Geothermal potential Studies Spain

Petratherm España s.l.

GEOELEC WORKSHOP

10-11-2011

VALENCIA

Raúl Hidalgo

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Global Corporate overview

Our company

- Leading Australian geothermal exploration and development company
- Projects spanning Australia and Spain
- Flagship project –Paralana

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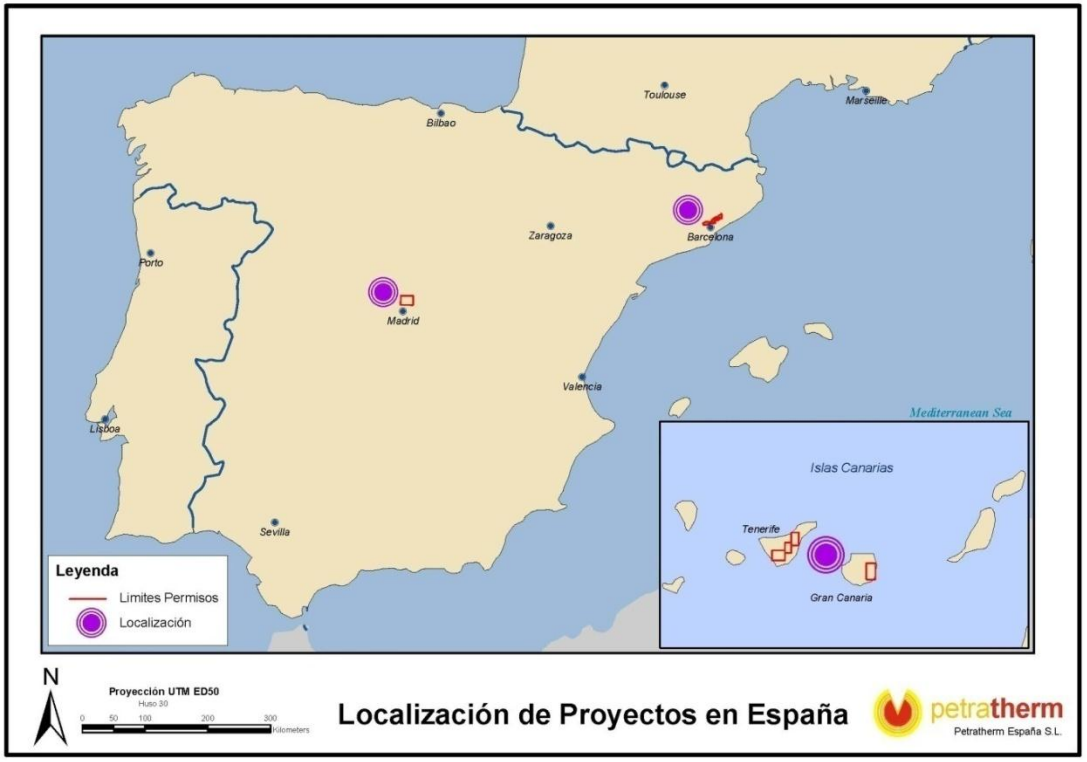
Corporate overview Spain



Petratherm España

- Established at the end 2005.
- In 2007 starts to secure a portfolio of 2,500 Km2 of exploration and investigation mining licenses

Main objectives

- Power generation
- Conventional geothermal systems, Canarias
- Hot Sedimentary Aquifers(HSA) and Enhanced Geothermal systems EGS, related to tertiary basins with granites and another associated heat sources
- Direct uses

Geothermal District Heating (GDH) Madrid

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Canary Islands Hidrothermal

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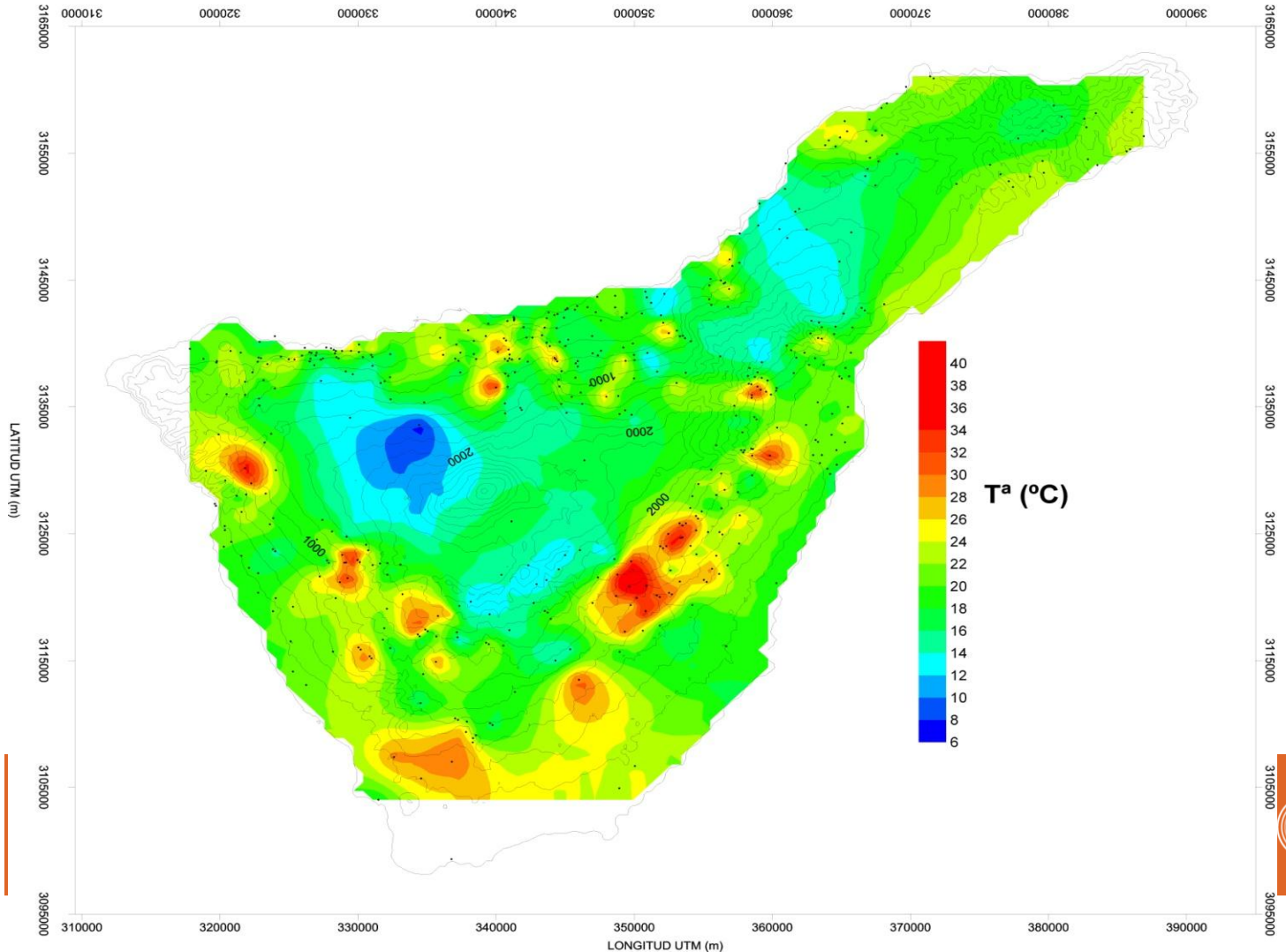
Recent exploration activity

