



ALCUE NET

Latin America, Caribbean and European Union Network on Research and Innovation

Geothermics in Italy

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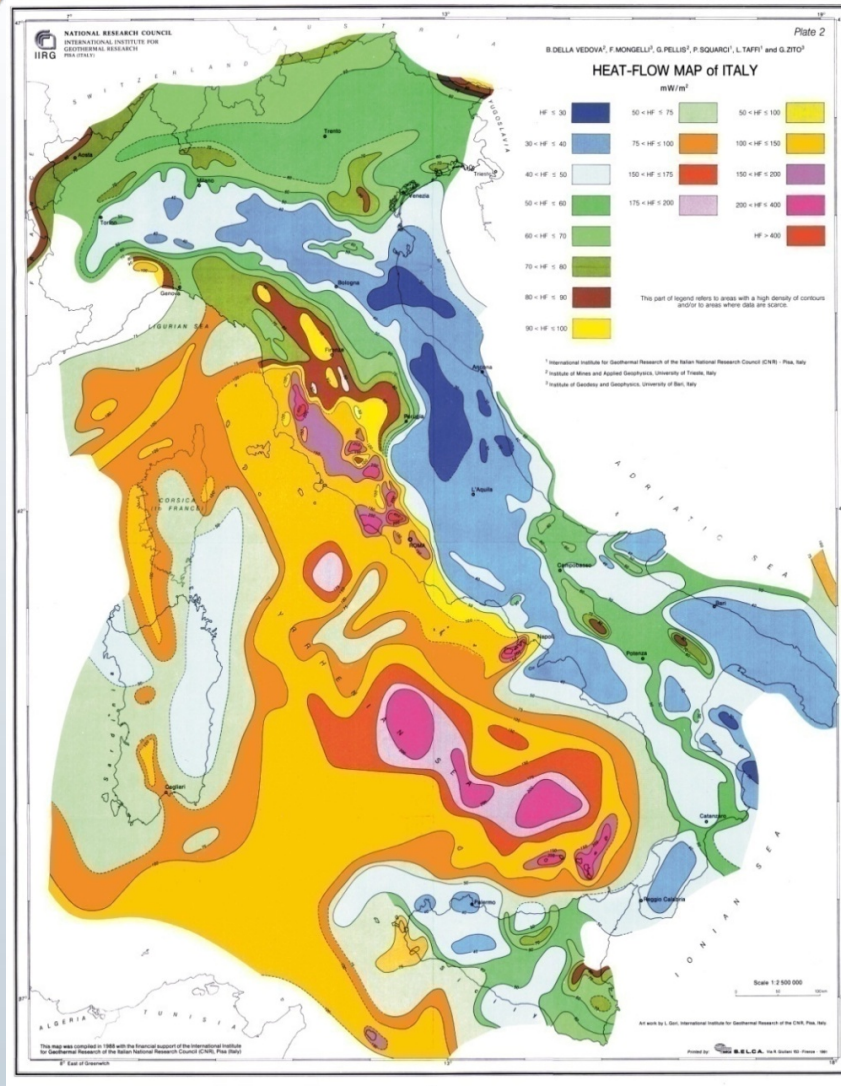
Geothermal Energy Workshop Salta – December 2014



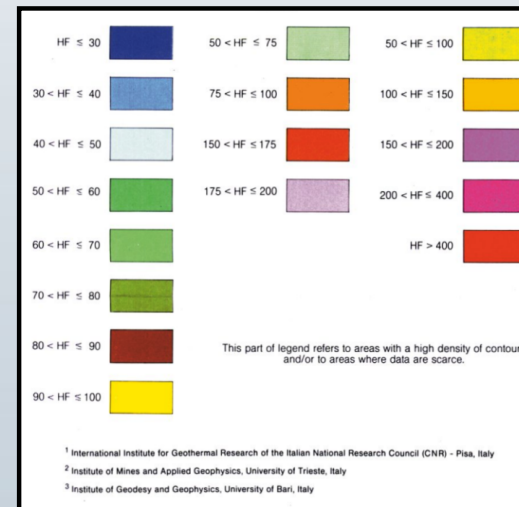
Ministero degli Affari Esteri



Heath flow in Italy

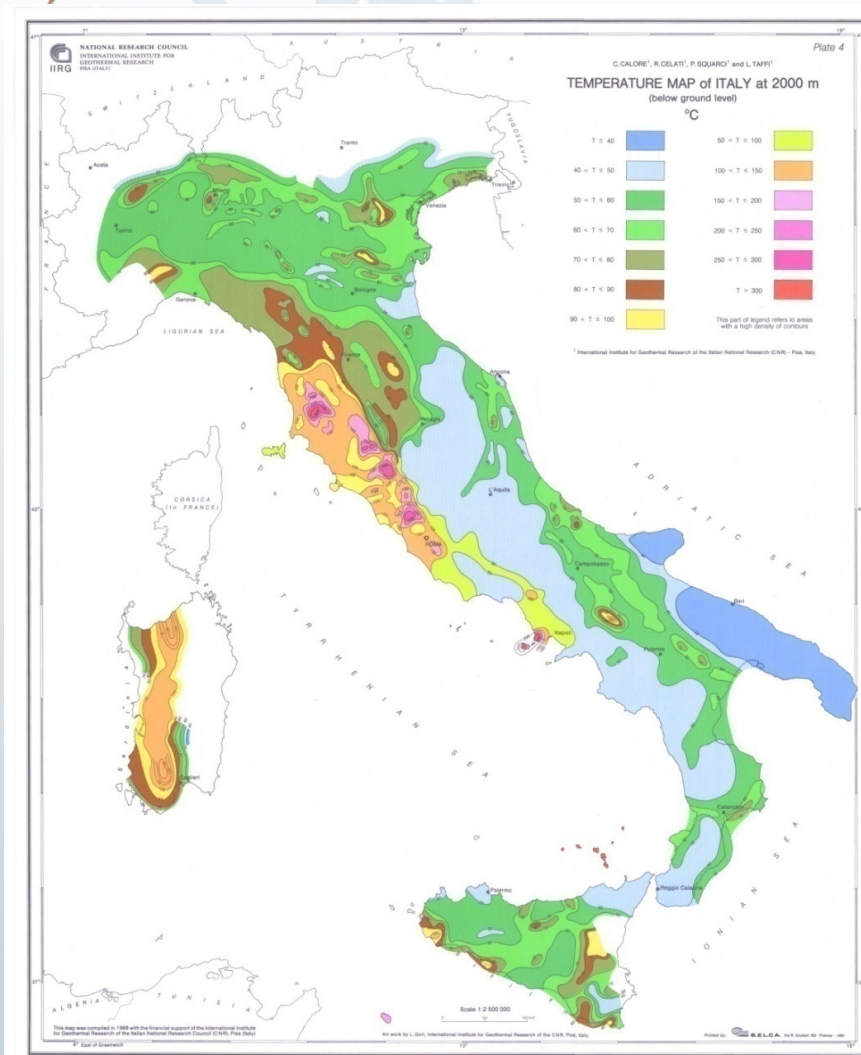


National efforts in 1970s-1990s led to the first quantitative assessment of the geothermal potential in Italy



