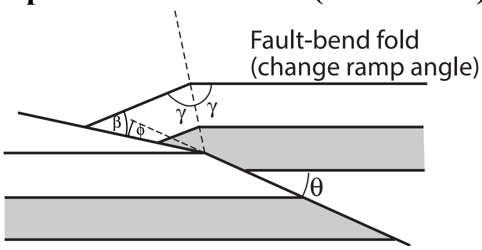
Foreland fold and thrust belts

Kink models for fault-bend and fault-propagation folds

Shape of fault-bend fold (kink model):



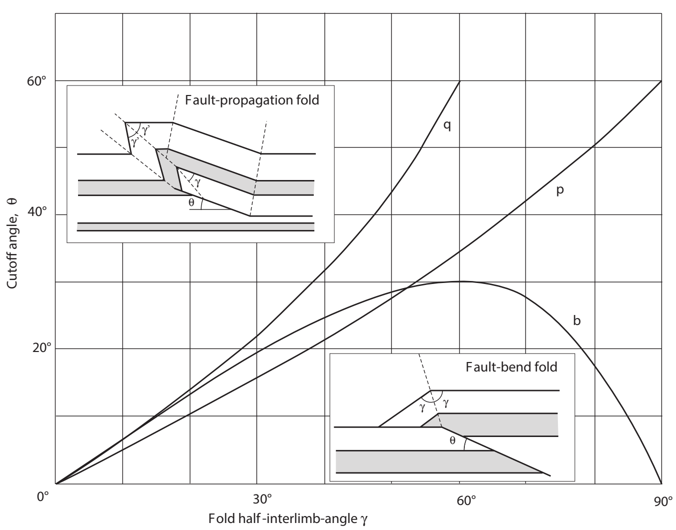
Change in dip ϕ at ramp

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

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

If we assume that $\theta = \varphi$ then

$$\varphi = \theta = \tan^{-1}\left(\frac{\sin 2\gamma}{2\cos^2\gamma + 1}\right) \text{ graphed below.}$$



Shape of fault-propagation fold (kink model):

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

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

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

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

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

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

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

Or, critical taper

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