- In 2007-2008 Petratherm applied 4 exploration licenses in Tenerife and Gran Canaria.
- Tenements were granted in 2008 and start to develop the following activities:
  - Modeling and compiling a digital database comprising all historical information
  - Structural mapping and satellite image interpretation
  - Geochemistry campaigns (soil gas , gas fumaroles, water)
  - MT survey campaign central part of Tenerife island (90 stations campaign 2009-2010)
  - 3D modeling data interpretation
- In 2009 applied for a tenement reduction to transform the exploration licenses into investigation licenses. The new 4 investigation licenses were granted in May-Jun2010
- Next objective: a gradient drilling campaign to allocate the geothermal reservoir in 2012, if successful first geothermal well 2013.

Water Temperature

Temperature map TENERIFE



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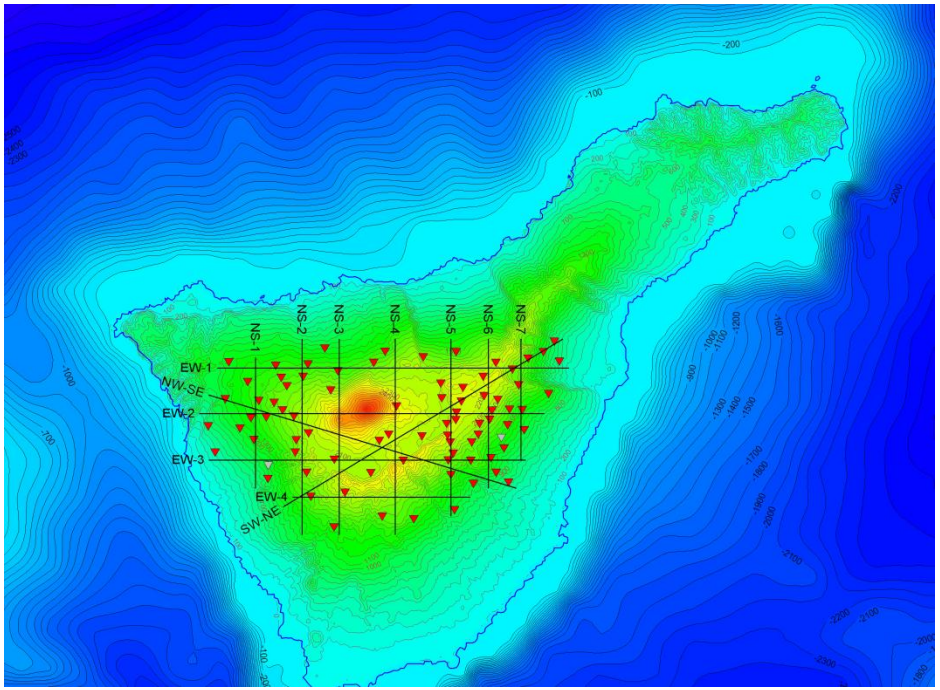
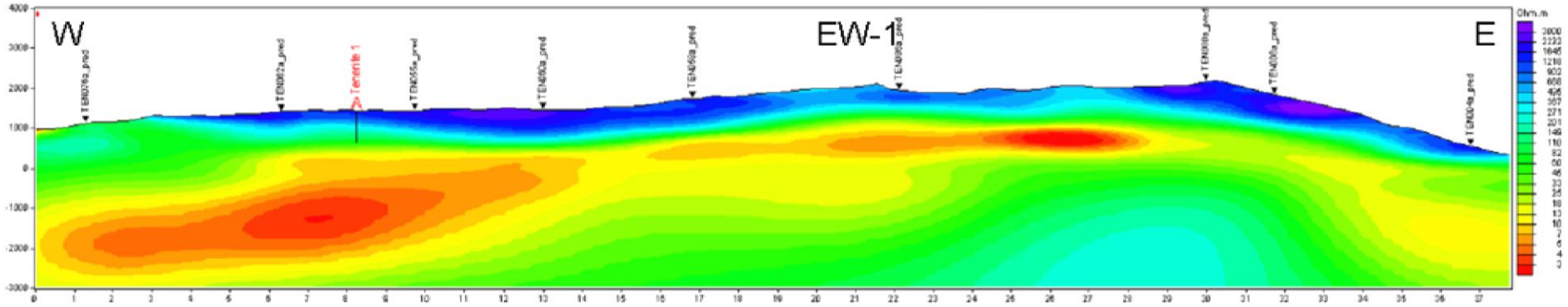
Tenerife MT survey (2009-2010) Geosistems