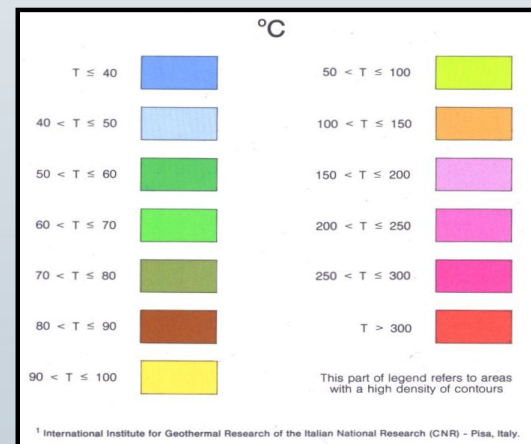


Temperatures at - 2000 m

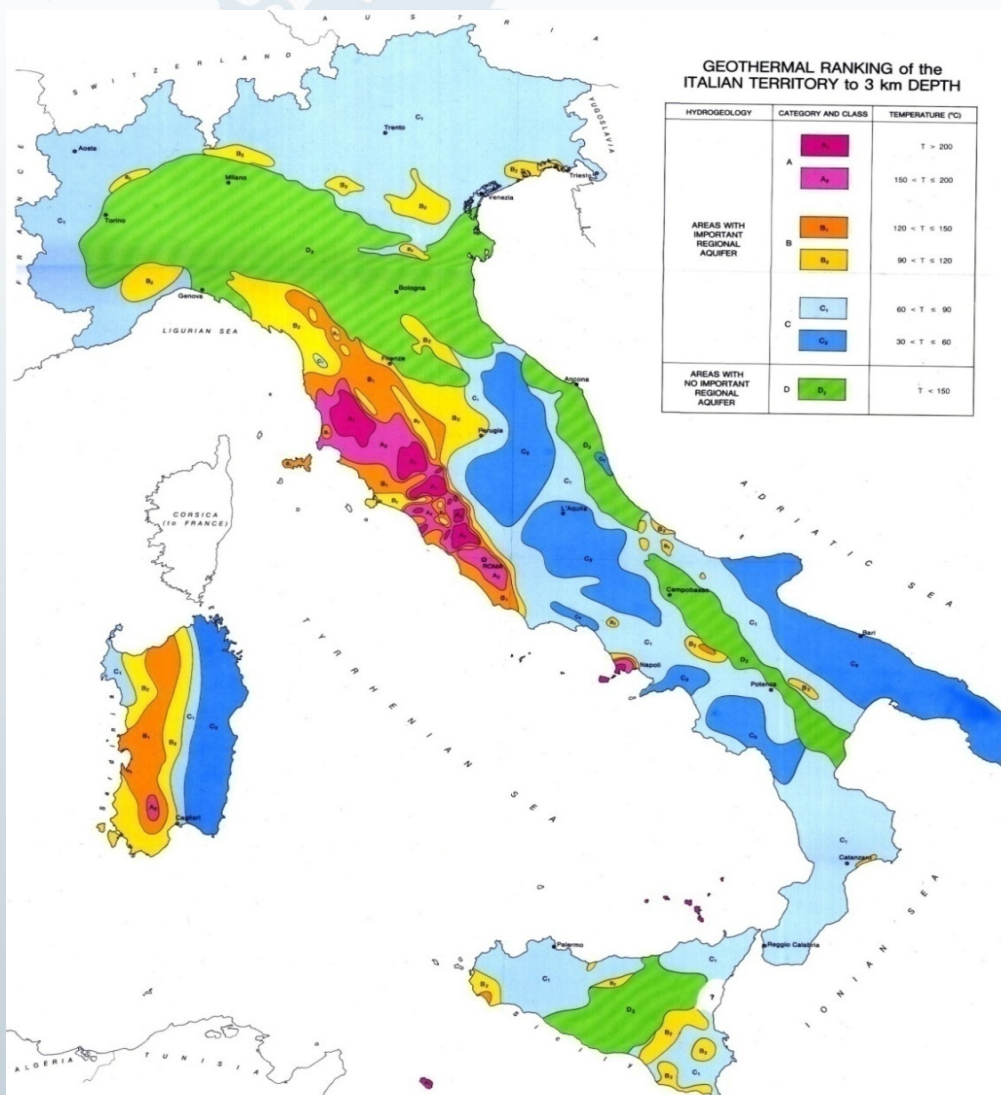


Cataldi R., Mongelli F., Squarci P., Taffi L., Zito G., and Calore C. (1995): Geothermal ranking of the Italian territory. *Geothermics*, Vol. 24, n. 1; pp. 115-129.

Geothermal resources are available in reservoirs at accessible depths in vast areas of the territory



Geothermal Ranking of Italy



The wide presence of permeable rocks at depth and impervious covers around high heat flow regions favours the development of high quality geothermal systems:

- **Resources at $T > 150$ °C within 3 km**, in large areas of the Tyrrhenian margin and volcanic islands;
- **Resources at $T = 50-150$ °C within 3 km**, in 50% of the national territory (in Po plain, Sicily and Sardinia)
- **Resources at $T = 30 - 50$ °C at shallow depths**, almost everywhere.

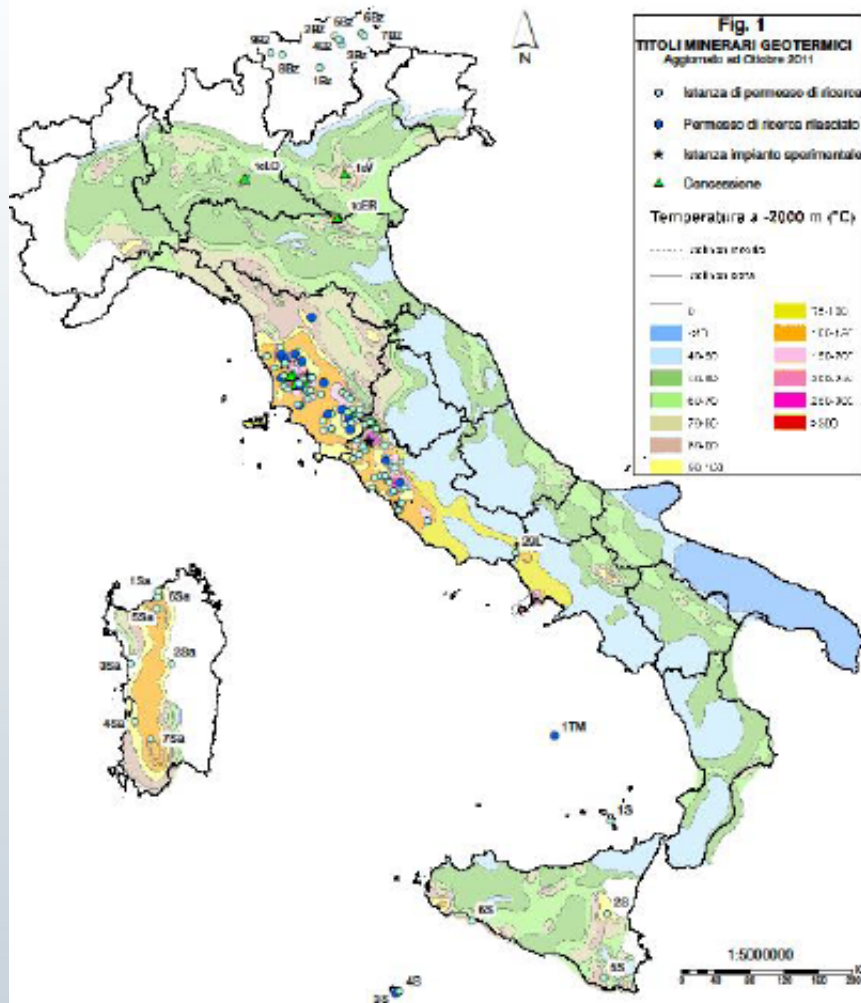
TOTAL CONSUMPTION OF ELECTRIC POWER (10^6 TEP) 170

