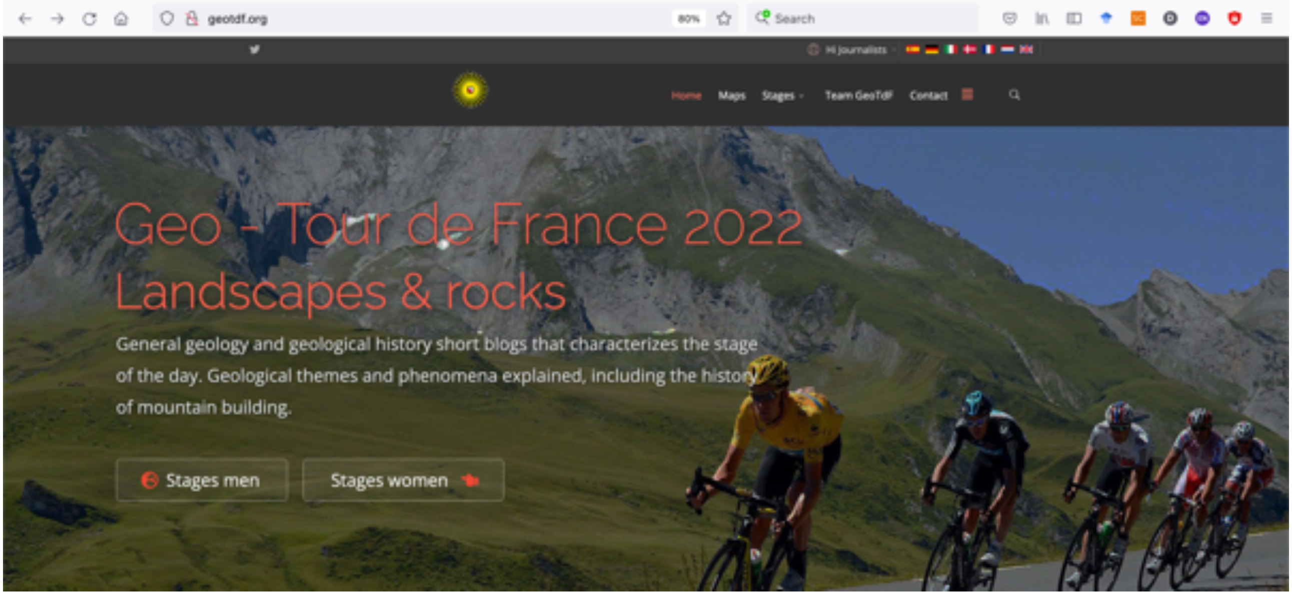



# The idea

[Background](#)

The idea for blogs of the Geology of the Tour de France was born out of combining two passions: geology and cycling.

Geoscientists tend to love the outdoors, and are a talkative bunch who can't stop explaining about their rocks, fossils, landscapes, and natural processes, and the field expeditions they undertook. At some point I realized that viewers of live coverages of cycling races like the Tour de France watch hours and hours of geological excursions. Surely, we couldn't let the opportunity pass to geo-monologue! And these races are covered by commentators that explain just about everything that passes the camera. All we had to do is help the commentators to explain a few things about the landscape and underlying hidden treasures. As it turns out, there are quite a few geoscientists who love cycling and watching the race, and quite a few cyclists with a keen interest in the environment. GeoTdF was born.

This web page is dedicated to the Geology of the Tour de France. But on the Twitter account @geotdf, we can't help ourselves and tweet about the geology of just about every race where we find something to tell you. So if you want your regular geo-fun fact, follow us, and drop your questions should you have any! We hope you enjoy, and we'll see you on the road!

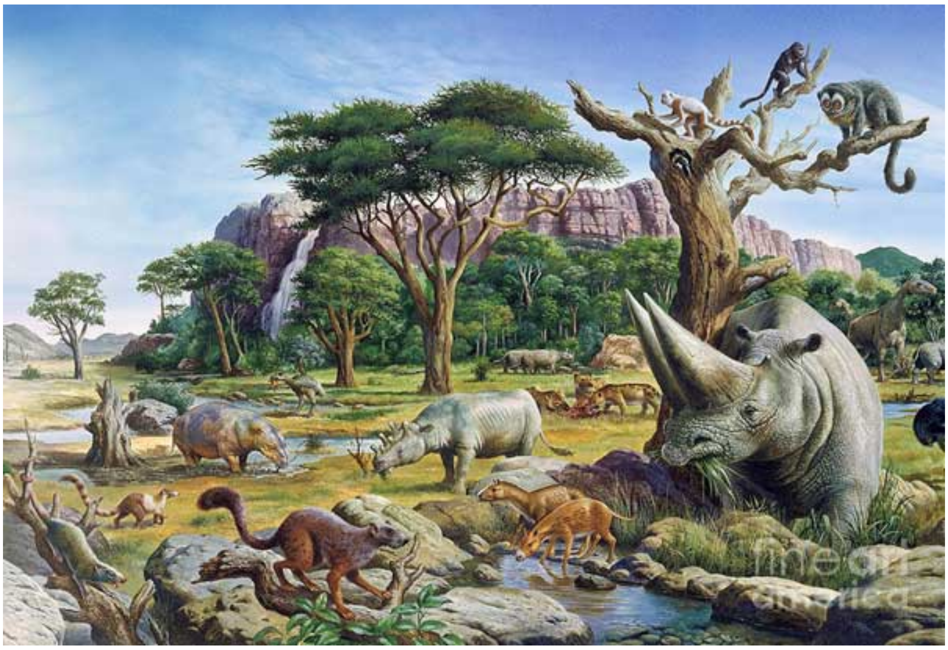
**REFERENCES TO IMAGES. All images in the blogs below come from internet pages. On the GeoTdF website, each figure is linked to the source.**

# Stage 1 | Paris - Paris / The warm Eocene, escargot for dinner

Women

| | | | | |
|---|---|---|---|---|
| 82 km | | Flat | | Warm Eocene: no ice on Earth |

Todays stage will bring the peloton over the Champs Élisées, through Paris. In this stage, from the center of the Paris Basin to the edge, we arrive in this stage in the Eocene (56–33.7 million years ago). The Eocene was warm, so warm that the sea level was 60m higher than today. Why? Because it was too hot for polar ice: all the water that is now stored in the polar caps was added to the ocean water in the Eocene. The Paris Basin was therefore a shallow inland sea at that time. A bit like the North Sea, with an opening to the ocean in the northeast. The oldest part of the Eocene is characterized by a climate warming towards a heat record. Peak heat was reached around 50 million years ago. At that time, Antarctica had Palm, Macadamia and Baobabtrees on the coast, hippos walked on the land masses around the North Pole and it was really blistering hot at the equator. In the Paris basin it was also warm, but also wet, it rained heavily, so that thick packages of sediments were dumped into the basin via rivers. As a result, the basin sometimes filled up completely with the sediments supplied by the rivers.



## The Eocene geological epoch was first defined in the Paris Basin

The term "Eocene" comes from Greek, and means "Beginning of the New Age." The term was coined in 1833 by geological hero Charles Lyell (1797–1875), who divided

