

## Geotour **France 2**: The Pink Granite Coast; Brittany at its best

*We are in the old and mysterious lands of the sorceress Morgana, the Arthurian legends, and the irreducible Gauls led by Astérix. But we are also surrounded by Hercynian granite intrusions, including the famous one of Ploumanac'h.*

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*"La Couronne du Roi Gradlon" (the Crown of King Gradlon), curious form of a coarse-grained hybrid (felsic-mafic) granite outcrop with deep pink feldspar crystals in the town of Trégastel (Côtes d'Armor)*

**Date of the visit to the places here presented:**

*August 12-14, 2010*

**Geotours travelers:**

*P. Cubas & R. Oyarzun*

**Aula**2**puntonet - 2021**



*Lannion, the perfect "base of operations".*

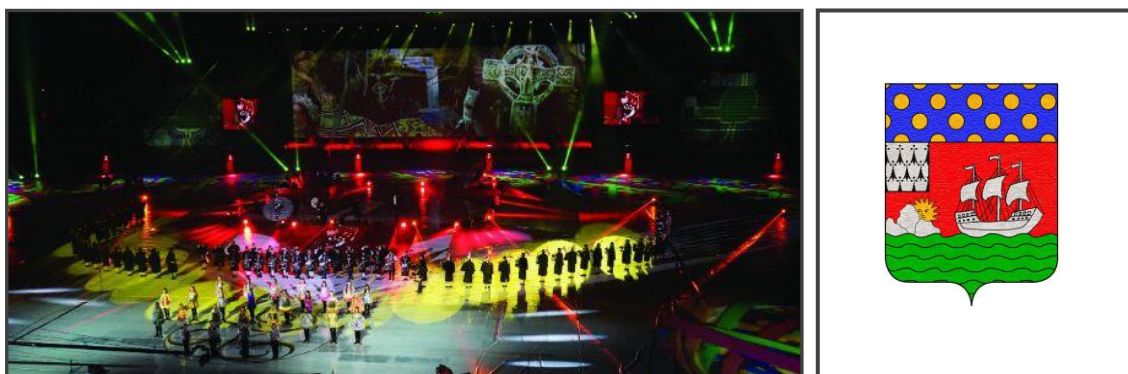
## Introduction

Where to start? Brittany is one of those regions of the world where everything or almost everything seems interesting or spectacular, but the remarkable thing is that it not only seems to be but it is.



Location of Brittany and its Departments, location of the Pink Granite Coast and Lannion (asterisk), the latter being the ideal place to start exploring the area. On the right: coat of arms of Brittany. Images<sup>1-3</sup>.

Whether you are looking for history, landscapes, beaches, water sports, hiking, charming villages, Celtic culture, menhirs or simply gastronomy, everything is in there, including the mythical village (from the comics) of those irreducible Gauls led by Astérix, that the only thing they feared was “that the sky would fall on their heads”, or the sorceress Morgana, intermingled with the Arthurian legends, Camelot and Brocéliande. Also, pay attention to the Celtic language still spoken in Brittany, the Breton, which is closely related to the Cornish, and more distantly related to the Welsh Celtic language (Wikipedia 2021a).



