

GEONATRA FIELD GUIDE SERIES

THE ATLANTIC SAHARA TRAIL

From Agadir to Dakhla

An 8-day geological road trip through Morocco's Western Sahara — the journey no English-language travel blog has ever mapped.

8

DAYS

2,800

KILOMETERS

60+

GEOSITES

3 Ga

OF EARTH HISTORY

By Daniel Harper · Western Anti-Atlas + Saharan Provinces

GEONATRA

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Why this trip

*Imagine driving 2,800 kilometers from a Berber surf town on the Atlantic, through the green oases of the southern Anti-Atlas, into the windswept dunes of the Western Sahara, and ending at a lagoon famous for kite-surfing — while crossing rocks that are **older than oxygen in Earth's atmosphere**.*

That is The Atlantic Sahara Trail.

This itinerary is built on the official **Volume 6 of the Nouveaux Guides Géologiques et Miniers du Maroc** (2011, Service Géologique du Maroc), authored by E.-C. Rjmati, A. Michard and O. Saddiqi. Geonatra has translated, reorganized and enriched it for English-speaking travelers — adding logistics, accommodation, safety guidance, and the cultural context the original scientific guide does not cover.

What makes this route extraordinary

- **3 East-West transects** through the entire geological history of southern Morocco
- **Bedrock from 3 billion years ago** (Mesoarchean of Awsard) to active sand dunes advancing every year
- A **rare blend of cultures** — Berber, Sahrawi, Moorish, with the ghosts of Spanish colonial trading posts
- One of the world's largest **Cretaceous bituminous basins** (Tarfaya)
- **Dakhla** — caught between Sahara and Atlantic, paradise of kite-surfers and Miocene fossils
- The **most accessible Archean rocks in Africa** at Aousserd

*** A PAUSE**

A word from Daniel — I have driven this route in pieces over many seasons. It is uncomfortable, long, sometimes hot, occasionally administratively annoying, and absolutely worth it. The geology is real. The Sahrawi tea is real. The silence between Aousserd and Tichla, when you stop the car and step out onto rocks that were already old when the first cells appeared in the sea — that is real too.

At a glance

DURATION 8 days (or 6 shortened)	DISTANCE 2,500–3,000 km
RETURN One-way + flight Dakhla→Casa	GEOSITES 60+ documented w/ GPS
TIME SPAN ~3 billion years	VEHICLE Sedan Day 1–Day 5 • 4×4 Day 6–Day 7
PERMIT Required for Day 6, Day 7	BEST SEASON October — April
BUDGET \$1,500–\$3,000 / person	DIFFICULTY Moderate — long days

Before you go — critical preparation

Visa & entry (US travelers)

US passport holders enter **Morocco visa-free for stays up to 90 days**. Your passport must be valid 6 months beyond entry date. No special visa is needed for the Western Sahara region (administratively part of Morocco's Southern Provinces).

The one permit you **MUST** have

For days **6 and 7** (south of Laayoune, toward Aousserd and Tichla), you need an **Ordre de Mission** — an official permit issued by the Moroccan Ministry of Energy, Mines, Water and Environment.

How to obtain it:

- Contact: **Direction du Développement Minier, Division du Patrimoine** in Rabat
- Apply **at least 3–4 weeks before your trip**
- Provide: passport copy, vehicle registration, itinerary, intended dates
- The permit is free but the bureaucracy is slow — start early

⚠ **WARNING**

Without this permit, military checkpoints south of Laayoune will turn you back. Period.

✦ **TRAVEL TIP**

A Moroccan geological guide or licensed tour operator can arrange this permit on your behalf, often faster than going direct. If you book a local guide for Day 6–Day 7 (recommended), they handle the paperwork.

The vehicle question

For the **first 5 days** (Agadir → Dakhla via paved roads), a regular sedan or compact SUV is fine. Roads are good asphalt.

For **6 and 7**, the route includes **piste sections (unpaved tracks): 30 km on Day 6, 100 km on Day 7**. You need:

- **4×4 vehicle** (rented in Dakhla — limited supply, book ahead)
- Two spare tires (sharp rocks)
- Extra fuel (no gas stations between Dakhla and Aousserd)
- At least 10 liters of water per person per day

Maps you'll need

- Carte routière du Maroc 1:1,000,000 (Michelin or Edicarte) — paper backup
- Geological Map of Morocco 1:1,000,000 (north + south sheets)
- Detailed sheets 1:100,000 — Tiznit, Sidi Ifni, Goulmime, Smara, Imlili
- **Maps.me** + Google Maps offline (downloaded before leaving Wi-Fi)
- GPS device or smartphone with offline OSM

Best season

PERIOD	CONDITIONS
October – April	Best. Temperatures 18–28°C daytime, cool nights.
May – September	Avoid. Temperatures regularly 40°C+ in interior. Sahara becomes hostile.
December – January	Cool, occasional rain in Anti-Atlas. Bring layers.
March – April	Sweet spot — warm, low wind, oases blooming.

Money & connectivity

- **Currency:** Moroccan Dirham (MAD). ~10 MAD = \$1 USD.
- **Cash king:** ATMs in Agadir, Tiznit, Tan-Tan, Laayoune, Dakhla. **None between cities.** Carry 3,000–5,000 MAD in cash for the deep south.
- **SIM card:** Maroc Telecom or Orange, ~30 MAD for 20 GB. Buy at Agadir airport. 4G in main towns, sketchy south of Boujdour.
- **Power adapter:** Type C/E (European 2-pin). US plugs do not fit.

Health & safety

- **Water:** drink bottled only. Carry 10 L per person/day on Day 6–Day 7.
- **Sun:** SPF 50, hat, sunglasses non-negotiable.
- **Travel insurance:** mandatory. Confirm coverage of Western Sahara region.
- **Mines warning:** old land mines from the 1975–1991 conflict may still exist near Day 4 (east of Smara) and off-track on Day 6–Day 7. **Stay on the road or piste at all times.**
- **Military checkpoints:** routine south of Tarfaya. Smile, present passport + permit, be patient. Photography of military installations forbidden.



