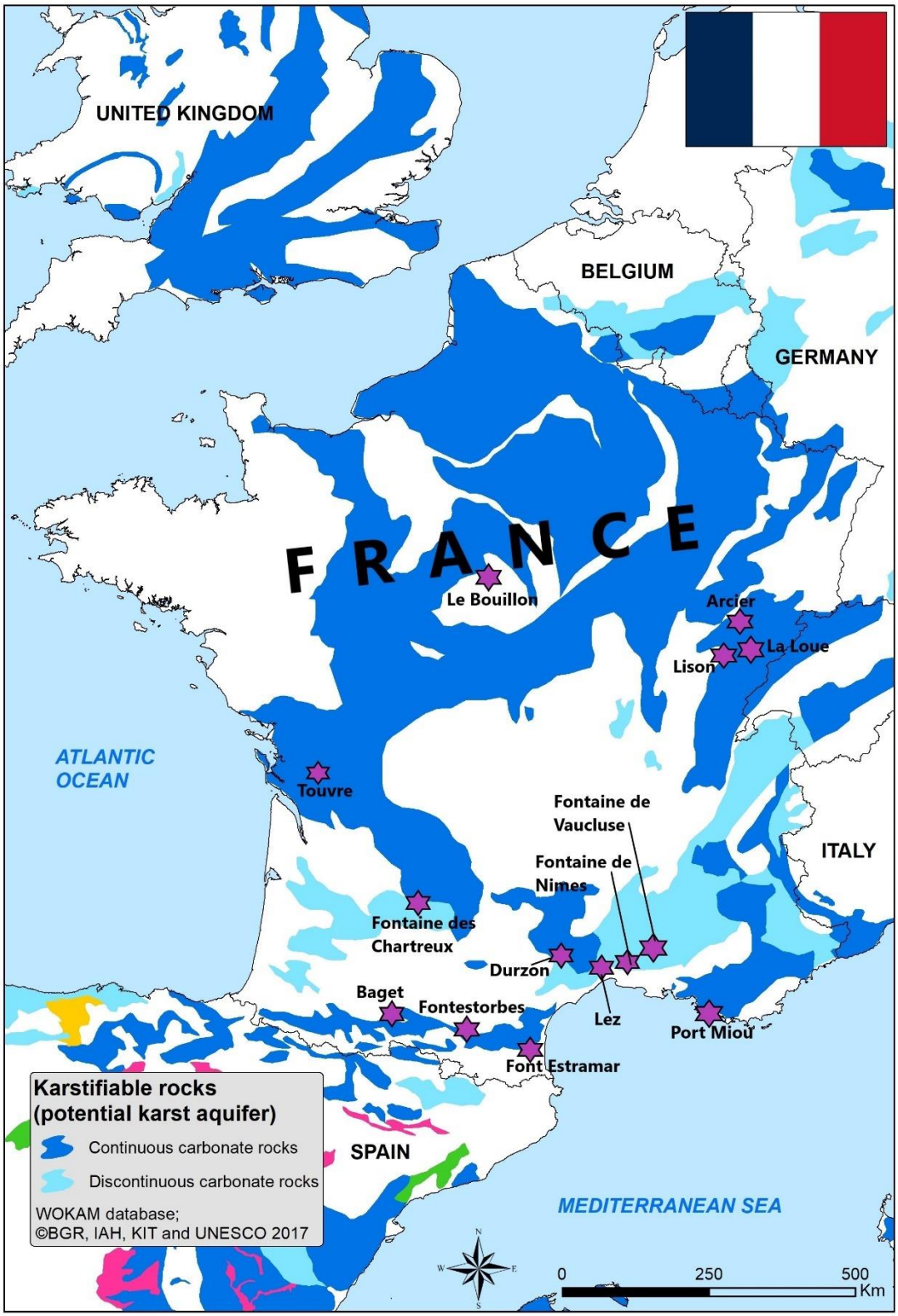

UNITED KINGDOM
BELGIUM
GERMANY
FRANCE
Le Bouillon
Arcier
La Loue
Lison
ATLANTIC OCEAN
Touvre
Fontaine de Vaucluse
Fontaine de Nimes
ITALY
Fontaine des Chartreux
Durzon
Baget
Fontestorbes
Lez
Port Miou
Font Estramar
SPAIN
MEDITERRANEAN SEA
Karstifiable rocks (potential karst aquifer)
Continuous carbonate rocks
Discontinuous carbonate rocks
WOKAM database;
©BGR, IAH, KIT and UNESCO 2017
0
250
500
Km

Country	MIKAS springs	Coordinates / Nearby City	Spring discharge (Q in l/s,min/av/max) / tapped or not	Criteria* in order / Main justification */ H-historic, A-aesthetic, S-scientific, E-Economic, Ec-ecologic	Data collected by
France 	1. **Fontaine de Vaucluse**	N 43° 55' 04", E 5° 07' 58" Z = 25 m asl Vaucluse, Provence-Alpes-Côte d'Azur	3100/17300/ 83300 Not tapped, spring water is used downstream for agriculture and recreative activities	***A, E, S, H, Ec*** *The Fontaine de Vaucluse (FdeV) is one of the most famous and best explored karst springs in the world (the discharge records: monthly mean since 1887, daily mean since 1967, hourly mean since 1994). FdeV is a lake spring with deep siphonal karst conduits, and is considered as locus typicus for all such springs worldwide (the term: "vauclusian type"). It is located in Provence, about 30 km East from the city of Avignon. Fontaine de Vaucluse is France's major spring in terms of average flow rate. Over one hydrological year, the mean water table level fluctuations at the outlet are of about 25m. It is characterized by deep siphonal karst conduits, the huge discharges variation and the high minimal discharge values during low flows. The spring comprises a siphonal pool with an upper outlet which flows only during high water periods, and a downstream outlet where groundwater continuously discharges through thick debris zone with huge fallen blocks, giving rise to the Sorgue River, one of the Rhône's tributaries. The catchment area is estimated on 1,160 km². The Lower Cretaceous limestones of Urgonian facies (Barremian-Aptian age) are 1,500 m thick and highly karstified. The thickness of the unsaturated zone can exceed 800 m. The conduit system had been developed during the Messinian salinity crisis (-7 to -5 Ma). The spring has conduit itself, explored by a ROV up to -308 m (203 m bsl). The spring and conduit are first-rate national and international tourist attraction: the main economic resource of Fontaine-de-Vaucluse, with an average annual attendance of 1.5 million visitors. Considered in the National Inventory of Geological Heritage as one of the most significant French sites (#PAC0601). Site selected for the Second 100 IUGS Geological heritage sites. Listed heritage site according to the French law (1930).*	Michel Bakalowicz, Naomi Mazzilli, Jacques Mudry, Leïla Serène
	2. **Port Miou**	N 43° 12' 18.86" E 5°30'46.72" Z= - 10 m asl Cassis, Provence-Alpes-Côte d'Azur	1000/3000 to 8000/50000 (difficult to measure flow under sea) Not tapped. Brackish water	***H, S, A, Ec, E*** *Submarine spring, main discharge of a large recharge area of 400 km², partly from upper karst aquifers leakages, connected to deep conduits of Messinian age. Port-Miou was cited for the first time in 1711 by L.F. Marsilli, considered as the father of oceanography. He*	Michel Bakalowicz, Bruno Arfib

			due to sea water intrusion at great depth. The first submarine spring where works attempted to mitigate sea water intrusion by underground dam.	*suggested the origin of this underground river in "the infiltration of rain and snow water from the Sainte Baume Mountain and the Cujes valley", that he compared to what he observed along the coast of Croatia, at Lika. During the 1960's and 1970's, engineers attempted to mitigate sea water intrusion by building dams in the conduit, about 500 m from the shore. Even if the source is not directly visible, the site of the Port Miou calanque (cove) is remarkable. A new species of aquatic subterranean Microcrustaceans (Tethysbaena ledoyeri n. sp.), and a new Marseilleviridae Port-Miou virus (nucleocytoplasmic large DNA viruses clade) were described from the spring. Port-Miou is one of the sites of the Karst National Observation Service, studied since the 1960's. It is included in Calanques National Park.*	
	3. **Lez**	N 43° 43' 05.3" E 3° 50' 39.3" Z = 65 m asl Prades-le-Lez, Hérault. Occitanie	300/2000/12000 (natural regime) 0/840/11900 (discharge under active management during 2008-2021, with pumping rate: 650/1050/1700) Tapped for Montpellier town (350,000 consumers). One of the most advantage intakes and successful engineering regulation projects in karst, globally.	***E, S, H, A*** *During the 1960's and 70's Prof. J.V. Avias and his team launched large project implemented in 1980's, by building of the large pumping station in Jurassic – Cretaceous aquifer (240 km^2 with autogenic limestone basin 130 km^2) over the Lez natural spring site. Firstly, cave diving mapped karst conduit up to 540 m at -101.3 m below actual spring level. Today "Prof. J.V. Avias" pumping station consists of 4 boreholes (av. rate 1.02 m^3/s) intersecting the main conduit at -48 m below spring level (17 m asl). By an active management of the aquifer present-day authorized drawdown might be increased of 20 m. When during autumn natural spring dries up, a continuous ecological flow (230 l/s minimum) is diverted to Lez River in order to preserve its aquatic biodiversity. Considered in the National Inventory of Geological Heritage as one of the most significant French sites (#LRO0001). It is Special Area of Conservation under the EU's Habitats Directive (92/43/EEC): Natura 2000 FR9101392, ZNIEFF FR910009574. Field site of the Karst National Observation Service (SNO Karst).*	Michel Bakalowicz Hervé Jourde
	4. **Fontaine de Nîmes**	N 43°50'25" E 4°20'56" Z= 56 m asl Nîmes, Occitanie	10 / 550 / 18000 Not tapped	**E, S, H, A** *"Jardins de la Fontaine", a historic site in the city of Nîmes is classified as an historic monument and a Remarkable Garden of France. In Nîmes, tourism is an essential part of the regional economy. This karstic spring was first dived in 1905 by F. Mazauric. More than 14 diving expedition were carried out by the Fontaine de Nîmes association between 1965 and 1998. Because the spring emerges in the town, where "Cevennes*	Michel Bakalowicz, Jean-Baptiste Charlier, Vincent Bailly-Comte, Jean-Christophe Maréchal,

				storms" are the cause of catastrophic flash floods (3/05/1988; 6 & 8/09/2005), a flood warning system has been implemented, measuring the water level at the spring at high frequency and transmitting it in real time at the Nîmes city monitoring services for its implementation into the flood warning system in case of rainfall forecasting. With a catchment area of 55 km² and a maximum estimated discharge of 30 m³/s in 1988, the specific maximum discharge rate reached rate of 550 l/s/km². Considered in the National Inventory of Geological Heritage as one of the most significant French sites (#LRO3033). Site listed as a historic monument on the 1840 list. Labelled as "Remarkable Garden" ("Jardin remarquable").	Bernard Ladouche
	5. **Le Loue**	N 47° 0′ 40″ E 6° 17′ 55″ Z= 543 m asl Ouhans, Doubs, Bourgogne-Franche-Comté	700/9900/83000 Intake for 2 hydropower plants (downstream) - drinking water supply for Ouhans village, as well as for Besançon urban area (55 km downstream of the spring)	***H, A, E, S*** *Beautiful wild natural site with impressive cliff over the spring issuing from large cave orifice. The catchment area of some 200 km² consists mostly of Upper Jurassic limestones. This is one of the most touristic sites over Franche-Comté region. Historically important "tracing test" for proving communication between the Doubs River and the spring, displayed by absinthe poured into this sinking river during a distillery fire in 1901. Spring water is used by 2 hydraulic power plants within the first 10 km of the river Loue. It also supplies drinking water to Ouhans village and* Besançon*. Listed site, according to the French law (since 1913). It is also considered in the National Inventory of Geological Heritage as one of the most significant French sites (FCO0015).*	Jacques Mudry, Jean-Baptiste Charlier
	6. **Lison spring**	N 46° 58′ 04″ E 6° 0′ 37″ Z= 380 m asl Nans-sous-Sainte-Anne, Doubs / Bourgogne-Franche-Comté	93/5300/73400 Not tapped	***A, H, S, E*** *Beautiful set of wild natural sites: Lison spring, Sarrasine cave, Creux-Billard sinkhole. The spring issuing from Middle Jurassic limestones (Doggerian), drains a basin of 140-160 km². The Lison Spring is the first French site where an industrial intake project was stopped by the population, enabling the vote of a law by the Parliament, for the protection of national sites, according to their natural value (Beauquier law, 1906). The ere is no direct use, but the Lison Spring is the major tributary of the Loue river abstracted for drinking water supply 50 km downstream, for Besançon; one of the first touristic sites of the Franche-Comté Region. Registered site, according to the French law since 1912 Considered in the National Inventory of Geological Heritage as one of the most significant*	Jacques Mudry, Jean-Baptiste Charlier, Michel Bakalowicz

