FCTUC

Geotermia

Energia para um futuro sustentável.

HDR/EGS Potencial of the Beiras region, Central Portugal

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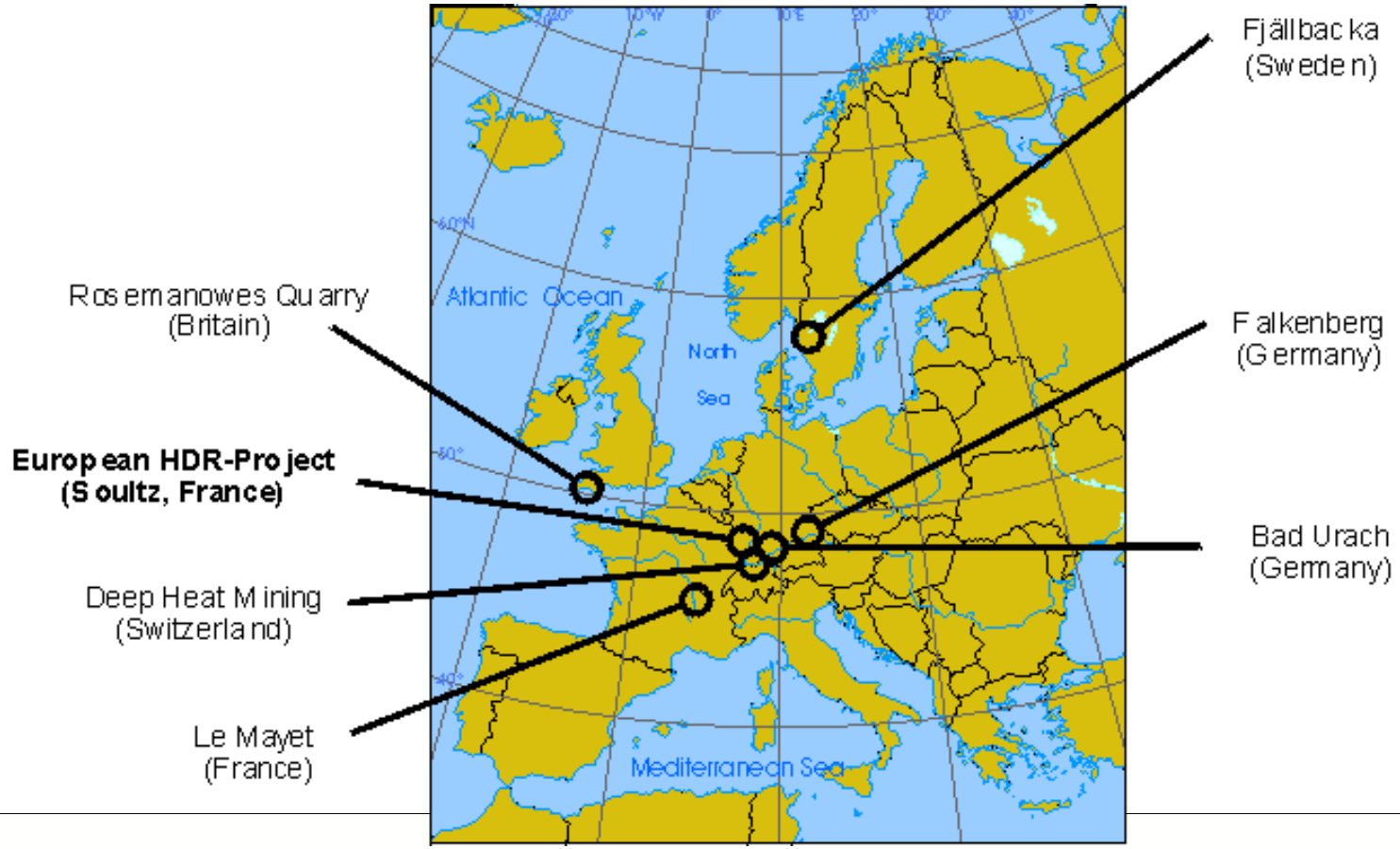
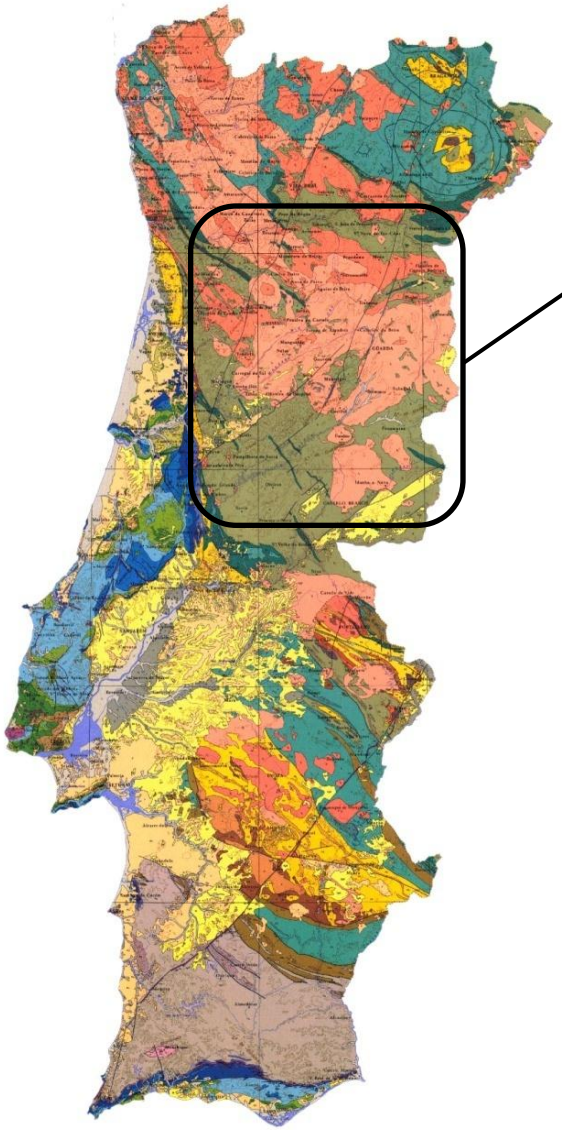
01. HISTORY OF HDR/EGS IN EUROPE



02. HISTORY OF HDR/EGS IN PORTUGAL



POTENCIAL TÉRMICO DAS ROCHAS GRANÍTICAS NUM SEGMENTO DO MACIÇO HESPÉRICO (PORTUGAL CENTRAL) (1)

POR

M. M. GODINHO, A. J. S. C. PEREIRA e L. J. P. F. NEVES (2)

03. A NEW STAGE FOR HDR/EGS - EUROPE

First EGS Power Plant – Soultz
1.5 MW (2008)

04. The Beiras project – some milestones

Late 2007 – Reevaluation by FCTUC of the EGS potencial of Central/Northern Portugal

February 2008 - Agreement between FCTUC and Patris Capital for the purpose of HDR/EGS development in Portugal

April 2008 - New company to deal with the project, Geovita, created by Patris Capital

April 2008 - Technical report prepared by FCTUC to request an exclusive prospect area in the Beiras region to DGEG (General Directorate for Energy and Geology)

December 2008 – An area of 500 km^2 in the Beiras region was granted by DGEG to Geovita for the purpose of prospecting geothermal resources

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continues...

