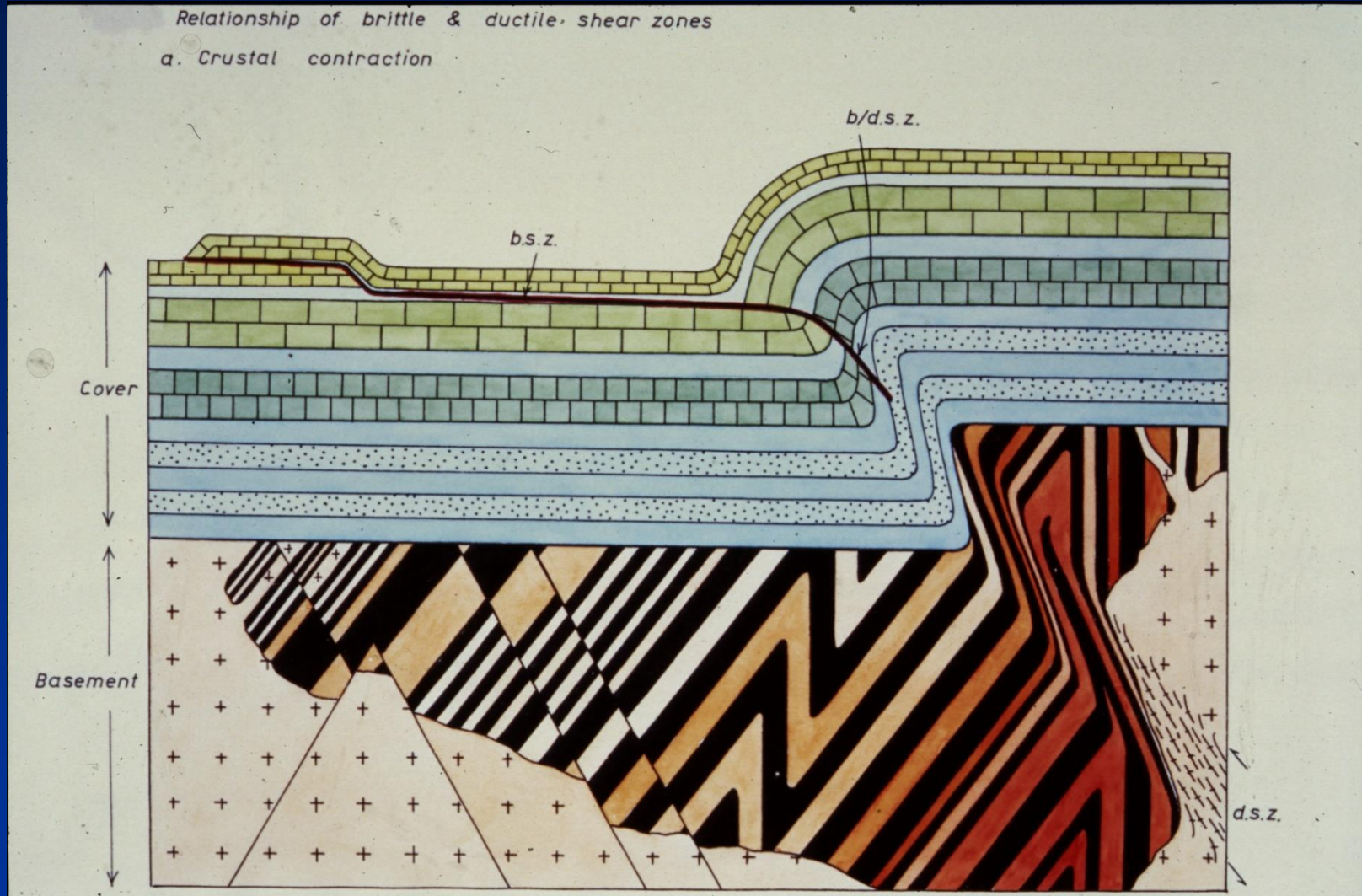


Dal duttile al fragile al duttile: faglie e zone di taglio



Da Ramsay & Huber, 1987

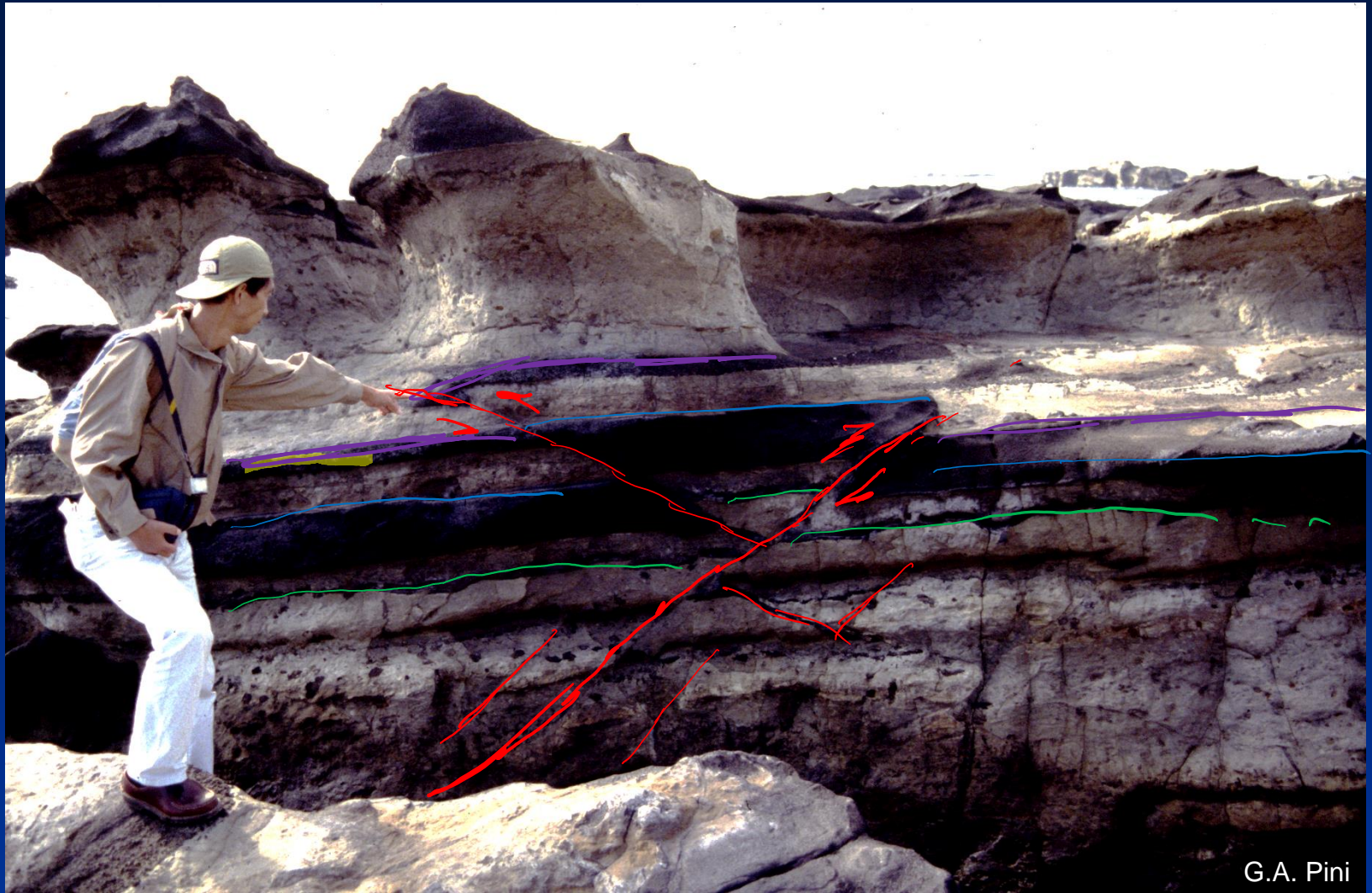
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- Dellisanti et al., 2008. Int J Earth Sci (Geol Rundsch), 97.
- Fossen H., 2010. Structural Geology. Cambridge University Press.
- Hatcher R.D., 1995. Structural Geology: Principles Concepts and Problems. Prentice Hall International.
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- van der Pluijm B., Marshak S., 2004. Earth Structure: An Introduction to Structural Geology and Tectonics, Second Edition. WW Norton & Company.

