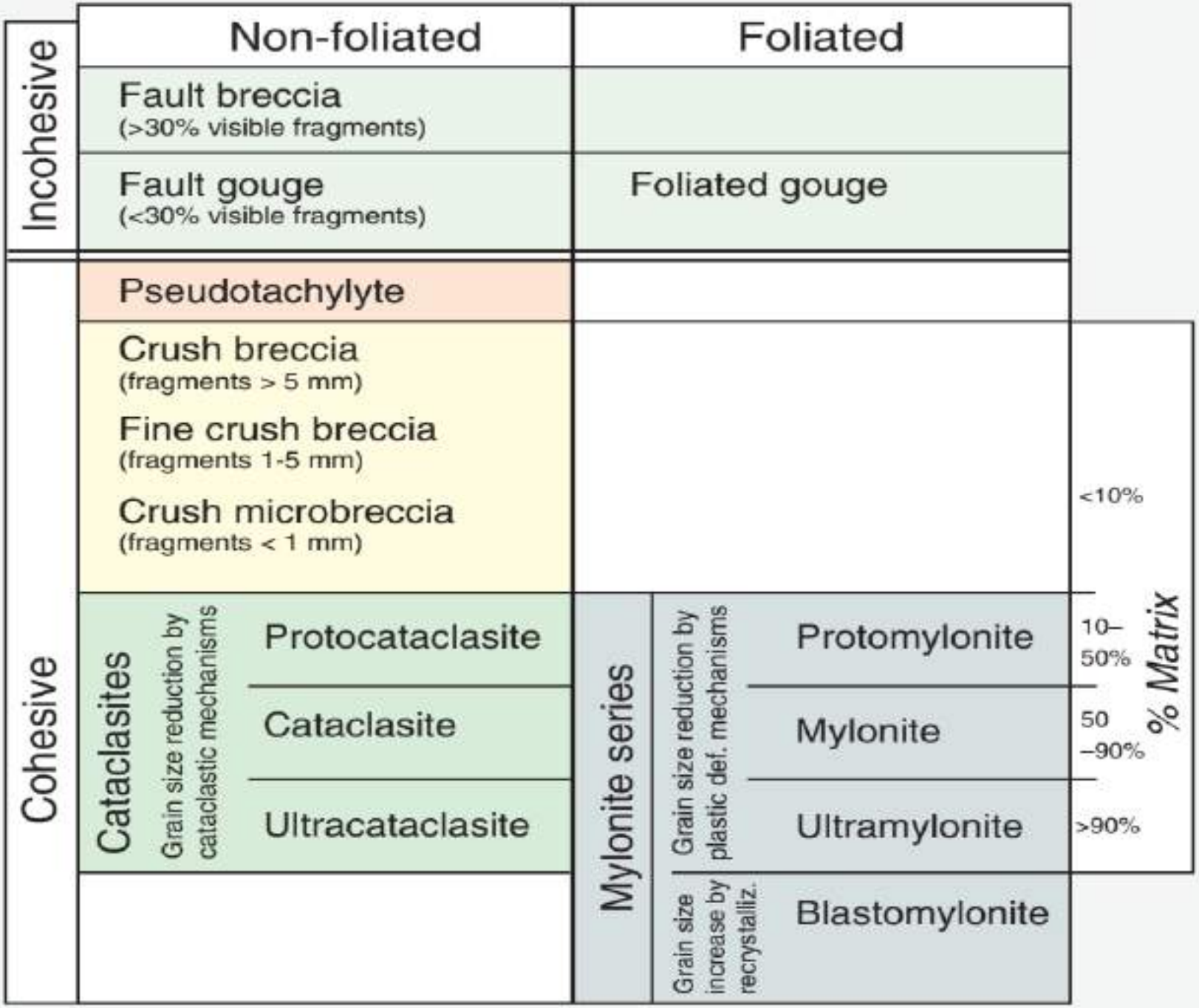
Structural Geology Part II

Fractures (Faults and Joints)

Mylonites, which are not really fault rocks although loosely referred to as such by Sibson, are subdivided based on the amount of large, original grains and recrystallized matrix. Mylonites are well foliated and commonly also lineated and show abundant evidence of plastic deformation mechanisms rather than frictional sliding and grain crushing.