05. The Beiras project – some milestones (cont.)

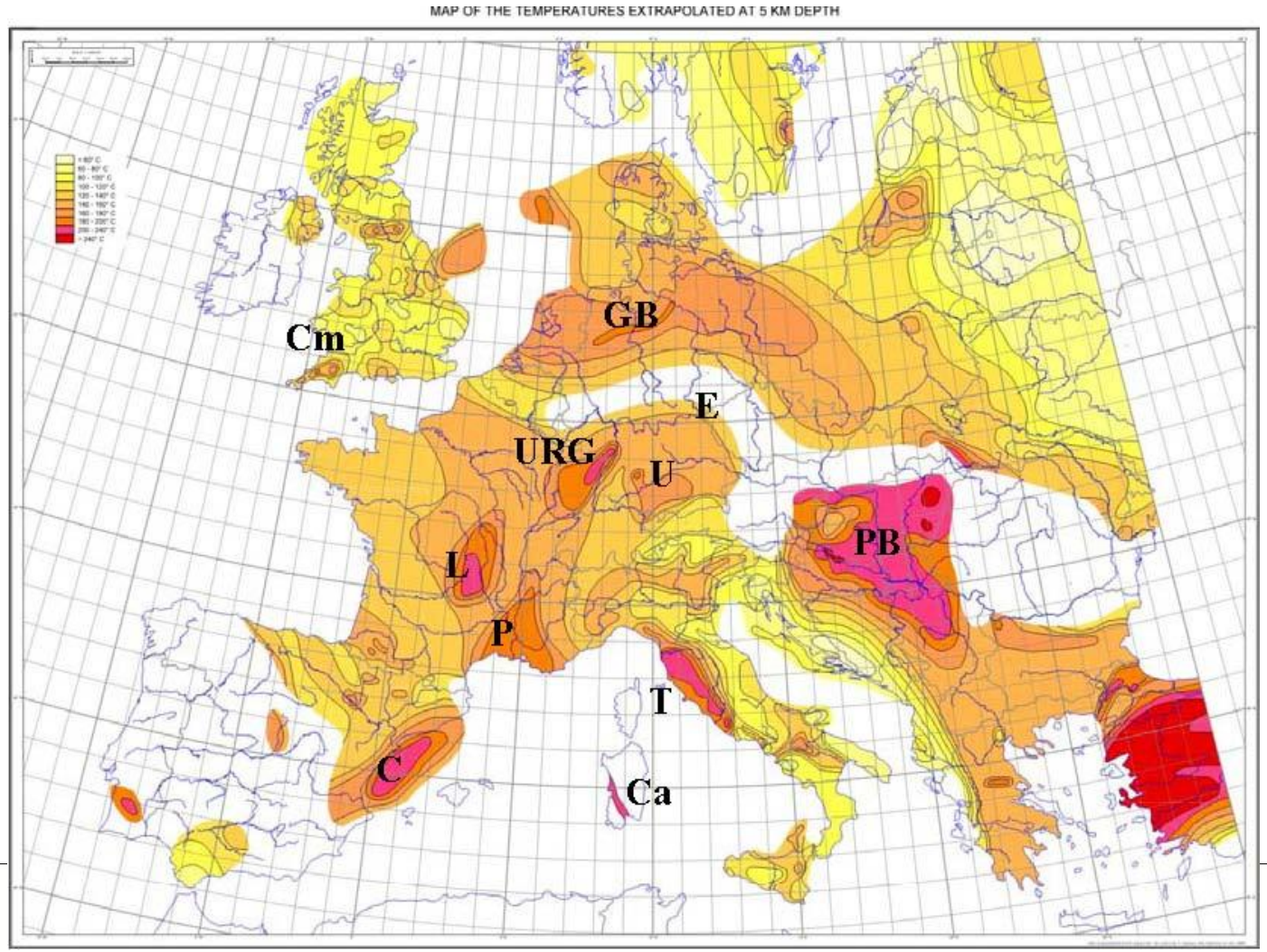
January 2009 – A permission to deliver 3 MW in the national energy grid was granted by DGEG to Geovita.

August 2009 – A guaranteed selling price of 0.27€ per kW/h was allowed by the state.

2009-2010– Geovita has actively searched for investors to join the project.

2011 – Geovita decided to abandon the project and renounced to the prospecting area.

06. Why the Beiras region?



Temperature extrapolation at 5 km depth (Genter et al., 2003)

7. Geothermal gradient and heat flow

Expected temperature at a certain depth depends on the local geothermal gradient, which measures the rate of change of temperature with depth (ºC *per* km).

Average geothermal gradients are in the range 25-30 ºC *per* km, and at least 40 ºC *per* km is necessary for EGS projects.

Geothermal gradient is determined by two different heat flow components; basal heat flow (Q_m) and radiogenic heat production (Q_0).

Conventional geothermal projects usually rely on high values of basal heat flow (Q_m); however for EGS projects radiogenic heat production can also play a significant role, namely when HHP granites are present.

8. Some lessons from the Cornwall granites

Region	Heat flow (mWm^{-2})	Heat production (μWm^{-3})
Cornwall granites	110	4.0 - 5.5

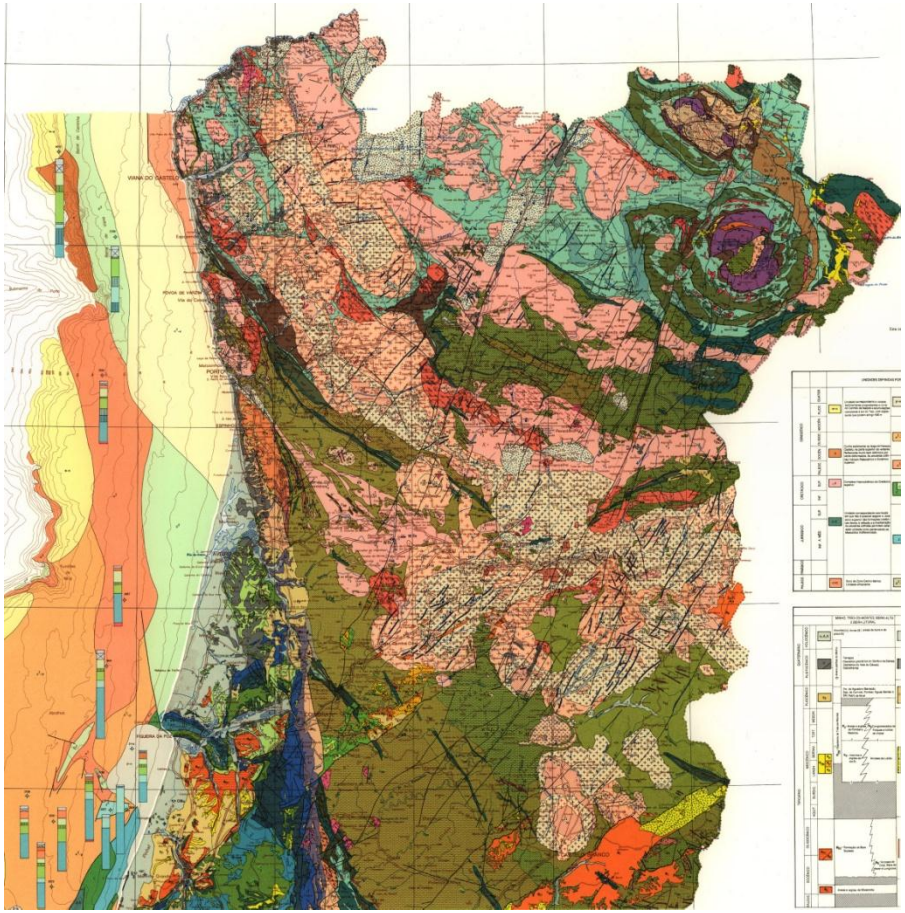
Webb *et al.* (1985)

