

SIO224 Homework 1

1a) The "age" of the Earth is given as 4.567Byr – what is meant by this number? How much later than this was the Earth differentiated into core and mantle? How do we know this?

1b) In what ways is the composition of carbonaceous chondrites different from the composition of the Sun? Why?

1c) Define the term "Pyrolite". In what ways is the composition of pyrolite different from a "solar" composition? Why?

2) Six samples of granodiorite from a pluton in British Columbia, Canada have strontium and rubidium isotopic compositions as follows:

$^{87}\text{Sr}/^{86}\text{Sr}$	$^{87}\text{Rb}/^{86}\text{Sr}$
0.7117	3.65
0.7095	1.80
0.7092	1.48
0.7083	0.82
0.7083	0.66
0.7082	0.74

a) What is the age of the intrusion (the half life for this system is 48,800Ma)

b) What is the initial  $^{87}\text{Sr}/^{86}\text{Sr}$  ratio of the magma at the time of the intrusion

NB – try doing a "least-squares" fit to the data

3) Resolution analysis: Assuming a spherically symmetric Earth, construct a resolving kernel which localizes information about density,  $\rho(r)$ , at a radius of  $0.7R$  ( $R$  is the radius of the Earth) using only the mass ( $M$ ) and moment of inertia factor ( $C/MR^2 = .3308$ ) as data, where

$$M = \int_0^R 4\pi r^2 \rho(r) dr$$

and

$$C = \int_0^R \frac{8\pi}{3} r^4 \rho(r) dr$$

Note that it is easiest to normalize density to the mean density of the Earth  $\rho' = \rho/\bar{\rho}$ , and radius to the radius of the Earth,  $x = r/R$ , so the above equations become:

$$\frac{1}{3} = \int_0^1 x^2 \rho' dx$$

and

$$\frac{.3308}{2} = \int_0^1 x^4 \rho' dx$$

You may ignore the errors in the data (i.e., the left hand sides of the above equations). Plot the "resolving kernel". What is your value of "spread" and how does this correspond to the peak width of the resolving kernel? What is the value of the "local average" of normalized density? How does this compare to the value in the Earth? Feel free to try other target radii but don't expect too much from just these two data.