How Lithology Affects Temperature Gradient

A classic poster from the
SMU Geothermal Laboratory

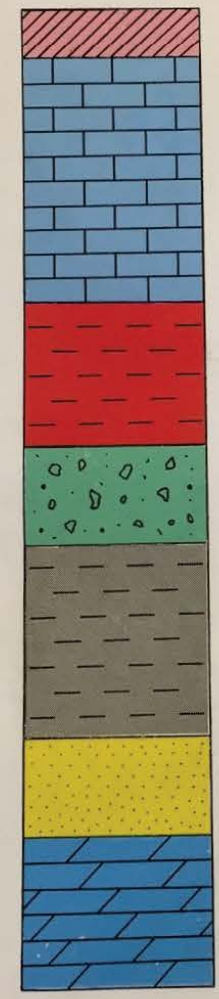
METHOD FOR THEORETICAL TEMPERATURE MODELLING

The first step is to determine the lithologic succession in a particular well. Various types of logs (sample, mud, electric) are used to pick each lithologic unit and its thickness. This data is used to calculate temperature according to the following formula:

$$T_z = T_o + \sum_i^N Z_i \, (Q/K_i)$$

T_z = Temperature at Depth z
T_o = Surface Temperature
Z_i = Thickness of each Lithologic Unit
Q = Heat Flow
K_i = Thermal Conductivity of each Lithologic Unit

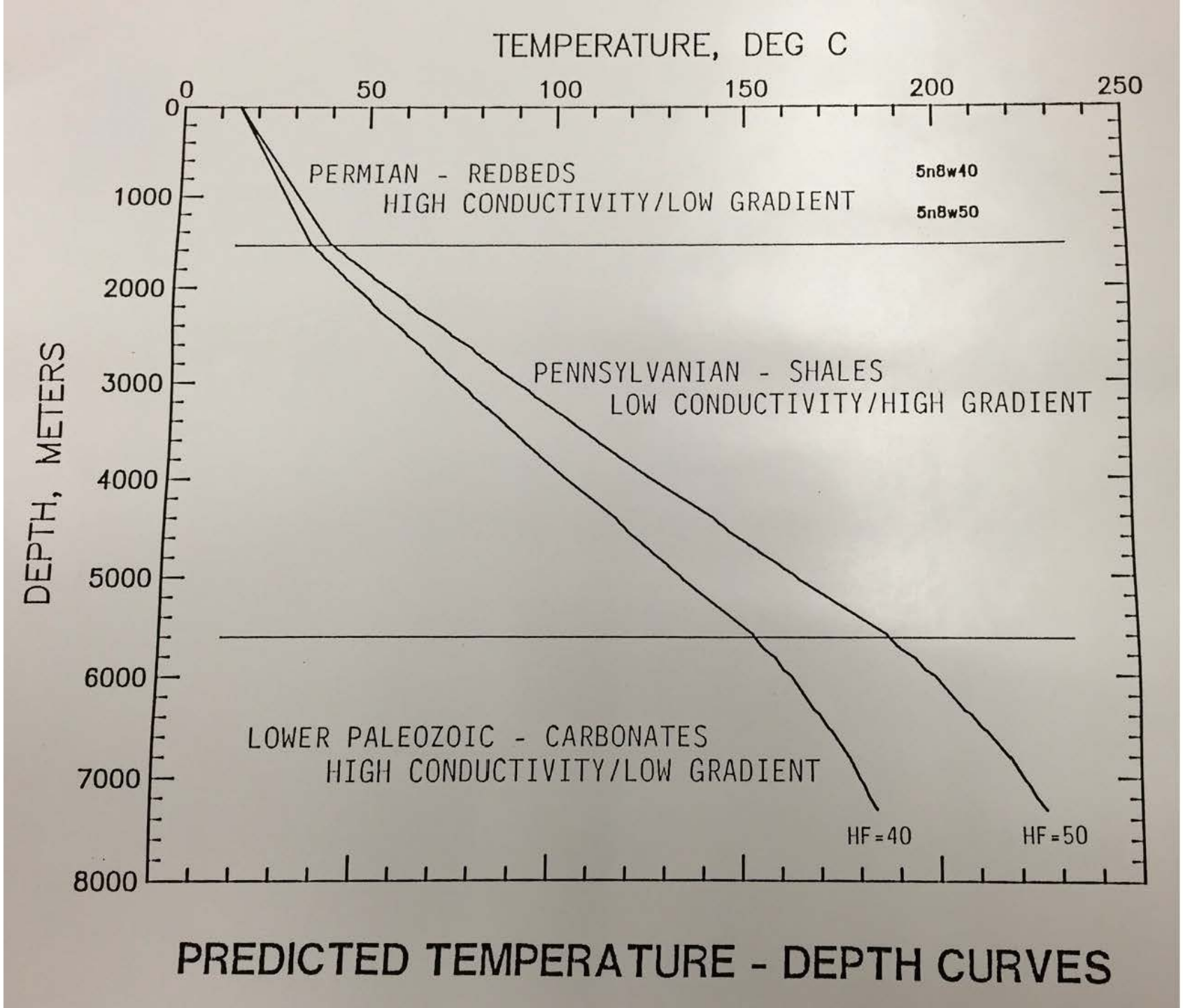
THICKNESS(m)	THERMAL CONDUCT. (W/mK)	TEMPERATURE CALCULATION FOR Q=40 mWm^{-2}
10	K=3.81	0.001*10(40/3.81)=0.105°
50	K=2.33	0.001*50(40/2.33)=0.858°
30	K=3.00	0.001*30(40/3.00)=0.400°
20	K=3.35	0.001*20(40/3.35)=0.239°
40	K=1.23	0.001*40(40/1.23)=1.301°
20	K=2.47	0.001*20(40/2.47)=0.324°
30	K=3.81	0.001*30(40/3.81)=0.315°



