Contents

ZOOM IN ON...

On the trail of the African Matterhorn

Alpine landscapes engender awe-inspiring experiences, tell stories and reveal extraordinary realities.

The African Matterhorn: An Outstanding Geological Story by Michel Marthaler offers a fresh look at the Alps.

An enduring passion for the Alps has inspired a collection of geo-guides which, depending on your expectations, either follows up or introduces the mother ship: *The African Matterhorn*.

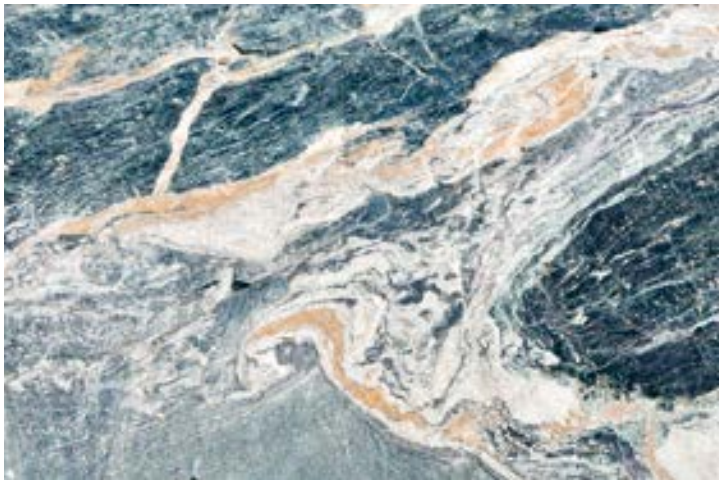
For those unversed in Earth sciences, these guided walks give unmediated access to geological insights, an approach similar to linking historical periods with monuments when visiting a beautiful city. Just as archaeologists ascribe historical periods such as the Iron Age, Ancient Greece, etc. to artifact, geologists attribute a rock formation age or, more generally, a geological period – Triassic, Jurassic, etc. – to a class of rocks (pages 14-15). The colours used in landscapes, maps and sketches each represent a group of rocks belonging to a specific geological period. Futhermore, as constant Earth crust movements shift rocks, these colours help ascertain their ancient geographical origins.

Alpine formation involves three broad palaeogeographic* spheres: two continents and an ocean colliding in a gigantic pile-up. The colours thereby help identify these three main actors of the geological Alpine narrative. As the colour code adopted in these geo-guides corresponds to the colour code in *The African Matterhorn*, those familiar with the book can have a shot at putting theory into practice on these geological hikes.

This collection provides a new key to deciphering geological landscapes. Although specialists may find it schematic, it provides easy access for anyone interested in the story rocks tell. The didactic approach presented in the introduction to this geo-guide (pp. 10-15), builds on the general idea that the Alps, like many other mountain ranges, went through three successive processes (three stories). Story 1 happens mainly on sea beds through a process of sedimentation, with marine deposits accumulating in successive layers (or strata) of rocks. Story 2 takes place several kilometres underground, where the combined pressure and heat of Earth crust movement warp and fold rocks. Finally, in Story 3, various erosion processes at play slowly shape subsurface rocks to form extant landscapes and over time reduce or even obliterate landforms.

This geo-guide can also be read like a travelogue, taking you on a journey from the comfort of your own home. Aimed at both informed enthusiasts and complete novices keen on unlocking the secrets of the Alps, these geo-guides offer a fresh perception of the world, expanding time and space in the span of a stroll. And, who knows, perhaps far beyond.

Nicolas Kramar, Director of the Musée de la nature du Valais



▲ The magic of rocks folding deep underground.

Itineraries

Access
The journey begins with the train from Visp to Zermatt, followed by the cable car to Trockener Steg via Furi and Schwarzsee.