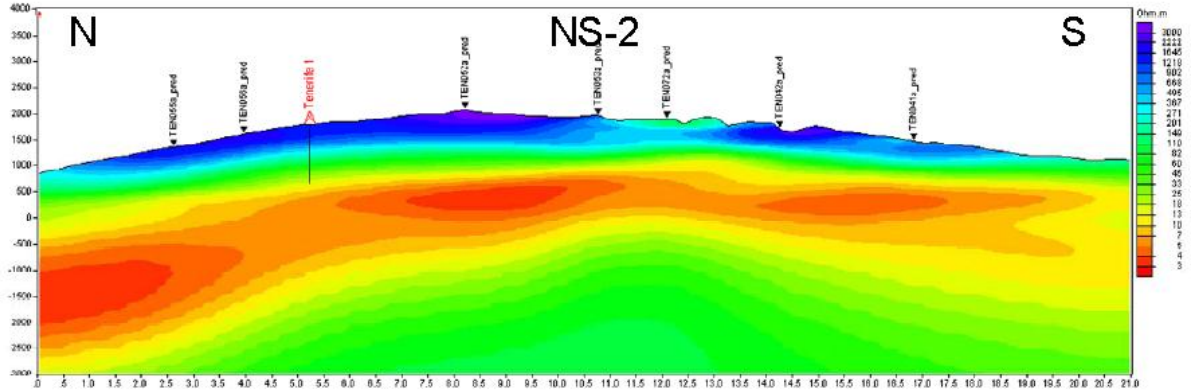
MT station,
Vertical magnetic loop



MT grid 2009 survey

2009-2010 MT inversion model





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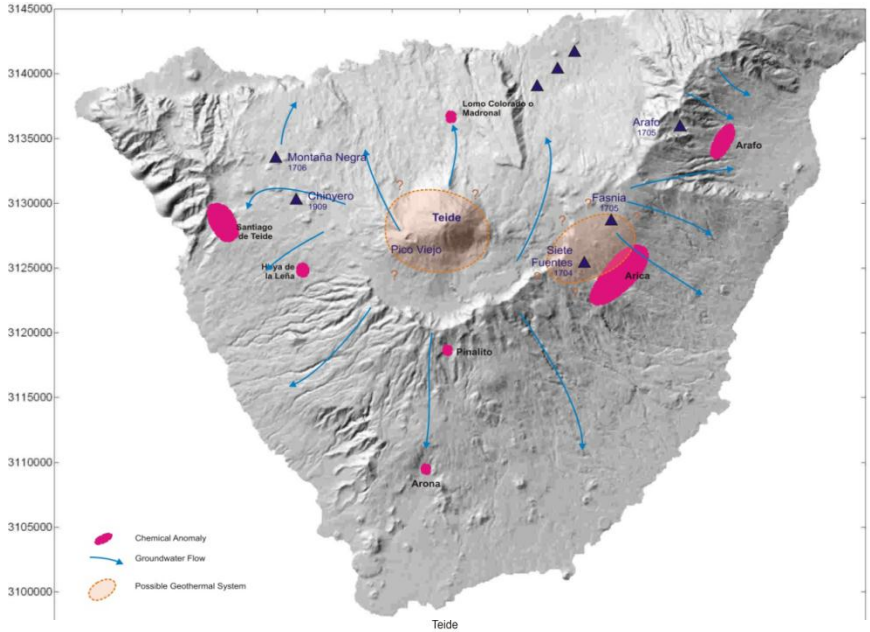
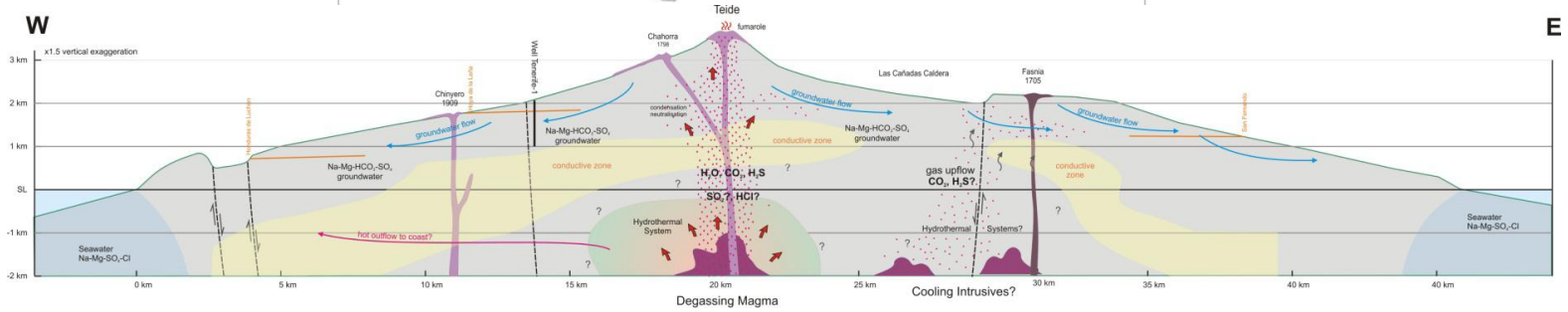
3d Preliminary model