Lessons learned:

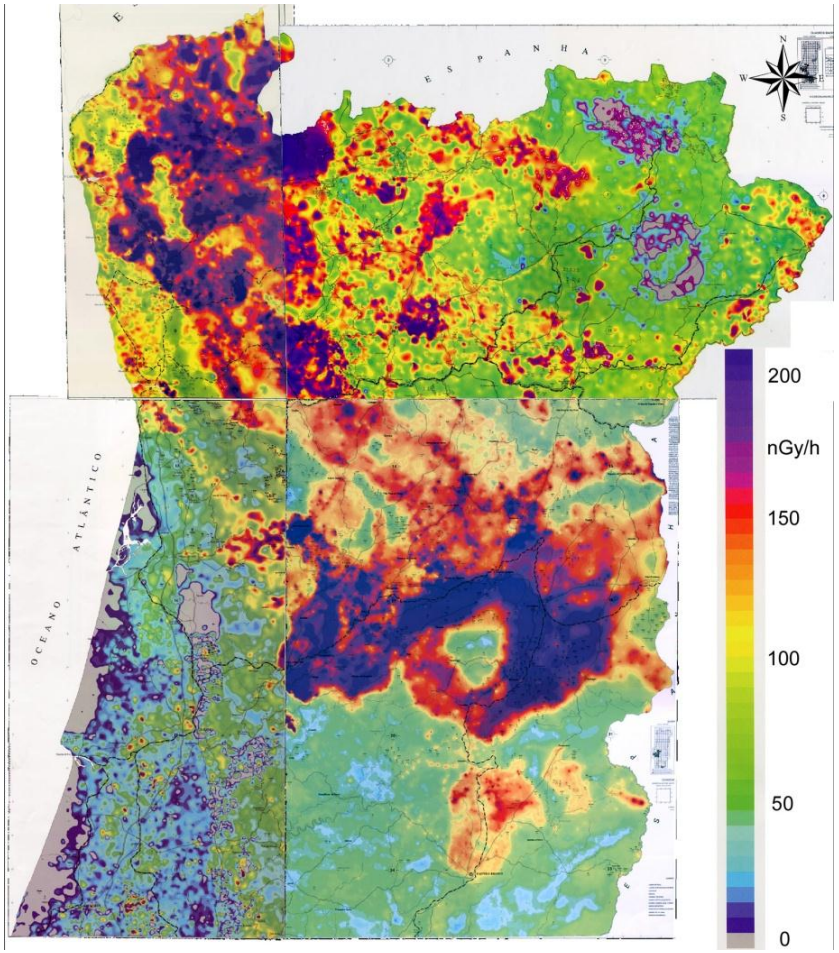
1) High heat flow will be produced from deep rooted voluminous granitic batholits, where U contents induce a high radiogenic internal heat production (HHP granites).

2) The presence of U in the form of uraninite leads to strongly underestimate heat production from superficial samples.

9. Gamma radiation in Central/Northern Portugal



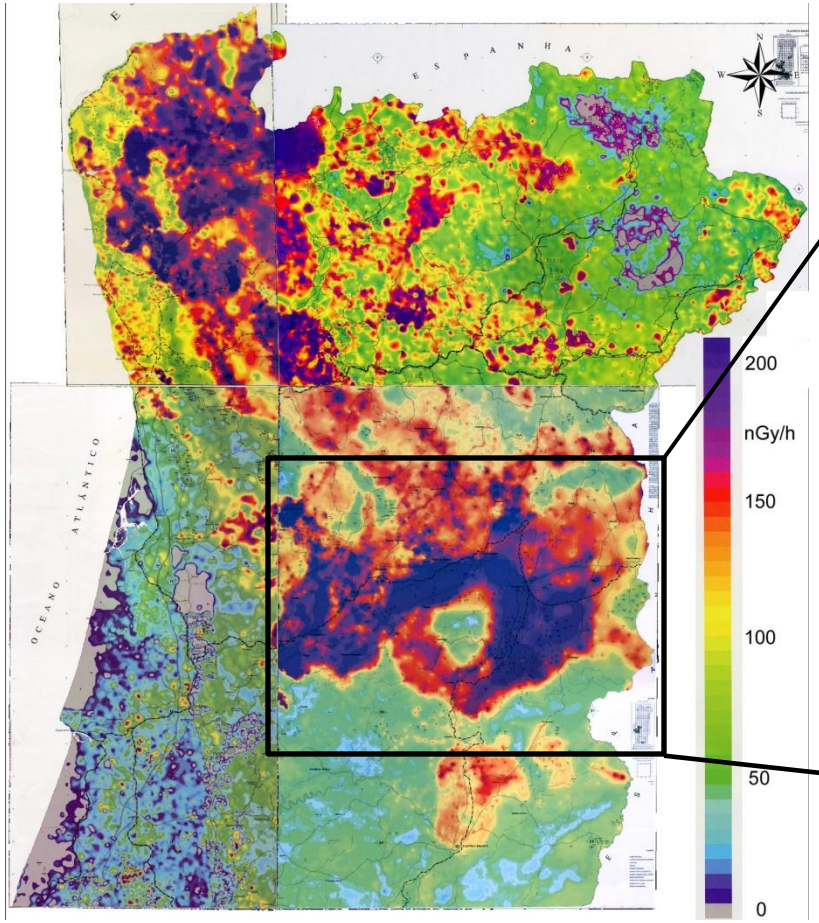
Geological map of Central/Northern Portugal