Rocce di faglia

- 1) Duttile superficiali
- 2) Fragili
- 3) Duttile

- 1) *Bande di scorrimento granuli in arenarie-siltiti; clivaggio scaglioso*
 - *Transizione: da scorrimento indipendente granuli a grain breakage; aumento pervasività e diminuzione spaziatura clivaggio scaglioso*
- 2) *Rocce di faglia da: taglio (clivaggio scaglioso), dissoluzione da pressione (PSC+meso-faglie+eventuale clivaggio scaglioso); cataclasiti, pseudotachiliti*
 - *Transizione: da cataclasiti a miloniti; pseudotachiliti*
- 3) *Zone di taglio duttile: miloniti (S-C e S-C' miloniti, pseudotachiliti (?), indicatori cinematici)*



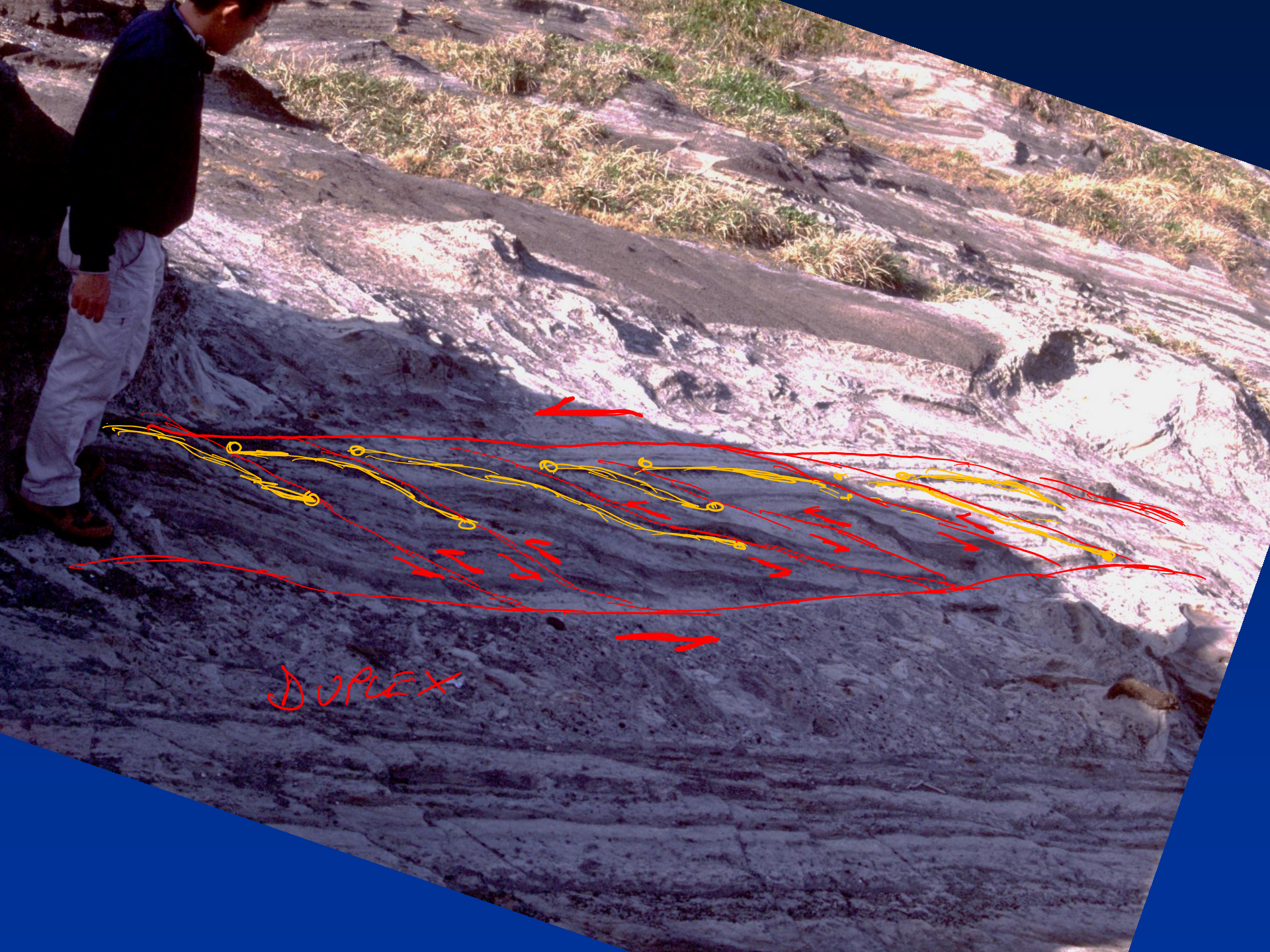
G.A. Pini

Kaitocho – Miura Peninsula (Japan)