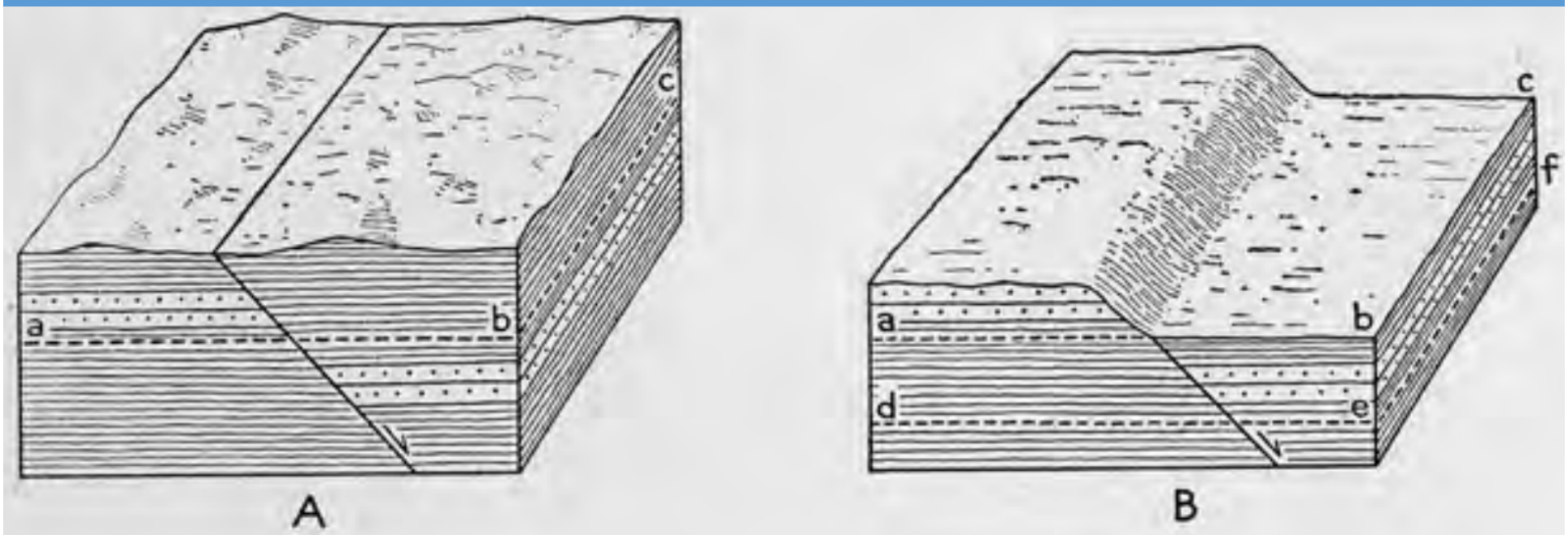
They form at greater depths and temperatures than cataclasites and other fault rocks; above 300 C for quartz-rich rocks.

