Field trip: Val de Ferpècle

Les Haudères - La Forclaz - Ferpècle - Glacier de Ferpècle - Les Haudères by Pierre Kunz (an excerpt from the booklet *Three Geologic Field trips in the Commune of Evolène "Upper Val d'Hérens – Valais" published by Evolèn'art), edited by S.Ruttimann and translated by C.Gutowski 2015.*

This field trip will introduce us to the **different facets of the Val de Ferpècle: the types of rocks to be encountered** as well as the information they can provide us on the **structure of the geologic nappes** or thrust sheets. We will also see the **glacial history of the Val de Ferpècle,** which is still in evidence today in the landscape.

Description

- Departure from Les Haudères in front of the Geology Centre (1440m).
- Take the road uphill from Les Haudères in the direction of the Hameau des Foches (mountain bike path – Cilo) Note: the path which leads directly to La Forclaz from the upper part of the village bypasses stop A-1.
- The *rock* faces dominating Les Foches are composed of *metabasalts.* However, the promontory on which Les Foches is built upon consists of *oceanic sediments* (gray *series - lustrous schists)* . The small *ravine* which separates Les Haudères from this promontory bears witness to the ancient bed of the tumultuous Borgne de Ferpècle. Before this river was canalised in the south and west of the village after glacial outbursts, there were flood damage and bridges washed away (1935,1943,1952).
  Les Foches groups together the first known habitations in Les Haudères, all built on an elevated site to avoid *flooding* and high water. A chalet dates from 1565. The entire side of the valley beneath the wall of La Forclaz is a source of active instability marked by *rockfalls* (as evidenced by the packets of fallen rocks extending as far as the road from Les Haudères to Evolène) as well as superficial slides, which cuted off the road to La Sage in the Spring of 1995.

- At 1475m, we take the right fork in the road, just above les Foches direction La Forclaz-Bréona. We Keep climbing on this road until the intersection with the route de La Sage.
- Along this road, about 20 m below the intersection is a splendid *glacial pothole* hollowed into the *metabasalt* (see the photo on the right and be careful of the traffic !).
- We continue along the path direction La Forclaz-Bréona.

Itinerary

See the interactive map of the itinerary available in the GéoGuide Val d'Hérens (« Map » tab)
http://www.evolene-geologie.ch/geologie/geoguide-herens-285.html

Stop A-1 (605605/103537) (46° 4' 59.961" 7° 30' 39.989")

Intersection of the Route de La Sage and the road climbing toward La Forclaz.
Here we find ourselves directly at the foot of the *rock* face of La Forclaz, here with a height of about 10-15m. The wall is **composed of gray and light green *metabasalts,* showing a white to beige *patina* with black traces due to water streaming**. Its aspect is most often massive, but there are localized appearances of more *tortuous schists.* Note also the presence of **numerous fractures, crumpling and meter–long *folds* towards the summit, punctuated by *veins* and nodules of white quartz**. These rocks are ancient *oceanic* lavas (the massive parts) along with **fine volcano-sedimentary materials** (ashes and *lapillis* for the more schistose parts).
The summit of the wall consists of gray calschist.

- Turning towards La Forclaz, the road crosses **underlying *metabasalts* which are *oceanic* sediments**. Here they are massive and are effectively *marbles* in the geological sense of the term which is to say recrystalised *limestones.* Surprisingly while these *marbles* show very fine crumpling and *bedding,* **fossils are completely absent**! They are themselves overlain by more schistose *sediments* (calschists).
- At 1530 m. near two chalets inhabited in the summer and a water reservoir, the paved path is bordered by stone dry walls of *serpentinites* (black–dark green *patina)* , as well as granitic *gneiss* coming originally from the *Dent Blanche* (white-light green *patina)* .

Rock face of La Forclaz

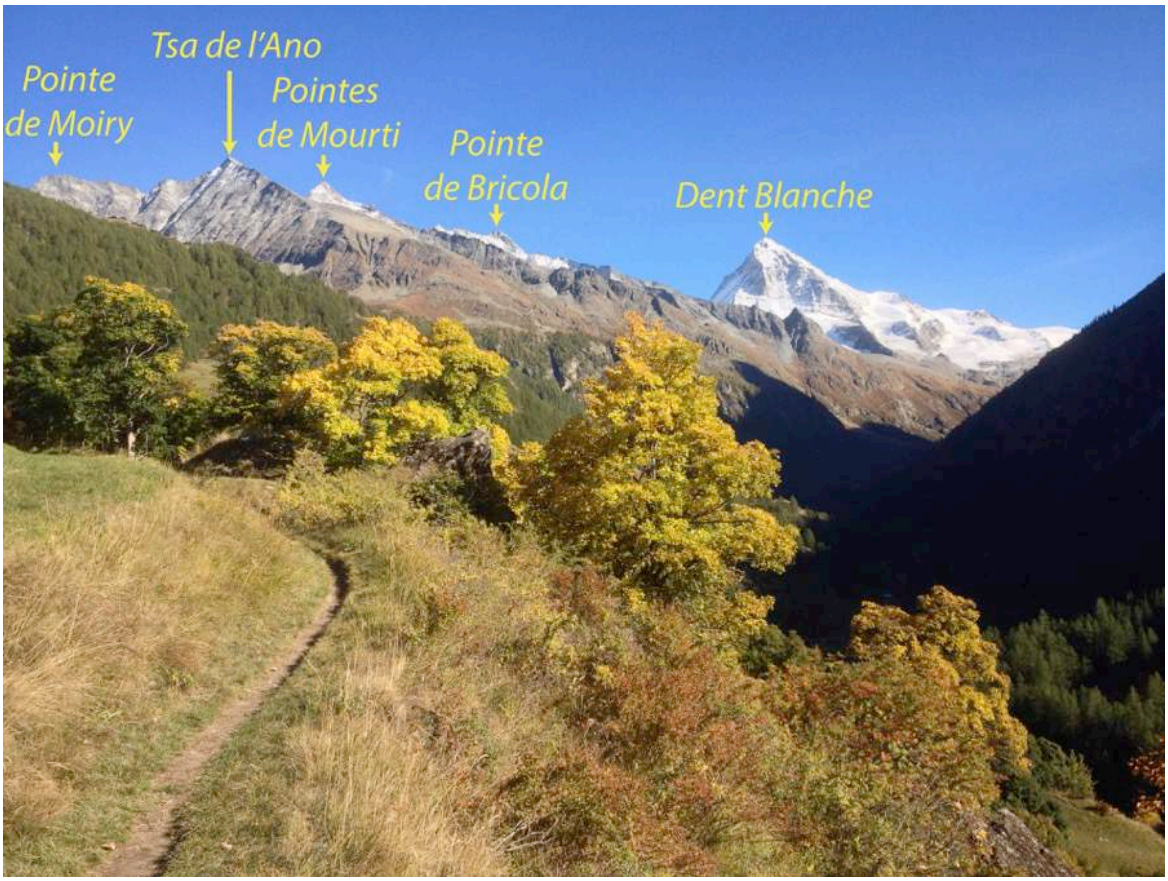
The entire side of the valley between Les Haudères and la Forclaz is **undergoing a slow subsidence, clearly visible in some places (broken outcroppings, leaning vegetation, irregular topography)**; but overall the movements appear somewhat slow or discontinuous. The subsided material is composed of *morainic* deposits and rocky elements scraped from the bedrock (*calschists*, *metabasalts, serpentinites)*.

At around 1590m, just below the entry to La Forclaz we come upon ancient terraces bordered by low walls. At this altitude grains, barley, rye, or potatoes will not grow. The terraces are good only for forage and pasturing. Note also the **presence of enormous boulders, either fallen or transported and deposited here by glaciers (erratic boulders)**.

Stop A-2 (605843/103600) (46° 5' 1.997" 7° 30' 51.035")

We meet up with the chemin des Foches and the road criss-crossing the pastures below La Forclaz; this is *the Plan de Brèonna*.
The view from here is quite unobstructed: We meet up with the chemin des Foches and the road criss-crossing the pastures below La Forclaz; this is *the Plan de Brèonna*.
The view from here is quite unobstructed:

- La Forclaz is above, with its chalets looking toward the southeast and its fields arranged in terraces. The village is situated on a kind of small balcony confined by three small hills; it owes its name to the pass ("fourche") one crosses leading to Ferpècle. **Along with the hamlet of Seppec, La Forclaz is the last inhabited place yearlong going towards Ferpècle.**
- The back of the Val d'Hérens with the *Dent Blanche* and the glaciers of Ferpècle and Mont Miné (the granitic *nappe of the Dent Blanche,* photo above).
- Les Haudères and the route d'Arolla, dominated by the Mont de Ritses, the Mont de l'Etoile and the Palanche de la Cretta (the *Tsaté nappe* with its *sediments* studded with green *oceanic* rocks).



View of the back of the Val de Ferpècle with the *Dent Blanche* (Photo: G. Stampfli)

Given their remarkably sunny exposure, the so-called villages situated"on the rocks " [in local dialect: *"Ch'lèchêss"* - Villa, La Sage, La Forclaz] appear to have been **the first inhabited places from the 12th century on.**
We follow for 500 m the road crossing the pastures below La Forclaz. At 1670m, at the intersection (606272/103539) with the road climbing toward the route La Forclaz-

Ferpècle, we take the path on the right leading down toward two *raccards* and a wall face in ruins beside a torrent.
We continue down on a hairpin path twisting through fields to the first gate (1620m), then go toward the southeast in the direction of the large *rock* face of the Roc Durand passing a second gate.