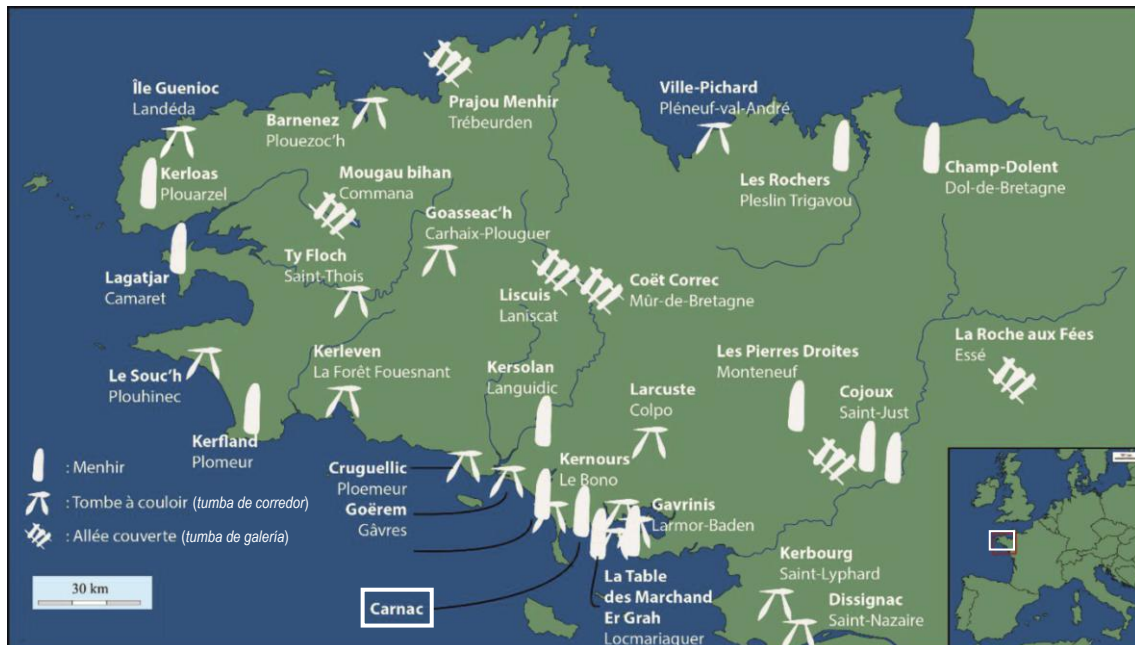
Brittany: interceltic festival of Lorient. On the right Lorient coat of arms. Images<sup>4,5</sup>.

In addition, if one menhir impresses, you have to try to observe thousands of them aligned as in Carnac. The Carnac alignments are the most famous and impressive megalithic assemblages of the Neolithic. It is the prehistoric site with the greatest wealth of megaliths in the world, almost 3000 menhirs that were built between 6000 and 2000 BC (Wikipedia 2021b).



Part of the menhir alignments of Ménéac in Carnac. Image<sup>6</sup> (Yolan Chériaux).

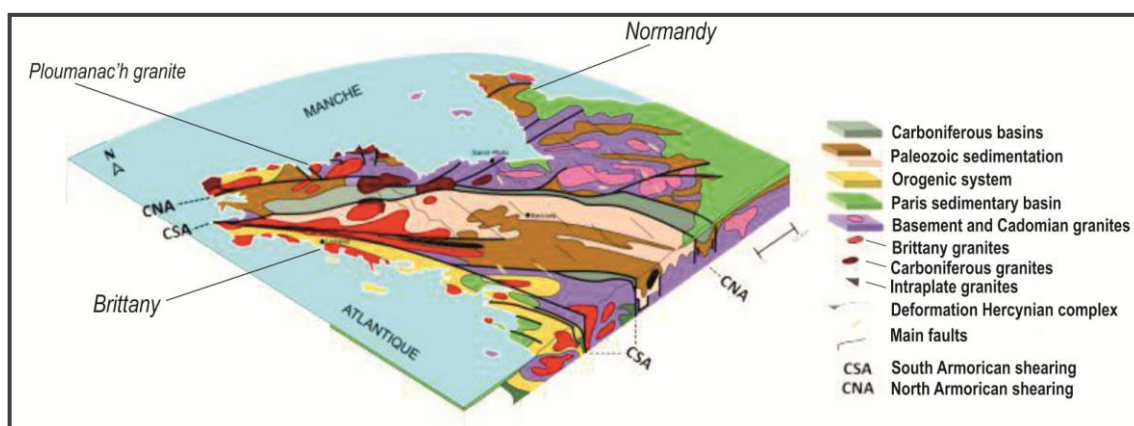
Beyond the ultimate significance of the alignments of menhirs (*a matter of discussion*), what we do know is that their construction was possible thanks to the presence of Hercynian (= *Variscan*) granite outcrops, specifically the local granite: Carnac-Sarzeau (*of Pennsylvanian age*).



Sites of menhirs, dolmens and other megalithic structures in Brittany. Gassien et al. (2020).

