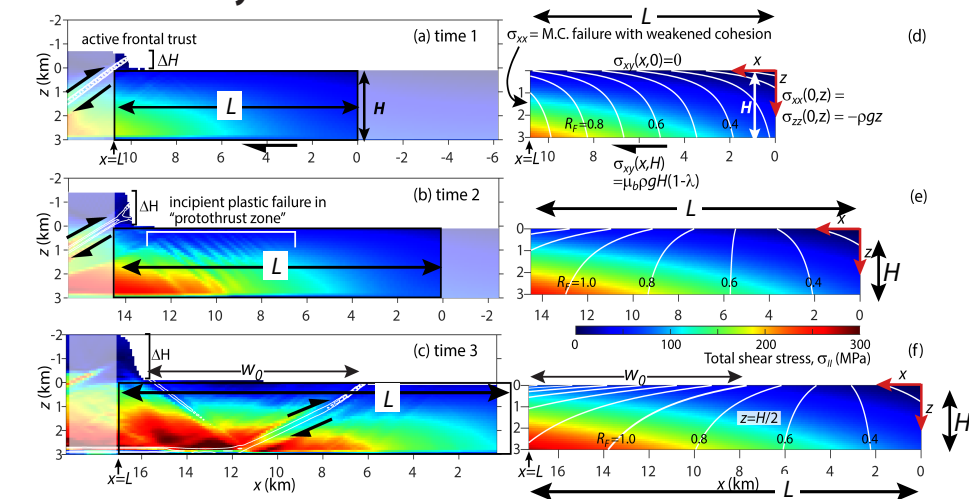


1. Introduction

Besides the overall wedge taper itself, the most prominent feature of accretionary wedges and fold-and-thrust belts is the series of imbricate thrust faults. The widths of the blocks of material between the thrusts reflects upon mechanical properties of the accreting sediment. We use numerical models and analytical stress solutions to illuminate the basic mechanics controlling thrust block width, and to define relationships to the thickness H of the sediments entering the wedge, brittle frictional strength of the sediment (ϕ, μ) and along the decollement (ϕ_b, μ_b), pore-fluid pressure ratio, λ , and dip β of the basal decollement.

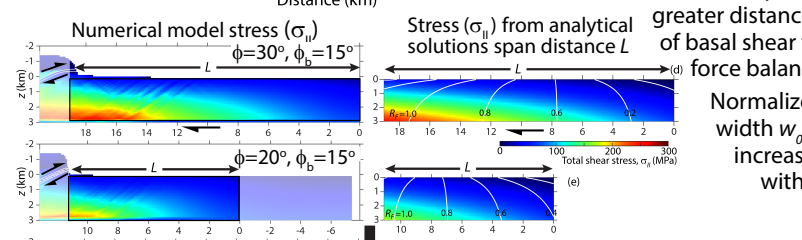
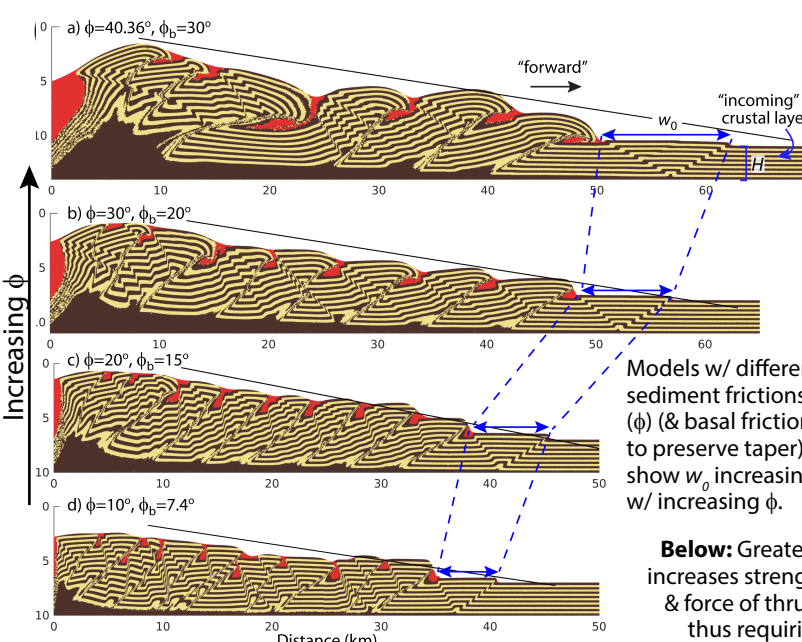
4. Stress field and forming a new thrust in the incoming sediment layer