DAY 01 · 330 KM · ~7 HOURS

Where Pan-African Granite Meets the Atlantic

Agadir to Guelmim via Ifni and Plage Blanche · 330 km

The westernmost Anti-Atlas, where the Variscan mountain belt was once as tall as the Himalayas, now eroded down to a coastal staircase of red cliffs and Pan-African basement.

Route overview: Leave Agadir on the N1 going southeast. Cross the agricultural Souss valley. Branch west at Tiznit toward Aglou-Plage, then south along the coast to Mirleft, Sidi Ifni, Legzira, then inland to Guelmim via the N12 with an excursion west to Plage Blanche.

★ Optional Stop — Youssef Ben Tachfine Reservoir

GPS 29°50'28"N · 9°29'52"W · Alt 180 m

A scenic view over the J. Tachilla syncline — Ordovician sandstones folded by the Variscan orogeny, forming a NNE-trending fold on the western flank of the Kerdous massif. Named after the second Almoravid sultan, who founded Marrakech and extended Muslim rule into Andalusia at the end of the 11th century.

★ Stop 1 — Aglou Quarries (Archaeocyath limestones)

GPS 29°47'48"N · 9°49'31"W

Around 1,200 m before Aglou-Plage, turn left onto a track to the working quarries. Here, **525-million-year-old Lower Cambrian limestones** preserve fossil **Archaeocyaths** — sponge-like reef builders that flourished briefly during the Cambrian Explosion before disappearing entirely.

The first marble reefs discovered in Morocco were found here by French geologist Bourcart in 1925. The quarry stones are sold worldwide as "*Grey of Agadir*" or "*Red of Agadir*" marbles.

◆ TRAVEL TIP

The quarry is active — ask permission at the workshop. Bring a small magnifying glass to see the circular Archaeocyath sections (1–1.5 cm wide).

★ Stop 2 — Mirleft (Adoudounian dolomites on Precambrian granite)

GPS 29°35'21"N · 10°02'19"W

Park 1 km from the town center, at the bend in the coastal road. Walk to the beach via the staircase. The cliffs south of the beach reveal **steeply NW-dipping dolomite layers (Lower Adoudounian, ~570 Ma)** resting transgressively on the **Mirleft granite (573–595 Ma)** — a Pan-African intrusion. You're standing on the boundary between two billion-year-old continental basements.

★ Stop 3 — Legzira (Lower Cretaceous on Precambrian)

GPS 29°26'48"N · 10°06'56"W

Park at the end of the Legzira track. Walk down to the beach via the staircases. Move toward the cliffs at the NE end of the beach. You will see **spectacular outcrops of Lower Cretaceous red sandstones, conglomerates and pelites (~130 Ma)** transgressing directly onto the **Pan-African granite (~580 Ma)** — a 450-million-year erosion gap exposed in a single cliff face.

⚠ WARNING

The famous Legzira arches that made this beach world-famous on Instagram collapsed in **September 2016** and **August 2018**. The southern arch is gone; one northern arch remains. The cliffs themselves are still breathtaking, and the beach is one of Morocco's most photogenic.

◆ WHY THIS MATTERS FOR TRAVELERS

Legzira is the **single most Instagram-worthy stop** on this entire route. Time your visit for **golden hour (1 hour before sunset)** — the cliffs glow red.

★ Stop 4 — Ifni-Mesti (Pan-African granodiorite)

The Ifni-Mesti granites contain frequent **mafic enclaves** typical of granodiorites. The Ifni massif is dated **660 ± 22 Ma**, the Mesti massif **681–688 Ma** — late-stage intrusions from the **Pan-African orogeny** that assembled the supercontinent Gondwana.

★ Stop 5 — Oued Assaka (Cambrian ripple marks)

GPS 28°58'19"N · 10°13'41"W

Stop before crossing the wadi. Below the road, **gently SE-dipping Middle Cambrian sandstones (~510 Ma)** show **fossilized ripple marks** and trace fossils (worm trails) on the bedding planes.

◆ WHY THIS MATTERS FOR TRAVELERS

You're walking on a **510-million-year-old beach**. The exact same ripples a wave leaves on a beach today.

★ Stops 6 to 10 — Variscan thrusts to Plage Blanche

These stops document the **westward gradient of Variscan deformation** — progressively more intense folding and schistosity as you approach the Atlantic. **Plage Blanche** (Stop 10, GPS 28°57'54"N · 10°35'52"W) is your first true Sahara beach experience — a 5 km wide white sand plain at the mouth of Oued Boussafene.

◆ TRAVEL TIP

If you're not a geology specialist, you can skip Stops 6 to 9 and go directly from Ifni to Plage Blanche, then to Guelmim. Saves ~1.5 hours.