Gamma radiation map of Central/Northern Portugal

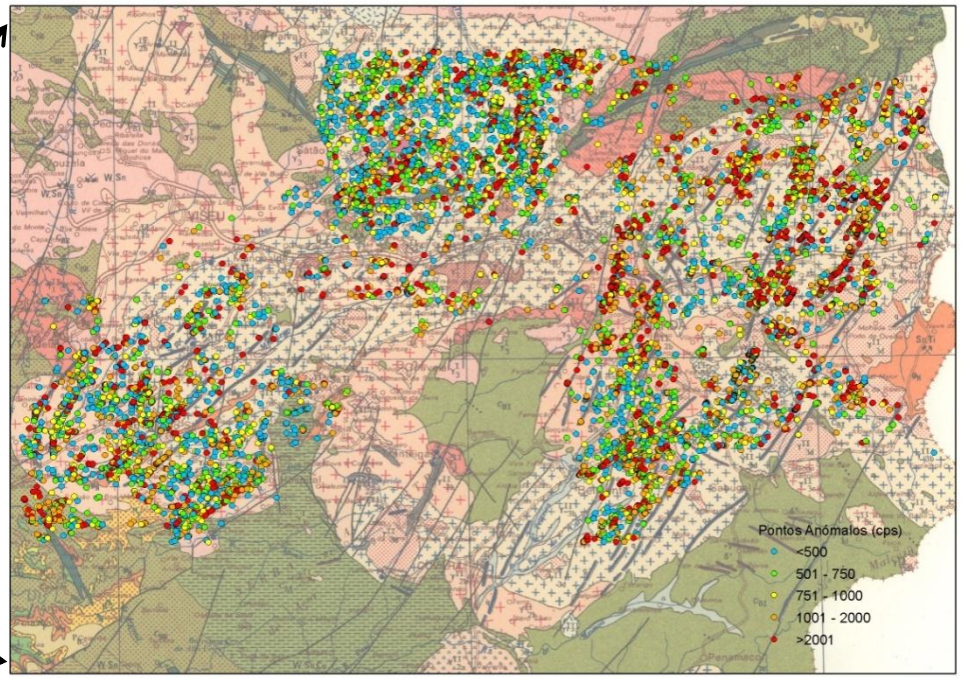
Source: LNEG

10. Uranium mobility and radiogenic heat production in the Beiras region



Surface gamma radiation map of Northern Portugal

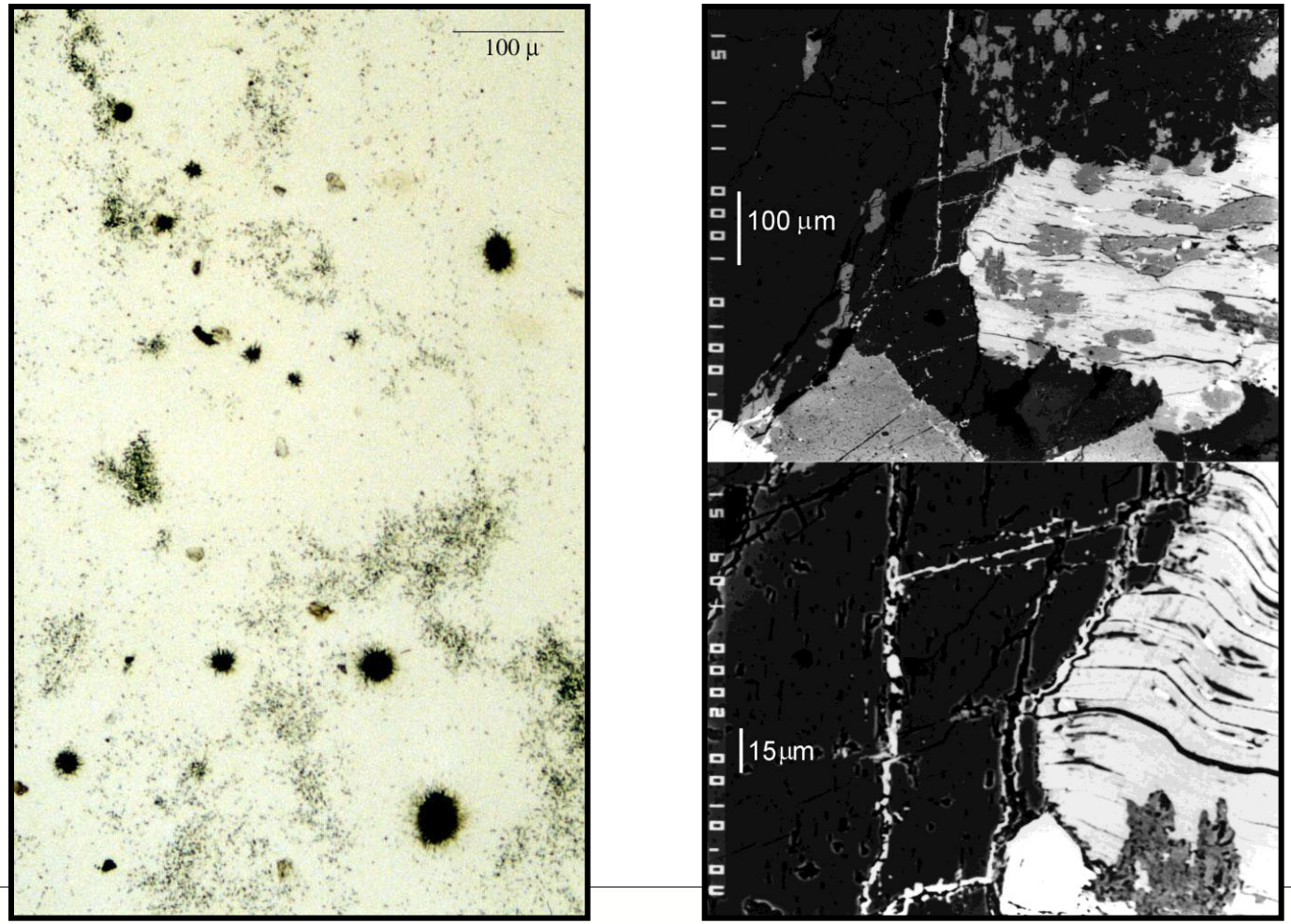
Evidence of primary uraninite



Radiogenic heat production:

- 4,4 μWm^{-3} from surface samples
- 5,6 μWm^{-3} considering a loss of 50% of U

