ÉDITIONS
LOISIRS
ET PÉDAGOGIE
discover

A geological excursion guide

Zermatt: An Ocean Safari

A Hike from Gornergrat to Riffelberg

Michel Marthaler
Micha Schlup
in collaboration with Nicolas Kramar

Translated from French by Prita Muthalali

Contents

INTRODUCTION

ITINERARY

DIAGRAMS AND MAPS

ZOOM IN ON...

On the trail of the African Matterhorn

Alpine landscapes provide all sorts of awe-inspiring experiences. They tell stories and lead us to uncover extraordinary realities.

The African Matterhorn: An Outstanding Geological Story by Michel Marthaler (previously published under the name *The Alps and our Planet*), has contributed towards taking a fresh look at the Alps.

An enduring passion for these mountains has now enriched the adventure with a series of geological guidebooks which, depending on your expectations, jockey for the position of either a follow-up or an introduction to *The African Matterhorn.*

For those unversed in Earth sciences, these guided walks enable unmediated access to geological insights, an approach similar to linking historical periods with monuments when visiting a beautiful city. Just as remains may be ascribed to a particular historical period such as the Iron Age, Ancient Greece or the Middle Ages, geologists impute a rock formation age or, more generally, a geological period such as the Triassic, Jurassic, or Cretaceous to a class of rocks. The colour code used in the panoramas, maps, and diagrams represents a group of rocks specific to a particular geological period. Furthermore, as constant Earth crust movements shift rocks, the colours help determine their ancient geographical origins.

The story of Alpine formation involves three broad paleo-geographic* domains: two continents and an ocean*, colliding to form a gigantic stack. The colour code adopted here helps distinguish between those three main actors of the geological narrative of the Alps and is identical to the one used in *The African Matterhorn*. Therefore, these geological walks allow you to fully experience theoretical knowledge gleaned from your reading.

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

This collection provides a new key to deciphering geological landscapes. Although specialists may find it schematic, it provides easy access to anyone interested in the story rocks tell. The pedagogical approach presented in the introduction to this guide (pp. 10-15) builds on the general idea that, as with many other mountain ranges, the Alps went through three successive processes. The first narrative, or Story 1, occurs mainly in seas where marine sediments accumulate over time in successive layers (or strata) of rocks. This process is called sedimentation. Story 2 happens several kilometres underground, where the combined pressure and heat produced through movements of the Earth's crust cause rocks to warp and fold. This is the story of metamorphic rocks. Finally, during Story 3, various erosion processes at play slowly shape rocks close to the surface to form existing landscapes and go on to reduce or even obliterate reliefs over time.

This geo-guide can also be read like a travelogue, taking you on a journey from the comfort of your own home. Whether you are an informed aficionado or a complete novice keen on unlocking the secrets of the Alps, this geo-guide offers a different perspective on 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 rock folds happens deep underground.

Itinerary

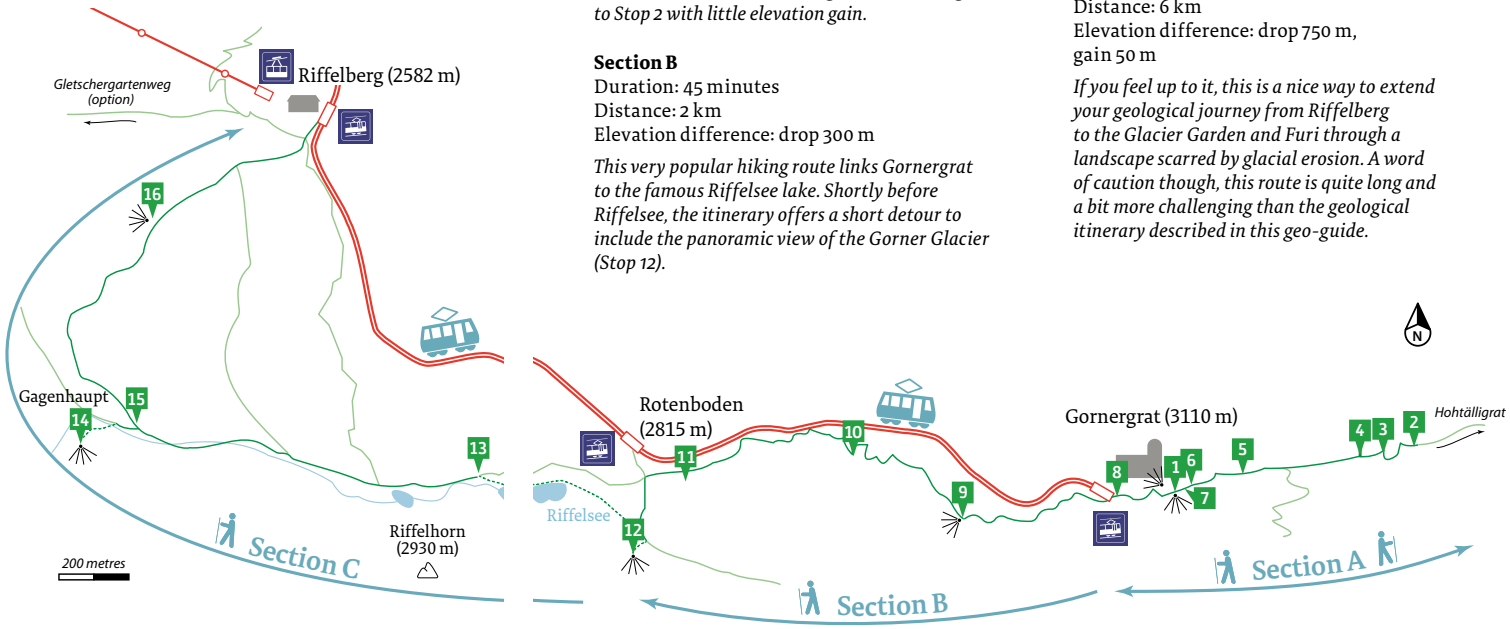
Access
The journey begins with the train from Visp to Zermatt, followed by the Gornergrat cogwheel railway (GGB) to the terminus. Return trip from Riffelberg.