- **Oil, gas, coal** 82 %
- **Hydroelectric and other renewables** 13 %
- **Imported** 5 %

Geothermal Energy (in 2010) $1,32 \times 10^6$ TEP (0.8%), of which

- **Electric power generation $1,02 \times 10^6$ TEP (0.6 %)**
- **Direct uses 300.000 TEP (0.2 %)**

Current boom of requests for research permits since 2010



More than 120 requests for research permits for high, medium and low enthalpy resources have been submitted to several Regional administrations (source UNMIG)

ALTO ADIGE	9
TOSCANA	51
LOMBARDIA	2
LAZIO	34
CAMPANIA (Campi Flegrei)	2?
SICILIA (e Isole Eolie)	6
SARDEGNA	7
MAR TIRRENO (Marsili)	1 a mare

Scenarios of growth (source UGI)

Ambiti di sfruttamento	2010			2020			2030		
SCENARIO I									
a) Energia geotermoelettrica	882,5 MWe	5,34 TWh/a	1020 kTEP/a	1.080 MWe	6,9 TWh/a	1.310 kTEP/a	1.500 MWe	9,4 TWh/a	1.860 kTEP/a
b) Usi diretti (incluse pompe di calore geotermiche)	1000 MWt	12.600 TJ/a	300 kTEP	2.510 MWt	26.350 TJ/a	630 kTEP/a	7.400 MWt	65.200 TJ/a	1.560 kTEP/a
c) Totale geotermia (a+b)	-	-	1.320 kTEP/a	-	-	1.940 kTEP/a	-	-	3.420 kTEP/a
d) Contributo della geotermia al consumo totale di energia	-	-	~ 0,8 % (*)	-	-	~ 1 % (*)	-	-	~ 1,5 % (*)
e) CO ₂ evitata (da a + b)	-	-	4.000 kTon/a	-	-	5.780 kTon/a	-	-	9.760 kTon/a

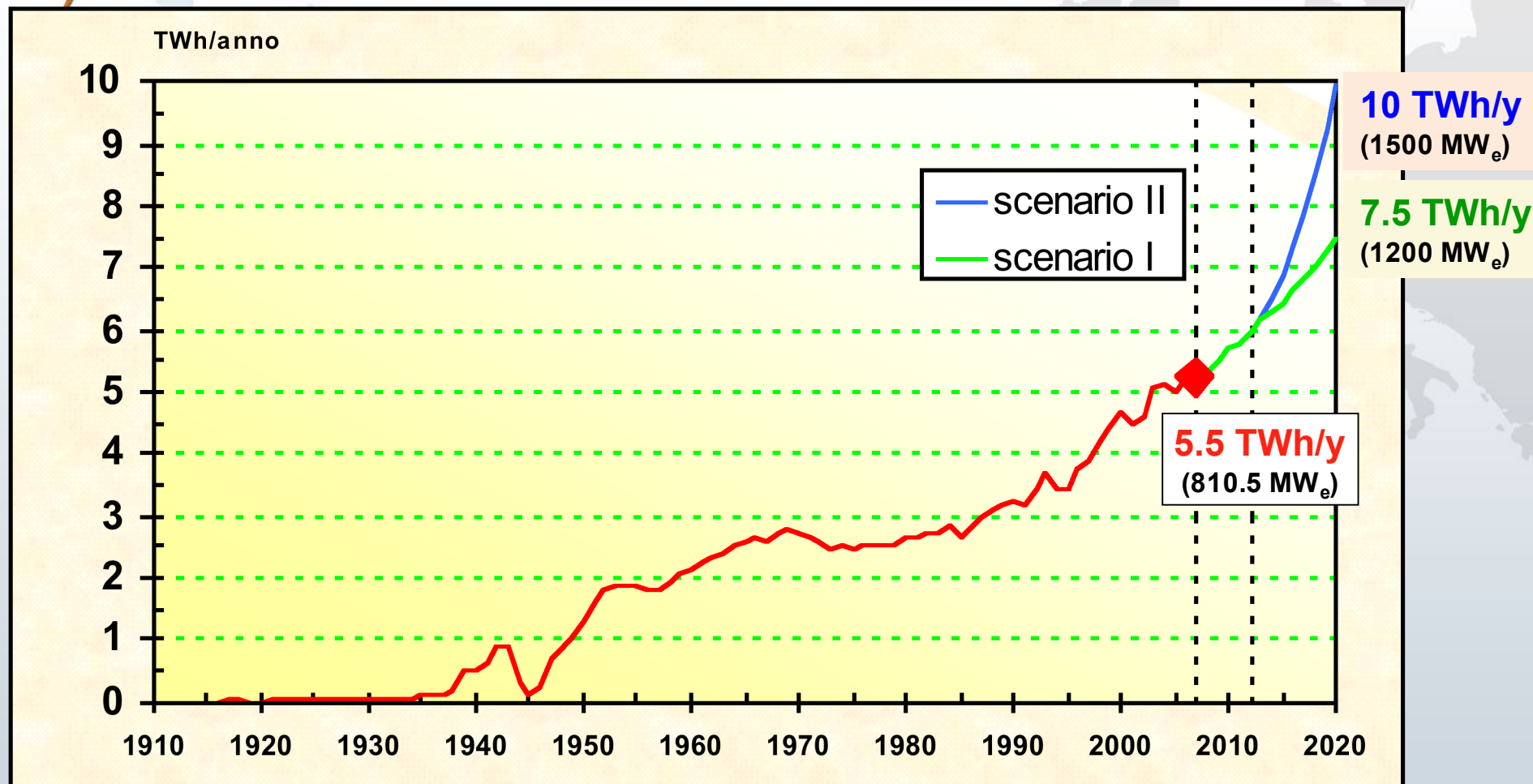
(*) Percentuali riferite ad un consumo totale di energia di ~ 170(?) milioni di TEP a consuntivo per il 2010, e di 190 e 230 milioni di TEP ipotizzati per i consumi totali di energia nel 2020 e nel 2030, rispettivamente.