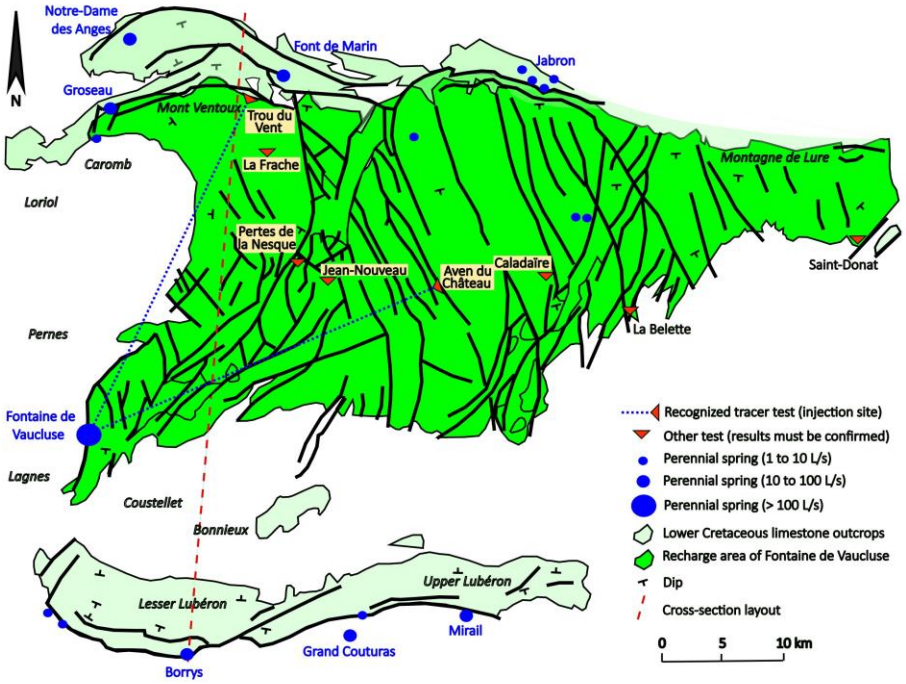
				French sites (FCO0004). Special Area of Conservation under the EU's Habitats Directive (92/43/EEC).	
	7. **Arcier**	N 47° 16’ 01” E 6° 07’ 16” Z= 275 m asl Vaire-Arcier, Doubs / Bourgogne-Franche-Comté	307/1170/6700 Tapped since 70 AD	***H, A, S, E*** *Spring drains basin of 113 km², mainly consists of Upper Jurassic limestones. Arcier spring is tapped since the 1st century CE. Remains of the Roman aqueduct are still visible, as much as the “Castellum divisorium”, dispatching water among the districts of the Roman city. In the 19th century, for the first time in France, a hygienist physician (Dr Baudin) established a relationship between typhoid epidemics on the recharge area of the Plateau and, after one-week, subsequent epidemics in Besançon, due to the consumption of water from Arcier Spring. At the same time, other districts of the city, supplied by distinct resources, did not undergo these epidemics. Today supplies water to 1/2-1/3 of Besançon population (56,000 citizens). Beautiful wild natural site. Supplying the historical centre of the city by drinking water for 1900 years, and fish farm (now stopped). Field site of the Karst National Observation Service (SNO Karst). Registered site, according to the French law (since 1947).*	Jacques Mudry
	8. **Durzon**	N 43° 59' 49" E 3° 17' 7" Z= 533 m asl Nant, Aveyron, Occitanie	600/1550/18000 Tapped. Gravity pipeline. A pumping station raises water for villages on the karst plateau	***S, E, A, Ec*** *The largest spring in Grands Causses with the largest dynamic storage. Drains a basin of c. 100 km² consists of Middle and Upper Jurassic dolomites and limestones. Tapped for the towns and villages of the Causse du Larzac and the Dourbie valley and feeds an important fish farm. Its drowned conduits explored by divers to -140 m along 2200 m. Beautiful site with large blue-green water basin surrounded by high trees at the foot of the limestone cliff marking the bottom of the reculée. Included in the core zone of the UNESCO Causses and Cévennes site. Hydro-geophysical observatory (gravimetry and tiltmetry) for studying the dynamics of the transport and storage of water, mainly in the unsaturated zone of its recharge area. Station of the International Geodynamics and Earth Tide Service (IGETS). Durzon River is protected for sculpin. Considered in the National Inventory of Geological Heritage as one of the most significant French sites (#MPY0856).*	Michel Bakalowicz, Christelle Batiot-Guilhe, Laurent Danneville
	9. **Font Estramar (Fontestramar Fontaine de Salses)**	N 42°51'39" E 2°57'28" Z= 0 m asl	800/1700/20000 Not tapped	***S, Ec, H*** *Permanent brackish spring linked to a group of submarine springs in the Salses lagoon, Font Dame. It drains basin of c. 150 km², consists of Upper Jurassic and Lower Cretaceous limestones. Deep*	Michel Bakalowicz, Perrine Fleury

		Salses-le-Château, Pyrénées-Orientales, Occitanie		*vertical conduit system developed during the Messinian Crisis of Salinity (~5,5 ka) explored by divers up to -308 m bsl (Sept. 2023), through 2900 m of flooded galleries. As such, it is the deepest diving underground exploration in the world and one of the best documented sites related to the Messinian Crisis. It contains original underground phreatic microbionte community of various microcrustaceans. It feeds the Sagnes d'Opoul wetlands, an extremely rich habitat for birds (Natura 2000 site). Considered in the National Inventory of Geological Heritage as one of the most significant French sites (#LRO2037).*	
	10. **Fontestorbes**	N 42° 53' 33" E 1° 55' 37" Z= 510 m asl Bélesta, Ariège, Occitanie	500/2100/13600 Not tapped	***S, H, A*** *Fontestorbes is one of the major karst springs in the Pyrenees, which basin covers c. 100 km². Fontestorbes waters cascade from a monumental porch opened in a cliff. The spring flows steadily most of the year, but in periods of low water, the resurgence exhibits intermittencies, most time during the touristic season. The periodicity of discharge is very regular when the flow rate drops below 1200 l/ at the spring. The flow shows a sudden drop to a few tens of l/s, followed 20 minutes later by a rapid increase to 1800 l/s. The period of the phenomenon is close to 78 min. Periodic water level fluctuations are also observed within the karstic system. The periodicity of the spring is so spectacular that it was described since long time, cited by Planque (1728), Astruc (1730), Darcy (1857) and Martel (1909). The intermittence mechanism was also studied by Mangin (1969) who built a scale model reproducing the intermittencies. This phenomenon is explained by the periodic emptying of a cave, acting as a reservoir drained by an upper conduit open to air, creating a head loss. Listed site according to the French law (1921). It is considered in the National Inventory of Geological Heritage as one of the most significant French sites (#MPY0980). Special Area of Conservation under the EU's Habitats Directive (92/43/EEC).*	Michel Bakalowicz
	11. **Baget (Las Hountas)**	N 42° 57' 20'' E 1° 01' 47'' Z= 498 m asl Balaguères, Ariège, Occitanie	40/430/2500 (Total discharge of the karst system: 40/510/10 000) Not tapped	***S, Ec, H*** *The first karst spring and its recharge area considered as a field lab for hydrological, geochemical and biological systematic studies (observed since 1968). Pumping test in a cave lateral to the main conduit at high flow rate (250 l/s) during the low flow stage. Long term studies on the drift of subterranean aquatic fauna and their populations. Study of the relationships between*	Michel Bakalowicz, David Labat

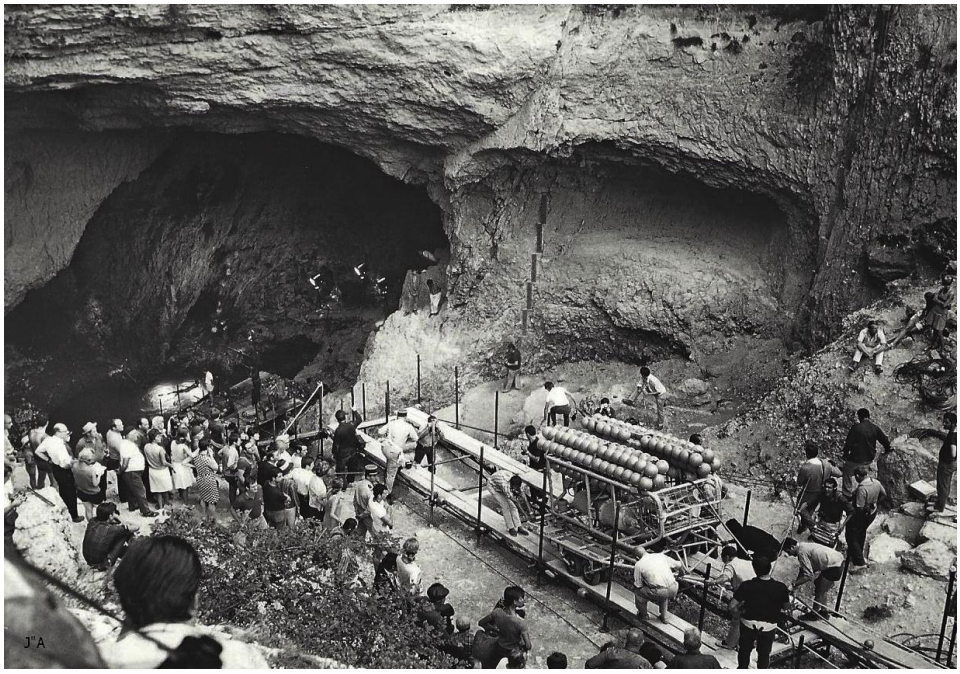
				epikarstic and deep karst aquatic fauna, and between karst and downstream alluvial aquatic fauna. It is considered in the National Inventory of Geological Heritage as one of the most significant French sites (#MPY0979). Field site of the Karst National Observation Service (SNO Karst). Part of the European inventory of ICARE project and the National Watershed Network.	
	12. **Fontaine des Chartreux**	N 44°26'33" E 1°25'55" Z= 115 m asl Cahors, Occitanie	800/2400/50000 Tapped for Cahors (25000 citizens), pumping station at the spring, since 1853. Electric pumps since 1926.	***H, A, E, S*** *Important historical site as Gallo-Roman cult of the Celtic goddess Divona Cadurcorum with ex-votos (coins). The Carthusian monks ("Chartreux") took possession of the site in 1362 and built a mill. Spring drains large basin of the Causses du Quercy, on the western flank of the Massif Central of c. 250 km². Basin mainly consists of Upper Jurassic carbonates. The spring emerges at the foot of the cliff on the left bank of the sinking Lot River which is connected to spring. Dominant inflow of Lot water is during low flow, with a decrease in EC and an increase in K, Na, Zn. First dive in 1948 (G. de Lavaur at -40 m), finally in 1998 at -138 m (Giodarno & Poinart). Considered in the National Inventory of Geological Heritage as one of the most significant French sites (#MPY0054). Also considered as "Grand Site" (remarkable site) in Occitanie.*	Michel Bakalowicz, Cyril Delporte, André Tarrisse
	13. **Touvre**	N 45° 39' 47" E 00° 15' 14" Z= 45 m asl Charante, Aquitane, Atlantic	3000/13000/20000 Tapped for water supply Angoulême city and suburbs (150000 inhabit.). Also used for irrigation and industry.	***E, S, A, Ec*** *A group of 3 Vauclusian type springs drains Upper Jurassic limestones. France's second-largest spring in terms of average flow rate. High amount of water in the spring is from four sinking rivers (up to 60%). The basin is 1200-1500 km², out of which c. 500 km² is karst (autogenic part). In the past, used for energy production, presently to supply potable water to Angoulême city. Provides ecological flow to the Charente River. The measurements are taken since 1919, presently 10 km downstream, at the Foulpougne dam. After statistical decisional analyses Touvre and Font de Lussac springs belong to the same karst system, whilst the Lèche spring does not. During flood episodes, the calcium bicarbonate type water is influenced by silicate tracers originated from the hardrock. The Touvre spring is a wide site for biodiversity: aquatic plants, birds. National Inventory of Geological Heritage (#POC0031).*	Jacques Mudry, Michel Bakalowicz
	14. **Le Bouillon - Loiret River Spring**	N 47°51'01" E 1°56'15" Z= 91 m asl	-50*/540/2300 Tapped by 3 wells close to the spring. 80% of the	***A, E, S, H*** *Le Bouillon is the main quasi-permanent overflow spring of a complex system of resurgences located upstream a series of springs all along the Loiret River. It*	Michel Bakalowicz, Stéphane Binet

