國立臺灣大學108學年度碩士班招生考試試題

1. 板塊構造(Plate Tectonics)學說主張地球最外一層岩石圈(lithosphere)，是由包括地殼及最上部地函組成的許多片剛性板塊(plates)所構成。
   (a) 各板塊間的相對運動可藉由剛性體在球面運動的數學模式來描述。說明如何以兩個運動學的參數定量描述兩板塊邊界的相對運動向量？（8%）
   (b) 板塊視為剛性體主要是根據板塊內部並未有明顯的變形，提出至少兩個地球物理觀察證據支持此假設。（8%）
   (c) 火山活動與板塊運動息息相關。說明於2018年6月噴發的夏威夷島基拉韋厄(Kilauea)火山以及同年12月位於印尼爪哇島與蘇門答臘間噴發的喀拉喀托(Krakatau)火山，其各自形成的原因為何？（8%）
2. 觀察地震測站所記錄P波和S波走時(traveltime)隨震央距(epicentral distance)的變化可用來推測地球內部層狀的速度構造發生明顯變化。
   (a) 解釋何謂震波走時的triplication現象？並指出至少兩處在什麼震央距和地球內部深度會造成此現象的發生。（12%）
   (b) 解釋地震學家透過何種地震波到時隨震央距的變化現象發現外核為液態，請同樣指出現象發生的距離和深度。（8%）
3. 說明如何利用測站所記錄的波形和其頻譜特徵分辨是核爆，火山地震或是淺層斷層構造地震所引起的訊號。（15%）
4. Briefly explain why the 2011 magnitude 9.0 Tohoku earthquake striking off the coast of Japan shortened the day of length by 1.8 microseconds. (5%)
5. (a) Explain what the free-air gravity anomaly and geoid anomaly are? (6%)
   (b) Observations of the free-air gravity anomaly profiles across the Western Pacific subduction zone show a belt of large negative anomalies along the deep-sea trenches but positive anomalies on the seaward side of the trenches. Explain why? (6%)
   (c) However, the geoid anomaly observed in the vicinity of the Western Pacific subduction zone shows positive anomalies. Explain why? (6%)
6. Assume that heat flow observed at the earth's surface is due to *conductive* heat transfer and that the earth can be modeled as a homogeneous half-space with uniformly distributed internal heat source $A=2\times10^{-8}\ Wm^{-3}$. Assume that the geotherm is *steady-state* (i.e., the temperature does not change with time), the thermal conductivity of mantle rocks, k, is 4 $W°C^{-1}m^{-1}$, and the temperature at the earth's surface (z=0 km) is 0°C. The heat flow measured at the surface has a steady-state value of $70\times10^{-3}\ Wm^{-3}$. According to the 1-D heat conduction equation,

$$\frac{\partial T}{\partial t}=\frac{A}{\rho c_p}+\frac{k}{\rho c_p}\frac{\delta^2 T}{\delta z^2}$$

(a) Solve the geotherm $T(z)$ as a function of A and k. (6%)
(b) Compare the geotherm calculated in (a) with the solidus of the basalt and olivine shown in Figure 1 and explain what implication of your geotherm is for melting in the upper mantle. (6%)
(c) We know the temperature of the outermost region of the core estimated from high-pressure experiments is about 3000-4400K. If the earth's mantle had the geotherm as that you derive in (a), what would the temperature be at the base of the mantle (take the approximate depth at the base of the mantle to be 3000 km to simplify the arithmetic calculation)? Is the estimate reasonable? If not, explain why your estimate is wrong? (6%)

見背面

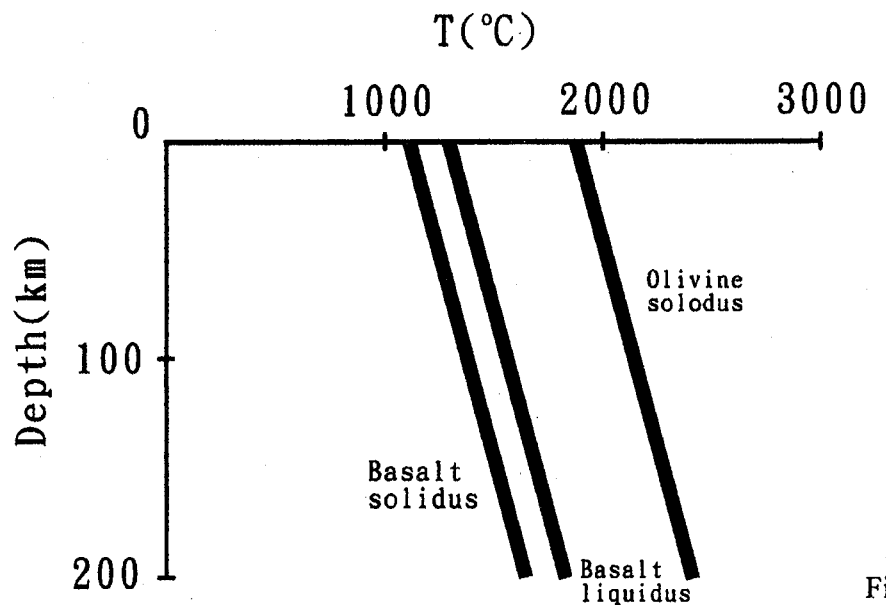

Figure 1

試題隨卷繳回