Le strutture duttili

Da Ramsay and Huber, 1987

Immagini e fotografie tratte da:

- Barker A.J., 1990. Introduction to Metamorphic Structures and Microstructures. Chapman & Hall.
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Da Ramsay and Huber, 1987

Le strutture duttili

CARATTERISTICHE:

1) Deformazione continua
2) Comportamento duttile della roccia

TIPI:

1) Strutture da deformazione omogenea *(variazione forma oggetti, boudinage)*

2) Fabric *(foliazione, scistosità, clivaggio da crenulazione, lineazioni)*

3) Strutture da deformazione disomogenea (eterogenea) *(interazioni oggetti-matrice, zone di taglio duttile)*

Deformazione di oggetti

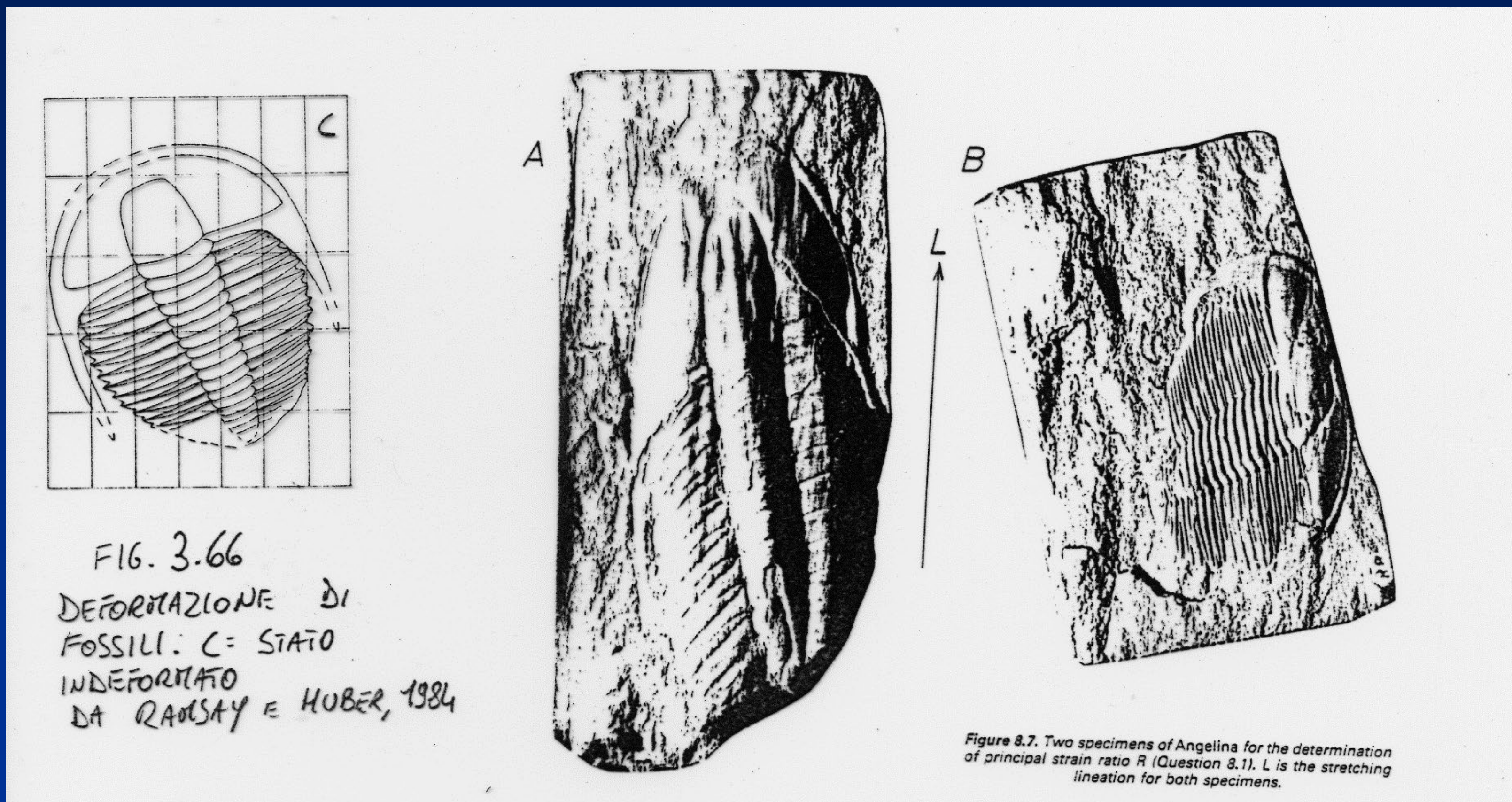
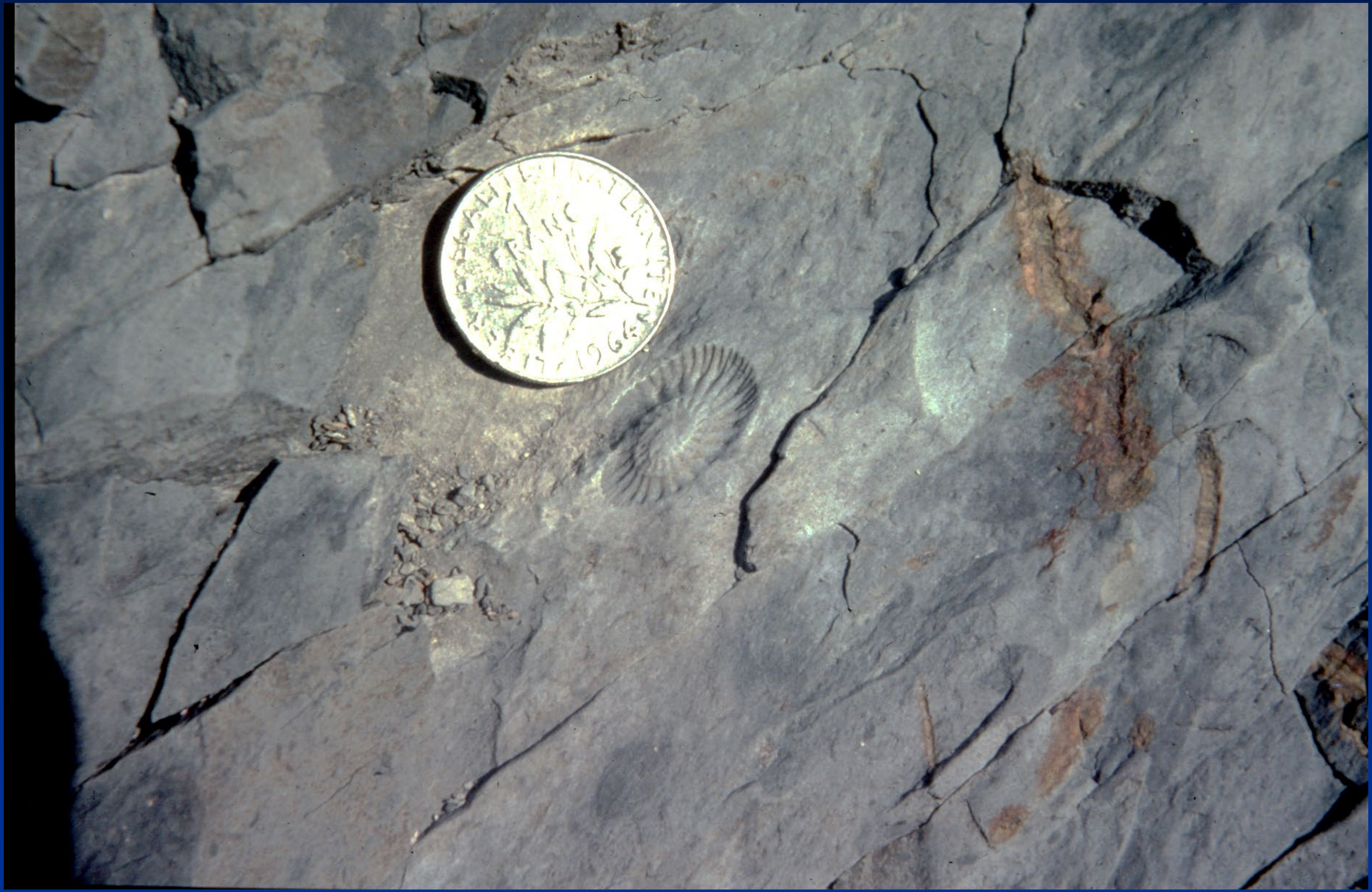


Figure 8.7. *Two specimens of Angelina for the determination of principal strain ratio R (Question 8.1). L is the stretching lineation for both specimens.*



Da Ramsay and Huber, 1987

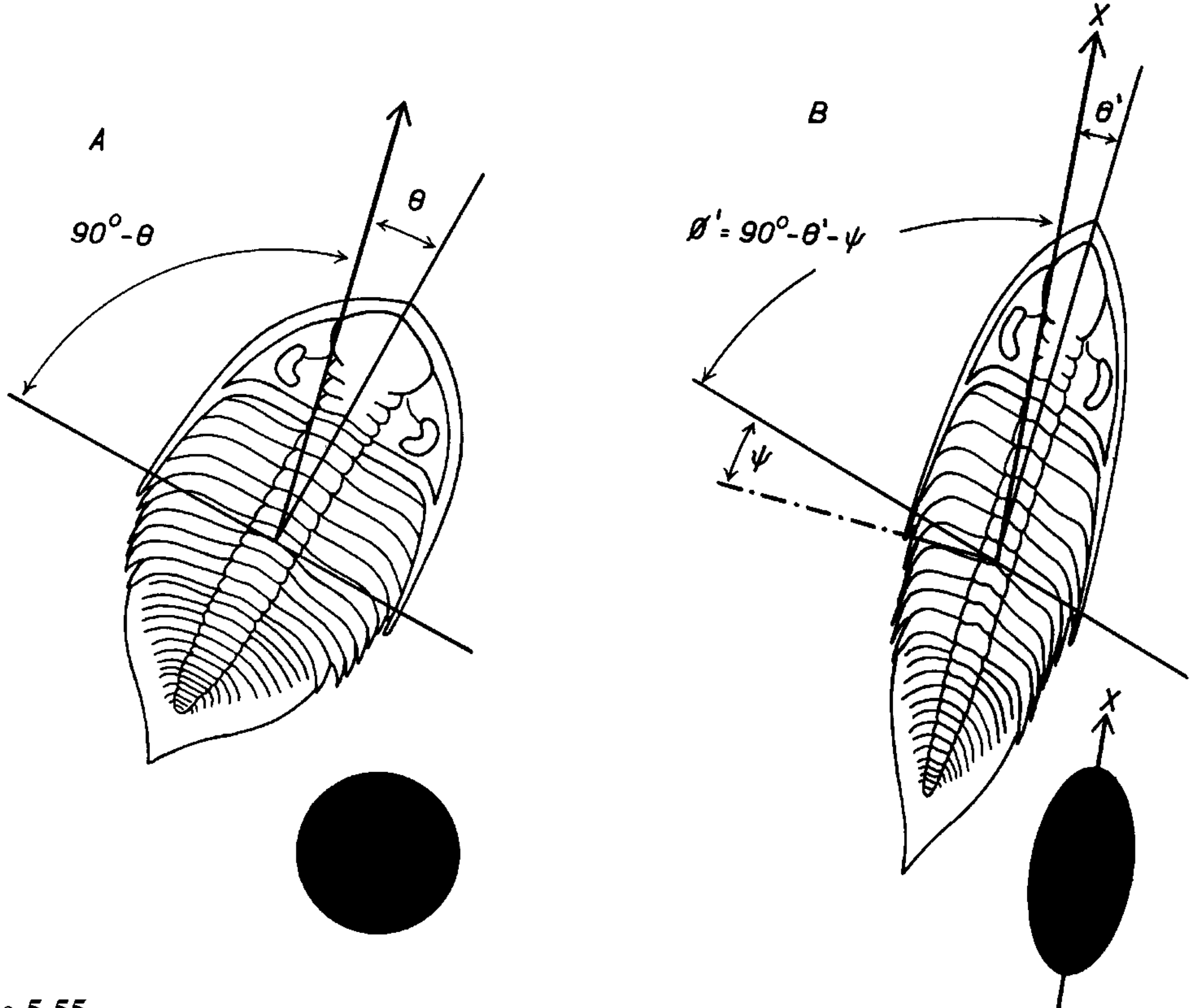


Figure 5-55

Changes in angle within an originally bilaterally symmetric fossil (A) as a result of strain (B). X is the direction of principal extensive strain, and ψ the angular shearing strain.

Da Ramsay, 1967

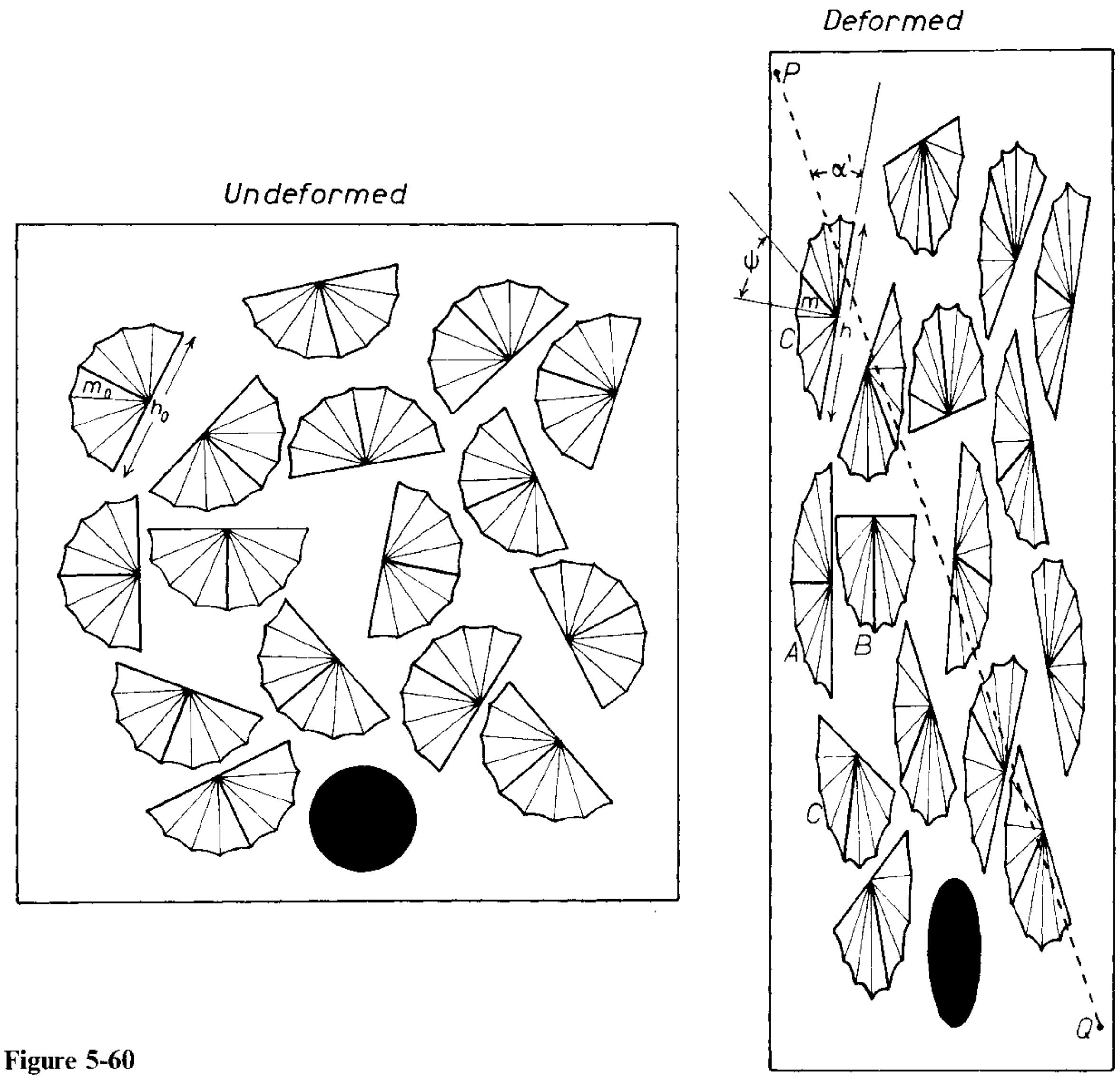


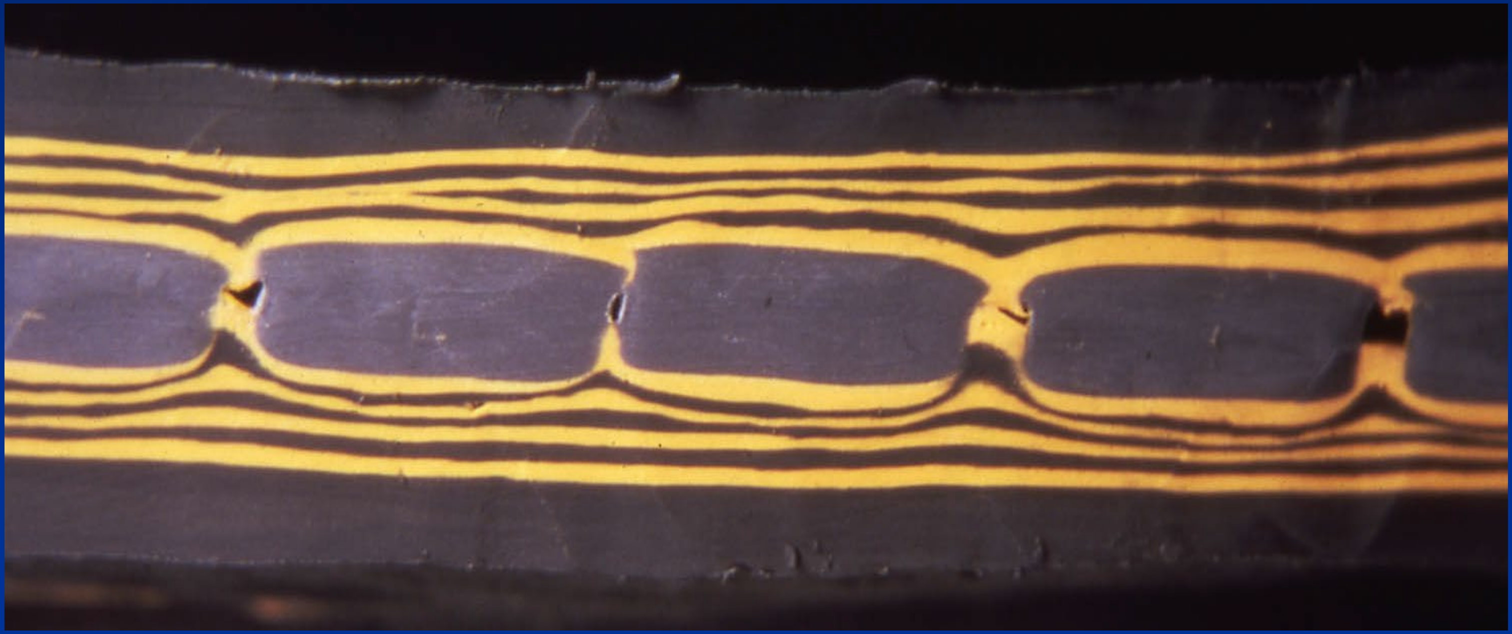
Figure 5-60

The shape changes in an assemblage of equal-sized, bilaterally symmetric fossils as a result of homogeneous strain. A is in the broad form, B the narrow form, and C the oblique form.