		Val de Loire, Orléans, Atlantic	total water supply of Orléans City and three neighbouring towns. .	*sometimes works inversely, swallowing water from the Loire River (estavelle) some 20 km upstream, up to 15 m³/s. Studied since 17th century. The spring is the centre of the flower garden known and used for long at attested by archaeological remains found in the submerged conduits by divers. Gardens were laid out around the spring as early as the 16th century. This site is one of the most visited in the region. It is included in the local water development and management plan "SAGE Val Dhuy Loiret" Considered in the National Inventory of Geological Heritage as one of the most significant French sites (#CEN0087). Field site of the Karst National Observation Service (SNO Karst) Architectural, Urban and Landscape Heritage Protection Zone (ZPPAUP). "Jardin remarquable" label from the French Ministry of Culture included in the Val de Loire, UNESCO World Heritage Site.*	

MIKAS - Fontaine de Vaucluse

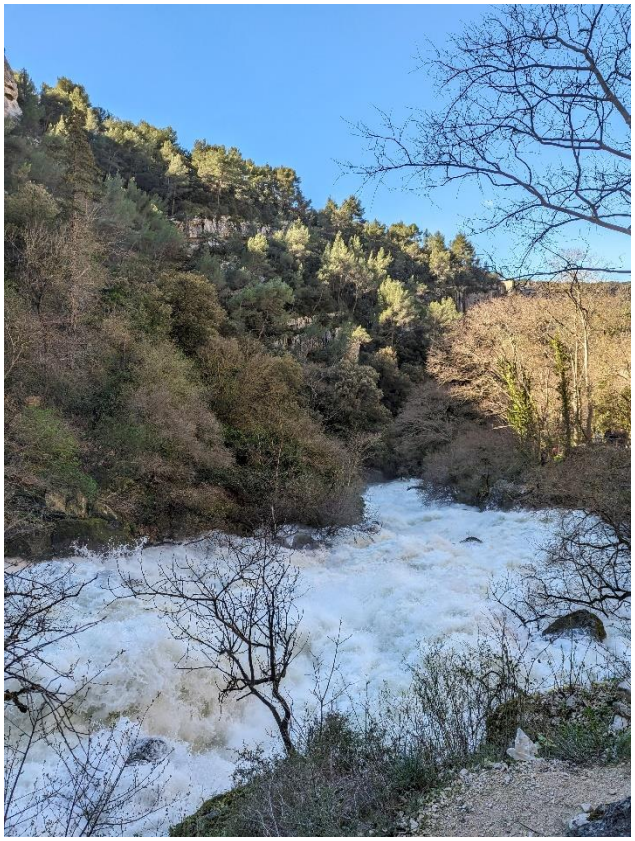


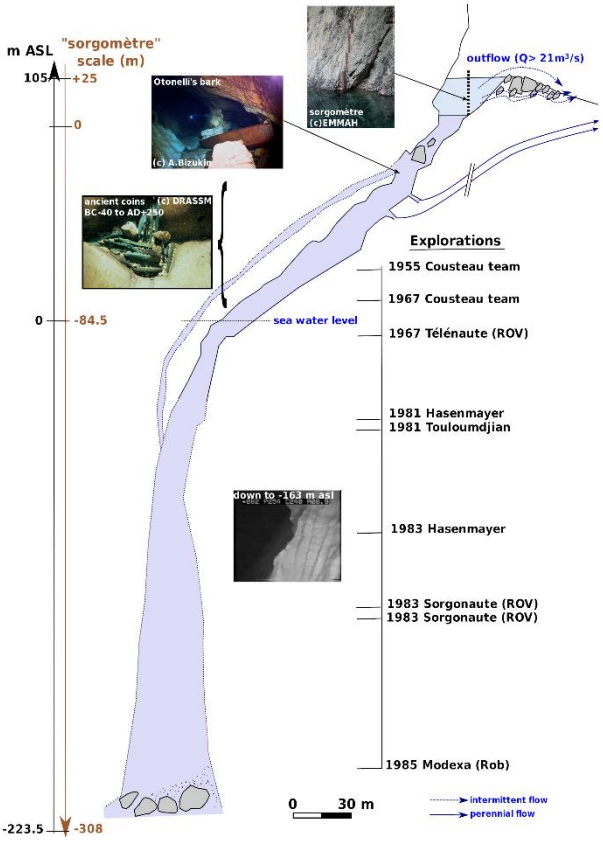
Simplified hydrogeological map - Recharge area of Fontaine de Vaucluse (from Blavoux et al., 1992, updated).



The Telenaute ROV launching, 1967. (Photo by J.Y. Cousteau. Courtesy from Syndicat Mixte du Bassin des Sorgues)

Fontaine de Vaucluse during flood (left. 58.7 m^3/s, photo C. Emblanch) and low flow stage (right). Courtesy from Syndicat Mixte du Bassin des Sorgues

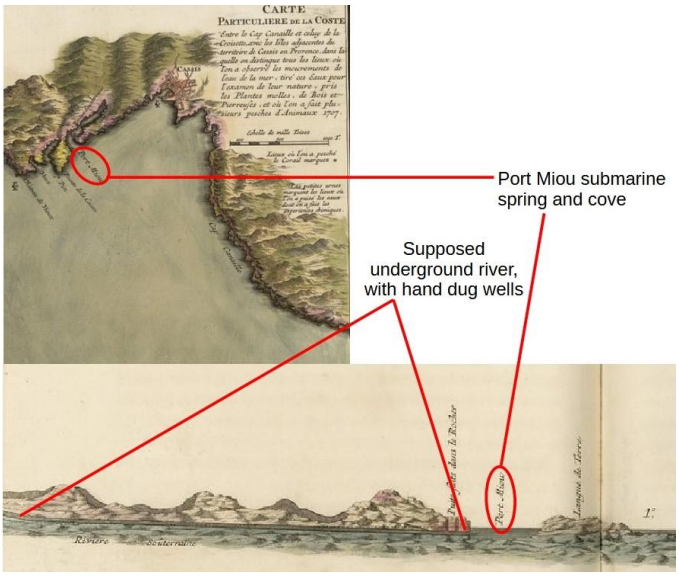




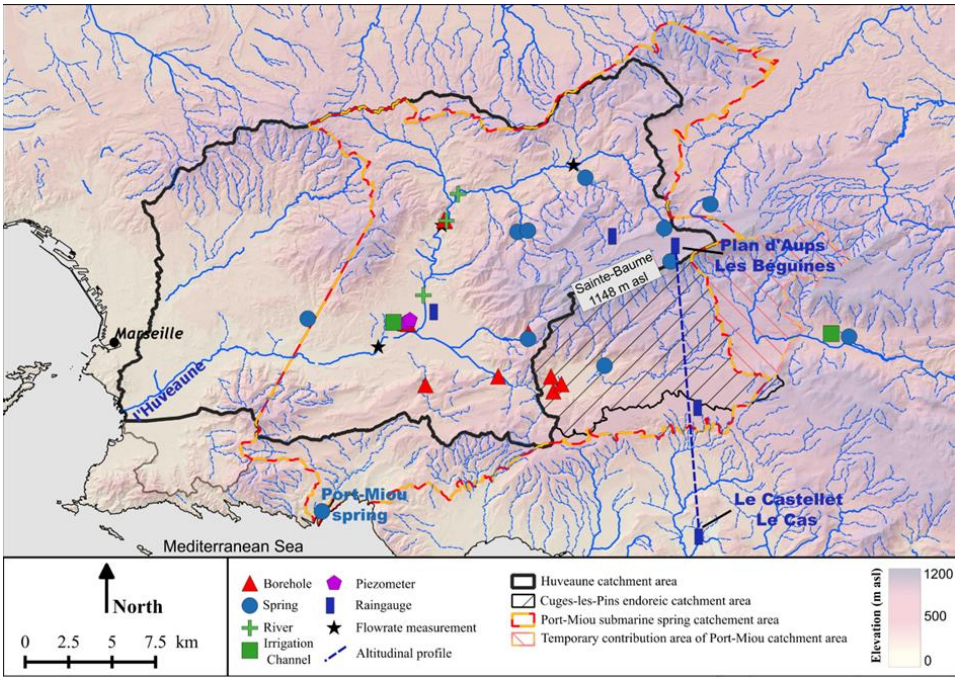
A few dozen meters down the spring, during flood (64.5 m3/s. Photo E. Simon, left);

Sketch of the Vaucluse vertical conduit, showing the progress of diving and ROV explorations (right).

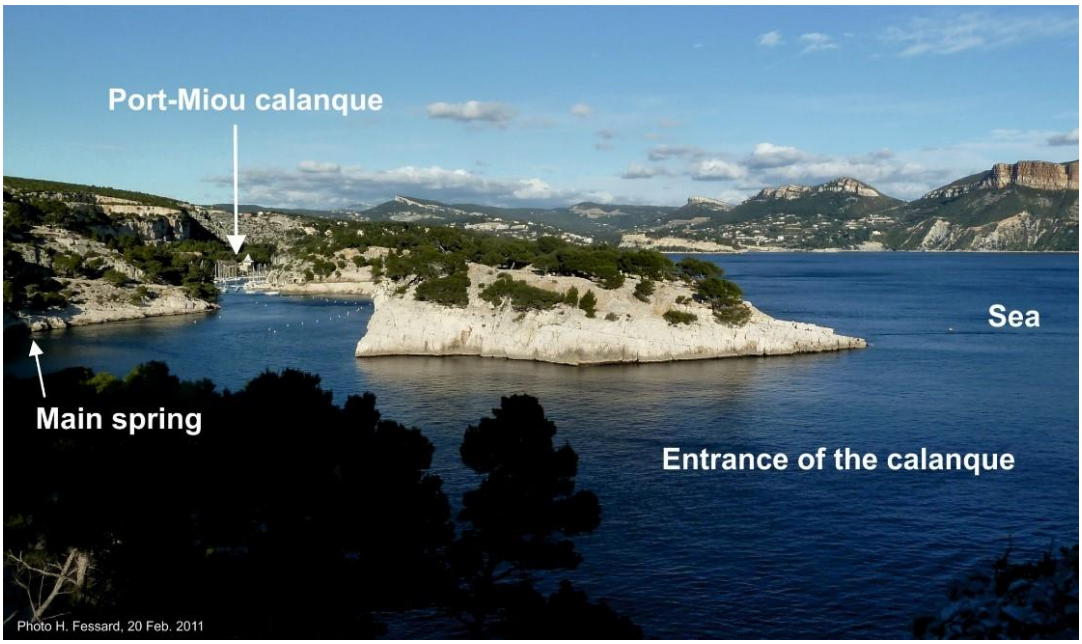
MIKAS - Port Miou



Location map and cross section of Port-Miou cove and submarine spring, according to Marsilli (1725).