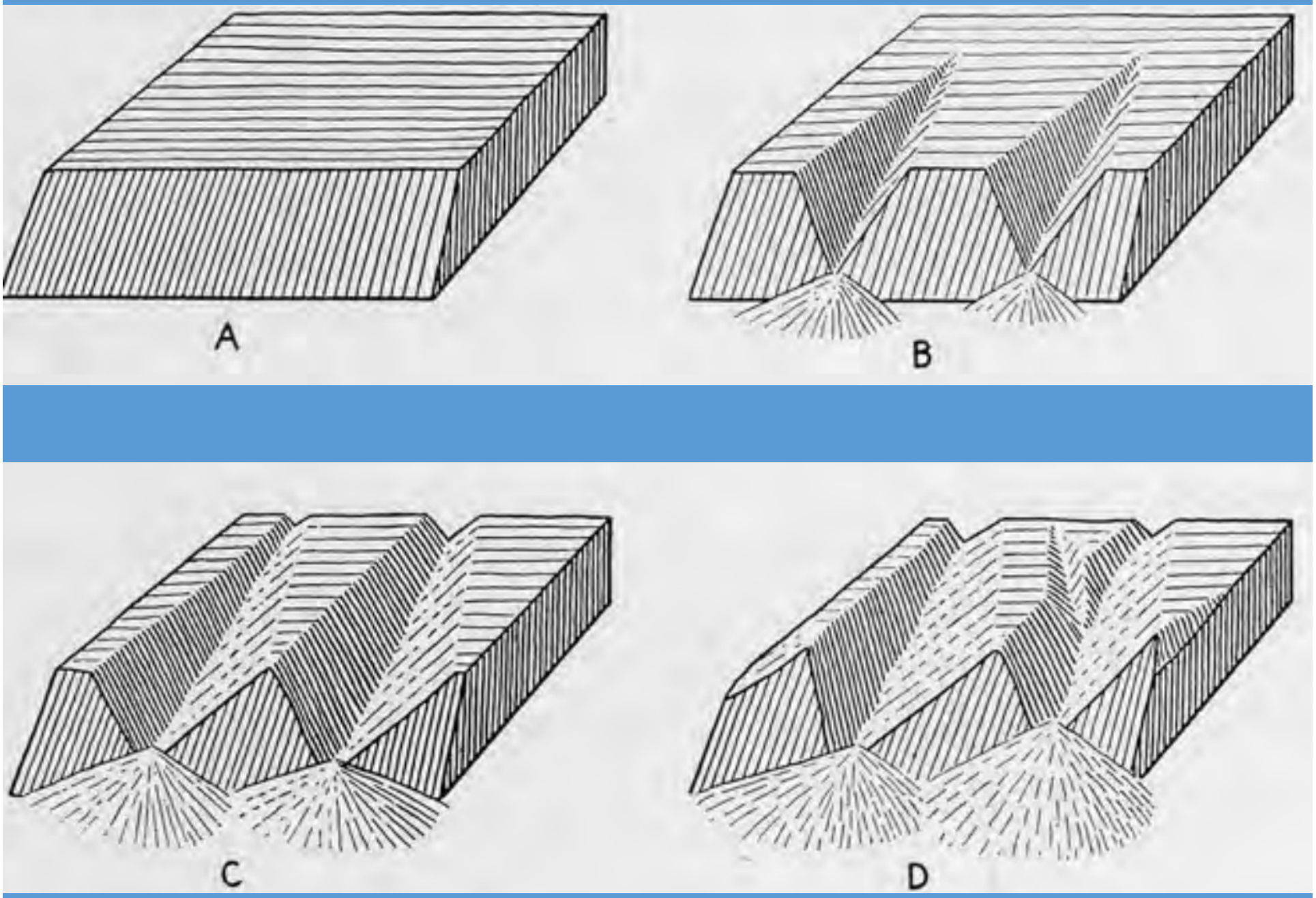
The blastomylonite, is a mylonite that has recrystallized after the deformation .


Incohesive
Cohesive
Non-foliated
Foliated
Fault breccia
(>30% visible fragments)
Fault gouge
(<30% visible fragments)
Foliated gouge
Pseudotachylyte
Crush breccia
(fragments > 5 mm)
Fine crush breccia
(fragments 1-5 mm)
Crush microbreccia
(fragments < 1 mm)
Cataclasites
Grain size reduction by cataclastic mechanisms
Protocataclasite
Cataclasite
Ultracataclasite
Mylonite series
Grain size reduction by plastic def. mechanisms
Protomylonite
Mylonite
Ultramylonite
Grain size increase by recrystalliz.
Blastomylonite
<10%
10–50%
50–90%
>90%
% Matrix

How to Identify faults in field ?

1. Discontinuity of structures.
2. Presence of slicken structures
3. Presence of Cataclasites
4. Presence of Fault braccias
5. Presence of horses and slice
6. Repetition and omission of strata.
7. Silicification and mineralization
8. Trellis drainage pattern
9. Abrupt change in sedimentological facies.
10. Physiographic features
    1. Offset ridge
    2. Scrap
        1. Fault scrap
        2. Fault line
        3. Triangular facets


a
b
c
A
a
b
c
d
e
f
B


A
B
C
D

Joints

Joints are defined as fractures of geological origin along which no appreciable displacement has occurred.