Stop A-3 (606359/103293) (46° 4' 52.031" 7° 31' 15.059")

The quarry of Bagnards at the base of the Roc Durand ["*ChéDuràn*n"].

Outcrop of pierre ollaire (soapstone) (Photo: G. Stampfli)

At this spot was **the old Bagnards quarry** (the name was taken from the workers of the Val de Bagnes who came to work the quarry), **exploited for *pierre ollaire* (*soapstone)* , which is a variety of serpentine**. The history of the quarry from its first origins is unknown, but the date 1770 is engraved over the entrance. In a report dating from 1919 on the potential of regional soapstone mines, this particular mine is only briefly mentioned as not having any activity for at least a few decades. **This most likely signifies that the mine had already been depleted at that time**. However the Swiss Army had plans dating from 1941 to use the mine as shelter for soldiers and equipment.

This site consists of a *barme* or in local dialect "bârma" (a kind of cavern under an overhanging *rock)* and an underground mine made up of several galleries forming a decametric network at the base of the wall. Three or four entrances are still visible, but are now somewhat filled in. **Access to these galleries is strongly discouraged for security reasons (falling ceilings)**.

The face of the Roc Durand is **mainly composed of *metabasalts* (lavas with slide marks still partially visible)** of the same type as site A1. **At the summit calschists appear in direct *contact* on the metabasalts**. At the base of this wall is a lens of *serpentinite* and *pierre ollaire* (*soapstone)* forming a large sub-horizontal *fold* at the center of which the galleries were dug through.
Near the main entrance to the mine one can see the dark *serpentinites* in small masses as well as white *talcschists* and *veins* of *gypsum* in gray needles. Crystals of light green

chromiferous *mica* (fuchsite) are also visible. These are all covered by a white to bluish powdery dust.

At the foot of the "quarry" the path continues on ancient terraces, probably made from the quarry debris or tailings.
The side of the valley is punctuated by a *series* of large blocks similar to the Roc Durand, cropping up along the pastures of the La Forclaz-Bréona region. Beneath these rocks, **the fields show an irregular aspect typical of zones which at one time have subsided or been compacted.**

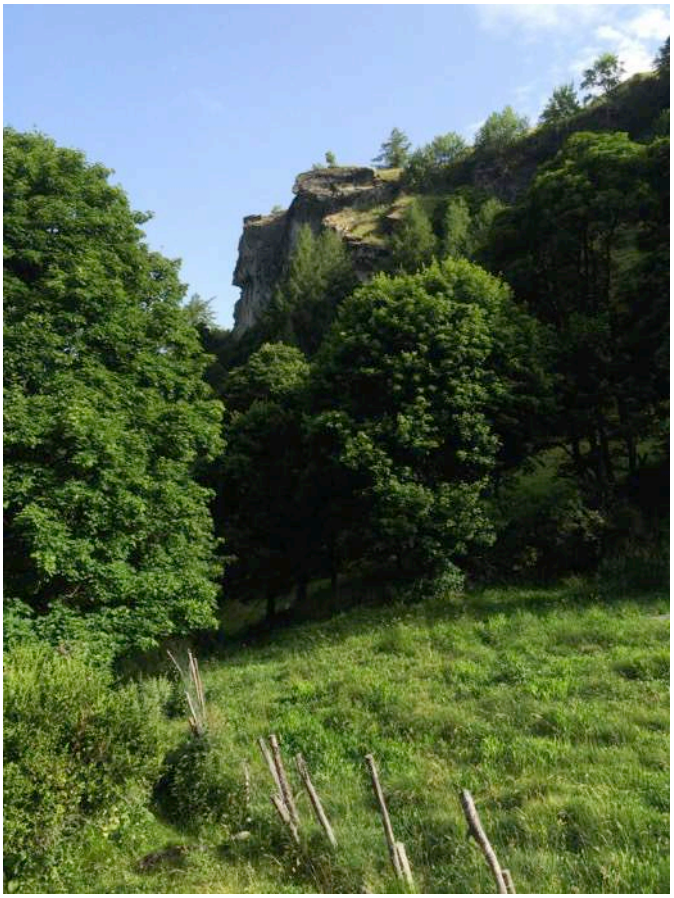
Caution! The path south of the mine crosses a recent *landslide* zone, so do not stay here!
At 1550m after the third gate, we join the horizontal road going toward Ferpècle. **The *rock* faces above us are calschists in direct *contact* with the *metabasalts.*** Notice in passing a magnificent closed *fold* of several metres, convex in form, situated just under the summit of the Roc Durand. There are also springs emanating from these rocks, which are marked by recent deposits of calcareous *tuffs.*

Pierre ollaire quarry (Photo: G. Stampfli)

Stop A-4 (606466/103106) (46° 4' 45.976" 7° 31' 20.003")

The La Forclaz - Seppec road at the foot of the *rock* faces making up the body of the Roc Durand - Lieufranc group.
At Le Leigerèt or Le Légeret.

Going from north to south, the *metabasalts* of the Roc Durand disappear under the relatively massive calschists near Lieufranc. Just above the road under an electric pylon there is an *outcrop,* about a metre thick, of very closely folded green *metabasalts* found inside the calschists (the primary *contact* of the volcanic basement and the *sedimentary cover)*.
On the original ocean floor, lava flows (which have now become *metabasalts)* poured out over reliefs which were most likely already extremely uneven. The *oceanic sediments* then quickly covered them over while numerous *landslides* also affected these volcanic structures. For these reasons, the lavas and *sediments* which were **already closely associated in the ocean, were then refolded together again during the formation of the Alps.** The stop A-4 is situated on a small promontory in a subsidence zone at the base of these walls.


Roc Durant (Photo: G. Stampfli)

Below the torrent waterfall coming from Bréona, on the dominating wall above us we can see more *metabasalts* folded into the *oceanic sediments*

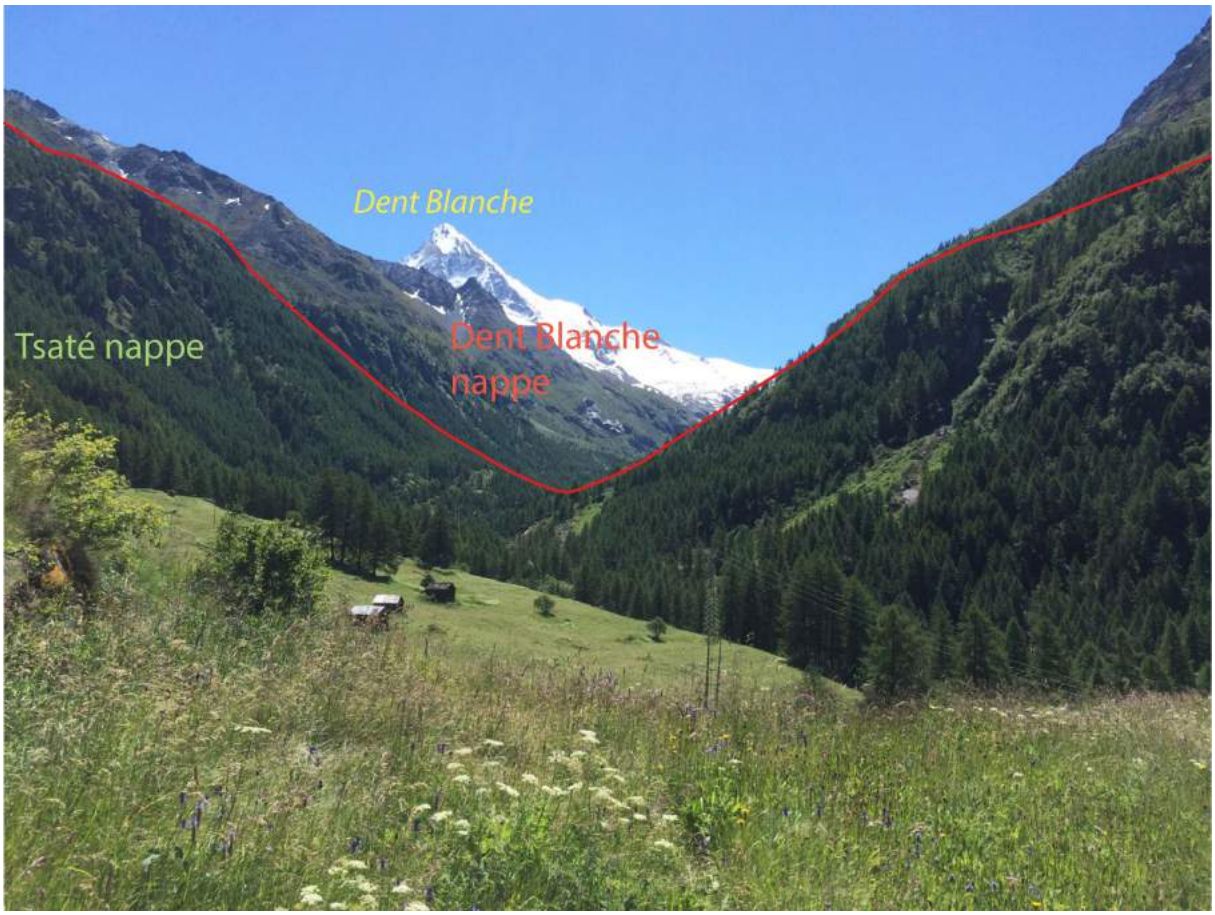
We cross the torrent, and after a fourth gate we follow the narrow path winding through the trees to the left across the pastures. We go towards (606659/102921). We climb the rocky promontory to get to a gate at (606724/102829).
The journey Lieufranc-Seppec is by a path, which climbs rapidly among **outcroppings of calschists and locally massive marbles**. These *sediments* show **a reddish to black patina**. In certain places **ancient *glacial potholes* can be seen hollowed out of the marbles** (1590 m)

Stop A-5 (606766/102798) (46° 4' 36.009" 7° 31' 33.985")

The Seppec promontory, near the small chapel.