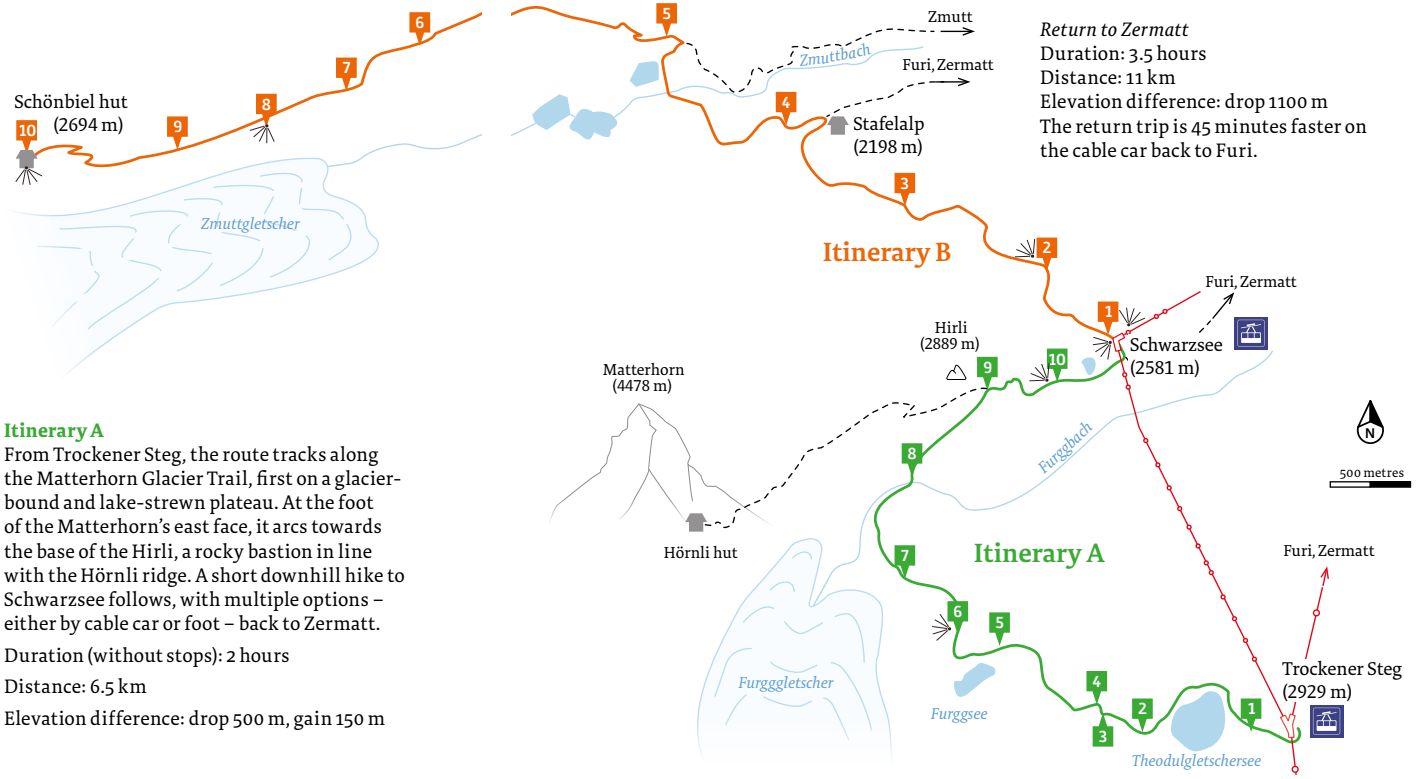
If coming by car, you must park in Täsch. Vehicles are not permitted any further.

Best hiking season
Both itineraries are accessible all year round thanks to the cable car (gondola), but high altitude environments make for snowbound routes most of the year. We recommend waiting until early July, or even late summer, to avoid the busy holiday season. Weather permitting, you can hike the trails until late October. For overnight accommodation and catering services, check the Schönbiel hut caretaker schedules.

Hiking trails
This geo-guide proposes two itineraries that tailgate. You may hike them back to back or on separate occasions. The first route takes you inside a large glacial corrie at the base of the Matterhorn's east face. The second meets the Zmutt valley at the base of the north face, before tracking up to the Schönbiel plateau for a magnificent view. Deviating only marginally on rare occasions, both itineraries travel along signposted hiking paths. Their level of difficulty corresponds to a mountain hiking trail (marked white-red-white, level T2).

Itinerary A, from Trockener Steg to Schwarzsee, takes about half a day to complete, geology included.