Da Ramsay, 1967

Da Ramsay and Huber, 1987

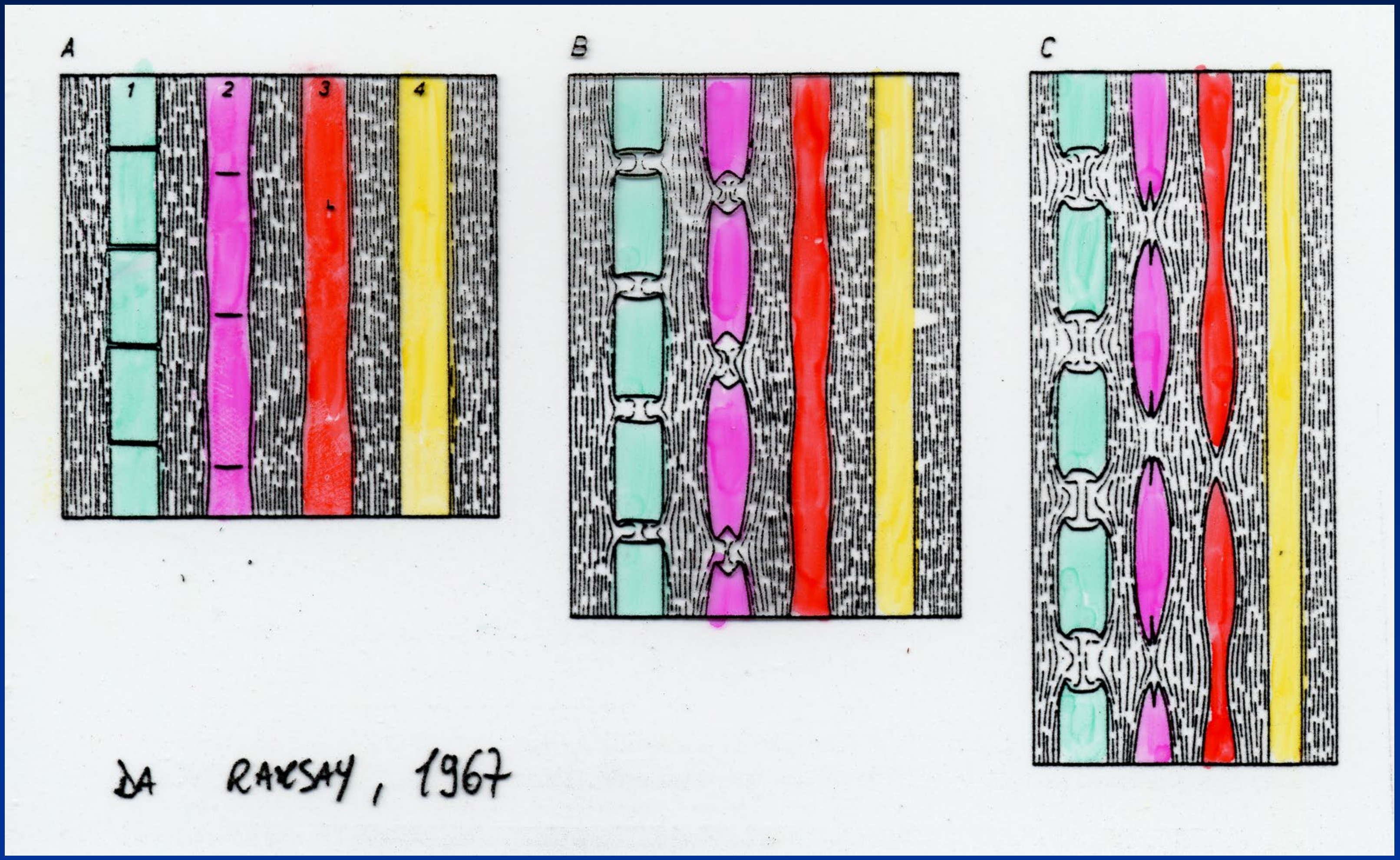
Da Ramsay and Huber, 1987



Da Ramsay and Huber, 1987

Da Ramsay and Huber, 1987

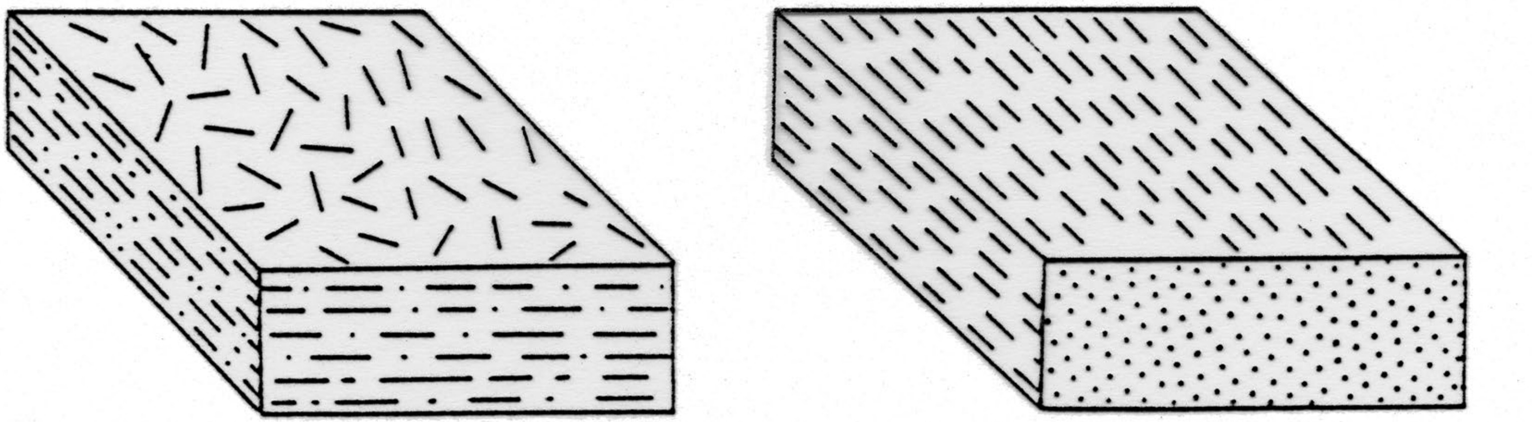
Boudinage



Boudinage asimmetrico


Chocolate boudinage

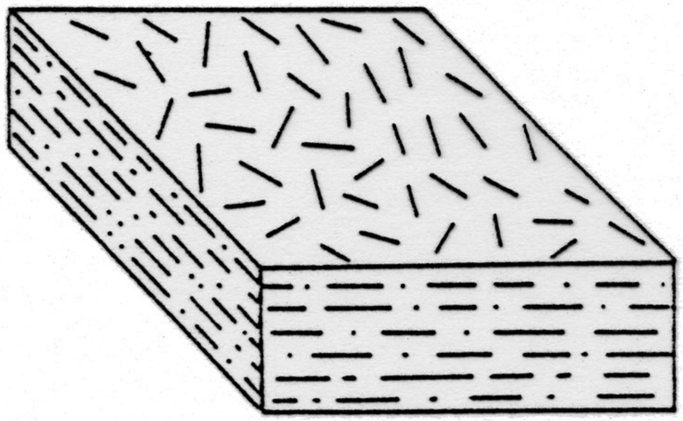
Fabric, foliazione, lineazione



Schematic block diagrams to illustrate the difference between S-tectonites (a) with a pronounced foliation (planar texture), and L-tectonites (b) with a pronounced lineation (linear texture). Metamorphic rocks such as schists and mylonites are generally L–S-tectonites, and have both a linear and planar component.

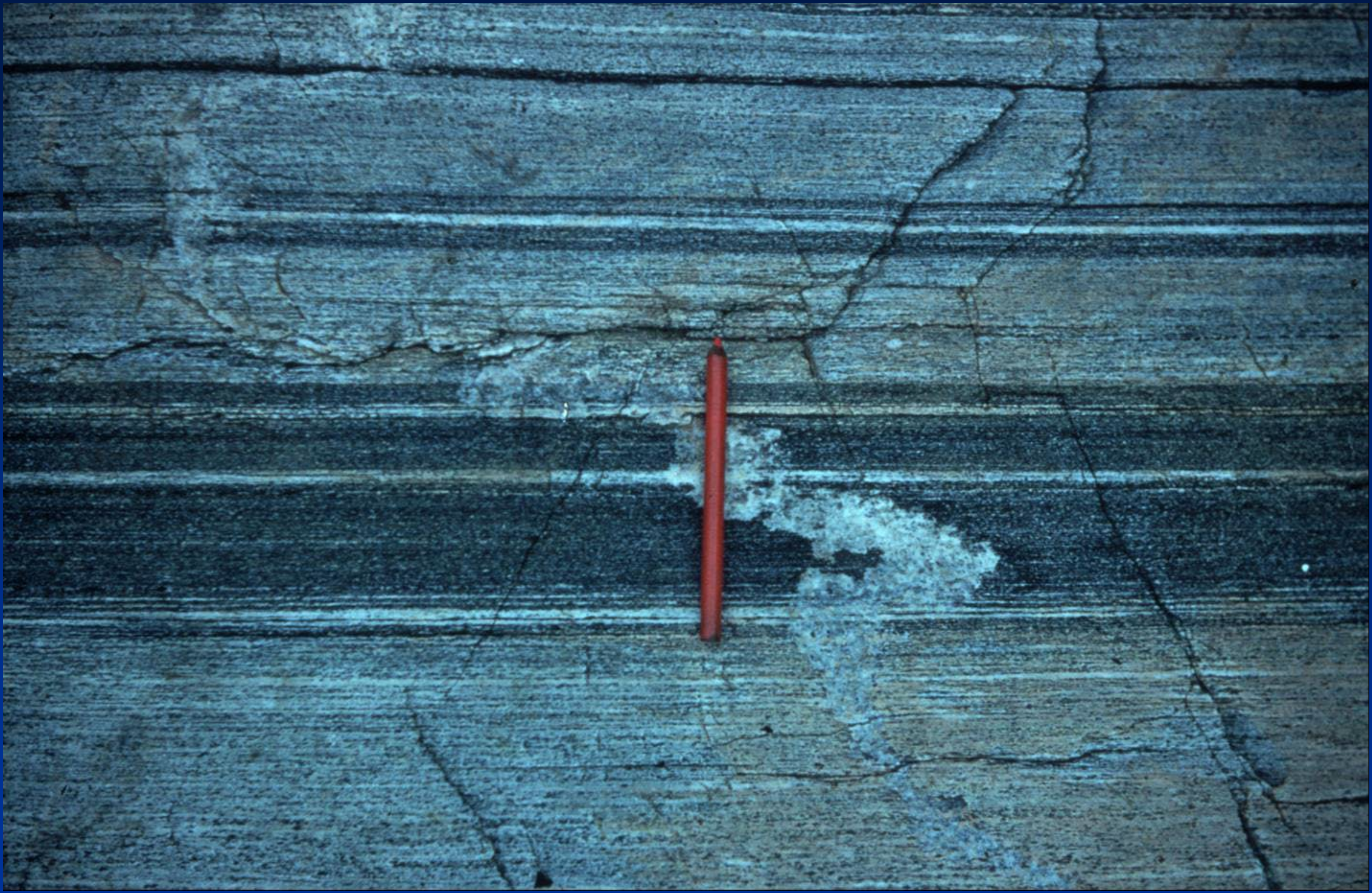
Da Barker, 1990

Fabric, foliazione



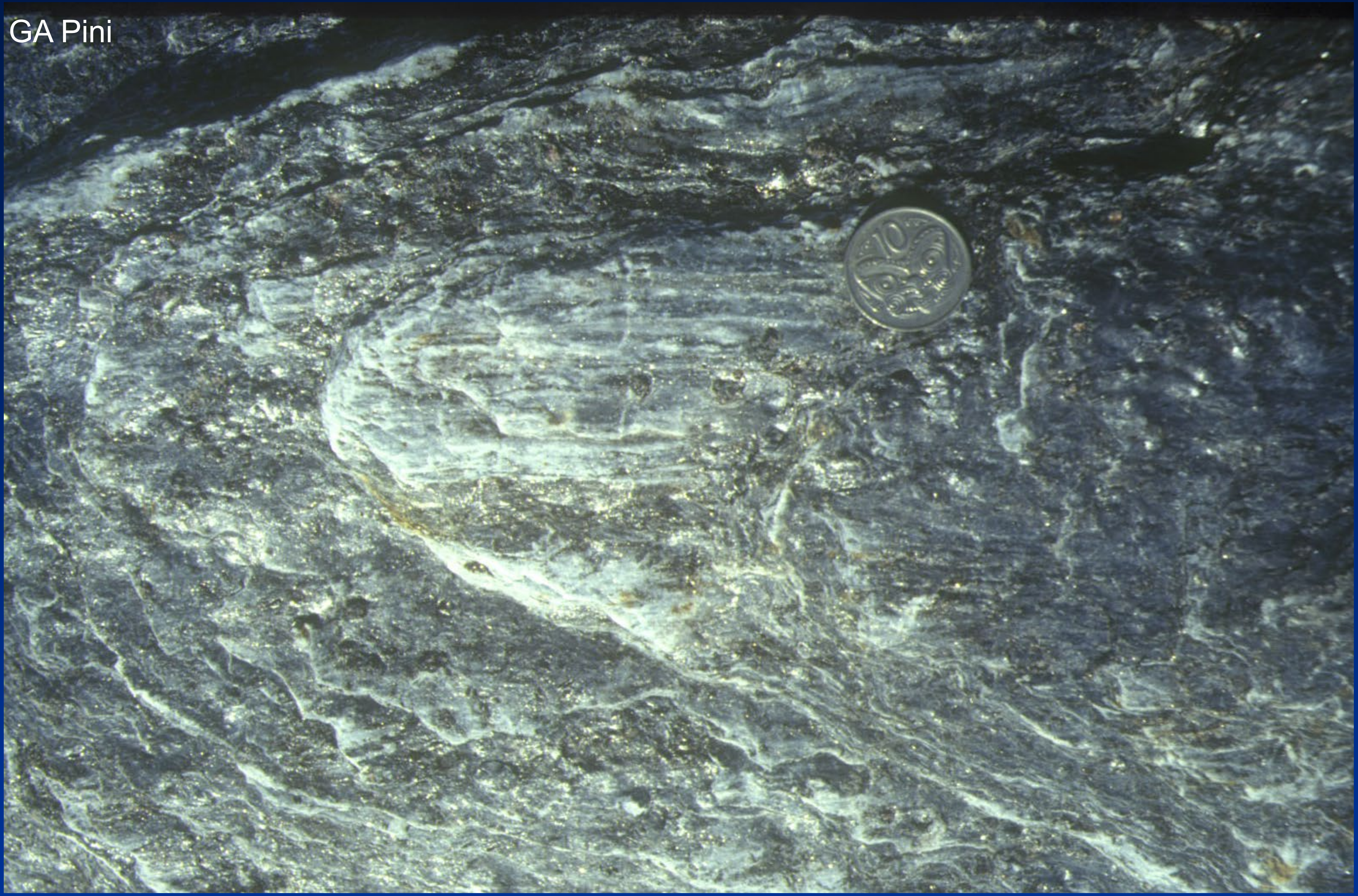
Schematic block diagrams to illustra
pronounced foliation (planar texture), and L-tec
texture). Metamorphic rocks such as schists and r
both a linear and planar component.

Da Barker, 1990



Da Ramsay & Huber, 1987

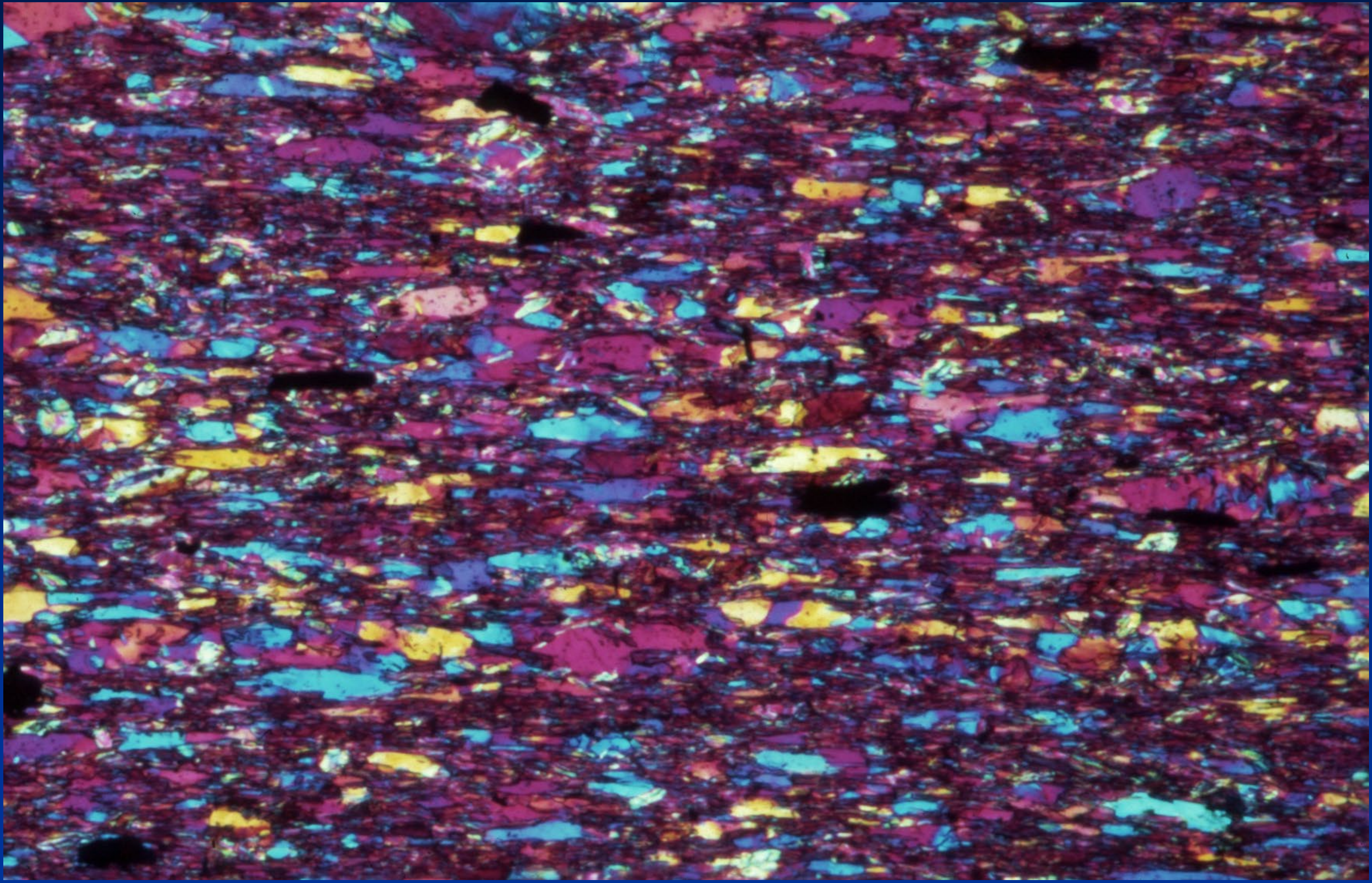

GA Pini
ONE DOLLAR


GA Pini

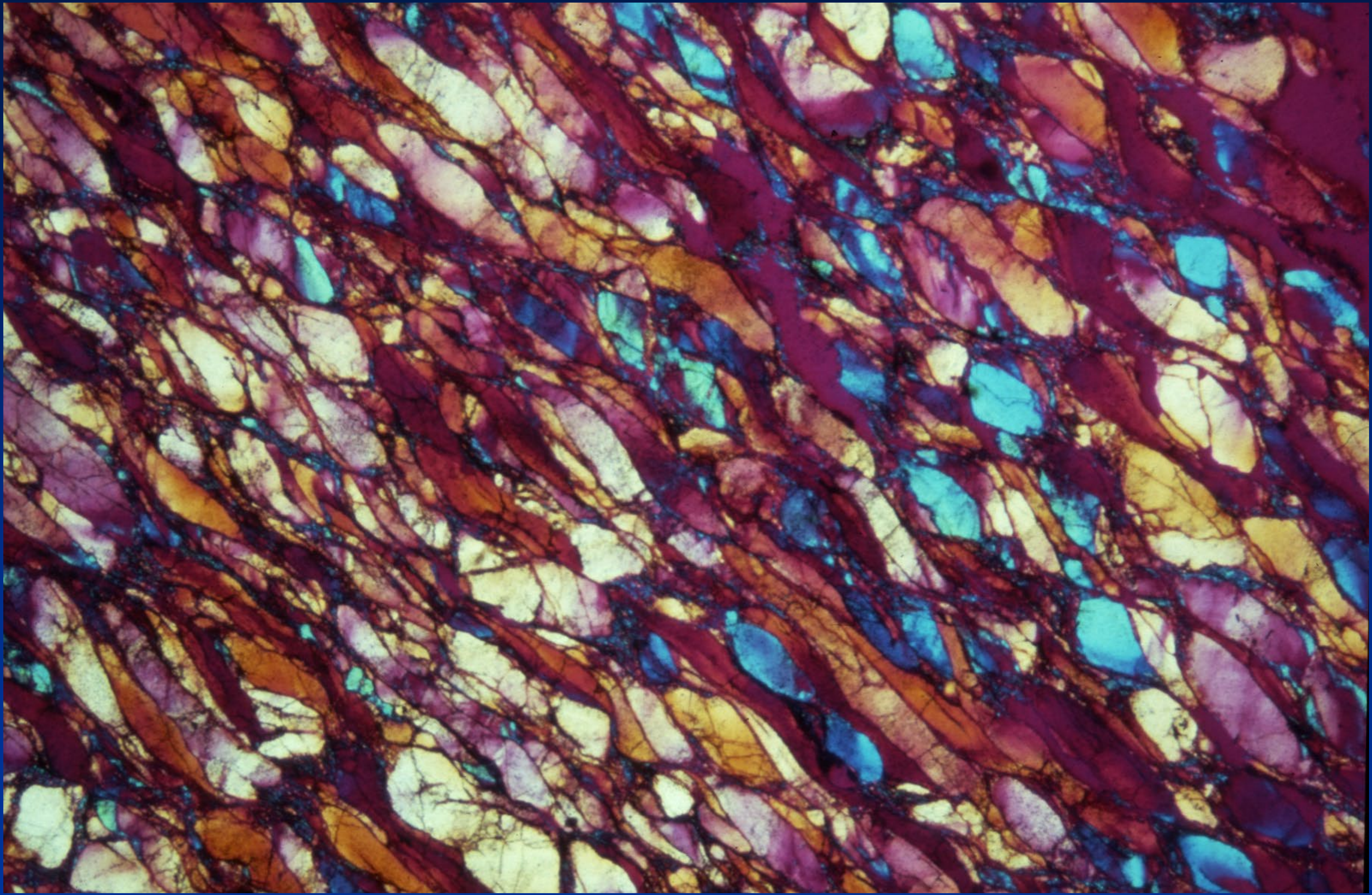
Da Ramsay & Huber, 1984

Da Ramsay and Huber, 1984

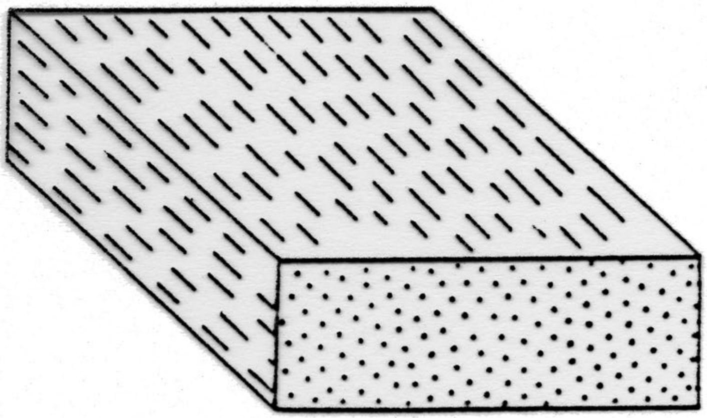
Slaty cleavage



Gneis foliation (o scistosità)



