# 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 $second^2$ ($cm/s^2$). The below relationships will prove helpful for solving this problem:

F(force) = ma
σ(normal stress) = F/A
1.0 bar = 1 x $10^6$ ($dynes/cm^2$)
1.0 dyne = 1.0 (gram)(centimeter)/($second^2$)
ρ (density)= $grams/cm^3$
1.0 kbar = $1x10^3$ bar
1.0 km = $1x10^5$ cm
a = Earth's gravitational acceleration at sea level = 980 $cm/s^2$

where:

s = seconds
m = mass
A = area
bar = 1.0 atmosphere of pressure (mean sea level)
cm = centimeter
km = kilometer
kbar = kilobar

# GY403 Structural Geology Lithostatic Stress Problem

## Answers:

### Part (1)

$F = ma$
$F = \rho V a$
$F = (3.1 g/cm^3)(5.0x10^5 cm)(1.0 cm^2)(980 g \cdot cm/second^2)$
$F = 1.519x10^9 g \cdot cm/second^2$
$F = 1.519^9$ dynes

lithostatic stress ($\sigma$) = F/A
$\sigma = 1.519x10^9$ dynes/ $1.0cm^2$
$\sigma = (1.519x10^9$ dynes/$1.0cm^2)/(1.0$bar/$1x10^6$ bar/$cm^2)$
$\sigma = 1.519x10^3$ bar
$\sigma$ = 1.519 kilobar

### Part (2)

assuming that the lithostatic load is due to a homogenous column of rock with density equal to 3.1 $g/cm^{3:}$

lithostatic stress rate = depth/stress = 5.0 kilometers / 1.519 kilobar (this example)
lithostatic stress rate = 3.29 kilometers / kilobar