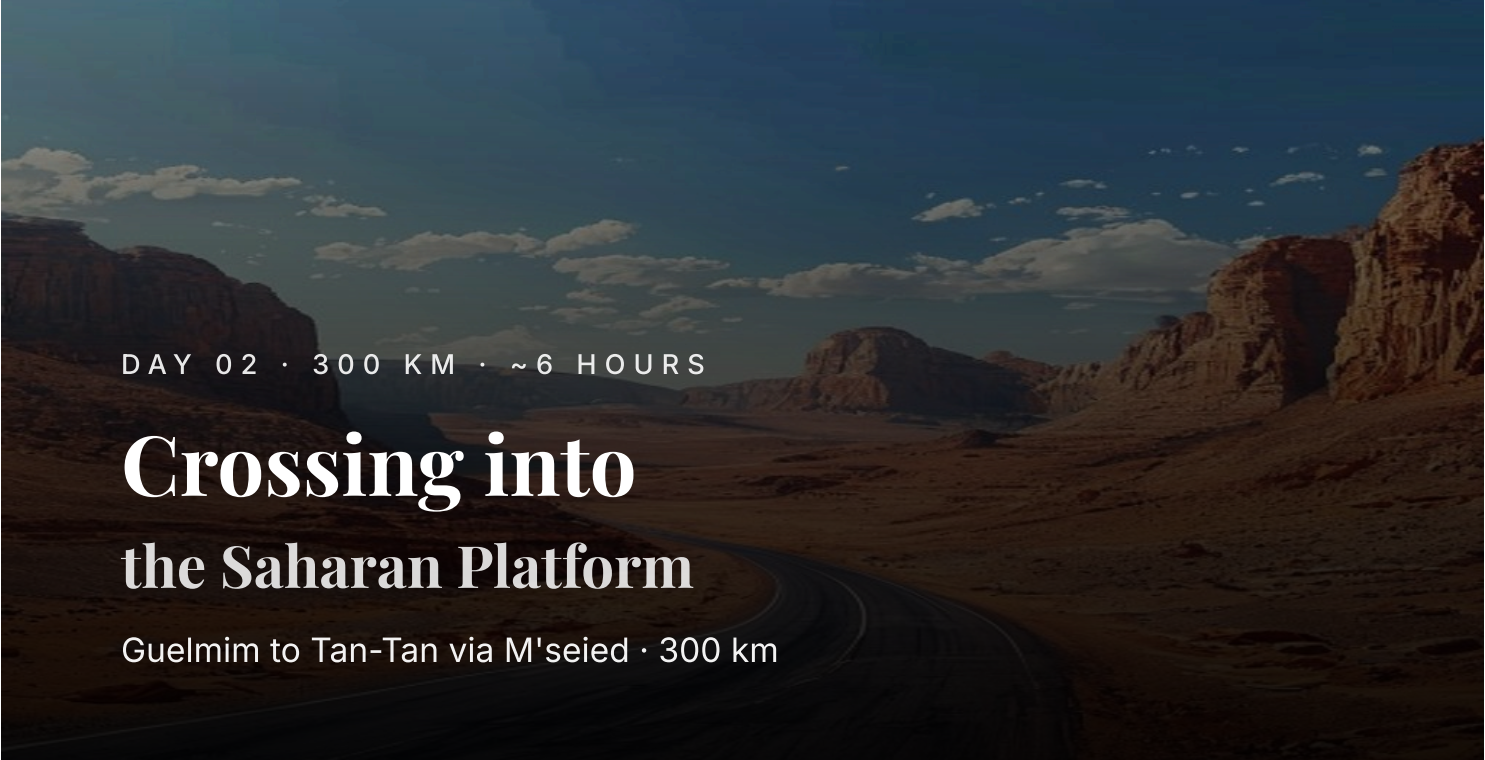
Overnight — Guelmim

Small administrative town, gateway to the Sahara.

- **Hôtel Salam Guelmim** — mid-range, central, ~400 MAD

- **Hôtel Tagant** — basic, friendly, ~250 MAD
- **La Maison Verte** — riad-style, charming, ~600 MAD

Famous for: the **Saturday camel market** (worth it if you're there Friday night/Saturday morning).



DAY 02 · 300 KM · ~6 HOURS

Crossing into the Saharan Platform

Guelmim to Tan-Tan via M'seied · 300 km

Crossing the southern tip of the Anti-Atlas into the Tindouf-Zag cratonic basin. The end of the folded mountain belt, the beginning of the flat-lying Saharan platform.

★ Stop 1 — Bas-Draa Precambrian outcrop

GPS 28°20'46"N · 10°56'03"W

About 15 km southeast of Tan-Tan on the P1600 road. **Dark green volcano-sedimentary conglomerates** of the **Ouarzazate Group (Upper Precambrian, ~570 Ma)** with hand-sized clasts of granite, schist, and quartzite. Two superimposed deformation fabrics: an early foliation (S1) parallel to bedding, and a later oblique schistosity (S2) — both Variscan.

◆ WHY THIS MATTERS FOR TRAVELERS

The Bas-Draa massif is one of the few "windows" in Morocco where you can touch rocks **2 billion years old** (Eburnean basement) — though it requires walking off-route to find them.

★ Stop 2 — Tilamsoun (vertical Cambrian quartzite bar)

GPS 28°16'40"N · 10°54'07"W

The road cuts through a **vertical quartzite bar** (the "Barre de Guelmim") — Middle Cambrian sandstones folded so tightly they now stand straight up. Look for fine, channelized layering inside the beds.

★ Stop 3 — Col du Jbel Zini (Ordovician glacial deposits)

GPS 28°13'22"N · 10°53'12"W

The pass crosses **periglacial pelites of the Upper Ashgillian-Hirnantian (~445 Ma)** — sediments left by the **end-Ordovician glaciation**, one of the most severe ice ages in Earth's history. From here you have a panorama south into the Saharan plains. Below you, a **flamingo-pink sebkha** (Sebkha Leimhaguen) sometimes holds water, sometimes dries to a salt crust.

★ Stop 4 — Rich Folds (Devonian)

GPS 28°05'43"N · 10°53'63"W

A series of **isolated perched synclines** in Lower Devonian (~410 Ma) limestones and sandstones. These are textbook examples of cylindrical Variscan folds, easily visible from satellite imagery.

* A PAUSE

This region was the site of a major tank-and-artillery battle in 1983 between the Royal Moroccan Armed Forces and the Polisario Front. Today it is peaceful, but you may see military patrols.

★ Stop 5 — Cluse de M'seied (Carboniferous Tazout, Tindouf basin edge)

GPS 28°00'58"N · 10°49'01"W

At the entrance of M'seied, the road cuts through the **Jbel Tazout** — a 350 km-long limestone ridge marking the boundary between the folded Anti-Atlas and the **flat Tindouf-Zag cratonic basin**. The Carboniferous limestones (~340 Ma) here are nearly horizontal.

⚠ WARNING

Do not venture far into the cluse — risk of residual landmines.

Overnight — Tan-Tan or Tan-Tan Plage

- **Hôtel Bir Anzaran** (El Ouatia) — mid-range, on the beach, ~500 MAD
- **Hôtel Adrar** — basic, central, ~300 MAD
- Cheap seafood at the port (grilled sardines, ~50 MAD)



DAY 03 · 300 KM · ~7 HOURS

Cap Juby and the Ghosts of Aéropostale

Tan-Tan to Laayoune via Tarfaya · 300 km

The Tarfaya-Laayoune coastal basin — one of the world's largest Cretaceous oil-source rock provinces. You will also visit Cap Juby, the legendary base of Antoine de Saint-Exupéry's mail-plane operations.