Fabric, lineazione

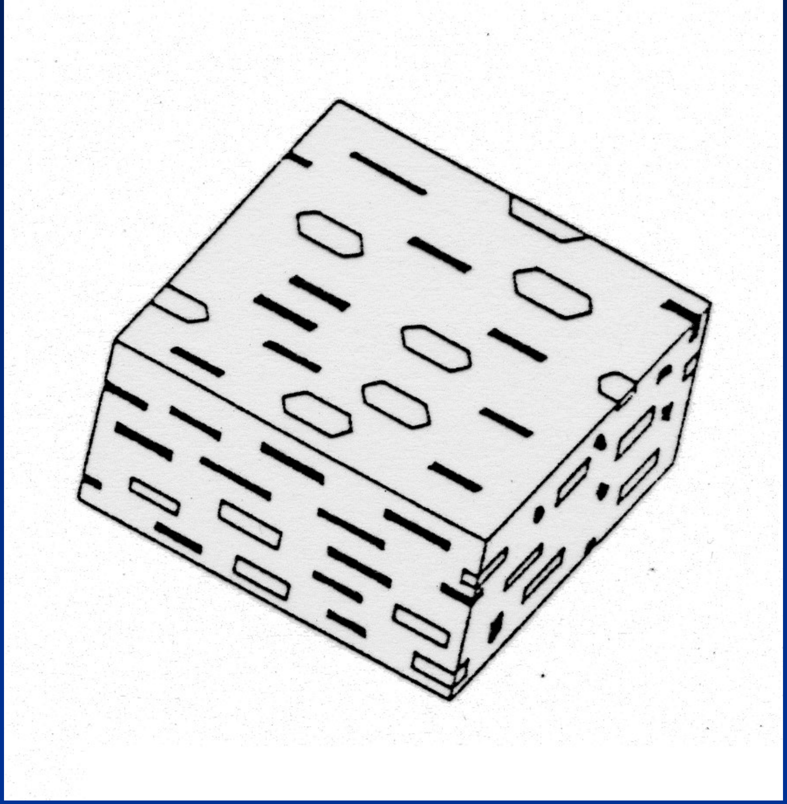


strate the difference between S-tectonites (a) with a
-tectonites (b) with a pronounced lineation (linear
nd mylonites are generally L–S-tectonites, and have

Da Barker, 1990

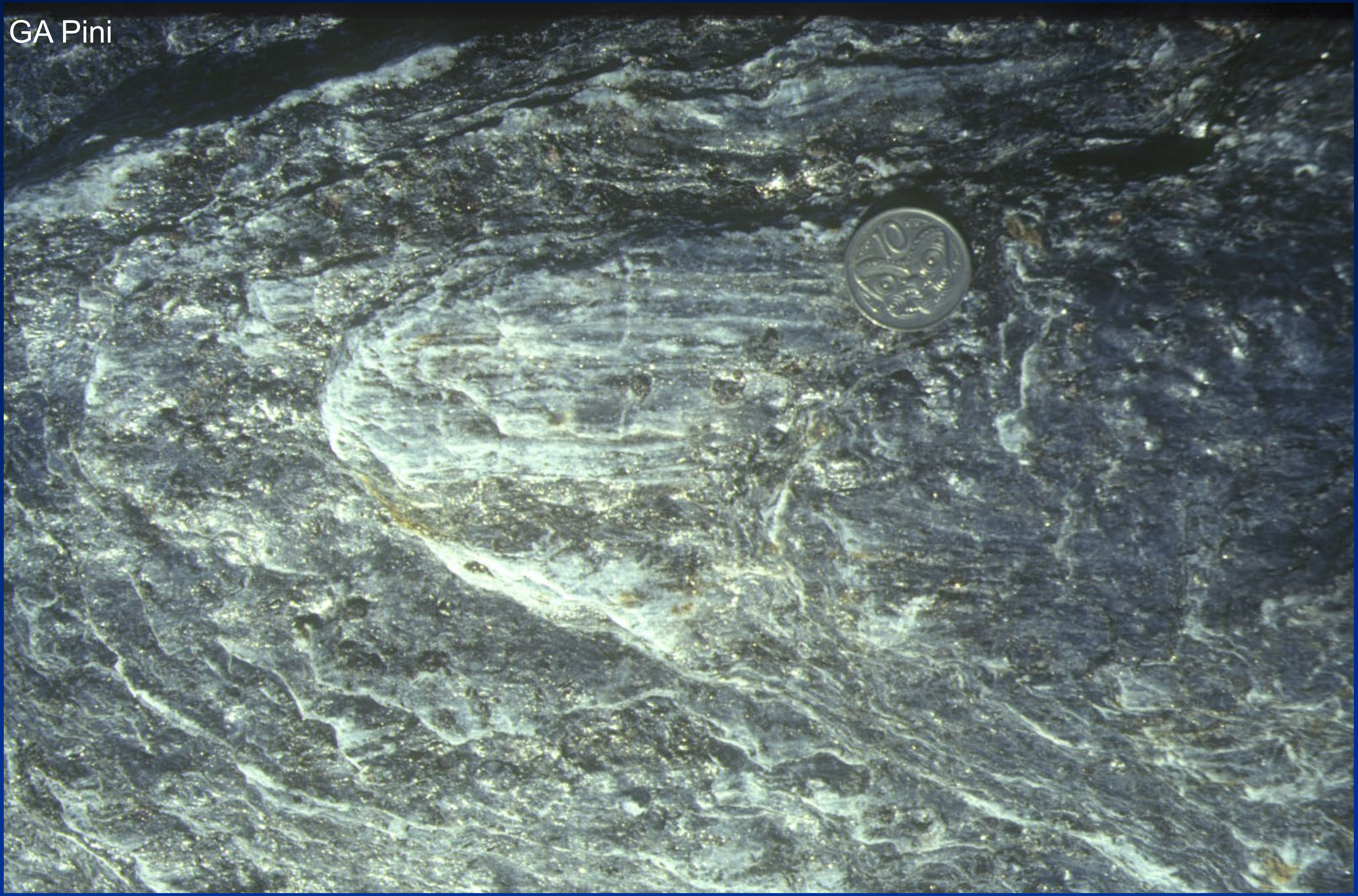
Lineazioni

Foliazione+lineazione (S-L)

