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# Low Temperature Deep Geothermal Operations for Direct Use in France: development of a national geothermal database and last review

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**ABSTRACT**

As part of a better monitoring of low temperature (30-150 °C) deep geothermal operations for heat production in France and in order to promote this form of renewable energy throughout the national territory, BRGM (French Geological Survey) in collaboration with ADEME (French Environment and Energy Management Agency) have implemented an application (web-based geothermal database) to follow-up detailed information on geothermal operations. Initially the database was defined to collect and disseminate geothermal data of the "Dogger" aquifer exploitations of the Paris basin, first sustainable aquifer used for district heating in France. Since 2018, the database has been extended to all deep geothermal operations in France for direct use (i.e. Paris basin, Aquitaine basin, Rhine Graben, South East basin, Limagne) and counts about 220 geothermal wells with 135 wells still operating.

The objective of this "national" database is to provide valuable information to project developers who need accurate data during feasibility studies and regulation and permitting processes. It also targets local authorities and private or public stakeholders to provide them information about current operations, resources and potential applications for heating. Moreover, the system is also promoting the use of geothermal energy as part of the objectives of the law on Energy Transition and Green Growth, which sets a target of 38% of renewable energy sources in final heat consumption by 2030 in France. The article gives also a review of low temperature geothermal operations in France.

## 1. INTRODUCTION

In order to identify and monitor deep geothermal exploitations for low temperature heat production (temperature range between 30-150°C) in France, BRGM and ADEME have developed a geothermal database in the early 2000's. Initially this geothermal database included well and reservoir characteristics (location, deviation, casing information, depth, hydrodynamic parameters…) and well monitoring data (pressure, temperature, flowrate, chemistry) of the Dogger limestone aquifer in Paris basin which is the main targeted aquifer for district heating networks in France since the early 1970's. Since 2007, with the successful recovery of geothermal activity, and after 20 years of no new geothermal operations, 60 deep geothermal wells were drilled in the Paris basin in Ile-de-France region for the supply of district heating networks. Other operations are in progress or have been carried out in the Rhine Graben for heat production or cogeneration (heat and electricity) due to higher temperatures and also in the Aquitaine basin (second sedimentary basin in France harnessed for geothermal energy) in Nouvelle-Aquitaine region with the implementation of a first deep geothermal operation (doublet) targeting the Jurassic limestone in summer 2019.

The recovery of geothermal activity in France was possible thanks to the establishment of appropriate support and financial risk mitigation tools as the "Renewable Heat Fund" and the "Geothermal Guarantee Fund". The Renewable Heat Fund is a financial aid for deep geothermal installations producing renewable heat as geothermal. This fund enables geothermal facilities to be economically competitive compared to conventional energy-using facilities as gas and fuel. The Geothermal Guarantee Fund has been revised in 2006 and covers the so-called "short-term" and "long-term" risks. The "short-term risk" is the risk, at the end of the drilling phase, of not obtaining a sufficient geothermal resource (lower flowrate and temperature than expected) to ensure the economic profitability of the operation. The "long-term risk" is the risk of seeing this resource, when it exists and is exploited, diminishing or disappearing over time (reduction of flowrate and temperature), or the risk of technical failure affecting wells, materials and equipment of the geothermal loop during the exploitation phase because of the "chemistry" of the geothermal fluid.

In order to monitor all these new operations on the national territory, BRGM and ADEME have decided to extend the "Dogger" database to all deep geothermal wells regardless of the targeted geological formation or basin. The objective is to have a unique system that gathers all the available information on deep geothermal wells for heat production. The following sections describe the new development in the database and give a review of the geothermal facilities and development at national level.

## 2. DEVELOPMENT AND MONITORING OF THE GEOTHERMAL DATABASE

### 2.1 The "Dogger" database

As part of various agreements between BRGM and ADEME since 2002, a database was set up to follow detailed information on geothermal operations targeting the hydrogeological formation of the Dogger limestone in the Paris basin (Hamm, 2017, 2016, Hamm and Giuglaris, 2014, Hamm et al, 2010). This database constitutes the "memory" of the Dogger geothermal exploitation since the 1970's when the first wells were drilled. Its purpose is to capitalize and gather knowledge on geothermal operations including the collection of valuable data of the well completion and of the resource and the long-term monitoring of the reservoir (pressure, temperature, flowrates, geochemistry...). The main users are future operators and project developers in charge of research permits and authorization requests for new operations or for rehabilitation of existing operations. The interface of the database was initially an Access application and was shift to a web application in 2013. The application was gradually upgraded to allow to automate the

download of monitoring data files such as exploitation data (production and injection flowrates, temperatures, pressures), geochemical data (in situ measurements, water and gas analyses, anti-corrosion treatment), and production test data. The download of data in the database is restricted to the administrator of the database. The application allows "users" to export all or selected data from a table.