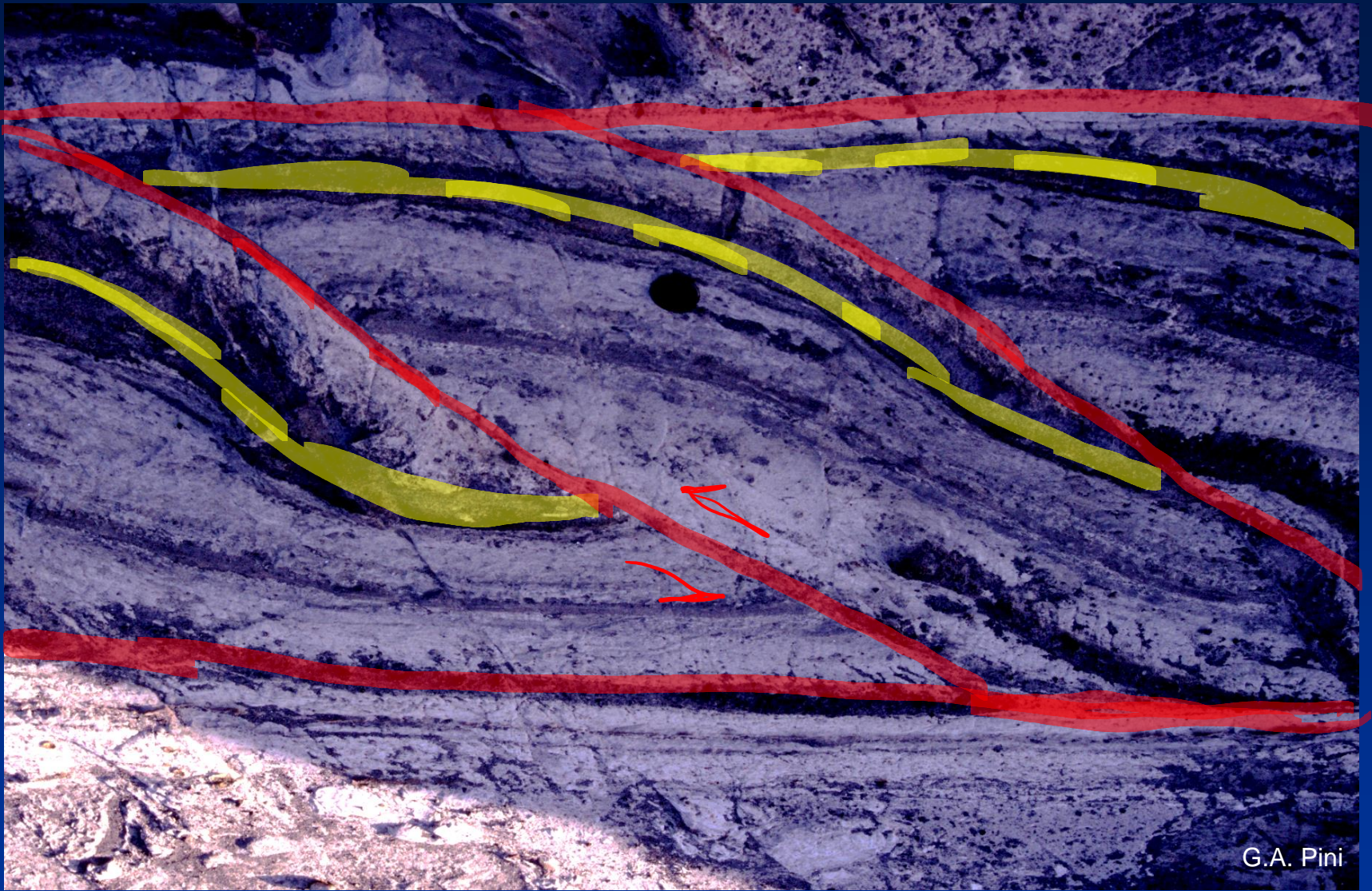
G.A. Pini

Kaitocho – Miura Peninsula (Japan)

