

# **Comparison of the thermal characteristics and temperature profile of the ground in Cyprus with other Mediterranean countries**

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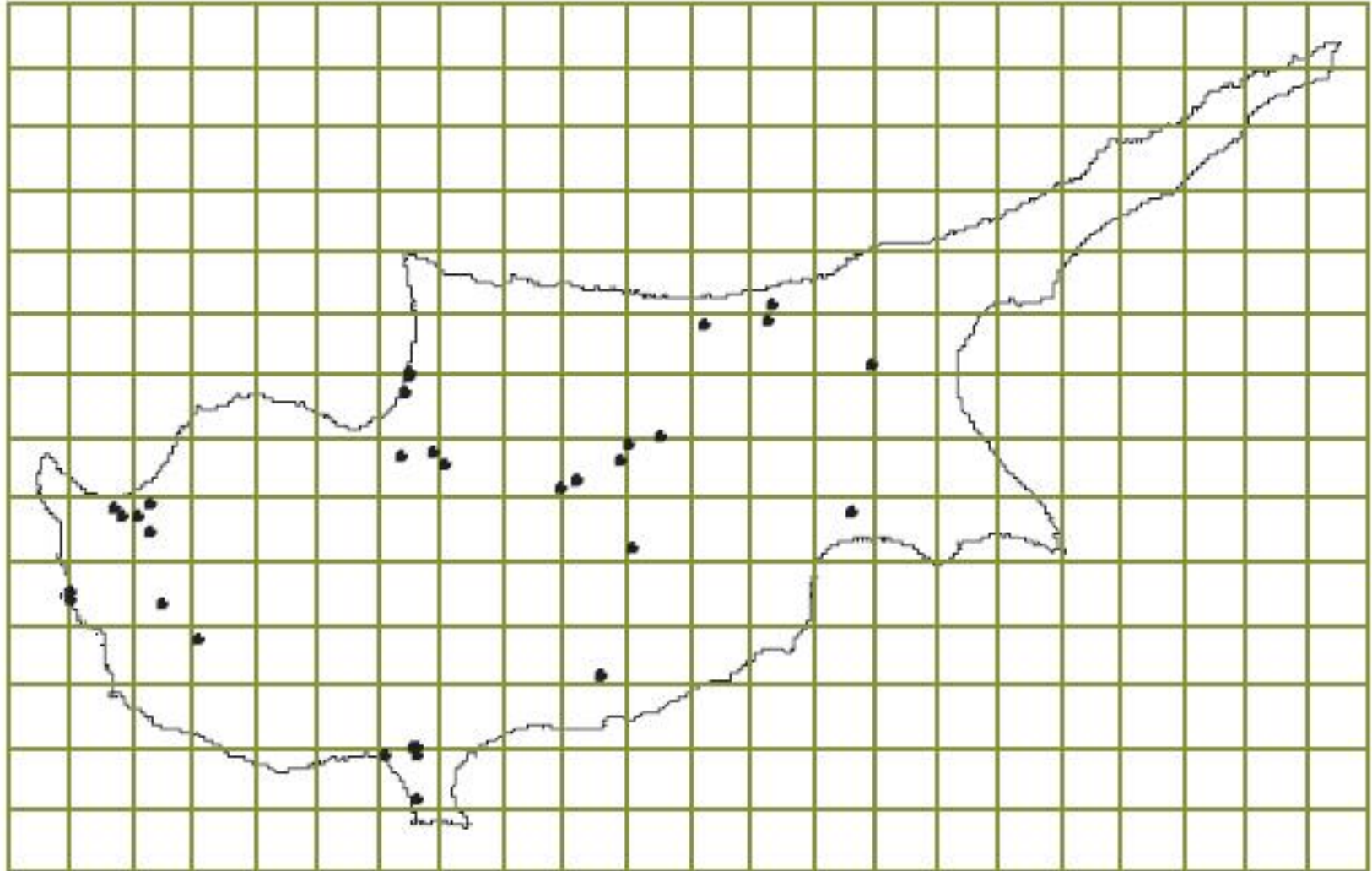
Studies show that:

- The ground temperature varies with depth.
- The ground therefore is divided into:
  - a) the surface zone where hourly variations occur
  - b) the shallow zone, with monthly variations
  - c) the deep zone, where the temperature is almost constant throughout the seasons and years
- The temperature in the deep zone is usually higher than that of the ambient air during the cold months of the year and lower during the warm months.