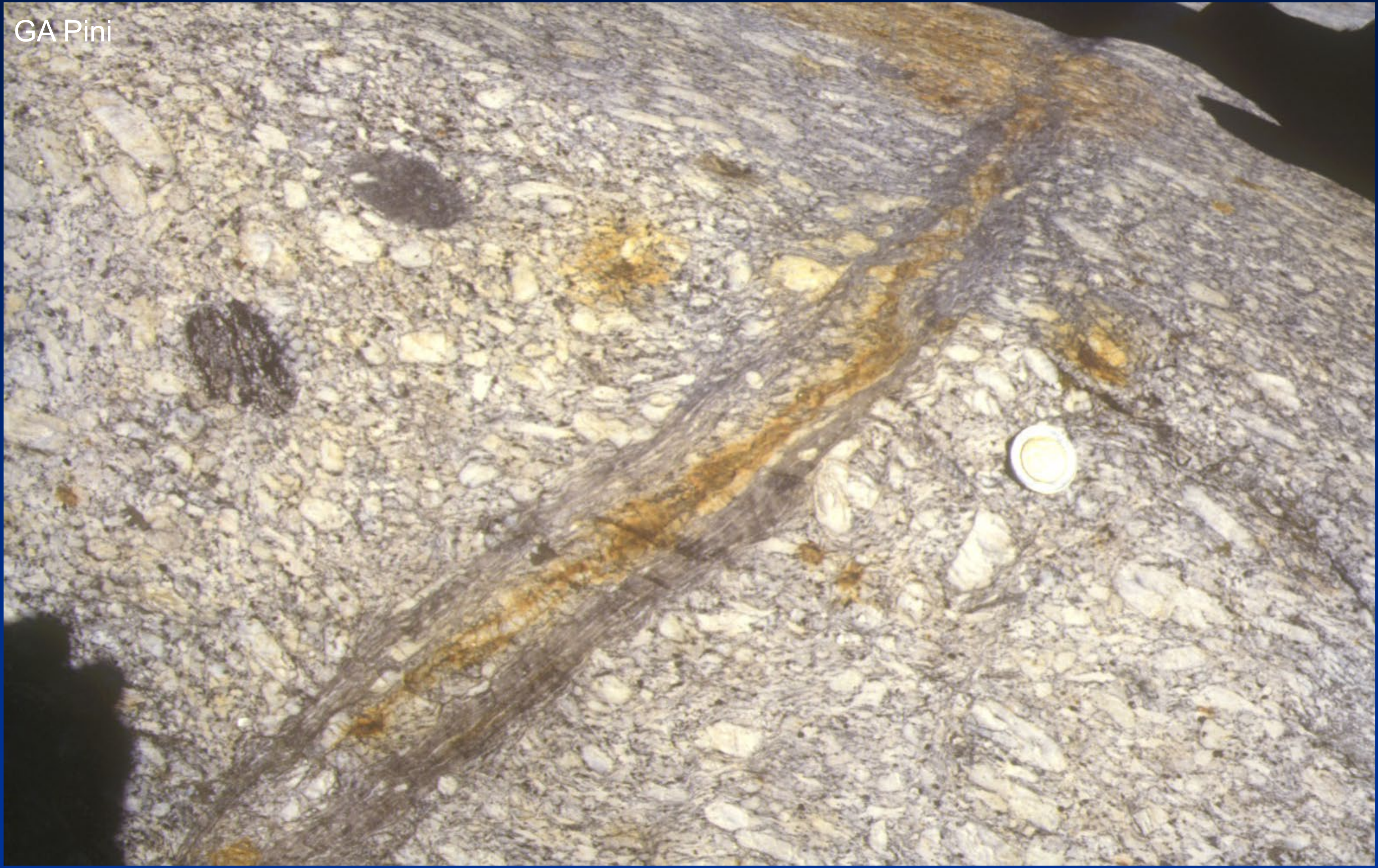


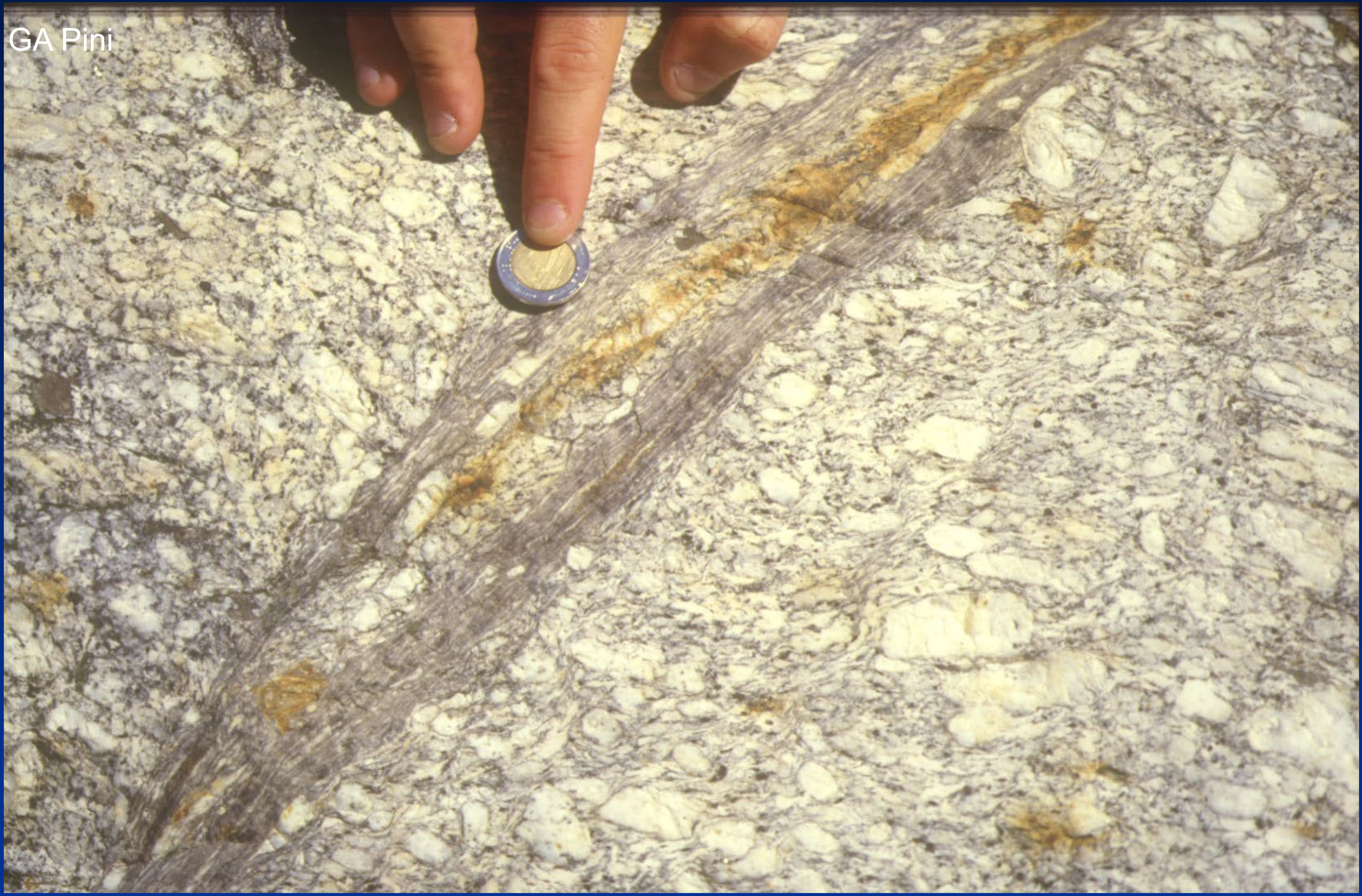
Da Nicolas, 1984

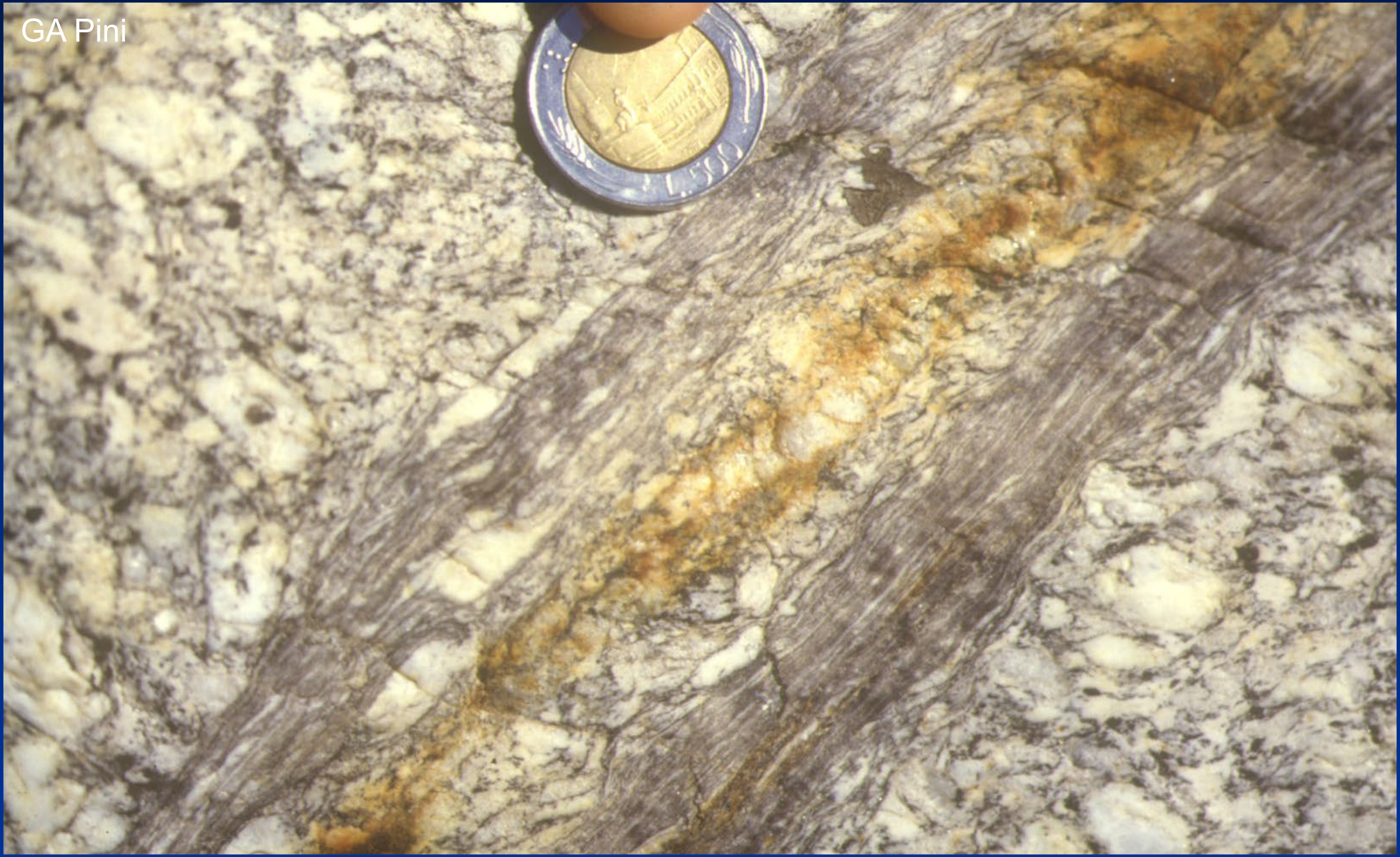

GA Pini
ONE DOLLAR


GA Pini

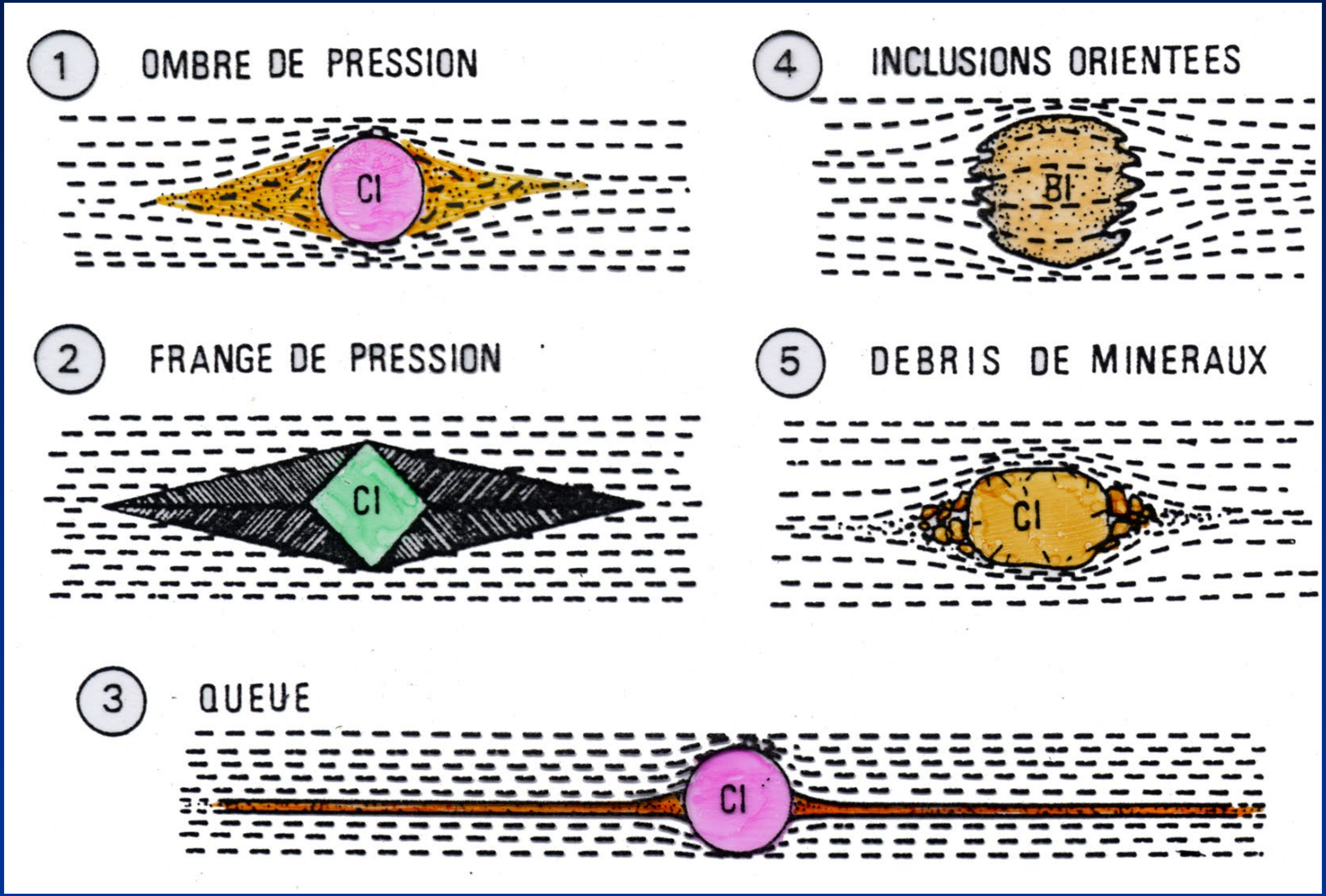
Strutture da deformazione disomogenea



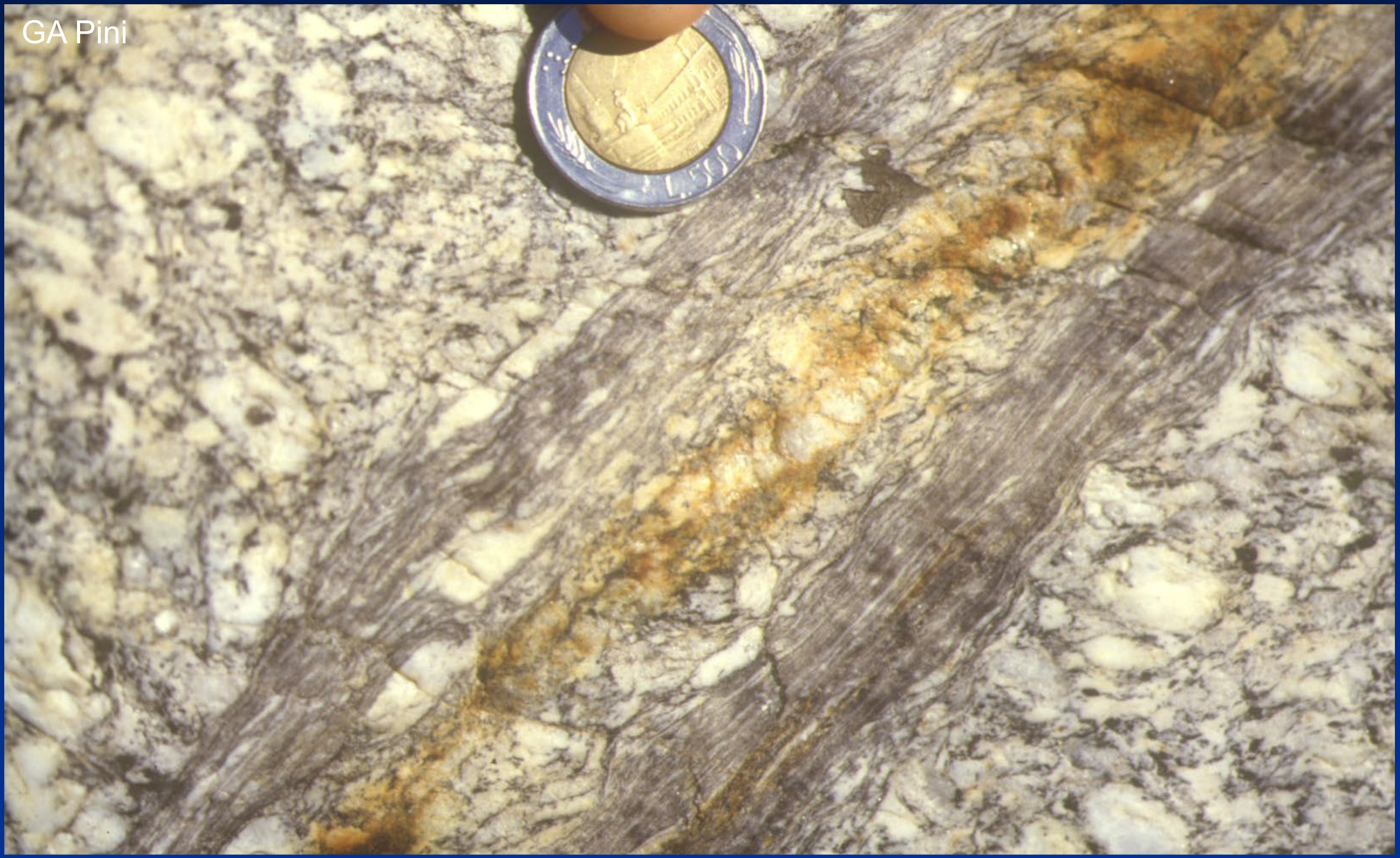

GA Pini


GA Pini

Strutture da deformazione disomogenea



Da Mercier & Vergely,1995


GA Pini

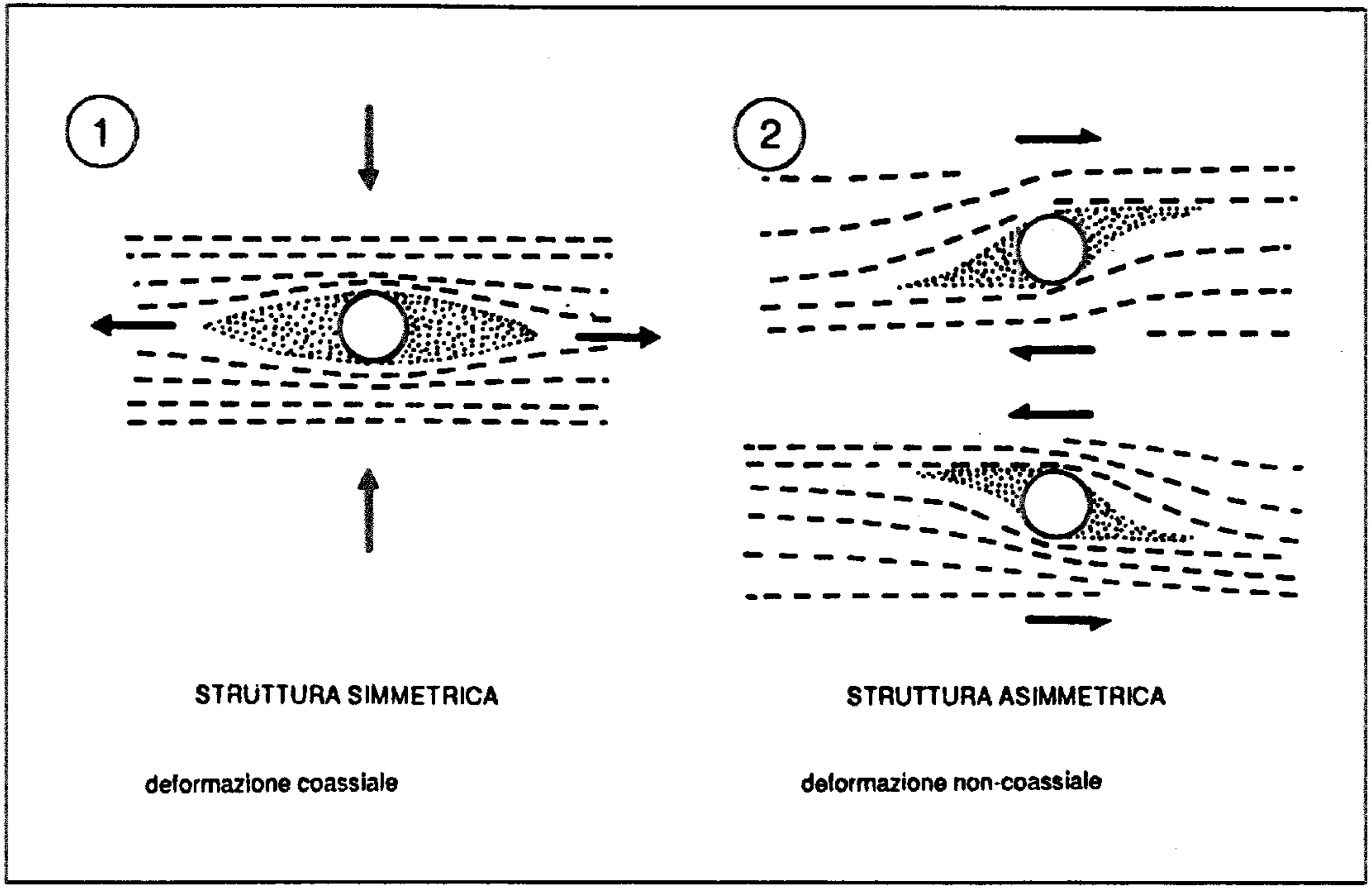
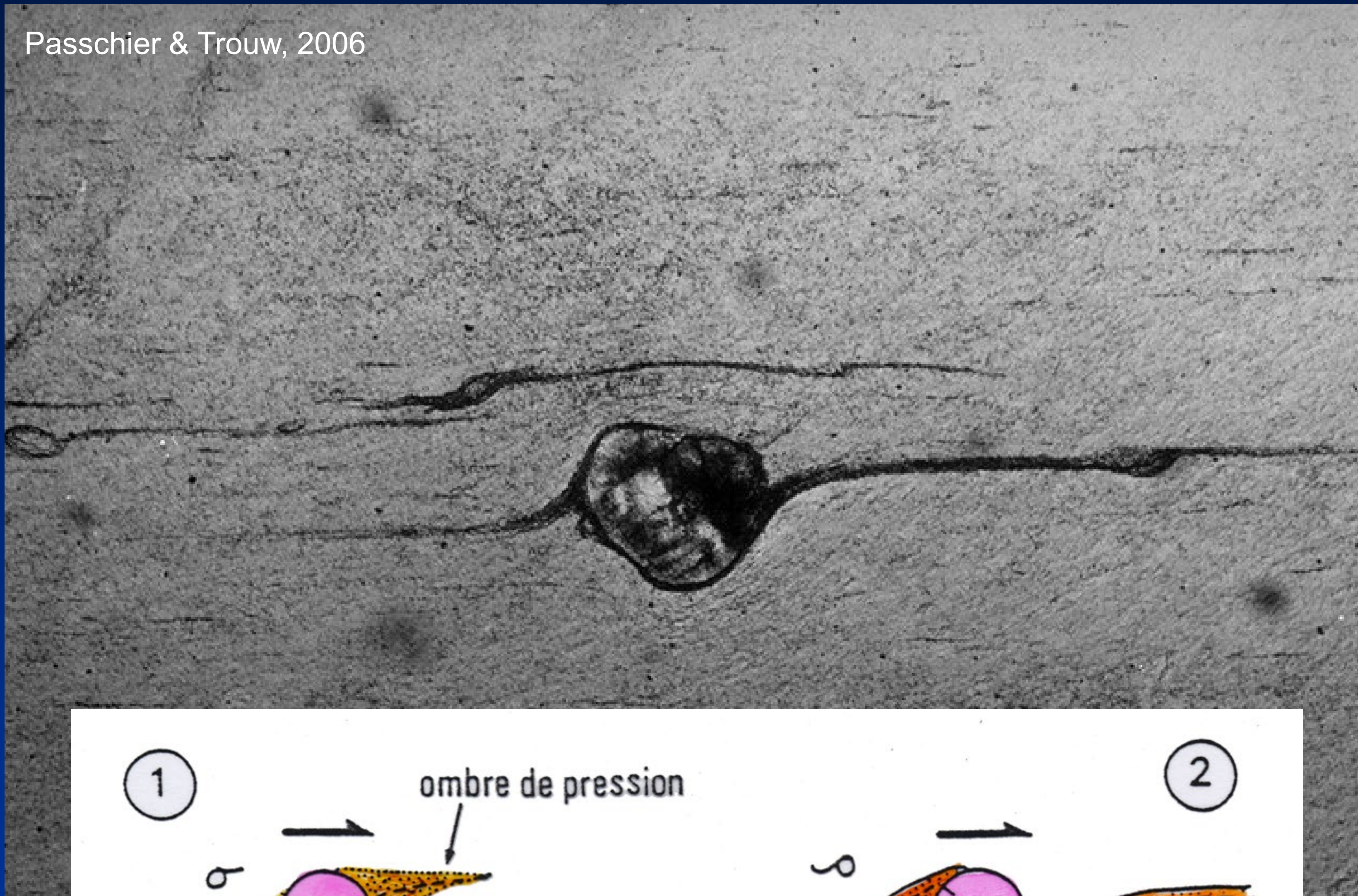


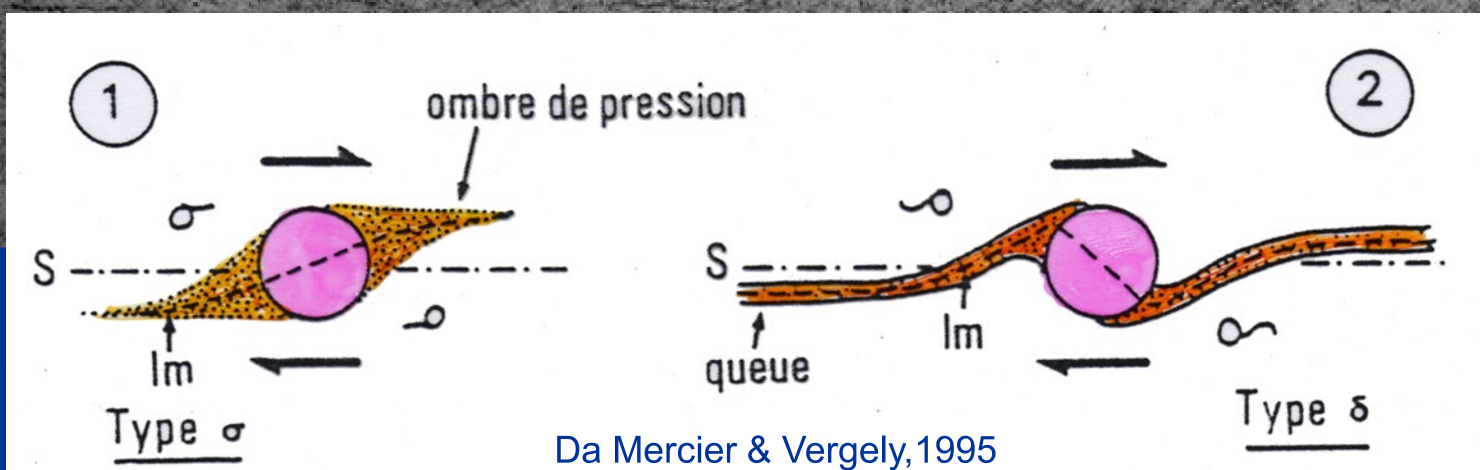
Figura 7.20. Relazioni tra simmetria delle strutture e modalità deformativa.