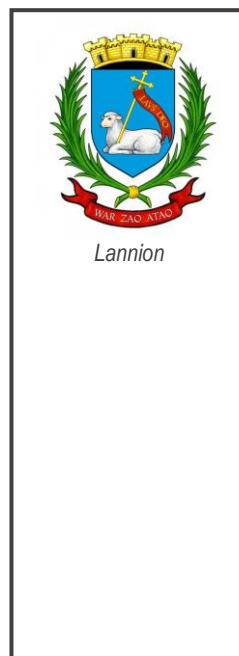
If there is something Brittany has is granites, and in the Department of Côtes d'Armor some outcrops are specifically recognized today as one of the greatest tourist attractions of this region of France. This is the "Pink Granite Coast" (*Côte de Granit Rose*) and the best outcrops are located along a strip that borders the coast from Milliau Island in the southwest to Ploumanac'h in the northeast (e.g. *Lardeux et al. 2005*).

Apart from granites, the geology also includes large areas of metamorphic rocks, and the reason why is simple, these units belong to the Armorican Massif, which together with the French Central Massif, the Hesperian Massif (*Spain-Portugal*), the Rhenish Massif (*Germany*) and the Bohemian Massif (*mainly in the Czech Republic*), constitute the large zones of deep deformation that resulted from the Hercynian Tectonic Cycle (= *Variscan Tectonic Cycle*).

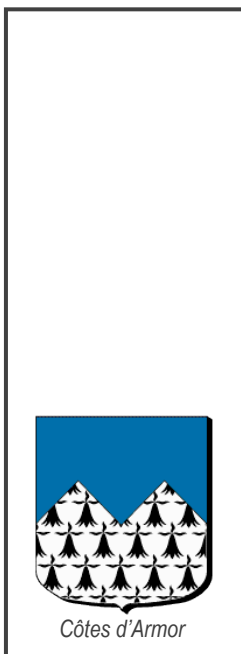


3D block diagram of the Armorican Massif. Adapted from SIGES Bretagne (2021).

But we don't want to give the impression that a visit to Brittany only involves geology, menhirs or related topics. As we mentioned at the beginning, Brittany is a little, or should we say, a lot of everything, and that "a lot of" includes, for example, typical dishes. In this regard, what is more typical in Brittany than a *galette*? The *galette* is the archetypal gastronomic specialty of the region, being a variant of the *crêpes*, but in which buckwheat flour is used for the dough instead of white wheat.



*The perfect little restaurant in Lannion (Madame Flock's Crêperie). Right: Lannion Coat of Arms: Image<sup>7</sup>.*