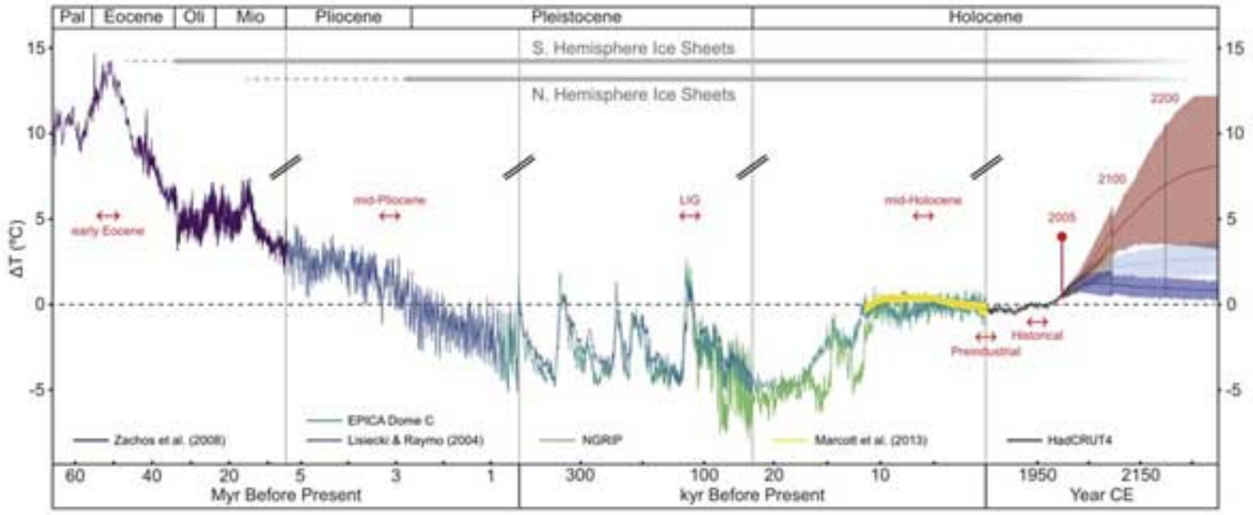



**Fig. 1.** Temperature trends for the past 65 Ma and potential geohistorical analogs for future climates. Six geohistorical states (red arrows) of the climate system are analyzed as potential analogs for future climates. For context, they are situated next to a multi-timescale time series of global mean annual temperatures for the last 65 Ma. Major patterns include a long-term cooling trend, periodic fluctuations driven by changes in the Earth's orbit at periods of $10^4$–$10^5$ y, and recent and projected warming trends. Temperature anomalies are relative to 1961–1990 global means and are composited from five proxy-based reconstructions, modern observations, and future temperature projections for four emissions pathways (*Materials and Methods*). Pal, Paleocene; Mio, Miocene; Oli, Oligocene.

the Tertiary (a longer unit of geologic time) into the Eocene, Miocene and Pliocene. He did this on the basis of the degree of similarity of molusc fossils (fossil cochleas) in the rock layers in this Basin, with the modern moluscs. He saw that the older the rock layers, the fewer species that still crawl around today are in those layers. In fact, geologists still use the subdivisions of Lyell as a time indication today.

The Eocene is further subdivided into shorter time periods, each with their own fossils. The part of the Eocene that is exposed within Paris, the white limestones on which the city was built, has been named after Paris: the Lutetian. The 'snails' that are found in the Lutetian of Paris can be up to half a meter long! These animals were probably exceptionally slow creatures. The riders today will make for a lot more fireworks than the Lutetian inhabitants of Paris.

I study climate and ocean conditions on and around Antarctica, during the Earths most recent 100 million years. Specifically, I study sediment cores to reconstruct the onset and development of the Antarctic circumpolar current around, and the ice sheet on Antarctica. Check the Geo-TdF-team-2022.

**Peter Bijl**

# Stage 2 | Meaux-Provins / Riding the Oligocene wheel of Brie

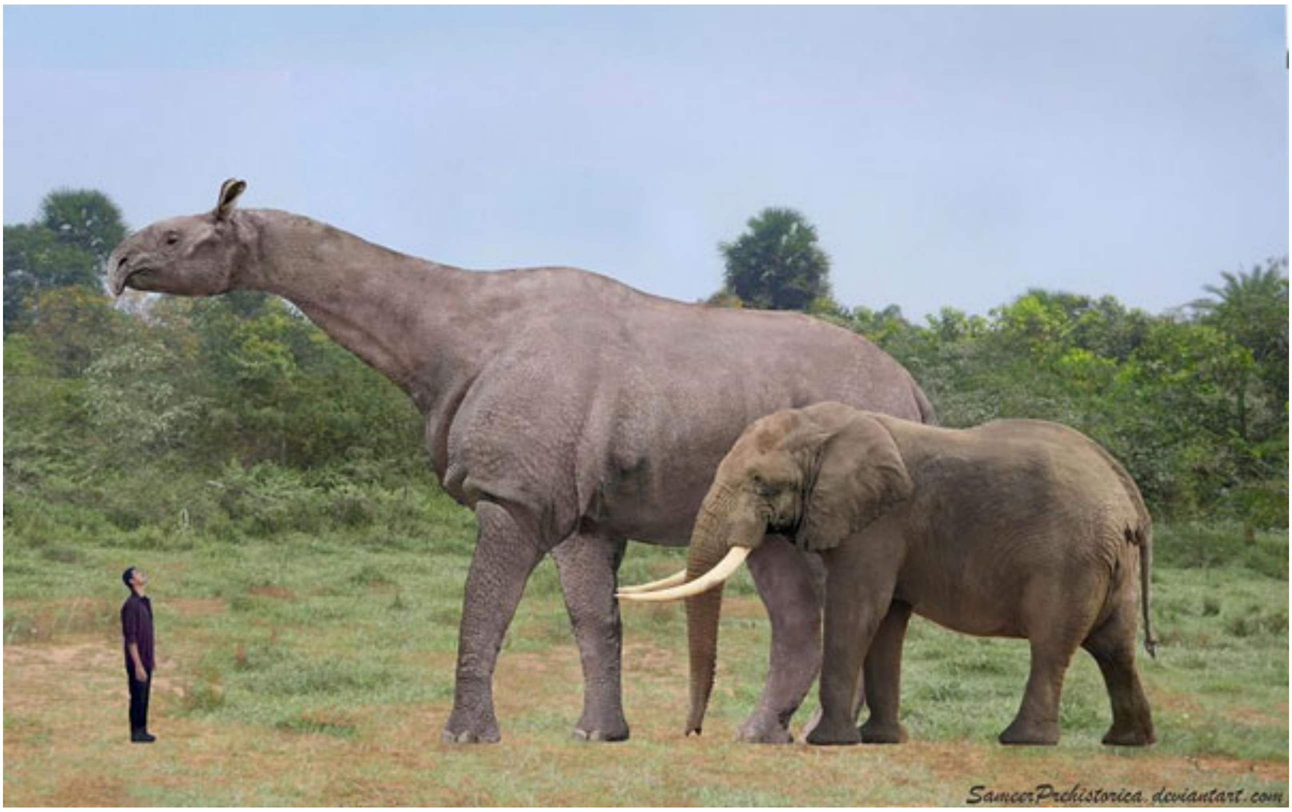
Women

| | | | | |
|---|---|---|---|---|
| 135 km | | Flat | | Global climate cooling exposing new |


Today's stage takes us 100m up a flat plateau, a bit like climbing up on a famous Brie cheese (Fig 1). But how does this relate to geology? After yesterday's warm and wet ride through the subtropical Eocene, our time traveling riders move up to the next younger, and completely different geologic epoch.

## Dramatic global climate cooling: From greenhouse to icehouse

The Oligocene started abruptly 34 million years ago with a dramatic global climate cooling from greenhouse to icehouse conditions. The opposite of today's warming: $CO_2$ levels went down and decreased the greenhouse effect, average temperatures cooled down 5-10°C and the huge Antarctic ice sheet suddenly formed. This completely changed the world. With so much water trapped in the ice sheet, sea levels dropped by



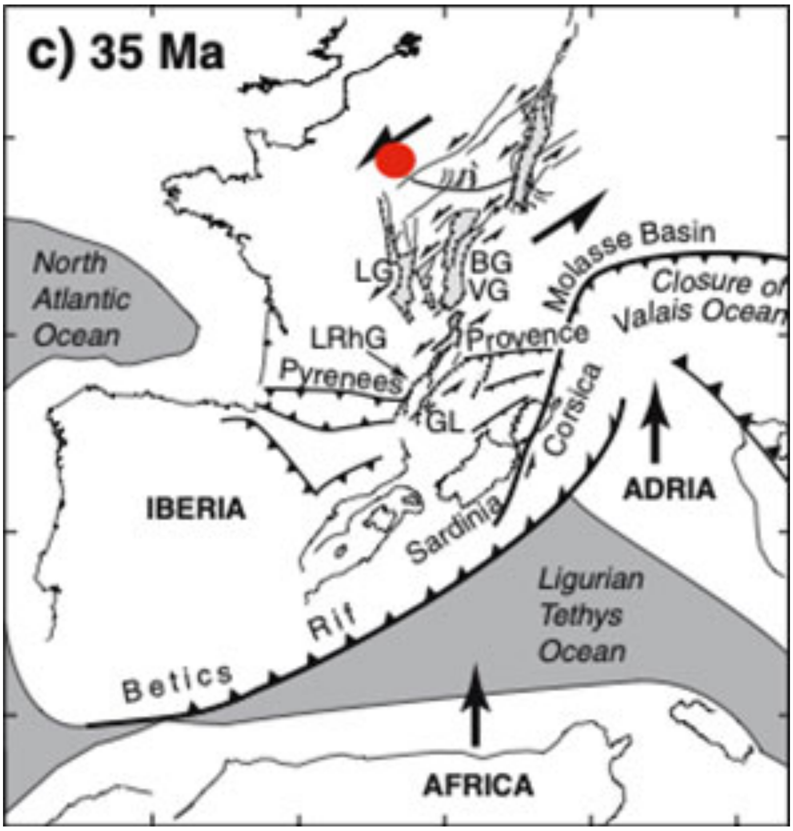

70 meters exposing vast expanses of new land. Lush evergreen forests turned into cold arid deserts with small bushes and pine trees covered mountains. Asian animals, including the largest mammals that ever existed (Fig 2), crossed the newly formed steppa over Eurasian to invade Europe.