This rocky promontory is made up of *metabasalts,* which **constitute the relief on which the hamlet of Seppec is built**; we can see local evidence of glacial polishing. Near stop A5, some very tight decametric *folds* appear in these volcanic formations; here they are clearly layered (from light green to whitish color).

Panorama looking uphill



Panorama up the valley showing the limit between the nappes (Photo: G. Stampfli)

Bodies of *metabasalts* and *serpentinites* make up the whole region of Seppec (right bank of the Borgne). ***Serpentinite* outcroppings found in particular all along the Ferpècle road** (stop E8) and bordering also on the upper reaches of the pastures in Seppec in the form of bold and magnificent lithologies with a dark *patina.* **The large lens of *serpentinites* descending from the Serra Neire down to the Borgne de Ferpècle very clearly separates the *metabasalts* of the *Tsaté nappe* from the granitic gneisses of the *Dent Blanche nappe* (Couronne de Bréona). The spot we are standing on here is very near the southern limit of the ancient alpine ocean!** On the two sides of the valley, the front of the *Dent Blanche nappe* follows the landscape, underlined by a massive ridge of grey *rock* cutting across the tree covered slopes. **The entire back of the Val d'Hérens, with its snow covered peaks, is thus situated in the *Dent Blanche nappe* and is associated with the "african" continent.**

The pastures of Seppec were probably at one time, part of an ancient alluvial terrace composed of materials deposited above the rocky *verrou* or the Seppec promontory. In addition this terrace was also covered over by the Bréona *torrent cone* and has now been eroded or cut into at its base by the Borgne de Ferpècle.

Panorama down the valley

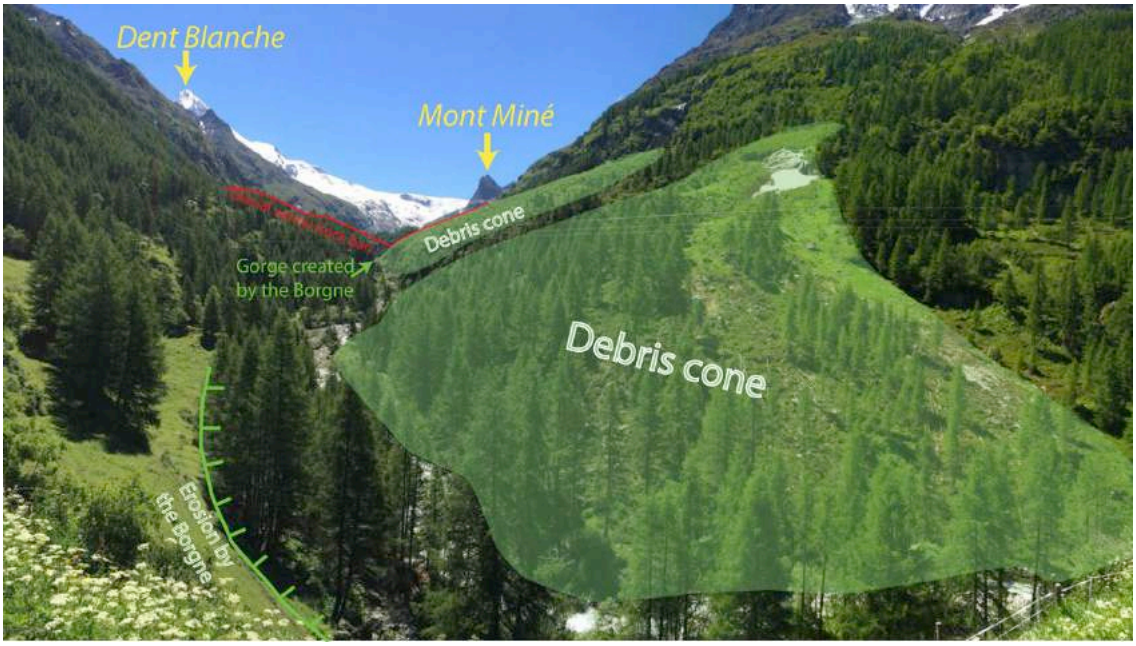
Panorama down the valley (Photo: G. Stampfli)

From this promontory, we get a **very good view of the entire zone which is slowly subsiding**, accompanied by *rock* falls between the Roc Durand and La Forclaz. This subsidence is most likely post-glacial in age (*Tardiglaciaire)* , but the **movements have been reactivated by the Borgne and has caused strong *erosion* at the base of this slope.** Another *debris cone* which has been covered over by pastures is situated on the left bank at the base of the Veisivi and has also been eroded by the Borgne (pastures - Vita course).

- Cross the hamlet of Seppec. **Notice the stilts on which certain wooden granaries (*raccards)* are built**. Follow the route de Seppec crossing the pastures. Please stay on the road!
- Notice the piles of stones and the low walls made from blocks of *serpentinite* and occasionally *metabasalts* bordering the fields which have been "stone cleared" to facilitate mowing

- At 1640m, at the extremity of the Seppec pastures, the road bears left. Take instead a path leading right (607197/102582) in the forest crossing the Bréona torrent and continuing towards Pra Floric (Prafleuri).
- Just above three "*raccards*" we can see a lengthy grayish rocky *outcrop* partially covered over by vegetation. This *outcrop* belongs to the *Tsaté nappe*; it is composed of strongly deformed *metagabbros.*
- Follow the path in the direction of the Pra Floric hamlet. Cross over the stream emanating from the Couronne de Bréona. The new bridge replaces the one washed away by a flood in 1994 (*lava torrent)* .

Stop A-6 (607433/102398) (46° 4' 23.014" 7° 32' 5")



Debris cones and glacial verrou (rock bar) (Photo: G. Stampfli)

Going towards Ferpècle, the visible outcroppings are all part of the *Dent Blanche nappe,* making up the massive reliefs and the snow-covered peaks.
The Borgne de Ferpècle has **carved out a *gorge* through a glacial *verrou* (*rock bar*)** accentuated by walls of *gneiss* around 20 m high.
On the right bank, these walls continue in a succession of outcroppings where we see a chalet, 3 pylons and the route de Ferpècle tunnel.
Facing this on the left bank are **two large debris cones, partially wooded over, descending from the Dents de Veisivi**; often the site of avalanches in the winter. These cones, cover over one of the flanks of the *verrou* and towards Pra Floric **even descend down to the bed of the Borgne, nudging its course toward the right bank**. The foot of the promontory upon which Pra Floric is built is **also eroded at its base and shows a large concave structure**. The same morphology appears farther upstream where a small *alluvial terrace* is also eroded.

We leave Pra Floric (Prafleuri) by the road on the left leading up to the Ferpècle road. Take the opportunity to stop E9 along the road.

We continue along the road to a bifurcation next to a gray *series* calschist *outcrop* (607714/102267 1710m) and take the right fork. Our path goes just below the road tunnel and rejoins the stop A-7.

Stop A-7 (607735/102121) (46° 4' 14.024" 7° 32' 19.001")

Dent Blanche gneiss (Photo: G. Stampfli)

The old Ferpècle road, bending to the left below the tunnel, just before *Renoillin*.

Right here **is the beginning of the *Dent Blanche nappe,* in other words Africa in a way!** The road tunnel has been dug through a body of banded *gneiss* situated in front of the *Dent Blanche nappe.* These gneisses have a green-gray *patina* covered with blackish streaks. Locally they show a relatively schistose and compacted structure, often in the form of plaques or flakes.

A lovely panorama opens looking down toward Pra Floric, Seppec and La Forclaz

- At 1730m, the road rejoins the main paved Ferpècle road above the tunnel exit. Above the tunnel arch can be seen banded gneisses, but here they are in massive form.

- We follow the road a few hundred metres up to Ferpècle /Salay. It intersects some outcroppings of granitic *gneiss* and we pass along the edge of the glacial *verrou* described at Pra Floric .

Closeup of eyed gneiss (Photo: G. Stampfli)

Stop A-7b (608100/101657) (46° 3' 59.004" 7° 32' 35.995")

Salay and Mourti torrent (Photo: G. Stampfli)

After a large bend in the road, the landscape opens onto a small plain where we find the hamlet of Salay. This site is bordered by two glacial verrous: below it, the Pra Floric *verrou,* already mentioned, and **above it a rocky massive where the installations of the Ferpècle dam are situated.**

In the centre of this small plain is an alluvial flood zone where the Borgne winds through, bound between prairie covered terraces and boulders. This zone has **a certain interest not only for its flora (green alder trees, willows) but also for its characteristic indigenous fauna (frogs, asps and lizards).**

On both sides of this *alluvial plain,* **large debris cones descend laden with *rock* fragments and boulders creating corridors for winter avalanches**. These cones represent outlets from *gorges* descending from the Veisivi massif on the left bank (*"Tsiné du Bièğnet"*, where avalanches in the winter of 1963 caused a death) and the Mourti torrent on the right bank.

Situated just slightly down from the mouth of this latter torrent, the Salay hamlet **is built upon an ancient cone, which is nudging the Borgne toward the left bank. This little village is well protected from floods and high water, but especially from winter avalanches in the corridor of the Mourti torrent.** Nonetheless, the slope above the hamlet is strewn with *rock* fragments as well as some large blocks of *gneiss* visible even in the village itself and around which chalets have been built!