Itinerary B, from Schwarzsee to the Schönbiel hut, calls for a 'long' half-day climb, excluding the return trip to Zermatt. We recommend staying overnight at the hut to savour the beautiful Matterhorn 'sunset'.



Itinerary A

From Trockener Steg, the route tracks along the Matterhorn Glacier Trail, first on a glacier-bound and lake-strewn plateau. At the foot of the Matterhorn's east face, it arcs towards the base of the Hirli, a rocky bastion in line with the Hörnli ridge. A short downhill hike to Schwarzsee follows, with multiple options – either by cable car or foot – back to Zermatt.

Duration (without stops): 2 hours

Distance: 6.5 km

Elevation difference: drop 500 m, gain 150 m

Itinerary B

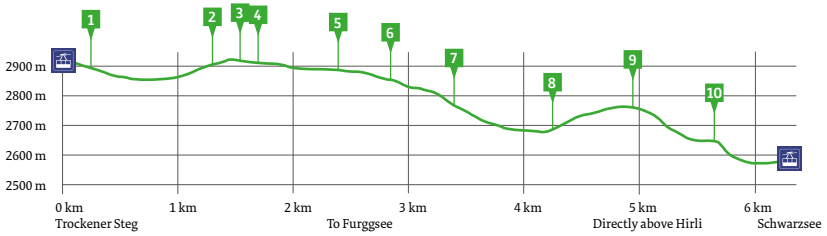
From Schwarzsee, the path heads downhill through meadows to the Stafelalp restaurant. It then crosses the Zmutt valley in a lightly wooded zone from where various Grande Dixence operational facilities are visible. On the far side of the valley, the path levels up with the Zmuttgletscher, tracking alongside its lateral moraine. After a final climb with a few hairpin bends, you arrive at the Schönbiel hut.

For multiple return options to Zermatt, backtrack down to Stop 4 near Stafelalp, where the simplest choice entails hiking along the right bank of the valley down to Furi.

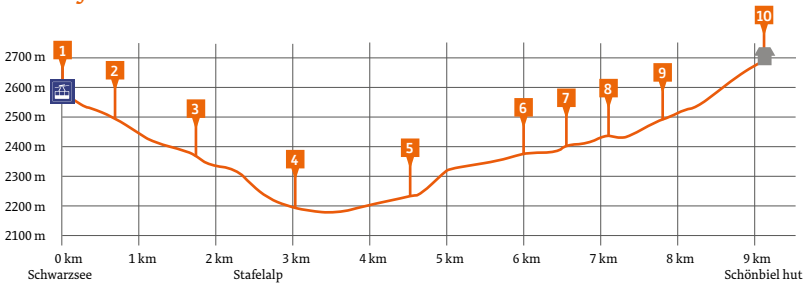
Outbound
Duration (without stops): 3 hours
Distance: 9 km
Elevation difference: drop 450 m, gain 550 m

Return to Zermatt
Duration: 3.5 hours
Distance: 11 km
Elevation difference: drop 1100 m
The return trip is 45 minutes faster on the cable car back to Furi.

Itinerary A



Itinerary B



The Matterhorn unfolded its ridges, framing its petrified batwings in the window. Its inky mass filled the sky. Only the summit was lit up by a hood of light.

Sylvain Tesson,
S'abandonner à vivre

◀ How could we possibly imagine tales as incredible as continental drift crafting this pastoral landscape? How could these large boulders clad in grass and shrubs emerge from an ocean? How could rocks of the skybound Matterhorn come from Africa?

All mountain rocks are immigrants

The mountain rocks and stones skirting the paths are not indigenous to where they are currently found. They always originate in another place, time, and environment. Greek philosophers already sensed this surprising truth. Eighteenth century scholars later classified rocks into two main groups based on origin. The Neptunists (late 18th century) believed that the stratified rocks of islands and mountains were engendered under the sea because they contained marine fossils. The Plutonists (rival theorists) claimed that volcanic rocks, including granite, were forged within the bowels of the Earth, in the kingdom of Pluto. They were all spot on.

Our good old planet is endowed with a prodigious memory, archived in its landscapes and rocks. If we listen properly, we can hear them invoke the boundless diversity of environments in which they evolved. Beneath the extant landscape lie other landscapes, lost in the mists of time.