Scenarios of growth (source UGI)

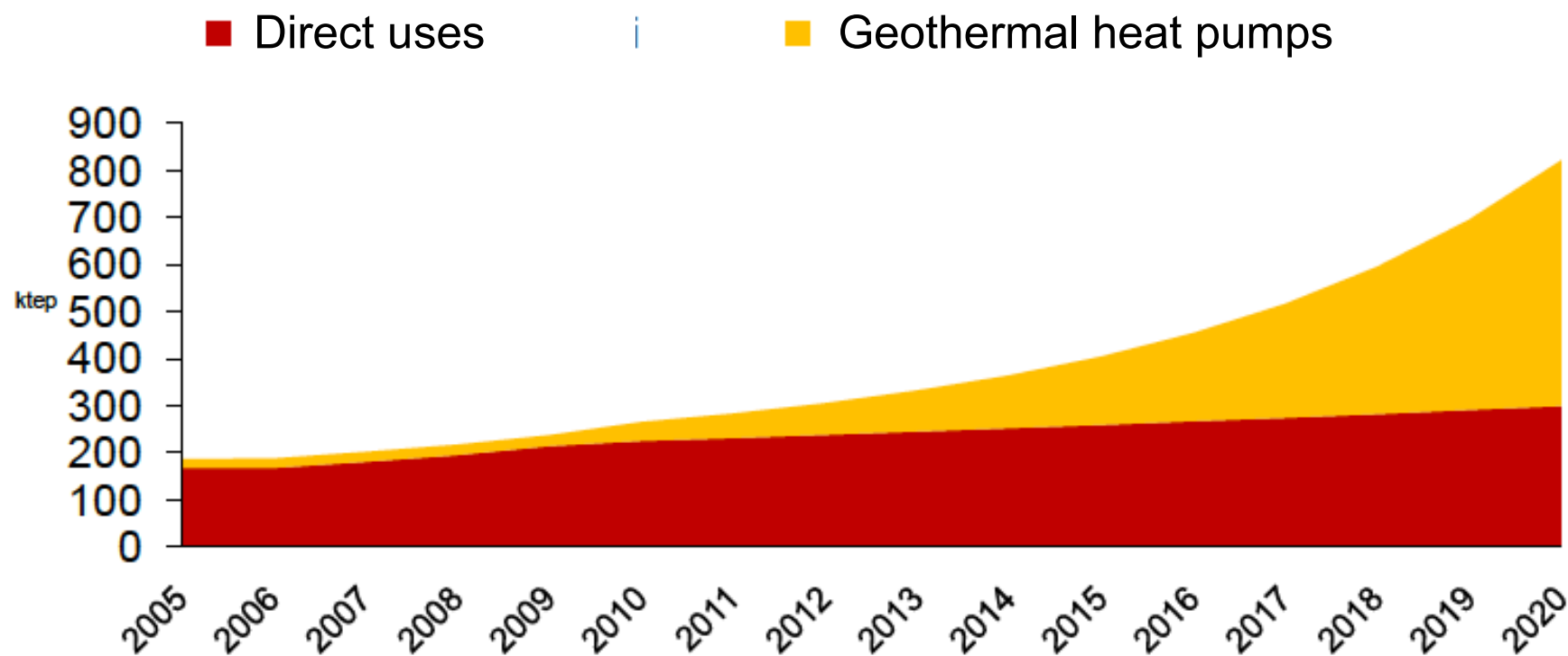
Ambiti di sfruttamento	2010			2020			2030		
SCENARIO II									
a) Energia geotermoelettrica	882,5 MWe	5,34 TWh/a	1020 kTEP/a	1.150 MWe	7,3 TWh/a	1.390 kTEP/a	2.000 MWe	12,0 TWh/a	2.280 kTEP/a
b) Usi diretti (incluse pompe di calore geotermiche)	1000 MWt	12.600 TJ/a	300 kTEP	2.750 MWt	30.660 TJ/a	740 kTEP/a	8.800 MWt	90.000 TJ/a	2.160 kTEP/a
c) Totale geotermia (a+b)	-	-	1.320 kTEP/a	-	-	2.130 kTEP/a	-	-	4.440 kTEP/a
d) Contributo della geotermia al consumo totale di energia	-	-	~ 0,8 % (*)	-	-	~ 1,1 % (*)	-	-	~ 1,9 % (*)
e) CO ₂ evitata (da a + b)	-	-	4.000 kTon/a	-	-	6.300 kTon/a	-	-	12.820 kTon/a

(*) Percentuali riferite ad un consumo totale di energia di ~ 170(??) milioni di TEP a consuntivo per il 2010, e di 190 e 230 milioni di TEP ipotizzati per i consumi totali di energia nel 2020 e nel 2030, rispettivamente.

Scenarios of growth (source UGI)



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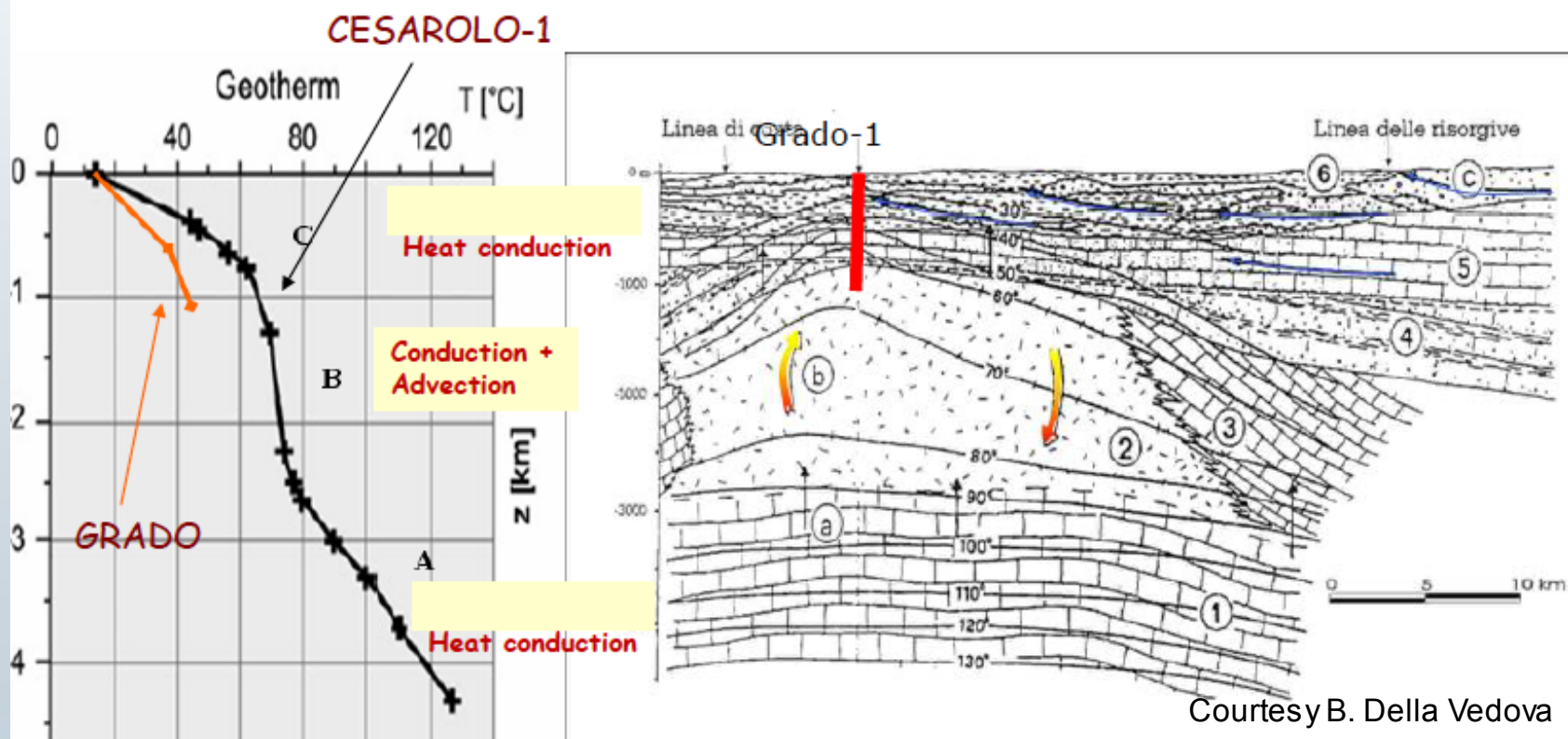
T. Franci: Misure per il raggiungimento degli obiettivi di sviluppo della geotermia in Italia, Ferrara 28 settembre 2011