# Reaching the Oligocene via the Côte de Tigeaux

To reach the Oligocene, the bikers will rise up a stack of sedimentary layers in the biggest climb of the day, the 135m of the "côte de Tigeaux" at km 15.9. Their time travel speed will be about 1 million year younger every 10m up. After leaving below the Eocene strata, they will go through the 'Calcaire de Brie', a hard layer deposited in an ancient giant lake extending from Paris to Epernay. Then they will reach the upper crust of the cheese made of the beautiful 'Sables de Fontainebleau'. These blond and pure sands are from ancient dunes, beaches and sand banks formed when the sea came back into an immense bay larger than the Baie du Mont Saint Michel.

# A major fault in the Côte de Tigeaux

The "côte de Tigeaux" also corresponds to a major fault, a huge scar deep in the Earth crust. It was left after a major continental collision between the ancient tectonic plates of Laurussia and Gondwana, forming the supercontinent Pangaea around 400-300 millions years ago. This fault is now all covered by the Oligocene sedimentary layers. It is like a big split that used to separate 2 parts of the table, now joined below the cheese. In the Oligocene, other tectonic plates were moving. The collision of the African and Iberian tectonic plates with Europe formed the Alps and Pyrennes while also opening large gashes (grabens) in the cheese crust (Fig 3). But this did not affect our region much. The deposited layers were not faulted, broken or folded. They remained flat and fortunately are still flat lying today. In fact, the cyclists are riding on the same surface left since the Oligocene time, only the climate has become even colder today and there are very different animals around, some of them riding bikes!




I focus on understanding how geodynamics, climate and life interact during major changes of our Earth evolution. [Check the Geo-TdF-team-2022]().

**Guillaume Dupont-Nivet**

# Stage 3 | Reims-Épernay / Cretaceous sea specialties

Women

| | | | | |
|---|---|---|---|---|
| 133 km | | Hills | | Crateceous |

After two days of rides through rocks of the Cenozoic - the period after the meteorite impact that killed the non-flying dinosaurs - the peloton will race through a part of the Paris Basin where Cretaceous rocks are exposed.

## Limestone formed by microscopically small organisms

At the end of the era of the dinosaurs (the end of the Cretaceous), large parts of northwestern Europe were covered by seawater. The climate was much hotter than today across the globe, and because there was no ice on the poles, sea level was a hundred meters or more higher than today. On the bottom of this warm Cretaceous sea, limestones formed, thick rock formation that, if you look at them under a microscope, consist grain by grain of shells and scales and skeletons of microscopically small organisms.

## Giant lizards of 15m in the Cretaceous sea

The Cretaceous sea was special in many aspects. While the dinosaurs roamed the land,

mosasaurs hunted the seas of the Cretaceous. Also near Reims, remains of mosasaurs have been found: loose teeth. Luckily, we have fossil findings from elsewhere that tell us what mosasaurs looked like: giant sea lizards, some more than 15 meters long, with flippers for steering, and a thick, muscular tail for propulsion. They were the top predators of the sea. The meteorite impact near Mexico, 66 million years ago, abruptly ended the Cretaceous, the dinosaurs, and in the sea, also the mosasaurs perished. The soils that formed on the limestone-rich subsurface of the Cretaceous are fertile ground for the champagne grapes. The winner of today will owe the bubbles to the sparkling Cretaceous era.

In the past two decades, Anne worked extensively in the Middle East, on dinosaurs from Oman, and dinosaur tracks from Yemen, and in Angola, where the PaleoAngola Project resulted in the discovery of a new dinosaur Angolatitan, and multiple new mosasaurs, including Prognathodon kianda.

**Anne Schulp**

Stage 4 | Troyes - Bar-Sur-Aube / Jurassic era: dangerous swimming paradise

[Women](#)

| | | | | |
|---|---|---|---|---|
| 126 km | | Hills | | Jurassic era |

The ladies will race their way eastwards today, and will travel from the Cretaceous deeper into geological time to arrive in the Jurassic. If you would have visited Northern France 170 million years ago, during the Jurassic era, you would have seen a tropical swimming paradise. Azure blue waters as far as the eye can see, with at the horizon the occasional island with white beaches and lush vegetation. From the Vosges to Wales, everything was submerged, a shallow sea at the margins of the mighty Tethys Ocean that extended southeastwards, as a giant tear between the continents Gondwana and Laurasia.

## The dangerous sea of the Jurassic era

And while you're sitting there on the beach of the Gulf of Luxembourg, with the warm carbonate sands in the Gulf tickling your feet, you could've thought you were at the Bahamas. Hammock, pina colada, and don't forget the sunscreen. But a refreshing dive into the sea, or even paddling the shallow sea, would have been a bad idea. The Jurassic seas were full of live, and not all was cuddly and sweet. of the cephalopods (the squids), like ammonites and belemnitesm were fine, even if those were vicious predators. But outright dangerous were a large collection of sea reptiles, kike Ichthyosaurs, swimming dinosaurs with eyes as large as saucers and with an athletic and smooth body that looks a lot like today's dolphins. A text book example of convergent evolution. These apex-predators, who find themselves near the top of the food chain, had to be careful themselves. Other sea reptiles were hunting them, such as Plesiosaurs, and Pliosaurs that could have monstrous dimensions of as much as 20 meters!

## Meat-eating Theropods on land

In this Jurassic Park, it was nice and warm. Not very surprising, because the global $CO_2$ concentration was about 5

times higher than today, well above 2000 ppmv. Highly favorable conditions for plants. At the shores of the larger landmasses like the Vosges, forests of swamp cypresses rose up, with closer to the ground ferns and related plants like palm-ferns and horsetails. We now find the pollen and microscopic spores of all these plant species as microfossils in the sediments that were deposits in the shallow Jurassic sea.

And amidst even more monstrous scaly reptiles, in this case dinosaurs like the plant-eating Sauropods and the meat-eating Theropods, these forests provided shelter for a warm-blooded little fellow, “model shrew”. It had five toes on each foot, a pointy snout, and hair. A Morganucodon. This is one of the oldest mammals, a distant ancestor of a long-extinct branch. It would take another 100 million years before a giant space rock would end the reign of all those monsters. And Morganucodon nodded in approval.

