

ICGC Geoindex – Deep geothermal energy

Deep Geothermal Resources in Catalonia (RGOPCat): synthesis of their potential

Deep geothermal resources are a renewable energy source existing in several places in Catalonia, little known and with a **very high exploitation and use potential**. To contribute to the dissemination of the current knowledge of this renewable energy resource, ICGC has drawn up the document RGOPCat (Deep Geothermal Resources in Catalonia (RGOPCat): synthesis of their potential). It aims to show the **location and classification of deep geothermal resources** based on their geological settings or geothermal plays and summarize the **evidence and actual uses** associated with each of them. Based on the available data, the synthesis also includes an estimate of the **depths and temperatures** that could be reached in each of the reservoirs identified as well as their **potential uses**.

Contents of deep geothermal resources potential areas tags

Code and area name

Available resources assessment for each of the geothermal plays identified according to AGRC (2010) and CGCC (2010). The following types of resources are differentiated:

a) Inferred: part of a geothermal resource where the RE (Recoverable Energy) is estimated with a low level of confidence (based on indirect data)

b) Indicated: part of a geothermal resource where the RE is estimated with a medium level of confidence (based on temperature (T) and reservoir dimensions data).

c) Measured: part of a geothermal resource where the RE is estimated with a high level of confidence (based on T, volume and water flow measurements in a well)

RP(m)	RT(°C)	Uses _a	Uses _p
0-7	150-170 [IGME, 1984]	A	B/C/D

Type: Hydrothermal systems in basin margin faults (CV3), in central extensional basin deep Mesozoic aquifers (CD1) and in central basin granite basement (CD3)

Actual uses (Uses_a) and potential uses (Uses_p) identified in the deep geothermal potential area

Types of geothermal plays within an area based on Moeck, I.S., (2014) classification. Each area can have one or more geothermal plays

Deep geothermal resources evidences for each of the geothermal plays identified. The references from which the data has been extracted are cited

RP(m)	RT(°C)	Uses _a	Uses _p
1500-2500	60-90	-	A/B

Resources CV3 (Measured): Shallow thermal groundwater in Montbrío del Camp (82°C@52m [ICGC, 2020])

Resources CD1 (Indicated): Several deep Mesozoic aquifers identified in Reus-1 borehole at 1432m [Echánove et al., 1976] (52°C@2015m [Fernandez, 1988])

Resources CD3 (Inferred): No evidences

RP(m)	RT(°C)	Uses _a	Uses _p
2500-7	90->120	-	A/B/C

Estimated Reservoir Depth (RD) based on the available geological information, estimated Reservoir Temperature (RT) based on chemical geothermometers [Albert, 1976] or considering a 3°C/100m gradient. Actual Uses (Uses_a) and Potential Uses (Uses_p)

Deep geothermal resources potential areas

- DO** Deep geothermal potential in orogenic domain (DO-01, DO-02, DO-03, DO-04, DO-05)
- CS** Deep geothermal potential in sedimentary basin domain (CS-01, CS-02)
- DE** Deep geothermal potential in extensional domain (DE-01, DE-02, DE-03, DE-04, DE-05, DE-06, DE-07, DE-08)

Catalog of geothermal play types based on geologic controls in Catalonia (Moeck, I.S., 2014)

Heat transfertype	Index	Type	Description	Examples
Convection dominated geothermal plays	CV2b	Plutonic	Fractured hydrothermal systems associated with granite batholiths with inactive volcanism	Hydrothermal system of Tredòs, Arties, and Les Val d'Aran) or Caldes de Boi (Alta Ribagorça)
	CV3	Extensional domain	Hydrothermal systems in basin margin faults	Hydrothermal system of la Garriga-Samalus
	CD1	Intracratonic basin type in extensional domain	Central basin hydrothermal systems in deep Tertiary and/or Mesozoic aquifers	Mesozoic aquifers in the Reus-Valls Neogene basin
Conduction dominated geothermal plays	CD2	Intracratonic basin type in orogenic domain	Central basin hydrothermal systems in deep Tertiary and/or Mesozoic aquifers	Mesozoic aquifers in the Ebre foreland basin and Tertiary/Mesozoic aquifers in the Vic plain
	CD3	Basement/crystalline rock type	Hydrothermal systems in granite basement aquifers	Fractured granite basement aquifers in the Vallès Neogene basin

Evidences, deep wells and prospection boreholes (>1000m deep)