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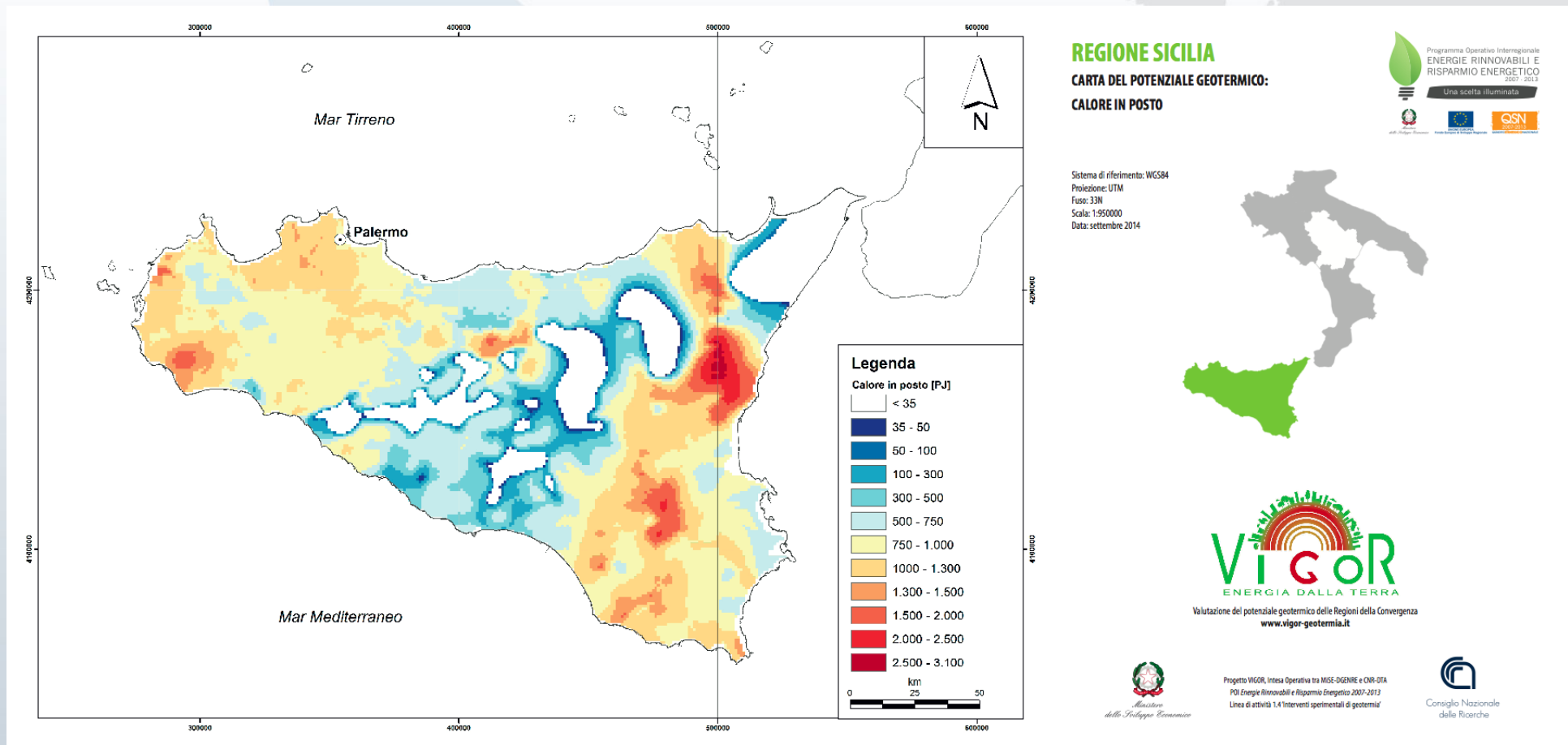
LOW T RESERVOIR: GRADO PROJECT

- ❖ Salt water in carbonates
- ❖ Freshwater in shallow aquifers

Flysh & Molasse
capping rocks



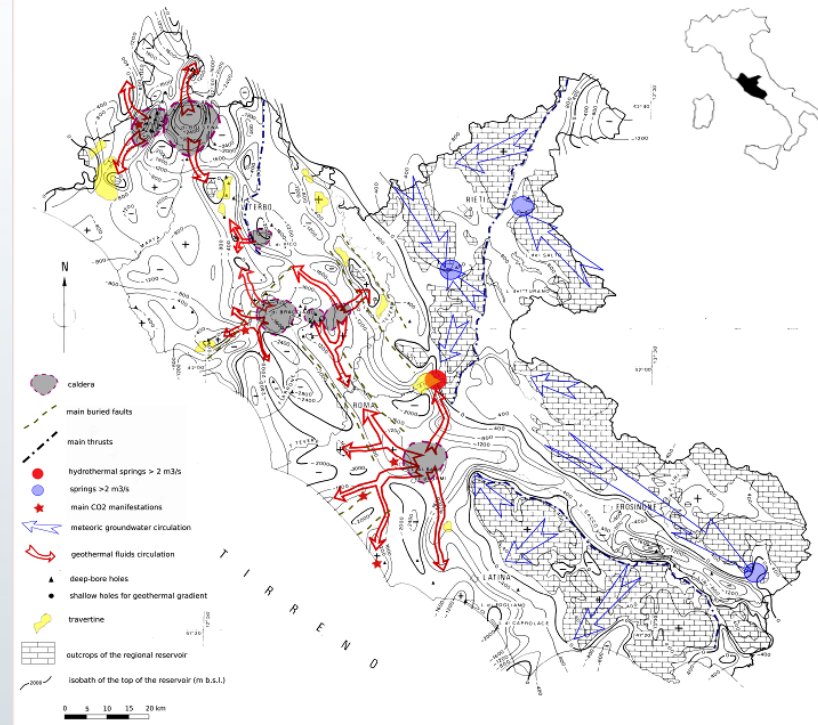
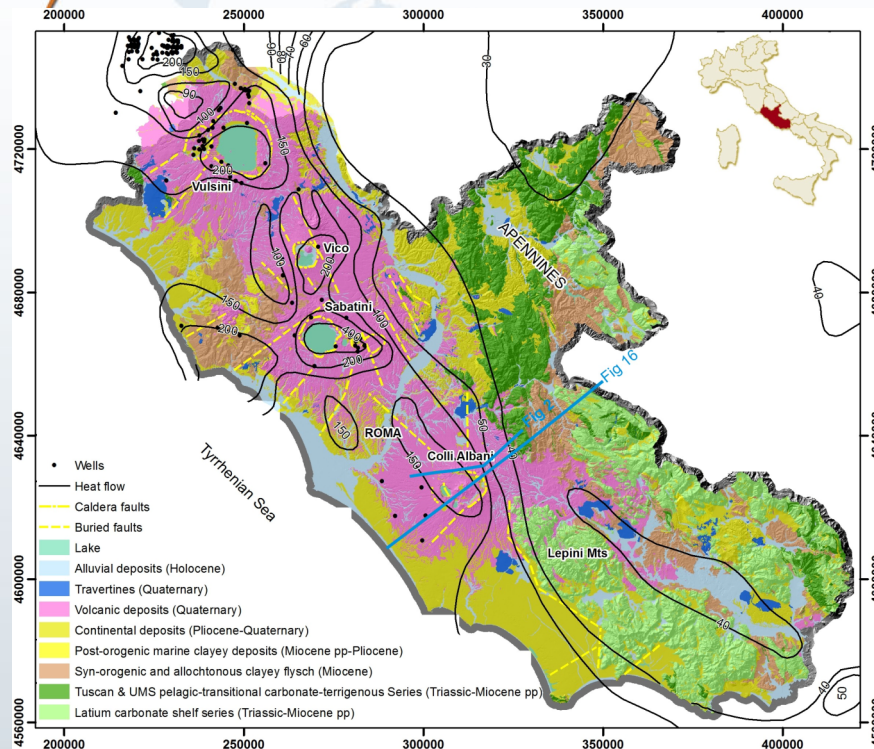
PON Vigor Project - CNR



