Tracking geological time and geological map

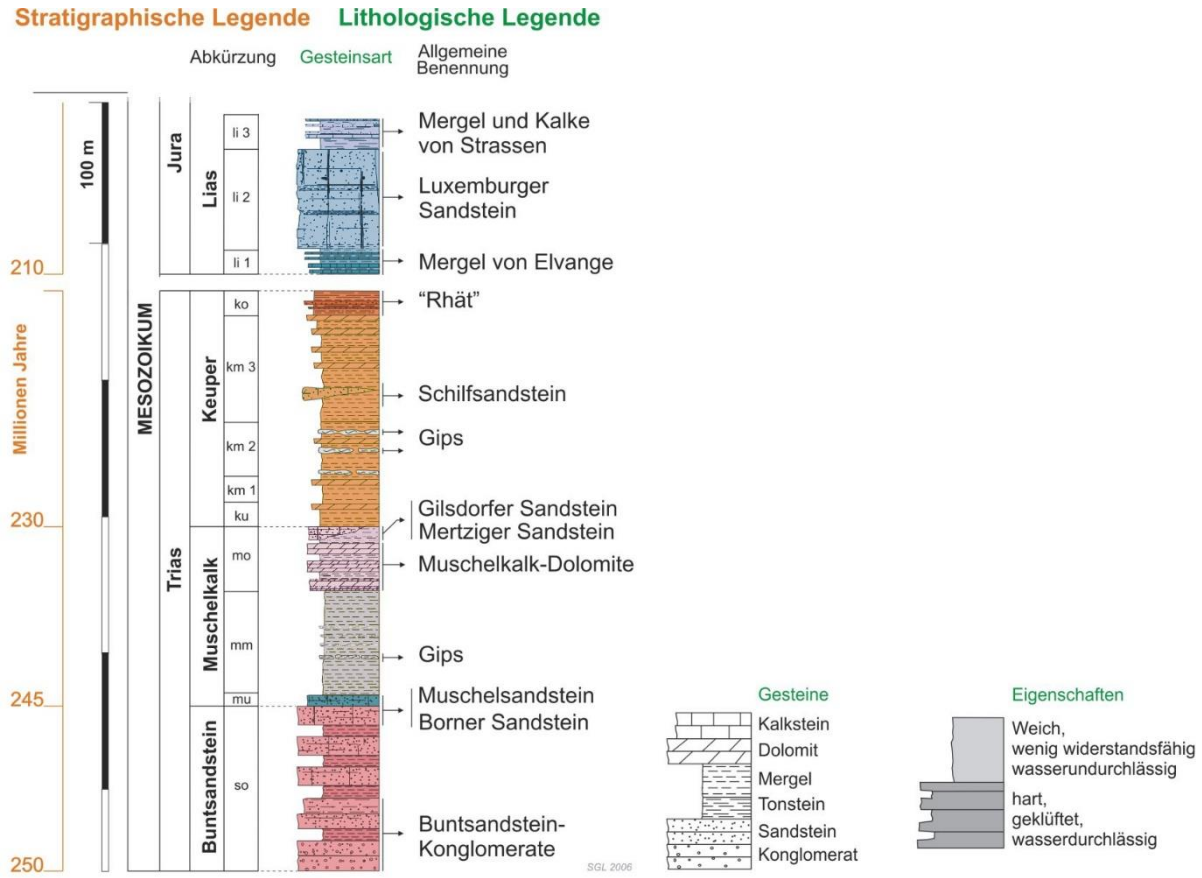
Geological time, which spans over millions of years, is rather difficult to grasp intuitively. The "pulse" of geological processes is very slow, and many processes simply take a huge amount of time. As an illustrative example, if one compares the thin (but annoying!) layer of limescale in a coffee machine to a limestone deposit, which can easily be several tens of meters thick, one can get a feel for the timeframe of geological processes. (The comparison is not entirely adequate because seawater is not boiling and therefore evaporates much slower. The formation of limestone is therefore even slower than suggested, but that is not a problem because we have millions of years at our disposal).

Just as naming days or months helps us to keep track of time, names (and their abbreviations) are used to describe the order of geological layers and their corresponding time periods. The boundaries between geological periods are set to coincide with stark changes in rock type, for example from a marl to a sandstone. Every set of geological layers that differs markedly from the layers beneath and above them is defined as a different geological period. Geological periods are named from the bottom upwards, because – just as in a pile of books – the older layers (books) are laid down first. This also leaves space for the layers that will be deposited in the future…

A change in geological layers: Marl (bottom) to sandstone (top) at an excavation at a construction site within the Natur- & UNESCO Global Geopark (Photo: SGL).

