FABRICS

I Main Topics
- A What are fabrics?
- B Planar fabrics
- C Linear fabrics
- D Penetrative vs. non-penetrative fabrics
- E Cleavage and folds
- F Comments on use of grain-scale observations

II What are fabrics?
- A The grain-scale structure of rock, especially that which develops as a result of deformation
- B Refers to the orientation and shape of the grains in a rock
- C Reflects changes in grain size and shape (i.e., deformation), rigid-body grain rotation, recrystallization, and fluid flow in rock
  <u>Mechanical, chemical, and fluid effects are important</u>

III Planar fabrics
- A Deformation induced layering; fabric elements parallel a common plane
- B Metamorphic foliation (visible alternation of layers of qtz & feldspar with mica, e.g., schistosity and layering in gneiss)

IV Linear fabrics
- A Fabric elements parallel a common line
- B Can be due to intersection of two non-parallel planar fabrics
- C Can reflect flow direction (e.g., in granites)
- D Can reflect the direction of principal elongation

V Penetrative vs. non-penetrative fabrics

A Penetrative: thoroughgoing (e.g., foliation in a schist)

B Non-Penetrative: localized (e.g., slickenlines on a fault plane)

VI Cleavage and folds

A Cleavage: Fabric in deformed, fine-grained rocks (e.g., ***slates***) where

1 Platy minerals are parallel to cleavage

2 Quartz is flattened

3 Quartz-feldspar-carbonate minerals associate into bands ("microlithons")

B Cleavage generally inferred to develop along plane parallel of flattening

C Changes in cleavage orientation reflect changes in the strain

D Folded rocks

1 Cleavage planes commonly parallel the fold axis; presumably folds and cleavage form contemporaneously. Strain varies with the curvature of folds, so cleavage should too.

2 Cleavage fans tend to converge towards places of highest curvature in folded rocks (see Fig. 29.2).

3 Because cleavage tends to form subparallel to axial planes, the cleavage-bedding angle can be used to locate fold hinges (see Fig. 29.2)

E Unfolded heterogeneous rocks:

Strain can vary on account of heterogeneity in a rock mass with higher strains in the more deformable material (i.e., lower Young's modulus or lower viscosity).

VII Comments on use of grain-scale observations

A Kinematics (sequence of deformations through time)

1 Cross-cutting relationships can be observed on the grain scale just as on the outcrop scale

2 Examples

B Absolute ages of deformation

1 Individual mineral grains can be dated using only mg of sample to assign a numerical age to deformation events.

2 Example: Fracture filings (URL and Sierra Nevada)

C Chemical changes accompanying deformation

1 The chemistry of a grain can now be analyzed at several points in an individual grain. When coupled with intragranular dating, changes in grain-scale chemistry can be tracked through time.

2 The chemistry of deformed and neighboring undeformed rocks can be examined to detect chemical changes and to infer mass loss accompanying deformation.

3 Examples: Chemistry of garnets, Martinsburg shale

D Changes in loading-temperature-fluid conditions

1 Textural changes in grain scale deformation can reflect transitions from ductile conditions (e.g., low strain rate, high temperature, high pressure) to brittle conditions (e.g., low strain rate, high temperature, high pressure)

2 Example: Sierra Nevada faults

E Pitfalls

1 Scale effects: Grain scale deformation is sensitive to grain-scale effects. The actions of nearby neighbors of comparable size are highly significant. Assumptions of homogeneity and continuity can break down.

2 Contamination: Minute amounts of contaminant can cause major changes in analytic results of grain-scale sampling

3 Examples: Grain-scale paleostress techniques, xenoliths

4 How does one address these pitfalls?

a Be alert to the variety of grain-scale effects that can occur

b Apply a technique at the appropriate scale

c Keep up with current developments in the literature

d Examine many samples statistically to separate "signal" from "noise"