www.vigor.it

Some funded projects in Italy

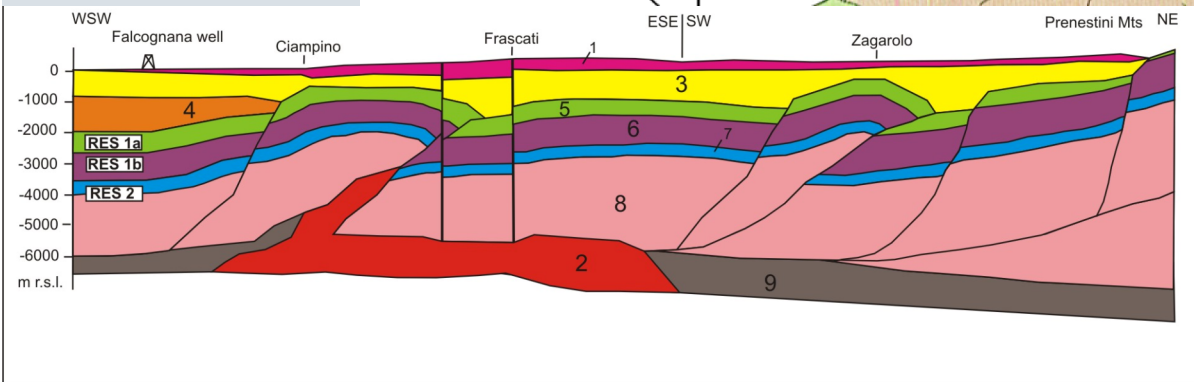
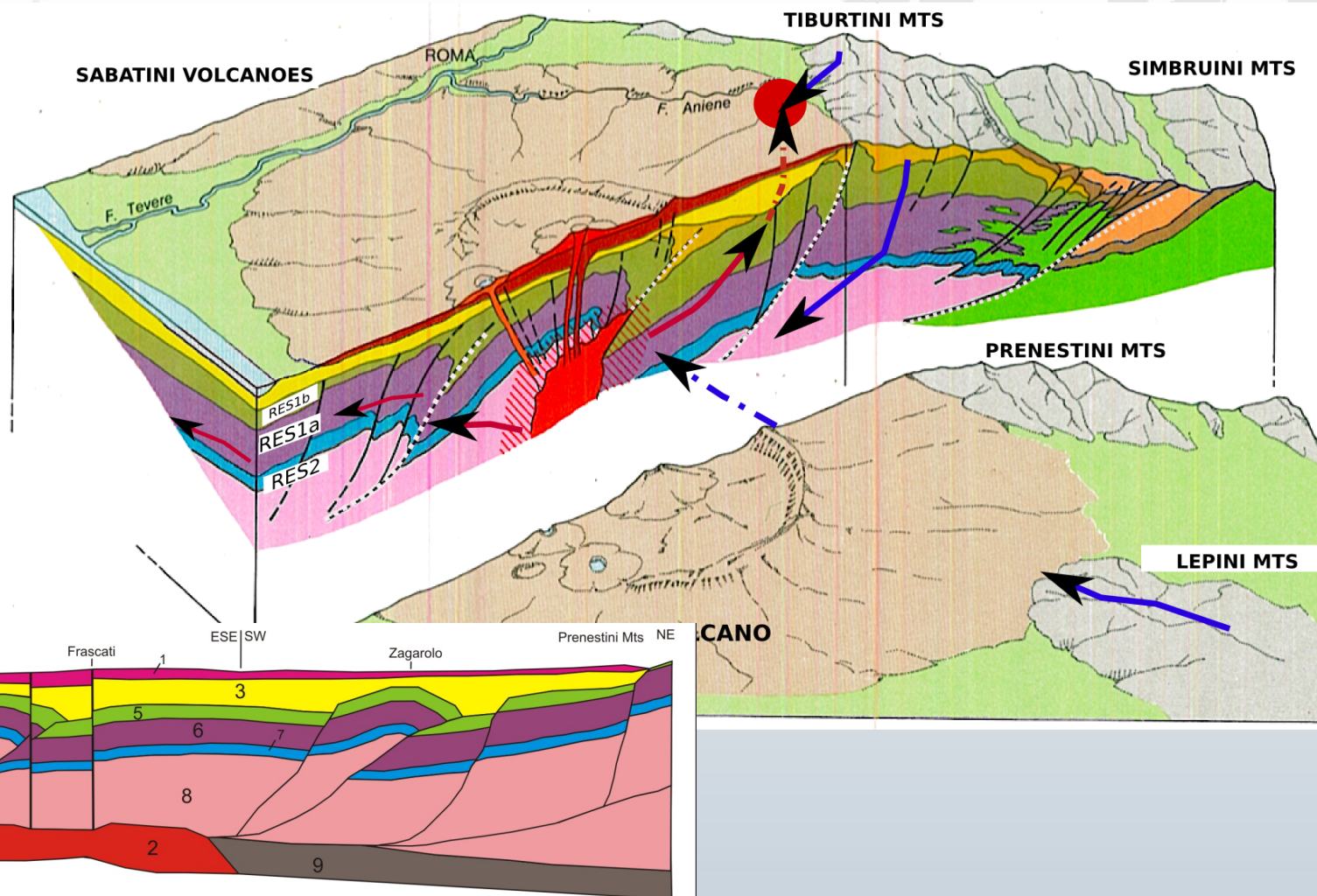
ALCUE NET RL Project - Assessment of Geothermal Potential - Univ Roma Tre



