

National University of Ireland, Galway  
 OLLSCOIL NA hÉIREANN, GAILLIMH  
 CHRISTMAS EXAMINATIONS 1<sup>ST</sup> SEMESTER 2000

4<sup>TH</sup> SCIENCE  
 IGNEOUS PETROLOGY(GE411) & METAMORPHIC GEOLOGY(GE412)

PAPER ONE  
 Prof. J.F. Dewey  
 Prof. P. Mohr  
 Dr. M. Feely

Time allowed: **Three** hours

Answer: **Four** questions: **Two** from Section A, and **Two** from Section B.  
 (Pocket calculators allowed)

SECTION A (GE411)

1. Present the main geological and lithological features of a granite batholith of your choice. Justify your preferred hypothesis for the genesis of the batholith.
2. Describe, with the aid of the attached diagram, the melting behaviour of ascending mantle peridotite at potential temperatures of: (a) 1300°C, and (b) 1500° C. Predict the lava types erupted in a young continental rift valley overlying (a) normal asthenosphere, and (b) a deep mantle plume. Compare your predictions from the diagram with actual contemporary geological examples.
3. Write an essay on either the Skaergaard intrusion,  
Or the Antrim flood basalt province.
4. Either, Compare trace element compositions in (a) granite magma produced by 10% batch melting of amphibolite gneiss, and (b) granite magma produced by 90% Rayleigh fractionation of basaltic magma. Employ the respective formulae for  $C_1/C_0 = (a) 1/F+D(1-F)$ , and (b)  $F^{D-1}$ .  
 For amphibolite, ppm are Rb = 20, Ba = 100, Sr = 200, La = 60, Yb = 15, Ni = 100, Cr = 200;  
 D values are Rb 0.01, Ba 0.02, Sr 0.2, La 0.1, Yb 0.5, Ni 2, Cr 10.  
 For basalt magma, ppm are Rb = 10, Ba = 50, Sr = 400, La = 40, Yb = 5, Ni = 200, Cr = 400;  
 D values are Rb 0.01, Ba 0.01, Sr 0.4, La 0.1, Yb 0.1, Ni 3, Cr 4.

Which trace elements and ratios would most sensitively discriminate between the two types of granite?

Or, Explain the isotope systematics of two of the following: Rb-Sr, Nd-Sm and Pb-Pb. Cite actual examples of their usefulness and limitations in geochronology.

## SECTION B (GE412)

5. Outline the principles of geothermobarometry and discuss in general the limitations associated with the determination of Pressure and Temperature. Then show how net transfer and cation exchange reactions are used to estimate the P-T conditions of metamorphism.
6. Write an illustrated essay on subduction zone metamorphism.
7. Explain how the fluid composition ( $X_{CO_2}$ ) in marbles can be controlled by internal and external buffering. Show how the shape of univariant reaction curves in T- $X_{CO_2}$  space are dependent on reaction type.
8. Discuss the contribution that metamorphic studies have made to the current understanding of the geological history of the Connemara Metamorphic Complex.