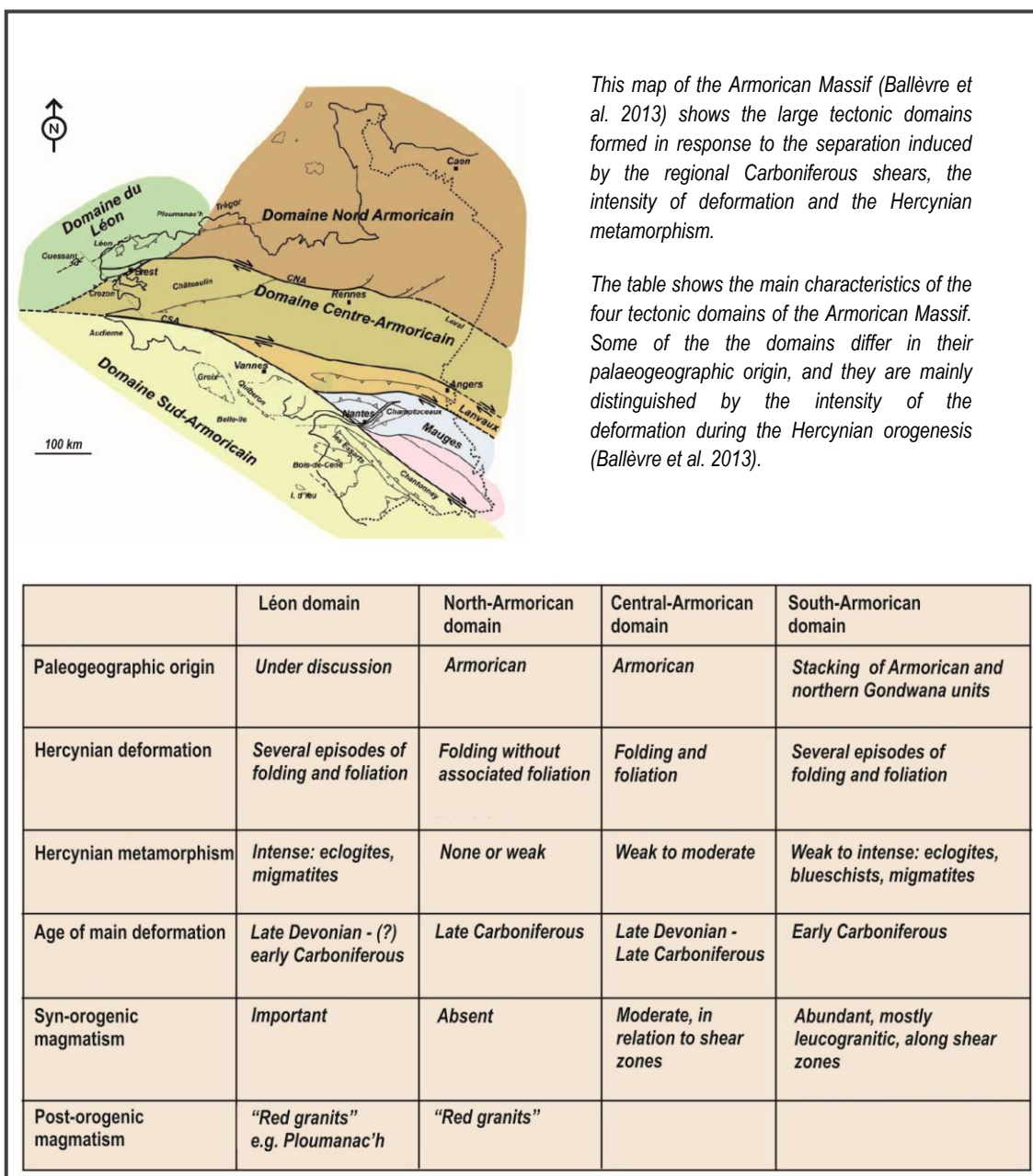
*And the perfect galette (Madame Flock's Super Galette Complete). Left: Côtes d'Armor coat of arms: Image<sup>8</sup>.*

Having said all this, we will now go on to tell the geological part of this geotour, starting with the regional context, to end with a visit to the Ploumanac's Intrusive Complex (Pink Granite Coast), the primary reason for this trip.

## Geology

We will refer now to the Armorican Massif, not without first drawing the attention onto the origin of the name. It may come from the Celtic expression *are mori* (“in the sea”), which evolved to *Aremorica* or “country facing the sea” (Wikipedia 2021c). It should also be clarified that the Armorican Massif concept goes geographically beyond Brittany, also encompassing Normandy. Incidentally, the name Brittany (*Breizh* in Breton) derives from the Latin “Britannia”, meaning “land of the Britons” (Wikipedia 2021d) and applies (*de facto*) to Brittany and Great Britain.

Ballèvre et al. (2013) indicate that the Armorican Massif can be divided into four main domains, which differ in 1) the nature and history of the Proterozoic basement; 2) its Paleozoic sedimentary and/or magmatic history; and 3) in the nature and age of the Paleozoic deformation. See the next figure and table.