★ Stop 1 — Tan-Tan Cretaceous & Plio-Quaternary terrace

GPS 28°28'45"N · 11°12'15"W

A panoramic outcrop showing the **classic Saharan stratigraphic stack**: Lower Cretaceous "Wealdien" red sandstones (river deposits, ~130 Ma) overlain by the **"Hamada slab"** of Miocene-Pliocene lacustrine limestones, capped by Quaternary dunes. You can see how the **paleo-coastline of 2.4 Ma ago** is preserved as parallel sand ridges visible from satellite.

★ Stop 3 — Amma Fatma Beach (Cenomanian–Turonian bituminous marls)

GPS 28°12'24"N · 11°46'40"W

One of the most scientifically important outcrops of the entire trip.

These **alternating limestones and bituminous marls** record one of the **largest oceanic anoxic events (OAE2) in Earth's history**, ~93 million years ago. The black, organic-rich layers are the **source rock for Moroccan offshore oil** — they preserve dead plankton from a time when global oceans went hypoxic due to runaway volcanism and greenhouse warming.

◆ WHY THIS MATTERS FOR TRAVELERS

You are looking at the same kind of rock that powers global industry today. And the cyclic banding records Earth's orbital wobbles (Milankovitch cycles).

★ Stop 4 — Coastal Karst Collapse

GPS 26°06'33"N · 12°02'21"W

A **karst pit (gouffre)** opens through the Quaternary limestone slab, connecting to the sea via an underwater tunnel. At the bottom, you can see the **bituminous Turonian marls**. Fenced for safety.

★ Stop 5 — Sebkha Tazra

GPS 27°54'15"N · 12°20'15"W

A salt-pan bordered by white cliffs showing the **classic OAE2 section** that Keller et al. (2008) used to demonstrate an oxic upwelling event just before the global anoxia. This same outcrop is correlated with the Pueblo, Colorado USA stratotype.

★ Stop 6 — Tarfaya & Cap Juby

GPS 27°56'25"N · 12°55'44"W

The tiny, sand-blown port town of Tarfaya is where **Antoine de Saint-Exupéry** lived from 1927–1929 as the manager of the Aéropostale's mail-plane base. Find the **small monument to Saint-Exupéry** north of the port, facing **"the Englishman's House"** — a colonial trading post built on a tidal islet.

◆ WHY THIS MATTERS FOR TRAVELERS

Tarfaya is a **literary pilgrimage site**. Saint-Exupéry wrote much of *Courrier sud* here, and his experiences over the Sahara inspired *The Little Prince*.

★ Stop 7 — Sebkha Tah (below sea level!)

GPS 27°41'55"N · 12°56'59"W

About 4 km before the Tah monument, take a track east to the edge of **Sebkha Tah**. The floor of this dried lake basin is at **-56 meters below sea level** — one of the lowest points in Africa. Isolated from the Atlantic by a wide dune cordon. The basin floor reveals Upper Cretaceous (Campanian) marls.

* A PAUSE

*Just south of this stop, you cross the **Marche Verte** line — the 1975 border where 350,000 Moroccan civilians peacefully marched into the former Spanish Sahara, leading to its incorporation into Morocco. A monument marks the spot.*

★ Stop 9 — Laayoune (Neogene unconformity)

GPS 27°09'58"N · 13°16'35"W

Road widening works in 2009 exposed a fresh cross-section of the **Miocene-on-Campanian unconformity** as you enter the city — a clear record of the major tectonic uplift event that ended Cretaceous marine sedimentation.