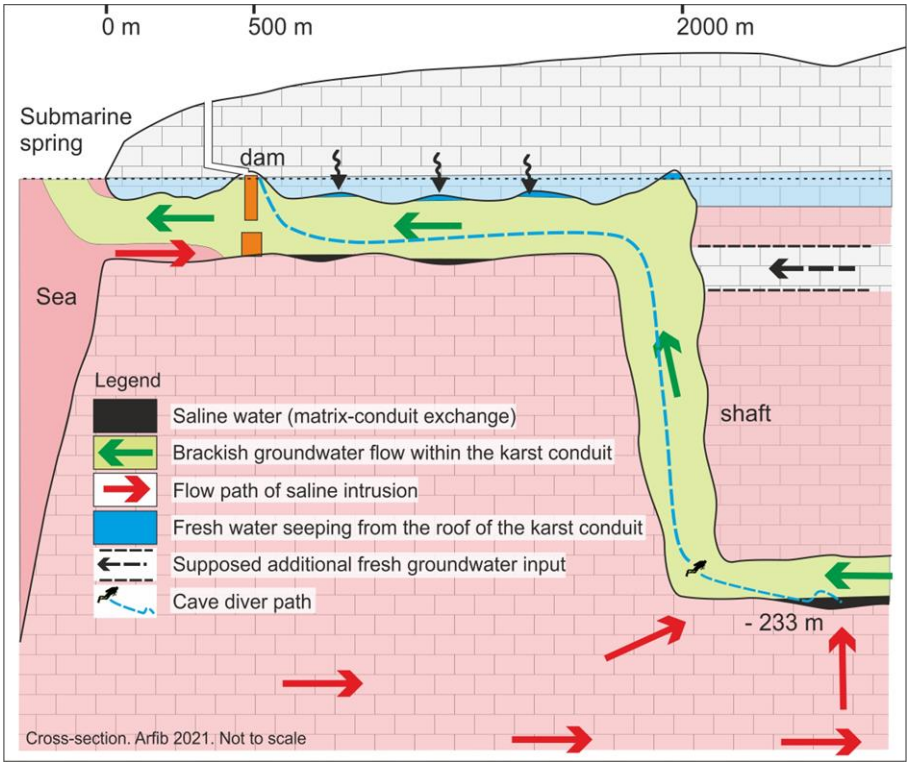


Elevation map with the contour lines of the Port-Miou recharge area and the Huveaune river watershed, and the location of regional groundwater sampling sites used by Garin, 2022.



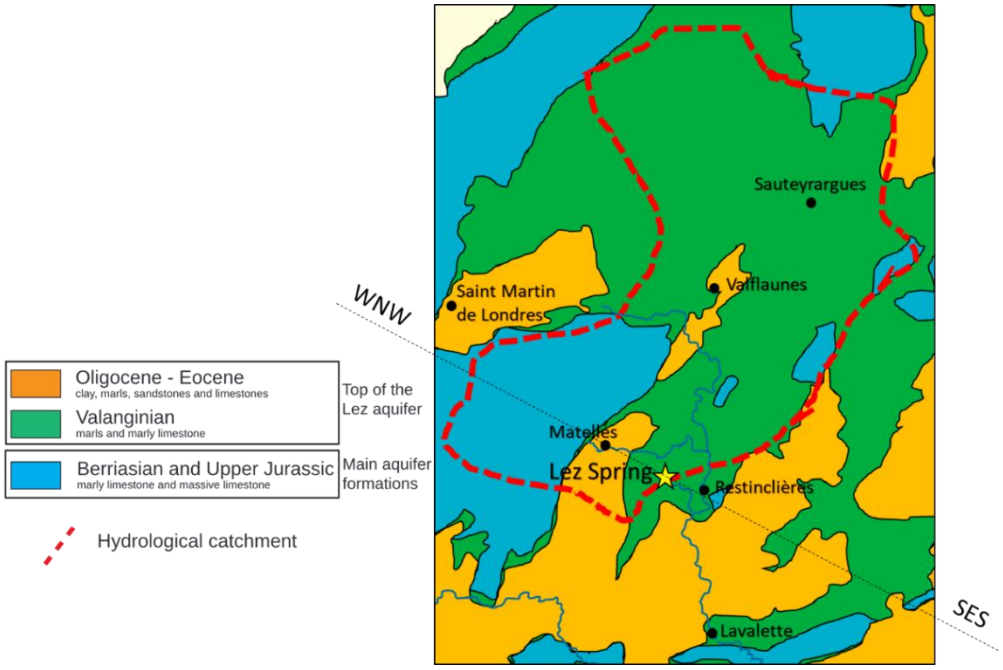
Panoramic view of the Port-Miou calanque (Photo H. Fessard).

Cave divers at the Port-Miou submarine and underground dam (Photo B. Arfib).

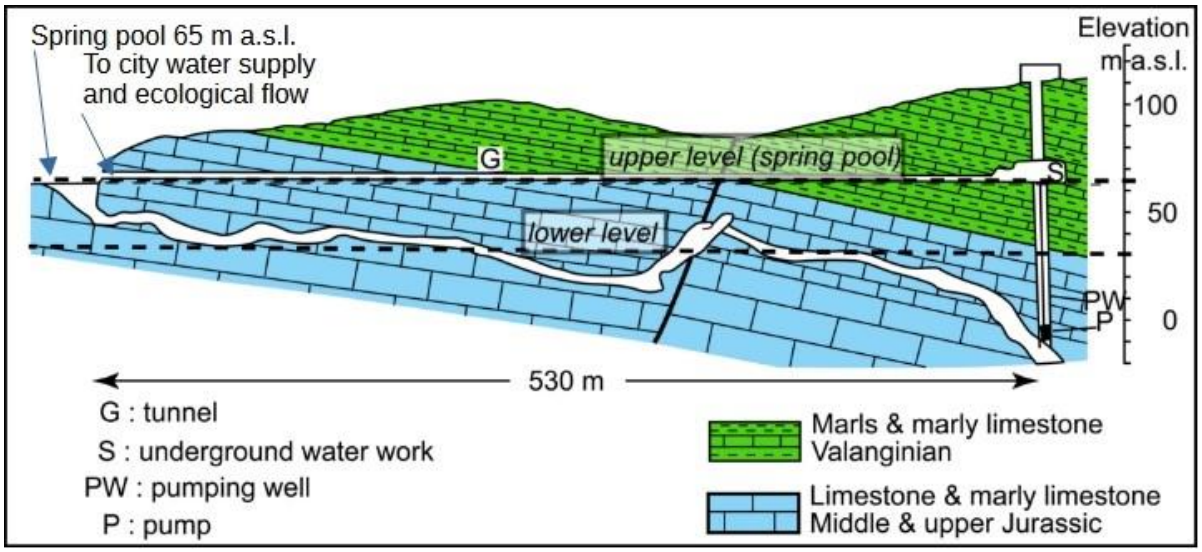


Schematic cross section of Port-Miou submarine karstic spring, explored by cave-diving up to 2000 m from the sea and 233 m below sea level. The underground submarine dam is located 500 m inland from the sea. Deep saline intrusion was revealed by continuous EC measurements at the dam and during the diving explorations (from Arfib & Mocochain, 2022).

MIKAS - Lez



2D simplified geological map of Lez Aquifer and hydrogeological basin of the Lez spring (modified after Dausse et al., 2019 and Leonardi et al., 2013)



Cross section showing the pumping station of the Lez Spring (from Bakalowicz, 2011).

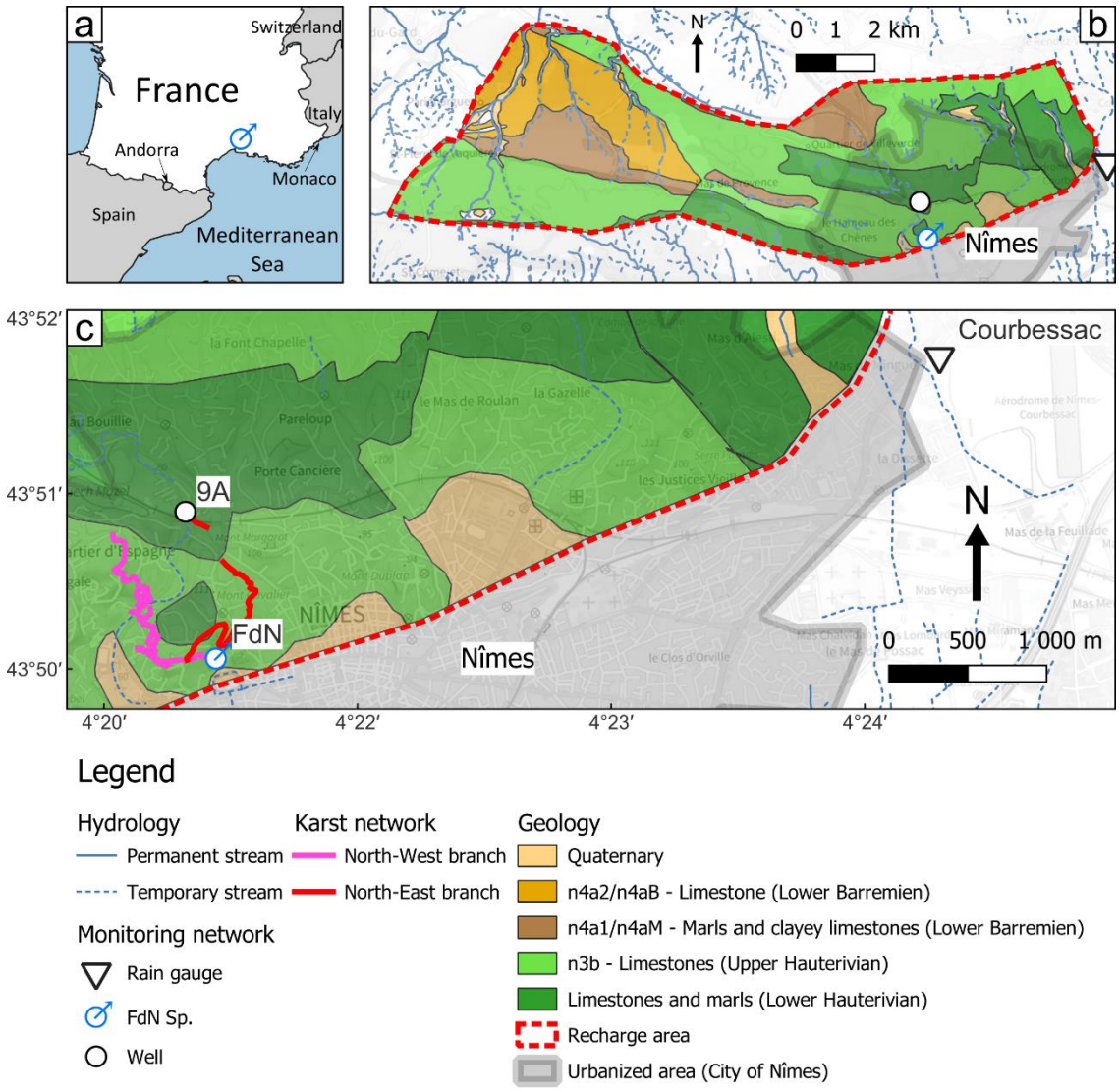
Entrance to the Lez spring pumping station, in honor of J. V. Avias, professor of geology at Montpellier University and former vice-president of A.I.H. (photo M. Bakalowicz)

Lez Spring under normal flow conditions (photo H. Jourde).

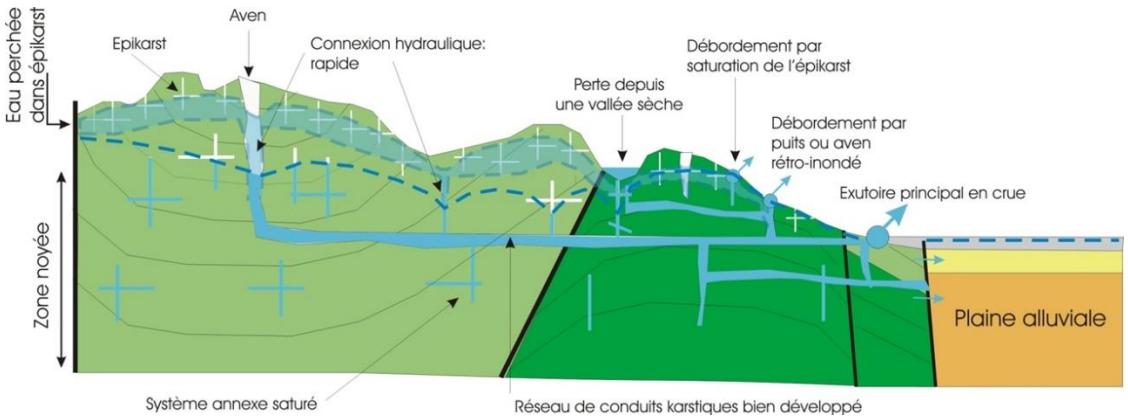
Lez Spring when the pumping flow rate at the spring exceeds the discharge rate (photo H. Jourde).

