12.005 Lecture Notes 23

Plates Summary and Fluids

Plates Summary:

Successes – "moats" and "rises" ubiquitous. Elastic flexure seems to apply.

Problems:

- Geophysical measurements of w are difficult.
- Reference level?
- Other sources of topography.

Alternative approach – use gravity

Consider same observed topography

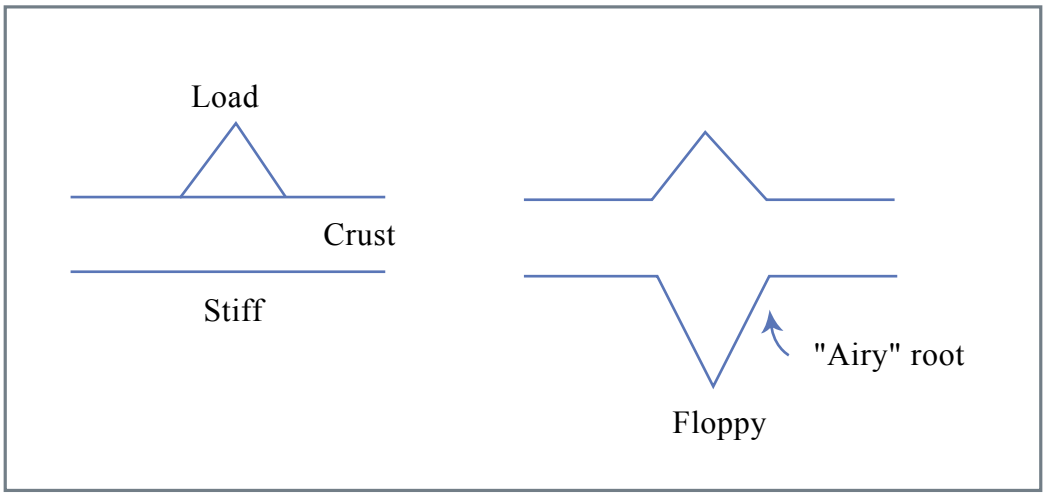

Figure 23.1
Figure by MIT OCW.

Fourier Series $t(x) \rightarrow t(k)$

Apply load $t_c = t_0 \cos kx$

Get displacement $D \rightarrow w = w_0 \cos kx$

$$w_0 = \frac{t_0}{\frac{\rho_m}{\rho_c} - 1 + \frac{D}{\rho_c g} k^4}$$

$$\delta g = g_0 \cos kx$$

$$g_0 : \ \rho_c (t_c - e^{-kH} w_0)$$

where H is crustal thickness and w_0 depends on k and D.

$$\delta g(k) \rightarrow \delta g(x)$$

Compare $\delta g(x)$ with data.

Fluids

Fluids – no memory of shape – flow under applied tractions, body forces, stop flowing (don't reverse flow) when "driving forces" removed.