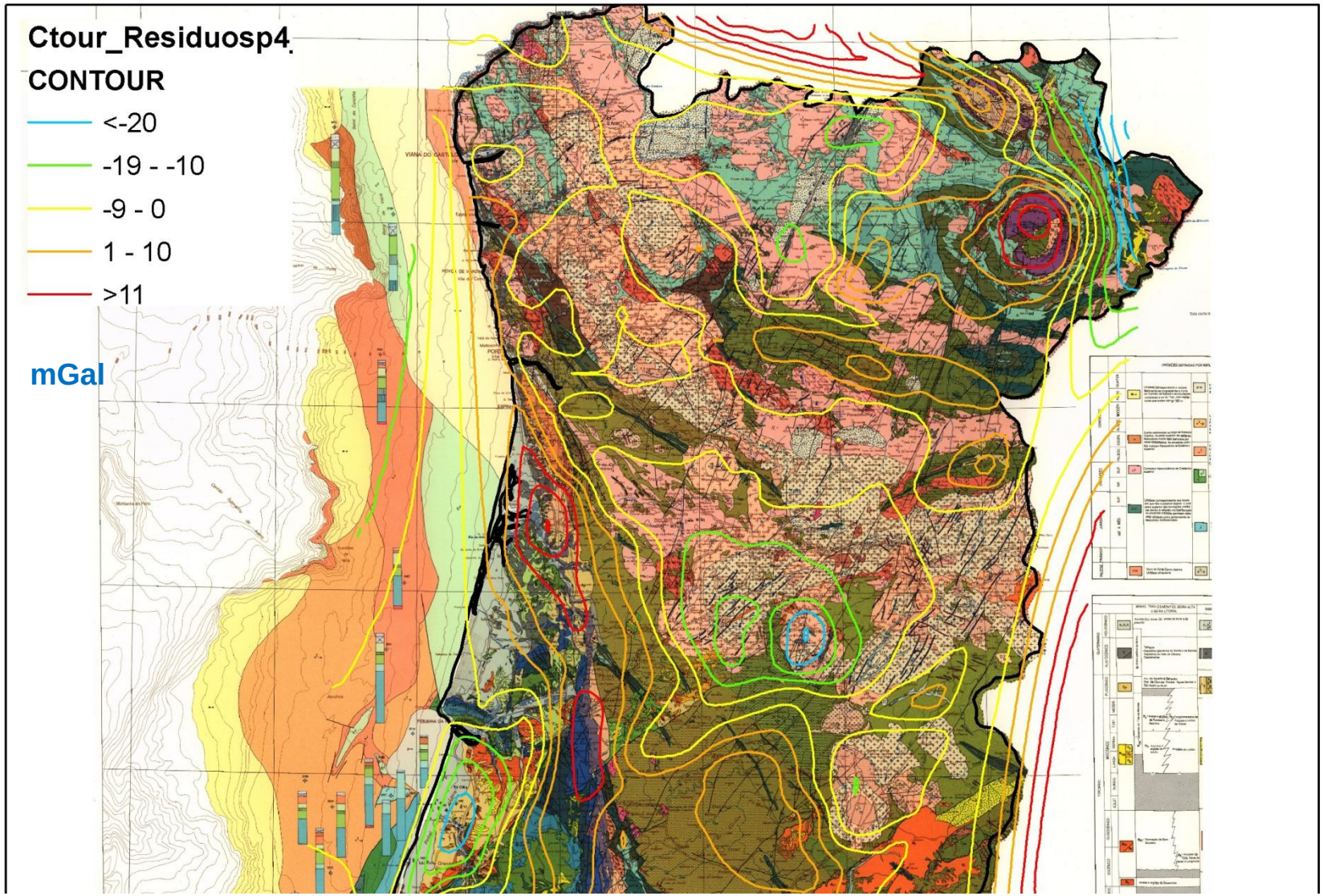
11. Evidence of uranium mobility in the Beiras region



Some evidence of uranium mobility by fission-track (left) and electron microscope techniques (right).

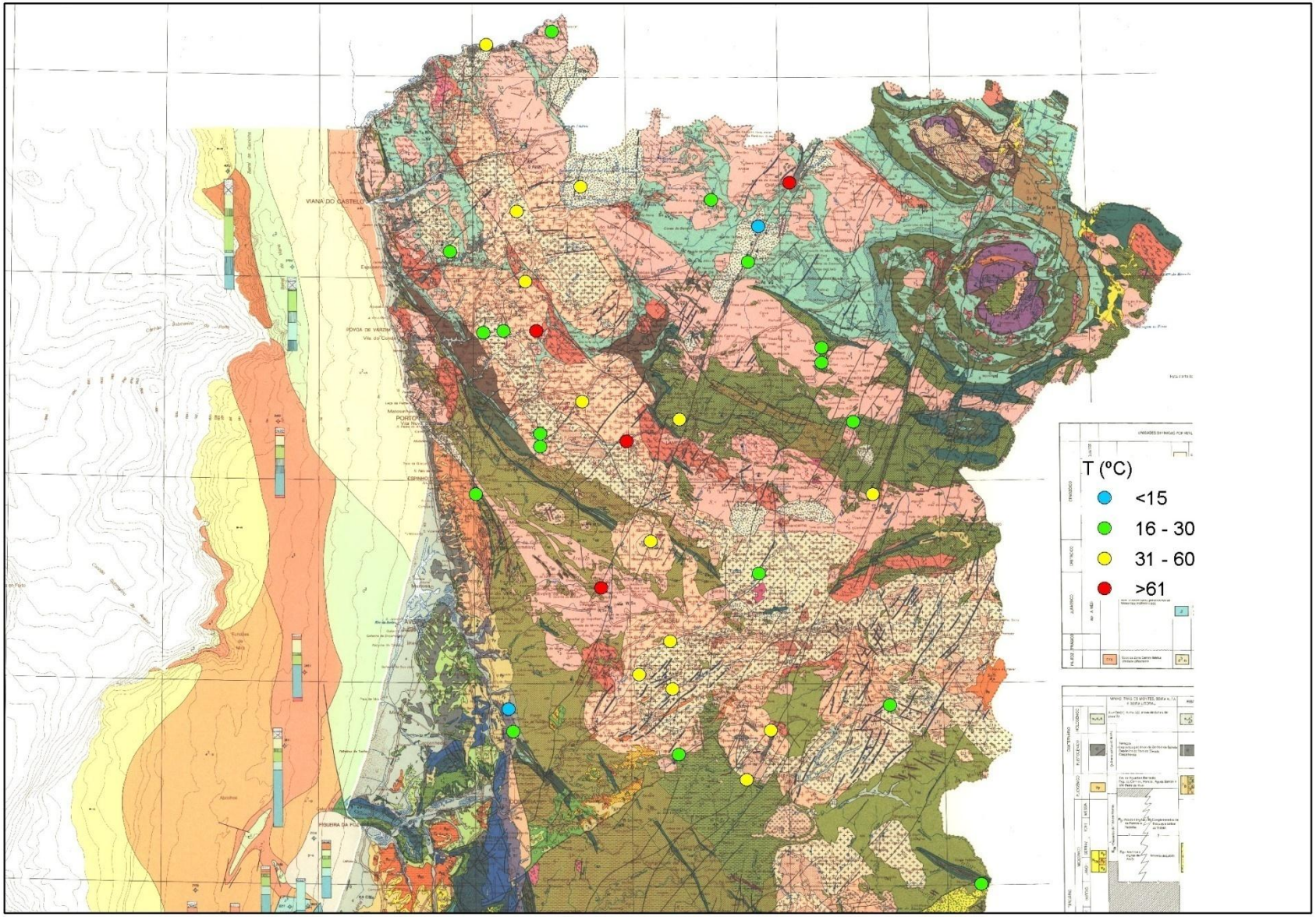
Source: Pereira *et al.* (1999)