Salay in 1917, author unknown
We can see the glaciers of Ferpècle and Mont Miné in the background, much closer than today! Note also the almost total absence of trees in the photo.

Note also the chapel built in 1895 and the *"Col d'Hérens"* hotel around 1880; **both were located in the safest zone of the village away from the dangers of avalanches!**

- Going out of Salay, we leave the paved road and take to the right a country path crossing the Borgne on a wooden bridge. At the first fork we follow the direction *"Circuit des Glaciers"*. The path leads through a small forest of *larch trees* at the **foot of an impressive *rock* face making up the base of the Dents de Veisivi.** From this face small lava torrents come down periodically consisting of water, mud and gravel and spreading out into the forest.
- The path continues up into prairies and across a patch of *green alders* and rhododendrons. We climb a ledge of *gneiss,* typical of the *"Arolla series"*. Highly visible in the path's double hairpin turn skirting the *rock* faces, they show numerous small crumpled *folds* with a green *patina* as well as quartz *veins.*
- Above the rocky ledge, the path leads by two shoulders (the Ferpècle mountain pasture with a cross, 1884m), before coming out on to a sort of converted terrace (608381/100947 1880 m), the **site of the electric power station of Ferpècle and a heliport.** We follow the paved road, passing by some granitic banded *gneiss* (white and green micas).
- Some 50m farther on, we come to the site of the Ferpècle dam (the accumulation basin). Near the crown of the dam, a large block of *gneiss* with a direction pointer "Glacier" in blue, shows some very good glacial *striations.*

Stop A-7c (608574/100731) (46° 3' 29.002" 7° 32' 57.972")

The Ferpècle dam (Photo: S. Ruttimann)

The dam **is built against a rocky massif of granitic, green *patina gneiss,* which is effectively a glacial *verrou.*** This massive body, even though locally fractured, makes up both sides of the *gorge* just below the wall of the dam. In some places we see large black streaks, signs of current water seepage, on the *rock* faces.

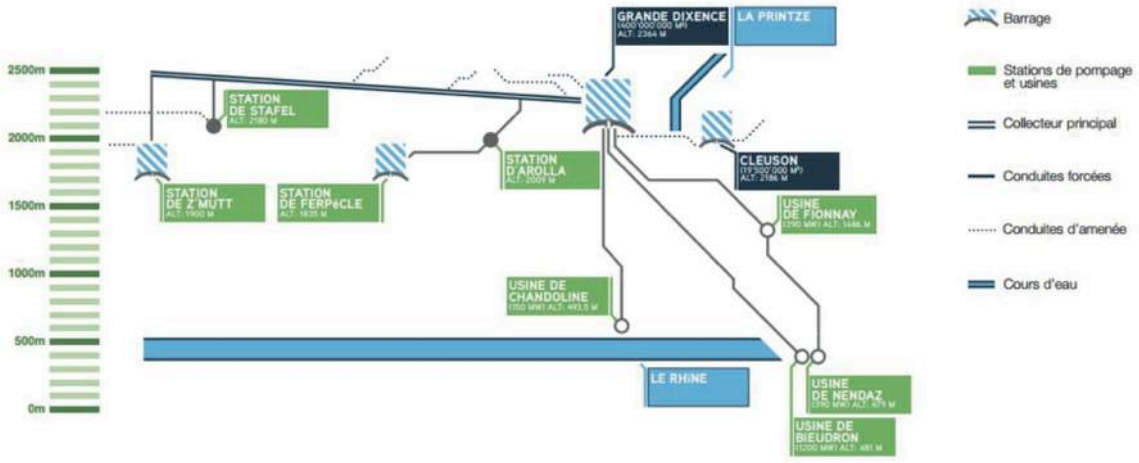
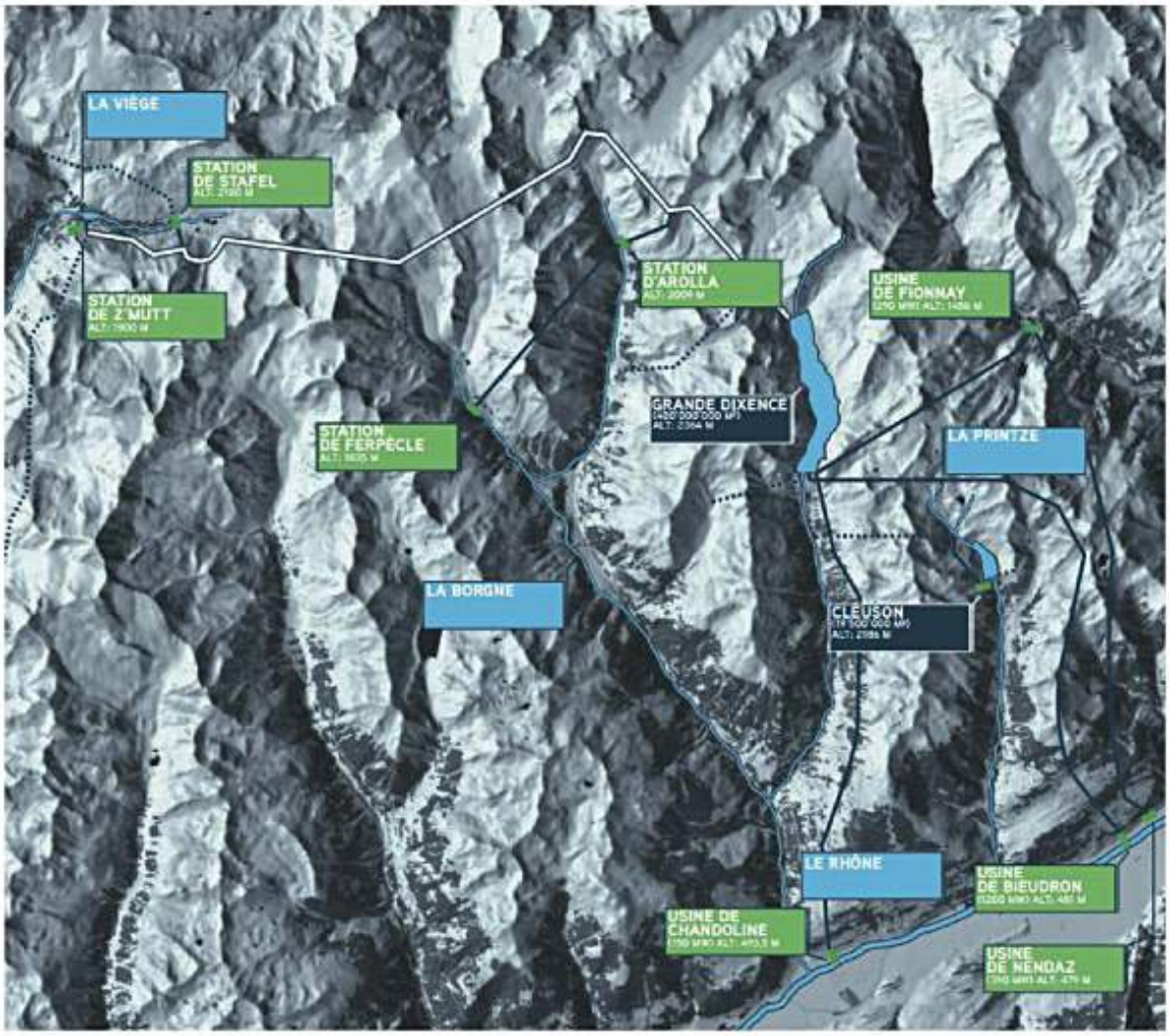


Diagram of the Grande Dixence SA complex (Source: Grande Dixence SA)

The dam fills up during the summer and is full by the end of September. **The glacial melt water is then turned back via a pressure pipeline under the Veisivi-Perroc Massif to the station at Arolla where it is sent on under pressure to the Lac des Dix**. Immediately below the dam, there is very little water flow, but the torrent regenerates itself rapidly a little farther downstream. Information signs posted by the Société de la

Grande Dixence give a detailed schema of the region's hydro-electric installations which gather and pump the melt water from the various glaciers.
It is worth noting that the paved roads linking the villages of the upper Val d'Hérens were **done by the Société de la Grande Dixence in the years 1955-1960 to aid in the exploitation of the glacial waters of the region.** The roads enabled materials to be brought up for the construction of the installations and the digging of the **many galleries which make up this hydro-electric complex.**



Schematic map of the installations (Source: Grande Dixence SA)

From the crown of the dam, we take a path climbing to the right, which joins a stony unpaved road. After several hairpin turns, it opens onto a shoulder.