MOP-3: Well for brine injection prospection

Lleida-1: Well/borehole for oil resources prospection

Jafre: Well/borehole for geothermal resources prospection

Main hydrothermal anomalies: Caldes de Malavela

Thermal spring: font del Lleó

Thermal water well: Caldes de Malavela

Geological elements

Thrust fault, Normal fault, Strike-slip fault, Granite batholiths

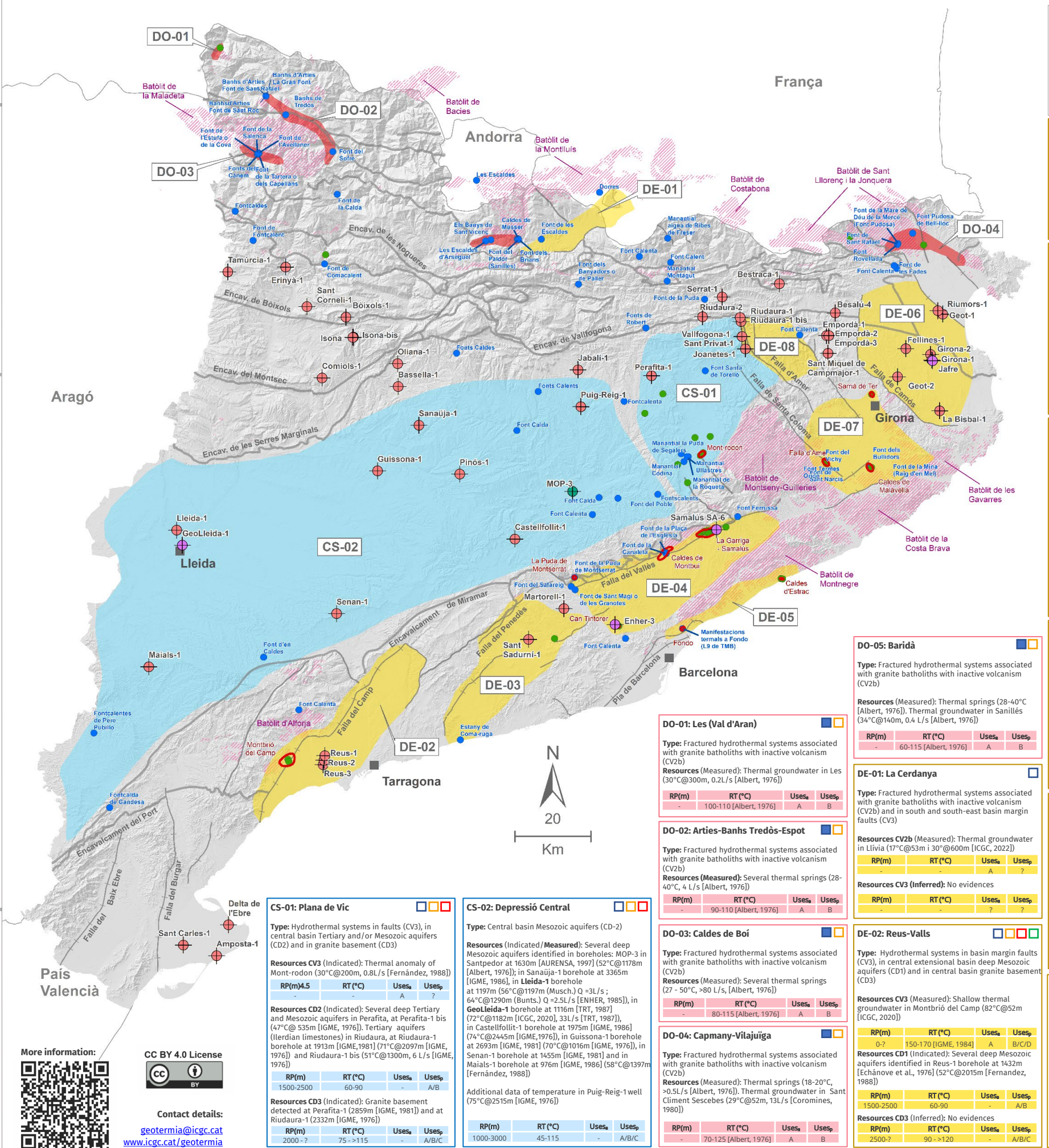
Actual uses and potential uses of the deep geothermal resources

Type	Uses _a *	Uses _p **	Temperature range	Uses description
A	[Blue]	[Blue]	30-60°C	Direct thermal uses for balnearies, agriculture or aquaculture. Individual facilities and/or urban district heating and cooling systems supported by water-to-water heat pumps
B	[Yellow]	[Yellow]	60-100°C	Direct thermal uses in urban or industry district heating and cooling systems with (maybe supported by high temperature water-to-water heat pumps)
C	[Red]	[Red]	>100°C	Direct thermal uses and electricity generation
D	[Green]	[Green]	-	Potential Lithium obtention from deep geothermal fluids

*Uses_a: Known actual uses of the geothermal resource (mainly balneary establishments and related activities).
**Uses_p: Potential uses of the geothermal resource depending on the estimated reservoir depth and temperature.