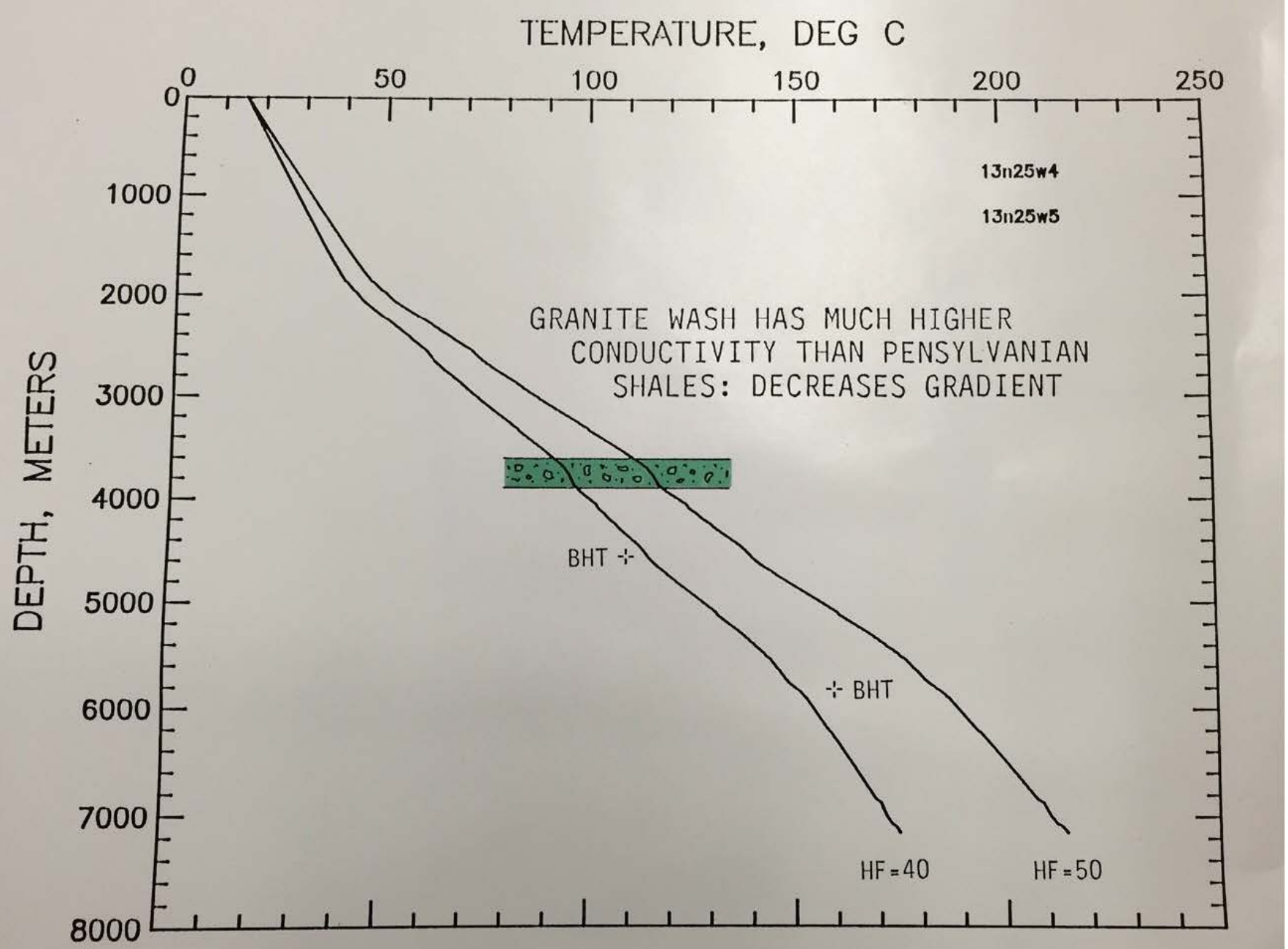
+

3.542 °C

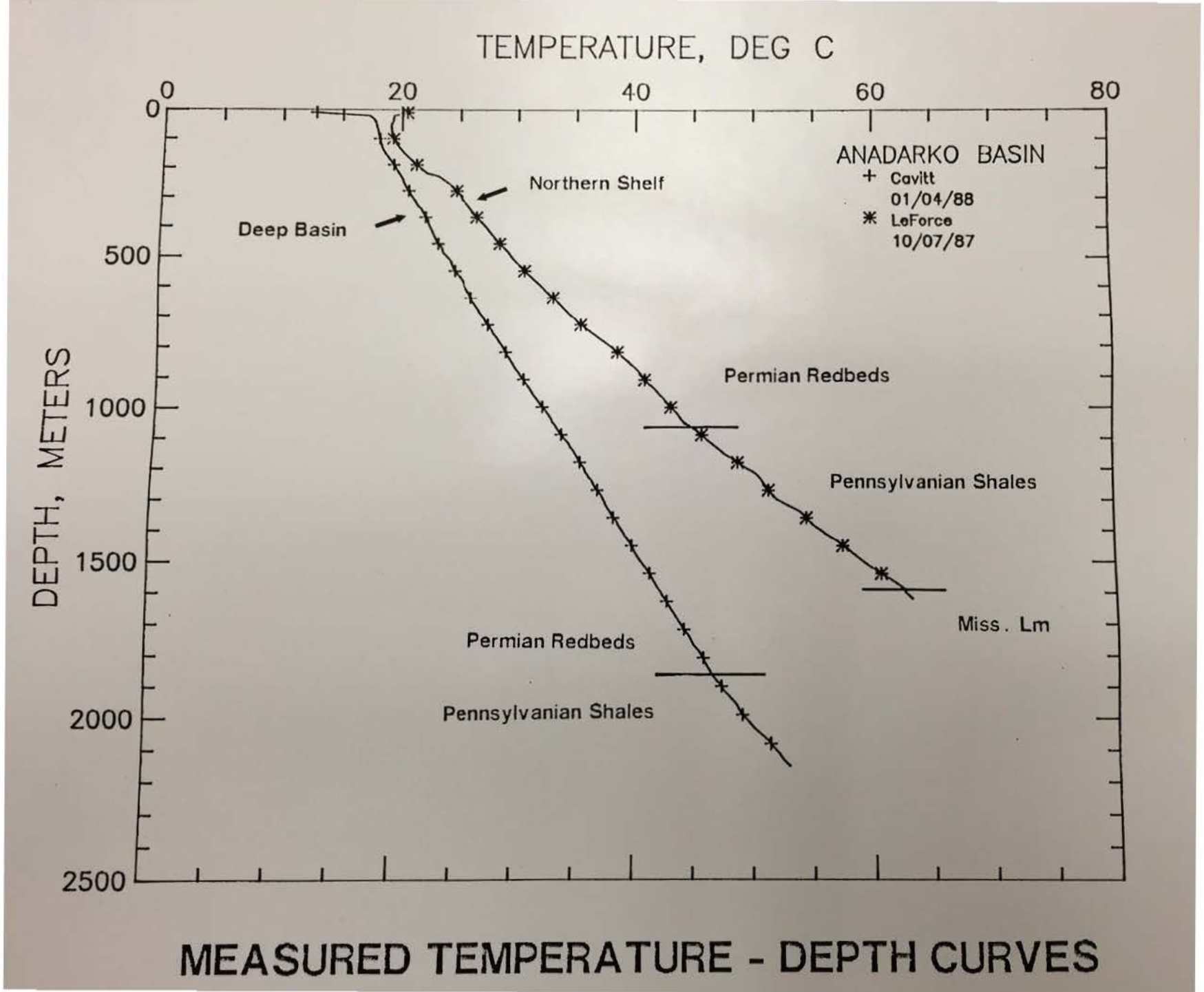
SUM OF TEMPERATURE INCREMENTS EQUAL TOTAL TEMPERATURE CHANGE ACROSS LITHOLOGIC SECTION



