GY403 Structural Geology

Lecture 6: Kinematic Analysis

Kinematics

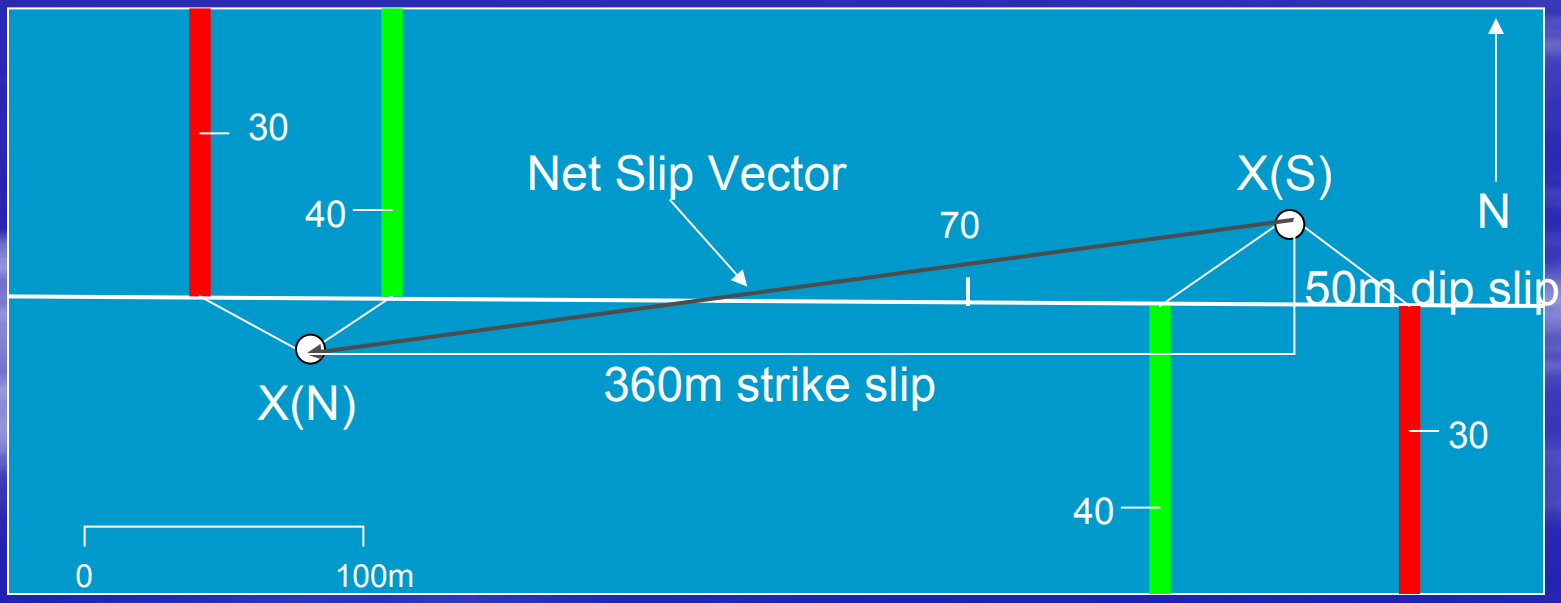
- Translation- described by a vector quantity
- Rotation- described by:
  - Axis of rotation point
  - Magnitude of rotation (degrees)
  - Sense of rotation (reference frame; clockwise or anticlockwise)
- Dilation- volume change
  - Loss of volume = negative dilation
  - Increase of volume = positive dilation
- Distortion- change in original shape

Rigid vs. Non-rigid Body Deformation

- Rigid Body Deformation
  - Translation: fault slip
  - Rotation: rotational fault
- Non-rigid Body Deformation
  - Dilation: burial of sediment/rock
  - Distortion: ductile deformation (permanent shape change)

