)	FORM = 'moraine crest, main'
	moraine crest (secondary)	FORM = 'moraine crest, secondary'
	kame terrace	FORM = 'terrace' AND PROCESS = 'glacial'
	esker	FORM = 'esker'
	Nye channel	FORM = 'Nye channel'
	rock glacier front	FORM = 'rock glacier front'
	gelifluction deposit	FORM = 'gelifluction'

	nivation hole	FORM = 'edge/scar' AND PROCESS = 'nival'
	avalanche deposit	FORM = 'avalanche deposit'
	avalanche impact zone	FORM = 'avalanche impact zone'
	snow moraine	FORM = 'snow moraine'
	bedrock step	FORM = 'edge/scar' AND PROCESS = 'karstic'
	underground channel	FORM = 'underground channel, certain'
	possible underground channel	FORM = 'underground channel, possible'
	lacustrine terrace	FORM = 'terrace' AND PROCESS = 'lacustrine'
	marine terrace	FORM = 'terrace' AND PROCESS = 'marine'
	relict lacustrine terrace	FORM = 'terrace, relict' AND PROCESS = 'lacustrine'
	relict marine terrace	FORM = 'terrace, relict' AND PROCESS = 'marine'
	cliff	FORM = 'cliff'
	dead cliff	FORM = 'dead cliff'
	coastal bench	FORM = 'coastal bench'
	berm	FORM = 'berm'
	longshore drift	FORM = 'direction, longshore drift'
	tidal channel	FORM = 'channel' AND PROCESS = 'marine'
	delta direction	FORM = 'direction, delta'
	perched delta front	FORM = 'perched delta front'
	dune crest	FORM = 'dune crest'
	wind direction	FORM = 'direction, wind'
	slope (backfilled or excavated)	FORM = 'edge/scar' AND PROCESS = 'anthropic'
	anthropic ridge	FORM = 'ridge, anthropic'
	agricultural terrace	FORM = 'terrace' AND PROCESS = 'anthropic'
	drainage	FORM = 'drainage'
	concrete dyke	FORM = 'dyke, concrete'
	stone dyke	FORM = 'dyke, stone'
	earth dyke	FORM = 'dyke, earth'
	weir	FORM = 'weir'
	irrigation channel	FORM = 'irrigation channel'
	abandoned irrigation channel	FORM = 'irrigation channel, relict'
	drainage channel	FORM = 'drainage channel'
	abandoned drainage channel	FORM = 'drainage channel, relict'
	undefined	FORM = NULL

Point features

Note: Indicated attribute values are those that appear in the dropdown menu interface. For the internal values assigned to these terms in the Value Map, refer to the Attribute Form section of the layer properties.

Symbol	Legend label	Dropdown menu value(s)
	dipslope	FORM = 'fault'
	witness butte direction	FORM = 'witness butte direction'
	source	FORM = 'source'
	waterfall	FORM = 'waterfall'
	fallen block	FORM = 'fallen block'
	erratic boulder	FORM = 'erratic boulder'
	thermokarst	FORM = 'thermokarst'
		
	ploughed ground	FORM = 'ploughed ground'
	pinacle, monolith	FORM = 'pinacle' OR 'monolith'
	cave, hole	FORM = 'cave' OR 'hole, karstic'
		
	karst spring	FORM = 'karst spring'
		
	sinkhole	FORM = 'sinkhole'
		
	ponor	FORM = 'ponor'
	doline	FORM = 'doline'
	nebkha	FORM = 'nebkha'
	micro-nebkha	FORM = 'micro-nebkha'
	mine	FORM = 'mine'
	foggara, khattara, qanat	FORM = 'foggara' OR 'khattara' OR 'qanat'
	avalanche defence	FORM = 'avalanche defence'
	undefined	FORM = NULL

Polygon features

Note: Indicated attribute values are those that appear in the dropdown menu interface. For the internal values assigned to these terms, refer to the Attribute Form section of the layer properties.

Symbol	Legend label	Dropdown menu value(s)
	witness butte	FORM = 'witness butte'
	outlier	FORM = 'outlier'
	lake	FORM = 'lake'
	ephemeral lake	FORM = 'lake, ephemeral'
	marsh	FORM = 'marsh'
	glacier	FORM = 'glacier'
	debris-covered glacier	FORM = 'glacier, debris-covered'
	permanent snow patch	FORM = 'permanent snow patch'
	sabkha	FORM = 'sabkha'
	alluvial fan	FORM = 'alluvial fan'
	pediment	FORM = 'pediment'
	fluvial accumulation area	FORM = 'accumulation' AND PROCESS = 'fluvial'
	rockslide	FORM = 'rockslide'
	rockslide with dislocation	FORM = 'rockslide with dislocation'
	landslide	FORM = 'landslide'
	translational landslide	FORM = 'landslide, translational'
	shallow landslide	FORM = 'landslide, shallow'
	talus slope	FORM = 'talus slope'
	vegetated talus slope	FORM = 'talus slope, vegetated'
	rockfall deposit	FORM = 'deposit, rockfall'
	colluvium	FORM = 'colluvium'
	gravitational accumulation area	FORM = 'accumulation' AND PROCESS = 'gravitational'
	glacial basin	FORM = 'glacial basin'
	roches moutonnées	FORM = 'roches moutonnées'
	drumlin	FORM = 'drumlin'
	moraine	FORM = 'moraine'
	deplaced moraine	FORM = 'moraine, deplaced'
	hummocky moraine	FORM = 'moraine, hummocky'
	fluvio-glacial deposit	FORM = 'accumulation' AND PROCESS = 'fluvio-glacial'