Ecological flow diverted towards the Lez river when the natural discharge becomes insufficient (photo H. Jourde).

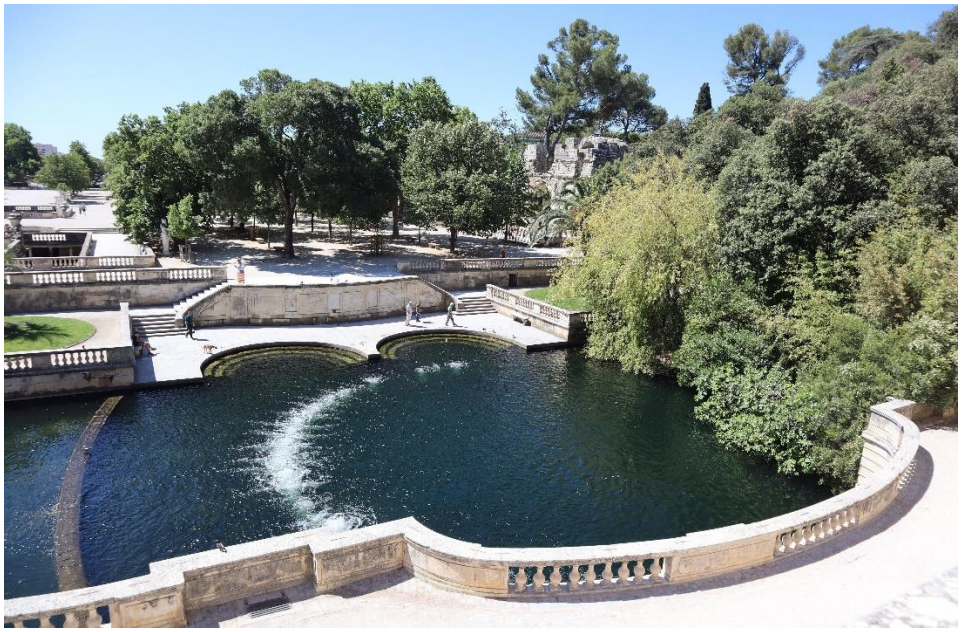
MIKAS – Fontaine de Nîmes



Recharge area of Fontaine de Nîmes. a): general location. b): hydrogeological context. c) urban part with the two explored branches (Bailly-Comte et al., 2023).

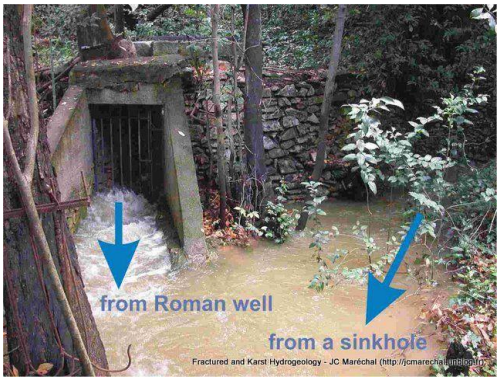


Hydrogeological conceptual model of Fontaine de Nîmes karst system during flood events (Maréchal et al., 2005).



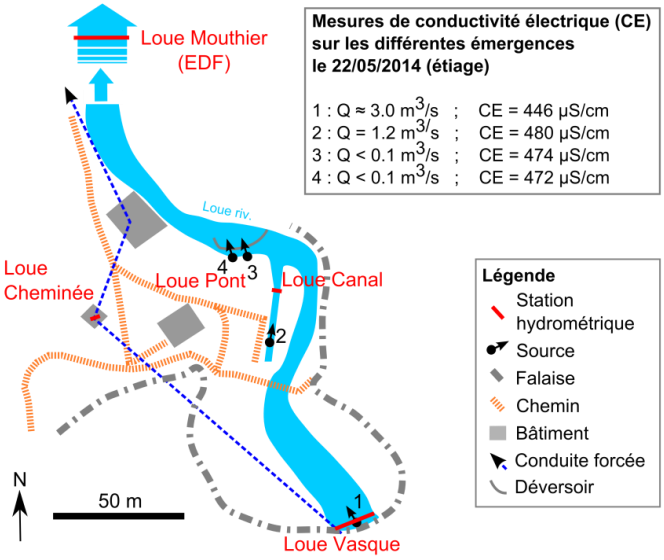
Fontaine de Nîmes during low flow stage (photo BRGM).

Fontaine de Nîmes during a flood (photo BRGM).

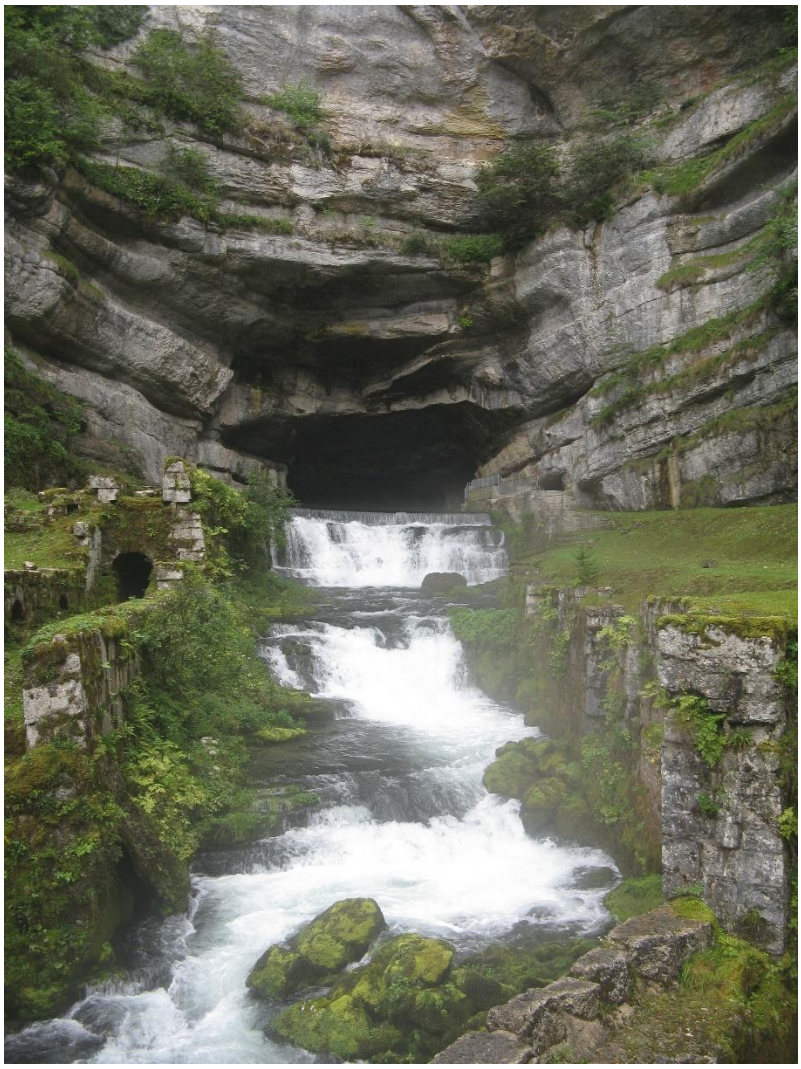


Gaffone Roman well overflowing during the 9 Sept. 2005 flood (photo G. Jouannen)

MIKAS – La Loue



Location of the 4 springs and 3 gauging stations at the Loue River Spring site (Charlier et al., 2014).

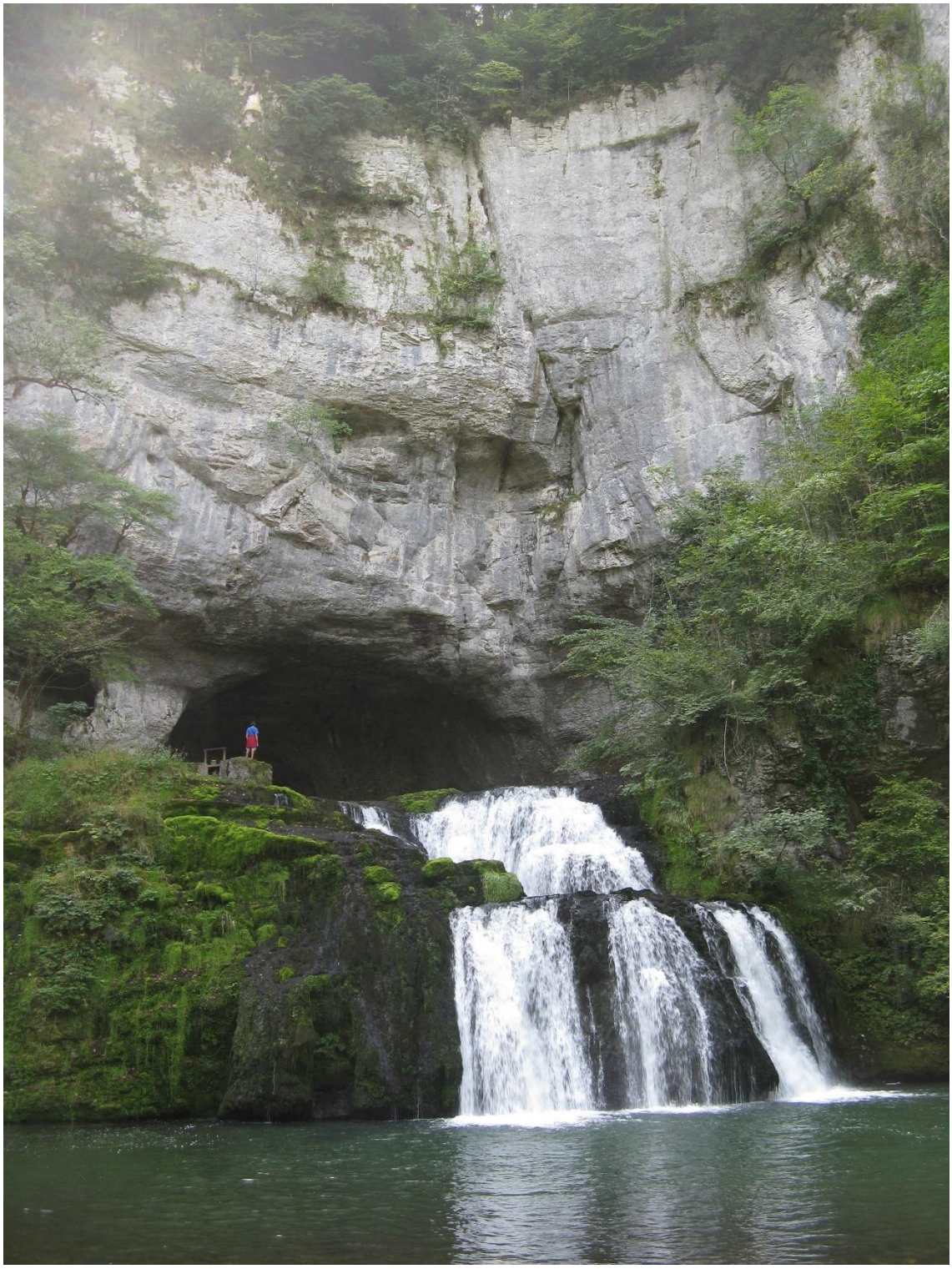


The Loue River Spring issuing from Upper Jurassic limestones during low flow period. Photo used for front page of Neven Kresic's book "Water in Karst: Vulnerability, Management and Restoration", McGraw Hill, (photo Z. Stevanović).