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

Best hiking season
Although Gornergrat is accessible by rail all-year round, high-altitude segments of the itinerary are snowbound most of the year. We recommend waiting until early July before venturing out. Late summer is the best time for hiking and to avoid the busy holiday season. Weather permitting, the footpath is accessible until the end of October.

Hiking trail
From the Gornergrat railway station, the route first tracks up to the observation platform (altitude 3130 m). It continues eastwards along the main ridge towards Hohtälli for about 20 minutes. It then backtracks to the Gornergrat station and down to Riffelberg (altitude 2582 m), with a few short detours along the way. The geo-guide describes 16 stops along the route.

The itinerary follows the paths marked out by yellow hiking signs. The level of difficulty corresponds to that of a mountain hiking trail (white-red-white, level T2). On rare occasions, some detours entail walking short distances on unmarked paths (in the vicinity of Riffelsee and Gagenhaupt).



Total hiking time: 2.5 hours, excluding the stops necessary for a better understanding of the geological history and structure of the surrounding landscape.

Depending on your comfort or the weather, you may shorten or discontinue the itinerary thanks to the Gornergrat railway.

Section A
Round trip
Duration: 45 minutes
Distance: 2.4 km
Elevation difference: gains and drops, 150 m

This route traces the main ridge above Gornergrat to Stop 2 with little elevation gain.

Section B
Duration: 45 minutes
Distance: 2 km
Elevation difference: drop 300 m

This very popular hiking route links Gornergrat to the famous Riffelsee lake. Shortly before Riffelsee, the itinerary offers a short detour to include the panoramic view of the Gorner Glacier (Stop 12).

Section C
Duration: 1 hour
Distance: 3 km
Elevation difference: drop 300 m, gain 100 m

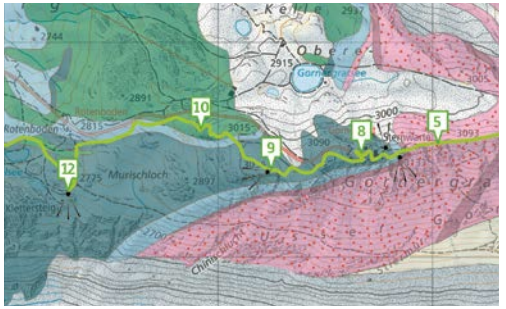
From Riffelsee, the route heads down along a dell to Gagenhaupt, from where a 10-minute round trip promises a breathtaking view of the Gornera Gorges (Stop 14). The path then tracks through meadows to Riffelberg.

An optional return route: Gletschergartenweg
Duration: 2 hours
Distance: 6 km
Elevation difference: drop 750 m, gain 50 m

If you feel up to it, this is a nice way to extend your geological journey from Riffelberg to the Glacier Garden and Furi through a landscape scarred by glacial erosion. A word of caution though, this route is quite long and a bit more challenging than the geological itinerary described in this geo-guide.

