# FAULTS (I)

I Main Topics
  A Why are faults important?
  B Observations of faults
  C Geologic classification of faults
II Why are faults important?
  A Faults generate earthquakes
  B Faults reveal how the earth has deformed through time
  C Faults (including deformation bands) play critical roles in fluid transport in the earth's crust (e.g., water, magma, petroleum & natural gas, and hydrothermal fluids [ore minerals])
  D Faults are zones of weakness to account for in engineering projects
III Observations of faults
  A Gross geometry
    1 Thin relative to their in-plane dimensions
    2 Bounded in extent
    3 Grossly planar (usually)
  B Relative displacement (slip) of opposing fault walls is parallel to the fault
  C Structural details of faults
    1 Overall structure: *~planar segments*
      Affects internal structure & fault behavior
    2 Internal structure: complicated fracture pattern
    3 Common for faults to be paralleled by other fractures. Typical *assumption* is that fault slip causes fault-parallel fractures to form (note that cross-cutting relationships don't help out).
    4 Common for hydrothermal/geothermal activity to occur near ends of fault segments (San Andreas, Wasatch faults)
  D Composition
    1 Breccia
    2 Fault gouge
    3 Mineralization

- E Kinematics
  - 1 Cut adjacent material; faulting post-dates the host rock
  - 2 ***Relative*** (not absolute) ***displacement*** (slip) of originally neighboring points ***is parallel to the fault***; relative displacement may or may not be small relative to fault length
- F Surface textures of faults
  - 1 ***Slickensides*** (polished surfaces)
  - 2 ***Slickenlines*** (striations); parallel to most recent(?) slip vector

IV Geologic classification of faults (see Fig. 24.1)

- A Geologic classification
  - 1 Based on orientation of slip vector relative to the strike and dip of a fault
  - 2 Slip determined by the relative displacement of **piercing points** that were originally neighbors on opposite faces of a fault.
  - 3 Piercing points mark intersection of a line with a fault
  - 4 The slip vector connects offset piercing points
  - 5 Slip is not the same as "movement" or "displacement"
- B **Strike-slip fault**: slip vector is predominantly horizontal (i.e., parallel or anti-parallel to the line of strike)
  - 1 Right lateral: in map view ***across*** a fault, a marker is offset to the right
  - 2 Left lateral: in map view across a fault, a marker is offset to the right
- C Dip-slip fault: slip vector is parallel (or anti-parallel) to dip
  - 1 **Normal fault**: hanging wall moves down relative to footwall
  - 2 **Thrust fault**: hanging wall moves up relative to footwall
    *Deeper (older) rocks thrust over shallower (younger) rocks*
- D Oblique-slip: combination of strike slip and dip slip
- E **Slip vs. Separation (see Fig. 24.2)**
  - 1 Slip: True relative displacement of originally neighboring points
  - 2 Separation: *Apparent* relative displacement of an offset feature as seen in a map or a cross-section
- F ***The amount and direction of slip can change with time and/or position along a fault!***

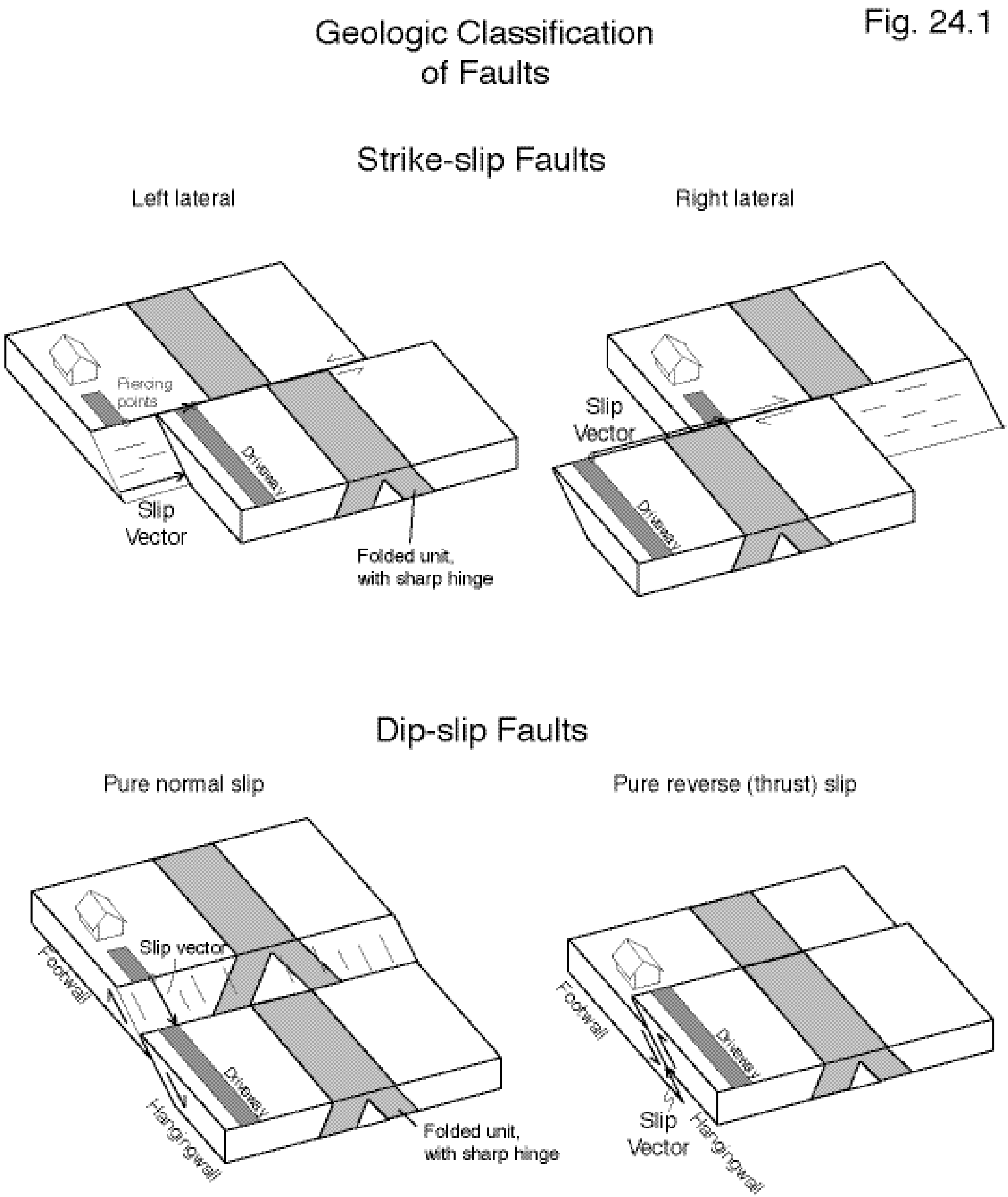
Geologic Classification
of Faults
Fig. 24.1
Strike-slip Faults
Left lateral
Right lateral
Piercing
points
Slip
Vector
Driveway
Folded unit,
with sharp hinge
Slip
Vector
Driveway
Dip-slip Faults
Pure normal slip
Pure reverse (thrust) slip
Slip vector
Footwall
Driveway
Hangingwall
Folded unit,
with sharp hinge
Footwall
Driveway
Slip
Vector
Hangingwall

Fig. 24.2

Contrast between slip and separation