Da Mercier & Vergely, 1996

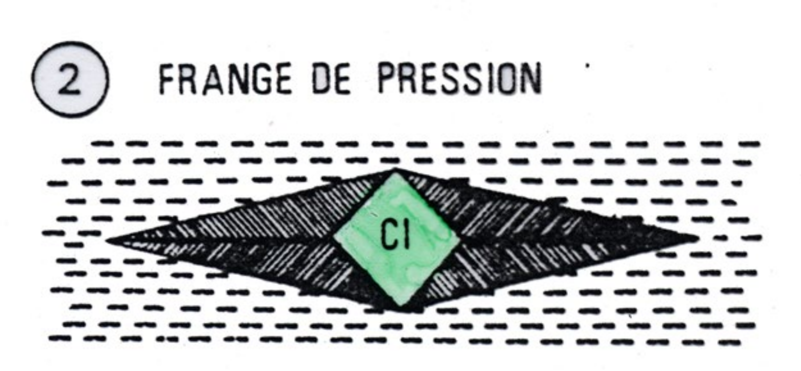
Passchier & Trouw, 2006



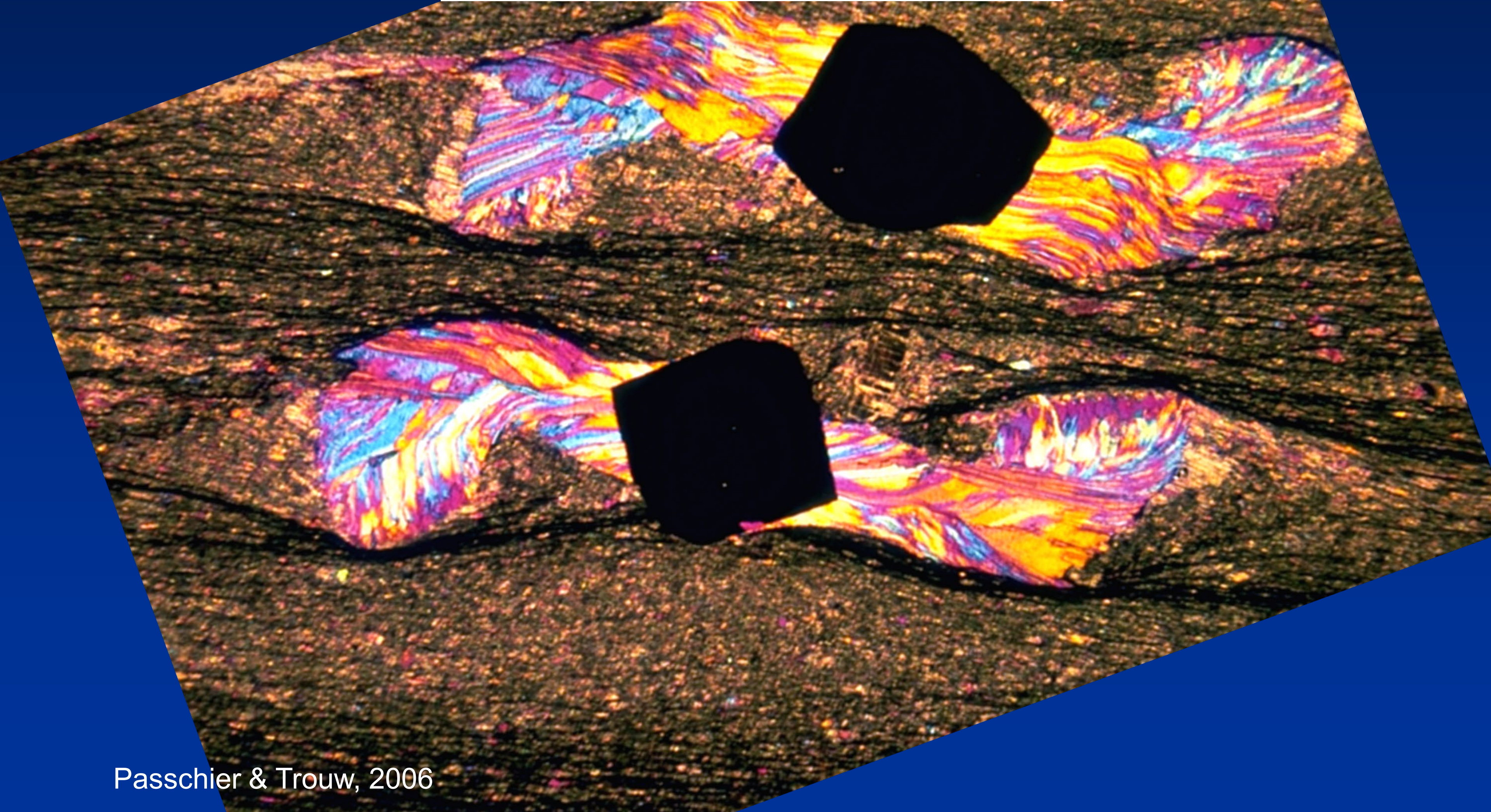
Passchier & Trouw, 2006



Da Mercier & Vergely,1995

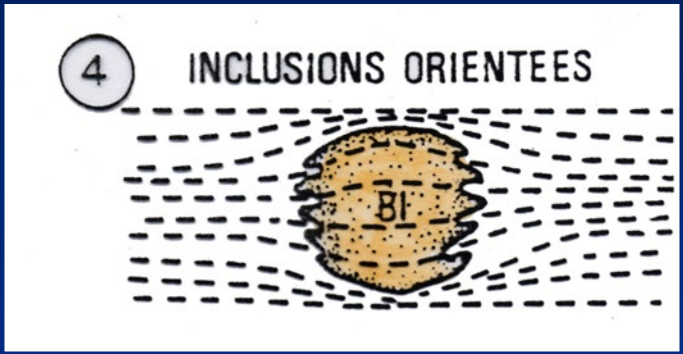


Da Mercier & Vergely,1995



Passchier & Trouw, 2006

Fabric “snowball” a “S” nei porfiroclasti



Da Mercier & Vergely,1995

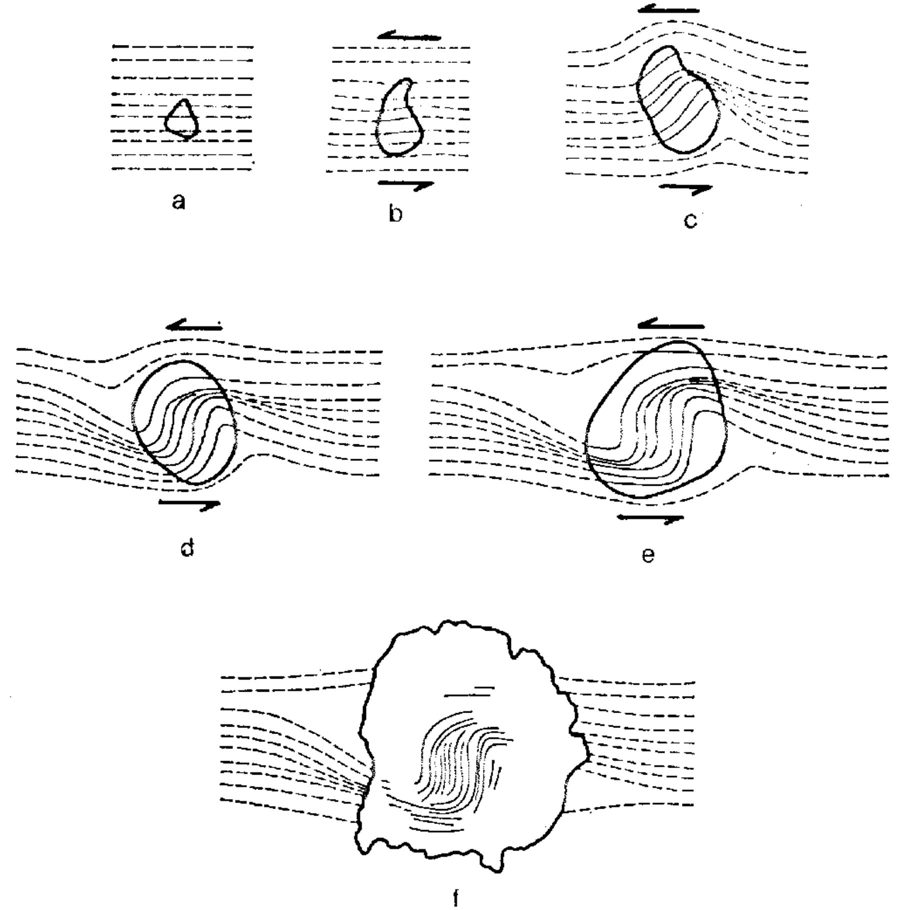
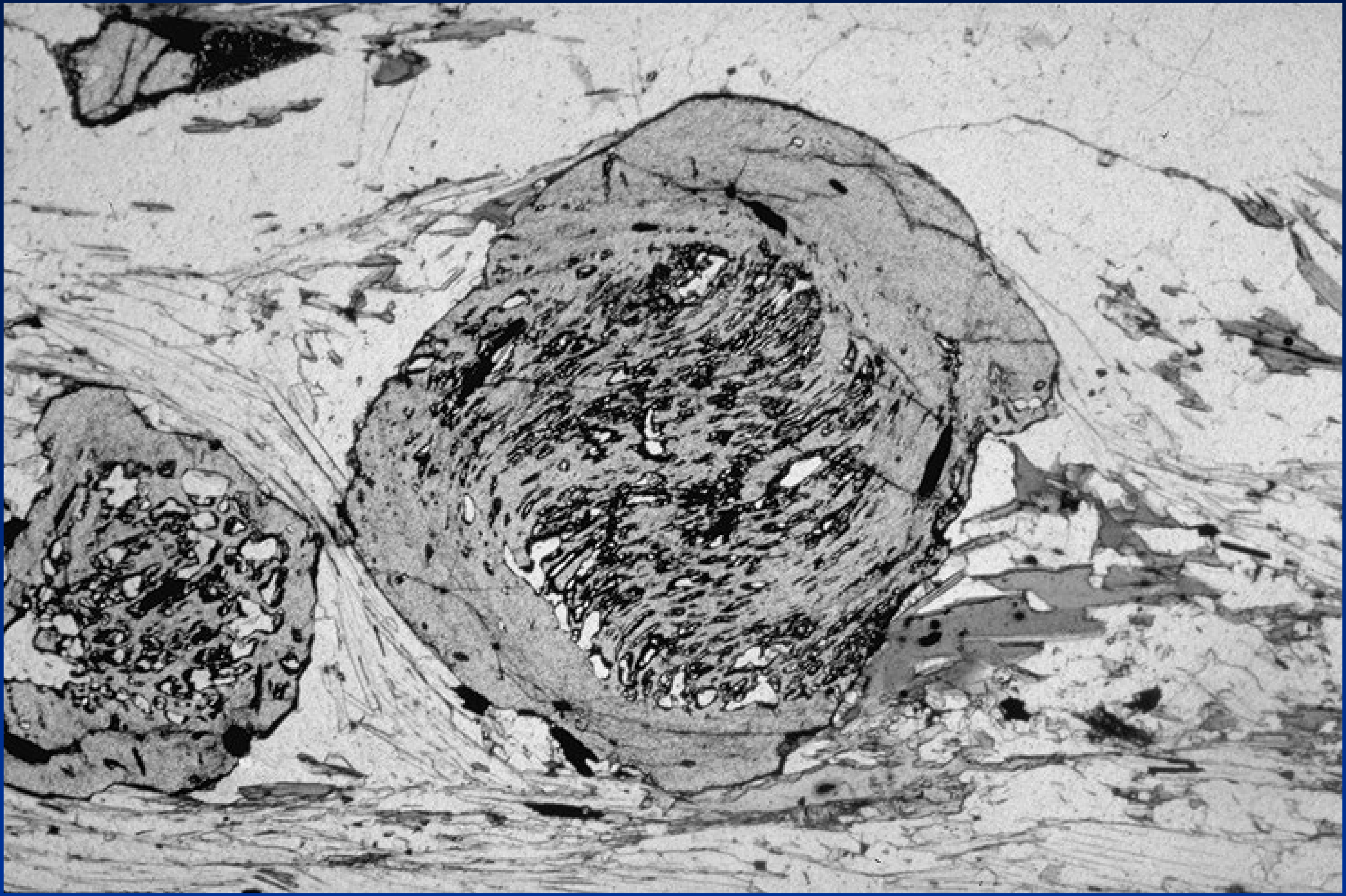


Figure 9.5 Model for the development of Snowball S-fabrics in porphyroblasts, especially garnet (after Spry, 1963).

Da Barker, 1990



Passchier & Trouw, 2006

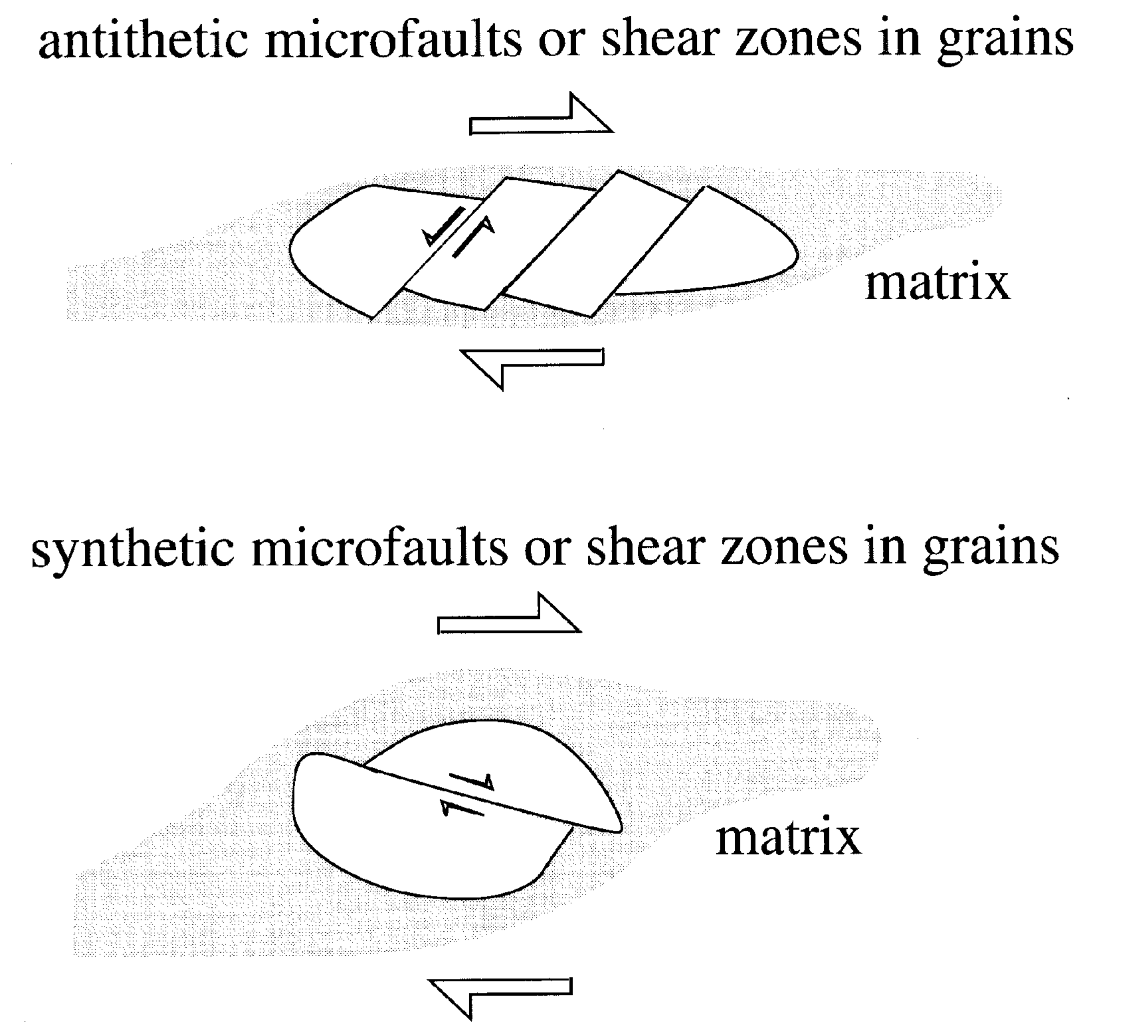
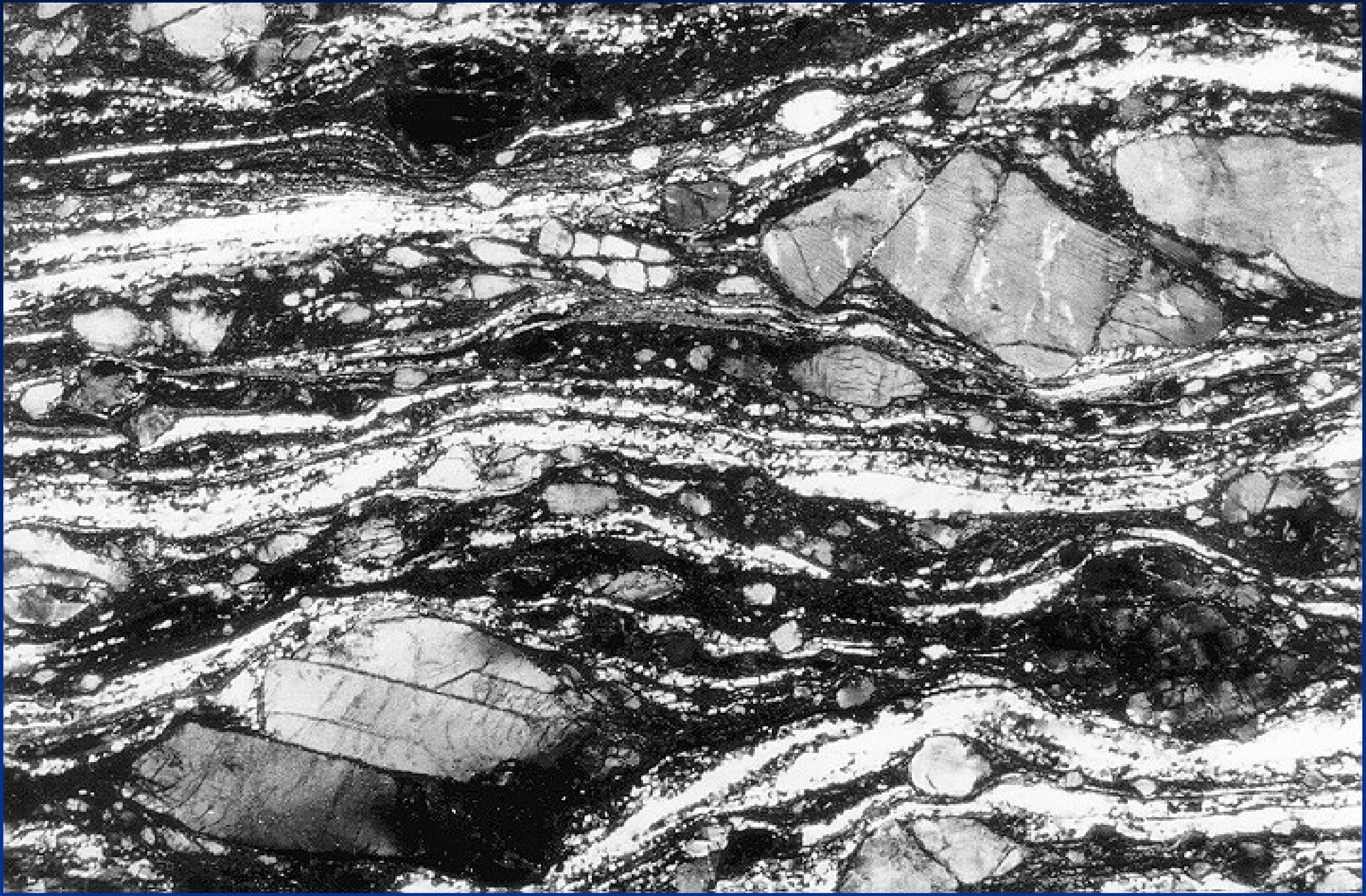


Fig. 5.31. Illustration of the two mechanisms of formation of stepped fragmented grains at similar bulk shear sense *(large arrows)*