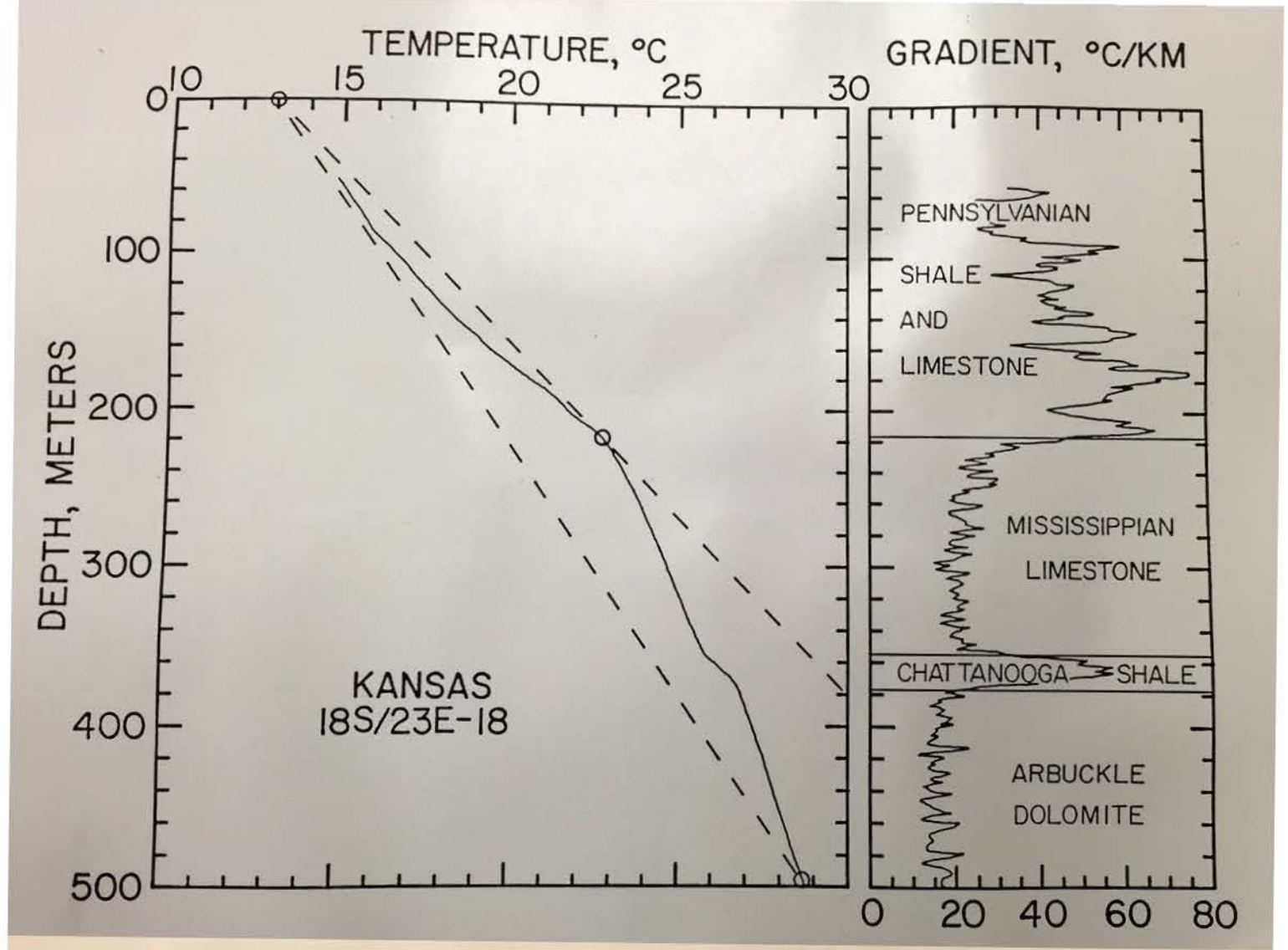
PREDICTED TEMPERATURE - DEPTH CURVES



PREDICTED TEMPERATURE - DEPTH CURVES



MEASURED TEMPERATURE - DEPTH CURVES



This temperature - depth curve shows the effect a change in thermal conductivity can have on the temperature profile of a well. The open circles on the figure represent two BHT's for this locality. Straight line gradients (dashed lines), do not reflect the true temperature profile of the well and would therefore cause large errors in thermal maturation calculations.