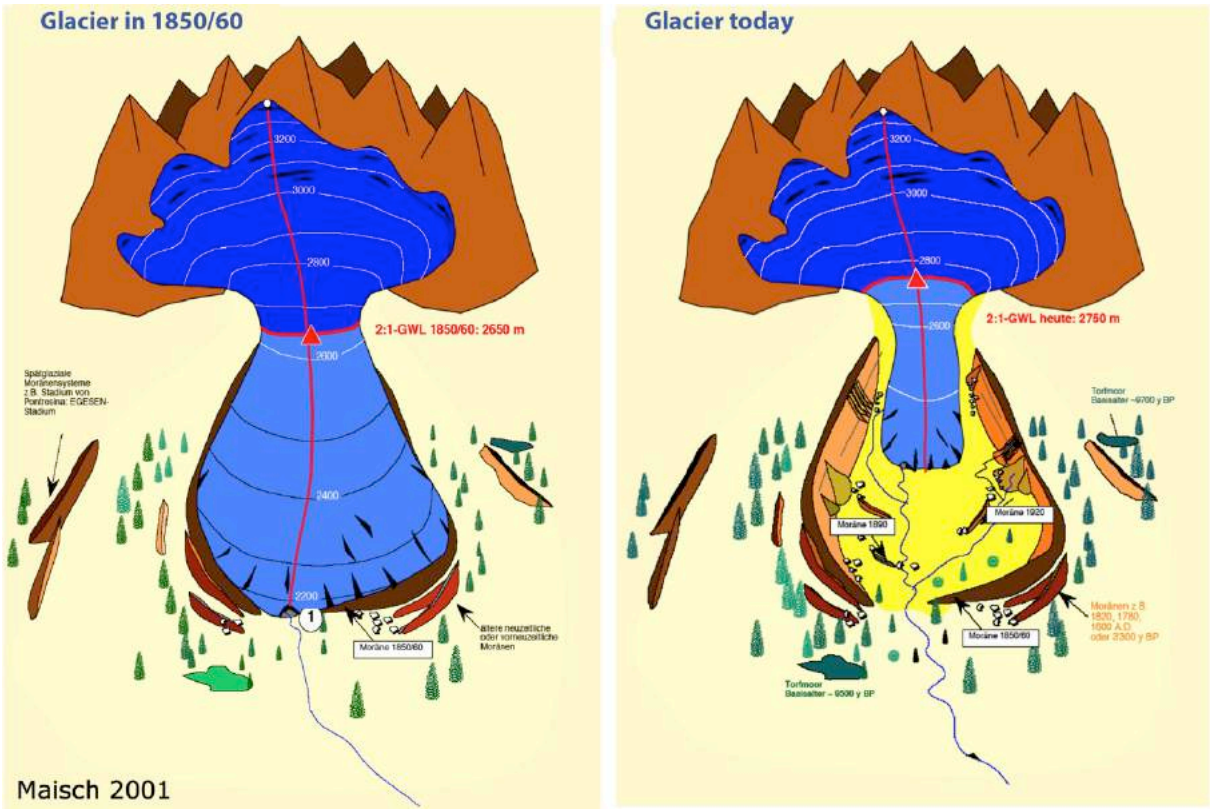
Stop A-8 (608661/100361) (46° 3' 16.994" 7° 33' 2.008")

The shoulder above the Ferpècle dam, road going towards the Mont Miné glacier.
This particular site **provides a good example of how traditions and the local dialect are still alive in the region of Evolène**. Early in the last century, it was called *"Pyà†óou byeùnyo* (glacier) *dóou Mon Miné"*, showing that **the glacier was much more advanced than today**. Now it is called *"Dessârza dóou Tsublìnn"*, because it was **a dumping site for the excavations** from the Grande Dixence construction work.
From here we have a magnificent unobstructed view of the back of the Val d'Hérens along with **the glacial morphologies:**

Panorama towards Bricola – Ferpècle glacier (Photo: S. Ruttimann, 2014)

- On our left: the foot of the Dent Blanche Massif (4357m) with the cabane de Bricola, now the property of the Grande Dixence group (2415m). **A large *debris cone* descends from La Maya** with numerous boulders scattered about on the slope, evidence of recent *rock slides*. **The entire slope at the foot of the Bricola face no longer shows its original topography**; numerous modifications to the *morainic* cover have been undertaken during the construction of the dam (fill-ins for temporary constructions etc.). **The terraces now visible are actually artificial and not typically glacial!**
- In the center of the valley, slightly to the left, **the Ferpècle glacier with its glacial tongue which at one time descended quite far down. Today the tongue can no longer be seen from this point.** At the base of the glacier appears a large body of light colored granitic rocks, these are mounded or *sheepback rocks* (*roches moutonnées)* , polished by the movement of the glacier. Facing us also is the black tower of the Mont Miné (2808m) standing at the intersection of the Ferpècle and Mont Miné glaciers, **which were still joined together in the beginning of the last century**. Notice the lateral *moraines* left by these two glaciers during their retreat, carpeting the flanks of the mountainside. The glacier on the right, Mont Miné, occasionally shows a beautiful cascade of blue ice.

On our right: the rocky foot of the Veisivi massif (dark *patina* with numerous black streaks). **It is covered by a high lateral *moraine* from the *Little Ice Age* (LIA), highly furrowed by *erosion* and partially invaded by vegetation.**

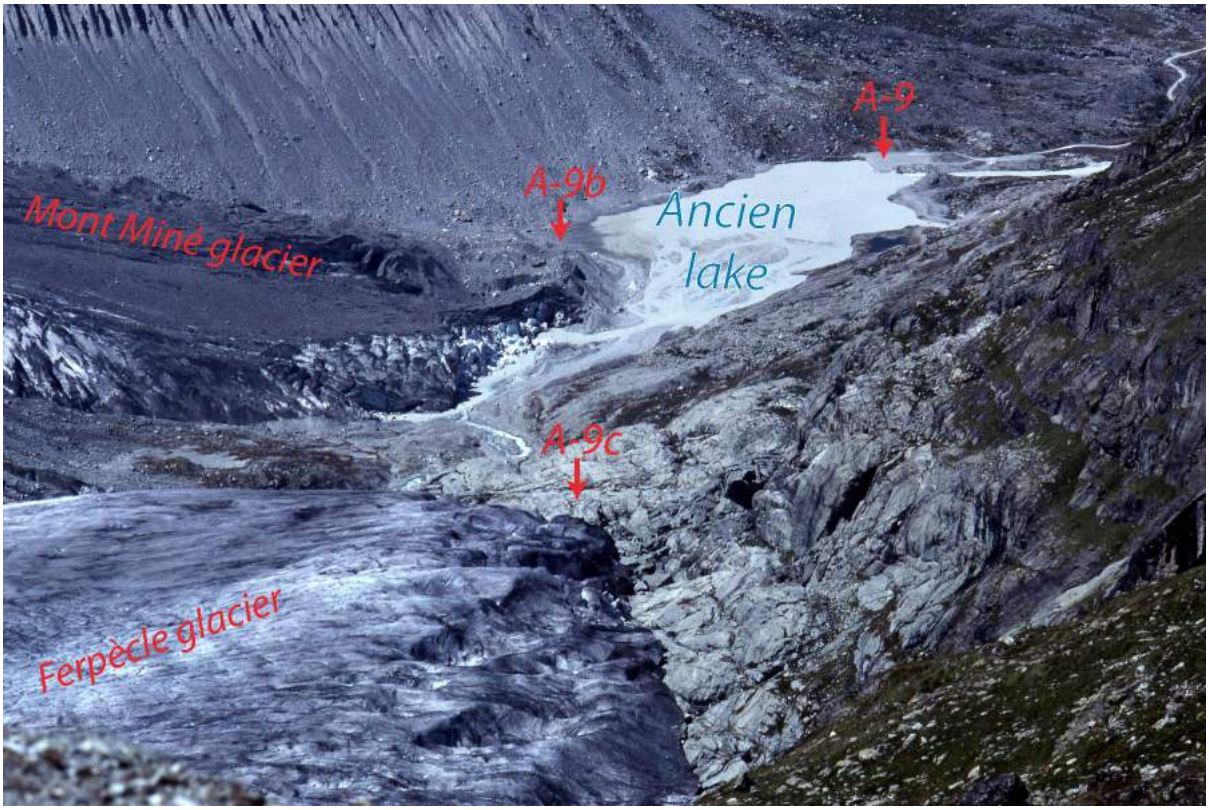


Glacier retreat since the Little Ice Age (Maisch, 2001)

Continue on the road to the next stop A-9

Stop A-9 (608855/99837) (46° 3' 0.013" 7° 33' 10.988")

Here we enter the heart of the glacial domain with the glaciers themselves on one hand and the proglacial margins on the other hand. This zone is also interesting for its so-called "pioneer" vegetation characterised by various colonising species (lichens, alpine grass, willowherbs, small birches and larches,...).



Proglacial lake in 1981 (Photo: A. Bezinge, 1981)