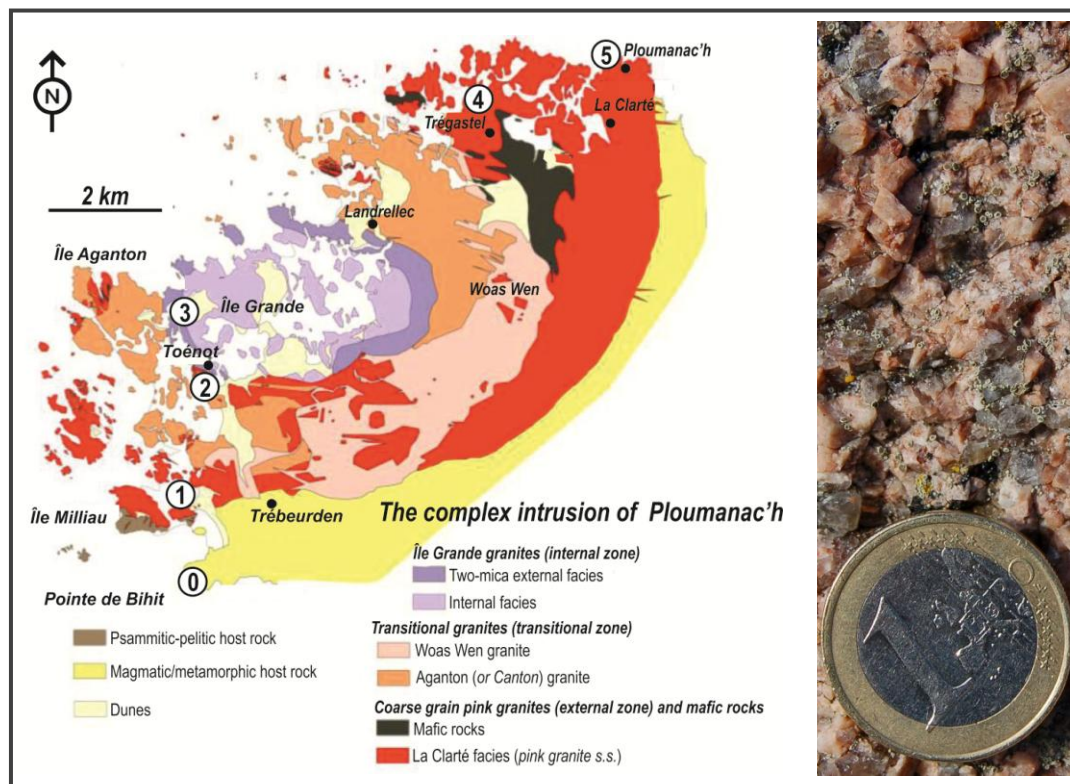


Our geotour will take us to the northeast of the Léon domain (see *previous figure*), where the magmatism developed late with respect to the Hercynian (= *Variscan*) orogenesis. This is somewhat what happened also in the Spanish Central System (*Central Iberian Zone of the Hesperian Massif*), where granites (s.l.) were preferentially emplaced during a post-orogenic extensional episode of late Hercynian age (*Doblas et al. 1994a,b*).

The granites are not usually particularly “showy rocks”, in fact, after a long walk in the field the rock may not have changed almost anything in its appearance (*same as in the case of the dull dolostones*). However, this is different in the area chosen for the geotour, because the Ploumanac'h intrusion is anything but boring. In fact, the Pink Granite Coast is one of the main tourist attractions in Brittany, and is worth a visit whether you are a geologist or not. If you love photography, this is the place to go.

The pink granite outcrops are striking, both for their color (*conditioned by the presence of almost 50% microcline*) and for their erosional forms, which include large rounded blocks of metric scale forming spectacular “granite chaos”. The color of potassium feldspar (*either orthoclase or microcline*) is usually white although it changes to pale pink and reddish due to the presence of iron ( $\text{Fe}^{3+}$ ), especially in the case of microcline (*Haldar & Tišljär 2014*). The classic site sightseeing is around the Min Ruz Lighthouse in Pors Kamor (*Ploumanac'h*).

The Ploumanac'h granite is a shallow (*epizone*) plutonic complex consisting of three main phases that were successively emplaced, so that the youngest one forms the nucleus of the complex (*Barrière 1976; Lardeux et al. 2005*). Radiometric dating of the granite gives ages of  $300 \pm 5$  Ma (*whole rock*) and  $300 \pm 6$  Ma (*K-Ar in biotite*) (*Adams 1976*).