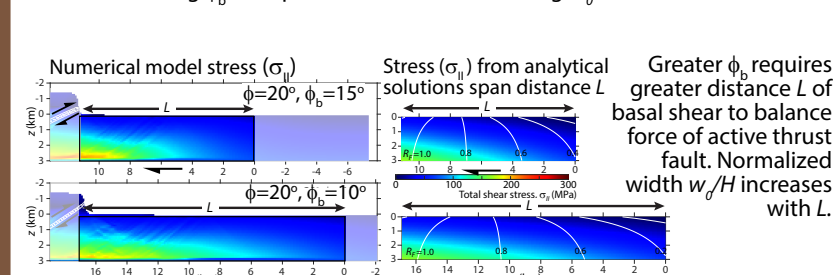
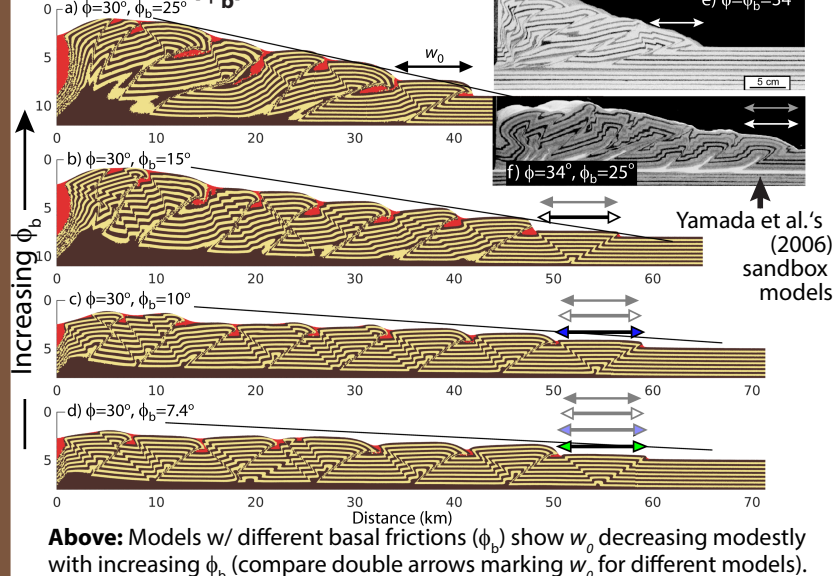
Stress (σ_x) from numerical model builds in the sediment forward of the wedge until a new frontal thrust forms. Analytical solutions show elastic stress (σ_x) building with time as in numerical model. R = ratio of stress to brittle strength.

"Force balance distance" L increases with fault topography (ΔH). L is the distance forward of the wedge over which the net leftward force due to basal shear balances the net rightward force from the active frontal thrust. L is also the distance where stress is substantially perturbed and thus within which the new thrust forms. Initial block width, w_0 (& w_0/H) increases with L .