The following diagram shows the usual sequence of geological layers in in the Natur- & UNESCO Global Geopark. It is only a subset of the geological layers found throughout Luxembourg. Depicted are:

- the age of the rocks (the geological period in which the layer was deposited) in millions of years,
- the thickness of a given layer in meters,
- the kind of rock and
- the properties of the rock.



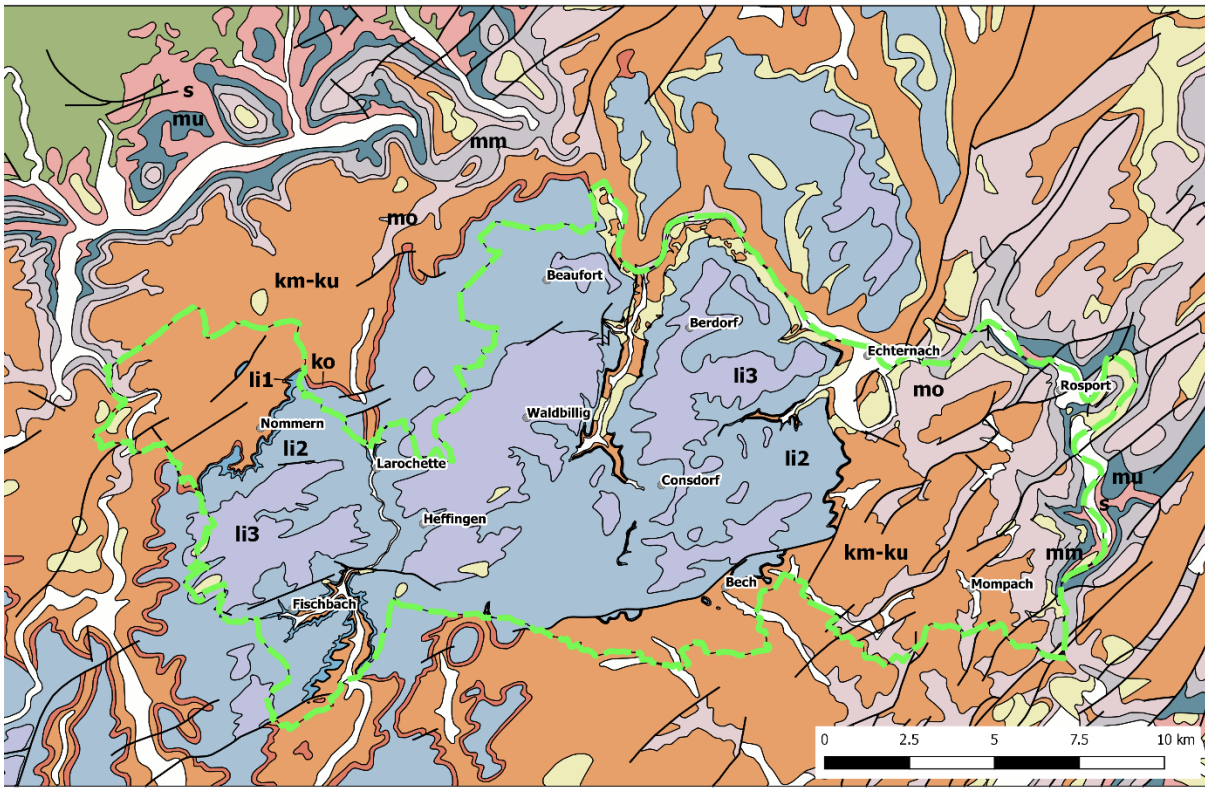
The legend to the geological map (see below) , (copyright: Service Géologique de l'Etat). Attention: The "Gilsdorfer sandstone" is not found within the region but more to the northwest.

Geological map

The rocks exposed throughout the Mëllerdall Natur- & UNESCO Global Geopark all originated during the Mesozoic, the second-to-last era of Earth's geological history. Within the Mesozoic, the geological periods that are the most relevant to the deposits found in this region are the Triassic and the Jurassic. The Triassic is further divided into the "Buntsandstein", "Muschelkalk", and "Keuper", and the Jurassic is divided into the "Liassic", "Dogger", and "Malm" (in this region, only rocks from the Liassic are found). More ancient rocks from the Paleozoic lie beneath the Mesozoic layers, but they do not pierce the surface anywhere within the Mëllerdall region. They can be found though in the north of Luxembourg in Ösling as deposits of slate, quartzite, and sandstone. Within the Natur- & UNESCO Global Geopark these rocks lie hidden beneath Mesozoic rocks. The youngest rock deposits within the region date from the Cenozoic. These are, for example, sediments recently deposited by rivers and streams. They are still loose and are therefore termed loose rocks.