### 2.2 Toward a "national database"

In 2018 and following new geothermal projects development in other geological formation or basin (Albian-Neocomian or Triassic aquifers in Paris basin, Jurassic limestone in Aquitaine basin), BRGM has extended the "Dogger" database to other potential aquifers and basins (Hamm and Maurel 2019). The main changes in the database concern additional information related to the targeted aquifer (sedimentary basin, geological formation, stratigraphic level, lithology), information on the municipality and the region (only the department was previously informed), additional information on the well / reservoir (vertical reservoir and drilling depth in addition to deviated depths, total thickness in addition to productive thickness, hydraulic transmissivity in addition to intrinsic transmissivity…) and completion (type of completion, depth of top and low perforation or screen,...). By default, in the "Dogger" database the reservoir was in "open-hole" so no information was necessary about completion. In addition, new developments concern the information on the geothermal loop where a specific table was added and containing the information of the annual geothermal energy produced (MWh/y), the number of equivalents heated dwellings, the share of geothermal energy in the district heating network, the presence of a heat pump, maximum power delivered, substituted hydrocarbons, and cogeneration if any. Figure 1 shows a schematic representation of the organization of the current database.

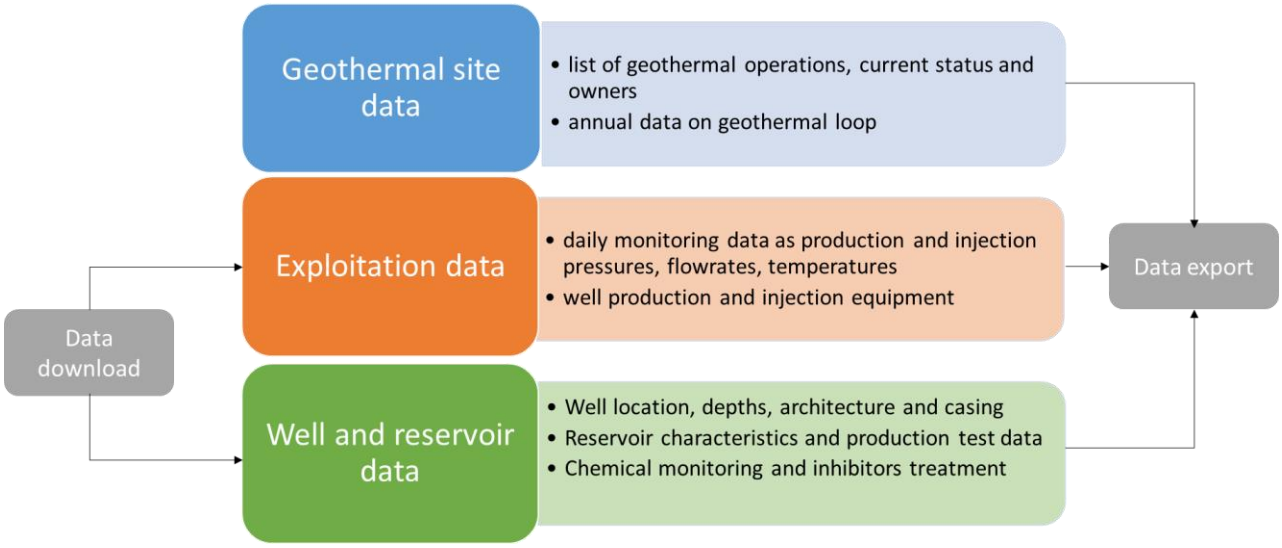


**Figure 1: Schematic representation of the database content**

The dissemination of the data follows different rules: a restricted access to all the data at http://sybase.brgm.fr to Administrations, ADEME and national project developers, as it was already the case for the "Dogger" database, and an open access to non-confidential data for a larger diffusion via www.geothermie-perspectives.fr. The dissemination of the data via the French "Geothermie Perspectives" site with the creation of a map layer and descriptive sheets presenting the technical information for each operation, will be operational at the end of 2019.

## 3. REVIEW AND LATEST DEVELOPMENTS OF LOW TEMPERATURE GEOTHERMAL OPERATIONS IN FRANCE

### 3.1 Geothermal operations in Paris basin

Low enthalpy geothermal operations were developed mainly between the 1970's and 1990's in Paris basin, with the achievement of 113 wells targeting the formation of the Middle Jurassic Dogger limestones (see Lopez et al, 2010), 2 wells targeting the Lower Cretaceaous Albian sands and 4 wells targeting the Triassic sandstones (one in Chateauroux and the others next to Nancy).