This geo-guide leads you not only from the Trockener Steg to the enchanting Schwarzsee at the base of the Matterhorn and on towards the Schönbiel hut but also on a quest through time and around the globe. Our planet today sheds light on the Alps of old. The geological travelogue aspires to translate the silent language of rocks and open our eyes to the beauty and depth of the landscapes whose secret past lies hidden in the mountain faces.

The Alps in three long stories

Mountain ranges are not immutable. They follow an orogenic cycle*, which describes their evolution from the genesis of rocks to the shaping of topography, followed by erosion.

Earthquakes in Valais and ongoing erosion are proof that the last cycle, the Alpine cycle, which began about 260 million years ago (–260 Ma), is still very active.

As Nicolas Kramar outlines in the preface, this geo-guide draws on three stories of the Alpine landscape that together build a didactic model through three processes of an orogenic cycle:

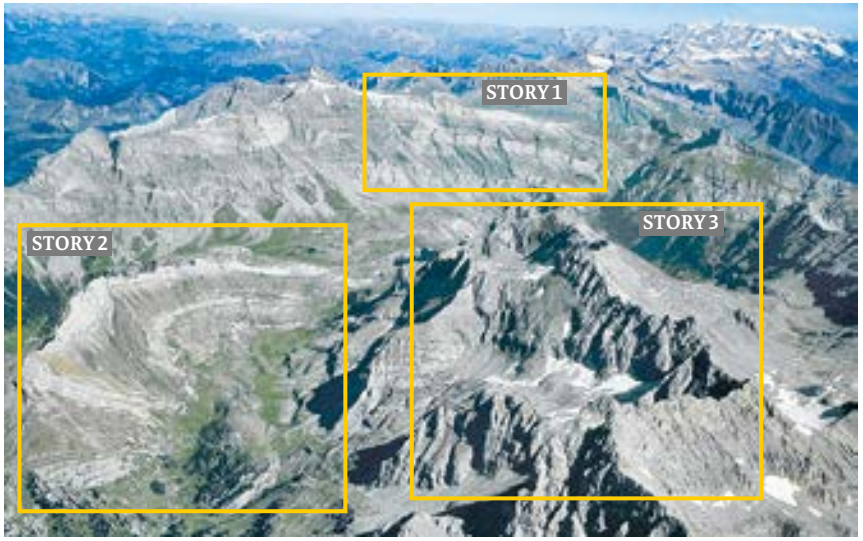
Story 1: genesis and solidification of rocks
Story 2: warping or deformation
Story 3: erosion

STORY 1

The story of rocks

This narrative takes a walk down a geological memory lane going back millions of years, recounting the ancient landscapes and palaeoenvironments from which rocks emerged: deserts, rivers, lakes, volcanoes, seashores and ocean depths. The rocks testify to a palaeogeography*, an ancient climate, archaic lifeforms, and their evolution. The oldest rocks in the Alps, engendered by ancient orogeneses*, date back about a billion years to –300 Ma. However, the vast majority fall between –260 and –40 Ma and tell the story of the Alpine cycle, the most recent and best known of the orogenic processes.

Marine sediment deposits.



▲ Aerial view of the Argentine, Diablerets and Muveran massifs.

STORY 2

The story of folds and movements that engendered mountains

This story is trickier to understand and explain because gigantic upheavals may, for instance, slowly transform a seascape into high-altitude snow-capped mountains. These changes are due to continental and ocean floor drift (or plate tectonics*), driven by the heat at the Earth's core. Our planet is constantly evolving, and plate tectonics will remain active for a long time to come. As for the Alps, plate tectonics caused large groups of rocks (continental and oceanic) to pile up and fold. All this occurring between –100 and –10 Ma, together with an orogenic crisis (end of stacking, folding, onset of uplifting) at around –35 Ma and is ongoing to a certain extent today.

Displacement, warping and folding of rocks many kilometres deep within the Earth.

Surface topography after erosion.