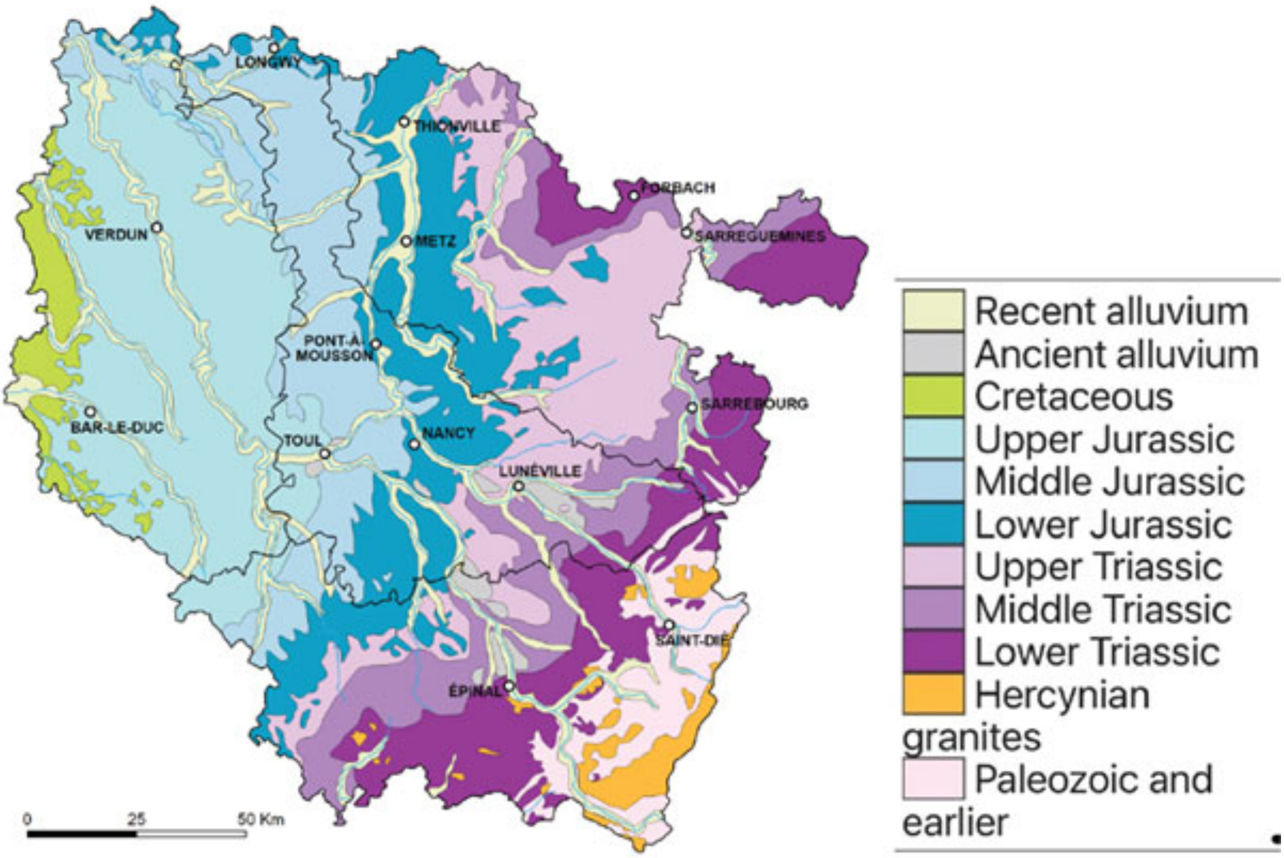
I am interested in understanding the evolution of the biosphere in deep time. I focus on major transitions in Earth history. I use a multidisciplinary approach combining paleontology with in- and organic geochemistry. Check the Geo-TdF-team-2022.

**Bas van de Schootbrugge**

# Stage 5 | Bar-le-Duc – Saint-Dié-des-Vosges / Back into geological time

Women

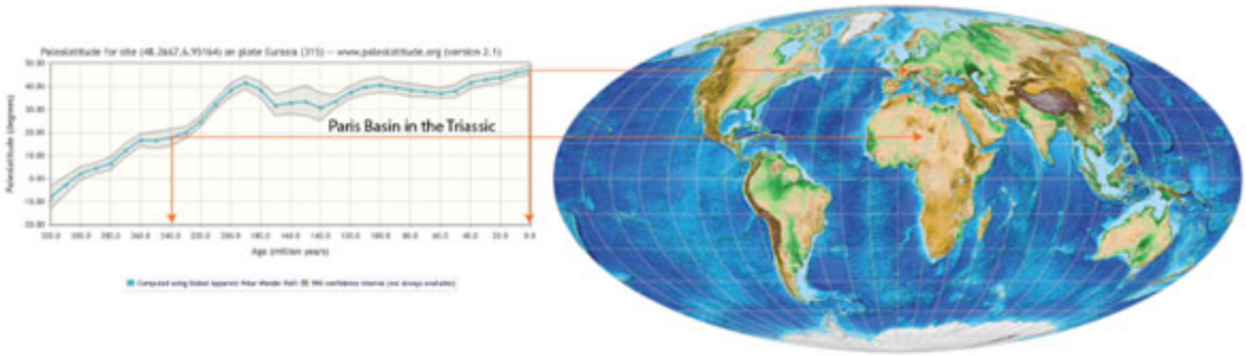
| | | | | |
|---|---|---|---|---|
| 175 km | | Flat | | From the Jurassic through the German Triassic in |




Today's stage leads the peloton through the eastern flanks and the oldest sediments of the Paris Basin. The television screen today will show green fields, but the worlds that existed when the rock formation below the wheels formed were not very green at all.

## A stage of 175 km and 106 million years

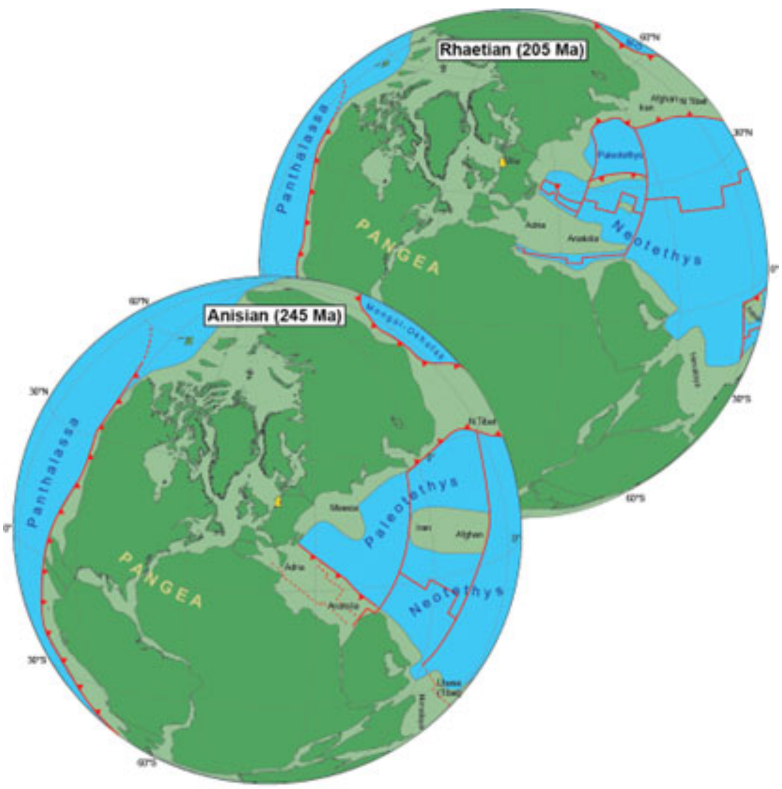
The stage will start in the upper Jurassic (~145 million years old) near Bar-le-Duc, in the world of the dinosaurs, and from there the riders will travel back through geological time to the lowermost Triassic (251 million years old) near Saint-Dié. This earliest Triassic was a hot, dry world that was struggling to recover from the biggest mass extinction in geological history (the




Permian-Triassic boundary). This P-T extinction was even less healthy than the Cretaceous-Tertiary boundary that wiped out the dinosaurs: more than 80% of species on earth went extinct. This mass extinction is aptly known as ‘The Great Dying”, and shows that a series of small changes in climate may eventually culminate in a gigantic catastrophe. But we will return to this later this Tour.