Since 2007 a regain in geothermal activity is observed, specifically thanks to the establishment of the "Renewable Heat Fund", with the drilling of 60 new wells in the Paris basin. Currently, 43 geothermal operations consisting of doublets (production and injection wells) or triplets (2 injection and 1 production wells) are in operation or under development in the Dogger aquifer in Ile-de-France region. In addition to the widely exploited Dogger aquifer, 6 operations (doublets) are targeting the sandy formations of the Albian (5) or Neocomian (1). Figure 2 and 3 show a map with the repartition of the geothermal operations (doublets, triplets or single producer) including geothermal operations that have been shut down so far around Paris area and in the other regions.

Table 1 summarize the different operations achieved in the Paris basin the last 60 years. 87 geothermal plants were developed during this period, mainly in Ile-de-France region, with the older shut down (34) or restored (8) by drilling a new production well and restoring the old wells with new casings. 3 operations (using single wells) also targeted the Lower-triassic sandstones in Grand-Est region but with no information about their current status. Currently among 53 geothermal plants are operating in the Paris basin using mainly doublets or triplets. New doublets are still in developments specifically in Ile-de-France region which concentrates already the majority of the geothermal operations in the Paris basin. At the end of this year, a new operation will target both the Triassic sandstones and Dogger limestones with the drilling of a production well in the Trias aquifer and a reinjection well in the Dogger aquifer to avoid reinjection difficulties that are currently faced in this kind of un- or little consolidated formation. This operation (production in Triassic sandstones in Ile-de-France) will be the first of this kind since the 1980's where there were some attempt to

target Triassic sandstones but that lead to failures (Melleray 1980, Cercy-Pontoise 1981, Achères 1982). A research program associated to the project will allow to core the Dogger carbonates and Triassic sandstones units. The acquisitions that will be done on the Triassic reservoir (core measurements and analyses, production test, flowmeter-log, Nuclear Magnetic Resonance-log…) will enable the characterization of the geothermal reservoir but also test and compare various exploratory techniques. In addition, percolation tests on Dogger cores will be carried out to evaluate the geochemical reactivity of Triassic fluids when reinjected into the Dogger carbonate reservoir.

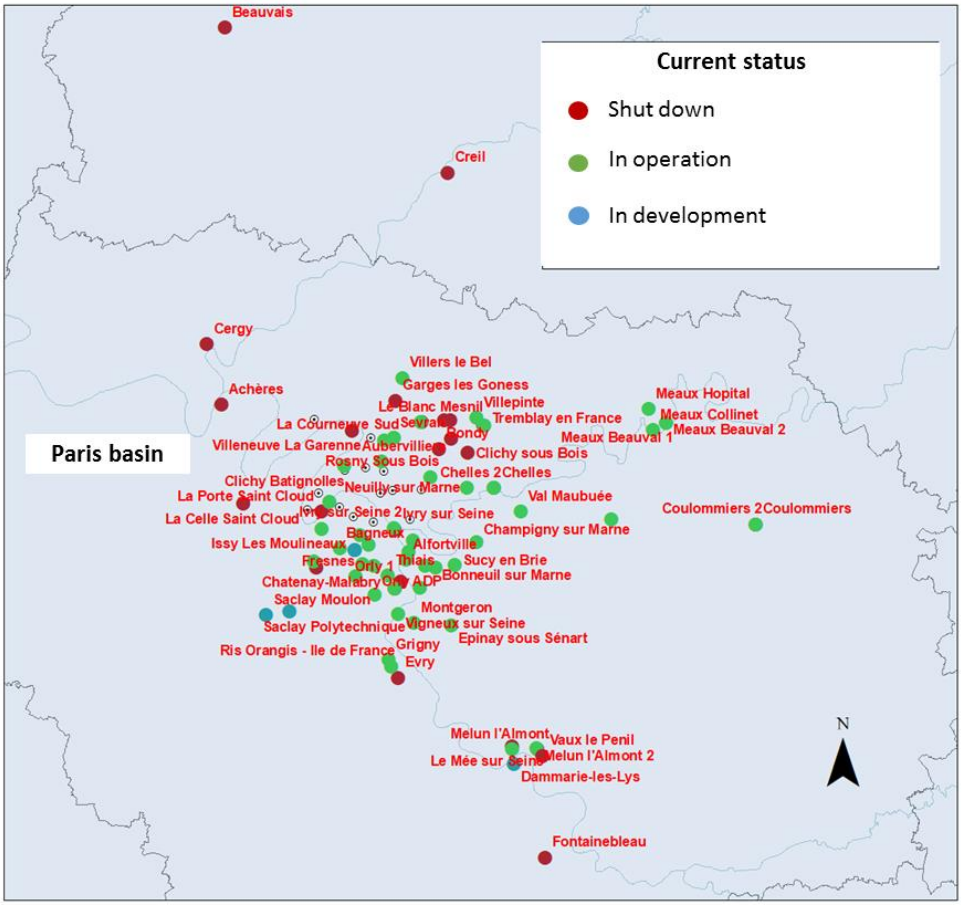


Figure 2: Location of deep geothermal operations in Paris basin (Ile-de-France and Hauts-de-France regions) and current status