STORY 3

The story of shapes and erosion

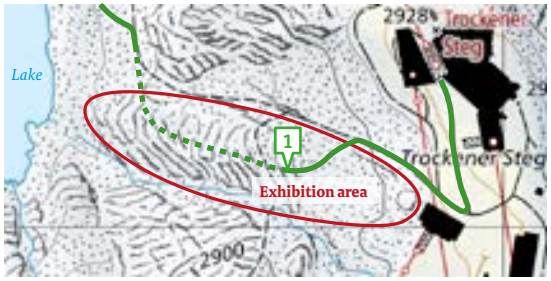
No sooner formed, every topographical relief or feature is exposed to erosion. This story begins synchronously with the uplifting of mountains and not in the aftermath of tectonics. Tectonics and erosion conspire: by trimming the relief, erosion buoys it up, raising it higher, as when unloading a boat. Two types of erosion happened in succession: mountain streams, tributaries and rivers eroded the young Alps during the uplifting phase (mainly between –40 and –10 Ma), then the enormous glaciers of the Quaternary (the last two million years of our long saga) shaped the mountains and landscapes we see today. The Zermatt and Rhône valleys are therefore much younger than the mountains surrounding them.

* Words followed by an asterisk are defined in the glossary.

An oceanic art gallery

From –160 to –80 million years (Ma), then from –50 to –40 Ma, recent past (about one hundred years)

On exiting the cable car at Trockener Steg, take the wide path towards the lake called Theodulgletschersee. A few hundred metres on, turn left towards a large brown rock table: the gateway to our rock art exhibition.