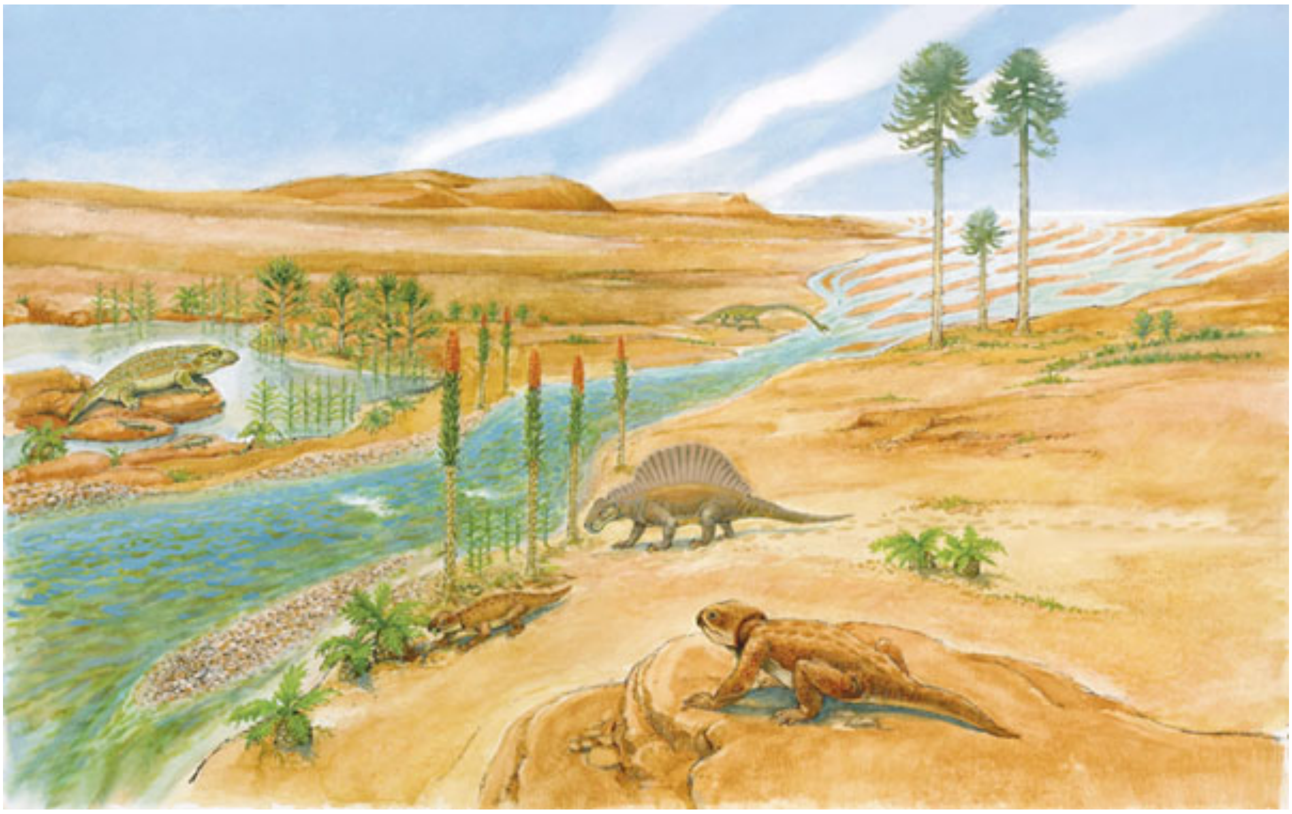
## The Germanic Triassic

The Triassic refers to the period in the geological timescale between 251-201 million years ago, sandwiched between the Permian (299-251 Ma) and the Jurassic (201-145 Ma). The name ‘Triassic’ means tripartite, and stems from the three clearly distinguishable rock units in the stratigraphy of northwest Europe: Buntsandstein, Muschelkalk, and Keuper. This subdivision is known as the “Germanic Triassic”. Originally, these three rock formations were even used to indicate geological time, but because they cannot be recognized outside of Europe, this terminology is only used in northwestern Europe these days.




## Red sandstone, white limestone, and evaporites

The brightly colored rocks of the Buntsandstein were deposited in a large basin that formed at the eastern edge in the heart of the supercontinent Pangea, in western and central Europe (from France and Spain, Belgium, the Netherlands, Germany, to Poland). The Buntsandstein (’colorful sandstone’ in German) is in France about 300 meters thick and mostly red-colored. This teint is the result of formation of iron oxides (hematite) in the rock. The sandstones formed in a hot, dry climate, whereby sand was transported from surrounding mountain ranges through large rivers and dunes, like in modern deserts. The red Triassic sandstones are very hard and resistant against weathering, and were therefore widely used for construction of important buildings (the Cathedral of Strassbourg, the castel of Haut-Koenigsbourg).



In the middle Triassic, the basin subsided and connected in southeast Poland to the Tethys Ocean. This led to the influx of seawater, and thick formations of limestones and evaporites formed. Evaporites, like gypsum and rock salt, form by desiccation of sea water, like in the Dead Sea. These formations now seal the porous Buntsandstein. As a result, the porous sandstones became reservoirs for natural gas, and they are now used more and more for the storage of CO2, or hydrogen that is an important alternative energy resource.

The limestones from the middle Triassic contain abundant fossil shells, and is therefore called in German 'Muschelkalk'. In teh late Triassic, the sea started to retreat and in extensive packages of evaporates started to form, amidst red continental sandstones from rivers. These are collectively known as the Keuper.

Based on the geology, today may be a good day for a German victory!

I use the magnetic field of the Earth to date the geological record. I am especially fascinated to correlate geological successions across the globe to better understand and unravel the geodynamic and climatic process of the geological past that have continuously changed the paleoenvironmental conditions on Earth.