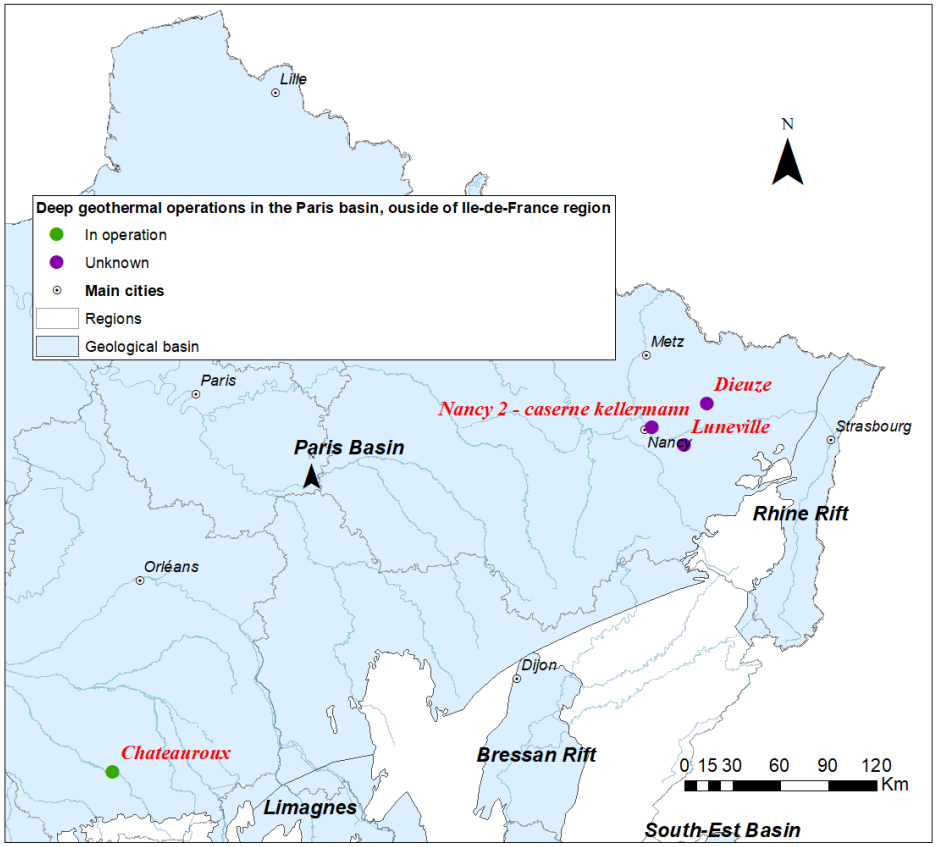


**Figure 2: Location of deep geothermal operations in Paris basin (Centre Val-de-Loire and Grand-Est regions) and current status**