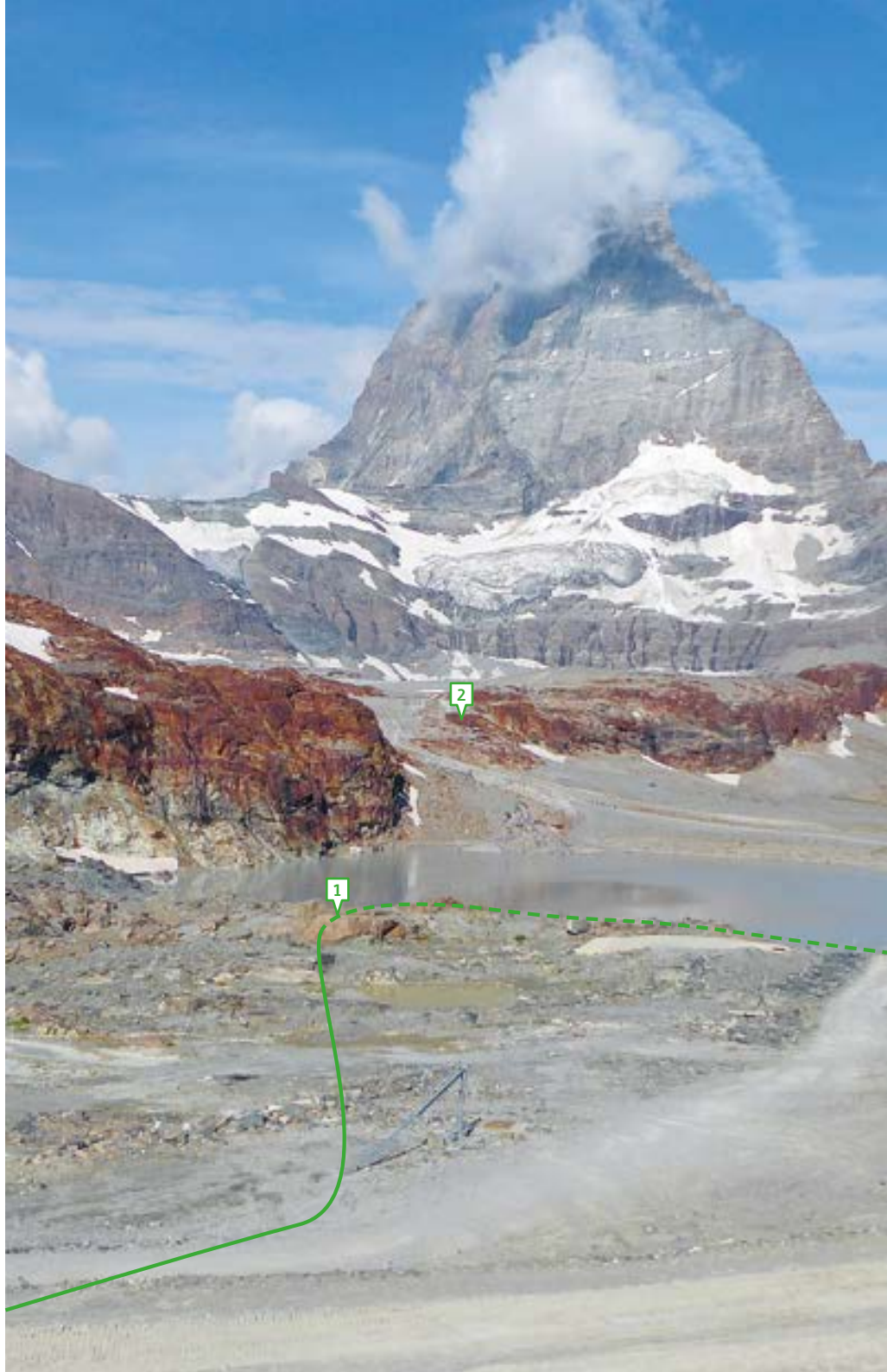


◀ Map outlining the natural art exhibition zone. The pin locates the first 'painting' explained in this book. It is well worth a visit before heading off-trail along a small ridge back to the main path towards the lake.

Mountain rocks are not very chatty and often turn a deaf ear to our questions. So why should we be interested in them? Perhaps because a persistant little voice from childhood reminds us that rocks have incredible stories to tell about the time and place of their birth. Children the world over believe rocks are homes to little gnomes. Stones make pretty pictures: they may be coloured and kneaded like playdough. So, our first stop today begins with an exhibition of rock art in one of nature's very own galleries.

A landscape can be narrated in three stories (pp. 12-13). The first story, that of rocks, transports us to an imaginary environment, far older than the mountains. Unlike flowers, rocks do not grow along mountain trails: those that outcrop* here at our feet were engendered at the bottom of an ancient ocean called the Tethys*. The oldest green

▶ Suggested pathways to the rock art gallery. The first stop is at the foot of a rock table at the far end of the berm, to the left of the path leading to the lake. You can then freely visit nature's works of art scattered between the Furggsattel chairlift and the lake (Theodulgletschersee). Follow a slight rocky ridge westwards to return to the path just before the lake.



▲ The first thing that strikes us in this landscape is the large rusty scar, which we will cross at Stop 2. Closer to us, a thick yellow-brown table marks the 'entrance' to the exhibition.

▲ In the foreground, we can see a stack of two rock masses. Below, ancient basalts typically bluish-green in colour, with a few whitish stripes. Above, a robust brown table rich in limestone, formed by marine sediments called calcareous schists deposited in the distant past (about 100 million years ago).

▶ As you approach the tabletop, you may observe green fragments in the brown limestone paste and wonder about their origin. They may have come from underwater reliefs, such as basaltic oceanic crust cliffs that collapsed into the limestone sediments deposited at their feet.

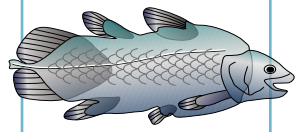
-hued rocks, dating back to the Jurassic (about –150 Ma), derive from the oceanic crust*. The youngest brown calcareous schists were deposited above them during the Cretaceous between –130 and –80 Ma.

Since we now find these beautiful rocks in the mountains, they must have then been carried at great depth and folded during the Alpine orogeny*. This is basically the short version of Story 2.

The third story tells of glaciers that eroded and sculpted the rocks during the Quaternary* (–2 Ma to today). Ice cover persisted here until about 50 years ago. Consequently, these rocks only outcropped very recently on the geological time scale. All along our hike, we will keep returning to these three long stories.

Climb onto the table to continue viewing the exhibition. Look out for the cyclops-eye stone right under your feet!

Coelacanthes such as this one populated the Jurassic seas. Some of them still exist today.



Libys superbus
(–150 Ma) ℓ. 60 cm

▼ The cyclops-eye stone: is actually calcareous schist strata (viewed from above) containing fragments of metabasalts.