6. Block width increases with sediment friction

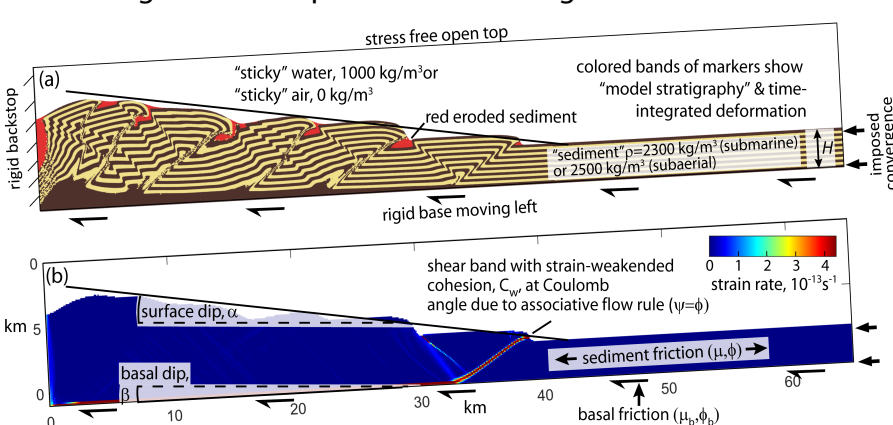


7. Width decreases with increasing basal friction (ϕ_b)

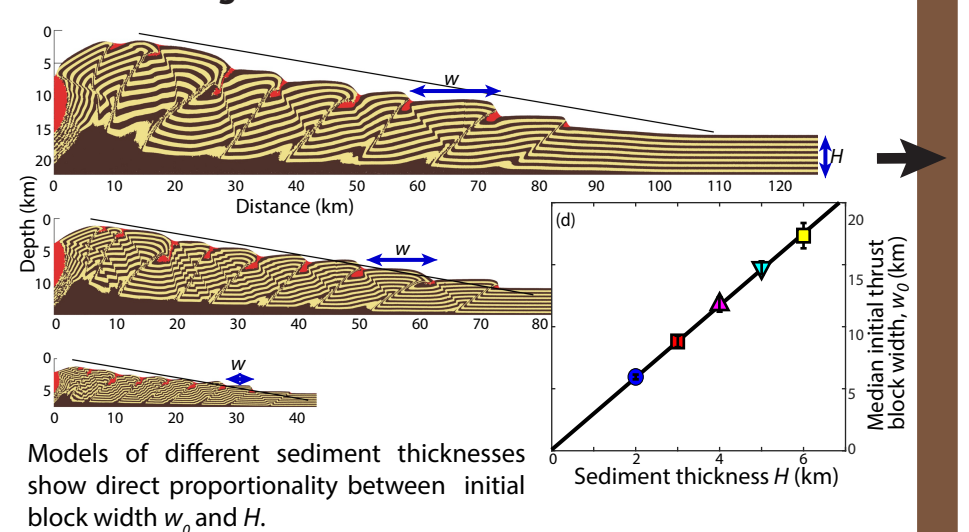


2. Numerical model

The numerical code is SiSTER uses finite-differences & the marker-in-cell method for simulating visco-elasto-plastic deformation in 2D. The Mohr-Coloumb criterion leads to bands of focused shear, resembling faults. Compaction/dewatering are not simulated.



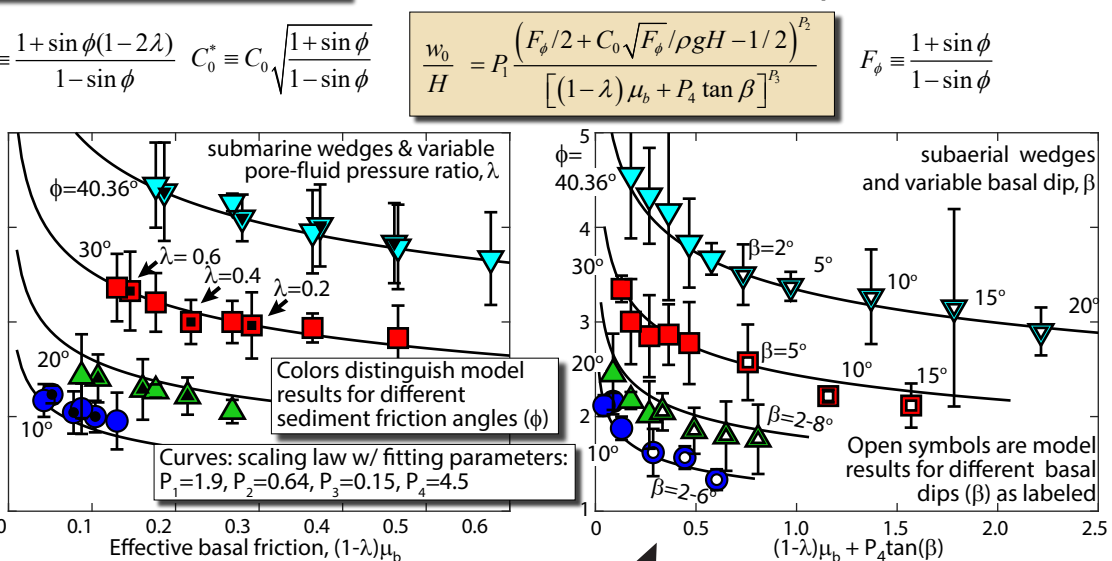
5. Block width is proportional to thickness H of incoming sediment



