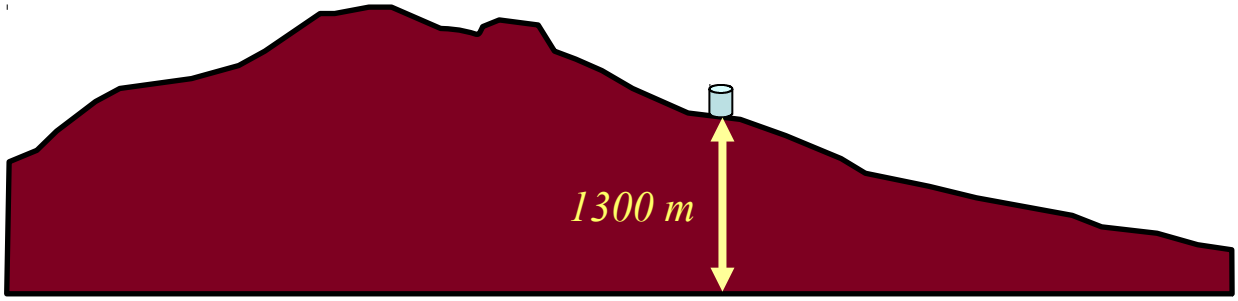
# Applied Geophysics – GEO 5660/6660
# Quiz # 3, April 20th

***Expected time to complete all 6 questions: ~1–1.5 hour***
*This test is OPEN-TEXT/-NOTES. Some basic relations are given on the last page!*

**1.** You want to investigate whether there is a lava tube underneath a specific basalt flow in **Craters of the Moon National Monument**. Because there is little if any erosion of lava flow; the thickness of lava flows cannot be determined by direct measurement. However, from a few core-holes that have been studied, it has been determined that pahoehoe flows range from 10 to 40 m and average about 20 m thick. Luckily, you have a (and only a) gravimeter at your disposal! Assuming a horizontal cylindrical lava tube, what is the smallest diameter tube you can hope to identify at the maximum possible lava depth, given a measurement uncertainty of 50 μ-gal? Assume mean basalt density is 3000 kg/m$^3$.

**2.** The elevation of a station used in a local survey (figure below) is provided relative to the mean sea level (MSL). **(a)** What is the free-air gravity correction for the above station? Is that positive or negative? Ignore latitude dependence. **(b)** What is the Bouguer correction? Is that positive or negative? Assume average density of crustal rocks is 2670 kg/m$^3$.

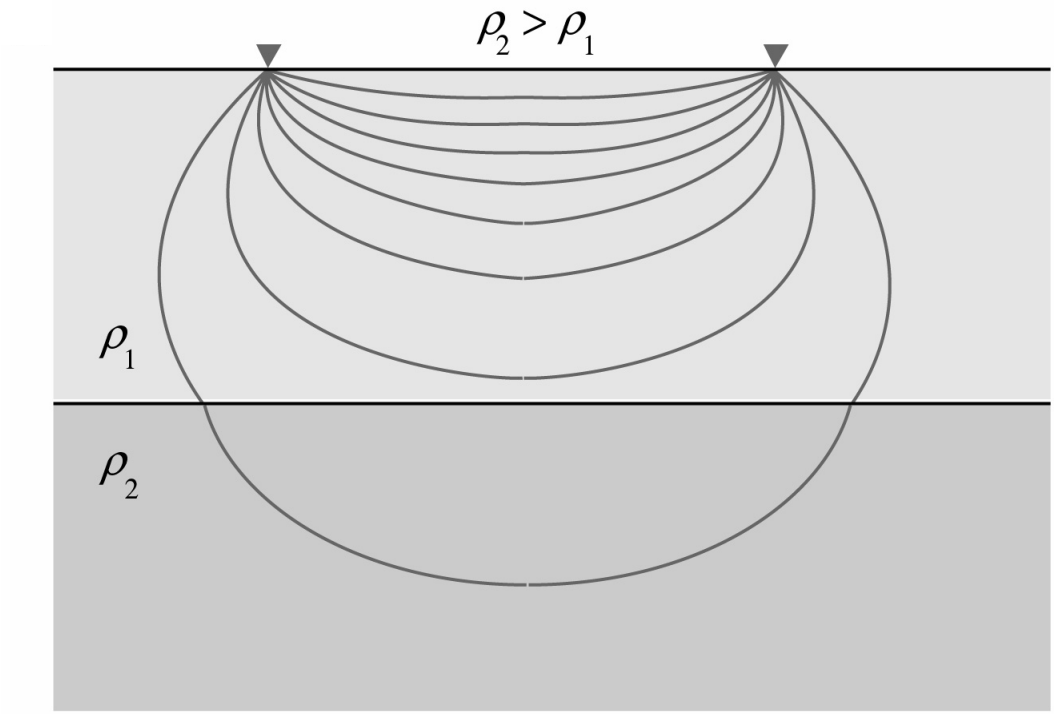



**3.** Roughly what fractions of the Earth's magnetic field originate from the following sources: **(a)** Monopole, **(b)** Dipole, and **(c)** Quadrupole? **(d)** Approximately where, geographically, is the N-pole of the Earth's dipole field currently located?

**4.** Magnetic field measurements at a certain station yield a vertical component, $H_z$ = 47,656.7 nT, and a horizontal component, $H_{xy}$ = 20,653.7 nT. (a) Assuming a linear dependence of the latitude of measurement with the field's inclination, estimate the latitude of this station? (b) If the declination at this station is 11.3955 degrees, what are the North ($H_y$) and East ($H_x$) components of the field?

**5. Qualitatively** explain the difference between using a DC-resistivity array for a "profiling" vs. a "sounding" survey? Which one of these surveys would you first run (at multiple locations) in order to inform the other?

**6.** Figure below shows **current flow lines** for a 2-layer model with a higher resistivity lower layer.
**(a) Qualitatively** sketch the current flow vectors (tangents) at the interface between the layers for the outermost (deepest) current line.
**(b)** How do the orientations with respect to the local normal change from layer 1 to laye 2?
**(c) Qualitatively** sketch a few equipotential lines for each electrode, including at least one associated with each current line crossing the layer interface.
**(d)** How does the convexity of equipotential lines change at the interface?

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## RELEVANT EXPRESSIONS

**I. Current vectors at an interface (angles relative to the local interface normal):**

$$\frac{\rho_1}{\rho_2} = \frac{\tan(\theta_2)}{\tan(\theta_1)}$$

**II. Basic Trigonometric relations:**

$$\sin(\theta) = \frac{y}{h};$$

$$\cos(\theta) = \frac{x}{h};$$

$$\tan(\theta) = \frac{y}{x};$$

$$h = \sqrt{x^2 + y^2}$$