Geothermal Gradient, Heat Flow and Depth to a Target Temperature

Temperature at depth from the surface temperature and geothermal gradient, the conductive heat flow through rock, and the depth needed to reach a target temperature.

Method: Conductive geothermal gradient and Fourier's law

Input parameters

Unit system: SI

Parameter	Value	Unit
Mean surface temperature	15.000	°C
Geothermal gradient (K per km)	30.000	
Rock thermal conductivity	2.5000	W/(m·K)
Depth of interest	3,000.0	m
Target temperature	150.00	°C

Calculated results

Parameter	Value	Unit
Temperature at the depth	105.00	°C
Conductive heat flow	0.075000	W/m²
Depth to the target temperature	4,500.0	m

Notes for this case

• Linear conductive gradient: T(z) = T_s + Gz and q = kG. Continental averages are about 25–30 K/km and 60–70 mW/m²; radiogenic heat, layering and convection change the profile, so use measured temperatures for drilling decisions.

Formula and method

$$T(z) = T_s + Gz, \quad q = kG, \quad z_t = \frac{T_t - T_s}{G}$$

Variables

T_s	Mean surface temperature	K
G	Geothermal gradient (K per km)	-
k	Rock thermal conductivity	W/(m·K)
z	Depth of interest	m
T_t	Target temperature	K
$T(z)$	Temperature at the depth	K
q	Conductive heat flow	W/m²
z_t	Depth to the target temperature	m

Method and standards

Conductive gradient.

Assumptions and limits

- Steady one-dimensional conduction; uniform rock.

References

Conductive geothermal gradient and Fourier's law

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/environmental/geothermal-ocean/geothermal-gradient-heat-flow

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.