12. Gravimetric data in the Beiras region



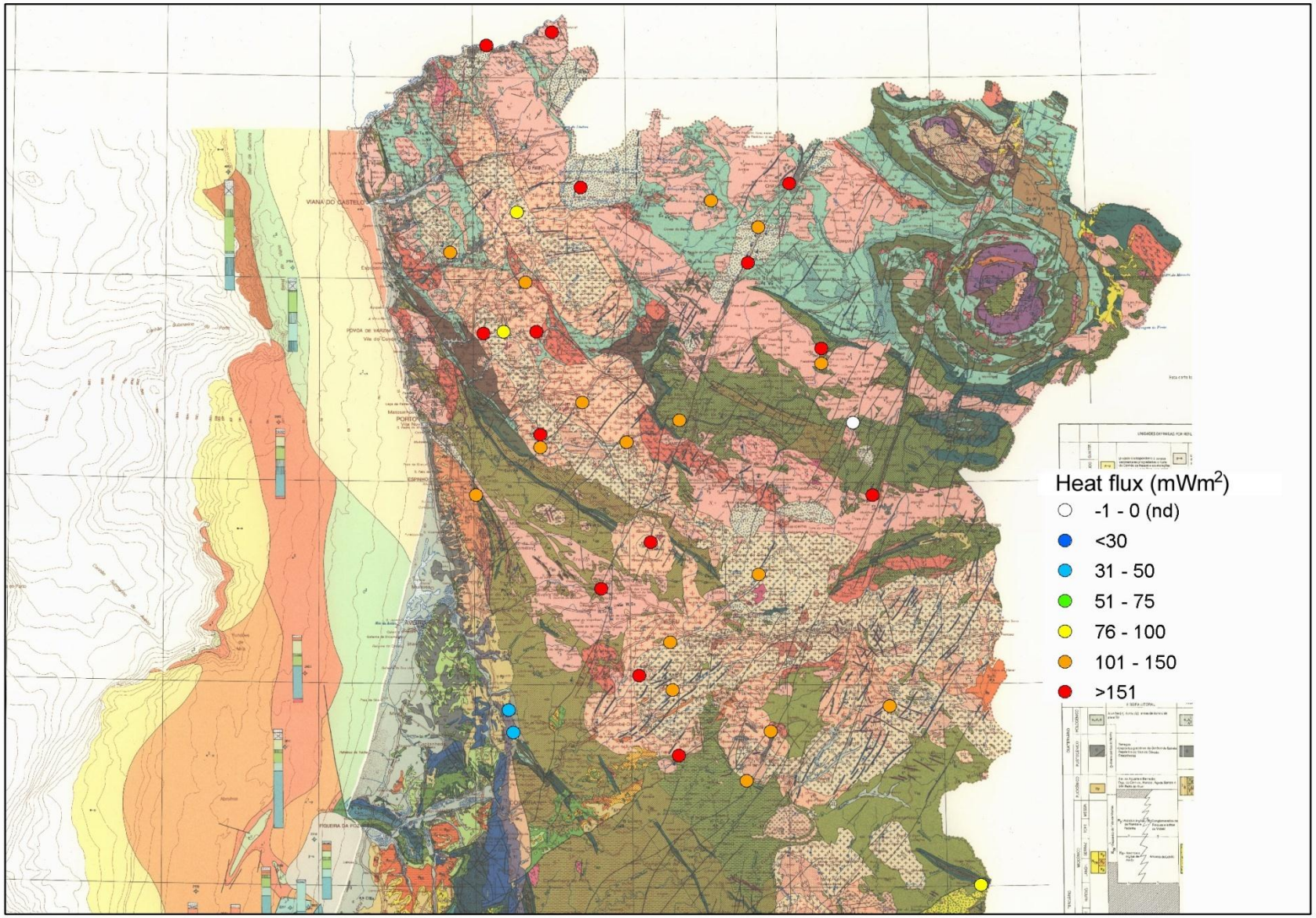
Source: gravietric map of Portugal (IM)