Left: geology of the Ploumanac'h Intrusive Complex; adapted from: Barrière (1977; original figure), Santarelli (2011). Circles and numbers: observation sites along the geotour. Right: a sample of La Clarté facies (very rich in pink microcline) from Site 1.

We shall start the geotour moving clockwise from Pointe Bihit to Ploumanac'h, showing the most characteristic images of each site and making simple and brief descriptions of the outcrops. It is not intended here to show all the variety of rock types along the route, although key lithological features of the intrusion will be displayed, either because they are of geological interest or the landscape deserves it.

- The Pointe de Bihit (Site 0) is actually a “mini peninsula” about to become an island (*here the French word *presqu’île* [almost an island] applies perfectly*), being the perfect site to observe the metamorphic host rocks of the Ploumanac'h intrusion that include the Gneiss of Trébeurden, an orthogneiss 2 Ga old (Santarelli 2011). The site also offers excellent views of the Bay of Lannion.

GPS parking site:

N48°45'36.91"

W3°34'37.85"

Google Earth



The Pointe de Bihit (Site 0)



*The outcrops are almost completely covered with crustose lichens, which generally prevent direct inspection without the use of a hammer, which (by the way) is an increasingly restricted practice, sometimes totally banned by the regional or local authorities in Europe. However, small lichen-free patchy sectors allow observation of quartz and feldspar and an incipient fabric (foliation, see white dashed lines). These rocks are reminiscent of some ortho-derived leucogneisses from the Sierra de Madrid (Spain), with a foliation that is also poorly developed.*

- In front of the Island of Milliau (*Île Milliau*) (*Site 1*). This sector offers the first views of Ploumanac'h granite in its external facies (*La Clarté facies*), with its characteristic pink-reddish color, being a granite rich in microcline. One of the most remarkable landscape aspects of the sector is the existence of what the Frech geologists call a “granite chaos”. The term granite chaos comes from the stacking of large rounded granite blocks (*“chirons” in French*), arranged one on top of the other or isolated. The images below correspond to the Trébeurden marina sector (*next to Porz Termen beach*), near Le Castel.

GPS parking site

N48°46'07.55"

W3°35'07.39"

Google Earth



Granite chaos in the beach sector of Trébeurden. *La Clarté facies*.



Left, peculiar shapes in the granite chaos. Right, the marina and pink granite outcrops.



The pink granite and the marina at Trébeurden beach. On the right a mineralogical-textural detail of the granite; note the massive presence of microcline (white arrow), and quartz (yellow arrow).

- Near Toénot (Site 2) we enter the “transitional facies”. These rocks correspond to a grayish fine-grained granite of the type locally known as Aganton, typical of the transitional facies. The rock is a monzogranite formed by microcline, plagioclase, quartz, and biotite, which compared to La Clarté facies (*apart from the difference in color: from pink to slightly pinkish gray*), is poorer in quartz but richer in plagioclase (Plaine 2013). Attention: intense sunlight can make the granites look more pinkish than they are on a gray day.

GPS parking site

N48°47'15.99"

W3°34'49.59"

Google Earth



The monzogranite of Toénot, see in the background Goaz Trez beach.



Rounded shapes of granite. Right, decompression joints (arrows), see in the background the island of Molène.



Pegmatitic feldspar veins cutting the granite. Right, a detail of the previous image.

- In Kastell Hereg (*Maison de la Reserve Naturelle des Sept-Îles*), Île Grande (Site 3), the internal facies of the intrusion finally emerge: the so-called “Île Grande Granite”. We visited and inspected the two-mica granites. The rock is a relatively fine-grained leucogranite, and its mineralogical composition includes quartz, microcline, plagioclase, biotite, muscovite, and cordierite, with apatite, zircon, and tourmaline as accessory minerals (*Plaine 2013*).

GPS parking site

N48°48'12.87"

W3°35'01.63"

Google Earth



Leucogranite outcrop near Kastell Hereg. Note the fracturing of the granite due to various sets of joints.



More fracturing. Right, curved decompression joints (arrows).



Left, straight (yellow arrows) and curved joints (white arrows). Right, the two-mica leucogranite.