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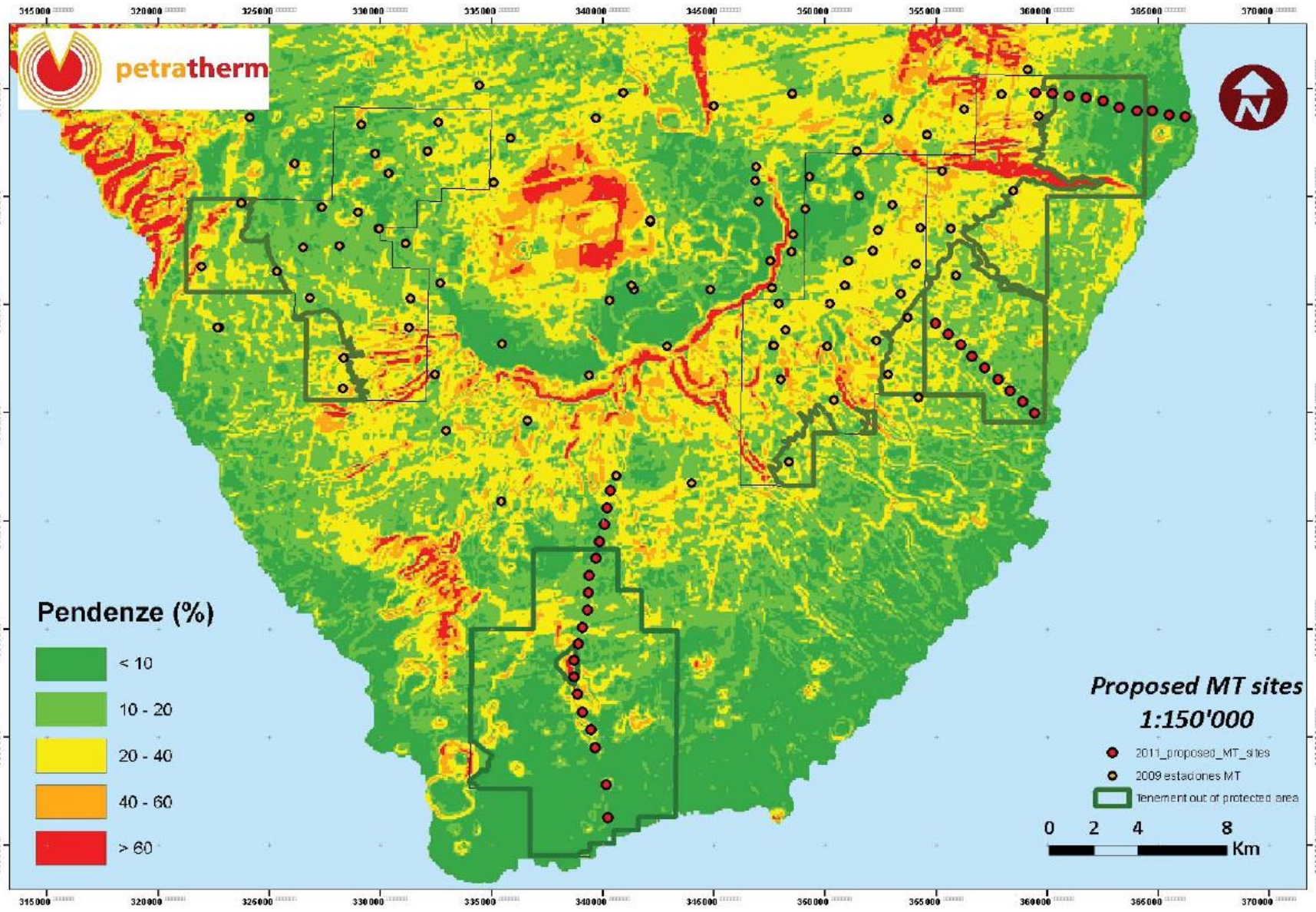
New MT profiles



Project Partners and Milestones

- In 2008 ITER & Petratherm signed a collaboration agreement for the development of geothermal energy in Canary Islands

- In the last 3 years Petratherm & ITER are spending close to 1 M € in geothermal exploration activities within Canarias. Next year is expected to expend more than 2M€ just in the slimhole campaign at Tenerife Island.

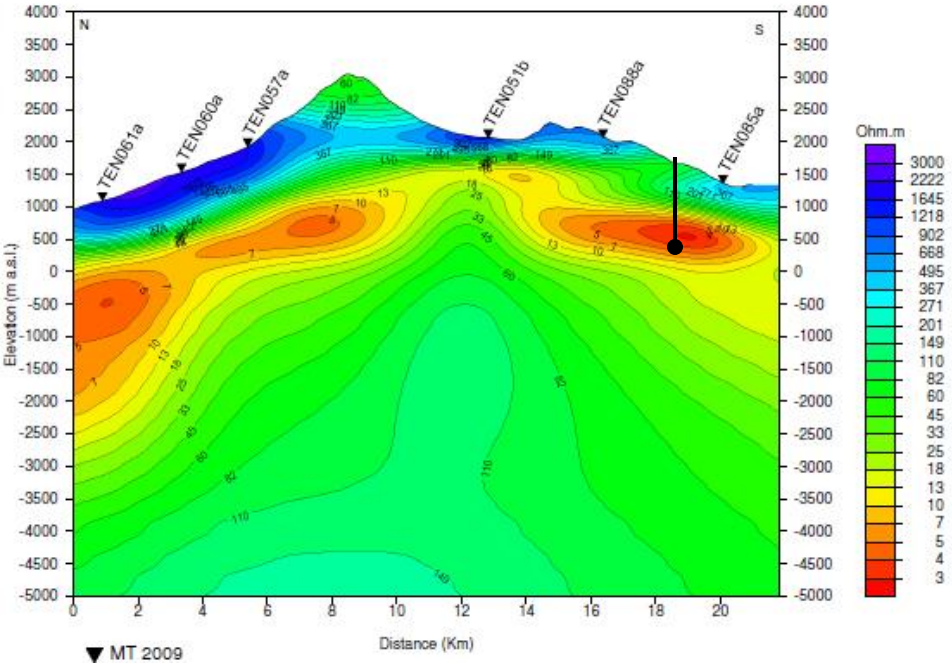
- June 2011 Petratherm applied for a R+D project together in a consortia with 2 universities and 2 local research institutes to the INNPACTO R&D Science and Innovation ministry 2011 call.