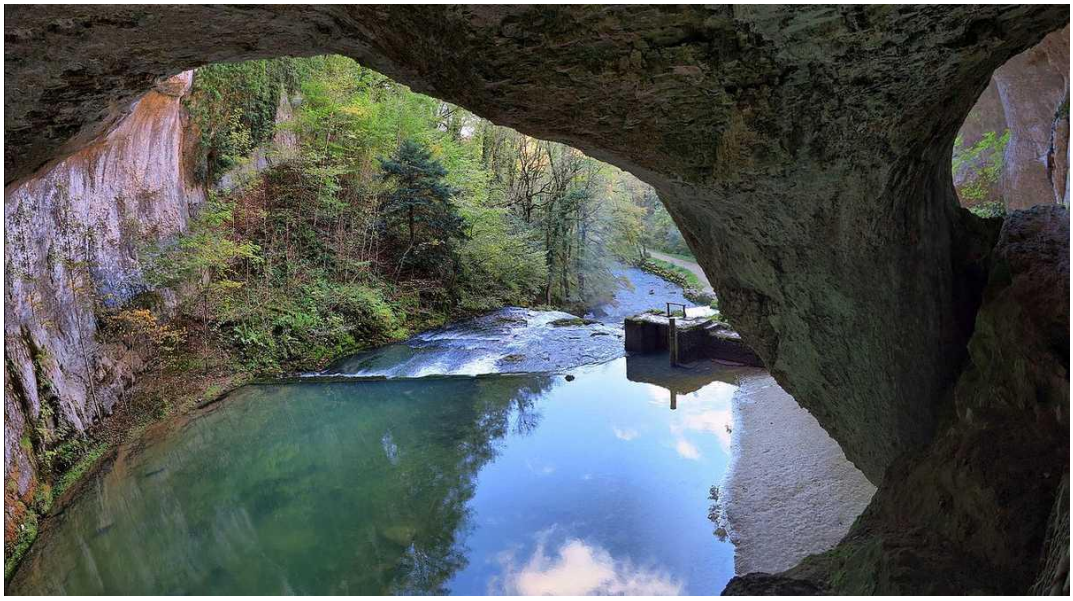
The Loue River Spring during low flow flood event season (photo J.-B. Charlier).

The Loue River Spring, by the famous French painter Gustave Courbet (1864), Metropolitan Museum of Art, New-York

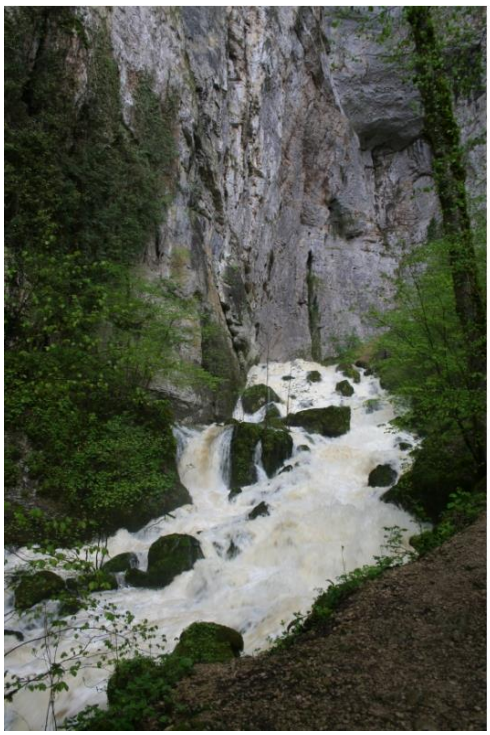
MIKAS – Lison spring



Impressive cave orifice from which is issuing Lison Spring water. Photo used for front page of "Karst: Environment, Management of the Aquifers" of Stevanović et al., GW Project (photo by Z. Stevanović)



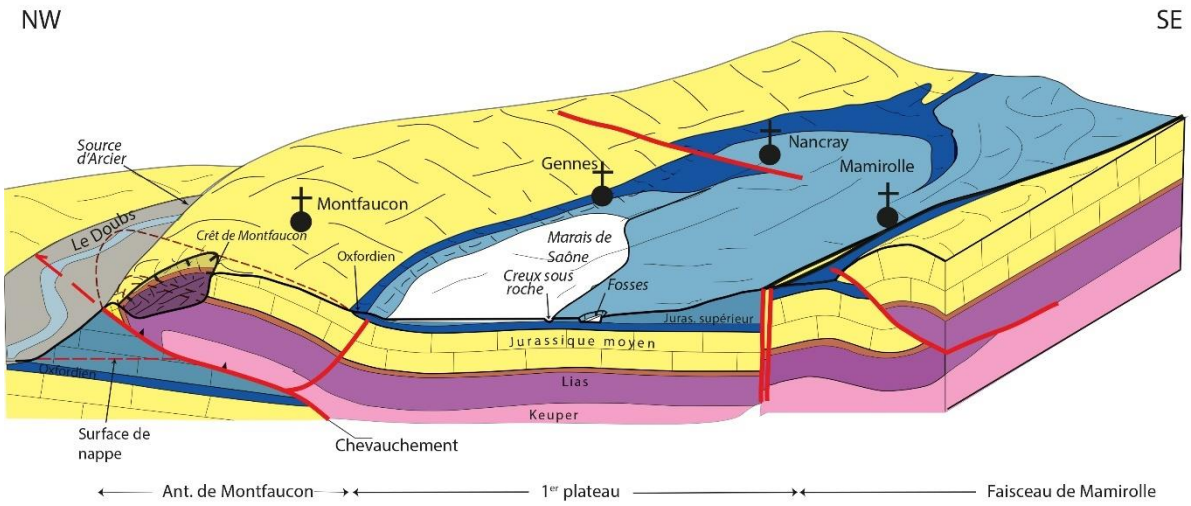
Lison Spring during high flow (upper photo) and low flow (photos J. Mudry).



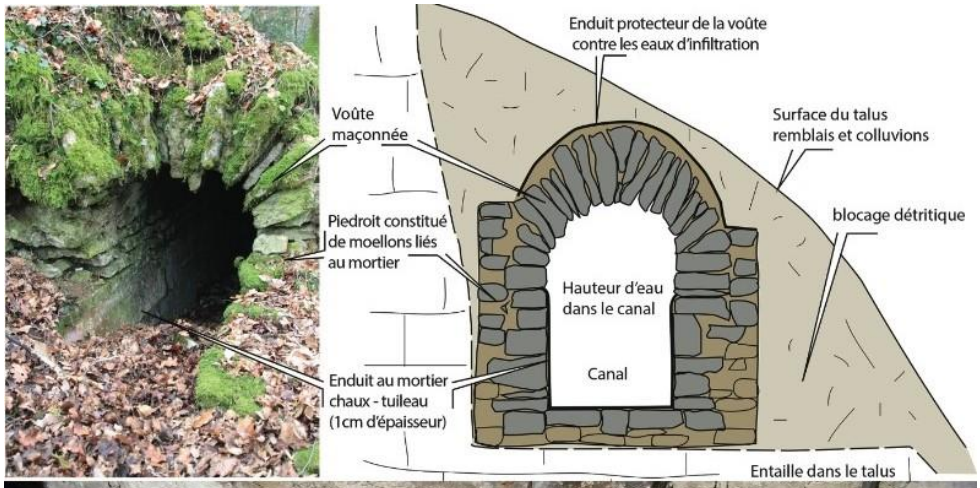
Lison Drainage area:

Sarrasine overflow spring(left), Creux Billard (right) (photos J. Mudry).

MIKAS – Arcier spring



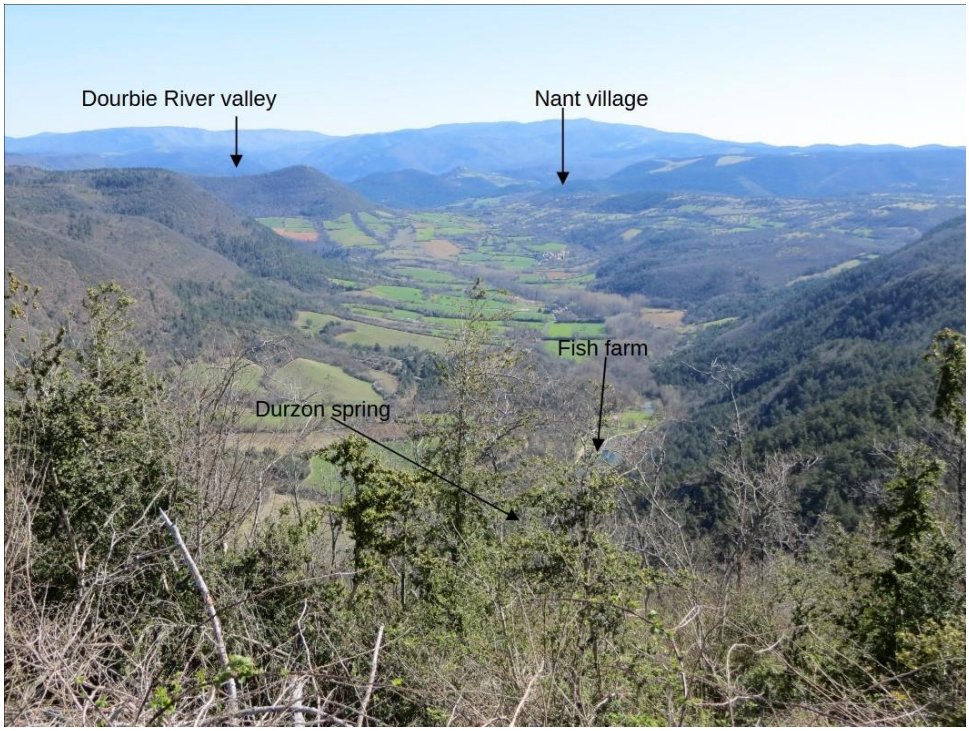
3D geological scheme of the Marais de Saône polje, in the recharge area of Arcier Spring (Chauve & Mudry, 2024).



Roman tapping of Arcier spring (2nd Century CE). Up: Remains of the Roman aqueduct (Chauve & Rolin, 2015). Down: Distribution basin in the city center of Besançon (photo J.-C. Barçon).

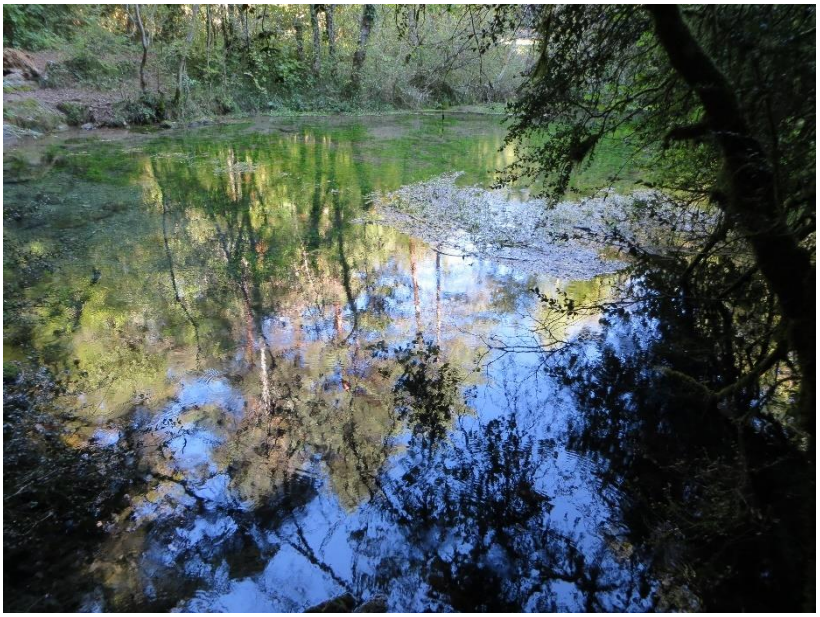
Overflow of Arcier Spring (photo P. Chauve).