- Trégastel (*Site 4*) is one of the most interesting sites from the point of view of granite petrology. There we find rocks that we will refer to as: 1) “hybrids” between La Clarté type facies and the mafic rocks of the area (see *geological map*), and 2) pink granite facies typical of La Clarté (*pink granite s.s.*). The hybrid rocks in turn present numerous mafic xenoliths with large residual feldspar crystals suggesting unmixing phenomena in the magmatic chamber. The ideal place to observe these features is the so-called “Couronne du Roi Gradlon”.

GPS parking site

N48°49'46.20"

W3°31'10.52"

Google Earth



“Hybrid” rocks of the Couronne du Roi Gradlon with numerous mafic xenoliths (arrows).



“Hybrid” rock (within the “Couronne”) with a xenolith (arrow). Right: detail of the xenolith with feldspars (arrow).



Hybrid rock: feldspars in a mafic matrix. On the right, typical La Clarté facies (pink in color) with sub-horizontal decompression joints highlighted by erosion (arrow).

- Ploumanac'h (Site 5), it is the archetypal site of the pink granite. Nine out of ten photos of the Pink Granite Coast are from Ploumanac'h, which shows the tourist interest (and geological, of course) that this area has. The characteristics of the intrusion here are practically the same as in Site 1, that is, we are dealing with a pink granite rich in microcline. Given the importance of the place we will show some extra images to better illustrate the beauty of the site.

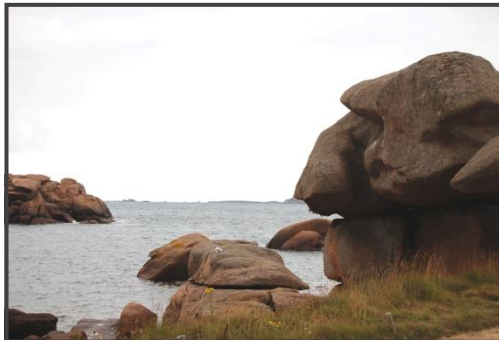
GPS parking site

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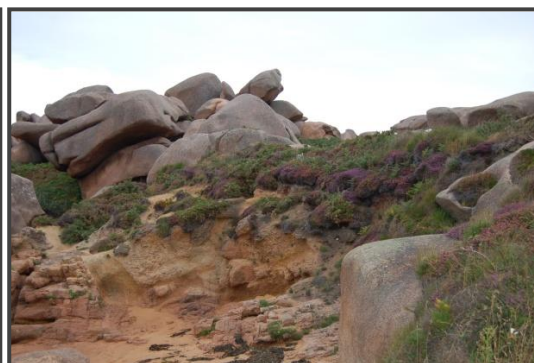
Google Earth



One of the most beautiful places to visit, the pink granite, a granite chaos (white arrow), and the Min Ruz lighthouse (black arrow).



Curious shapes around the lighthouse.



The "hippopotamus", a singular rock. On the right, granite chaos on weathered granite.



More granite chaos. On the right a rock (of the same chaos) that appears to have been sculpted by Henry Moore.



*Ulex gallii* (caution: pretty yellow flowers on thorny plants) and heather growing amidst the "chaos".



The pink and "not" so pink granite. On the right, detail of its mineralogy and texture; quartz (yellow arrow), microcline (white arrow), and plagioclase (black arrow).

*Well, this all what we wanted to show this time.  
Hasta la próxima — Goodbye — à bientôt — d'ar e'hentañ gwel*