Area	Evaluation Method	A ₁ <60%	A ₂ >50%	H _{Res1}	H _{Res2}	V _{A1Res1}	V _{A1Res1+2}	V _{A2Res1}	V _{A2Res1+2}	D _{Res1}	D _{Res2}	Q _{A1Res1}	Q _{A1Res1+2}	Q _{A2Res1}	Q _{A2Res1+2}	T _{av} (°C)	W- (MW)	W+ (MW)
Grottaferrata-Ciampino	AxBxC	24	69	1	2	24	72	69	207	1	2	960	2880	2070	6210	125-175	112	1092
	C	82	-	1	2	82	246	-	-	1	2	3280	9840	-	-	125-175	384	1730
La Zolforata	C	44	-	1	2	44	132	-	-	2	3	1760	5280	-	-	125-175	206	928
Ardea	C	48	-	1	2	48	144	-	-	2	3	1920	5760	-	-	125-175	225	1013
Tivoli springs												7200 ^A				23		67
Totals																	927	4763

Giordano et al., 2014, Earth Science Reviews

Deep circulation and compartments



Giordano et al., 2013, Earth Science Reviews,

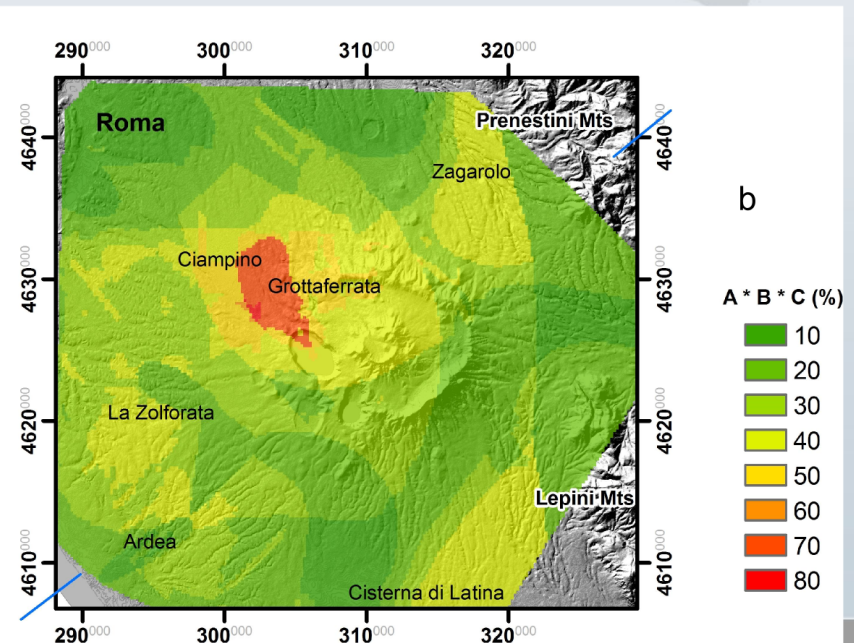
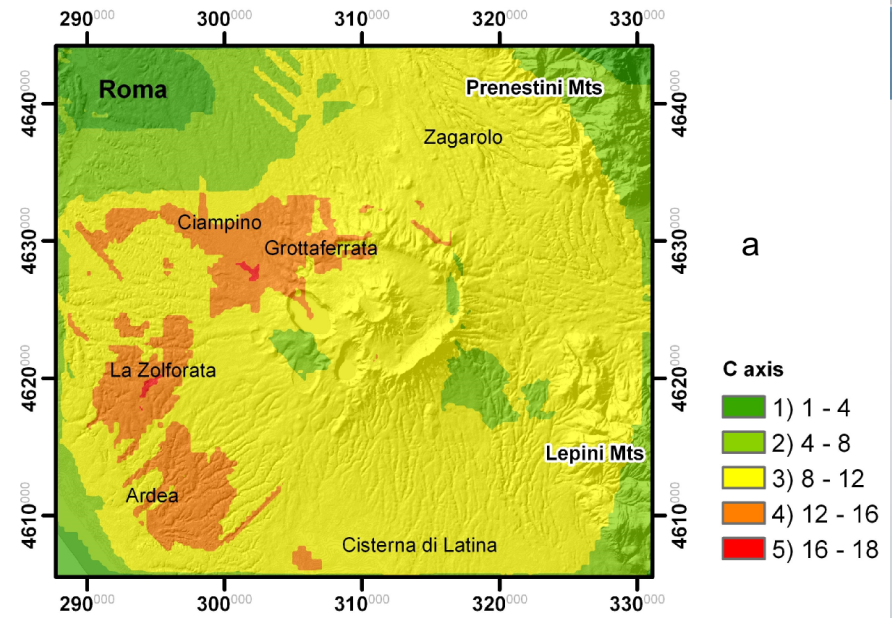
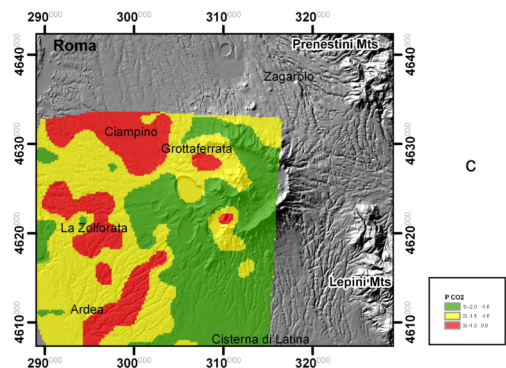
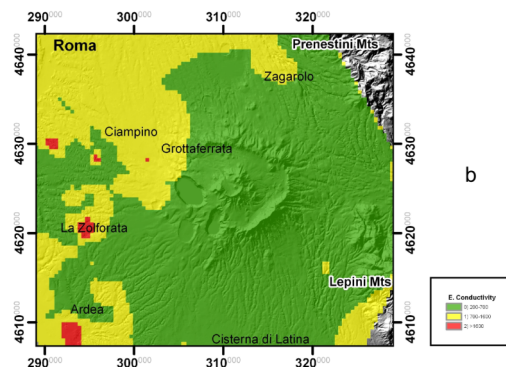
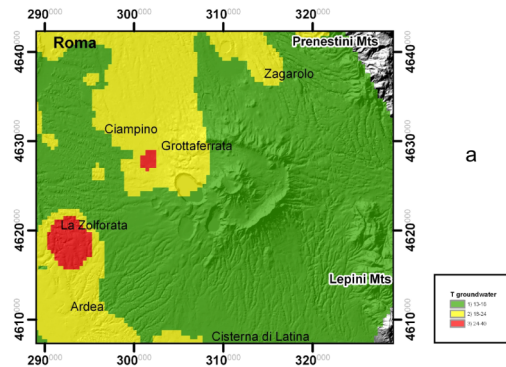
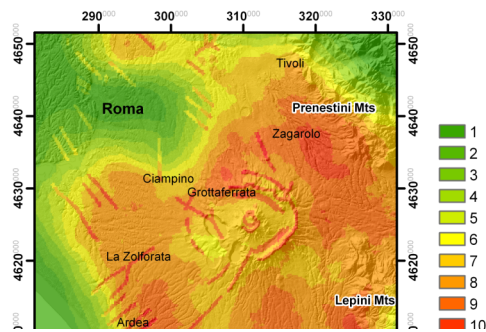
INDICATORS OF DEEP PERMEABILITY - ZONING