MIKAS – Durzon spring



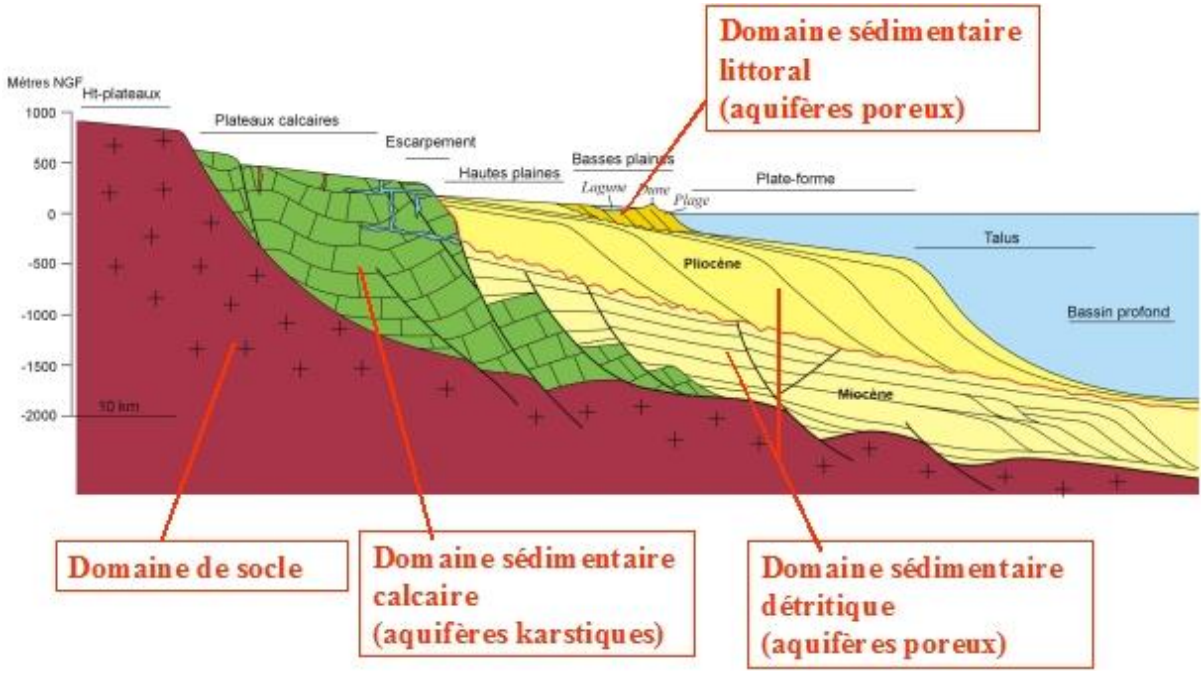
Valley of the Durzon River (Photo M. Bakalowicz)

The Durzon spring in winter, looking upstream (photo L. Danneville).

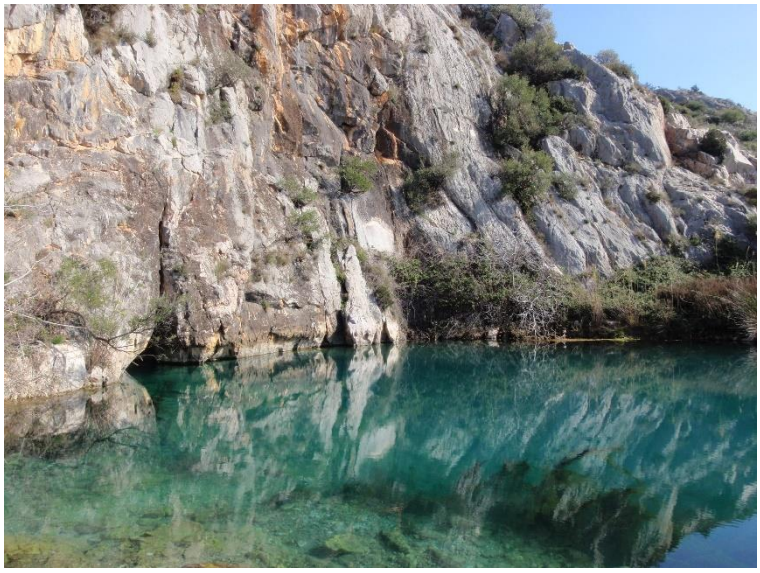


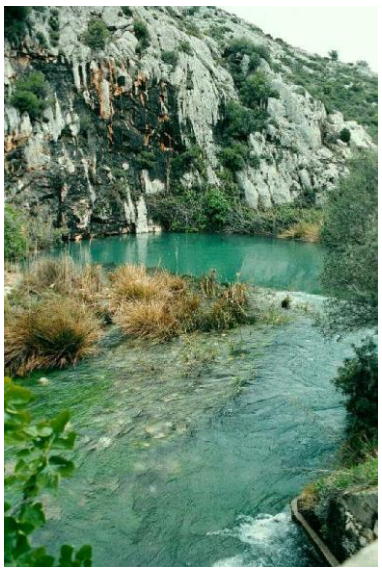
The Durzon spring, looking downstream (photo M. Bakalowicz).

MIKAS – Font Estramar spring



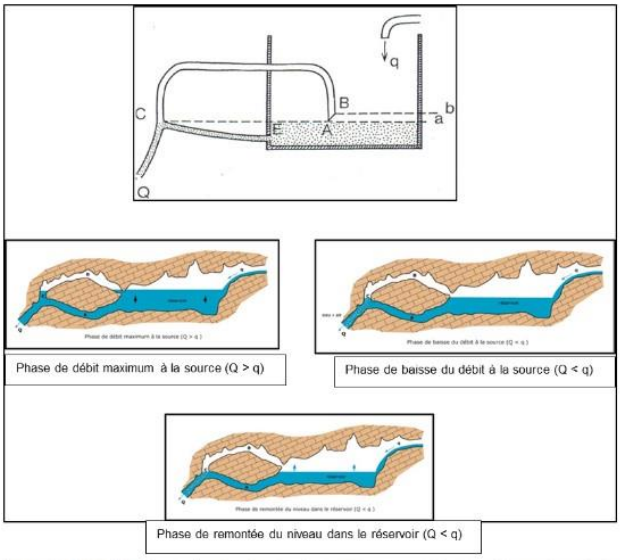
Schematic cross section of the carbonate massif with karst development at depth during the Messinian Salinity Crisis (from BRGM Report).



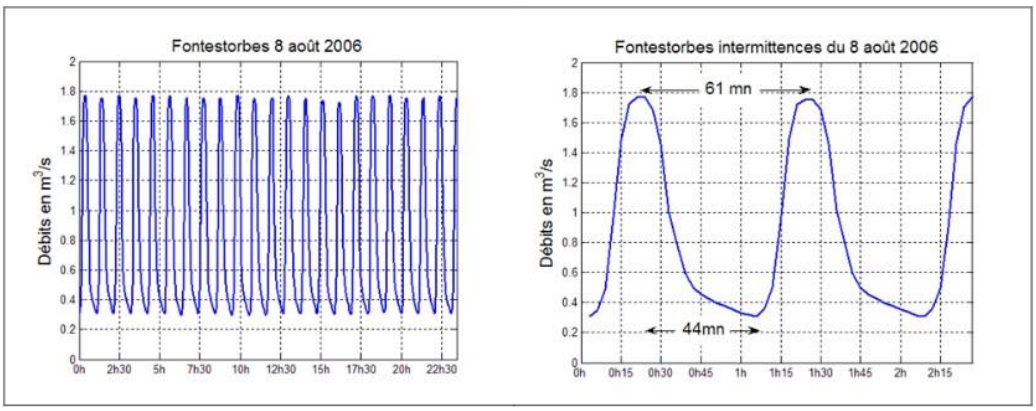


Font Estramar spring (photos, left: P. Fleury; right: BRGM).

MIKAS – Fontestorbes



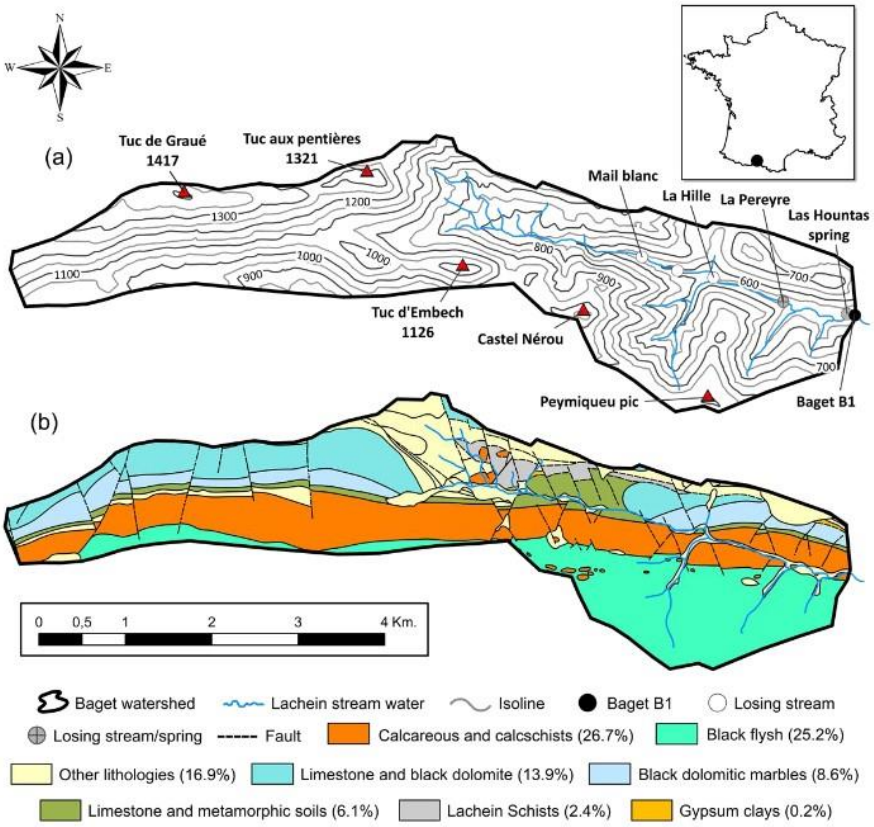
Hydrogeological system producing the periodic flow, according to Mangin (1973) (from BRGM Report 2015 RP-64209-FR).



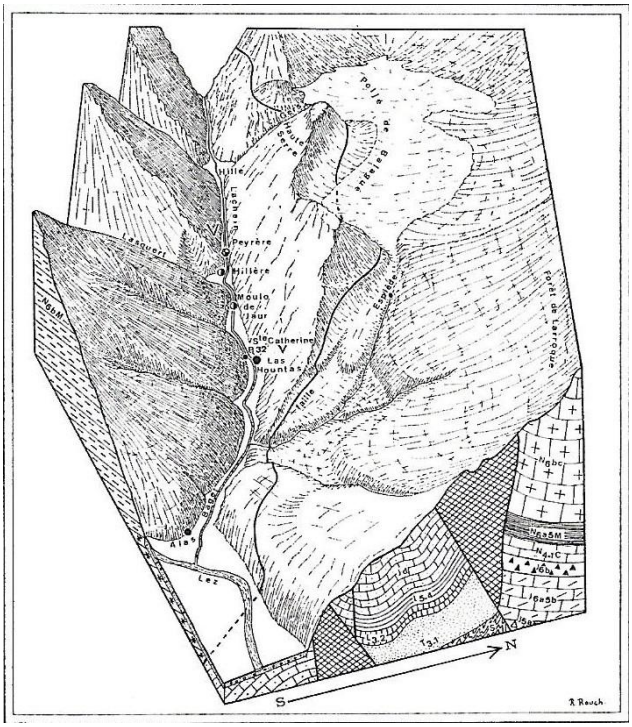
Example of spring hydrograph during intermittencies (from BRGM Report 2015 RP-64209-FR).

Fontestorbes spring, during low flow (photo BRGM).

MIKAS - Bates (Las Hountas)



Topographic and geological map of Baget system (Ulloa-Cedamanos et al., 2020)

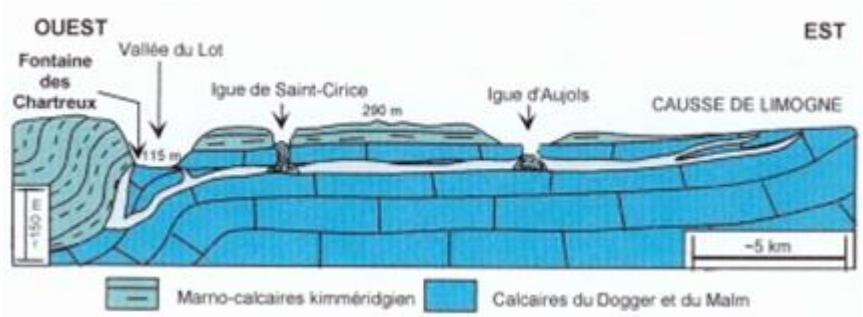


Geological 3D representation of the Baget karst system (from Mangin, 1976).