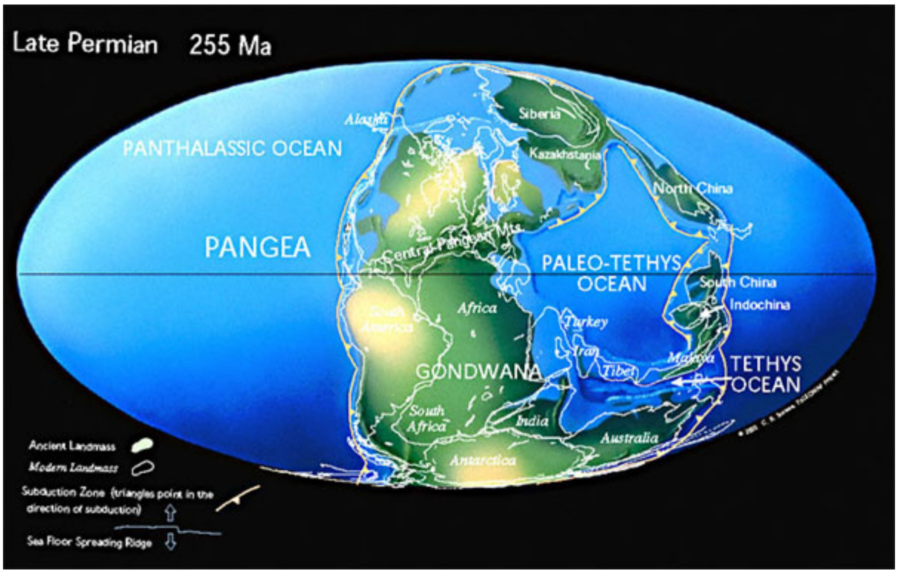
**Wout Krijgsman**

# Stage 6 | Saint-Dié-des-Vosges – Rosheim / A rough ride through the Permian interior of Pangea

Women

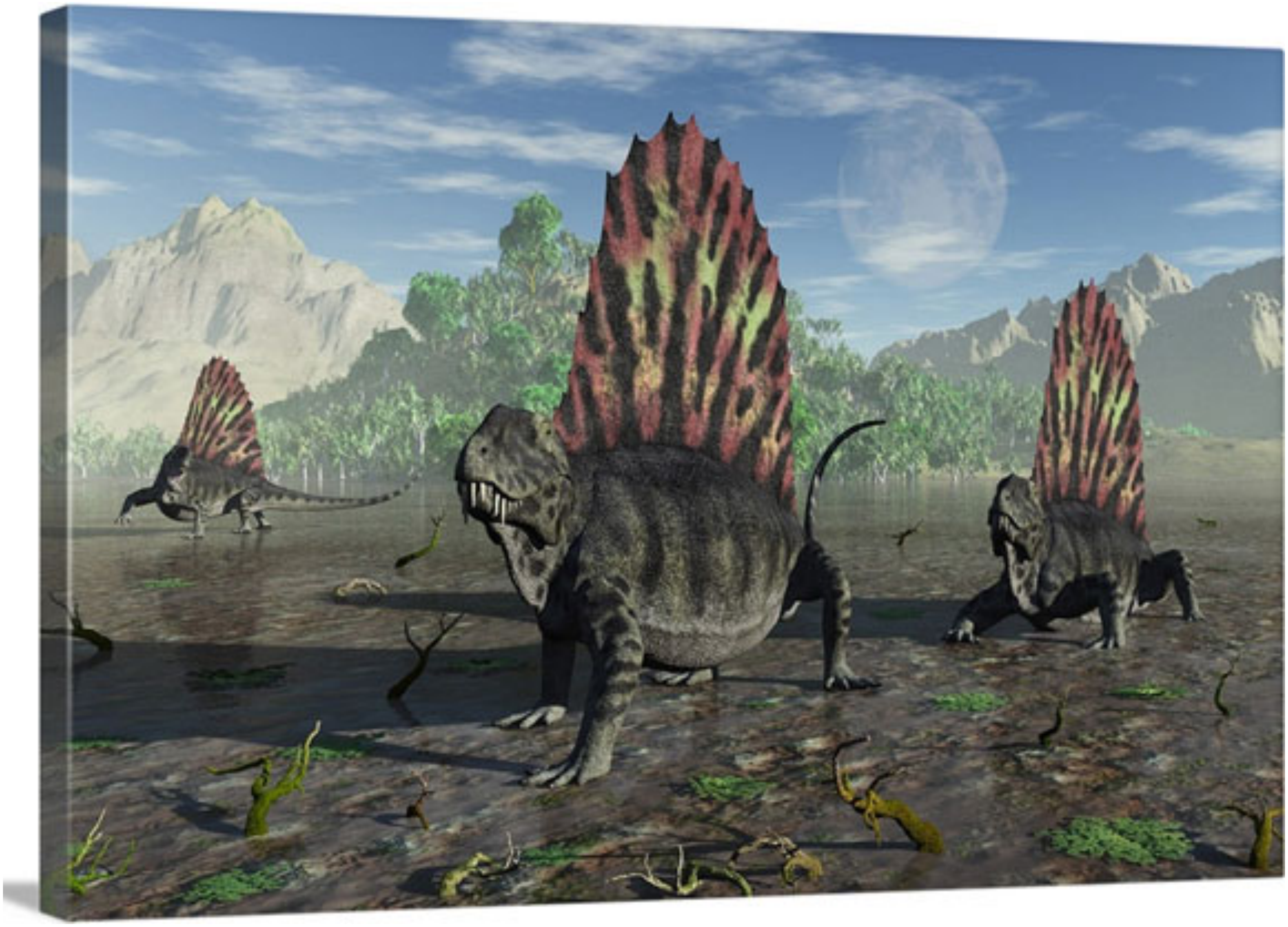
| | | | | |
|---|---|---|---|---|
| 128 km | | Hills | | Permian period; the last part of the Paleozoic era |

After five days of time-traveling through the Paris Basin, the riders are now sinking into the deeper rock record of the Vosges massif. Today's ride will bring the peloton through rocks that were deposited in the Permian period, the last part of the Paleozoic era, between 299 and 252 million years ago. And of all the periods that are visited by the Tour de France Femmes, the Permian was probably the least hospitable.




## A desert icehouse

Imagine: you'd be riding through the vast interior of the supercontinent Pangea. A Tour de Pangea would bring you from Antarctica to Siberia, and none of it would have been easy cruising. The Permian climate was cold, and dry. A vast icecap covered Antarctica, southern



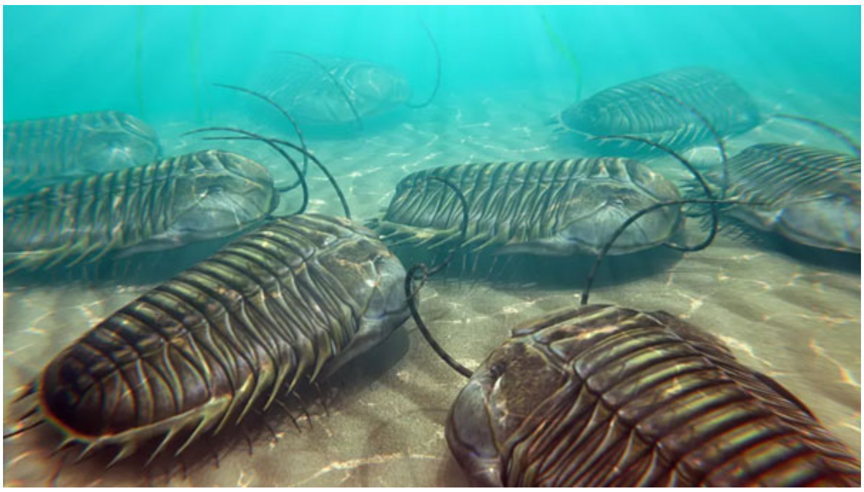
Africa, most of South America, and also Siberia. In the equatorial area, where the Vosges were located in the Permian, the interior of Pangea was bone-dry, and you'd find yourself in a colder, but probably still unpleasantly hot Sahara-on-steroids. Almost everywhere in Europe and North America, thick packages of red desert sandstones are found, formed in dunes or sabkhas. But in the Vosges, where we are today, the Permian was rich in explosive volcanism. Dry, dusty, explosive. Terrible conditions for a bike ride.

## Permian critters - safe in the desert

Imagine you tried to get in the break-away during this stage, and after your acceleration you find yourself… all alone. Under normal circumstances that would already make for a tough day. But in the Permian, you'd be looking over your shoulder every minute. The lush rainforests of the Carboniferous? Dead and buried. No hope for shelter there, you'd have to wait for tomorrow's stage. No, the dry Permian lands were occupied by ferns and conifers. Had you escaped in the Carboniferous, land animals were mostly amphibians: they need water to lay their eggs so the desert would have been pretty safe for you. But by Permian times, evolution had figured out a way to reproduce under land conditions: amniotes developed. Amniotes, which include you and me, are a clade of organisms that include birds, reptiles, and mammals, who developed a membrane around their eggs that prevent drying-out. So they could invade the dry lands. So you better watch out for Dimetrodon, the top predator, more than five meters long, with an enormous sail on its back and ferocious teeth.

Life in the Permian was good for insects! Following the lush forests of the Carboniferous, oxygen levels were high, and insects could grow BIG. Is that a helicopter you hear above you? Nope. Its

Meganisopter, a primitive ancestor of the dragonflies, with a body of 47 cm and a wingspan of 75 cm. If they started bugging you, you'd have little trouble to speed up.



## The end of a rough period was even worse

The cold period of the Permian was ended with two global warming spikes. A first one, not too devastating yet, occurred around 260 million years ago, when the Emeishan flood basalts erupted in South China. Kilometers-thick piles of basalt lavas poured out over an area of 0.3 million square kilometers. But the Siberian traps, 252 million years ago, were the final nail in the coffin. They covered an area of 7 million square kilometers, caused a doubling of atmospheric $CO_2$ and other greenhouse gasses, causing a global temperature rise of as much as 5°C. And the Siberian lavas rose up through thick layers of rock salt, producing gases that may have destroyed much of the ozone layer. The result? 95% of all marine species went extinct, including the trilobites that had roamed the ocean for nearly 300 million years. 70% of all land life perished. Even many of the insects perished, the only mass extinction of insects that is known so far. It would take life 30 million years to recover. You may want to push your pedals a bit harder to get this stage over and done with!


I am a geologist and I study plate tectonics and the driving mechanisms in the Earth's mantle, mountain building processes, and the geography of the geological past. I enjoy geological fieldworks all over the world, and translating the results to science and a broad public. Check our complete team.