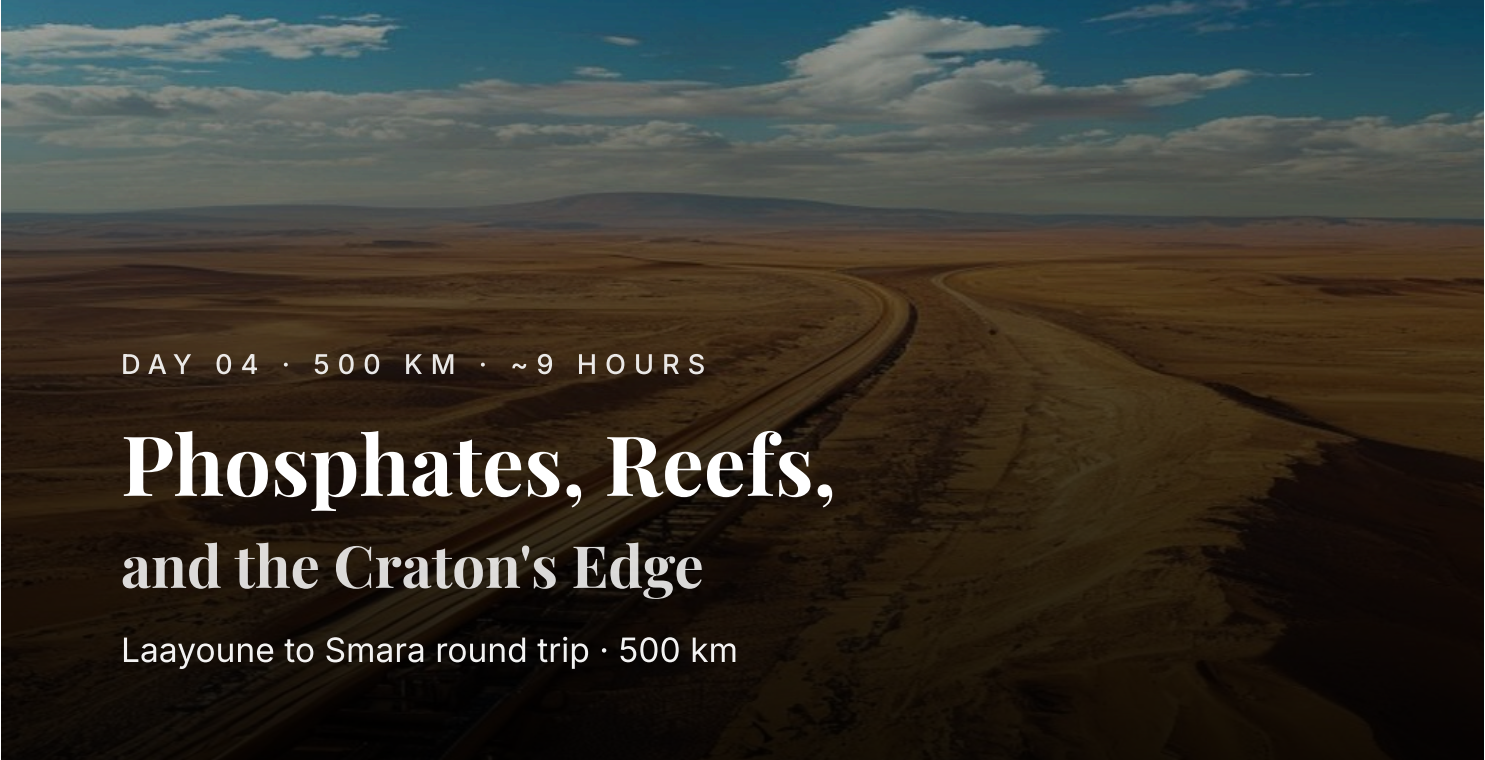
Overnight — Laayoune

Capital of the Southern Provinces. ~250,000 inhabitants.

- **Hôtel Parador Laayoune** — 4-star, colonial charm, ~900 MAD
- **Hôtel Sahara Line** — mid-range, ~600 MAD

- **Hôtel Lakouara** — budget, basic, ~250 MAD

Local specialty: **Sahrawi tea ceremony** (three glasses, each progressively sweeter — refusing one is impolite).



DAY 04 · 500 KM · ~9 HOURS

Phosphates, Reefs, and the Craton's Edge

Laayoune to Smara round trip · 500 km

The Variscan fold belt of the Zemmour, the phosphate mines of Boukra (the world's longest conveyor belt), and the Devonian reef mounds at the edge of the West African Craton.

⚠ WARNING

From Stop 3 onward, the area may contain residual mines from the conflict period. **Never leave the road.** A military permit is recommended; check at Smara military post.

★ Stop 1 — Boukra Phosphate Conveyor

GPS 26°42'81"N · 13°06'46"W

52 km south of Laayoune. You will cross the **96-kilometer-long Boukra–El Marsa phosphate conveyor belt** — **the longest in the world**, built by the Spanish in the 1960s. About 5% of the load is lost to the wind, creating the white plume visible from satellite.

◆ WHY THIS MATTERS FOR TRAVELERS

You are at the heart of the **Moroccan phosphate empire** — Morocco holds 70% of world phosphate reserves, the basis of global fertilizer production.

★ Stop 3 — Asken Ordovician Fold Arc

GPS 26°39'57"N · 11°56'00"W

A spectacular **arcuate fold of Ordovician (~470 Ma) quartzites** — convex eastward, visible from satellite. The vertical quartzite beds emerge from the desert sand and were partly buried by Lower Cretaceous transgression.

★ Stop 5 — Devonian Fold Arc (Givetian reefs)

GPS 26°41'42"N · 11°46'52"W

West of Smara, a **belt of Variscan folds in Givetian (~387 Ma) limestones** — the same age as the famous **Devonian reef belts of the Canning Basin, Australia**. The reefs here grew along the edge of the **West African Craton** in a 1,500 km-long carbonate belt extending into Algeria.

✦ TRAVEL TIP

The **Zaouïa of Smara** — a religious complex built with Middle Devonian stones — is worth a visit before continuing east.

★ Stop 6 — View into the West African Craton

From a Givetian cuesta, you can see the **tabular cratonic platform** stretching east. The horizontal layers of Devonian limestones host **coral and stromatoporoid reef mounds** that ringed the emerged craton during the Givetian, from here to central Algeria.

Overnight — Laayoune (return to same hotel)



DAY 05 · 540 KM · ~7 HOURS

540 km Along the Atlantic Sahara

Laayoune to Dakhla via Boujdour · 540 km

The endless Atlantic Sahara coast — 540 kilometers between two cities, almost no settlements between. Living dunes, cliffs of Miocene marl carrying oyster fossils, and at journey's end, the lagoon city of Dakhla.

⚠ WARNING

Long driving day. Plan to arrive in Dakhla by 4 PM to report to military and civilian authorities (main square + Awsard Annex on the seafront).

★ Stop 1 — Seguiet-el-Hamra View

GPS 27°09'28"N · 13°13'31"W

Two km from Laayoune city center, the road dominates the Seguiet-el-Hamra ("Red Stream") river, sunken 50 m below in a sea of dunes. The **Laayoune dune cordon is 10 km wide and 300 km long**, born on the Tarfaya coast and marching south-southwest. The river itself disappears under the sand downstream — only reappearing at the ocean at Fom El-Oued.

◆ TRAVEL TIP

The dunes here are a perfect introduction to **active Saharan geomorphology**. Stop, walk into them, feel the wind shape the ridges in real time.

★ Stop 2 — Boujdour Coast & Basin

GPS 25°58'59"N · 14°30'10"W

About 16 km south of Boujdour, a track drops over the cliff to a wide beach where more than one ship has run aground. The **Atlantic continental shelf** here is wide with a gentle slope (~0.5%). Subsurface profiling reveals normal faults at the top of the slope and compression at the bottom — evidence of **gravity-driven slumping**.

◆ WHY THIS MATTERS FOR TRAVELERS

This stretch of coast is **one of the most under-explored deep-water hydrocarbon provinces in the world**. The basins beneath your feet may hold tomorrow's oil — and yesterday's geological mysteries.

★ Stop 4 — "Aguerguer" Landscape

GPS 24°49'57"N · 14°50'51"W

The landscape opens into the **"aguerguer"** — a dissected terrain of **Moghrebian marls interbedded with cave-riddled limestones**. Wind and Quaternary streams have sculpted it into a maze of buttes, mesas, and caves. Looks alien. Feels alien.

★ Stop 6 — Miocene Cliffs Without a Beach

GPS 24°12'19"N · 15°25'23"W

90 km north of Dakhla. The slab edge collapses in massive blocks revealing varicolored **Miocene marls (ochre, red, white)** beneath. **Notably, no beach** — suggesting **active subsidence** of this coastal stretch.