Joints occurs generally in parallel or sub parallel called *joint set*.

Classification of Joints:

Tension joints:
Tension joints are those, which are formed as a result of tension forces. These joints are relatively open and have rough and irregular surfaces.

Shear joints:
These are joints associated with deformed rocks especially folded rocks. These joints occur as intersecting or crisscrossing sets at a high angle. These joints are referred to as conjugate joint system.

Mural Joints:
These joints are common in granites and related plutonic rocks and some hypabyssal rocks. These joints appear in a three dimensional network, the joint sets being mutually perpendicular to each other. The joints break the rock into separate somewhat cubical blocks.

Sheet Joints:
These joints also are seen in granites and other plutonic rocks. In this case there is one set of prominent joints parallel to the ground surface whose spacing generally increase with depth and a second set running at right angles.

Columnar Joints:
These joints are seen in basalts and some other volcanic igneous rocks. They consist of vertical and horizontal joints separating the rock body into a number of vertical polygonal (quite often hexagonal prismatic columns). When the horizontal lavas cool weak planes are developed by radial contraction causing these joints.

Stylolitic joints

Stylolitic joints have a characteristic saw-tooth profile and an interdigitating cone-like form in three dimensions. The interlocking ‘teeth’ are normal or oblique to the joint surface. Stylolitic joints are form due to deformation mechanism is called **pressure solution**. Stylolites are particularly common in limestone.

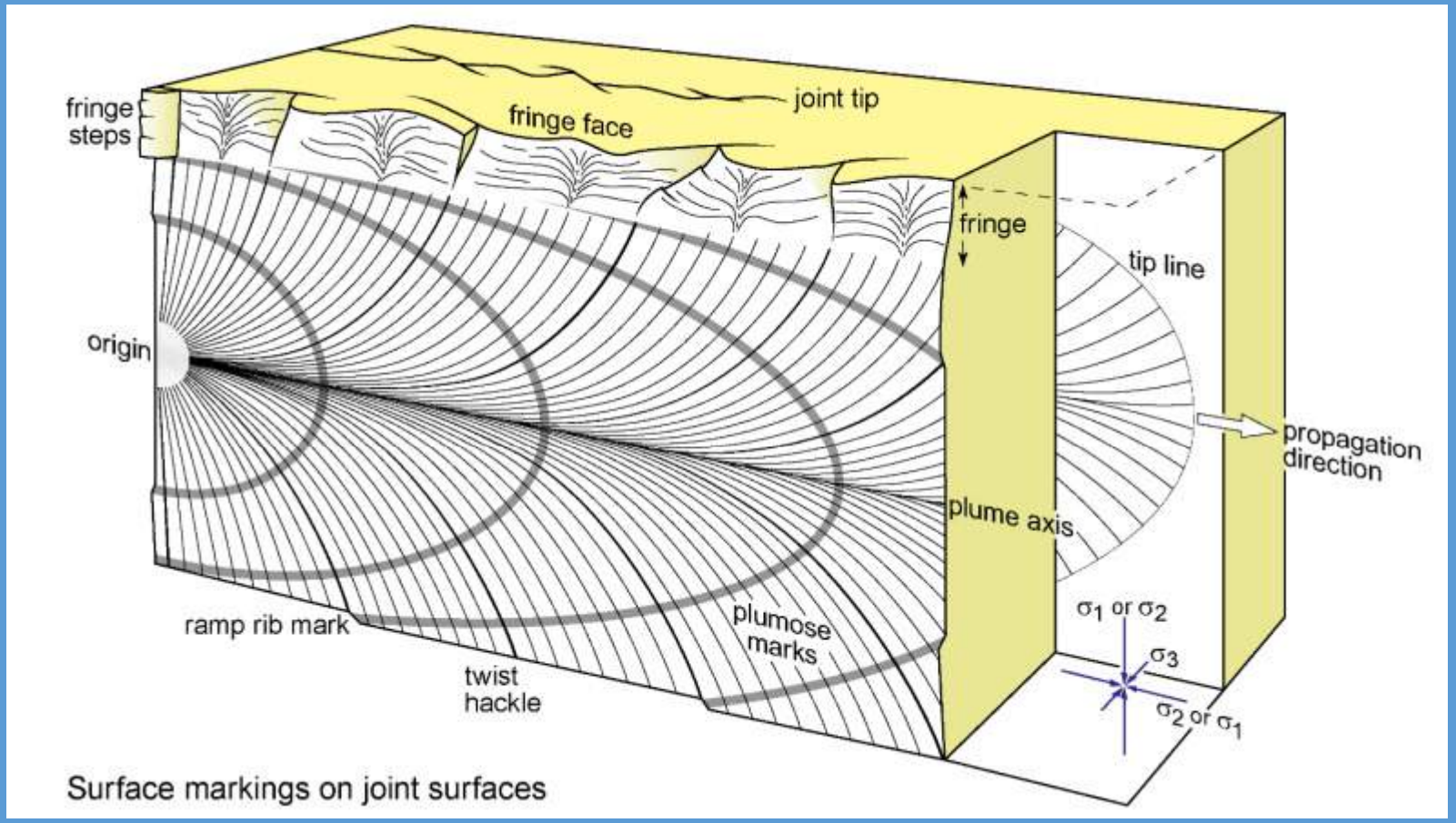
Exfoliation joints or **sheet joints** are surface-parallel fracture systems in rock, and often leading to erosion of concentric slabs.