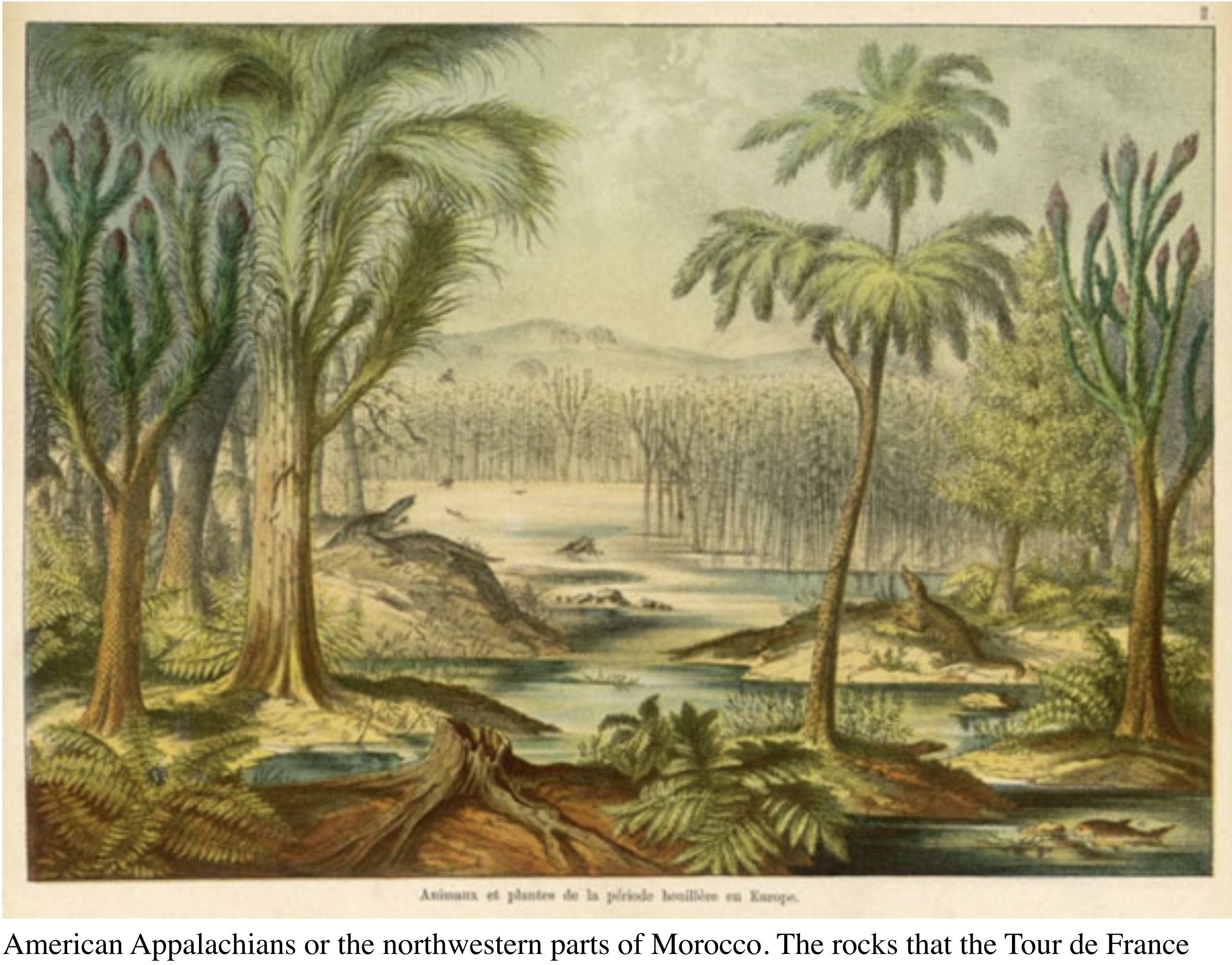
**Douwe van Hinsbergen**

# Stage 7 | Sélestat – Le Markstein / Supercontinent assembly

Women

| | | | | |
|---|---|---|---|---|
| 127 km | | Mountains | | A plant heaven in the Carboniferous: turned into the world's |

As the riders ascend the Vosges today, they find themselves in times of geological turmoil. The rocks along the stage have seen the last stages of the formation of the supercontinent Pangea: we ride over the collision zone of rocks derived from the mega-continent Gondwanaland in the south, and the Euramerican continent to the north. The result was the formation of mountain ranges whose scars we now see in the Ardennes and Vosges, but that are now all over the globe, including for instance the

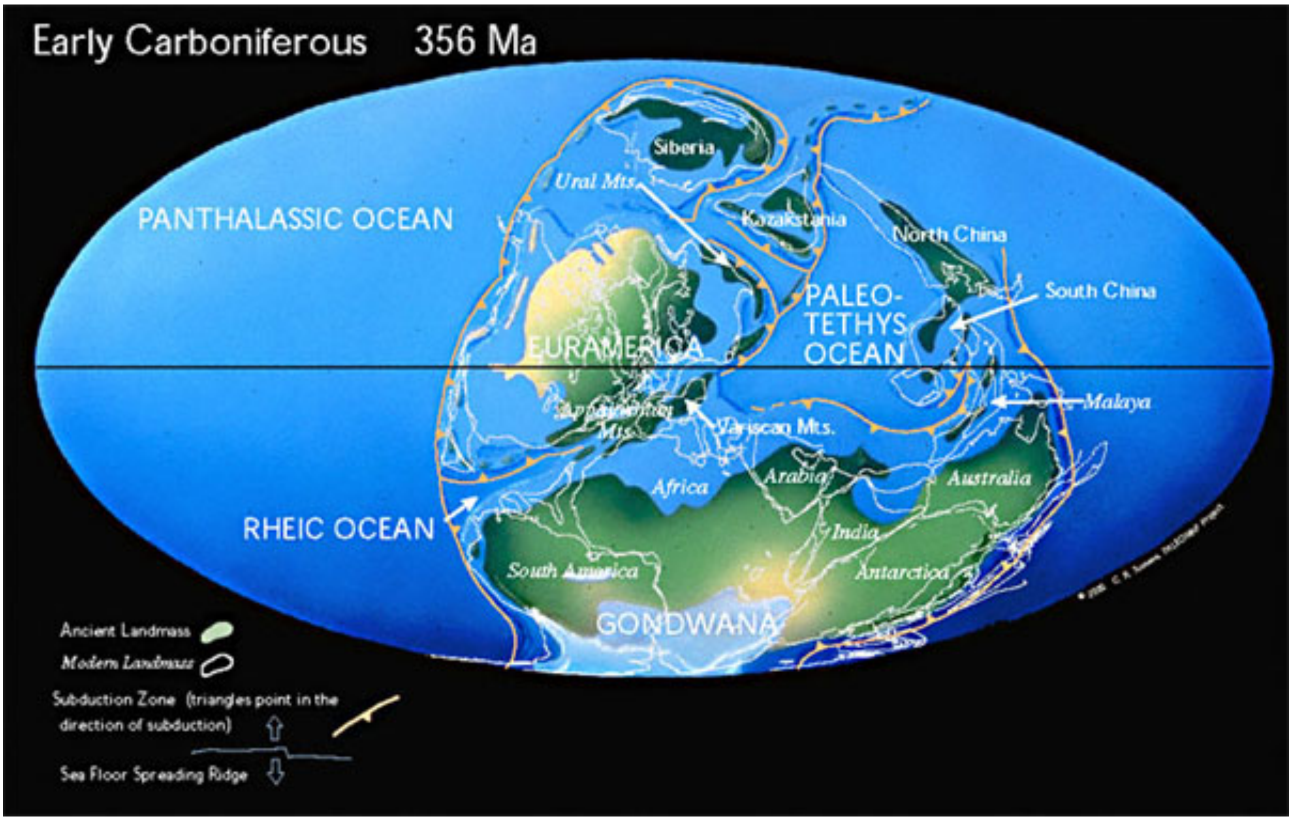


Animaux et plantes de la période houillère en Europe.

American Appalachians or the northwestern parts of Morocco. The rocks that the Tour de France Femmes travels through today was located south of the equator and formed during the Carboniferous period (360 to 300 million years ago). Sea-level was higher, but the climate was not unlike today, with high temperatures on the equator and ice on both poles.