13. Naturally occuring hot springs in the Beiras region

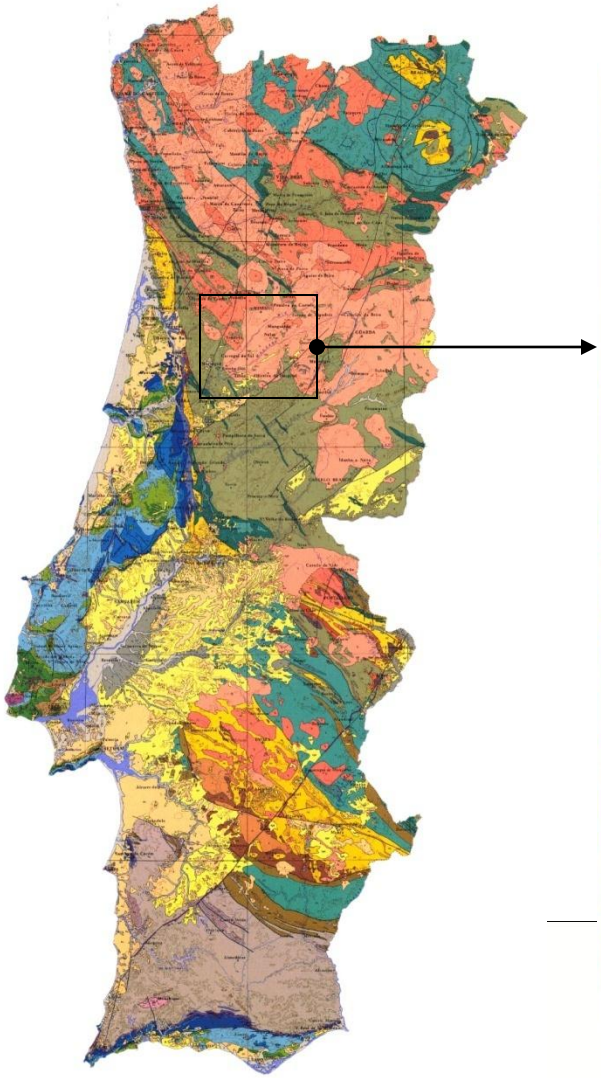


14. Estimated heat flow from the chemistry of thermal waters

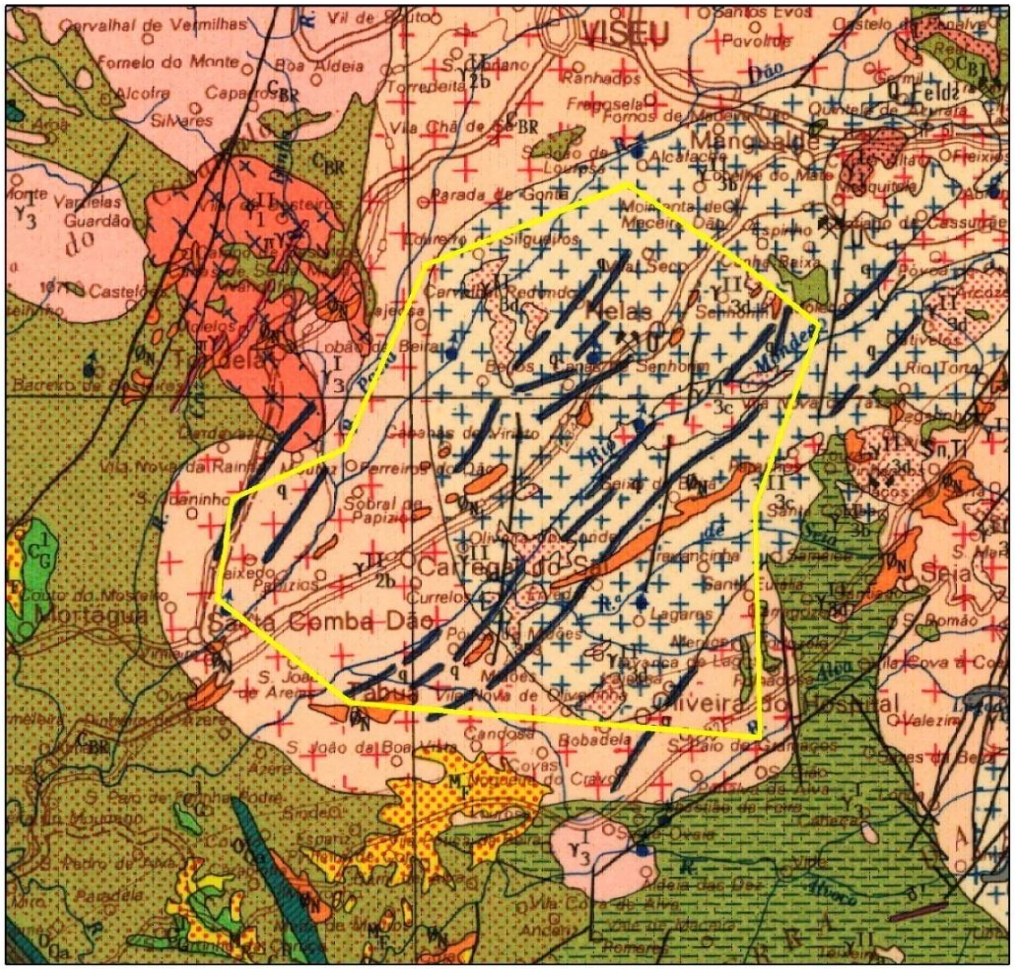
Swanberg & Morgan (1978)



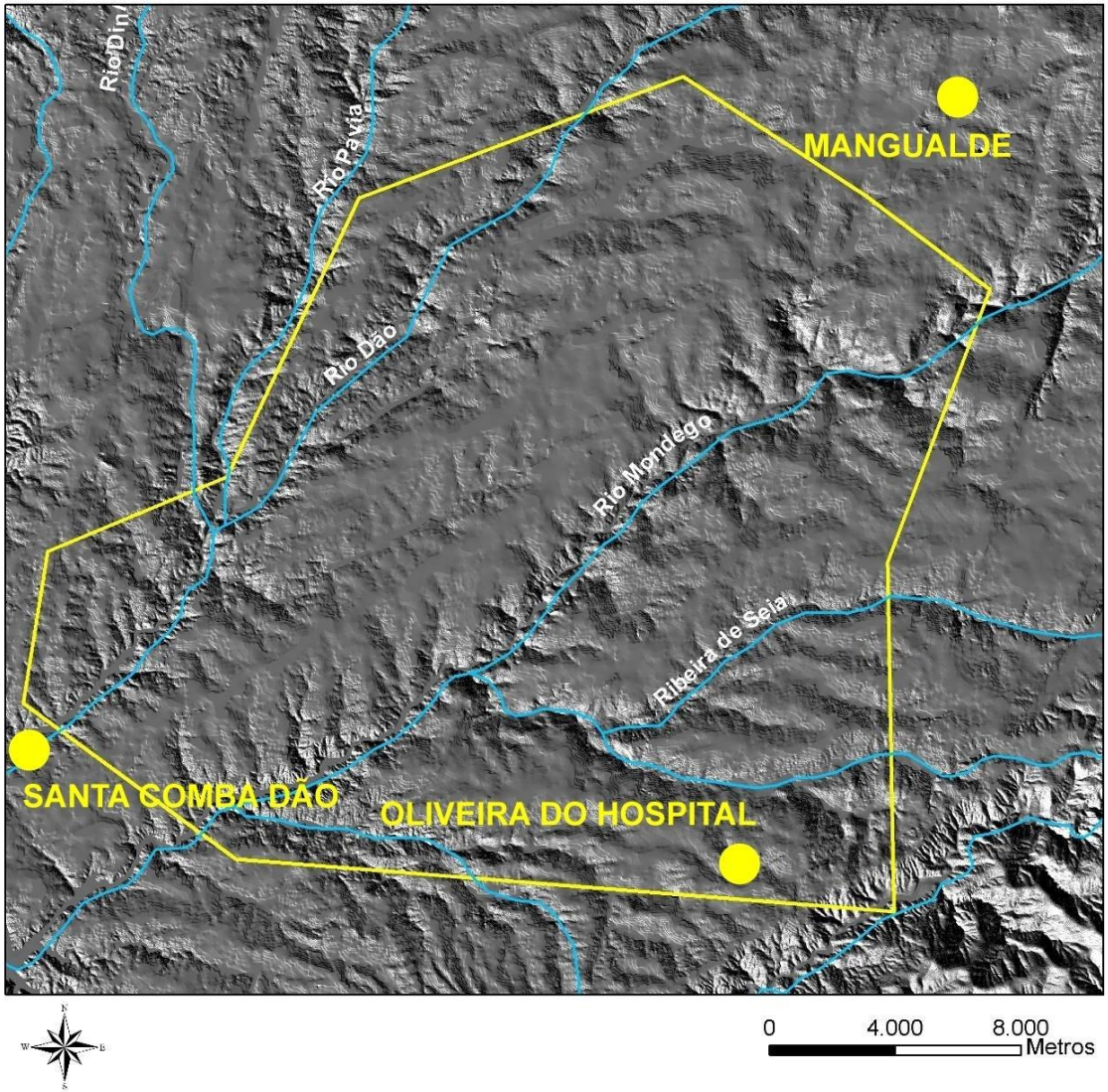
15. Area selected for the Beiras project



