

GY403 Structural Geology Lithostatic Stress Problem

Given Conditions

Suppose that a 1.0 cm^3 cubic block of basalt is buried to a depth of 5.0 kilometers in oceanic crust. Assume that the overburden rock is also homogenous basalt with a constant density from the surface down to the cube of 3.1 grams per cubic centimeter (g/cm^3). Calculate the following

- (1) Lithostatic stress on the buried basalt cube in terms of kilobar of stress
- (2) Rate of lithostatic stress increase with depth in units of kilometers per kilobar (km/kbar)

Assume that Earth's gravitational acceleration due to gravity is constant over the scale of the above problem, and has a value of 980 centimeters per second² (cm/s^2). The below relationships will prove helpful for solving this problem:

$$F(\text{force}) = ma$$

$$\sigma(\text{normal stress}) = F/A$$

$$1.0 \text{ bar} = 1 \times 10^6 \text{ (dynes/cm}^2\text{)}$$

$$1.0 \text{ dyne} = 1.0 \text{ (gram)(centimeter)/(second}^2\text{)}$$

$$\rho \text{ (density)} = \text{grams/cm}^3$$

$$1.0 \text{ kbar} = 1 \times 10^3 \text{ bar}$$

$$1.0 \text{ km} = 1 \times 10^5 \text{ cm}$$

$$a = \text{Earth's gravitational acceleration at sea level} = 980 \text{ cm/s}^2$$

where:

s = seconds

m = mass

A = area

bar = 1.0 atmosphere of pressure (mean sea level)

cm = centimeter

km = kilometer

kbar = kilobar