Newton's concept of viscosity – subject fluid to shearing

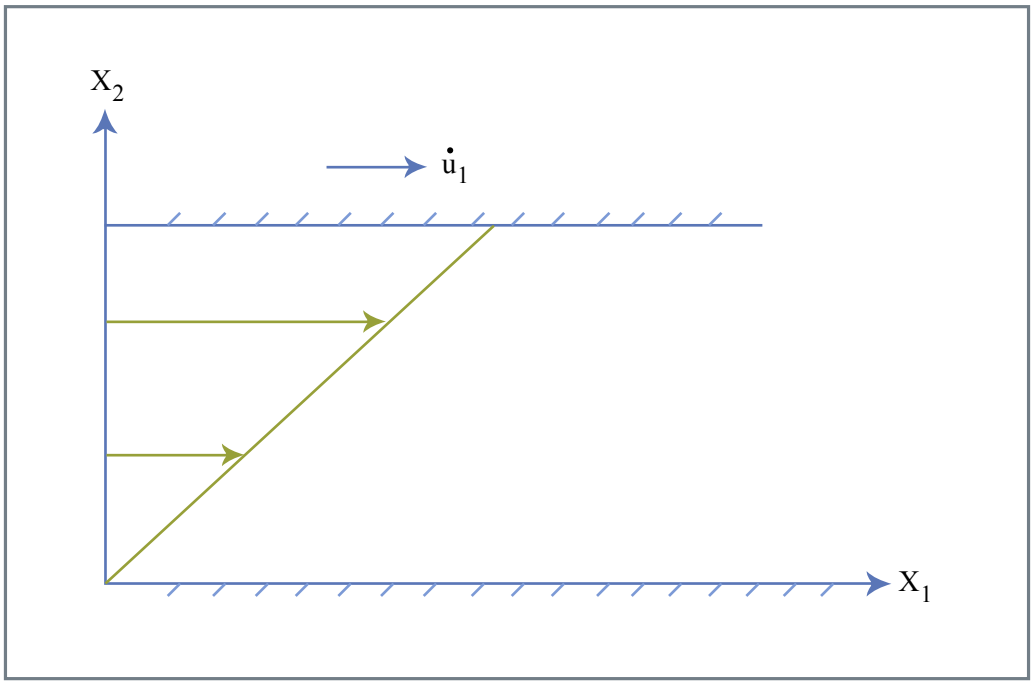

Figure 23.2

Figure by MIT OCW.

$$\sigma_{12} = \mu \frac{\partial \dot{u}_1}{\partial x_2}$$

where μ is shear viscosity.

Substance	μ (Pa · sec) at 20°C	Poise (10 Pa · sec)
air	$2 \cdot 10^{-5}$	$2 \cdot 10^{-4}$
water	10^{-3}	10^{-2}
glycerine	1	10
ice (0°C)	10^{13}	10^{14}
glass	10^{17}	10^{18}
"Earth"	$10^{19} - 10^{21}$	$10^{20} - 10^{22}$

Physical cause – gasses – (vertical) motion of particles with different horizontal velocities.

- Fluids – elastic resistance to distortion of atomic "cages" as atoms and molecules "slide by".

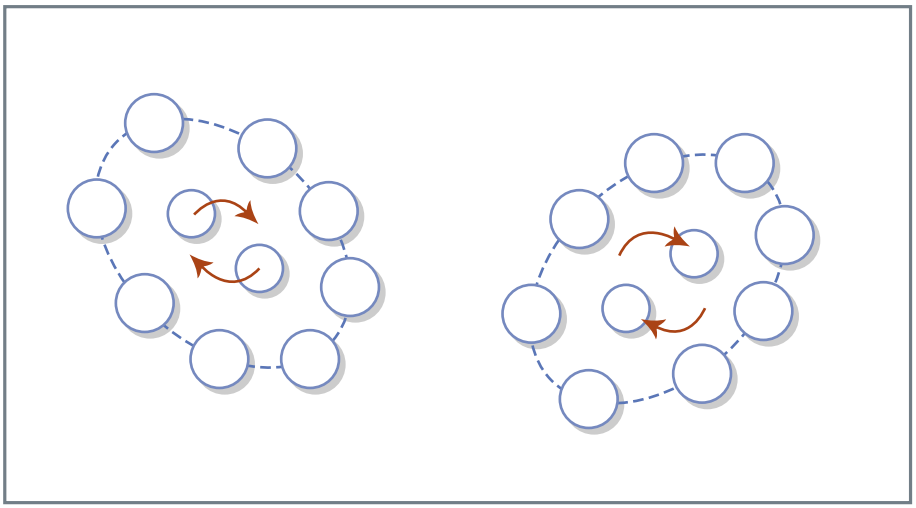

Figure 23.3

Figure by MIT OCW.

- Solids – diffusion of defects in the lattice (vacancies or interstitials); motion of dislocations in lattice structure.