Plumose structures:

Plumose structures are aggregates of gentle, curvilinear undulations (the **hackle marks**) that radiate from the point where the joint originated and fan outward from a generally straight, more rarely curved axial line, then resembling the shape and imprint of a feather. The **origin** commonly is some rock heterogeneity such as ripples on bedding planes or inclusions (concretion, nodule, clast, fossil, etc.) in beds. Hackles are often very fine near the joint origin.

Hackles diverge sharply at angles of about 30° from the central axis, gradually curving to angles of about 70° near the margins of the joint surface. The scale of plumose patterns seems to depend on the grain size of the rock.

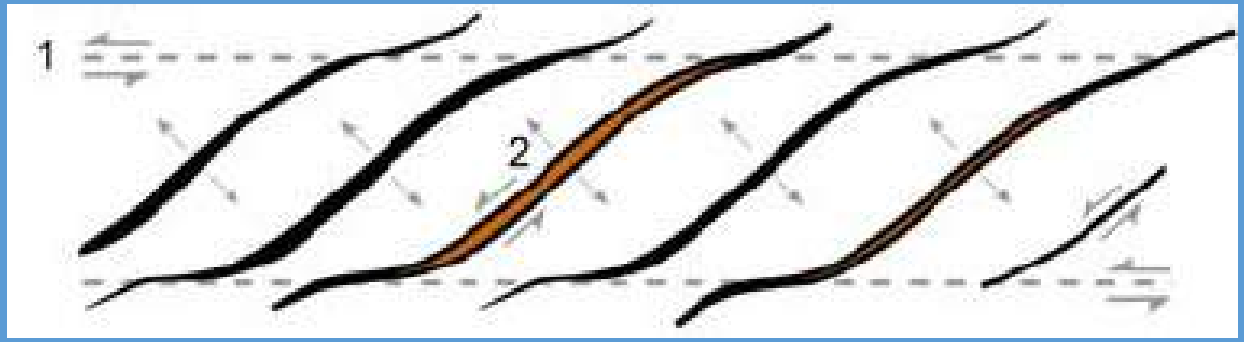
Rib-marks form a series of regular, concentric and arcuate changes or ramps in the orientation of the joint surface, giving cuspate, waveforms or rounded ridges or furrows.



Surface markings on joint surfaces

en echelon

The term '**en echelon**' refers to closely-spaced, parallel or subparallel, overlapping or step-like minor structural features in rock (faults, tension fractures).



pinnate fractures

Extension fractures that occur along a fault as en échelon arrays pattern that point in the direction of fault movement.