✦ TRAVEL TIP

The small dunes between road and cliff are **scattered with Neolithic chipped flints** and ancient oyster shell accumulations — these dunes sheltered prehistoric fishermen for millennia. Look but don't take.

★ Stop 7 — Dakhla Lagoon: Miocene + Artesian Well

GPS 23°53'97"N · 15°42'67"W

Four km west of the lagoon crossroads, descend to the lagoon edge. A short track leads to an **artesian well**, producing water at **~40°C, rich in hydrogen sulfide**, drawn from the **Lower Cretaceous aquifer 300 m below**. A marker of the deep continental aquifer system that supplies Laayoune and Dakhla.

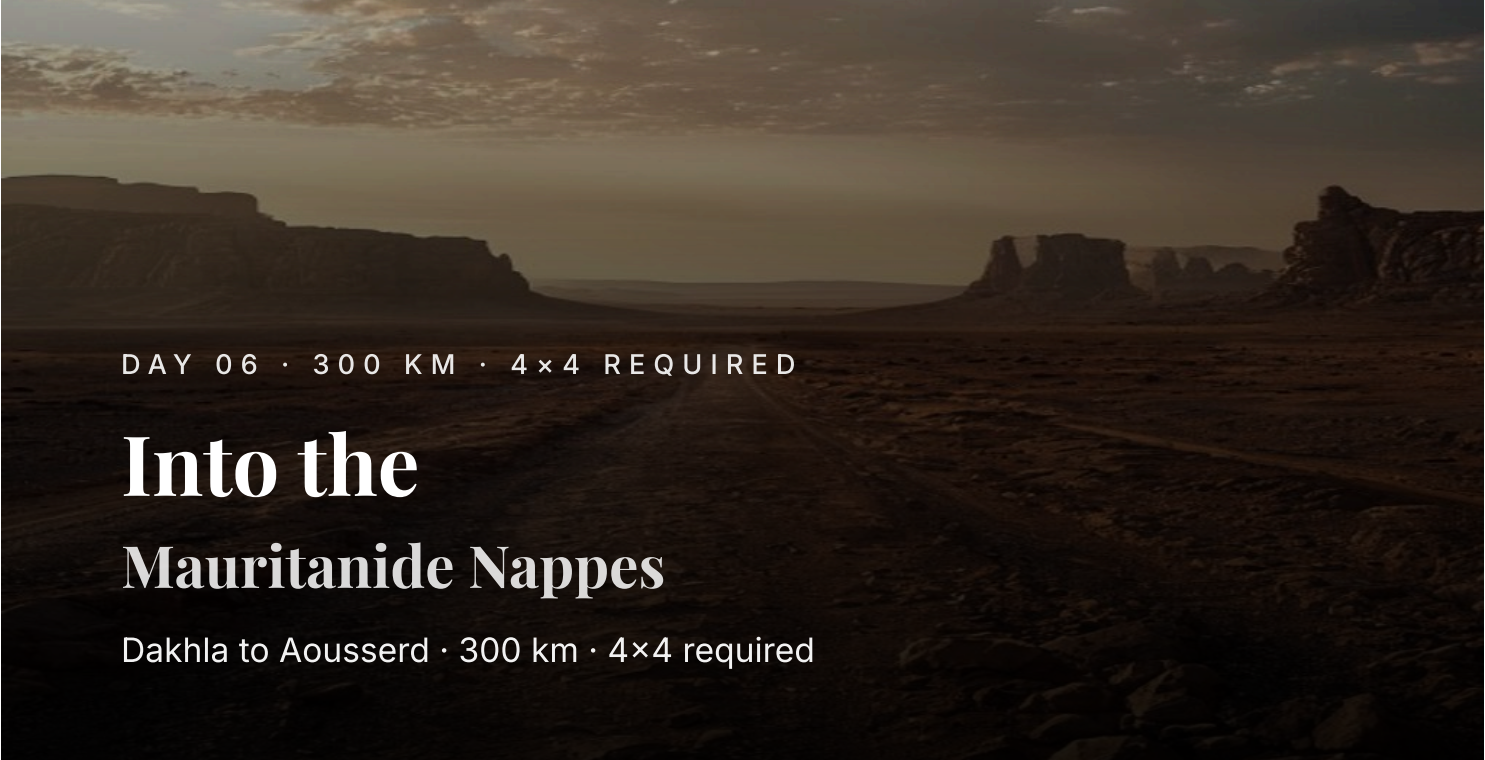
Welcome to Dakhla

Dakhla is one of the world's premier kite-surfing destinations. The peninsula is 40 km long, caught between ocean and lagoon, ringed by paleodune ridges.

- **City of Dakhla** — basic hotels (~300–600 MAD)
- **Dakhla Lagoon (25 km south)** — kite-surf resorts, beach lodges (~800–2,500 MAD)

- Dakhla Attitude — premium kite-surf camp
- Westpoint Dakhla — mid-range
- PK25 / Camp Sahara — budget eco-lodges

Famous for: **oysters** (lagoon farms), **kite-surfing** (steady 25-knot trade winds), **dunes meeting ocean**.



DAY 06 · 300 KM · 4×4 REQUIRED

Into the Mauritanide Nappes

Dakhla to Aousserd · 300 km · 4×4 required

⚠ WARNING

Permit required. 4×4 required. Inform police in Dakhla of your departure and ETA Aousserd. Plan to arrive at Aousserd by **5 PM**. Refuel completely in Dakhla.

Today you leave the Atlantic marine basin behind and cross into the Moroccan Mauritanides — the southernmost remnant of the Variscan mountain belt that once stretched from here to the Appalachians. At day's end, beyond Aousserd, you will see the Reguibate Shield: the eastern edge of the West African Craton, with rocks 3 billion years old.

★ Stop 2 — "Rocher du Sphinx"

GPS 23°35'27"N · 15°41'53"W

38 km from the Dakhla crossroads, on the left side of the road, a rock formation evokes **the Sphinx of Giza** — sculpted by wind erosion from the **continental Moghrebian** (Helix-bearing calcarenites). A great photo stop.