# Carbonoferous rainforests: world's largest coal deposits

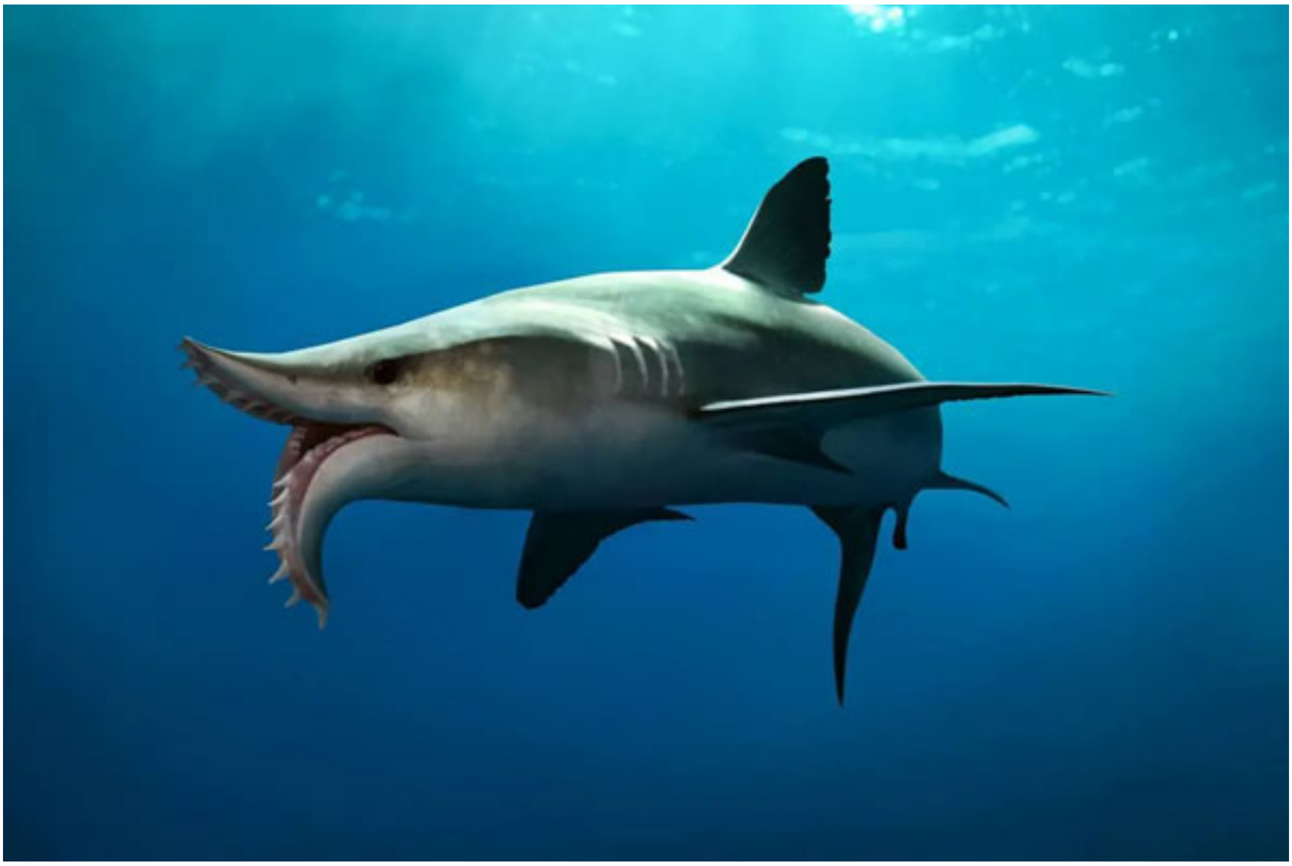
With global climate being more or less the same as today's, it may not strike you as a surprise that the Carboniferous Tour-cyclist would have seen an environment in the Vosges that looks like Brazil today. The Carboniferous equatorial regions had no shortage of water, and the continents were covered in swamps and lush rainforests where plants, like ferns, could grow up to 40 meters tall. But the Carboniferous rain forests were the first of their kind: in earlier times, land plants had only just developed and were in short supply. Due to the lush greenery,




the percentage of oxygen in the atmosphere rose from ~20% (about today's values) to more than 30 %...and this allowed insects to grow larger and larger to rather scary proportions, the size of modern birds. And all these plants are still heating our modern world in more than one way. They created massive deposits of peat, which later turned into the world's oldest and largest coal deposits. These are are still being mined in, for instance, the Ruhr area in Germany and in Pennsylvania in the US, heating our homes and, through $CO_2$ release, global climate. The Carboniferous is named after this coal (Carbon).

# Steep terrain

So look around today and imagine living 300 million years ago. Find yourself marvelling at the



swamps and rainforest on the edge of a big mountain range. You would start the stage with a sweaty ride in the Brazilian Amazon, in a damp and green world. In the ponds you'd find major amphibians the size of crocodiles, or with funny hammerheads, armored fishes, early sharks of more than 6 meters long, and sea scorpions that looked a bit like horseshoe crabs. In the second halve of the stage, the ride starts climbing in the Vosges, the old and (now) eroded Hercynian mountain range. But if this was still the Carboniferous, the climbs would be longer, steeper, and full of active volcanoes: you would climb from the Amazon into the Andes mountains of Peru and Colombia. We expect a warm, wet, and exciting stage!

I study geodynamics, more specifically the interaction between the mantle and plate tectonic processes on the surface and on a very large scale. As we can not go into the mantle, my computer models are based on data from rocks all around the world that tell the story of plate tectonics. Check our complete team.

**Erik van der Wiel**

# Stage 8 | Lure – Planche des Belles Filles / Escape from a hot pot

[Women]

| | | | | |
|---|---|---|---|---|
| 123 km | | Mountains | | The Devonian: Invasion of land, fish wars, and land of |

The final stage of the Tour de France Femmes leads the peloton to the highest peaks and through the oldest rocks: of the Devonian. The climate in the Vosges, then located just south of the equator, during the Devonian Period would resemble cycling around the Red Sea today: unforgiving heat, dry air, little vegetation. On the one

hand, it would be very safe: no animals would run under the wheels, no more flies in the eyes, no mosquitos attracted by the sweat.

## The invasion of land

On the other hand, very little vegetation would offer shade. Because in the Devonian, plants had only just started invading the land, accompanied by an odd spider or myriapod that ventured out of the sea to feed on carcasses washed up on the shore. If you were very lucky, you might stumble upon an animal looking like a crocodile lurking in shallow ponds and using its four clumsy paws to plod onto the land:

the ancestors of all four-limbed animals, including ourselves, were still figuring out the basic moves needed outside of water.

## Fish wars

It was eerily quiet in the Devonian world, with only the whistle of the sand on the dunes. No birdsong, no crickets chirping, no flies buzzing, not even wind murmuring in tree crowns. Our Devonian ancestors didn't quite know how to breathe on land and their throats were not yet ready to howl or bark. But if the dry Devonian land resembled a red-colored Sahara or Mars surface, the oceans were not so much different from today. If you were to do a snorkel and descend into the underworld of the Devonian Sea, you would see it teeming with fish and reefs built by corals and sponges. You might start wondering if there was a war going on: the fish would look like submarines, clad in thick armor plates and with disturbingly large jaws that had the bite force of an irritated grizzly.

## Land of active volcanoes

There was something more disturbing than the armored fish: the Vosges during the Devonian were a land of active volcanos that sent steaming lava into the ocean and covered the land with dust. It also increased the CO2 levels in the atmosphere, causing something of a Devonian global warming. The effects were catastrophic: large swaths of the ocean became anoxic: the water contained very little or no oxygen. Similar to what we predict might happen on Earth in the future, the CO2, rising temperature and lack of oxygen cooked the reefs and decimated marine organisms in one of the largest extinction events in history. It was time to get out of the boiling ocean and conquer the land. Life on land seems considerably less challenging today, although the women climbing La Planche des Belles Filles today may feel like they're struggling like their Devonian ancestors today!

I am a palaeobiologist, so I try to understand evolutionary and ecological processes through the lens of the rocks in which they have been preserved. This is a journey from single crystals under an electron microscope to biodiversity at the scale of entire palaeocontinents. I get to share the joys of this journey with students, which is very rewarding. Check our complete team.

**Emilia Jarochowska**

# Geoscience?

Background

The first association you may have with geoscience are the landscapes - from high mountains and steep cliffs of the Alps to the wide open flatlands of NW France. These landscapes, their evolution, the rivers and glaciers that flow through them, the nature of the soils, and the hazards that they contain, such as landslides, are studied by a field of geoscience known as physical geography. Processes that shaped the modern landscapes are typically on the order of hundreds of thousands of years or less.

The realm below these landscapes contains a record of a much longer history, of millions to billions of years. Geological processes such as sedimentation and volcanism make kilometers-thick piles of rock. These piles contain an archive of the geography of the past, but also life and climate, in the form of fossils and the chemical compounds they contain. At the edges of tectonic plates, these rocks become folded and broken, uplifted and eroded. They are buried and change their mineralogy, they may melt in places, fluids move through them, ore deposits form, earthquakes happen, volcanoes erupt. And the study of the rock record and the long-term reconstruction of the history of the Earth's geography, climate, life, deformation, and mineralization is covered by the field of geology. And even deeper parts of the Earth, beyond tens of kilometers, is the realm of which the only abundant records come from lavas brought up from the deep studied by geochemistry, or where we use waves or magnetic fields to image Earth's interior and its processes, studied by geophysics.

Each blog will briefly explain a geo-process that is related to that day's stage. If you want to know more, find us on Twitter. And if you want to know more about a study in geoscience, check out the institutes where the blog writers work, all over Europe. And maybe we will see you in the field!