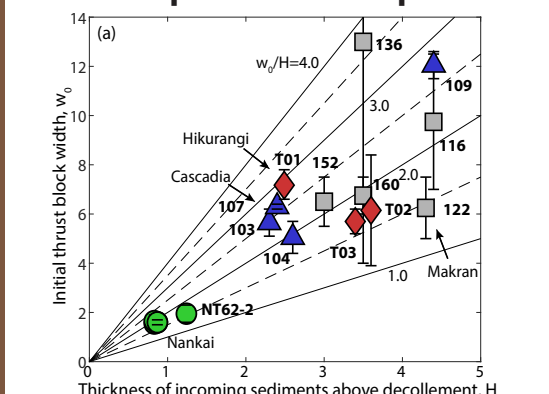
$$\frac{L}{H} = \frac{F_{\lambda, \phi} / 2 + C_0 * / \rho g H - 1 / 2}{(1 - \lambda) \mu_b + \tan \beta}$$

$$F_{\phi, \lambda} = \frac{1 + \sin \phi (1 - 2\lambda)}{1 - \sin \phi} \quad C_0 = C_0 \sqrt{\frac{1 + \sin \phi}{1 - \sin \phi}}$$

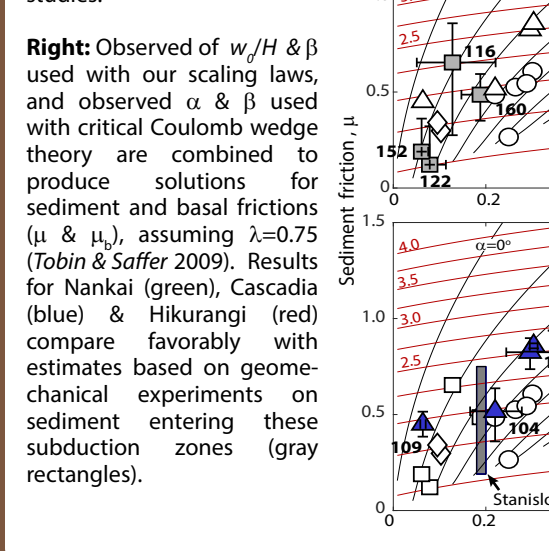
$$\frac{w_0}{H} = P_1 \left(\frac{F_{\phi} / 2 + C_0 \sqrt{F_{\phi} / \rho g H - 1 / 2}}{(1 - \lambda) \mu_b + P_4 \tan \beta} \right)^{P_2} \quad F_{\phi} = \frac{1 + \sin \phi}{1 - \sin \phi}$$



12. Scaling combined with critical Coulomb wedge theory to estimate sediment strength at front of four example submarine prisms