**Table 1. Deep geothermal operations in Paris basin (in red geothermal plants that are no more operated)**

| Geothermal site | Year of achievement | Status (or year of shutdown) | Formation targeted | Type of exploitation | Geographic location |
|---|---|---|---|---|---|
| Dieuze | 1957 | unknown | Lower triassic sandstones | single production well | Grand-Est |
| Melun L'Almont | 1969 | shutdown | Dogger limestones | doublet | Ile-de-France |
| Villeneuve-La-Garenne | 1975 | shutdown | Dogger limestones | doublet | Ile-de-France |
| Creil 1 | 1976 | shutdown | Dogger limestones | doublet | Hauts-de-France |
| Creil 2 | 1976 | shutdown | Dogger limestones | doublet | Hauts-de-France |
| Le Mee-Sur-Seine | 1978 | 2010 | Dogger limestones | doublet | Ile-de-France |
| Coulommiers | 1980 | 2012 | Dogger limestones | doublet | Ile-de-France |
| Luneville | 1980 | unknown | Lower triassic sandstones | single production well | Grand-Est |
| Aulnay-Sous-Bois-Rdv | 1981 | 1994 | Dogger limestones | doublet | Ile-de-France |
| Beauvais | 1981 | shutdown | Dogger limestones | doublet | Hauts-de-France |
| Cergy-Pontoise | 1981 | 1991 | Dogger limestones | doublet | Ile-de-France |
| La Courneuve Sud | 1981 | operating | Dogger limestones | doublet | Ile-de-France |
| Montgeron | 1981 | 2018 (?) | Dogger limestones | doublet | Ile-de-France |
| Orly 1 Gazier | 1981 | 2011 | Dogger limestones | doublet | Ile-de-France |
| Acheres | 1982 | 1989 | Dogger limestones | doublet | Ile-de-France |
| Clichy-Sous-Bois | 1982 | 2015 | Dogger limestones | doublet | Ile-de-France |
| Creil-Le-Plateau | 1982 | shutdown | Dogger limestones | doublet | Hauts-de-France |
| Epernay | 1982 | shutdown | Dogger limestones | doublet | Grand-Est |
| Evry | 1982 | 1998 | Dogger limestones | doublet | Ile-de-France |
| Fontainebleau | 1982 | 1991 | Dogger limestones | doublet | Ile-de-France |
| La Courneuve Nord | 1982 | 2017 | Dogger limestones | doublet | Ile-de-France |
| La-Celle-Saint-Cloud | 1982 | 1989 | Dogger limestones | doublet | Ile-de-France |
| La-Porte-Saint-Cloud | 1982 | 1989 | Dogger limestones | doublet | Ile-de-France |
| Le Blanc Mesnil | 1982 | 2011 | Dogger limestones | doublet | Ile-de-France |
| Meaux Collinet | 1982 | operating | Dogger limestones | doublet | Ile-de-France |
| Sevran | 1982 | 1989 | Dogger limestones | doublet | Ile-de-France |
| Meaux Beauval 1 | 1982/2013 | operating | Dogger limestones | triplet (new production well in 2013) | Ile-de-France |
| Meaux Beauval 2 | 1982/2013 | operating | Dogger limestones | triplet (new production well in 2013) | Ile-de-France |
| Meaux Hopital | 1982/2013 | operating | Dogger limestones | triplet (new production well in 2013) | Ile-de-France |
| Ris Orangis | 1982/2015 | operating | Dogger limestones | triplet (new production well in 2015) | Ile-de-France |
| Aulnay-Sous-Bois-Vgs | 1983 | 1994 | Dogger limestones | doublet | Ile-de-France |
| Bondy | 1983 | 1989 | Dogger limestones | doublet | Ile-de-France |
| Chatenay-Malabry | 1983 | 1997 | Dogger limestones | doublet | Ile-de-France |
| Garges-Les-Gonesse | 1983 | 1987 | Dogger limestones | doublet | Ile-de-France |
| La-Villette | 1983 | never exploited | Dogger limestones | doublet | Ile-de-France |
| Tremblay-En-France | 1983 | 2016 | Dogger limestones | doublet | Ile-de-France |
| Vaux-Le-Penil | 1983 | 1998 | Dogger limestones | doublet | Ile-de-France |
| Chateauroux | 1983 | operating | Dogger limestones and Triassic sandstones | two production wells | Centre Val de Loire |
| Chevilly-Larue | 1984 | operating | Dogger limestones | doublet | Ile-de-France |
| Creteil Mont Mesly | 1984 | operating | Dogger limestones | doublet | Ile-de-France |
| Epinay-Sous-Senart | 1984 | operating | Dogger limestones | doublet | Ile-de-France |
| Ivry-Sur-Seine | 1984 | 1994 | Dogger limestones | doublet | Ile-de-France |
