

National University of Ireland, Galway
OLLSCOIL NA hÉIREANN, GAILLIMH

SUMMER EXAMINATIONS 1999

MSc Examination

Applied Geophysics

Paper Four

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Time allowed : Three hours

Answer Question 1, and any three of the remaining six.

1. Write an essay on:
 - (a) Airborne geophysics
 - (b) Geophysics for geothermal energy exploration
 - (c) Geophysics in archaeology
 - (d) Seismic stratigraphy
 - (e) Earth sciences and the information society
2. The large scale thermal and mechanical behaviour of the earth has been likened to that of a heat engine. Discuss the concept of the earth as a heat engine.
3. Explain the principle of isostasy and distinguish between the versions of isostasy due to Pratt and Airy respectively.

Using Airy isostasy, find an expression for the final depth of a basin filled with sediment in terms of the initial water filled depth and the relevant densities.

Discuss the implications of the observation that many deep sedimentary basins are entirely filled with shallow water sediments.
4. A dry flat sand covered area near the west coast of southern Africa is believed to conceal a buried river channel cut in Palaeozoic bed rock. The coarser deposits in the channel form an aquifer, which is likely to yield a modest water supply. Suggest geophysical methods, which could help locate and delineate the aquifer. Describe each method and indicate suitable field procedures for this problem.

5. A large oil-fired power plant is to be built near the Alaskan coastline somewhere within a site with dimensions 7km x 1km. The region is characterised by permafrost soils, often containing large bodies of massive ice, sitting on schist bedrock. You have access to a sensitive gravity meter, GPR, magnetometer, 24 channel seismograph, electrical resistivity and EM ground conductivity equipment. You have a tight schedule to complete a reconnaissance survey and a detailed investigation of a potential construction site.
- Write a competitive tender for the job. Pay attention to the physical properties of the environment, the merits or otherwise of each of the techniques, the order in which you would deploy your instruments, details of line/station spacing, frequencies, etc. and presentation of results.
6. You have acquired a profile of VLF-R data and have a computer program to calculate the theoretical apparent resistivity and phase responses over a layered earth. Outline briefly, how you would use trial and error forward modelling on selected data to give quantitative information on sub-surface layering.
- The trial and error modelling suggests that the sub-surface is a single layer resting on a gently underlating basement. Sketch the contours, in the appropriate parameter space, of the misfit between the observed data and the theoretical responses of an initial guess for a 2-layered earth. Be careful to explain your terms and annotate your diagram.
- Without giving full mathematical details, describe how the algorithm could be incorporated into any non-linear iterative inversion programme.
- Comment on how the presence of a single borehole on the profile could help to constrain your inversions.
7. Write a critical review of the Short Note by McBride et al.
- Use your own words and avoid direct quotation unless it is essential to your argument.