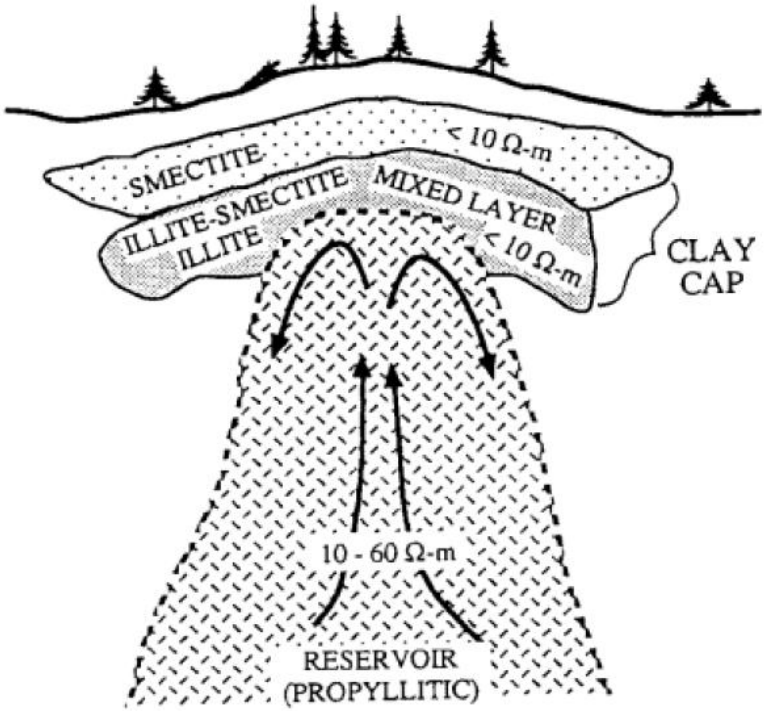
- The application was successfully granted, obtaining close to 1M Eur (grants+ soft loan) to fund a 1.6 M€ basic exploration 4 years program

GEOTHERCAN 2011-2014

- 3D Models to define Canary Islands Geothermal Potential.
- Focusing on 6 areas; 4 in Tenerife, 1 in Gran Canaria and 1 in La Palma.
  - Volcano-structural studies (ULL-PETRATHERM)
  - Geochemistry (ITER-INVOLCAN)
  - MT studies (BARCELONA U.)
  - Muons tomography studies (ITER-TOKIO U.)
  - 3D modeling (PETRATHERM, BARCELONA U.)
  - Main objective: provide with 3D compiled geothermal models as a tool to help on drilling decision.

Next Phase Gradient- Geothermal wells





Next objective a gradient 1500-2000m drilling to the base of the clay cap

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Madrid Basin
EGS

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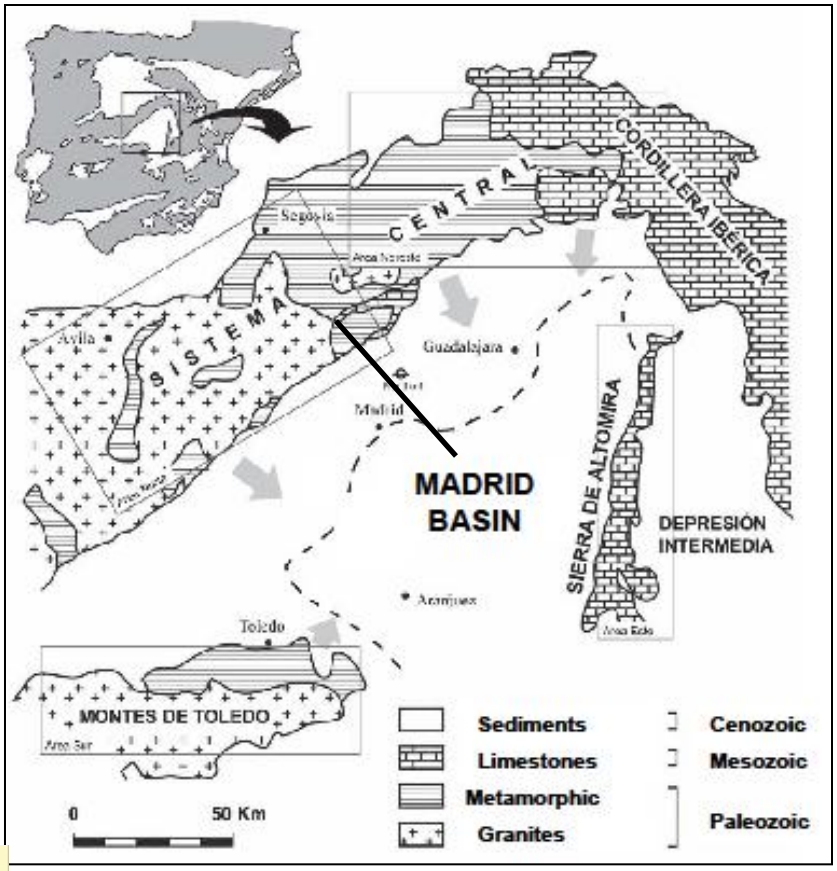
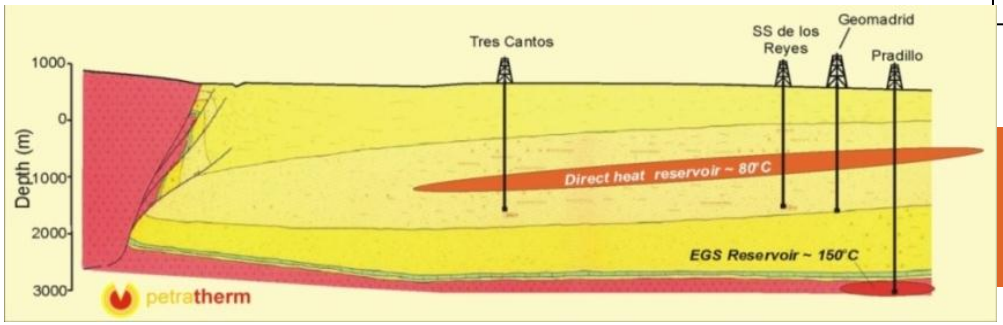
Madrid basin geothermal potential

- An oil well drilled by Shell 1980 intersected two zones with anomalous temperatures showing the geothermal potential of the basin.
- A low temperature zone, 88ºC at 1.750 m associated to tertiary sandstones
- A medium temperature zone, 150ºC was found at 3.400 m associated to cretaceous sediments and to basement rocks contact.