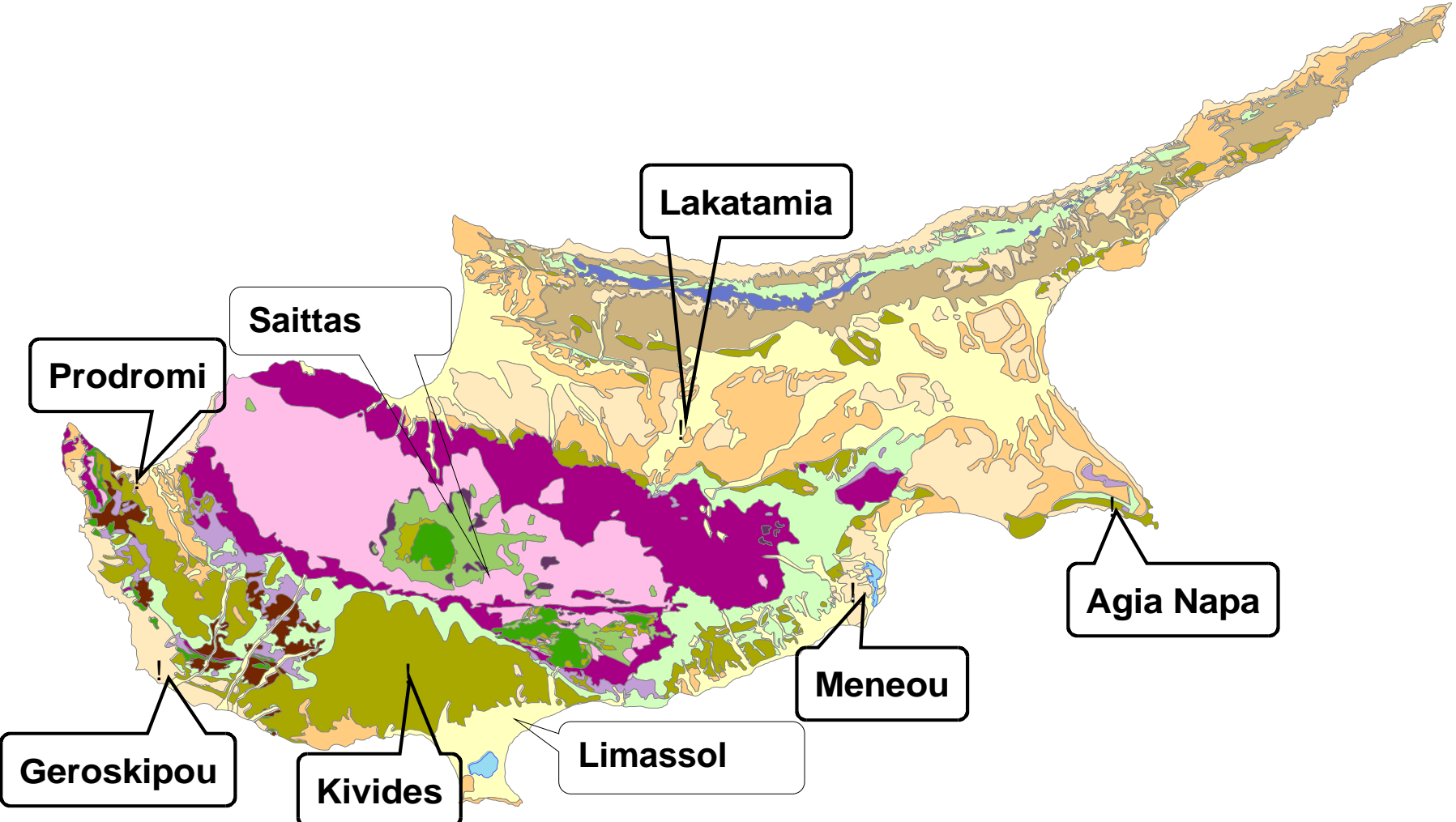
- The temperature of the ground is a function of:
  - thermal conductivity
  - density
  - specific heat
  - geothermal gradient
  - water content and flow
  
- In Cyprus, according to the formation of the ground:
  - the surface zone reaches a depth of about 0.5m
  - The shallow zone penetrates to 7-8 m