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DE-05 Maresme – Barcelonès [Blue, Yellow, Green]

Type: Fractured hydrothermal systems associated with granite batholiths with inactive volcanism (CV2b)

Resources CV2b (Measured): Thermal groundwater in Caldes d'Estrac (38°C@30m [ICGC, 2020], 3L/s [Albert, 1976]). Thermal groundwater in Fondo (22-56°C [ICGC, 2020])

RP(m)	RT(°C)	Uses _a	Uses _p
-	80-110 [Albert, 1976]	A	B

DE-03: Penedès [Blue, Yellow]

Type: Hydrothermal systems in basin margin faults (CV3) and in central basin deep Mesozoic aquifers (CD1)

Resources CV3 (Inferred): Thermal groundwater in Subirats (31°C@110m [Albert, 1976]) inactive in our days

RP(m)	RT(°C)	Uses _a	Uses _p
-	-	-	?

Resources CD1 (Indicated): Mesozoic aquifers detected in Sant Sadurni-1 borehole at 850m [IGME, 1976]

RP(m)	RT(°C)	Uses _a	Uses _p
200-2800	30-100	-	A/B

DE-04: Vallès [Blue, Yellow, Green]

Type: Hydrothermal systems in basin margin faults (CV3) and in central basin granite basement (CD3)

Resources CV3 (Indicated/Measured): Thermal springs and groundwater in la Garriga (up to 61°C, >7L/s [Albert, 1976]). Thermal springs and groundwater in Caldes de Montbui (up to 71°C, >9L/s [Albert, 1976]), geothermal prospect well Samalus SA-6 (90°C@1000m, >8L/s [IGME, 1986]). Thermal anomaly in Can Tintorer, based on "Enher" well (58°C@400m, 70L/s [CGS, 1985])

RP(m)	RT(°C)	Uses _a	Uses _p
-	95-120 [Albert, 1976]	A	B/C/D

Resources CD3 (Inferred): No evidences

RP(m)	RT(°C)	Uses _a	Uses _p
1000-?	45->105	-	A/B

DE-06: Empordà [Blue, Yellow, Green]

Type: Hydrothermal systems in basin margin faults (CV3), in central extensional basin deep Tertiary and/or Mesozoic aquifers (CD1/CD2)

Resources CV3 (Inferred): No evidences

RP(m)	RT(°C)	Uses _a	Uses _p
-	-	-	?

Resources CD1/CD2 (Indicated/Measured): Deep Tertiary aquifers (Ilerdian limestones) detected in Girona 2 borehole (63°C@1666m [IGME, 1981]) and Jafre well (54°C@914m, 17L/s [Rupf, 2020])

RP(m)	RT(°C)	Uses _a	Uses _p
1000-3500	50-110 [Albert, 1976]	-	A/B/C

DE-07: La Selva [Blue, Yellow, Green]

Type: Hydrothermal systems in basin margin faults (CV3) and in central basin granite basement (CD3)

Resources CV3 (Measured): Thermal springs in Caldes de Malavela (up to 60°C, 8L/s [Albert, 1976]). Thermal groundwater in Santa Coloma de Farners (47°C@57m, 0.8L/s [Albert, 1976]). Thermal groundwater in Sarrià de Ter at Camp dels Socs well (30°C@200m [ICGC, 2020])

RP(m)	RT(°C)	Uses _a	Uses _p
-	90-120 [Albert, 1976]	A	B/C/D

Resources CD3 (Inferred): No evidences associated with the granite basement

RP(m)	RT(°C)	Uses _a	Uses _p
>150-?	-	-	?

DE-08: Fossa d'Olot [Blue, Yellow, Green]

Type: Hydrothermal systems in basin margin faults (CV3), in central extensional basin deep Tertiary aquifers (CD1)

Resources CV3 (Inferred): No evidences associated with the basin margin

RP(m)	RT(°C)	Uses _a	Uses _p
-	-	-	?

