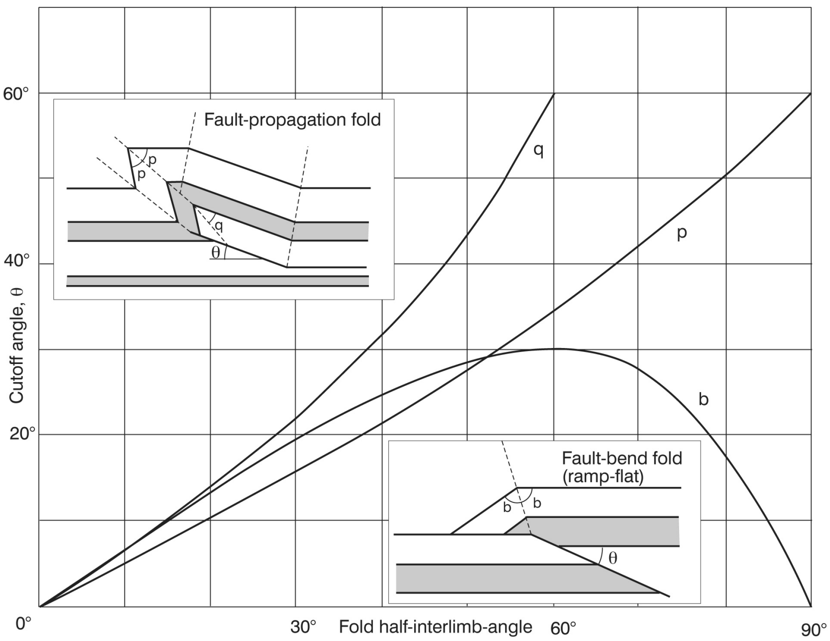
Orogens and crustal shortening

Kink models for fault-bend and fault-propagation folds



Shape of fault-bend fold (kink model):

Change in dip ϕ at ramp

$$\phi = \tan^{-1}\left[\frac{-\sin(b-\theta)\left[\sin(2b-\theta)-\sin\theta\right]}{\cos(b-\theta)\left[\sin(2b-\theta)-\sin\theta\right]-\sin b}\right]$$

where b is the half-interlimb angle of fold at the front of the structure, and θ is the ramp angle

Shape of fault-propagation fold (kink model)

$$2\sec\theta - \cot\theta = \left[\frac{1-2\cos^2 q}{\sin 2q}\right]$$

where q is half-interlimb angle of fold at the crest of the structure, and θ is the ramp angle.

Half interlimb angle p at leading edge of structure above tip of propagating fault, $p = q+\theta/2$

Foreland basin subsidence

Shape of foreland basin:

z = downward deflection

x = horizontal distance

z_{max} maximum downward deflection

$$z = z_{\max} e^{-x/\alpha} \cos\left(\frac{x}{\alpha}\right)$$

where α is a constant that depends on the flexural rigidity of the lithosphere D, the density contrast $\Delta\rho$ and gravity g

$$\alpha = \sqrt[4]{\frac{4D}{\Delta\rho g}}$$

Wavelength of buckle folds

For a viscous layer (thickness d, viscosity μ_1) immersed in a less viscous medium (viscosity μ_2), the initial wavelength of buckle folds is given by

$$W = 2\pi d \sqrt[3]{\mu_1 / 6\mu_2}$$

Coulomb thrust wedges

For décollement slope β

Internal strength of wedge k

Internal fluid pressure ratio λ_I

Décollement friction μ_b

Décollement fluid pressure ratio λ_b

Surface slope is α where

$$\alpha = \frac{(1-\lambda_b)\mu_b - (1-\lambda_i)k\beta}{(1-\lambda_i)k+1}$$

Metamorphic belts

Steady-state Geotherm Equation

$$A = \frac{-Az^2}{2k} + \left(\frac{Q^*}{k} + \frac{(AxD)}{k}\right)z$$

where

T = Temperature (K)

z = depth

A = radioactive heat production

Q^* = mantle heat flux

k = thermal conductivity

D = crust thickness