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89.304 - IGNEOUS & METAMORPHIC PETROLOGY
PRESSURE & TEMPERATURE

1. Calculate and graph the pressure-depth relationship for the outer part of the earth (from 0 to 400 km). The following layers are encountered going from the surface to 400 km: a 25-km-thick granitic layer with a density of 2750 kg m^{-3}, a 10-km-thick lower basaltic crust with a density of 3000 kg m^{-3} and underlying upper mantle with a density of 3300 kg m^{-3} which is constant to 400 km. This problem can be done on a spreadsheet.

2. Calculate the radiogenic heat productivity of basalt in µW m^{-3} given the following data.

Element	e_i (mW kg^{-1})	c_i (ppm)
U	9.66×10^{-2}	0.9
Th	2.65×10^{-2}	2.2
K	3.58×10^{-6}	15,000

The density of basalt is 2800 kg m^{-3}. Compare the individual contributions of U, Th and K to the total heat productivity.

3. The surface heat flow in the Basin and Range province of the western United States is unusually high - 87.86 mW m^{-2}. The heat flow - heat productivity relation for this region is modeled using a 9.4-km-thick crustal layer in which radioactive heat-producing elements are concentrated. Given a radiogenic heat productivity for this layer of 2.1 µW m^{-3}, compute the reduced heat flow into the base of the 9.4-km-thick layer from the mantle below. Comment on the value of the reduced heat flow.