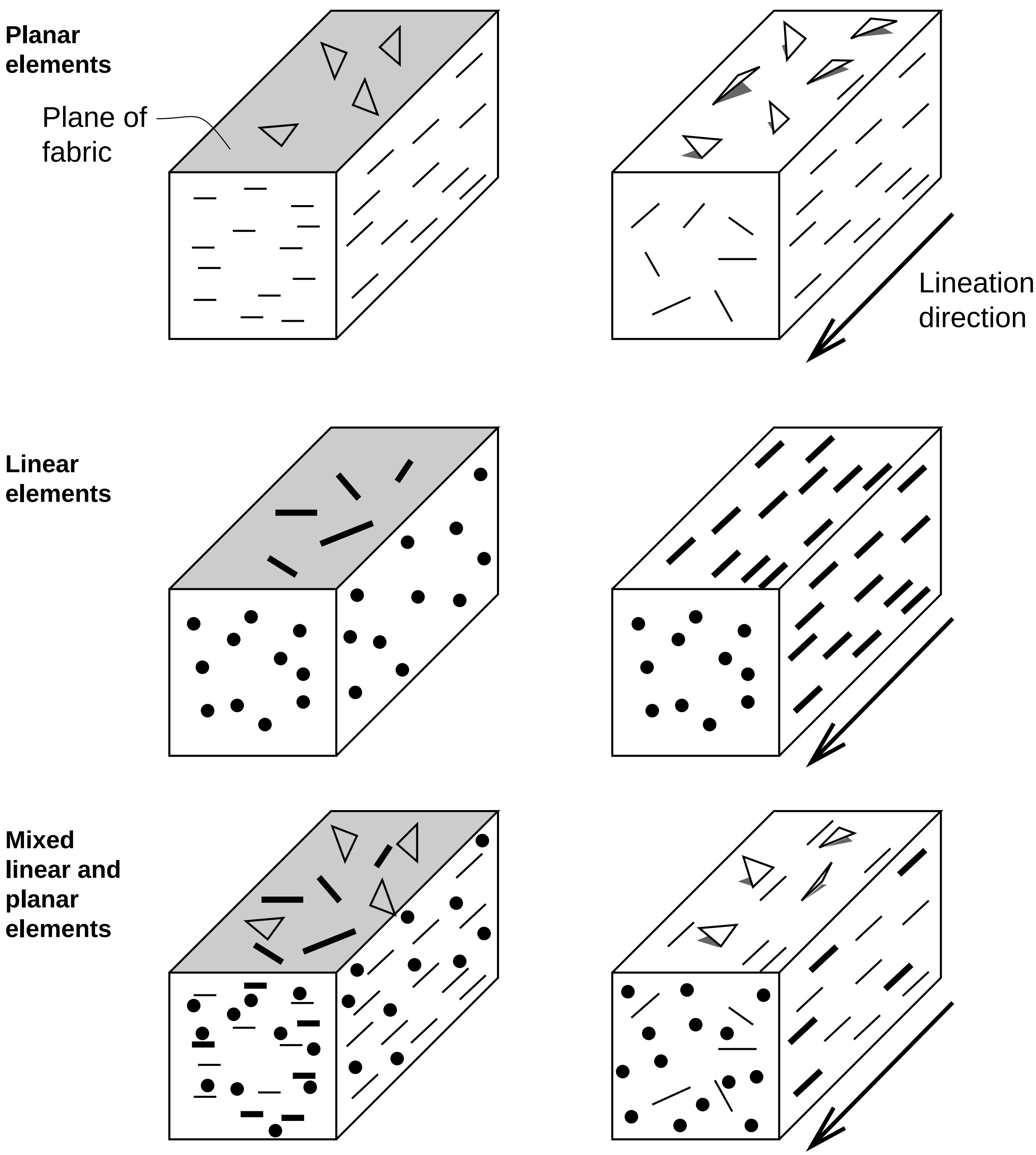
e Conduct analyses in a clean, careful, and systematic manner

APPEARANCES OF PLANAR AND LINEAR FABRICS Fig. 29.1

(More than one view is commonly needed!)

Planar Fabric
All elements parallel the fabric plane
Elements do not parallel a common line

Linear Fabric
All elements parallel a common line
Elements do not parallel a common plane



Cleavage in Folded Rocks

Fig. 29.2

(modified from Suppe, 1985)