Calvo et al 1989



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Historical data compilation

Done to date:

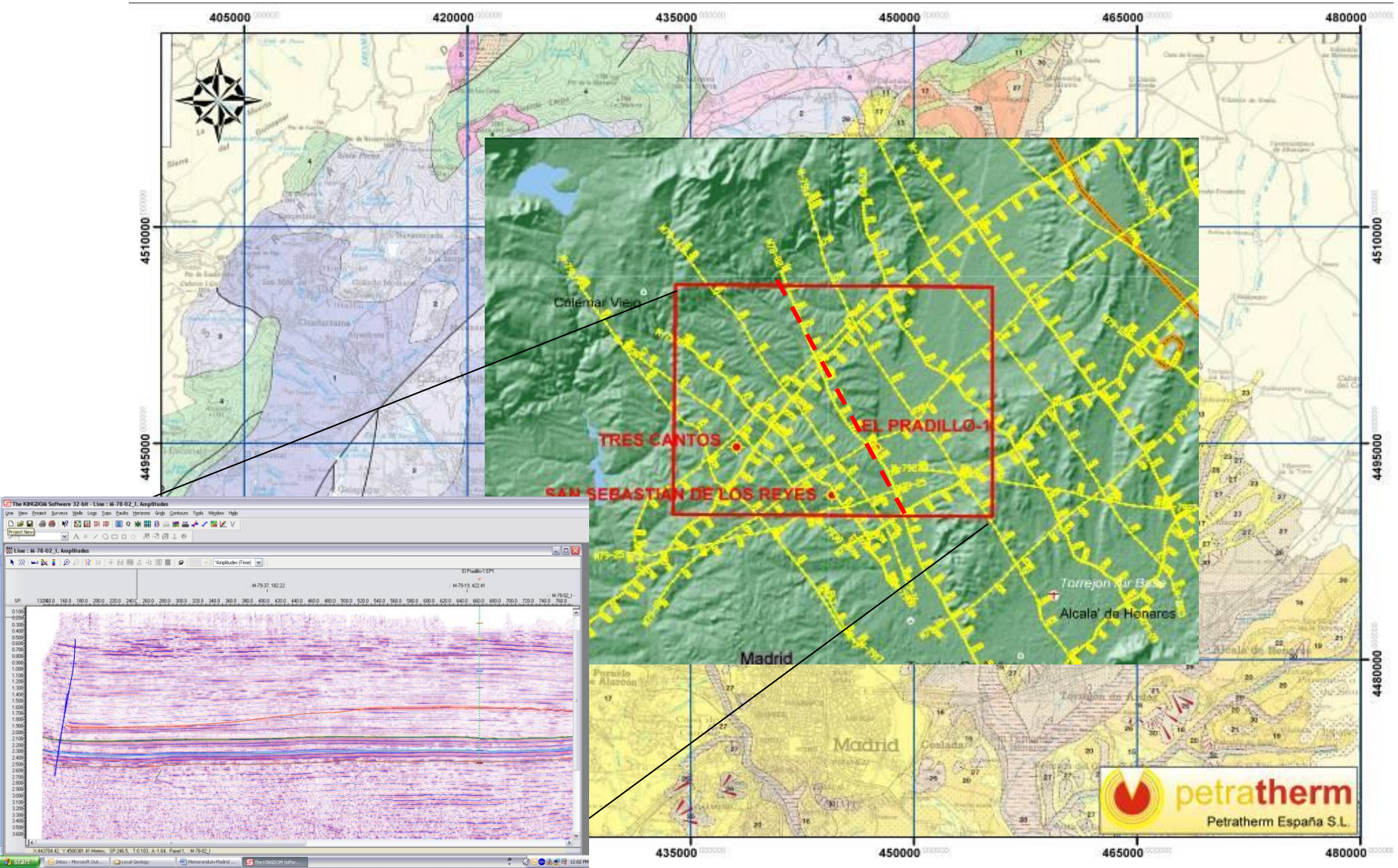
- Geology, Structural geology
- Geophysics (reinterpret seismic and gravity surveys)
- Drilling data reinterpretation
- Preliminary 3D modeling

To be done

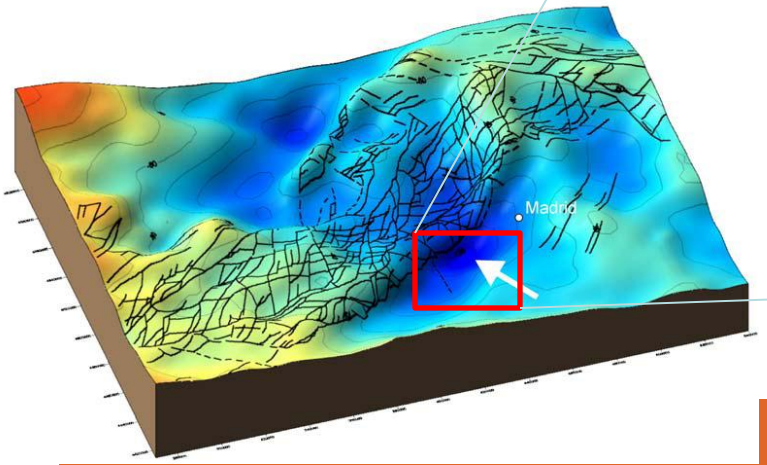
Definition of a detailed thermo-mechanical 3D model
Launch of a demonstration project in Madrid to proof of concept

- Geothermal exploratory well
- 2nd Geothermal well
- Circulation test
- Pilot plant