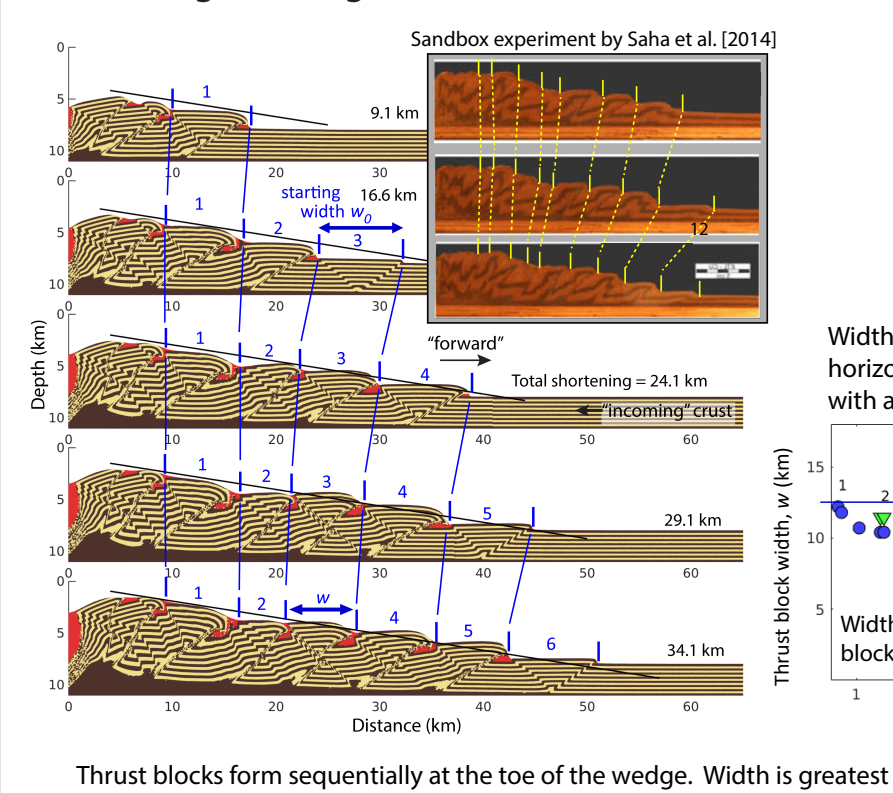
Above: w_0 correlates with H , supporting our results and reaffirming those of prior studies.



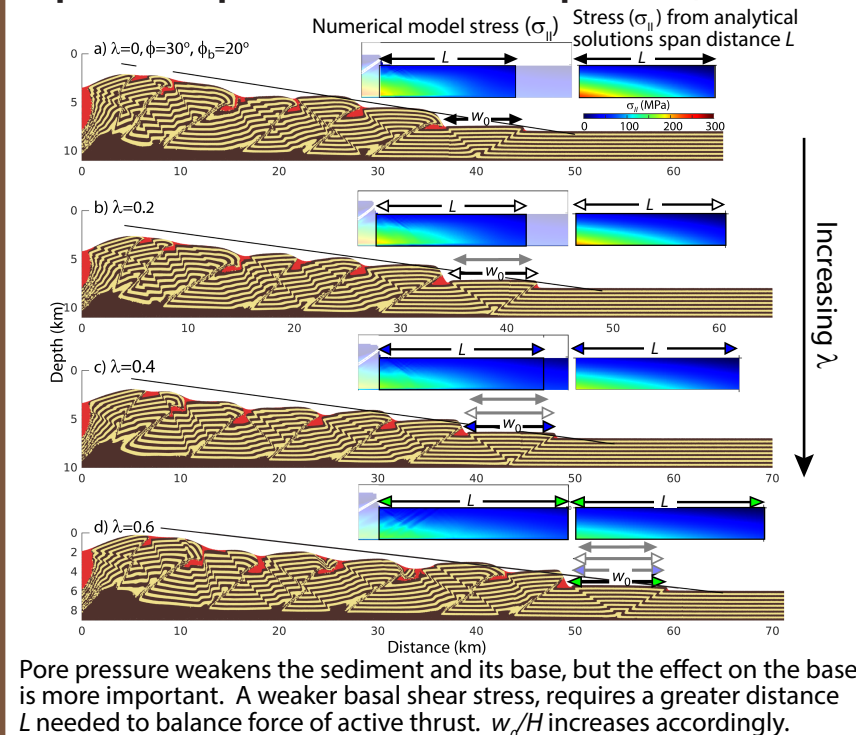
11. Conclusions

The width of imbricate thrust blocks **increase** with sediment thickness H , friction μ & cohesion C_0 , and pore-fluid pressure ratio λ , and **decrease** with basal friction μ_b and dip β , due to their influence on the distance forward of the wedge where stress is substantially perturbed by subduction. This distance L is that needed for the net force due to basal shear to balance the opposing force of the active frontal thrust. Our scaling law can be combined with critical Coulomb wedge theory to estimate the strength parameters (μ , μ_b and λ) of sediments at the front of accretionary wedges.

3. Forming the wedge and evolution of thrust block width



9. Block width increases weakly with λ (ratio of pore-fluid pressure to lithostatic pressure)



11. Block width decreases with increasing basal dip, β