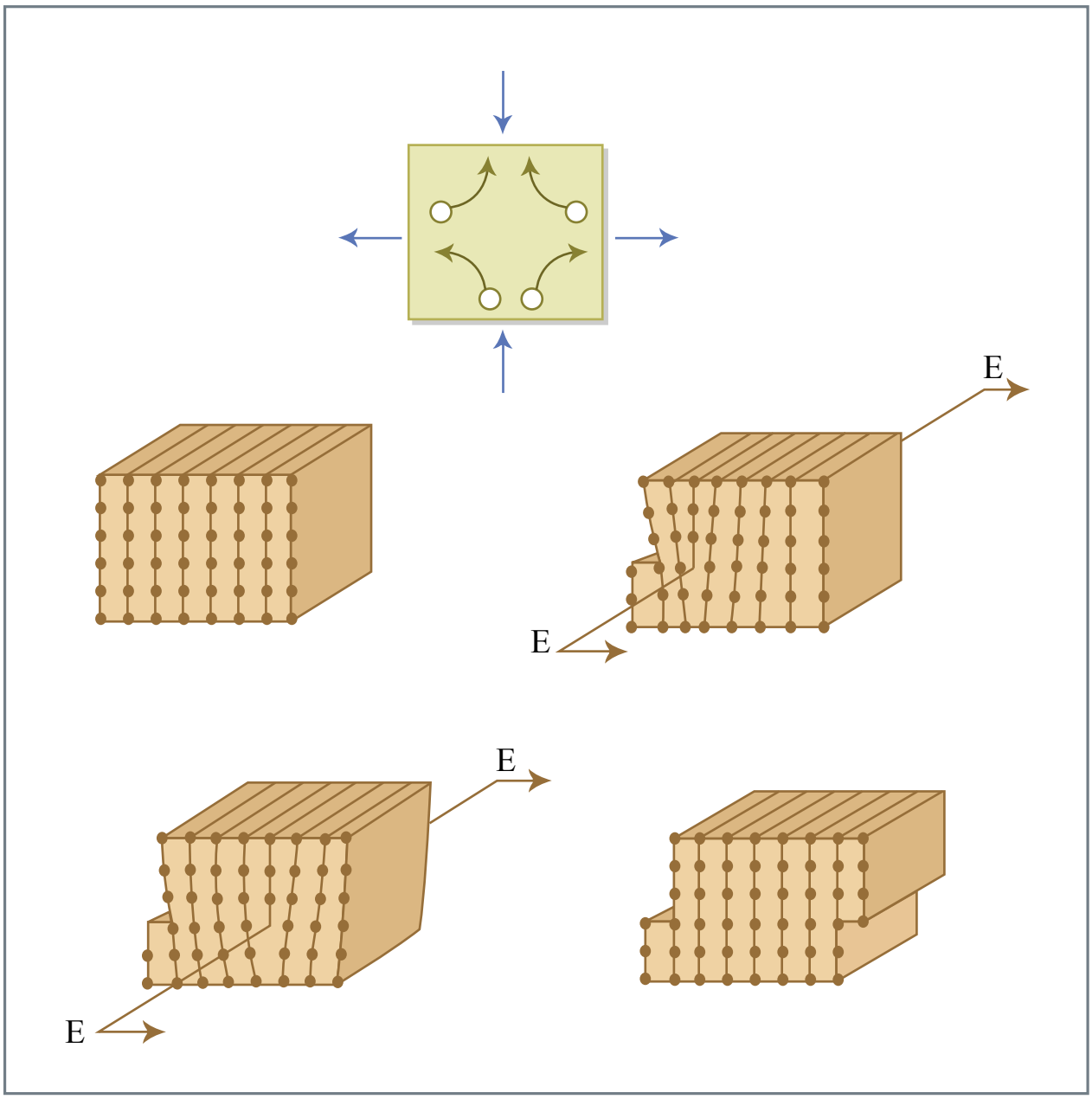

Figure 23.4

Figure by MIT OCW.