Contractional Systems - Thrust Faults
Ch. 16

Many diagrams are from Earth Structure, van der Pluijm and Marshak, 2004.

What kind of fault is it?

Precambrian

Paleozoic

How Thrust belts form

Van der Pluijm and Marshak (2004)

Thrust Belt in a Sandbox

Parts of a Thrust-Belt

Van der Pluijm and Marshak (2004)

Critical Wedge Growth

$\Phi_c = \text{critical wedge angle}$

$\Phi_c = \alpha_i + \beta$

Addition of new thrust slices at toe

$\phi_0 = \phi_0$ re-established
Alps Cross Section


Components of a thrust belt

Basement
Basal Detachment

Origin of Foreland Basins

“Depression”
(open space that
becomes the
foreland basin)

“Load”
(caused by the
weight of the
fold-thrust belt)

Van der Pluijm and Marshak (2004)

Sevier Thrust Belt, Wyoming

• Complex Imbricate fan
• Basement involved def.
• Thin-skin def.

Van der Pluijm and Marshak (2004)

Asia Topography

Van der Pluijm and Marshak (2004)

Appalachians

Van der Pluijm and Marshak (2004)
Sequence of deformation

Forward propagation of deformation front

Faults of the Canadian Rockies

Distribution of Shortening

Mt. Yamnuska, Canadian Rockies- McConnell Thrust

Mt. Yamnuska, Canadian Rockies- McConnell Thrust
Dev. Limestone
Palliser Fm.
Cretaceous, Belly River Gp.
Front Ranges
E
W
Lewis Thrust
Detached folds - Jura Mts.
Gypsum
Detachment surface
Front Ranges
E
W
Pz limestone
Jur-Kootenay Fm.
Pop-up Structure - A Faulted Fold
Calico Bluff, Eagle, AK
Thrust Breaching the Surface - Landers, CA
Geometry of Thrust Sheets

The shape of the fault plane determines the geometry of the folds.

The hanging wall conforms to the shape of the footwall.

Thrust belt movie

Start

• Structural Methods Interactive Resource
• Disc 2, Chapter 9
Does this look familiar?

Thrust Movie 2
Start 2nd movie

Duplex in seismic data
Longmen Shan thrust belt, Sichuan, China
Jia, et al. 2006
Duplex Structure in thin-bedded sandstones and shales

Fault Propagation Folding Trishear

Mechanical Paradox of Thrust Sheets
- Stress required to move a thrust sheet is larger than the strength of the rock
- Like trying to push a Jell-O block across the table
Solutions:
1. Reduce Basal Friction → High fluid Pressure
2. The sheet does not move all at once

Role of Fluid Pressure

Like pushing a wrinkle out of a rug

Take-Home Points
- Thrusts put older on younger or high grade on low grade
- A thrust belt is like a pile of dirt in front of a bulldozer
- Foreland/hinterland, forethrusts/backthrusts
- The thrust load causes subsidence of the foreland basin
- Thrusts follow weak layers (detachments) and cut strong layers (ramps)
- Shape of the fault determines shape of folds above
- Thrust can repeat the stratigraphic section
- Fault strain can be taken up by folding above
- Thrust sheets move like a propagating dislocation