Tectonically stable area

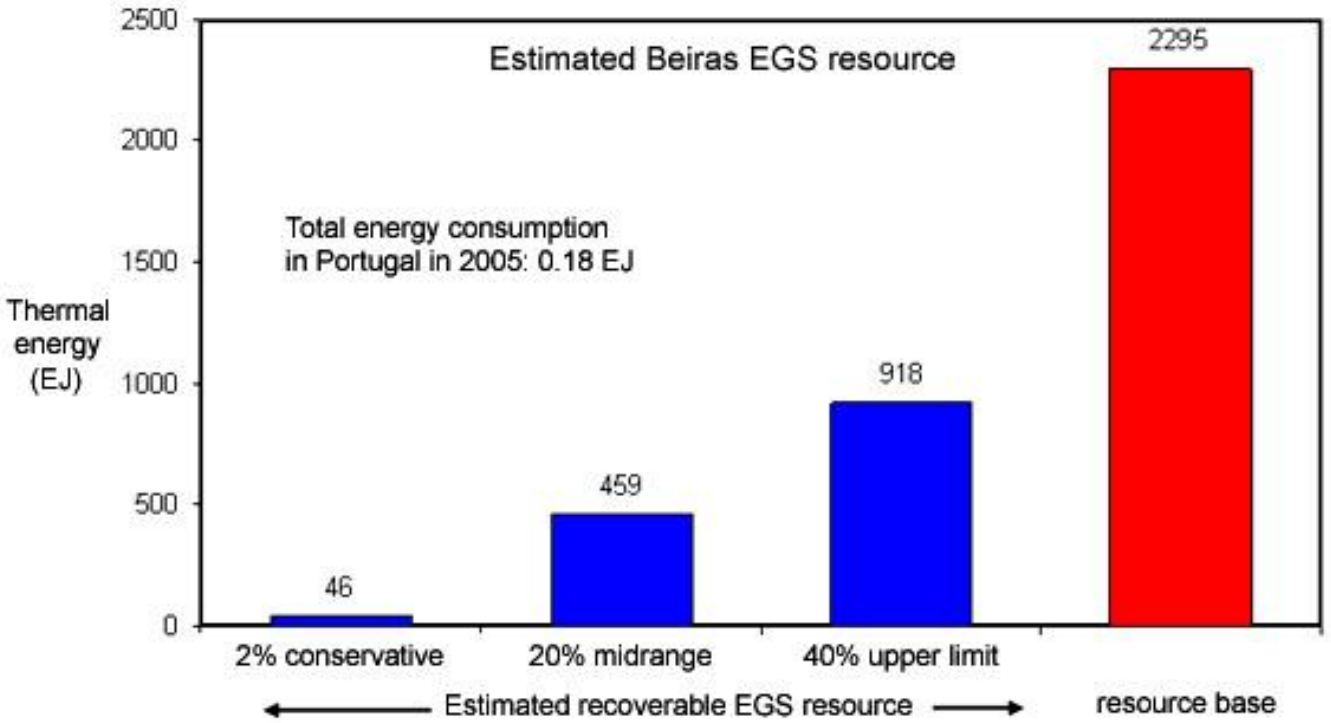


16. Area selected for the Beiras project (cont.)



17. Preliminary temperature modeling and resource estimation

Geothermal gradient is estimated to be in the range 36 – 42 ºC *per* km



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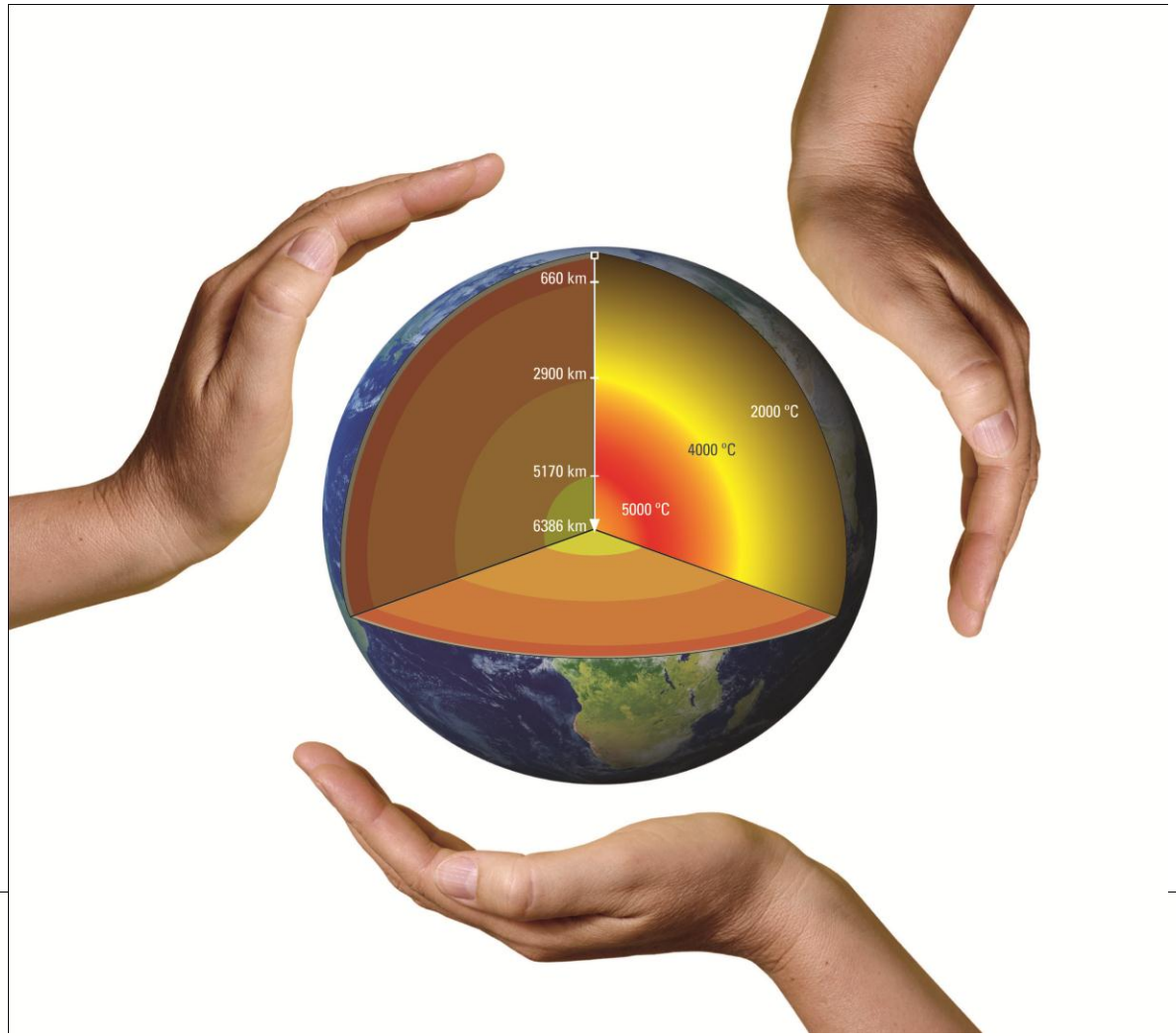

Thank you for your attention!