Passchier & Trouw, 2006

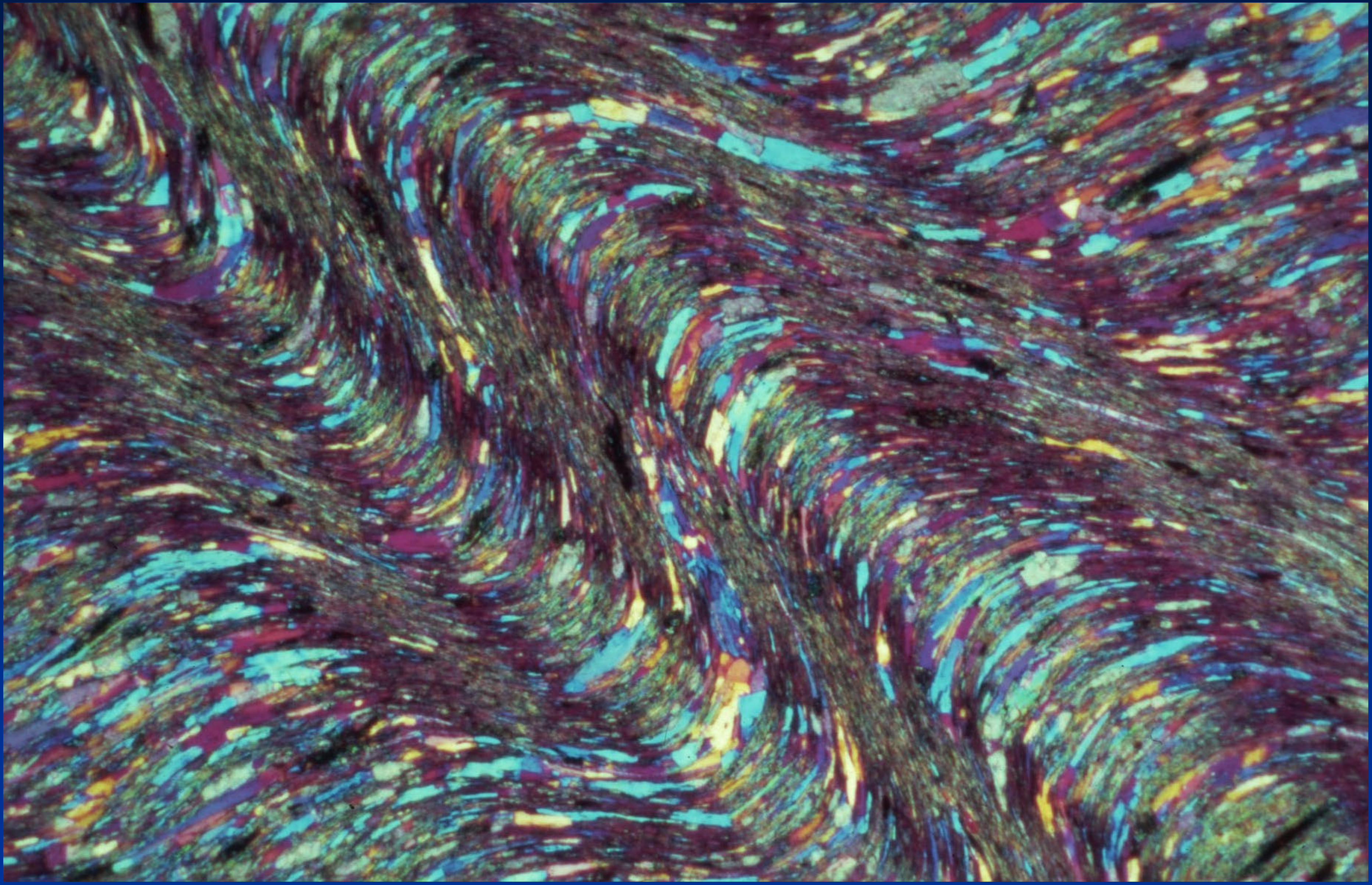


Passchier & Trouw, 2006

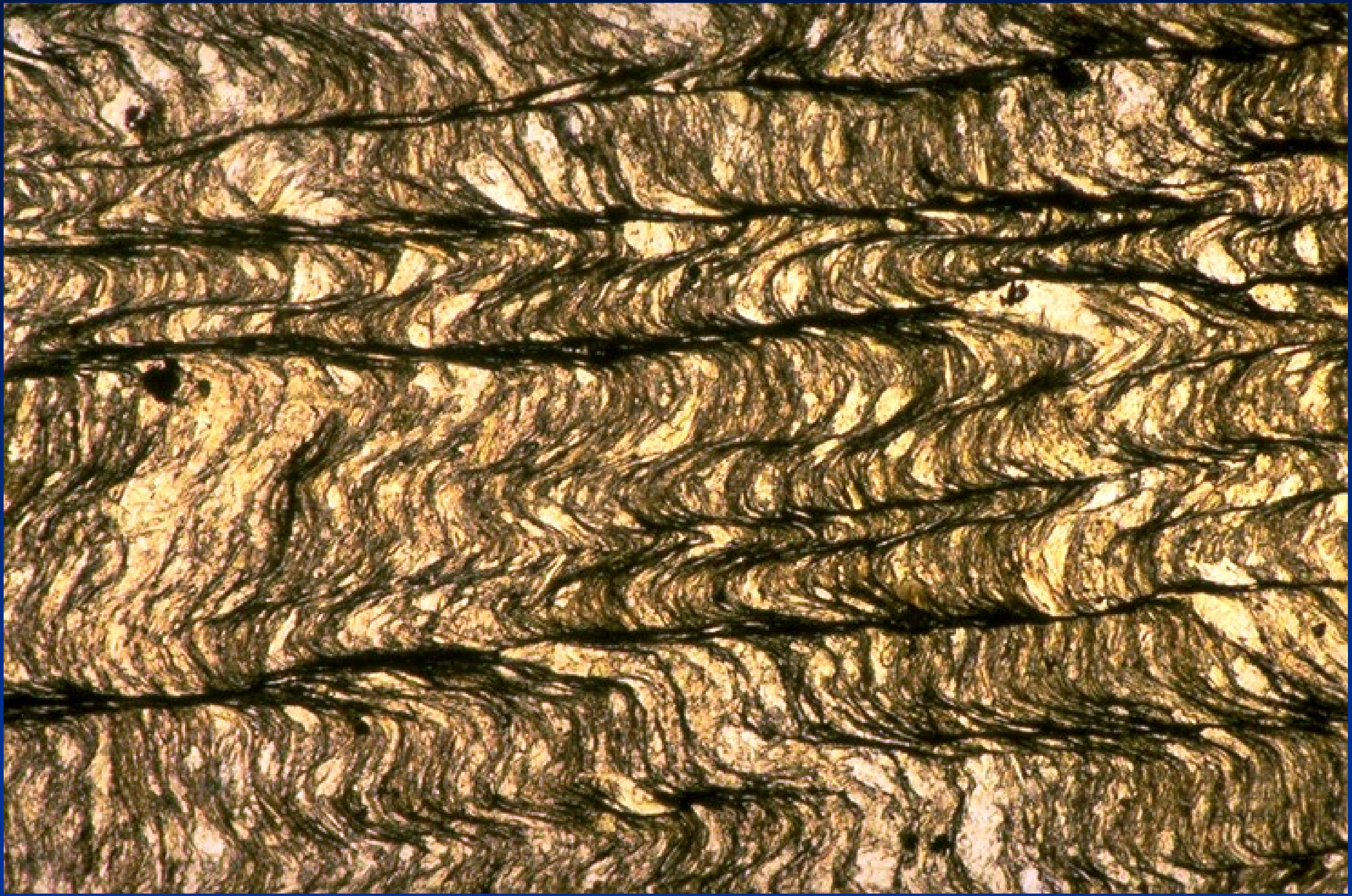
Clivaggio da crenulazione

Da Ramsay and Huber, 1987

Da Ramsay and Huber, 1987



Da Ramsay and Huber, 1987



Passchier & Trouw, 2006

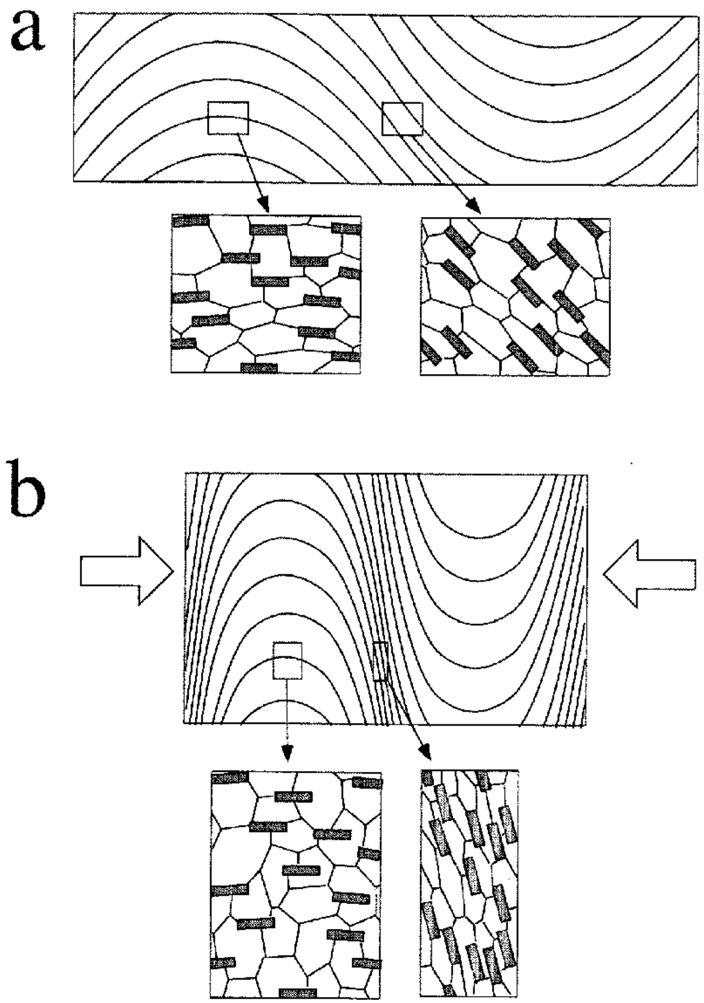
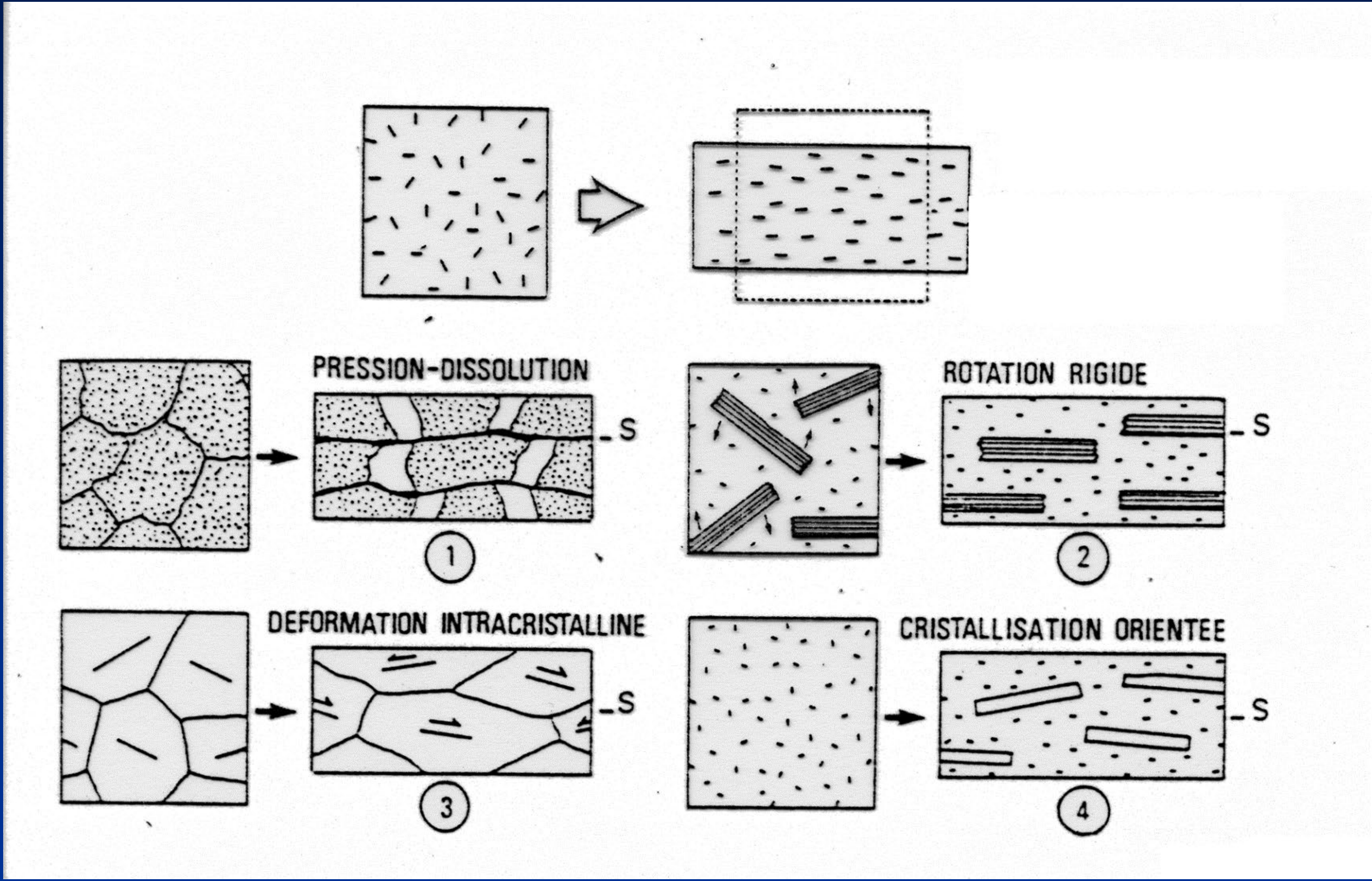


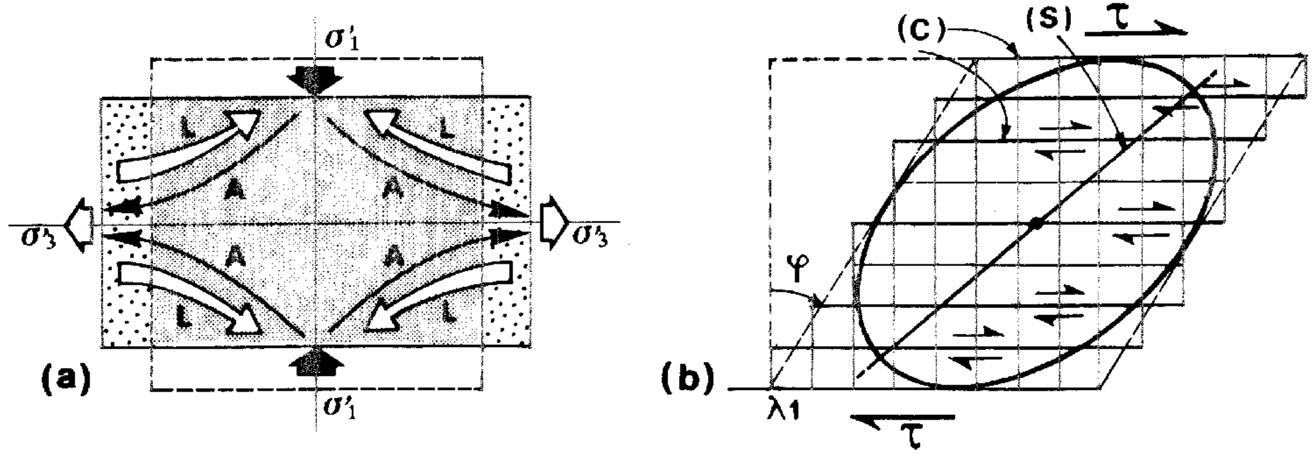
Fig. 4.21a,b. Progressive tightening of folds with formation of a differentiated crenulation cleavage (S_2) by preferential dissolution of quartz in fold limbs caused by the orientation of quartz-mica contacts with respect to the σ_1 direction; resolved normal stress over these contacts is higher in fold limbs than in hinges. **a** and **b** are two stages in progressive deformation (cf. Figs. 4.11, 4.12)

Da Passchier & Trouw, 2006

Genesi della foliazione



Da Mercier & Vergely,1995



7.2. (a) Déformation coaxiale d'un cristal par diffusion des atomes (A) et des lacunes (L) ;
(b) Déformation non co-axiale d'un cristal par glissement sur une seule famille de plans cristallographiques.

Da Mercier & Vergely,1995

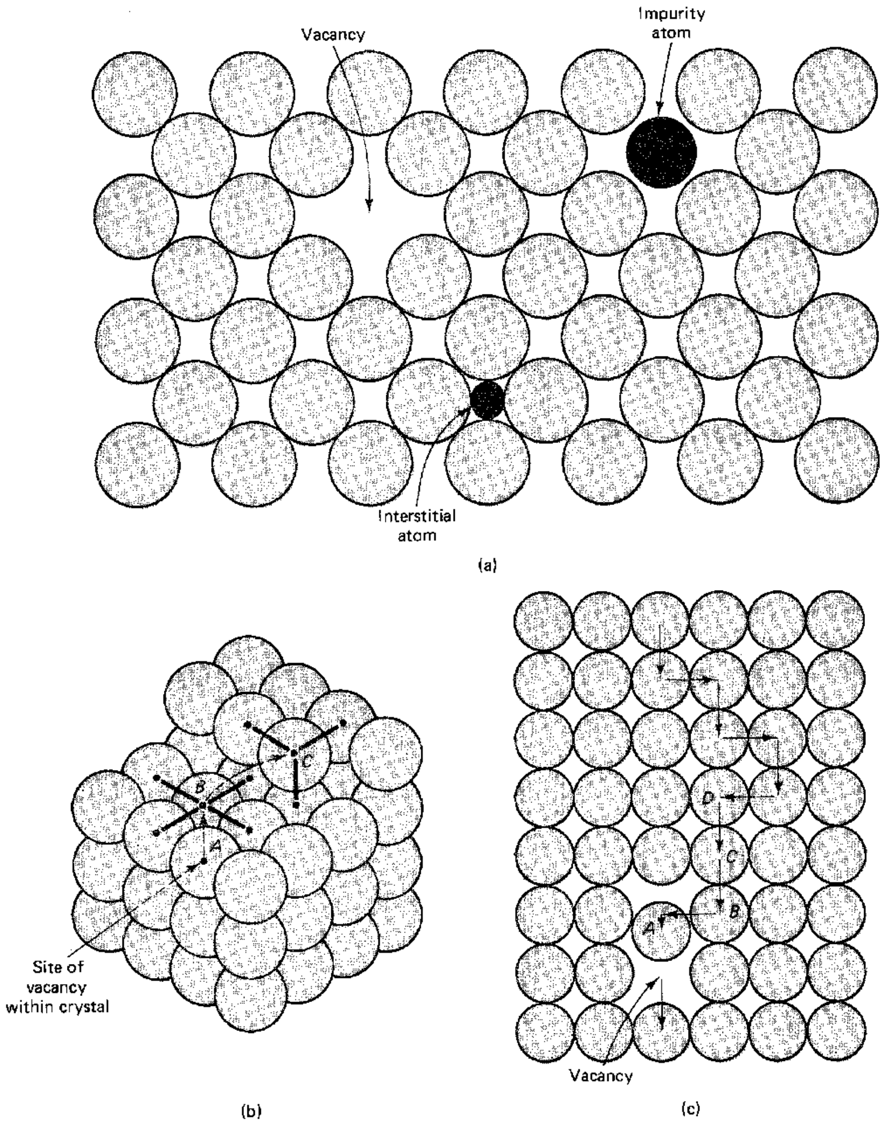
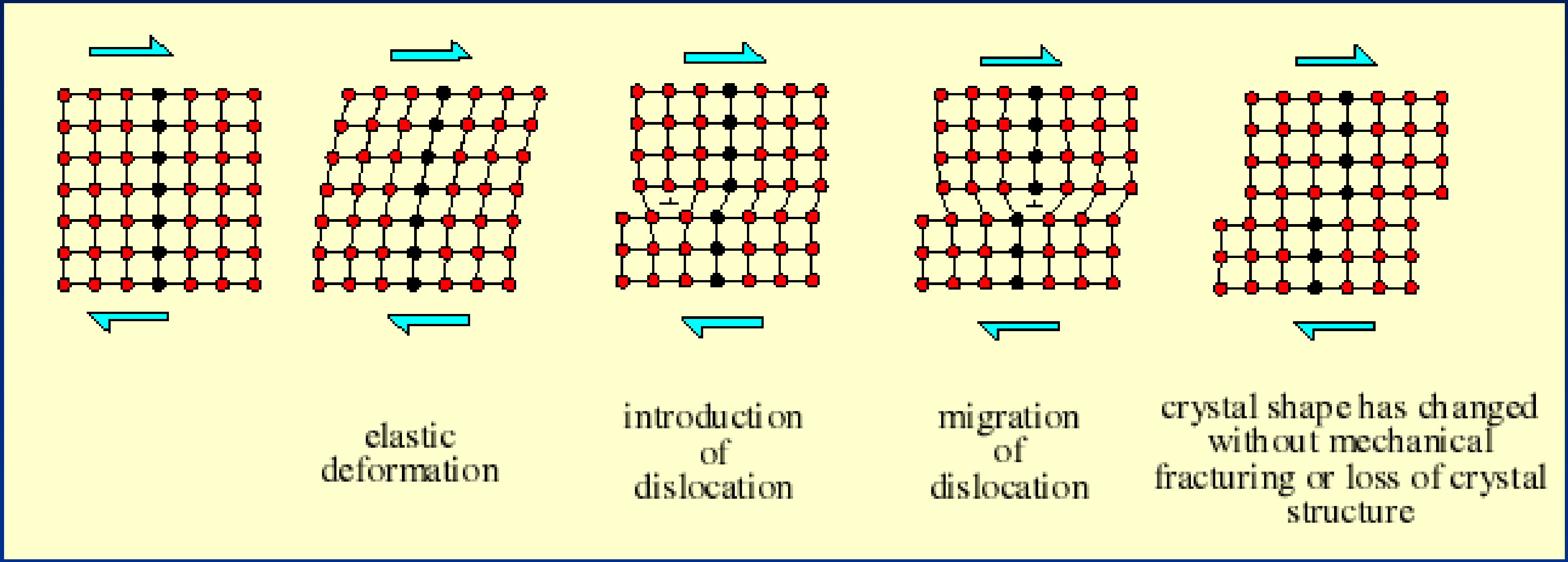


FIGURE 4–5 (a) Simple kinds of point defects. (b) Creation of a vacancy at *A*, one layer below the surface of the crystal, requires breaking five bonds of the atom at *B*, moving it to *C* on the surface of the crystal and forming three bonds, breaking five bonds of the atom at *A*, and moving it to *B*, forming four bonds. Thus the energy required to form the vacancy is the energy of the net three bonds broken. (c) Vacancies play an important role in solid-state diffusion. For example, atom *A* is moving into an adjacent vacancy, atom *B* may then move into the hole left by *A*, atom *C* may then move into the hole left by *B*, and so on, producing a flux of one atom downward across the crystal and one vacancy upward across the crystal.