| Nancy 2 - Caserne Kellermann | 1984 | unknown | Lower triassic sandstones | single production well | Grand-Est |
| Vigneux-Sur-Seine | 1984 | 2018 | Dogger limestones | doublet | Ile-de-France |
| Sucy-En-Brie | 1984/2008 | operating | Dogger limestones | triplet (new production well in 2008) | Ile-de-France |
| Villiers-Le-Bel-Gonesse | 1984/2017 | operating | Dogger limestones | triplet (new production well in 2017) | Ile-de-France |
| Bonneuil-Sur-Marne 1 | 1985 | 2013/2018 | Dogger limestones | doublet | Ile-de-France |
| Cachan 1 | 1985 | operating | Dogger limestones | doublet | Ile-de-France |
| Cachan 2 | 1985 | operating | Dogger limestones | doublet | Ile-de-France |
| Chelles | 1985 | 2010 | Dogger limestones | doublet | Ile-de-France |
| L'Hay-Les-Roses | 1985 | operating | Dogger limestones | doublet | Ile-de-France |
| Maison Alfort 1 | 1985 | operating | Dogger limestones | doublet | Ile-de-France |
| Orly 2 Le Nouvelet | 1985 | 2005 | Dogger limestones | doublet | Ile-de-France |
| Thiais | 1985 | operating | Dogger limestones | doublet | Ile-de-France |
| Champigny | 1985/2012 | operating | Dogger limestones | triplet (new production well in 2012) | Ile-de-France |
| Alfortville | 1986 | operating | Dogger limestones | doublet | Ile-de-France |
| Maison Alfort 2 | 1986 | operating | Dogger limestones | doublet | Ile-de-France |
| Villeneuve St-Georges | 1986 | operating | Dogger limestones | doublet | Ile-de-France |
| Fresnes | 1986/2014 | operating | Dogger limestones | triplet (new production well in 2014) | Ile-de-France |
| Tours Agf Mirabeau / Crystal | 1989 | operating | Albian sands | doublet | Ile-de-France |
| Melun L'Almont 2 | 1989/1995 | operating | Dogger limestones | doublet | Ile-de-France |
| Orly 2 Le Nouvelet 2 | 2007 | operating | Dogger limestones | doublet | Ile-de-France |
| Aubervilliers | 2009 | operating | Dogger limestones | doublet | Ile-de-France |
| Orly Adp | 2010 | operating | Dogger limestones | doublet | Ile-de-France |
| Coulommiers 2 | 2011 | operating | Dogger limestones | doublet | Ile-de-France |
| Val-Maubuee | 2011 | operating | Dogger limestones | doublet | Ile-de-France |
| La Courneuve Nord 2 | 2011/2017 | operating | Dogger limestones | doublet | Ile-de-France |
| Issy-Les-Moulineaux | 2012 | operating | Albian sands | doublet | Ile-de-France |
| Plessis Robinson | 2012 | operating | Neocomian sands | doublet | Ile-de-France |
| Bonneuil-Sur-Marne 2 | 2012/2018 | operating | Dogger limestones | doublet | Ile-de-France |
| Le Mee-Sur-Seine 2 | 2013 | operating | Dogger limestones | doublet | Ile-de-France |
| Neuilly-Sur-Marne | 2013 | operating | Dogger limestones | doublet | Ile-de-France |
| Arcueil-Gentilly | 2014 | operating | Dogger limestones | doublet | Ile-de-France |
| Villejuif | 2014 | operating | Dogger limestones | doublet | Ile-de-France |
| Clichy-Batignolles | 2014 | operating | Albian sands | doublet | Ile-de-France |
| Bagneux | 2015 | operating | Dogger limestones | doublet | Ile-de-France |
| Bailly-Romainvilliers | 2015 | operating | Dogger limestones | doublet | Ile-de-France |
| Rosny-Sous-Bois | 2015 | operating | Dogger limestones | doublet | Ile-de-France |
| Tremblay-En-France 2 | 2015 | operating | Dogger limestones | doublet | Ile-de-France |
| Villepinte | 2015 | operating | Dogger limestones | doublet | Ile-de-France |
| Dammarie-Les-Lys | 2017 | operating | Dogger limestones | doublet | Ile-de-France |
| Grigny | 2017 | operating | Dogger limestones | doublet | Ile-de-France |
| Ivry-Sur-Seine 2 | 2017 | operating | Dogger limestones | doublet | Ile-de-France |
| Saclay Moulon | 2017 | operating | Albian sands | doublet | Ile-de-France |
| Saclay Polytechnique | 2017 | operating | Albian sands | doublet | Ile-de-France |
| Vigneux-Sur-Seine 2 | 2018 | operating | Dogger limestones | doublet | Ile-de-France |
| Cachan 3 | 2018 | operating | Dogger limestones | doublet | Ile-de-France |