Every geological layer on a geological map is assigned an internationally standardised colour based on its age. Wherever a geological map shows a certain colour, a rock of that age lies at

the surface. Consequently, geological maps only contain information about the age of a rock deposit. However, within the confines of the relatively small Natur- & UNESCO Global Geopark pretty much the same rocks were deposited at the same time, so that one can read off the kind of rock from the colours on the map fairly confidently.



Geological map of the Natur- & UNESCO Global Geopark (copyright Service Géologique de l'Etat, www.geologie.lu). (bright yellow and white patches: largely quarternary deposits, dashed green line: Mëllerdall Natur- & UNESCO Global Geopark)

The oldest layers of rock found within the Mëllerdall region date from a geological period known as “Buntsandstein” (which corresponds roughly to the Lower Triassic), abbreviated “so”. These deposits consist mainly of colourful (red!) sandstones, therefore the name (bunt is German for colourful). These are found only in the east of the UNESCO Global Geopark, in the valley of the river Sauer. The layers that lie on top of the Buntsandstein, the "Muschelkalk” (roughly the Middle Triassic), are named for another region. Within the Natur- & Geopark, the deposits from this age do not contain limestone (“Kalk”), nor many shells (“Muscheln”), though in some locations many sea lily stalks can be found. Instead, sandstone (mu), marl with gypsum (mm), and dolomite (mo) were deposited here in that order. On top lie mainly marly sediments dating from the Keuper (ku-km, roughly the Upper Triassic), which ends with sandstone and clay stone deposits (ko). Subsequent Jurassic deposits are limited to sediments from the lower Liassic (li, roughly the Lower Jurassic). These are located in the central part of the Natur- & UNESCO Global Geopark, and form a

layer of “Luxembourg Sandstone” (li2), wedged between layers of limestone/clay stone (“marls of Elvange” (li1), “marls and limestones of Strassen” (li3)).

The layers in the Natur- & UNESCO Global Geopark Mëllerdall were deposited in a large extended depression akin to a trough. This “Weilbach syncline” extends from the “Born anticline” in the southeast to the Ösling in the northwest. Because the deposition of the layers followed the shape of the trough, the same layer is found higher up at the edges of the trough than in its centre. In addition, the sediment layers have shifted vertically relative to one another at deep cracks, also known as faults. The result is that rocks of different ages lie at the same height. The youngest rocks can be found in the centre of the trough. The rocks found at the surface become older the further one proceeds away from the centre. These layers disappear beneath progressively younger sediments towards the southwest, in the direction of the “Paris Basin”, which also once was an ocean basin.

On the idealised cross section through the Mëllerdall region the trough-like depression in the geological layers is clearly visible. One can also see the vertical faults that cut through all layers. Also depicted are joints, vertical cracks within a given layer that do not run quite as deep.

This geological cross section through the region was built as part of the LEADER-project “Mensch & Stein” (“Humans & Rocks”) in the municipalities of Beaufort and Mompach (since 2017 Rosport-Mompach). Every layer consists of stone blocks sourced from the geological layer it represents.

Fossils

Fossils can also be very useful in dating sedimentary rocks. Throughout earth’s geological history, ecological conditions changed from one period to the next, favouring different groups of organisms at different times.

Within the Natur- & UNESCO Global Geopark, fossils can only be found in some layers, which are largely difficult to access. Very common is the fossil oyster *Gryphaea arcuata*, colloquially named “devil’s claw”. It can be found in considerable numbers in the “marls and limestones of Strassen” (li3) on parts of the plateaus in the middle of the region. Because rain flushes them off the plateaus into streams, it can also be found within all streams that originate from plateaus covered with the “marls and limestones of Strassen”.

A specimen of the fossil oyster Gryphaea arcuata, *sourced from the li3 layers.*

Many specimens of the "devil's claw" can be found at the Schiessentümpel, among the gravel of the Black Ernz.

Collecting fossils is prohibited within the entire region of the Natur- & UNESCO Global Geopark Mëllerdall!

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