*Paloma & Roberto*

## References:

- C.J.D. Adams (1976) *Geochronology of the Channel Islands and adjacent French mainland*, *Journal of the Geological Society London*, 132: 233-250.
- M. Ballèvre, V. Bosse, M.P. Dabard, C. Ducassou, S. Fourcade, J.L. Paquette, J.J. Peucat & P. Pitra (2013) *Histoire géologique du Massif Armoricaïn: Actualité de la recherche*. *Bulletin de la Société géologique et minéralogique de Bretagne*, 10-11: 5-96
- M. Barrière (1976) *Architecture et dynamisme du complexe éruptif centré de Ploumanac'h (Bretagne)* *Bulletin BRGM*, 3: 247-295.
- M. Doblas et al. (1994a) *Variscan-late Variscan-early Alpine progressive extensional collapse of central Spain*. *Geodinamica Acta*, 7: 1-14.
- M. Doblas et al. (1994b) *Extensional tectonics in the central Iberian Peninsula during the Variscan to Alpine transition*. *Tectonophysics*, 238: 95-116.
- B.A. Duff (1979) *The palaeomagnetism of Cambro-Ordovician redbeds, the Erquy Spillite Series and the Trégaste-Ploumanac'h granite complex, Armorican Massif (France and the Channel Islands)*. *Geophysical Journal of the Royal Astronomical Society*, 59: 345-365.
- P. Gassien, F. Cousseau & M. Besse (2020) *Le mégalithisme en Bretagne*. SY-GAIA, <https://sy-gaia.ch/le-megalithisme-en-bretagne/>
- S.K. Haldar & J. Tišljär (2014) *Basic Mineralogy: Alkali Feldspars*. In: S.K. Haldar & J. Tišljär (eds) *Introduction to Mineralogy and Petrology*, Elsevier, 39-79.
- H. Lardeux et al. (2005) *Guide Géologique de la Bretagne*. *Guides Géologiques Régionaux*, Dunod, 221 pp.
- J. Plaine (2004) *Joyau géologique du Trégor, le magmatisme composite du complexe granitique de Ploumanac'h, Côtes-d'Armor, France*. <https://sgmb.univ-rennes1.fr/geotopes/decouvertes/23-decouvertes/67-ploumanac-h>
- N. Santarelli (2011) *Promenade géologique dans le granite de Ploumanac'h et son encaissant*. Amis –Trégor 2011. [http://www.amis-mineraux.fr/conferences/conference%20\\_26\\_mars\\_2011.pdf](http://www.amis-mineraux.fr/conferences/conference%20_26_mars_2011.pdf)
- SIGES Bretagne (2021) *Histoire géologique de la Bretagne*. <http://sigesbre.brgm.fr/Histoire-geologique-de-la-Bretagne-59.html>
- Wikipedia (2021a) *Breton language*. [https://en.wikipedia.org/wiki/Breton\\_language](https://en.wikipedia.org/wiki/Breton_language)
- Wikipedia (2021b) *Carnac*. <https://es.wikipedia.org/wiki/Carnac>
- Wikipedia (2021c) *Armórica*. <https://es.wikipedia.org/wiki/Arm%C3%B3rica>
- Wikipedia (2021d) <https://en.wikipedia.org/wiki/Brittany#:~:text=The%20word%20Brittany%2C%20along%20with,the%20Roman%20province%20of%20Britain>.

**Source of some of the images (Internet):**

1. <https://fravatoutca.wordpress.com/2015/07/27/petit-tour-en-bretagne-1-guidel-plage-la-laita-gr-34/>
2. <http://www.livingthedrea.com/new-blog/a-laise-breizh>
3. [https://en.wikipedia.org/wiki/Armorial\\_of\\_France#/media/File:BlasonBretagne.svg](https://en.wikipedia.org/wiki/Armorial_of_France#/media/File:BlasonBretagne.svg)
4. [https://www.francetoday.com/culture/brittany\\_travel\\_festival\\_interceltique\\_de\\_lorient/](https://www.francetoday.com/culture/brittany_travel_festival_interceltique_de_lorient/)
5. [https://fr.geneawiki.com/index.php?title=Fichier:Blason\\_Lorient-56121.png](https://fr.geneawiki.com/index.php?title=Fichier:Blason_Lorient-56121.png)
6. [https://commons.wikimedia.org/wiki/File:Menhirs\\_carnac.jpg](https://commons.wikimedia.org/wiki/File:Menhirs_carnac.jpg)
7. <https://www.heraldry-wiki.com/heraldrywiki/wiki/Lannion>
8. <https://www.heraldry-wiki.com/heraldrywiki/wiki/C%C3%B4tes-d%27Armor>