Resources CD1 (Indicated): Tertiary aquifers (Ilerdian limestones) in Riudaura - 1 and Riudaura-1 bis boreholes (71°C@2097m, 6 L/s [IGME, 1976])

RP(m)	RT(°C)	Uses _a	Uses _p
1500-2500	60-90	-	A/B

Resources CD3 (Inferred): No evidences

RP(m)	RT(°C)	Uses _a	Uses _p
2500-?	90->120	-	A/B/C

DO-01: Les (Val d'Aran) [Blue, Yellow]

Type: Fractured hydrothermal systems associated with granite batholiths with inactive volcanism (CV2b)

Resources (Measured): Thermal groundwater in Les (30°C@300m, 0.2L/s [Albert, 1976])

RP(m)	RT(°C)	Uses _a	Uses _p
-	60-115 [Albert, 1976]	A	B

DE-01: La Cerdanya [Blue]

Type: Fractured hydrothermal systems associated with granite batholiths with inactive volcanism (CV2b) and in south and south-east basin margin faults (CV3)

Resources CV3 (Inferred): No evidences

RP(m)	RT(°C)	Uses _a	Uses _p
1000-3500	50-110 [Albert, 1976]	-	A/B/C

DO-02: Arties-Banhs Tredòs-Espot [Blue, Yellow]

Type: Fractured hydrothermal systems associated with granite batholiths with inactive volcanism (CV2b)

Resources (Measured): Several thermal springs (28-40°C [Albert, 1976]).

RP(m)	RT(°C)	Uses _a	Uses _p
-	90-110 [Albert, 1976]	A	B

DO-03: Caldes de Boi [Blue, Yellow]

Type: Fractured hydrothermal systems associated with granite batholiths with inactive volcanism (CV2b)

Resources (Measured): Several thermal springs (27 - 50°C, >80 L/s [Albert, 1976])

RP(m)	RT(°C)	Uses _a	Uses _p
-	80-115 [Albert, 1976]	A	B

DO-04: Capmany-Vilajuïga [Blue, Yellow]

Type: Fractured hydrothermal systems associated with granite batholiths with inactive volcanism (CV2b)

Resources (Measured): Thermal springs (18-20°C, >0.5L/s [Albert, 1976]). Thermal groundwater in Sant Climent Sesebes (29°C@52m, 13L/s [Coromines, 1980])

RP(m)	RT(°C)	Uses _a	Uses _p
-	70-125 [Albert, 1976]	A	B

CS-01: Plana de Vic [Blue, Yellow, Green]

Type: Hydrothermal systems in faults (CV3), in central basin Tertiary and/or Mesozoic aquifers (CD2) and in granite basement (CD3)

Resources CV3 (Indicated): Thermal anomaly of Mont-rodon (30°C@200m, 0.8L/s [Fernández, 1988])

RP(m)	RT(°C)	Uses _a	Uses _p
4-5	-	A	?

Resources CD2 (Indicated): Several deep Tertiary and Mesozoic aquifers in Perafita, at Perafita-1 bis (47°C@535m [IGME, 1976]), Tertiary aquifers (Ilerdian limestones) in Riudaura, at Riudaura-1 borehole at 1913m [IGME, 1981] (71°C@2097m [IGME, 1976]) and Riudaura-1 bis (51°C@1300m, 6 L/s [IGME, 1976])

RP(m)	RT(°C)	Uses _a	Uses _p
1500-2500	60-90	-	A/B

Resources CD3 (Indicated): Granite basement detected at Perafita-1 (2859m [IGME, 1981]) and at Riudaura-1 (2332m [IGME, 1976])

RP(m)	RT(°C)	Uses _a	Uses _p
2000-?	75->115	-	A/B/C

CS-02: Depressió Central [Blue, Yellow]

Type: Central basin Mesozoic aquifers (CD-2)

Resources (Indicated/Measured): Several deep Mesozoic aquifers identified in boreholes: MOP-3 in Santpedor at 1630m [AURENSA, 1997] (52°C@1178m [Albert, 1976]), in Sanauja-1 borehole at 3365m [IGME, 1986], in Lleida-1 borehole at 1197m (56°C@1197m (Muscl), Q=3L/s; 64°C@1290m (Bunts.), Q=2.5L/s [ENHER, 1985]), in GeoLleida-1 borehole at 1116m [TRT, 1987] (72°C@1182m [ICGC, 2020], 33L/s [TRT, 1987]), in Castellfolit-1 borehole at 1975m [IGME, 1986] (74°C@2445m [IGME, 1976]), in Guissona-1 borehole at 2693m [IGME, 1981] (70°C@1016m [IGME, 1976]), in Senan-1 borehole at 1455m [IGME, 1981] and in Maials-1 borehole at 976m [IGME, 1986] (58°C@1397m [Fernández, 1988])

RP(m)	RT(°C)	Uses _a	Uses _p
1000-3000	45-115	-	A/B/C

Additional data of temperature in Puig-Reig-1 well (75°C@2515m [IGME, 1976])

More information: QR code

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