### 3.2 Geothermal operations in other basins (Aquitaine basin, Rhine Graben, South East basin, Limagne)

Low enthalpy geothermal operations were also developed mainly between the 1960's and 1990's in the Aquitaine basin, South-Est basin, Limagne and late in 2010's in the Rhine graben. Outside the Paris basin, 39 wells were drilled in total for district heating, industrial heating, fish farming, greenhouse heating or leisure usage (nautical center and pool). Only two operations have been put in service in the last 20 years out of the Paris basin (Montpellier Mas Rouge and Gallière wells put into service in 2016 and Rittershoffen in 2017).

Currently, 20 geothermal exploitations using 28 wells are in operation, 6 are shutdown, 2 wells were drilled but never developed and 3 wells have an undetermined status. Figure 4 presents the locations of the operations and the associated status.

The majority of the operations are producing geothermal fluids with single well technique except for Rittershoffen (Alsace), Mas Rouge - Gallière (Hérault) and Bègles operations (Gironde). For single well operations, the water is either used (e.g. fish farming) or discharged at surface (in water course or sewage network) depending on the fluid composition and in accordance with regulations.

The largest number of operations outside the Paris basin is located in the Aquitaine basin (Gironde, Charente-Maritime, Landes, Lot-et-Garonne, Haute-Garonne and Gers) where 14 operations are currently in exploitation. The water produced over the geothermal exploitations reach temperatures that may vary from 20°C to 75°C and depths between 200 and 2 500 m. Various horizons are targeted (from Eocene to Triassic formations) with different lithology (e.g. sands, sandstones, limestones or dolomites). Exploitation flow rates are also variable depending on the utilization. They range from 10 $m^3$/h to supply fish farm and pool with hot water or up to 200 $m^3$/h for district heating.

In Alsace, the doublet of Rittershoffen produces hot water at 177°C at 250 $m^3$/h at the interface between Triassic formations and the granite basement around 2 700 m depth.

A new deep geothermal operation (doublet) will target the Jurassic limestones named "Calcaires à Filaments" in Bordeaux (Aquitaine basin) in summer 2019. This geothermal operation is the first in this geological unit in Aquitaine basin, only four oil wells have reached and characterized this formation (Sainte-Hélène, Saint-Médart, Saint Jean d'Illac and Bouliac). The reservoir is about 1500 m deep and its temperature around 70°C compared to the upper cretaceous formation (750 m deep and average temperature of 45°C). This exploratory project envisage an alternative solution with a fallback to the upper cretaceous aquifer in case the reservoir was not enough productive for the economy of the project.

Several other geothermal projects are also currently being studied in the Aquitaine basin (e.g. exploitation of the undeveloped well of Grand Parc in Bordeaux drilled in 1985, creation of a doublet in Talence and Lormont, creation of a reinjection well in Mont-de-Marsan) and in the South-Est basin (e.g. creation of a doublet in Castelnau-le-Lez, Hérault).

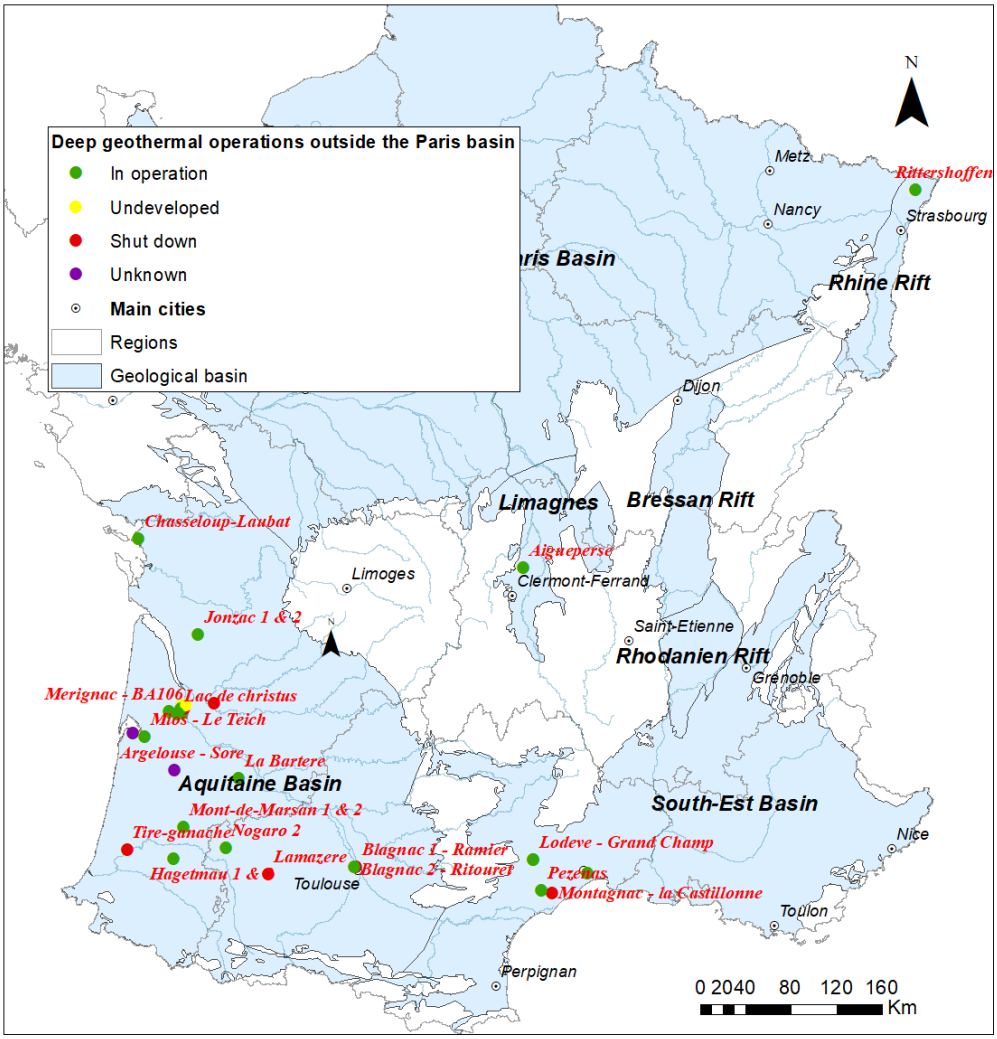


**Figure 3. Location of deep geothermal operations in other French sedimentary basins and current status**

**Table 2. Deep geothermal operations in other basins (Aquitaine basin, South-East basin, Limagne and Rhine-Graben), in red geothermal operations shut down or undeveloped**