★ Stop 3 — Lower Cretaceous + Neolithic Rock Engravings

GPS 23°19'36"N · 15°13'58"W

Walk ~300 m right of the road to dark hills. **Conglomeratic sandstones at the base of the Lower Cretaceous** unconformably overlying the Archean basement. The hill is a **Neolithic sanctuary**. Several rocks carry **engravings of animals and abstract figures** carved during the African Humid Period (~6,000 years ago) when the Sahara was savanna.

◆ WHY THIS MATTERS FOR TRAVELERS

You are looking at art carved when the Sahara was full of giraffes, elephants, and rivers. A double layer of "deep time": geological (130 Ma sandstone) and human (6 ka engraving).

★ Stops 4 to 11 — Across the Mauritanide nappes

A series of stops across **amphibolites, mylonitic orthogneisses, garnet micaschists, calc-silicate marbles, and quartzite mylonites** — rocks transformed by deep burial and Variscan shearing. The Laglat zaouia (Stop 10, `GPS 22°36'44"N · 14°28'57"W`) sits in a cirque of micaschist cliffs.

⚠ WARNING

Watch for venomous snakes along the Laglat cliff base — some species here are tree-climbers.

★ Stop 13 — Autochthonous Paleozoic + Reguibate Shield Panorama

`GPS 22°37'38"N · 14°24'29"W`

The day's grand finale.

Climb the hill south of the wadi. You cross orthogneisses of the Archean basement, then see **Upper Ordovician sandstones unconformably overlying the granite-gneiss basement** — a 2.5-billion-year erosion gap, exposed in a single hillside.

From the summit (334 m), the panorama opens **eastward across the Reguibate Shield** — Earth's most ancient surfaces. Beyond Aousserd you see the 580 m peaks of Bou Gattaya — the **Aousserd nepheline syenite ring intrusion** (tomorrow's stop).

Overnight — Aousserd

A small, isolated military and administrative outpost. **Government guesthouse** ~\$20-40, basic. Bring sleeping bag, extra water, phone power bank. Phone reception spotty. Tea & conversation with locals: abundant, free, memorable.



DAY 07 · 240 KM · PISTE, MILITARY ESCORT

Touching the 3-Billion-Year-Old Rocks

Aousserd to Tichla to Entajat · piste, military escort

⚠ WARNING

The most isolated day of the trip. Full fuel, extra water (10 L per person), satellite communications recommended. Beyond Tichla, a **military escort vehicle is strongly recommended**. Inform military authorities of your itinerary before departing Tichla.

The day you touch the oldest rocks in Morocco. Mesoarchean basement, ~3 billion years old — older than free oxygen in Earth's atmosphere, older than every complex multicellular organism, older than every continent that has ever existed except the supercontinent from which our planet's first land emerged.

★ Stop 1 — Dli'at An'Nsour Agmatites · First contact with the Archean Basement

GPS 22°35'52"N · 14°24'09"W

Superb outcrops of heterogeneous migmatites (agmatites) are exposed: angular basic enclaves fragmented and stretched, granitic veinlets folded into **ptygmatic curves**, subhorizontal foliation. **Estimated age: Mesoarchean (~3 billion years).**

* A PAUSE

A pause to consider what you're seeing. When this rock formed:

- *The atmosphere had **no free oxygen***
- *Life consisted only of **single cells in shallow seas***
- *Earth's surface temperature was higher than today*
- ***No continent existed** in its modern form*
- *The Sun was 30% dimmer*

This rock has been at Earth's surface, or close to it, for ~3 billion years. It has seen the entire evolution of life. It has been a witness.

★ Stop 2 — Aousserd Nepheline Syenite (Ring Intrusion)

GPS 22°33'01"N · 14°19'02"W

An **elliptical ring intrusion (8 km E-W, 12 km N-S)** penetrating the Archean basement. The rock is massive, with rounded joints. **Age:** probably **Neoproterozoic (~676–687 Ma)** by correlation with the dated Bou Naga ring intrusions of Mauritania. Likely linked to the **fracturing of the West African Craton** during Pan-African continental rifting.

★ Stop 4 — Tichla Greenstone Belt: Felsic Metavolcanics

GPS 21°46'12"N · 14°49'16"W

Quartz-feldspar metasediments and felsic metavolcanic tuffs. Part of the same volcanic-sedimentary suite dated at **~2,965 Ma (2.97 billion years)** in the Chami greenstone belt of Mauritania.

◆ WHY THIS MATTERS FOR TRAVELERS

Greenstone belts are **archetypal Archean structures** — assembled volcanic-sedimentary basins reworked by anatexis and granitization. They commonly host gold, iron, and base metal deposits — the Tasiast gold mine in Mauritania, in this same belt system, is one of West Africa's largest.

★ Cheikh Hmami Sanctuary

A cluster of wells in a sacred site (185 m altitude). A small house of guards offers **fresh water and tea** on the return. Recommended hospitality stop.

★ Stops 6 & 7 — Entajat Metagabbro Sheets

GPS 21°55'10"N · 15°09'05"W

Stacked thrust sheets of metagabbros and metabasement, visible in satellite imagery. The Adrar Souttouf gabbros may date to **~595 Ma (Late Pan-African)**, later metamorphosed under high-pressure conditions (eclogite facies in Mauritania, ~330 Ma) during the **Variscan collision**.

Overnight — Tichla (return)

Stop at Cheikh Hmami for the gardeners' tea hospitality and the desert silence. Lodging in Tichla is military or makeshift.

DAY 08 · 400+ KM · RETURN

Carbonatites and the Long Drive Home

Tichla to Dakhla · 400+ km · return

Return to civilization. Three possible itineraries — the most rewarding includes two final remarkable geological stops at the carbonatite massifs and the Tisnigaten thrust.

OPTION	ROUTE	TIME	NOTES
A — Asphalt	Tichla → Aousserd → Dakhla, same as outbound	~5 h	Easiest
B — South circuit	Round south of Ouled Delim massif	~6 h	Long scenic alternative
C — Piste via carbonatites	Tichla → Aousserd via dirt road, then asphalt to Dakhla	~7 h	★ Most rewarding

★ Stop 1 — Gleibat Drag Iron-Bearing Carbonatites

GPS 22°12'05"N · 14°54'52"W

Carbonatites are extremely rare rocks — globally, only ~600 known occurrences. They are igneous rocks rich in carbonates born from melts that originated in the deep mantle. They are the world's **primary source of rare-earth elements (REE), niobium, and tantalum** — critical for electronics, magnets, and green technology.