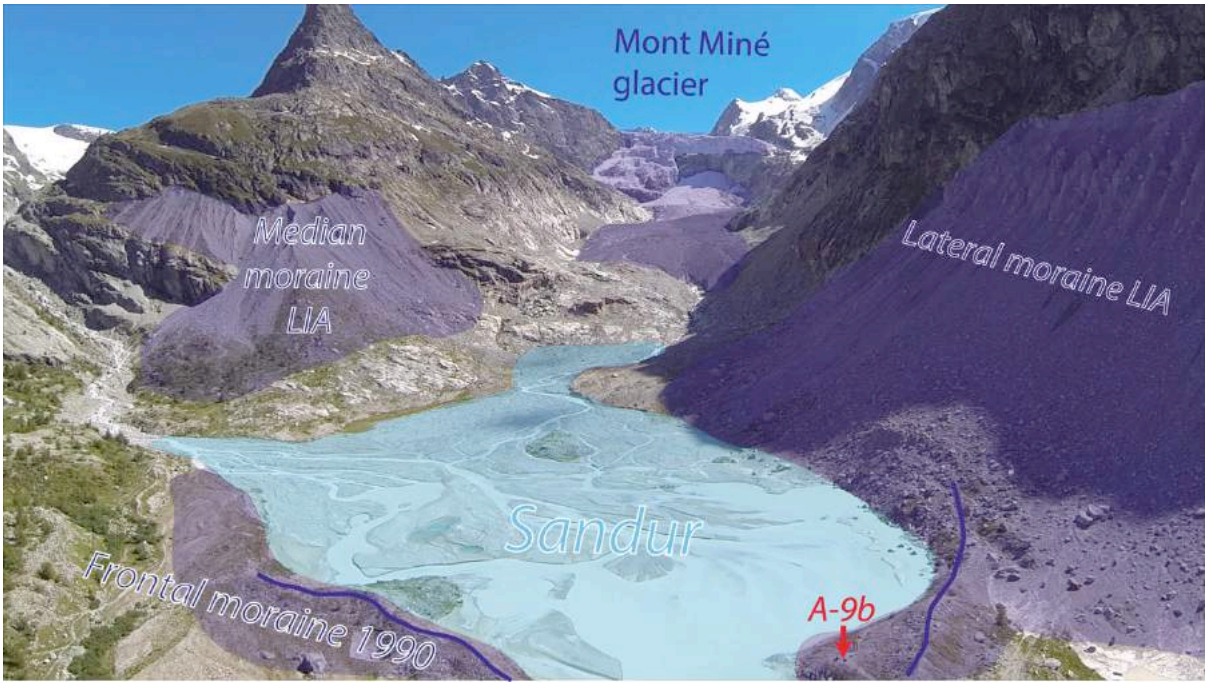
The plain at the foot of the Mont Miné glacier shows us the recent presence of a glacial accumulation lake, now totally disappeared, where the moraine of 1990 just in front of us had created a new natural dam**. The concrete outlet of this one-time "lake", rests on a glacial verrou made up of sheepback rocks showing beautiful glacial polished rocks with horizontal glacial striations on the right bank.** This retention lake was intended to be a catchment basin to prevent the silting up of the Ferpècle dam with sediments**. In fact, it has played its intended role very well and is now totally filled in by sediments!**

Mont Miné glacier in 1989 (Photo: G. Stampfli)

Ferpècle glacier in 1989 (Photo: G. Stampfli)

Continue for about 200 m to rejoin the stop A-9b.

Stop A-9b (608889/99601) (46° 2' 52.386" 7° 33' 12.533")



Sandur before the frontal moraine of 1990 (Photo: S. Ruttimann, 2014)

We now find ourselves on **an ancient frontal *moraine* of the Mont Miné glacier, which marks the position of the glacier's frontal advance during the years 1980-1990**. Since then, the glacier has **retreated approximately 800m** (measured in 2015)! In front of this *moraine* a ***fluvio-glacial* deposit plain has formed** with the materials having been transported and then laid down by melt water torrents at the front of the glacier. They are glacial *clay* minerals and *morainic* materials carried along by the glacier (sands, gravels and blocks) originating from the abrasion of rocks by the movement of the ice. The torrents here are numerous and change their courses quite often; they are thus **said to be braided**. This plain constitutes **what glaciologists call a Sandur: alluvial deposits made up of drift** (unsorted *fluvio-glacial sediments)* .

Aerial view of the Sandur (Photo: S. Ruttimann, 2014)

Access to the front of the glacier is possible but is **not recommended and can be dangerous. Beware!**
In 1989 it was still possible to see a glacial gate (a mouth where melt water comes out of the glacier) in the form of a large archway. **At one point, the Mont Miné glacier dammed up even the flow of melt water coming from the Ferpècle glacier creating a dammed up glacial lake.** An abrupt and **catastrophic emptying of this type of reservoir** occurred in 1943 and again most notably in August, 1952 when the archway gave way after a spell of very hot weather. The mass of water from this *glacial outburst* flood (a kind of "water pocket") descended in just 15 minutes as far as Les Haudères; the damages were minimal, but all the bridges were swept away.

Depending upon the level of water flowing in the torrents, it is sometimes possible to cross over to the right bank without getting (too) wet. But beware of the current and the apparent depth of the channels!
To cross to the other bank, **it is still preferable to use the bridge situated 300m downstream** (1960m). Take notice of the nice glacial polishing evident on the *sheepback rocks* supporting the bridge.

Beware of the next stop! Stop A9c is accessible only to experienced and well equipped climbers: there is no trail and there are serious risks of flash floods due to water intake purges! Never stay in the stream beds even if they appear dry !

Stop A-9c (609757/98949) (46° 2' 31.234" 7° 33' 52.876")

Glacial pothole (S. Ruttimann, 2015)

It is possible to continue on upstream on the right bank towards the front of the Ferpècle glacier, which has also greatly retreated. **But beware, this stop should only be undertaken by experienced, well-equipped hikers. The path is very difficult and there are great risks of flash floods ! Never stay in the stream bed even if they appear dry !** During the climb to the glacier we can see **some superb *outcrops* of sheepback rocks** (*roches moutonnées,* average altitude 2100m directly below the cabane de Bricola). This small massif of *gneiss* shows the **typical morphology of glacial erosion: polishing, *striations,* large *glacial potholes* and especially some magnificent traces of ancient subglacial channels dug out in the *rock* under the glacier called *Nye channels***.

There are two principal ways that water flows beneath a glacier:

- One is a **system called "distributive"** with a laminar flow on the surface of the glacier bed (bedrock) or by tiny channels of millimetre or centimetre size

- The other is a **system called "channelized"** which comprises two different types of channels, both of metric width, also beneath the glacier: the **Nye channels and the Rothlisberger channels**. The difference between them is that the Rothlisberger channels are dug into the ice while the Nye channels are dug into the bedrock. Nye channels imply great stability of the channel position, which permits *erosion* sometimes quite deep. It is the latter that we can observe here!

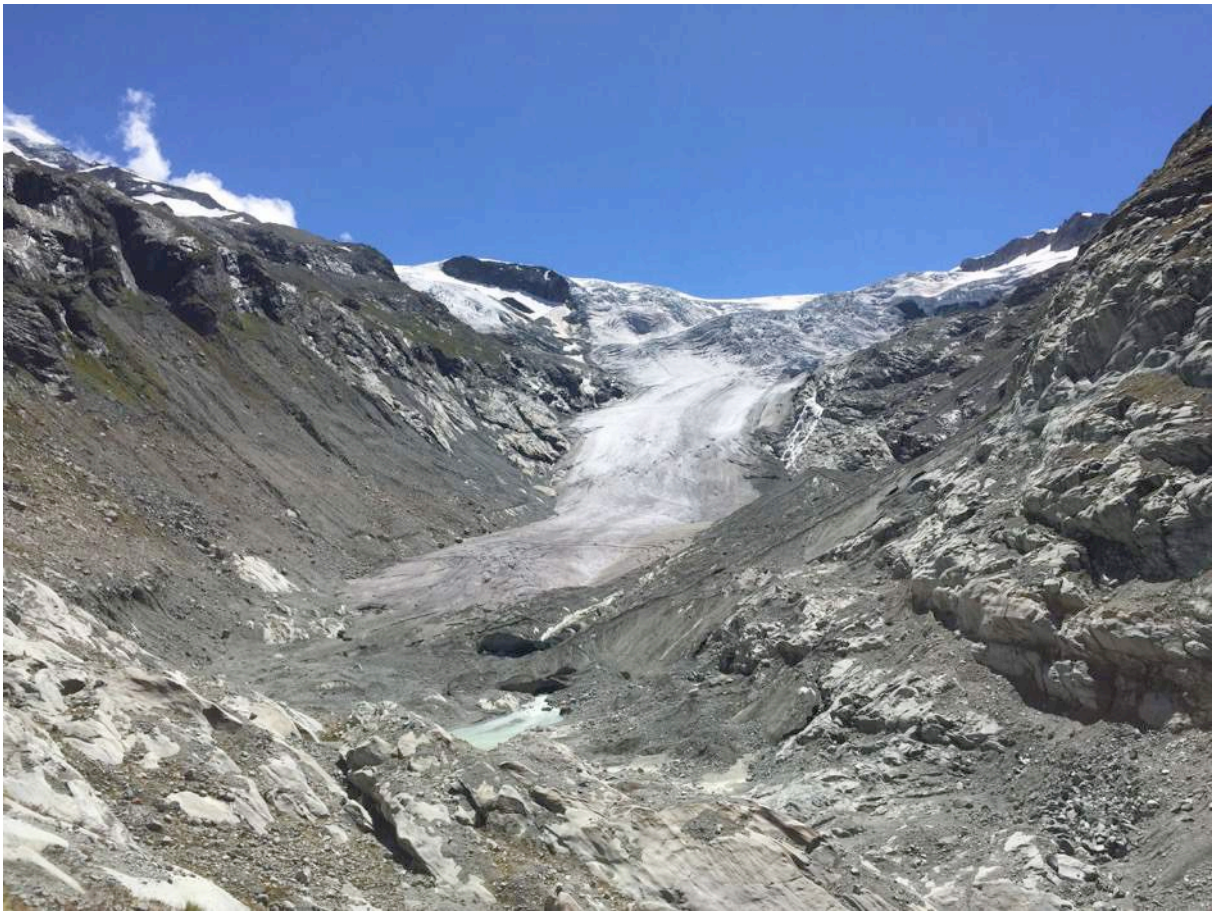
  Glacial potholes (or swirlholes) are also formed by *erosion.* Swirling melt water charged with abrasive *sediments* under the glacier creates these circular cavities.

Nye channel dug into bedrock (Photo: S.Ruttimann, 2015)

Röthlisberger channel in the Haut Glacier d'Arolla (Photo: S. Ruttimann)

Admire the splendid view of the Ferpècle glacier with its impressive crevasses and seracs extending up high!

