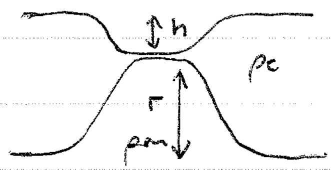
29 April 08.

EART 162 HWK#4

2 1a) isostatic => no lithospheric strength

b)



isostasy ; $(h+r)\rho_c = r\rho_m$

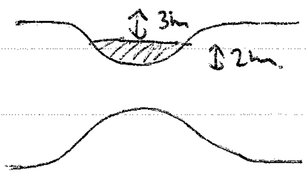
$$r = \frac{h\rho_c}{\rho_m - \rho_c}$$

minimum crustal thickness $= h + r$

$$= h\left\{1 + \frac{\rho_c}{\rho_m-\rho_c}\right\} = h\,\frac{\rho_m}{\rho_m-\rho_c}$$

4 ∴ min. crustal thickness = 20.4 km.

c)



$\Delta g = 2\pi \Delta\rho G h$ $\quad h = 2\text{km}$ $\Delta\rho = 2.9$ g/cc

$\Delta g =$ 243.6 mGal (at surface).

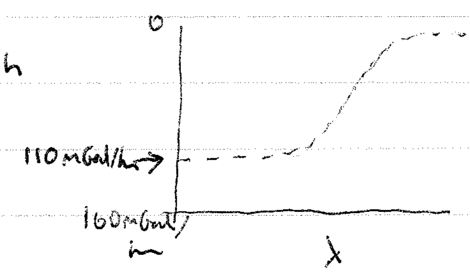
attenuation $= \exp(-kz) = \exp\left(-\frac{2\pi}{1200}\times 300\right) = 0.21$

10 4 => gravity anomaly @ s/c. alt = 50.6 mGal

2 a) at short wavelengths $\Delta g = 2\pi G\rho h$

$\Rightarrow \Delta g/h = 2\pi G\rho$

$\Rightarrow \rho = (\Delta g/h)\ 1/2\pi G$



2 $\Delta g/h$ = 110 mGal/km => ρ = 2.6 g/cc

1 b) roughly 600 km

c) $\frac{Dk^4}{\Delta\rho g} = 1$ when $C = 0.5$ $\quad k = \frac{2\pi}{\lambda}$ => $D = 3.7\times10^{23}$ Nm

3

d) $D = \frac{E T_e^3}{12(1-\nu^2)}$ $\quad \nu = 0.25$ $E = 100$ GPa => T_e = 34.8 km

2

e) Similar value to continents on Earth.

Surprising because surface temperature higher => would expect lower elastic thickness, assuming $\frac{dT}{dz}$ similar for both planets.

One answer could be that Venus is dry, and so rock remains elastic at higher temperatures. (An alternative would be a lower

3 temperature gradient on Venus).

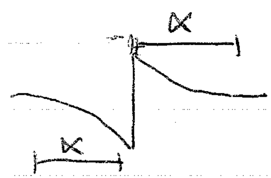
f). At short wavelengths attenuation is more of a problem – less signal at spacecraft altitude. To make better measurements would require the spacecraft to go lower – but the

14 3 atmosphere is in the way.

3 a) $D = \frac{E T_e^3}{12(1-\nu^2)}$ $\alpha = \left(\frac{4D}{\Delta\rho g}\right)^{1/4}$ $\alpha = \left(\frac{E T_e^3}{3(1-\nu^2)\Delta\rho g}\right)^{1/4}$

$\Rightarrow \quad T_e = \left\{\frac{3(1-\nu^2)\Delta\rho g \alpha^4}{E}\right\}^{1/3}$

3

b) 

$\alpha \approx 10$ km

2

c) No, because $\alpha \ll$ radius of Europa, so long-wavelength

2 variations are going to be isostatic => no gravity anomalies

2 d) $\alpha = 10$ km $\Rightarrow$ $T_e = 2.3$ km.

2 e) $F = \frac{k\Delta T}{d} = \frac{3 \times 90}{2.3} = 117$ mWm^{-2}

f) This heat flux is a bit higher than the Earth average value (80 mWm^{-2}). Since Europa is much smaller than Earth, either this heat flux is a record of an ancient event,

14 3 or tidal heating on Europa is important.

14 + 14 + 10 = 38