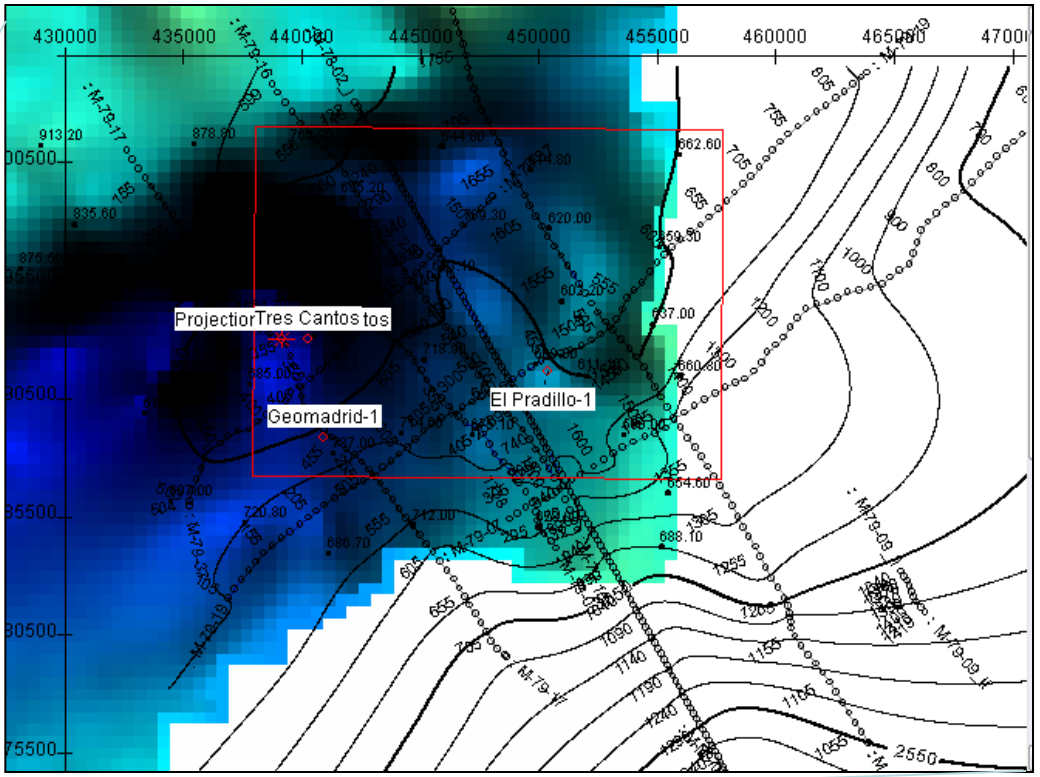
Basin structure interpretation



Basin structure interpretation



CS Gravity 3D model (A. Martin 2004)



Detailed NW limit Madrid basin Petratherm structural model

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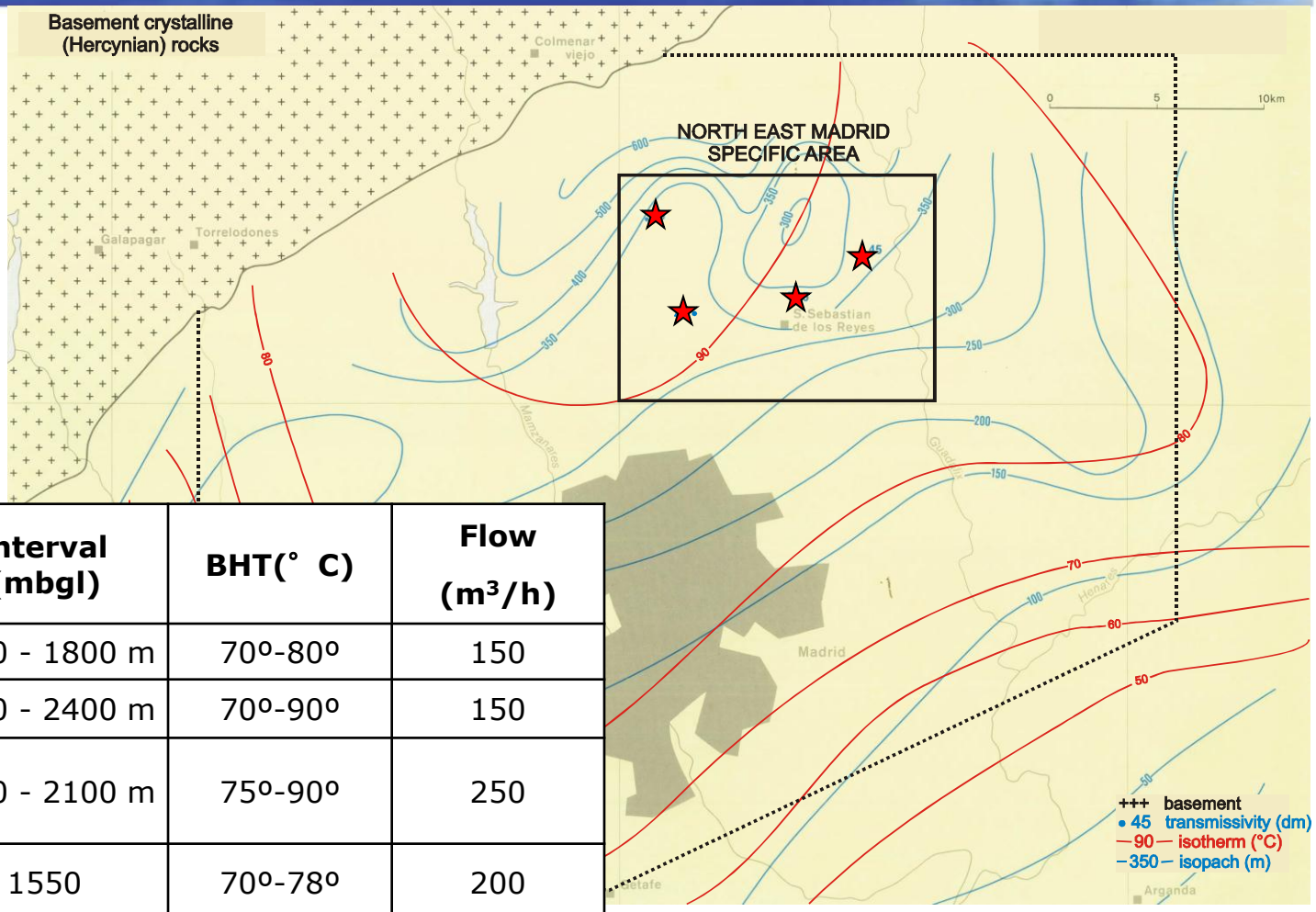
Geothermal resource estimation