Note that the glacier came down to this point in the years 1980-1990(see the photo by A. Bezinge, Stop A-9).

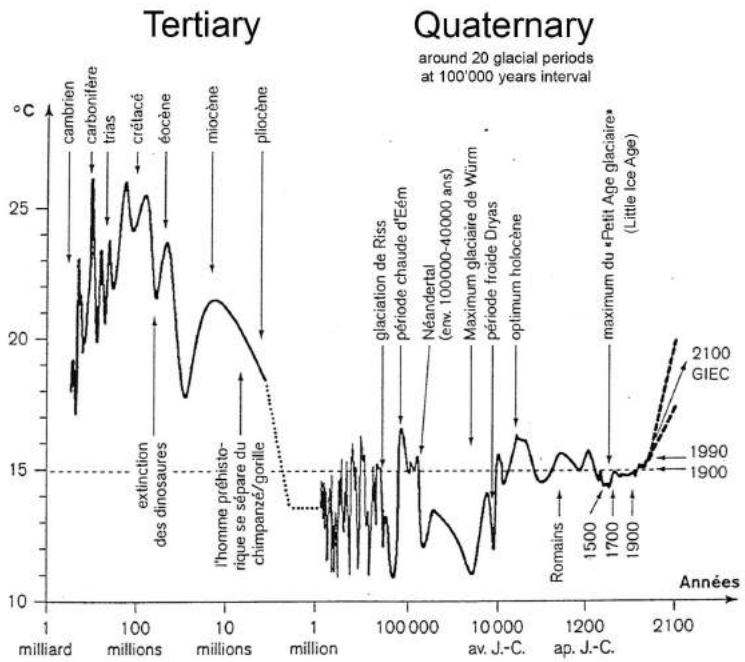


View of the Ferpècle glacier (Photo: S. Ruttimann, 2015)

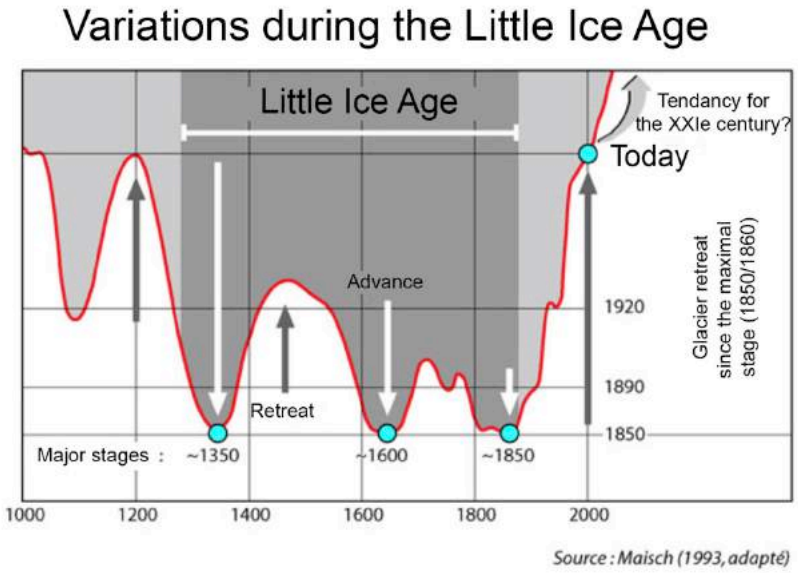
Descend down the massif by the same route and continue on the path toward Stop A-9d.

Stop A-9d (609091/100392) (46° 3' 17.999" 7° 33' 21.996")

From this point we can **admire the high moraine dating from the Little Ice Age (LIA), which was created by the converging of the Ferpècle and Mont Miné glaciers**. But first let us have a look at glacial history during the Quartenary Period.
The last glaciation (the fourth during the Quartenary Period, representing the last 1.87 million years) **took place in the alpine regions between 80'000 and 10'000 years ago: the *Würm* glaciation**. The last major stages of this glacial advance (Daun, Dryas recent, etc) date from around 13'000 to 10'500 years ago. Traces are still locally visible in the Ferpècle region (remains of superposed *moraine* strings, *terraces,* glacial *striations, sheepback rocks,* etc.). **Yet during Roman epoch, a forest of *Arolla pines* grew here at an altitude of 2400m!**



Evolution of temperatures during the Tertiary and Quaternary periods (Gassmann, 1996)



Glacial variations during the Little Ice Age (Maisch, 1993 modified)

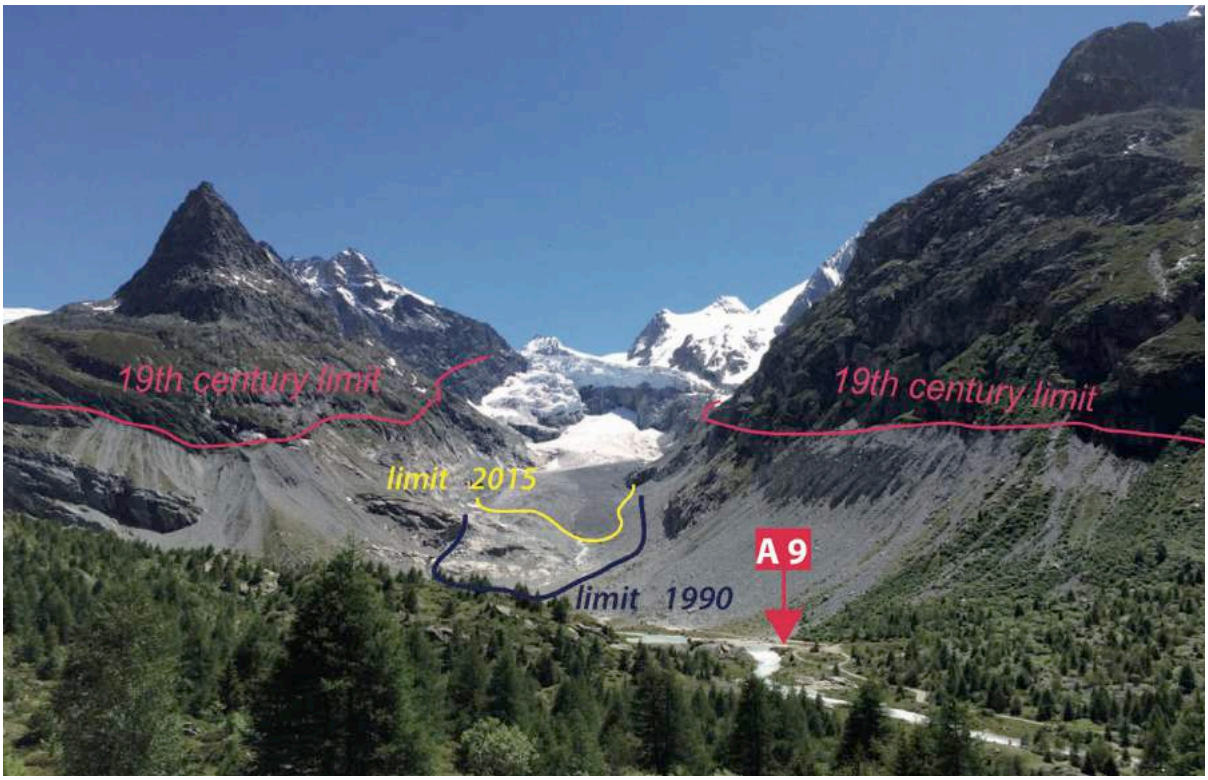
More recently, the *Little Ice Age* lasted in the Valais region from the beginning of the 14th century to around 1850 (the maximum advance stage of the Valais glaciers is 1820), followed by several fluctuations around the end of the 19th century. **Witnesses to this last epoch of climatic cooling are the frontal and lateral *moraines,* particularly well developed here** as well as in Arolla, at the Tsijiore Nouve glacier and the Bas Glacier d'Arolla. Here at the site A-9d, the two glaciers, Ferpècle and Mont Miné, joined together to form a glacial tongue 800 m wide which even reached as far down as the mountain pasture of Ferpècle (1884m) around 1820! (see the table of glacial stages)

After strong advances in the years from 1970 to the end of 1980, the 1990's marked a general tendency of glacial retreat.