Da Suppe, 1985



elastic
deformation
introduction
of
dislocation
migration
of
dislocation
crystal shape has changed
without mechanical
fracturing or loss of crystal
structure

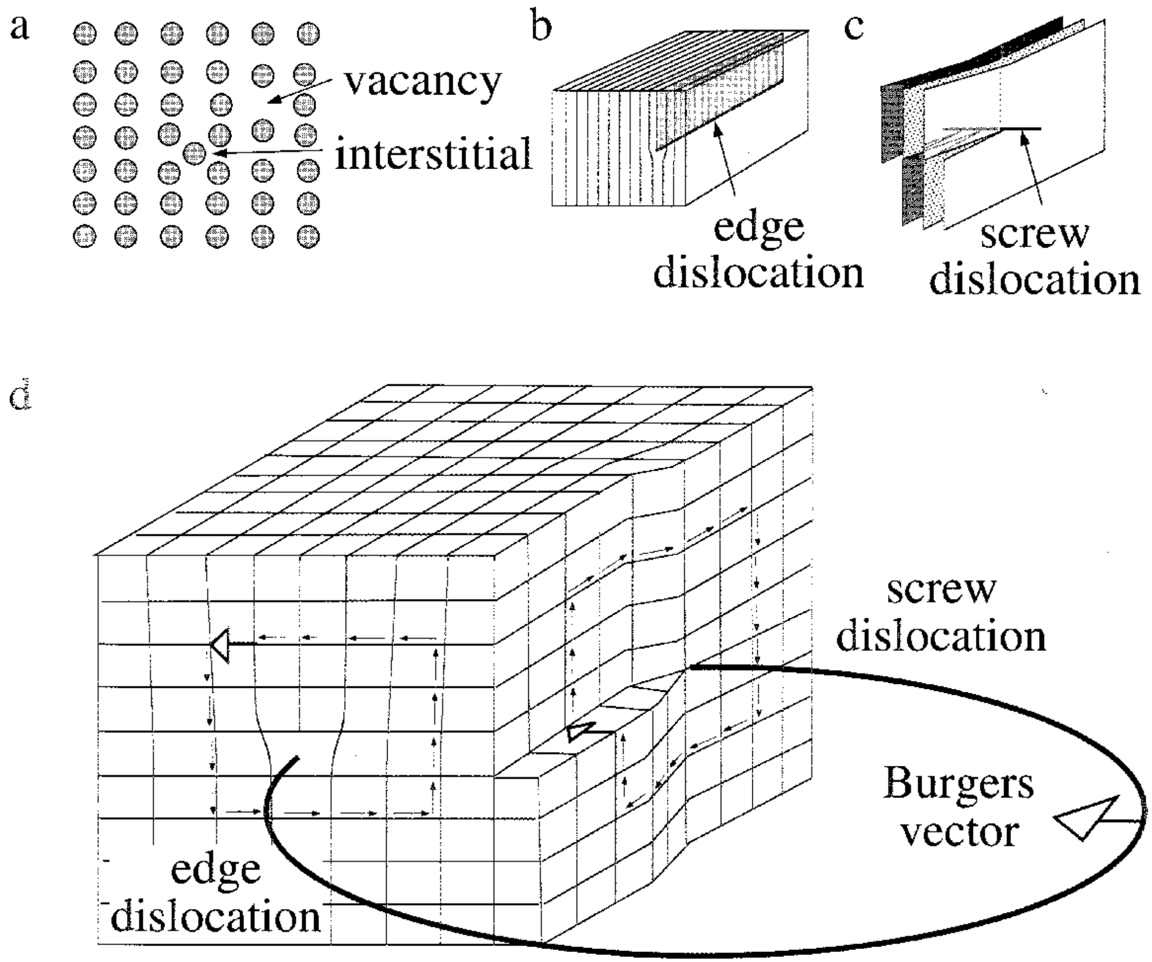
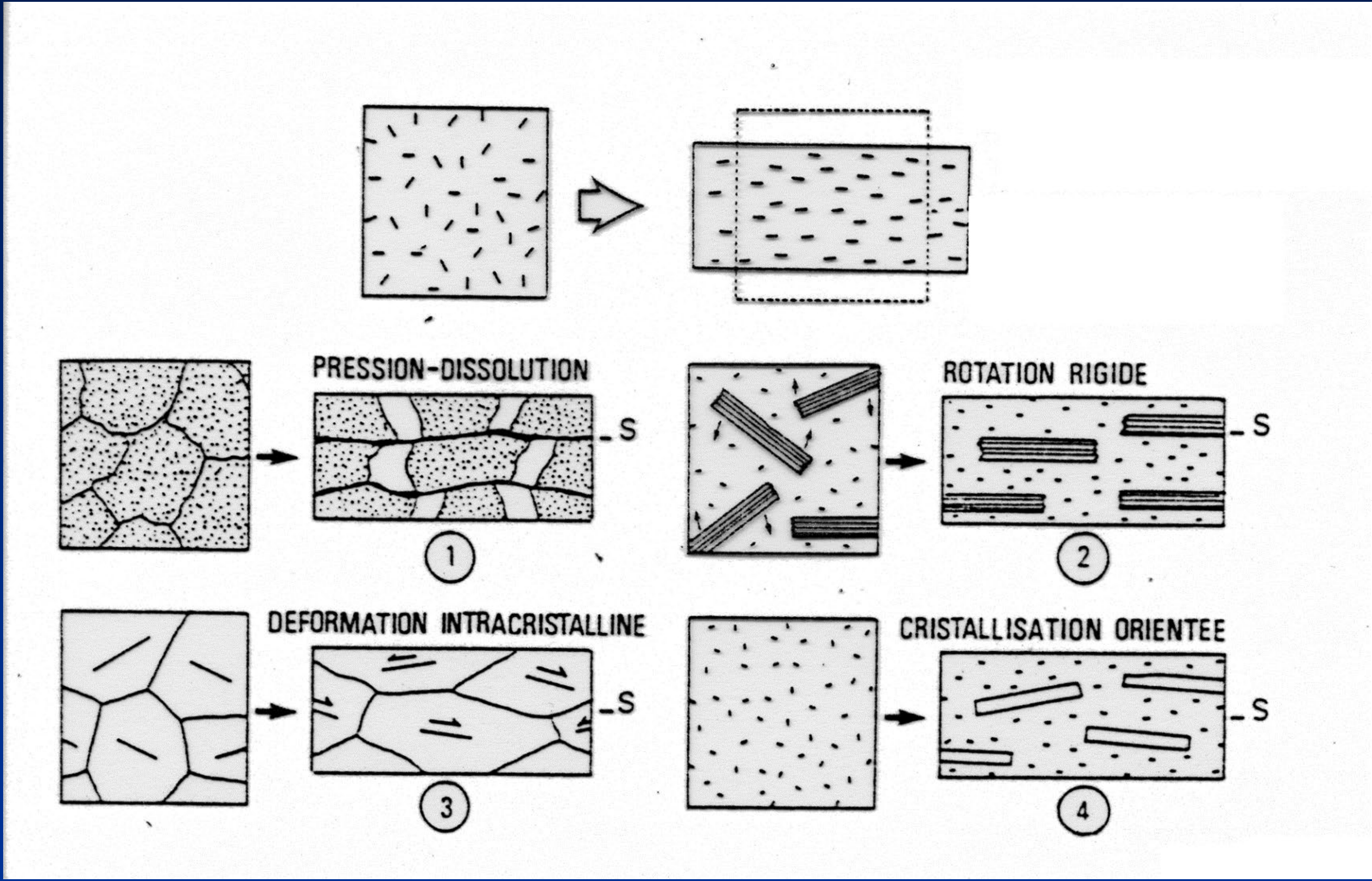


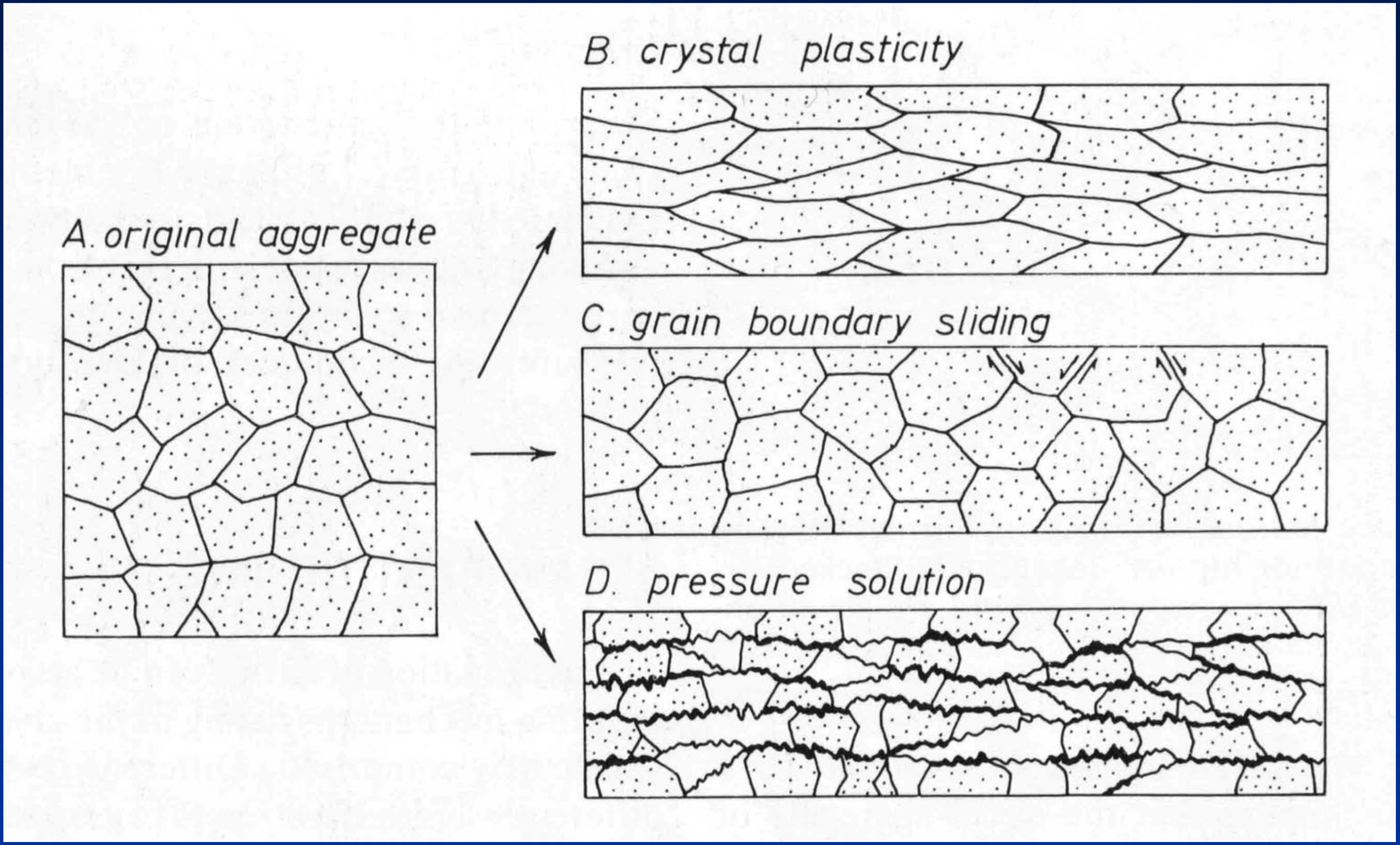
Fig. 3.7. a Lattice with two types of point defects. **b** Edge dislocation defined by the edge of a half-plane in a distorted crystal lattice. **c** Screw dislocation defined by a twisted lattice. **d** Dislocation with edge and screw dislocation regions in a crystal. A square itinerary of small arrows around the dislocation is used to find the Burgers vector of the dislocation, indicated by ***open arrows***

Da Passchier & Trouw, 2006

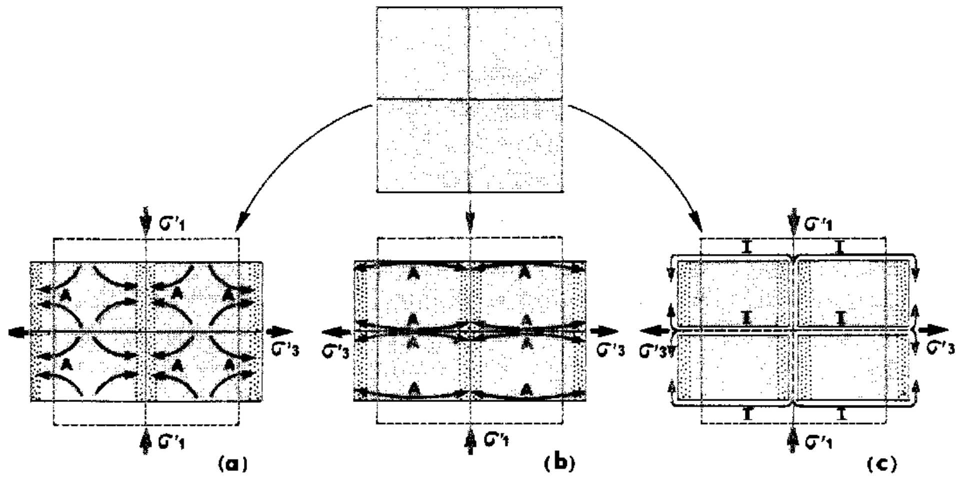
Genesi della foliazione



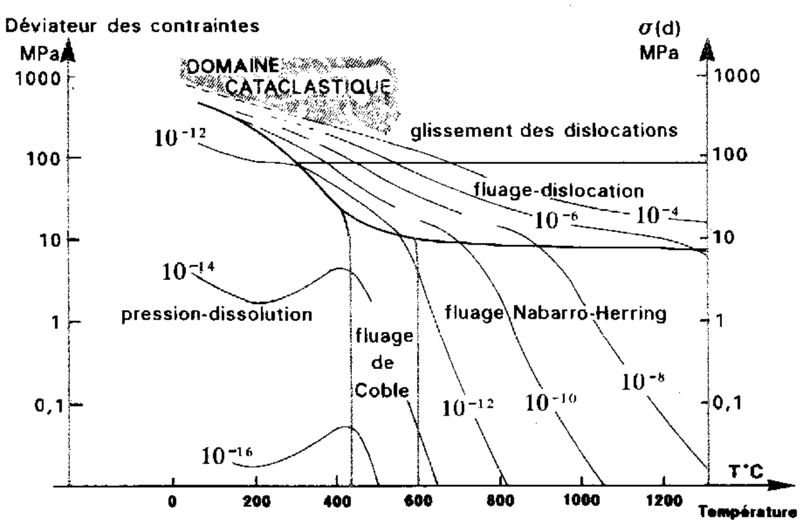
Da Mercier & Vergely,1995



Da Ramsay and Huber, 1984



7.6. Mécanismes de transfert de matière par diffusion (a) fluage de Nabarro-Herring, (b) fluage de Coble et (c) par pression-dissolution. La forme initiale des grains est en tiretets. A : atomes, I : ions.



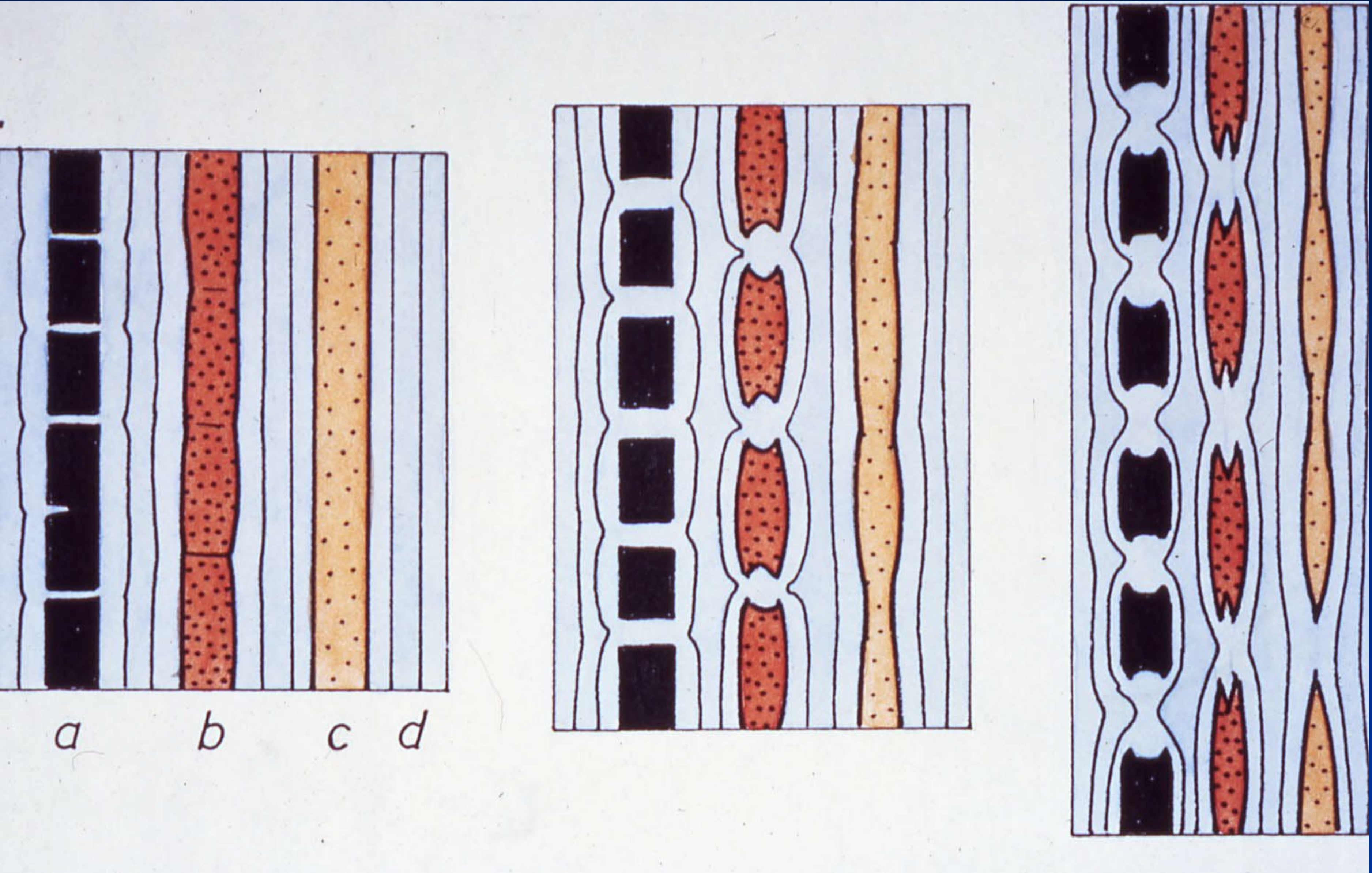
7.7. Carte des domaines (T – σ) de déformation de la calcite ; la taille des grains est de 100 μ et la pression de fluide de 100 MPa pour la pression-dissolution (d'après Rutter, 1976, *Phil. Trans. Roy. Soc. London*, A283, 43-54). Les courbes représentent les taux de déformation par seconde. On a considéré que pour $\dot{\varepsilon} > 10^{-4}\ S^{-1}$ la déformation est cataclastique à basse température.

Da Mercier & Vergely,1995

Strutture fragili-duttili

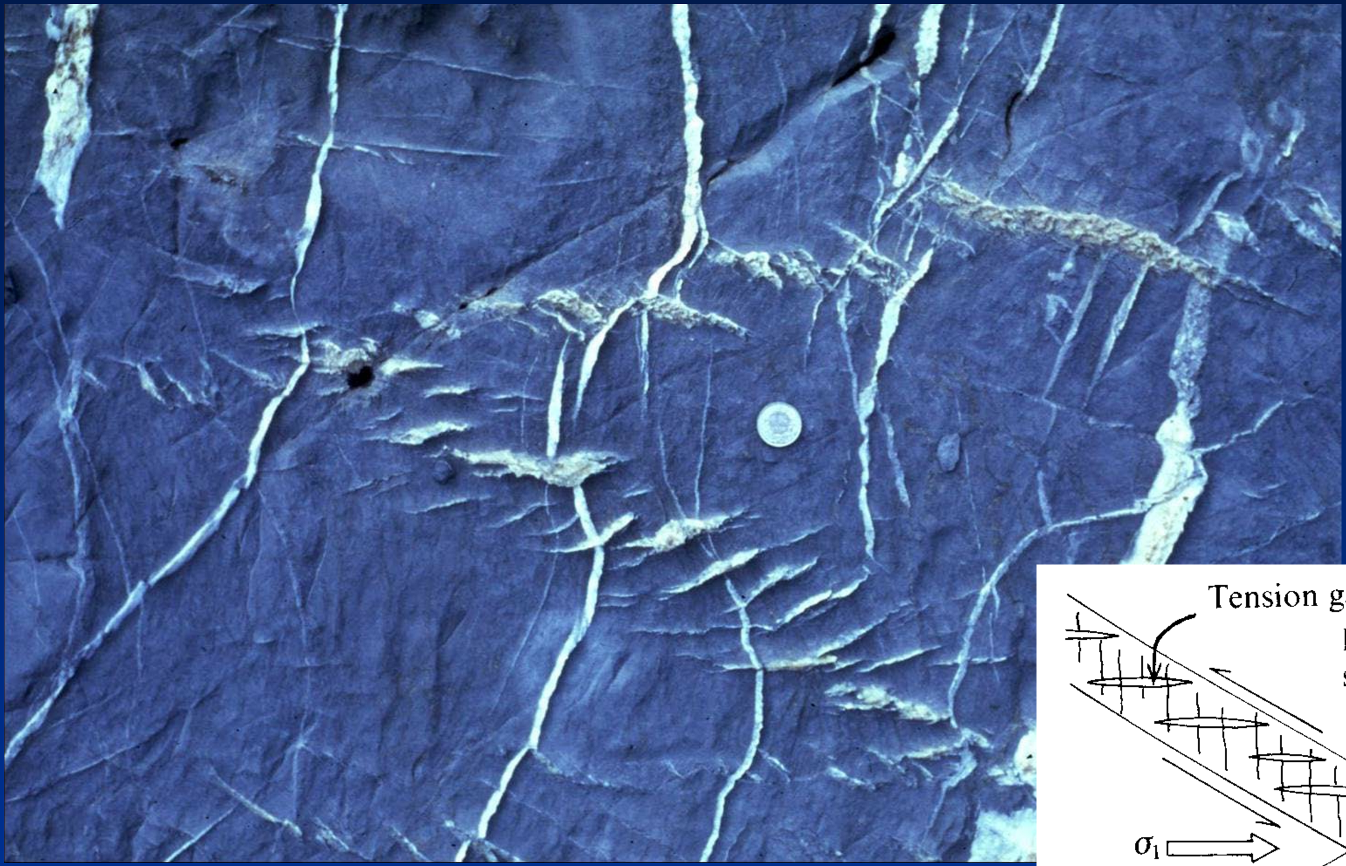
(certi casi di boudinage; vene a schiera)