	till	FORM = 'accumulation' AND PROCESS = 'glacial'
	rockfall deposit on glacier	FORM = 'deposit, rockfall on glacier'
	rock glacier	FORM = 'rock glacier'
	relict rock glacier	FORM = 'rock glacier, relict'
	push moraine	FORM = 'push moraine'
	rock glacier	FORM = 'solifluction lobe'
	creeping scree	FORM = 'creeping scree'
	small terrace	FORM = 'small terrace'
	patterned ground	FORM = 'ground, patterned'
	sorted ground	FORM = 'ground, sorted'
	paced ground	FORM = 'ground, paved'
	gelifraction deposits	FORM = 'deposit, gelifraction'
	thermokarst	FORM = 'thermokarst'
	thufurs	FORM = 'thufurs'
	kettle lake	FORM = 'kettle lake'
	periglacial accumulation area	FORM = 'accumulation' AND PROCESS = 'periglacial'
	avalanche deposit area	FORM = 'avalanche deposit area'
	avalanche erosion area	FORM = 'avalanche erosion area'
	avalanche impact zone	FORM = 'avalanche impact zone'
	exposed solution channels	FORM = 'solution channels, exposed'
	buried solution channels	FORM = 'solution channels, buried'
	gelifracted solution channels	FORM = 'solution channels, gelifracted'
	eroded solution channels	FORM = 'solution channels, eroded'
	gypsum karst	FORM = 'gypsum karst'
	ouvala	FORM = 'ouvala'
	closed basin	FORM = 'closed basin'
	karstic accumulation area	FORM = 'accumulation' AND PROCESS = 'karstic'
	sandy beach	FORM = 'beach, sandy'
	cobble beach	FORM = 'beach, cobble'

	tidal flat	FORM = 'tidal flat'
	salt marsh	FORM = 'salt marsh'
	delta	FORM = 'delta'
	lacustrine/marine accumulation area	FORM = 'accumulation' AND PROCESS = 'lacustrine' OR 'marine'
	dune construction	FORM = 'dune construction'
	vegetated dune construction	FORM = 'dune construction, vegetated'
	nebkha field	FORM = 'nebkha field'
	micro-nebkha field	FORM = 'micro-nebkha field'
	reg	FORM = 'reg'
	tafoni	FORM = 'tafoni'
	mushroom rock	FORM = 'mushroom rock'
	deflation basin	FORM = 'deflation basin'
	yardang	FORM = 'yardang'
	aeolian accumulation area	FORM = 'accumulation' AND PROCESS = 'aeolian'
	vegetated aeolian accumulation area	FORM = 'accumulation, vegetated' AND PROCESS = 'aeolian'
	active quarry	FORM = 'quarry'
	abandoned quarry	FORM = 'quarry, abandoned'
	dump	FORM = 'dump'
	embankment	FORM = 'embankment'
	ditch, trench	FORM = 'ditch' OR 'trench'
	ski run	FORM = 'ski run'
	anthropic accumulation area	FORM = 'accumulation' AND PROCESS = 'anthropic'
	anthropic hill	FORM = 'anthropic hill'
	agricultural terrace	FORM = 'agricultural terrace'
	soil on bedrock	FORM = 'soil on bedrock'
	organogeneious accumulation area	FORM = 'accumulation' AND PROCESS = 'organic'
	undefined	FORM = NULL

Appendix II: Additional information for symbology development

II.1: Codes for PROCESS field

AEO	aeolian
ANT	anthropic
FGL	fluvio-glacial
FLU	fluvial
GLA	glacial
GRA	gravitative
HYD	hydrography
KAR	karstic
LAC	lacustrine
NIV	nival
ORG	organic
PGL	periglacial
STR	structural

II.2: Colour codes

Landform type	CMYK colour				HTML colour	RGB colour			Use case
Structural	0	100	100	0	#ff0000	255	0	0	All
Hydrography	80	10	00	05	#30daf2	48	218	242	Lines, points, borders
	40	00	00	00	#99ffff	153	255	255	Surfaces (except glaciers)
	15	00	00	00	#d9ffff	217	255	255	Glaciers
Fluvial	100	0	100	20	#00cc00	0	204	0	Lines, points, borders
	55	00	55	15	#62d962	98	217	98	Surfaces
Gravitative	10	50	100	5	#da7900	218	121	0	Lines, points, borders
	0	15	50	5	#f2ce79	242	206	121	Surfaces
Glacial	80	100	0	10	#2e00e6	46	0	230	Lines, points, borders
	30	35	0	5	#aa9df2	170	157	242	Surfaces
Periglacial	10	100	0	10	#cf00e6	207	0	230	Lines, points, borders
	5	50	0	5	#e679f2	230	121	242	Surfaces
Nival	10	100	80	10	#cf002e	207	0	46	Lines, points, borders
	10	50	40	10	#cf738a	207	115	138	Surfaces
Karstic	100	0	40	0	#00ff99	0	255	153	Lines, points, borders
	0	60	100	0	#ff6600	255	102	0	Underground structures
	60	0	25	0	#66ffbf	102	255	191	Surfaces (except below)
	5	50	0	5	#e679f2	230	121	242	Gelifracted solution channels
	0	0	45	10	#e6e67e	230	230	126	Covered solution channels
Lacustrine/marine	100	40	0	40	#005c99	0	92	153	Lines, points, borders
	50	20	0	30	#598fb3	89	143	179	Surfaces
Anthropic	0	0	0	50	#808080	128	128	128	Lines, points, borders
	0	0	0	25	#bfbfbf	191	191	191	Surfaces
Aeolian	0	11	79	0	#ffe336	255	227	54	Lines, points, borders
	0	0	25	0	#ffffbf	255	255	191	Surfaces
Organic	0	0	40	10	#e6e68a	230	230	138	Soil on bedrock
	50	30	100	0	#80b300	128	179	0	Organogenous accumulation