Reading maps and geological diagrams

This geo-guide includes geological maps, indicating the itinerary at a scale of 1:25,000, as well as diagrams (sketches, panoramas, sections, block diagrams). Three main colours indicate the ages of the rocks and their paleogeographic origins (in reference to a more ancient landscape and an earlier distribution of continents and oceans before and during the creation of mountains):
– shades of pink: ancient Europe
– shades of blue-green: Tethys Ocean*
– shades of orange: ancient Africa



▶ *Extract of the 1:25,000 geological map (see inside back flap)*
– Stop 5 in a pink zone represents 250-million-year-old (Ma) rocks native to ancient Europe.
– The rocks at Stops 8, 9, and 12, in dark blue-green, oceanic in origin, are "only" 180 million years old.

◀ Could these children imagine for a moment that the rock they are scaling was born at the bottom of an ocean when dinosaurs walked the Earth?

All mountain rocks are immigrants

Mountain rocks and stones skirting the paths are not indigenous to where we find them. They always originate in another place, time, and environment. Greek philosophers already sensed this surprising truth. 18th-century scholars later classified rocks into two main groups based on origin. The Neptunists (late 18th century) thought that, as the stratified rocks of islands and mountains contained marine fossils, they were born under the sea. The Plutonists (rival theorists) claimed that volcanic rocks, including those such as 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 closely, we can hear them recounting the boundless diversity of the environments in which they evolved. Beneath the extant landscape lie other landscapes, lost in the mists of time.

This little geo-guide leads you, not just along the Gornergrat ridge, but on a quest through time and around the globe. It aspires to translate the silent language of rocks and open your eyes to the beauty and depth of the landscapes, whose secret past lies hidden in the mountain faces.

We came back to the guide and perceived all around us the sheer havoc wreaked by the African plate.

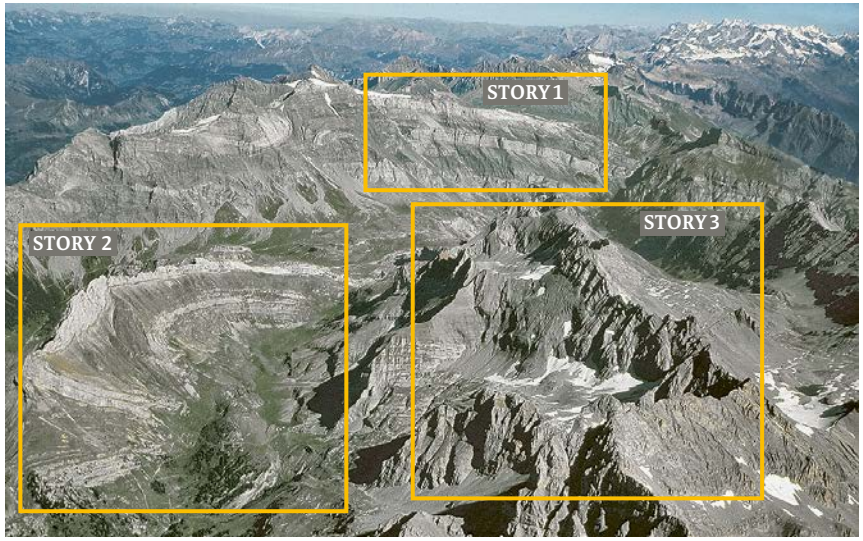
Laurence Boissier, *Histoire d'un soulèvement*

Recounting the Alps in three long stories

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

Earthquakes in Valais and very active ongoing erosion are proof that the last cycle, the Alpine cycle, which began around 260 million years ago (–260 Ma), is not quite over.

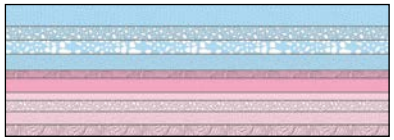
As Nicolas Kramar outlines in the preface, this geo-guide draws on three stories of the Alpine landscape that together build a didactic model through three processes of an orogenic cycle:
Story 1: genesis and solidification of rocks
Story 2: warping or deformation
Story 3: erosion



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

STORY 1

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

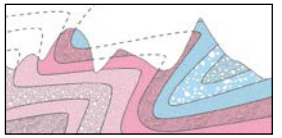


Marine sediment deposits.

STORY 2

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

Displacement, deformation and folding of rocks many kilometres deep inside the Earth.



Erosion and surface relief cross section.

STORY 3

The story of shapes and erosion
Every newborn relief is immediately exposed to erosion. This story begins synchronously with the uplifting of mountains and not in the aftermath of tectonics. Tectonics and erosion conspire: by reducing 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 their uplifting (mainly between –40 and –10 Ma), then the enormous glaciers of the Quaternary* period (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 that surround them.