| Geothermal site | Year of achievement | Status | Formation targeted | Type of exploitation | Basin | Geographic location |
|---|---|---|---|---|---|---|
| Pezenas | 1949 | operating | Middle Jurassic limestones and dolomites | single production well | South-Est basin | Occitanie |
| Argelouse - Sore | 1959 | unknown | Upper Jurassic limestones | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Aigueperse | 1959 | operating | Granitie basement | unknown | Limagnes | Auvergne Rhône Alpes |
| Pessac - stadium | 1961 | operating | Upper Cretaceaous limestones and sands | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Mios - Le Teich | 1964 | operating | Upper Jurassic limestones and dolomites | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Blagnac 1 - Ramier | 1967 | shut down | Eocene sands | single production well | Aquitaine basin | Occitanie |
| Lormont Genicart | 1969 | undeveloped | Upper Cretaceaous limestones and sands | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Mont-de-Marsan 1 & 2 | 1975/1981 | operating | Upper Cretaceaous limestones and sands | two production wells | Aquitaine basin | Nouvelle Aquitaine |
| Blagnac 2 - Ritouret | 1976 | operating | Eocene sands | single production well | Aquitaine basin | Occitanie |
| Lodeve - Saint-Fulcran | 1977 | operating | Upper Jurassic limestones and dolomites | three production wells | South-Est basin | Occitanie |
| Lodeve - Grand Champ | Unknown | operating | Unknown | single production well | South-Est basin | Occitanie |
| Gujan Mestras (la hume 1 & 2) | 1979/1984 | unknown | Lower Eocene limestones | two production wells | Aquitaine basin | Nouvelle Aquitaine |
| Tire-ganache | 1979 | shut down | Upper Cretaceaous limestones and sands | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Hagetmau 1 & 2 | 1980/1991 | operating | Lower Eocene limestones | two production wells | Aquitaine basin | Nouvelle Aquitaine |
| Jonzac 1 & 2 | 1980/1994 | operating | Triassic sandstones and dolomites | two production wells | Aquitaine basin | Nouvelle Aquitaine |
| Bordeaux Benauge | 1981 | shut down | Upper Cretaceaous limestones and sands | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Bordeaux Mériadeck | 1981 | operating | Upper Cretaceaous limestones and sands | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Lamazere | 1981 | shut down | Eocene sands | single production well | Aquitaine basin | Occitanie |
| Libourne Geyrosse | 1981 | shut down | Eocene sands | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Begles GP1C/GP2F | 1982 | operating | Eocene | doublet | Aquitaine basin | Nouvelle Aquitaine |
| Nogaro 2 | 1982 | operating | Eocene sands | single production well | Aquitaine basin | Occitanie |
| Pessac - saige formanoir | 1982 | operating | Upper Cretaceaous limestones and sands | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Chasseloup-Laubat | 1984 | operating | Dogger limestones | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Merignac - BA106 | 1984 | operating | Upper Cretaceaous limestones and sands | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Bordeaux Grand Parc | 1985 | undeveloped | Upper Cretaceaous limestones and sands | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Montagnac - la Castillonne | 1987 | shut down | Upper Jurassic limestones and dolomites | single production well | South-Est basin | Occitanie |
| La Bartere | 1990 | operating | Upper Jurassic limestones and dolomites | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Mas Rouge - Gallière | 1990/2015 | operating | Upper Jurassic limestones and dolomites | doublet | South-Est basin | Occitanie |
| Lac de christus | 1994 | operating | Paleocene limestones and dolomites | single production well | Aquitaine basin | Nouvelle Aquitaine |
| Rittershoffen | 2012/2014 | operating | Triassic-Palezoic granite basement | doublet | Rhine Rift | Grand-Est |

## 4. CONCLUSIONS

Low temperature geothermal heat production is facing a regain of activity in France these ten past years thanks to favorable conditions and incentive policies (Renewable Heat Fund, Geothermal Guarentee Fund). The maintenance and update of a national database identifying all the geothermal wells on the national territory is a major issue to map and monitore the current geothermal operations and their status. If the operations are well known and identified in Ile-de-France region, some operations in other regions or basins are less control and their status remain unknown or their operating permit are under regulation.

## ACKNOWLEDGMENTS

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