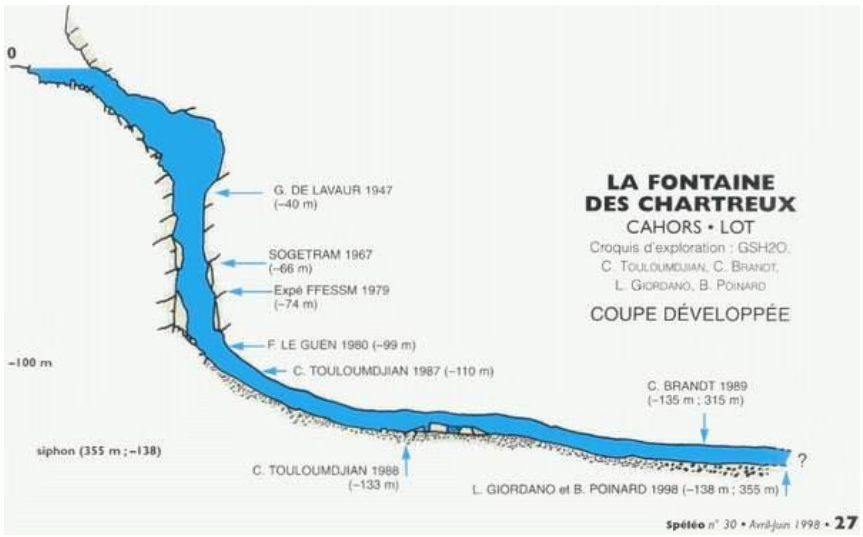
Las Hountas and the field lab, during a winter flood (photo D. Labat).

The main hydrometric station, downstream Las Hountas, controlling the total flow from the main spring and the overflow springs (photo D. Labat).

MIKAS - Fontaine des Chartreux



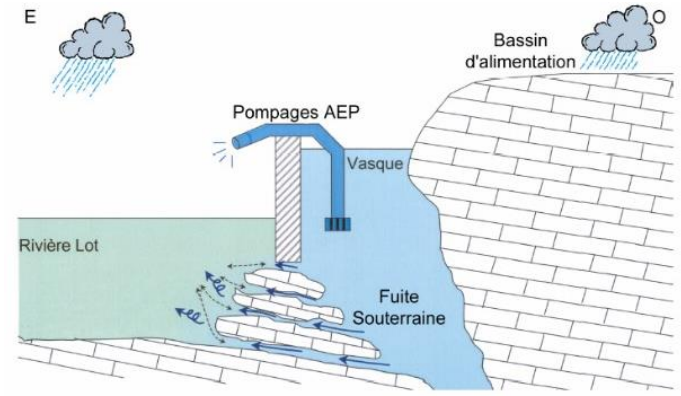
Hydrogeological cross section of Fontaine des Chartreux recharge area, with the assumed main conduit (from Astruc & Soulé, 1977).



Cross section showing the Fontaine des Chartreux conduit explored by divers (from Giordano & Poinard, 1998).

General view of the Fontaine des Chartreux, on the left bank of the Lot, with the famous Valentré bridge (14th century) in Cahors (photo C. Kupiec).

The Fontaine des Chartreux flowing into the River Lot (photo C. Kupiec).

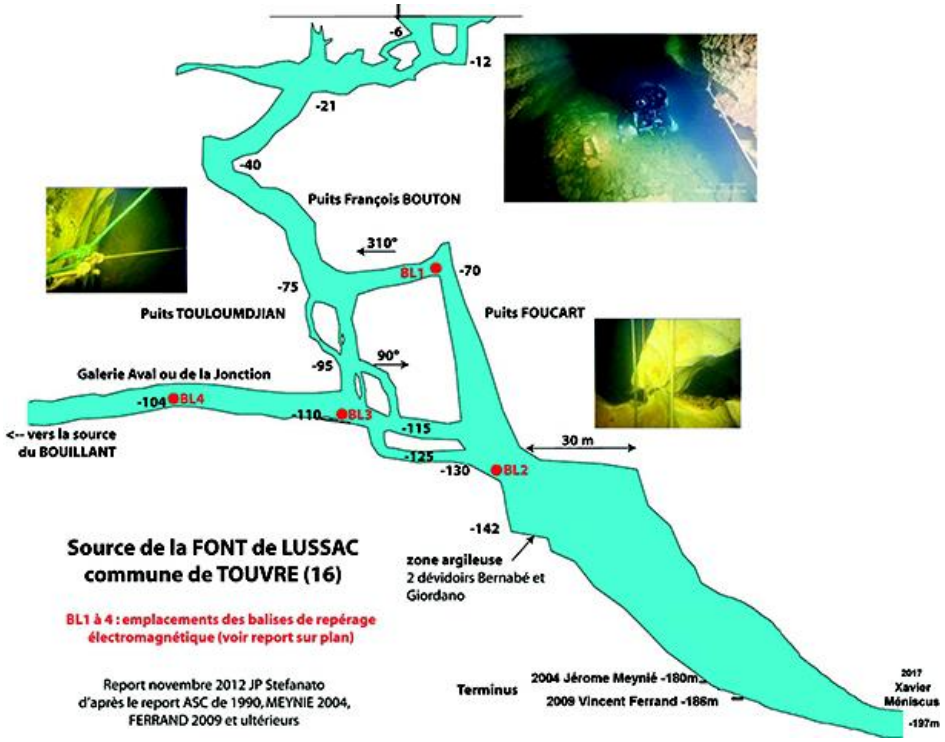


Simplified representation of Fontaine des Chartreux's functioning (Hoareau, 2005). Direct leakage into the river Lot demonstrates the difficulty of estimating flow rates using hydraulic models.

MIKAS - Touvre

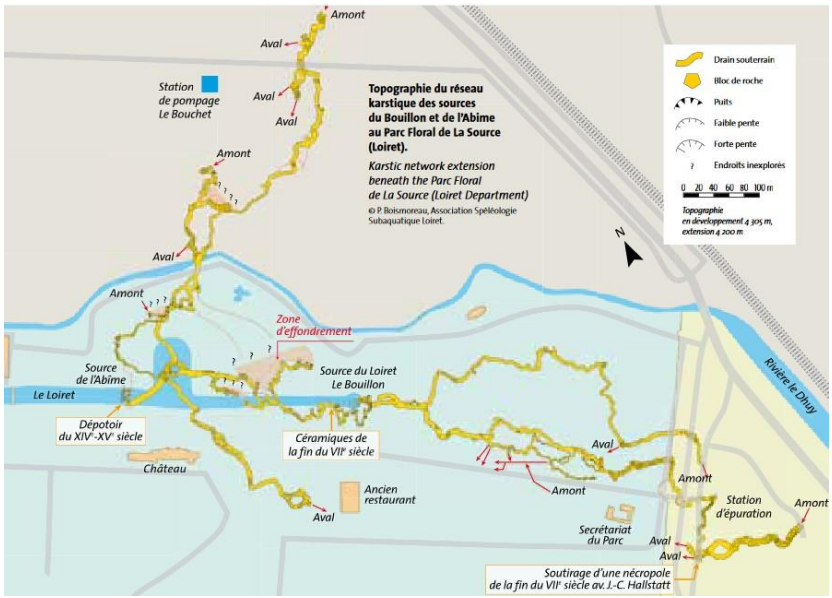
Le Bouillant, the main spring of the Touvre River (photo J. Mudry)

Le Bouillant spring, Touvre River and pumping station (https://www.charentelibre.fr/charente/ruelle-sur-touvre/source-de-la-touvre-un-mystere-leve-a-120-m-de-fond-6427154.php)

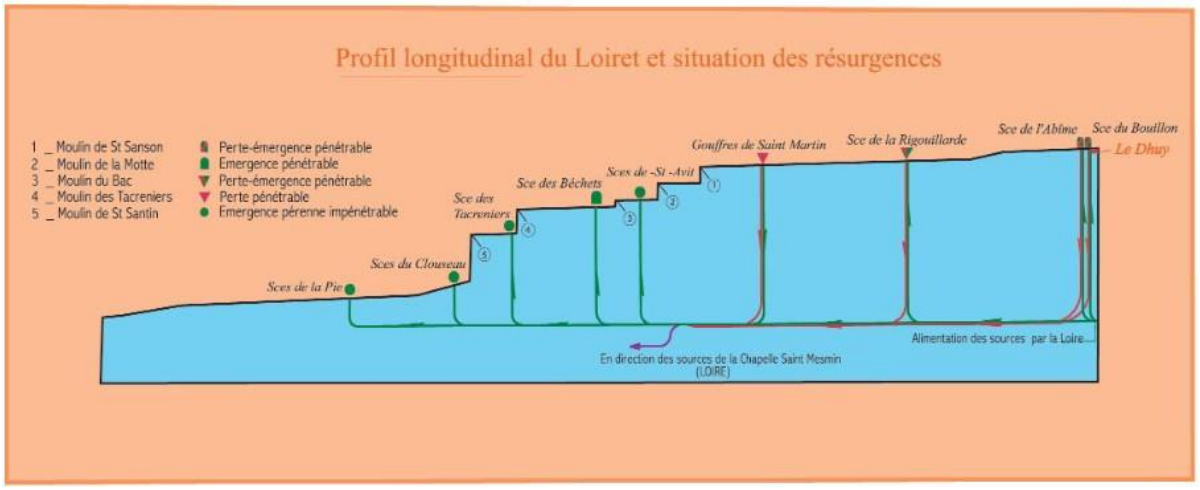


Cross-section of the Font de Lussac, one of the Touvre springs (https://subaqua.ffessm.fr/article/les-sources-de-la-touvre)

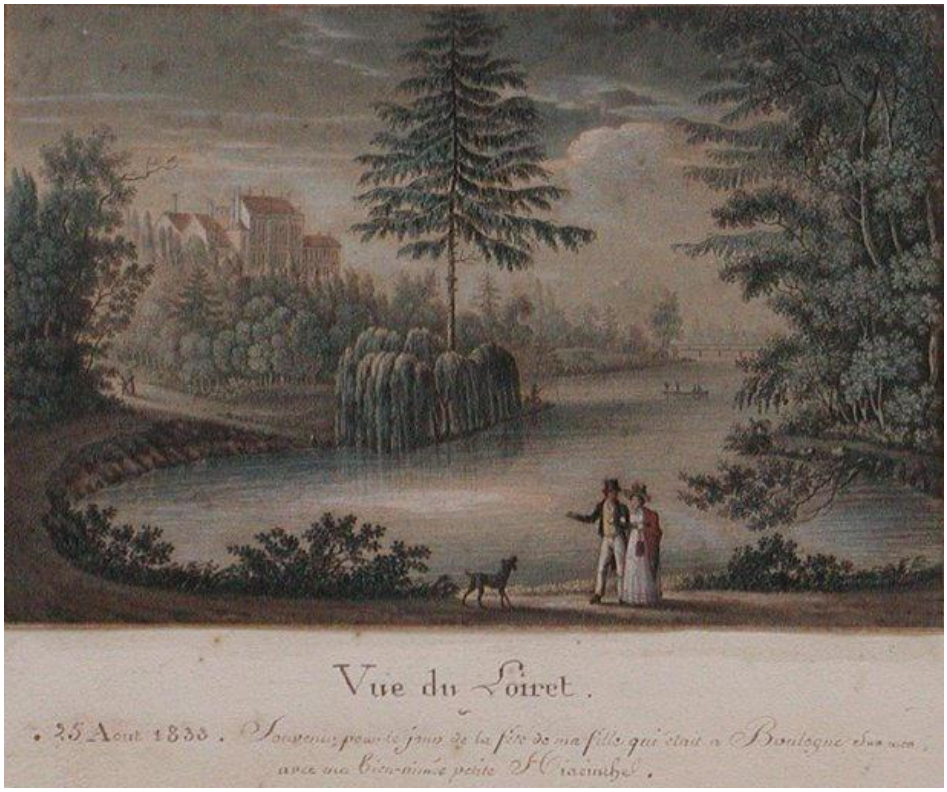
MIKAS - Le Bouillon (Source of Loiret River)



Map of the karstic conduits explored by divers from Le Bouillon, Loiret River Spring (Gutierrez and Binet, 2010).



Schematic cross section showing the resurgences downstream Le Bouillon. Green arrows show upward flow; read arrows show downward flow, or inversac (extract from https://www.assises-riviere-loiret.fr/images/DIAGNOSTIC/Fiche_alimentation.pdf, based on Lepiller, 2006).



View of Loiret Spring (19th century print, https://www.wikiwand.com/fr/Fichier:La_source_du_Loiret,_estampe_1.jpg)

Le Bouillon, spring of Loiret River (https://www.parcfloraldelasource.com/les-jardins/la-source/).