# Geological map of Cyprus depicting Morgan's (1973) borehole locations.

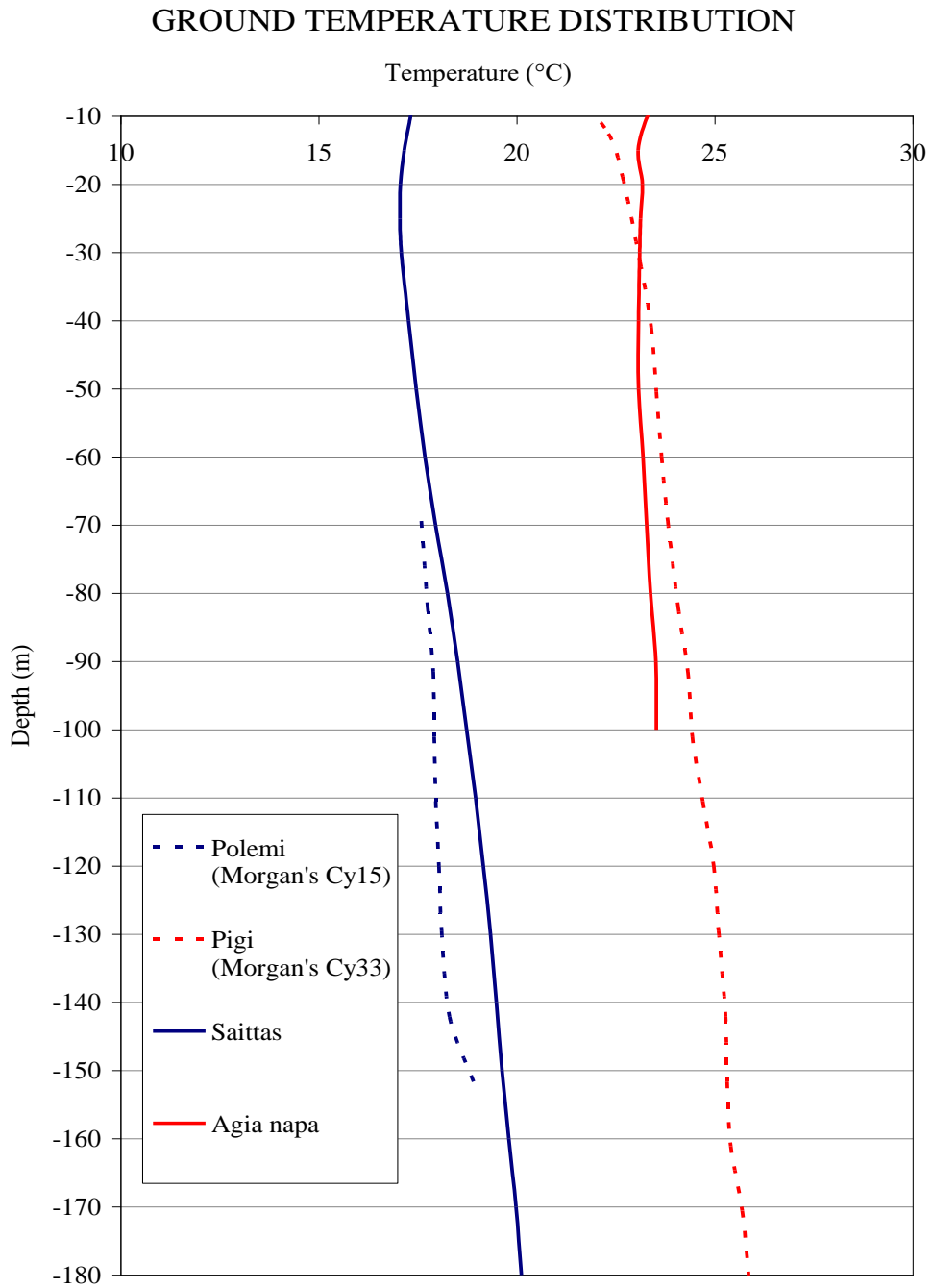
The map was prepared by the Geological Survey Department of The Ministry of Agriculture and Natural Resources of Cyprus on a 10x10 km grid.



# Geological map of Cyprus depicting the new borehole locations under investigation



Comparison of the ground temperature range recorded in this project and the study carried out by Morgan for Cyprus.







Thermal Response Test results for various locations with a fluid flow of about 14-16 l/min.

Location	Initial fluid temperature (°C)	Thermal conductivity, $\lambda$ (W/mk)
Agia Napa	23.5	1.58
Lakatamia	23	1.68
Geroskipou	24	1.42
Geroskipou	21.5	1.97
Meneou	22	1.72
Meneou	22.3	1.4
Prodromi	24	1.87

Thermal properties of the ground up to the depth of 100 m reported in Cyprus, Portugal and Jordan

<b>Location</b>	<b>Deep zone Temperature range (°C)</b>	<b>Thermal conductivity range, <math>\lambda</math> (W/mk)</b>
Cyprus	$\approx 18.3 - 23.2$	$\approx 1.40 - 1.97$
Cyprus (Morgan's study)	$\approx 18 - 24.2$	$\approx 1.3 - 2.3$
Portugal (Town of Evora)	$\approx 18.2 - 19.3$	$\approx 2.8 \pm 0.2$
Jordan (BH5)	$\approx 26 - 31$	$\approx 1.55 - 5.67$
Jordan (BH9)	$\approx 24.5 - 26$	$\approx 1.55 - 5.67$

# Results and Conclusions

- The deep zone temperature of the ground in Cyprus is constant throughout the year and is within the range of  $18.3^{\circ}\text{C}$  -  $23.2^{\circ}\text{C}$ ,  $5^{\circ}\text{C}$  difference between lower and higher recorded temperature. The warmer site is the one in Agia Napa, sea-side area on the southeast of Cyprus, while the coldest is the one in Saittas, mountainous area on the mainland.
- The results of the project undertaken by the Cyprus University of Technology agree with the results of the project carried out by Morgan in 1970's.
- Ground temperatures in the boreholes examined in Jordan are higher than the ones in Cyprus and those in Portugal, as expected.
- The ground temperature distribution in the borehole examined in Portugal has the lowest range than those in Cyprus and Jordan and is about  $1^{\circ}\text{C}$ . The ground temperature range in Cyprus and Jordan is almost the same and is about  $5^{\circ}\text{C}$ .
- The lithology of the ground is the most important factor affecting its geothermal characteristics.
- Limited information is available regarding the thermal characteristics of the ground in warm climates and especially the area of the Mediterranean Sea.