GX1151

National University of Ireland, Galway
OLLSCOIL NA hÉIREANN, GAILLIMH

WINTER EXAMINATIONS 2000

3rd SCIENCE
INTRODUCTION TO GEOPHYSICS IY301

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Time allowed: Three hours.
Answer five questions.

Q.1 Explain the Pratt and Airy isostatic compensation models. Estimate the thickness of the crustal root beneath a mountain plateau 3km high using plausible values for the average densities of the crust and mantle and assuming Airy compensation.

Why is flexural isostasy a better model for understanding the process of compensation? Explain how observations of gravity and topography can be used to characterise the flexural strength of the lithosphere. Comment on the physical properties that control the lithosphere strength.

Q.2 The Earth's magnetic field is represented mathematically using spherical harmonic analysis. Give a simple explanation for the meaning of the g_1^0 and the $(g_1^0 + g_1^1 + h_1^1)$ terms of the expression. Illustrate your answer with diagrams.

The magnetic field changes with time over a wide range of timescales. Describe the characteristics and timescales of secular variations and geomagnetic reversals.

Explain the importance of geomagnetic reversals for plate tectonics.

Q.3 Starting from the law of radioactive decay, derive the relationship between half-life and decay constant. How many atoms of the radioactive parent are left after 5 half-lives?

Explain how the ratio of the number of daughters to number of radioactive parents can be used to estimate the time since the beginning of a simple radioactive decay process. State your assumptions.

Briefly describe how the Uranium-Lead method could be used to date the age of meteorites. Comment on the age of the Earth.

p.t.o.

Q.4 Discuss the mechanisms of heat loss from oceanic crust. Compare and contrast this with the heat flow variation with age of continental crust.

Briefly describe with the aid of a sketch two possible mechanisms of convective heat transfer in the mantle.

Q.5 Sketch the travel-time versus distance curves along a 250km reversed seismic refraction profile over continental crust with a dipping Moho. Explain the concepts of critical distance, cross-over distance, apparent velocity, intercept time and reciprocal time.

Summarise the main results from refraction seismology experiments for the structure of the continental and oceanic crust.

Q.6 Define the following terms: lithosphere, asthenosphere, subduction zone and triple junction. Illustrate three types of triple junction that are dynamically stable.

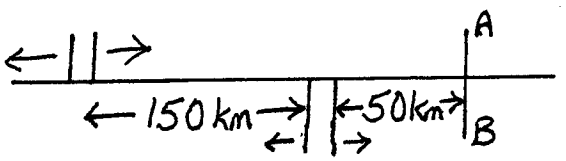
Summarise the major tectonic processes that occur at a convergent plate boundary (e.g. Andes). Comment on why it is possible to obtain earthquakes that result from extensional stresses in such a large-scale, compressional environment.

Q.7 Give a brief plate tectonic explanation of the fault plane solutions for earthquakes occurring along fracture zones offsetting segments of a mid-ocean ridge. Explain the existence of fracture zones in oceanic crust that persist for long distances beyond mid-ocean ridge segments.

The depth (in metres) of the ocean floor shows a systematic variation with the age of the ocean floor (in Myr) according to the equation:

$$D = 2600 + 365t^{1/2}$$

Give an estimate of the difference in depth along the profile AB shown below:



Assume the half-spreading velocity is 5cm/yr.

Q.8 Write short notes (1 page should be more than enough) on each of the following:

a) The geoid and the spheroid
b) Detrital Remanent Magnetisation of rocks
c) PP, sS, ScS, SKS and PKIKP seismic phases
d) The equation for conductive heat flow in the Earth