Strutture fragili-duttili: certi casi di boudinage

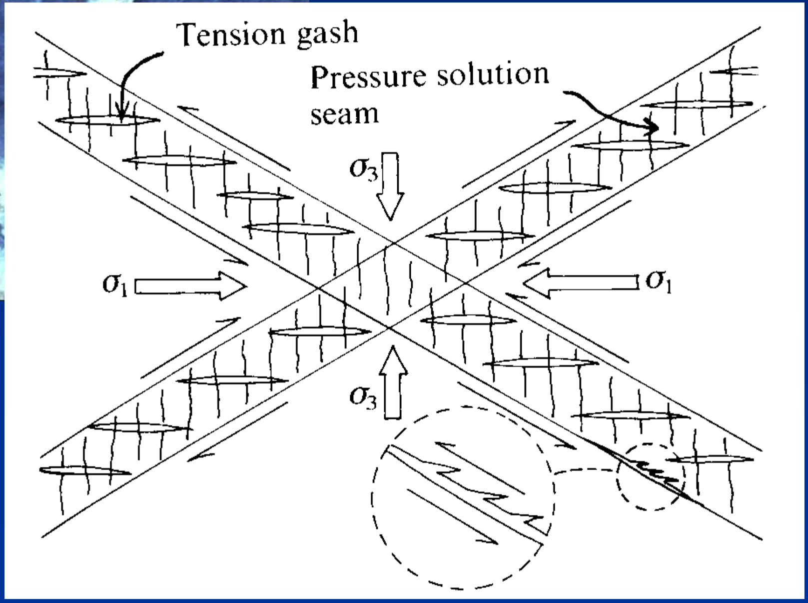


Da Ramsay, 1967

Strutture fragili-duttili: vene sigmoidali a schiera



Da Ramsay and Huber, 1987



Da Price and Cosgrove,1990

Da Ramsay and Huber, 1987

Da Mercier & Vergely, 1996

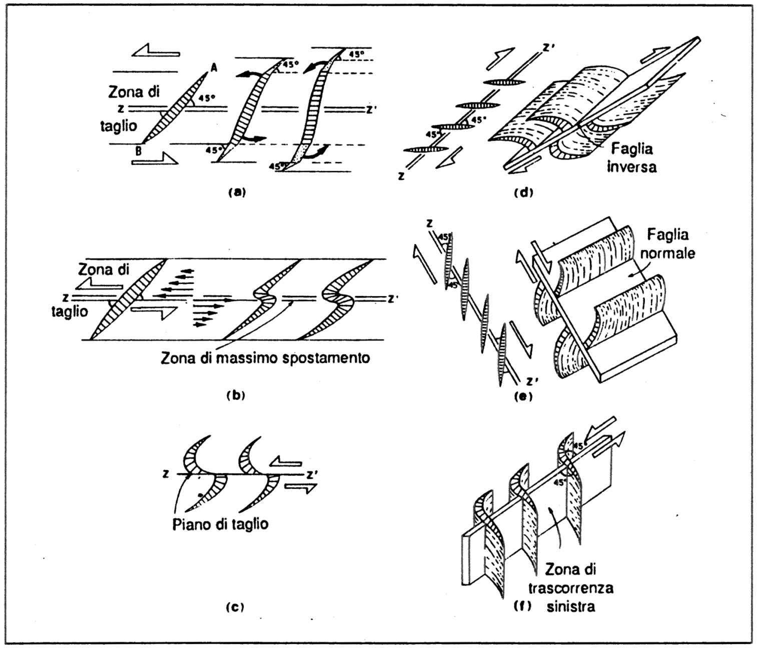
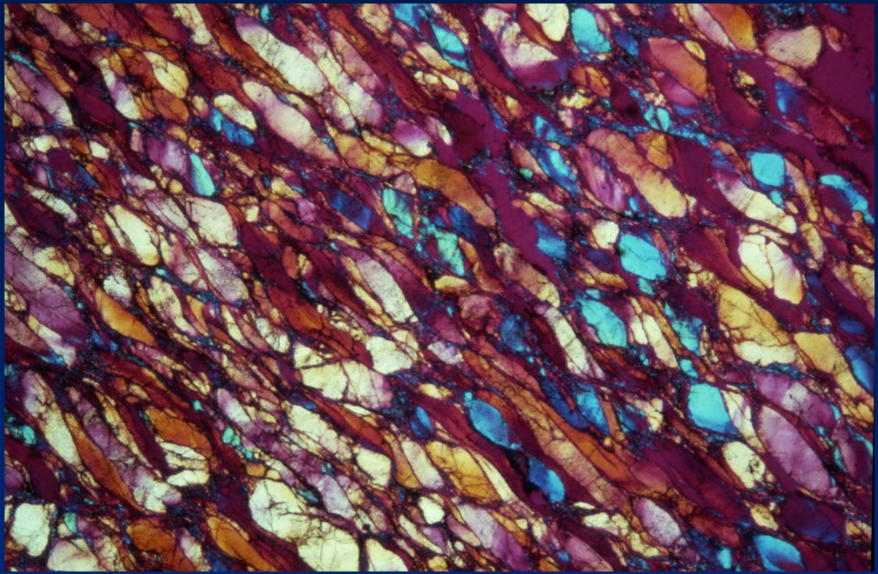
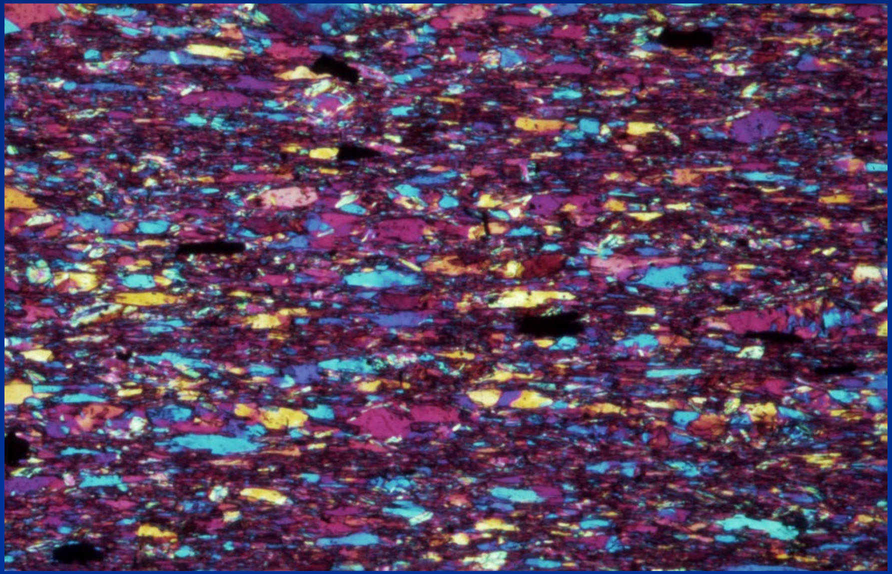


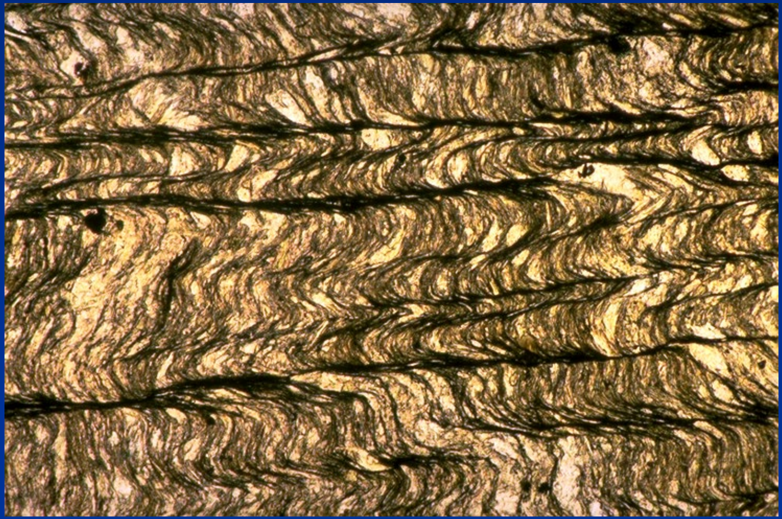
Figura 4.18. Squarci da tensione «en échelon» lungo una zona di taglio *zz'*.

Da Ramsay and Huber, 1987

Classificazione del Clivaggio

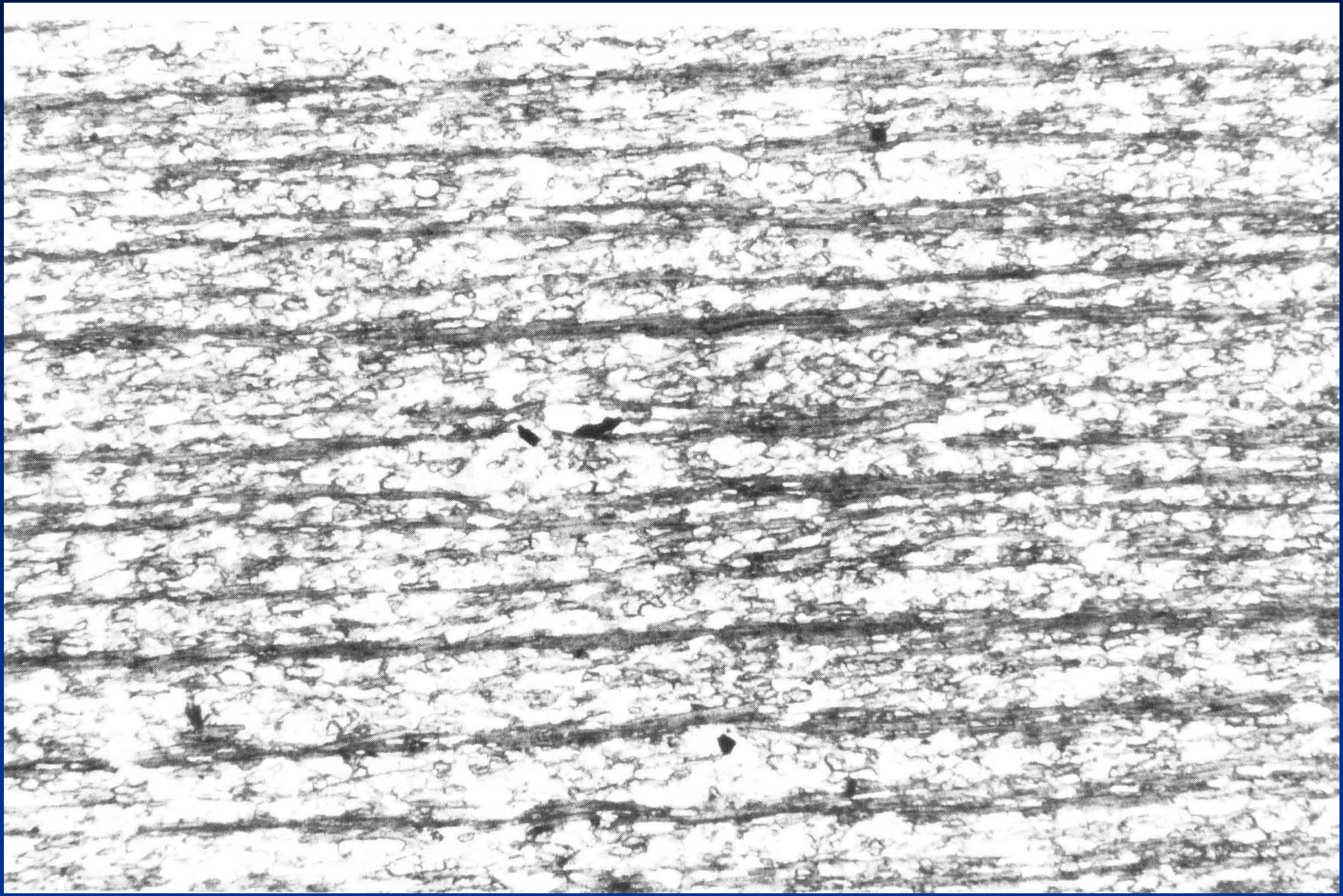






Passchier & Trouw, 2006

Cleavage domains e microlithons



Passchier & Trouw, 2006

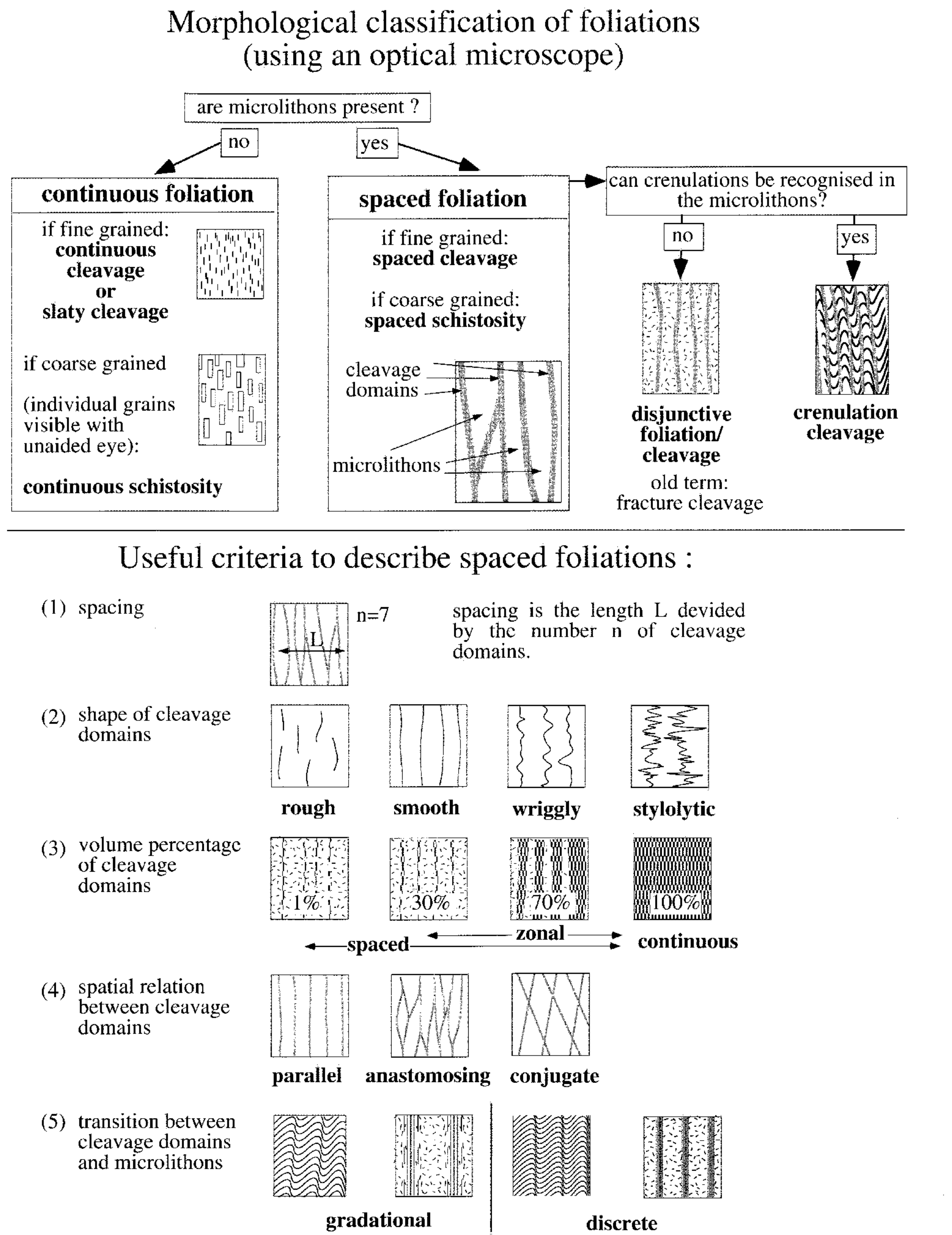


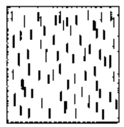
Fig. 4.6. Morphological classification of foliations using an optical microscope. (After Powell 1979 and Borradaile et al. 1982)

Da Passchier & Trouw, 2006

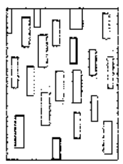
Morphological classification of foliations
(using an optical microscope)

are microlithons present ?

- **no** → **continuous foliation**
  - if fine grained: **continuous cleavage** or **slaty cleavage**



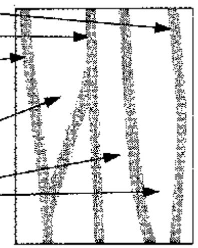
  - if coarse grained (individual grains visible with unaided eye): **continuous schistosity**



- **yes** → **spaced foliation**
  - if fine grained: **spaced cleavage**
  - if coarse grained: **spaced schistosity**

cleavage domains

microlithons



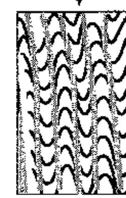
→ can crenulations be recognised in the microlithons?

- **no** →

disjunctive foliation/ cleavage

old term: fracture cleavage

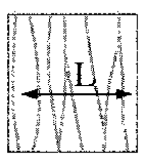
- **yes** →



crenulation cleavage

Useful criteria to describe spaced foliations :

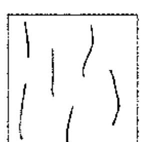
(1) spacing



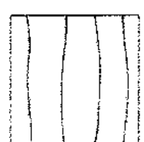
n=7

spacing is the length L devided by thc number n of cleavage domains.

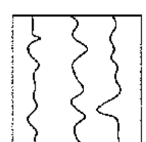
(2) shape of cleavage domains



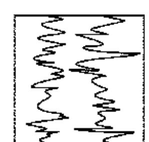
rough



smooth



wriggly



stylolytic

fracture cleavage

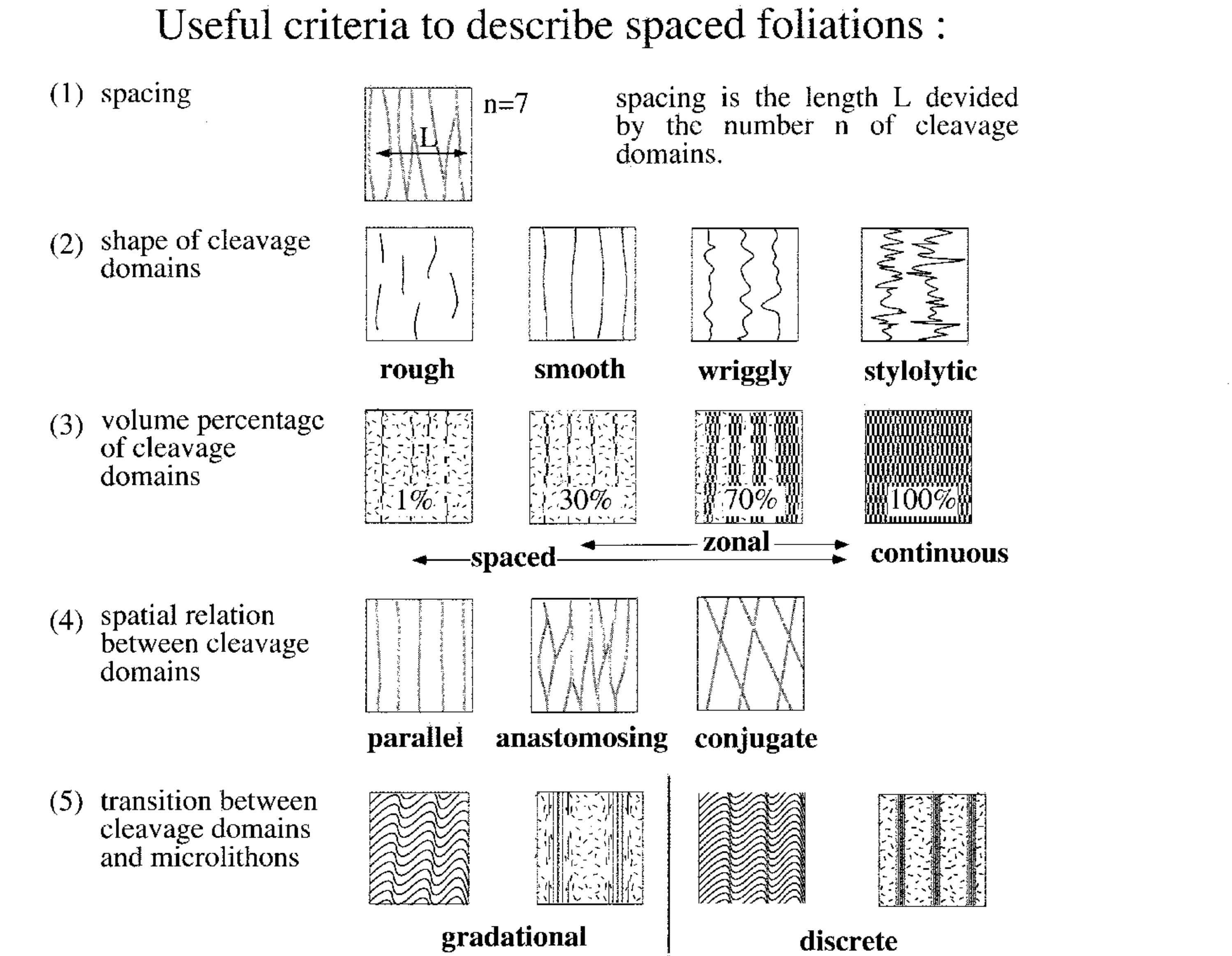


Fig. 4.6. Morphological classification of foliations using an optical microscope. (After Powell 1979 and Borradaile et al. 1982)