The Glibet Atil (Lahfouda) carbonatite has been prospected by ONHYM and shown to contain **elevated concentrations of niobium, tantalum, and light REE** in the iron-rich cap.

◆ WHY THIS MATTERS FOR TRAVELERS

You are looking at one of Africa's **strategic critical mineral resources**, in its raw outcrop form.

★ Stop 2 — Tisnigaten Quartzites: Truncation on Devonian

GPS 22°20'40"N · 14°36'28"W

A stunning angular truncation: a **quartzite slab thrust onto blueish Devonian limestones** (Silurian-Lower Devonian with orthoceras fossils). The thrust contact is visible in natural cross-section — textbook perfect.

Departure: Dakhla → Casablanca

Royal Air Maroc flies daily Dakhla → Casablanca, ~1,500–2,500 MAD (\$150–250), 2h25 flight. **Book at least 2 weeks ahead** — seats fill, especially in winter kite-surf season.

✦ TRAVEL TIP

Schedule at least 4 hours connection in Casablanca between Dakhla flight and international flight — domestic flights occasionally delay due to winds.

Accommodation guide

CITY	STAY	COST	NOTES
Agadir	Riad Villa Blanche, Atlas Amadil Beach	\$80– 200	Departure point
Mirleft	Maison Vue Mer	\$50– 100	Optional before Guelmim
Guelmim	Hôtel Salam, La Maison Verte	\$30–70	Functional
Tan-Tan Plage	Hôtel Bir Anzaran	\$40–60	Beachside
Laayoune	Parador, Sahara Line	\$60– 120	Best comfort south of Agadir
Dakhla city	Hôtel Doumes, Sahara Regency	\$40– 100	Functional
Dakhla Lagoon	Dakhla Attitude, Westpoint	\$100– 300	Kite-surf resorts
Aousserd	Maison d'hôtes admin.	\$20–40	Bring sleeping bag

The 6-day shortened version

If you only have 6 days, the official guide suggests:

1. **Skip the Smara loop (Day 4)** — save 1 day
2. **Merge Day 2 + Day 3 into a single fast Tan-Tan-to-Dakhla day**

This trims the trip to ~6 days but you lose the **Variscan fold belt of Smara** and the **Devonian reef mounds** — major scientific highlights. Geonatra recommends the full 8 days if at all possible.

Beyond the rocks — culture, food, hospitality

The Sahrawi tea ceremony

In every Sahrawi or Berber home you visit, expect **three glasses of mint tea**, each progressively sweeter. The saying goes: *"The first glass is as bitter as life, the second as strong as love, the third as sweet as death."* Refusing a glass is impolite — accept all three.

What to eat

- **Tajine** — slow-cooked meat & vegetables, everywhere
- **Camel meat** — common in the south
- **Dakhla oysters** — farmed in the lagoon, world-class
- **Grilled sardines** at Tan-Tan port (~\$5 a kilo)
- **Saharan dates** — buy at Guelmim market
- **Argan oil** (from the Souss valley near Agadir)

Cultural sensitivities

- Dress modestly, especially women

- Ramadan — restaurants closed during the day in many towns
- Photography: ask before photographing people, **never photograph military**
- Friday is the holy day — many shops closed midday
- Tipping: 10% in restaurants, 10–20 MAD for hotel staff, 50–100 MAD for a half-day guide

Frequently asked questions

Is it safe for US travelers?

Yes. Morocco is one of the safest countries in Africa. The Western Sahara region is administered and secured by Morocco; police and military are visible but courteous. Follow checkpoint procedures.

Can I do this in a regular car?

For Day 1–Day 5: yes. For Day 6–Day 7: absolutely not. You **must** rent a 4×4 (in Dakhla or Agadir).

Do I need a guide?

Recommended for Day 6–Day 7 — a local geologist or experienced driver helps with permits, navigation, military relations, and finding the geological stops. For Day 1–Day 5, you can self-drive.

How much does it cost?

Per person, splitting a 4×4 between 2–3 travelers: **Budget** \$1,200–1,500 · **Mid-range** \$1,800–2,500 · **Comfort** \$3,000+

What's the best time to go?

October to April. Outside that window, the Sahara is too hot to enjoy.

Can I shorten it further than 6 days?

You can do only Day 1–Day 3 (3 days, Agadir → Laayoune) and fly back from Laayoune. You'll miss the most scientifically unique part but still see the Anti-Atlas

and Tarfaya.

Can I extend it?

Yes — add days to explore the Saghro Mountains (Eastern Anti-Atlas), the Drâa Valley oases, the Erg Chebbi dunes, or the Imouzzer waterfalls.

Is internet available?

4G in all major towns. Sketchy on Day 5 (Boujdour stretch). **Almost nothing on Day 6–Day 7.** Download offline maps before leaving Dakhla.

Sources & further reading

This guide is based on the official Moroccan geological source:

Rjimati, E.-C., Michard, A. & Saddiqi, O. (2011). *Anti-Atlas occidental et Provinces sahariennes / Western Anti-Atlas and Saharan Provinces*. Volume 6 of *Nouveaux Guides Géologiques et Miniers du Maroc*. Notes et Mémoires du Service Géologique du Maroc, n° 561. 91 p.

Additional key references:

- Michard et al. (2008). *Continental evolution: the geology of Morocco*. Springer.
- Keller et al. (2008). OAE2 event at Tazra section, Tarfaya basin.
- Wendt & Kaufmann (2006). Devonian reef mounds of the Zemmour.
- Hafid et al. (2008). Tarfaya-Laayoune coastal basin offshore stratigraphy.
- Geological Map of Morocco 1:1,000,000 (1985), Service Géologique du Maroc.

Geonatra related articles:

- [Anti-Atlas Geology: 3 Billion Years of Pan-African History](#) — Hub overview
- [3 Billion Years Below the Sahara: West African Craton](#)
- [Bou Azzer: A Lost Ocean in Morocco's Anti-Atlas](#)
- [Deep Time in Morocco's Atlas Mountains](#)

About Geonatra



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