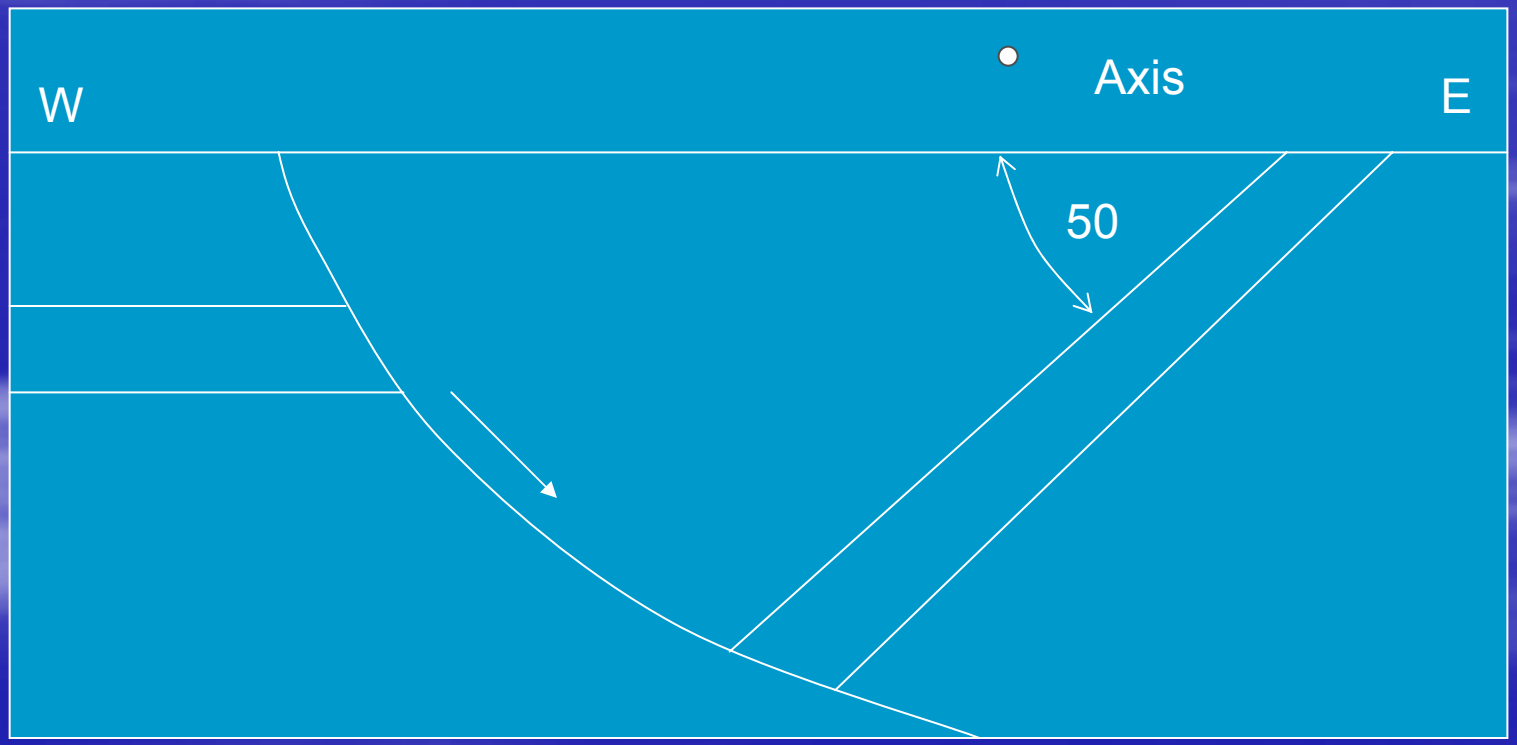
Translation Examples

- Slip along a planar fault
  - 360 meters left lateral slip
  - 50 meters normal dip slip
  - Classification: normal left-lateral slip fault



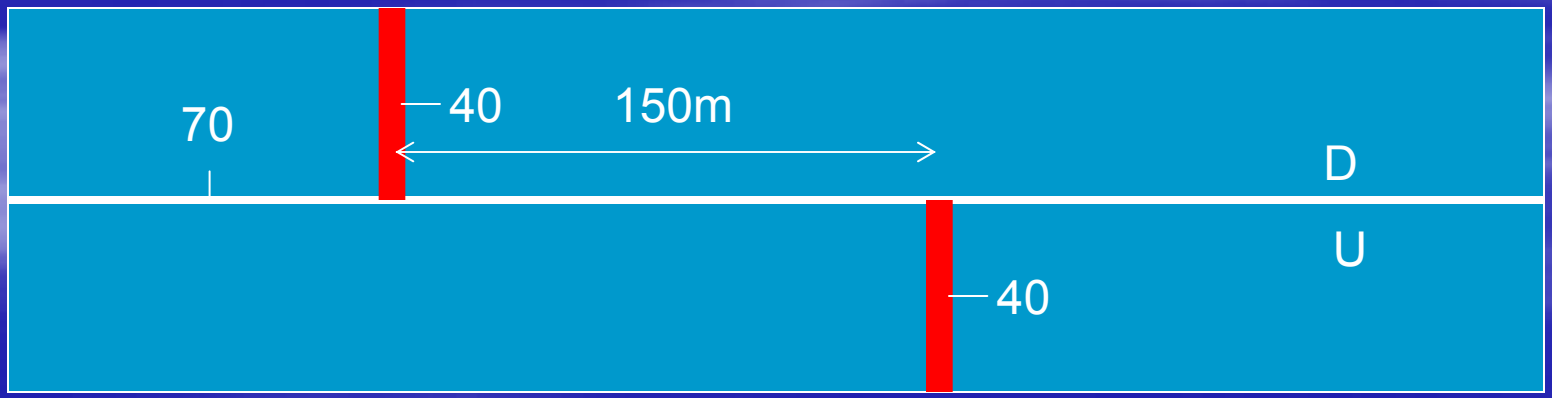
Rotational Fault

- Fault slip is described by an axis of rotation
- Rotation is anticlockwise as viewed from the south fault block
- Amount of rotation is 50 degrees