Well	interval (mbgl)	BHT(° C)	Flow (m^3/h)
Pradillo	1600 - 1800 m	70º-80º	150
Tres Cantos	1600 - 2400 m	70º-90º	150
San Sebastian de los Reyes	1600 - 2100 m	75º-90º	250
Geomadrid 1	1550	70º-78º	200

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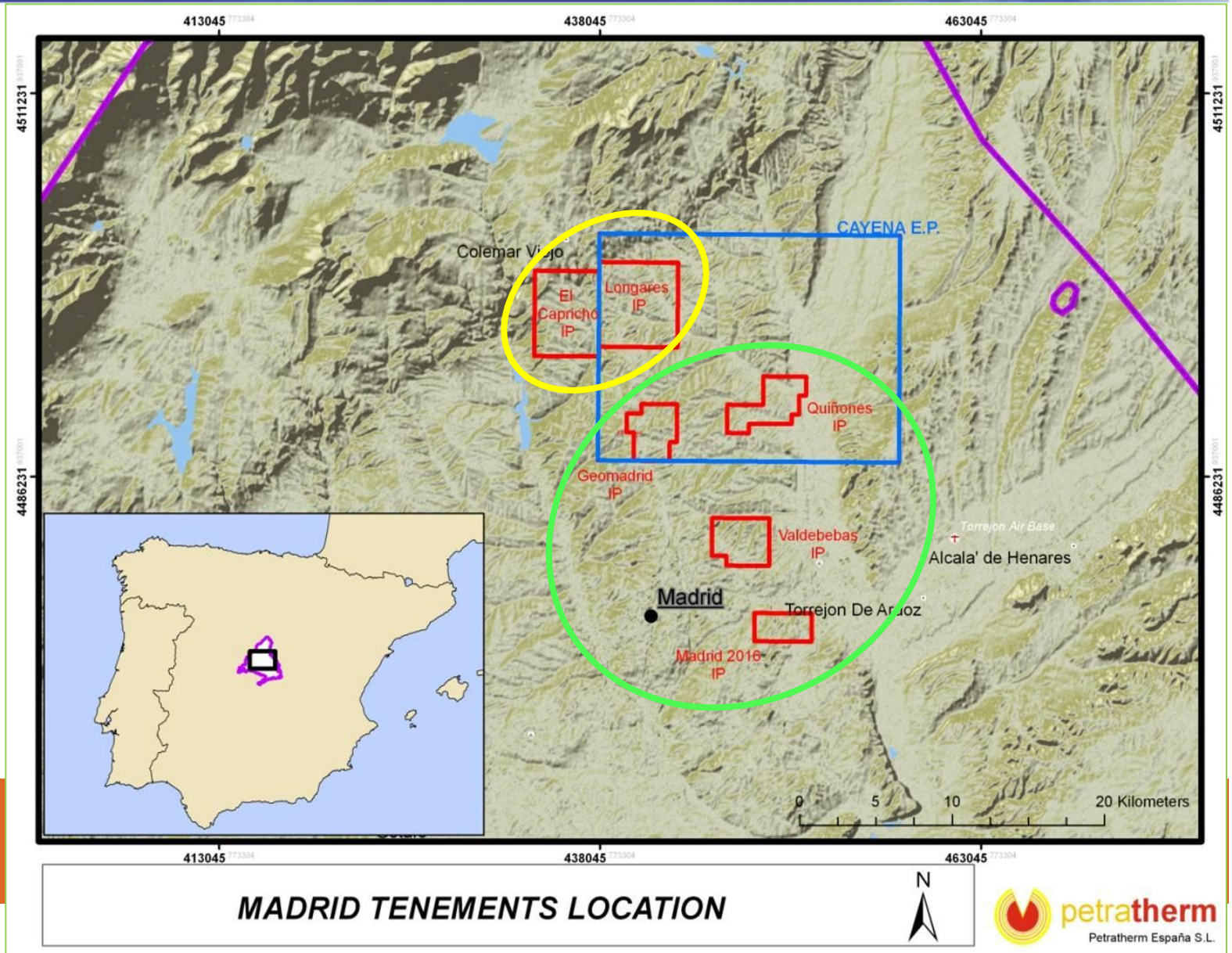
Geothermal resource evaluation

Item	Grand Madrid	NE Madrid
Heat in place (HIP) 10^{15} PJ	181,000	22,000
Recoverable heat (RCH) 75 yrs PJ	25,000	3,500
Exploitable heat (and power) (EXH) 75 yrs PJ	730	170
EXH / RCH ratio (%)	3	5

From Ungemach et al 2008

Mining licenses Petratherm Madrid



Next planned activities

To be done

Definition of a detailed thermo-mechanical 3D model

Launch of a demonstration project in Madrid to proof of concept

- Geothermal exploratory well
- 2nd Geothermal well
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Conclusions

- Private initiative is completing pre-drilling investigation programs
- Several prospective areas have being defined including the drilling target layouts
- Support of federal government
  - Early R&D exploration programs (grants+financing)
  - Developing 2011-2020 Renewable Energy Plan for Geothermal (PER)
- Next priority for the Spanish geothermal industry:

"Development of drilling support schemes (demonstration projects, new technology grants,etc..) just to be implemented from the new PER"

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