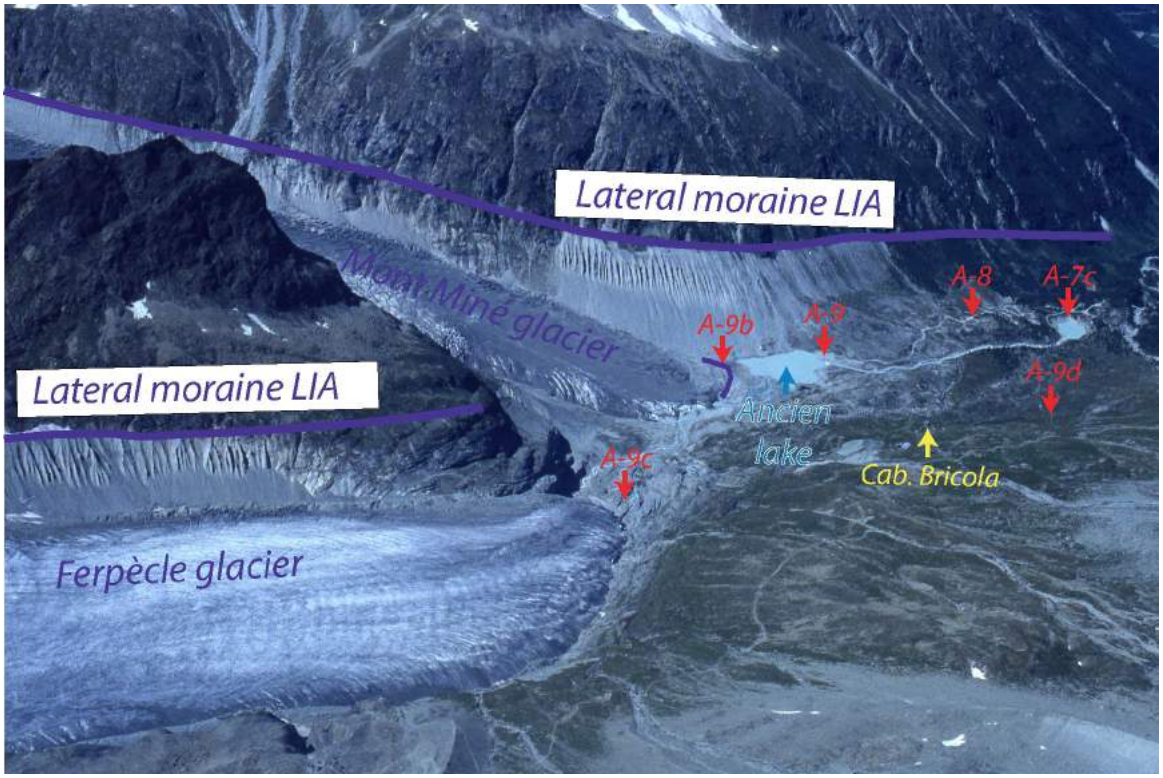
Gravure of the Mont Miné and Ferpècle glaciers united during the *Little Ice Age* after a drawing by Bühlmann, July 1835. The Salay hamlet is just under the terminal tongue, Pra Floric is visible on the right . (Bühlmann, 1835, original in the l'EPFZ library)

Since 1850, the date when the retreat of the glaciers began, around 100 glaciers have disappeared in the Swiss Alps. During the past 150 years, the alpine glaciers have lost about one third of their surface and half of their volume (source: WWF Suisse).

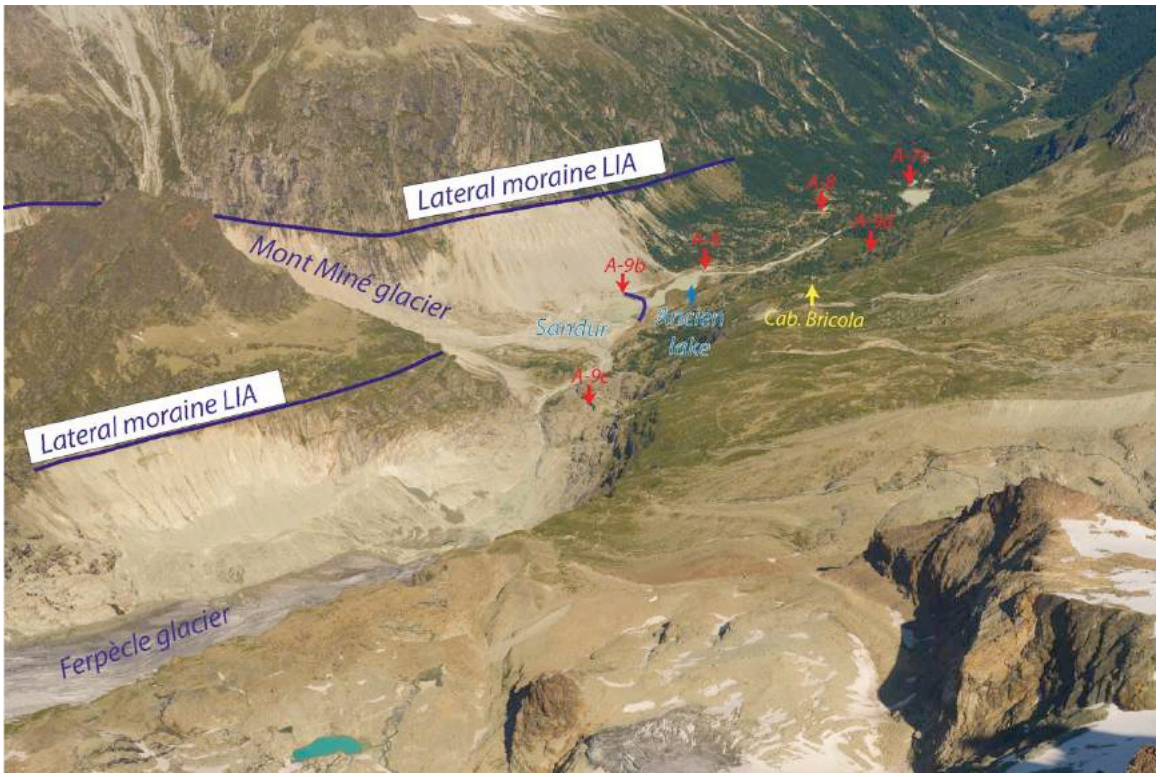
Unfortunately, the *moraines* we see today are often composites, which is to say they are made up of modified *morainic* materials reshuffled and mixed during the course of successive glaciations. However, the presence of soils and at times fossilised wood permits a re-establishment of the chronologic sequence in the formation of these *moraines* (chronologic markers). But **in general, the last glacial period (*Würm)* strongly eroded the more ancient deposits, which were themselves often obliterated by the development of the current soils.**



Panorama with different stages of the Mont Miné glacier (Photo: G. Stampfli, 2015)



Position of Ferpècle and Mont mine glaciers in 1980. One can see the old lake near stop A-9 as well as the frontal *moraine* towards A-9b (Photo: A. Bezinge, 1980)



Position of the Ferpècle and Mont Miné glaciers in 2015. One can see the old lake has filled up and a *sandur* has formed above A9b with the retreat of the glacier. (Photo: S. Ruttimann)

Continue on the path along the flank of the hillside to Salay. Then take the road to PraFleuri and branch off on the lower path to rejoin stop A-9e. It is also possible to return to the dam and the parking place by taking the path descending from A-9d

Stop A-9e (606717/102698) (46° 4' 32.767" 7° 31' 31.686")

Outcrop of metabasalts (Photo: G. Stampfli)

From Salay, we continue descending on the paved road, then just before the tunnel we rejoin the road we followed when climbing to Seppec. After the chemin de Pra Floric rejoins the pasture road to Seppec, continue about 20 metres, then follow a path descending sharply to the left (1640 m 607175/102582). This road skirts around the fields by the south running along the edge of the terrace above the Borgne. **Note the *erosion* at the foot of the *terrace* made by the river.**

At 1610m, at the extremity of the Seppec pastures, the path passes vertically under the site A-5; it then crosses a rocky ridge and descends down to Les Haudères (direction Le Légeret). In this ridge is an *outcrop* (just next to a gate) of light green to yellow *metabasalts,* which show vertical *schistosity* and some large metre sized closed *folds.* **The sculptured aspect is accentuated by dissolution cavities.**

At 1580m, just after a small prairie, the path passes by the foot of a calschist face, which constitutes a large"bârma", 5 to 6 m high. This "bârma" (*barme)* shows a good cross section of *lustrous schists.*

Stop A-10 (606659/102828) (46° 4' 36.987" 7° 31' 29.002")

A large *barme* or overhang, called "Bârmadè la Pouéipa", running alongside the Seppec-Lieufranc path (by a wood depot).

The appearance of the calschists and *marbles* of this outcrop: light gray color with occasional rust spots. Important *schistosity* is accentuated by small *folds* as well as numerous *veins* of calcite with quartz. The formation of this "bârma" (*barme)* is **perhaps due to a large scale tipping over of this *outcrop.***

Other blocks, the size of ten metres or so, show the same type of movement between the path and the stream bed of La Borgne; this slope from all evidence appears unstabilised. The other *barmes* also show very massive calcareous *sediments* (*marbles* with reddish patinas).

Large barme of calschists and marbles (Photo: G. Stampfli)

- At 1560m, the path passes Lieufranc (a prairie with two *raccards)* . From this site it is possible to reach Les Haudères on the left bank by means of a small path crossing La Borgne (beyond the gate for the Vita course). Underneath the bridge over La Borgne, we can see some very good *glacial potholes* hollowed into the calschists.
  Another alternative is to continue on the right bank following the path in the direction of Les Haudères passing Le Légeret (three *raccards* in a line, another gate). Here the slope is scattered with large blocks of *metabasalts,* along with calschists originating from the *rock* fall zone at the foot of the Roc Durand face.
- We follow the path which climbs very slightly and pass by another gate on a rocky promontory composed of *serpentinites.* **This promontory was polished by the passage of glaciers (visible glacial *striations)*** .
- At 1530m, the path is supported by a stone dry wall and passes beneath another small *"bârma"* (a small, enclosed chapel). It is essentially gray calschist, but near the base appears **a variety of light to whitish colored *serpentinite,* rich in talc. This is not exactly a *pierre ollaire* (*soapstone)* in the strict sense of the term, but rather a kind of talcschist**. This *serpentinite,* locally breccciated and oxydized, is closely folded into the *sediments. Lustrous schists outcrop* all along the road, either massive (marbled) or more schistose and phylllitic (calschists).
- We continue along the path descending through a thin forest. We cross through the last gate, then via a wider path join the Les Haudères-La Sage road by a large curve.

Zoom on calschistes

We arrive at Les Haudères from above near the Hôtel Pension des Alpes (1450m).