12. Kinematics

I Main Topics
A Definition and use
B Relative ages
C Displacements vs. relative displacements

How Did Points in Outcrop Move Through Time?

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How Did Points in Outcrop Move Through Time?
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II Definition and use of kinematics
A The study of the position of bodies through time without regard to the forces causing motion
B Used to describe how a body changes position, orientation, shape, and/or size through time
C Important for correctly assigning causes and effects

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III Relative ages
A Cross-cutting relationships
  1 Younger features can cut older features; older features cannot cut younger ones
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Cross-cutting relationships

Angular unconformity, Siccar Point, Scotland

Nonconformity, Tapeats Sandstone overlying schist, Grand Canyon
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Cross-cutting relationships

Mafic dike cutting aplite dike, Kings Canyon National Park, CA

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Cross-cutting relationships

Joint cutting biotite crystal

From Paul Segall
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Cross-cutting relationships

Plutons

http://gsabulletin.gsapubs.org/content/115/12/1570/F1.large.jpg

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Cross-cutting relationships: “Pathologic” examples
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Inclusions

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III Relative ages

C Interaction of structures

1 Older structures can affect the initial formation of younger structures, but younger structures cannot affect the origin of older structures
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Interacting structures: T-shaped intersections
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Interacting structures: Hook-shaped fractures

Curving, hook-shaped paths of interacting cracks at four different scales

From Pollard and Aydin, 1984

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IV Displacements vs. relative displacements

A Most of the displacements geologists measure are relative displacements (GPS is sort of the exception)
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IV Displacements vs. relative displacements

B A lack of relative displacement does not equate to a lack of absolute displacement (examples: joints and faults)

C Structural geologists usually cannot measure displacements relative to an undeformed initial state; we only see the final deformed state
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IV Displacements vs. relative displacements

D Models influence what we measure, where we measure, and how we interpret our measurements

1 Faults and joints (see B)
2 Dependence on our concept of the initial state: is it deformed or undeformed?