Fault Separation vs. Slip

- Fault separation: the apparent slip as viewed on a planar outcrop
- Fault slip: must be measured with net slip vector using a linear feature offset by the fault.



Quantitative Strain Analysis

- See separate presentation below:

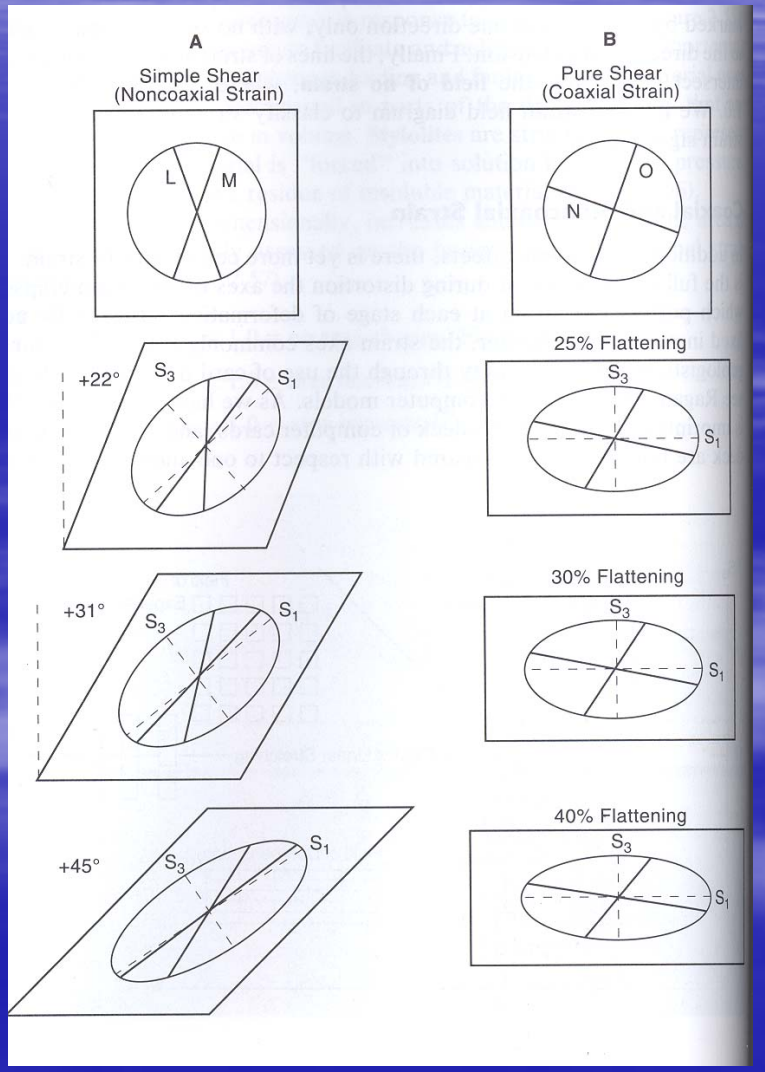
http://www.usouthal.edu/geography/allison/GY403/strain.pdf

Pure Shear vs. Simple Shear

- Pure Shear: also known as coaxial strain and/or flattening strain.
  - Principle axes of finite strain ellipse remain at same orientation through progressive strain
- Simple Shear: also know as non-coaxial strain.
  - Principle axes of finite strain ellipse rotate through each stage of progressive strain.

Simple Shear vs. Pure Shear

- Example from textbook:



Summary for Future Exams

- Know the 4 components of kinematic analysis, including rigid vs. non-rigid body deformation, and geological examples.
- Know the definition of homogenous vs. non-homogenous strain and geological examples.
- Know the general equations for the Mohr circle for strain, and how to calculate S, e, λ, γ, Ψ, and α from the axial lengths of the finite strain ellipse.
- Be familiar with Ernst Cloos (1947) study of deformed ooids and the relationship to plane strain
- Be familiar with the concept of pure shear vs. simple shear
- Know the definitions of fault separation versus fault slip; be able to classify a fault based on the net slip vector