Density and
orientation of
deep fractures

Ground water
Temperature

Ground water
Electrical
Conductivity

Ground water
PCO2



C axis

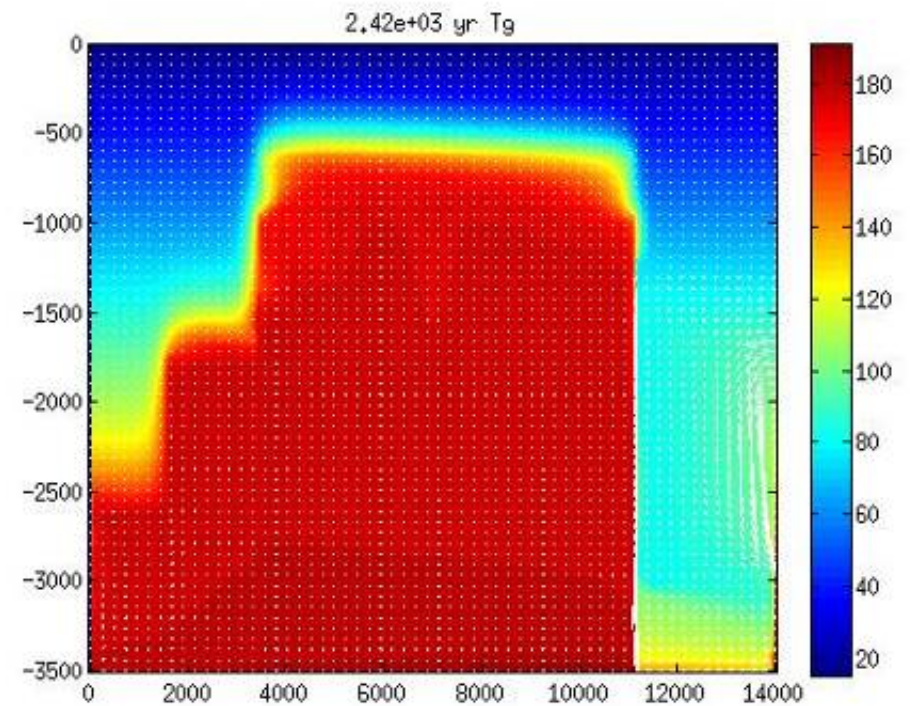
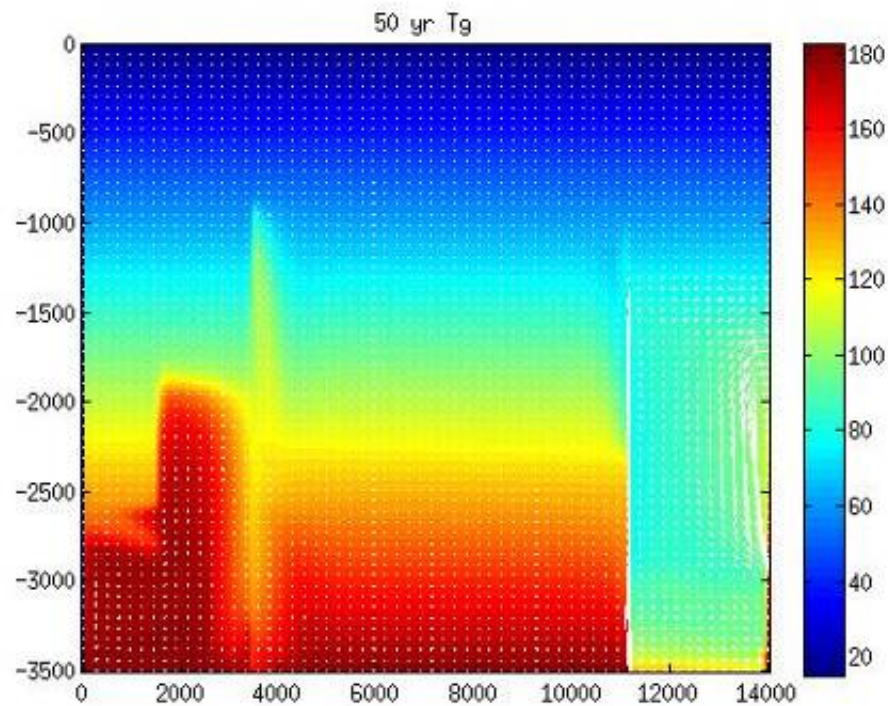
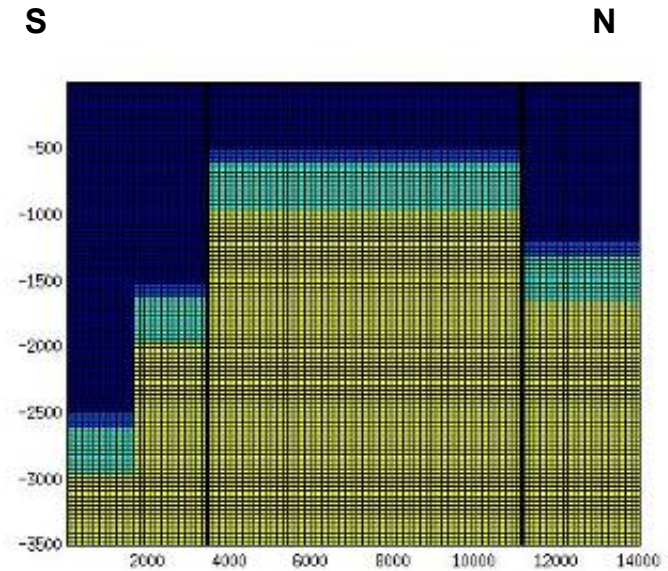
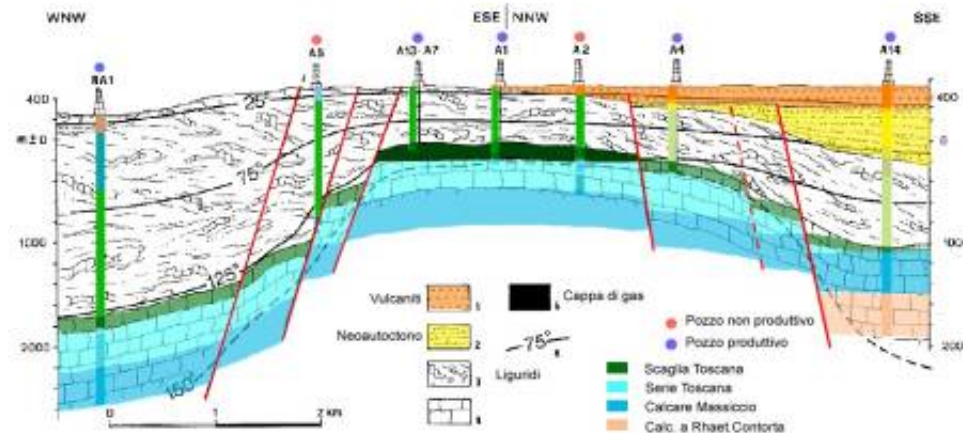
- 1) 1 - 4
- 2) 4 - 8
- 3) 8 - 12
- 4) 12 - 16
- 5) 16 - 18

b

A * B * C (%)

- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80

TOUGH2 NUMERICAL SIMULATIONS OF LATERAL ADVECTION THROUGH RESERVOIRS



- There are still significant margins for improving the identification and use of geothermal resources in Italy
- The current situation is broadly positive with tens of small to medium companies requesting or managing research permits
- Several public institutions and associations at national level (Universities, Cnr, Enea, Ingv, Ministry for Foreign Affairs, UGI) and at international level (EU) are promoting and/or supporting scientific programs in Italy
- Specific problems occur for complicate and slow beaurocracy at regional level, although the situation varies largely across regions