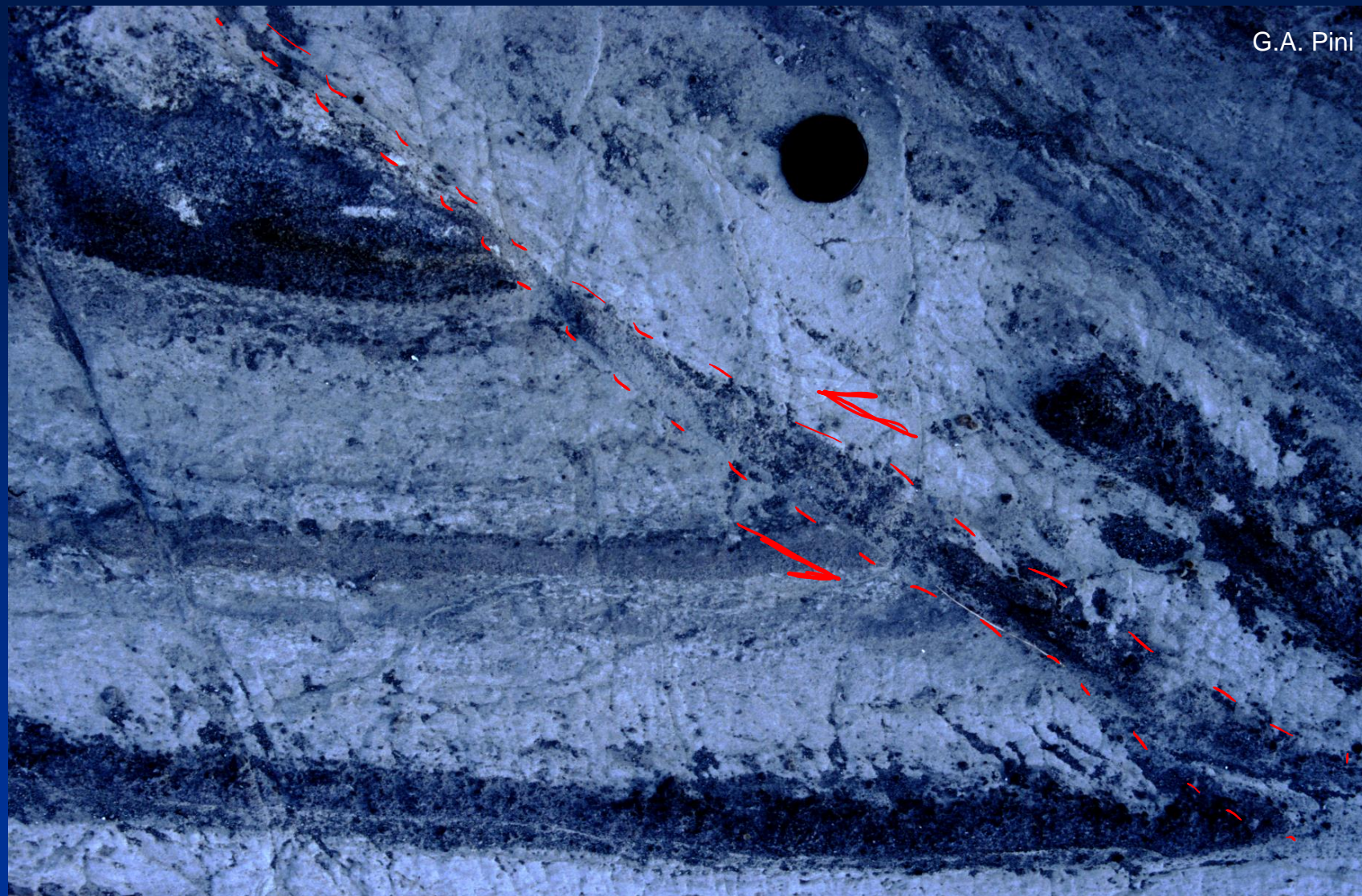


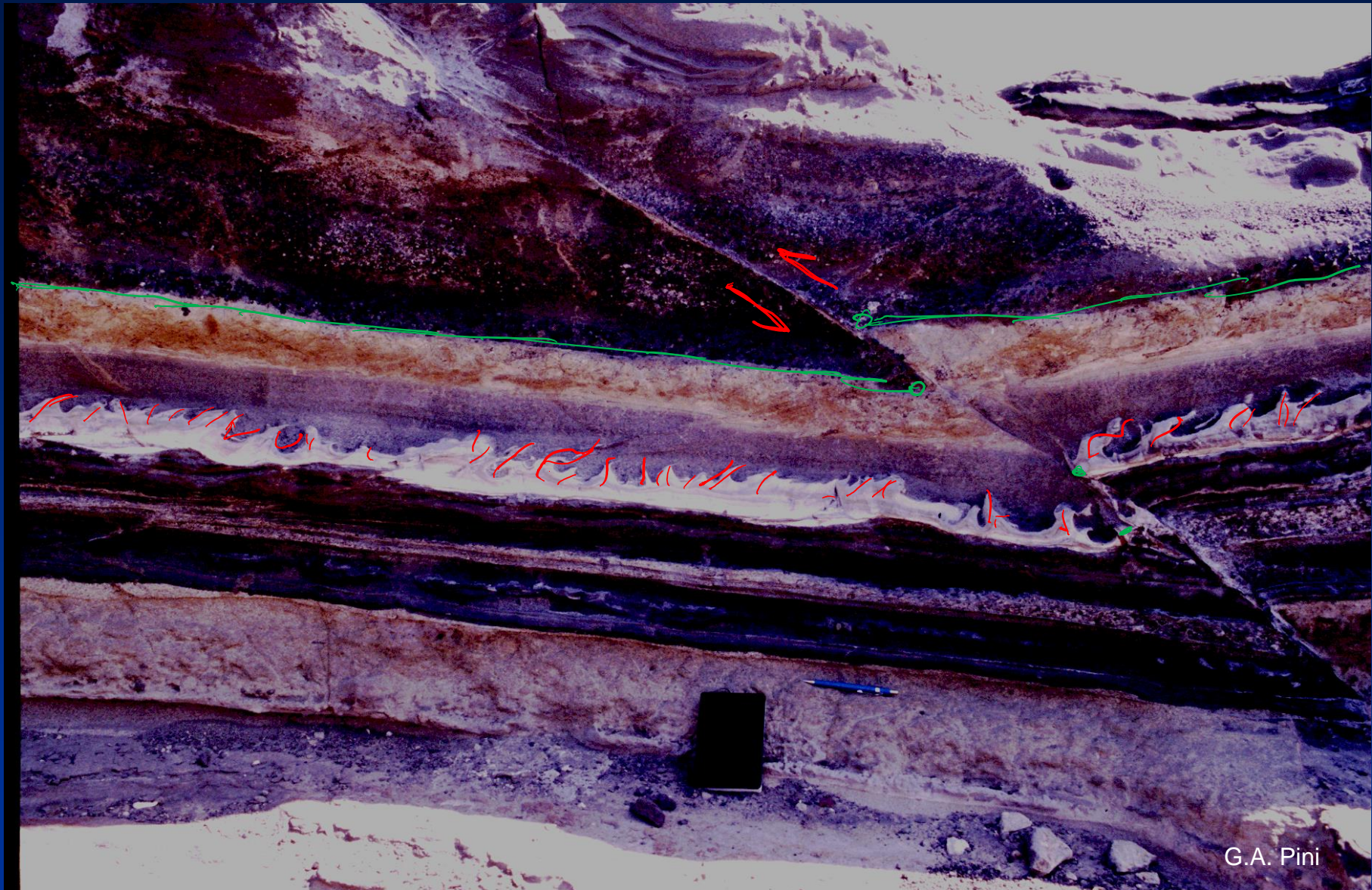


DUPLIX



G.A. Pini





G.A. Pini

Caratteri delle shear zone in sabbie-arenarie al variare dello strain/stress di confinamento

Increasing Strain & Effective Confining Stress

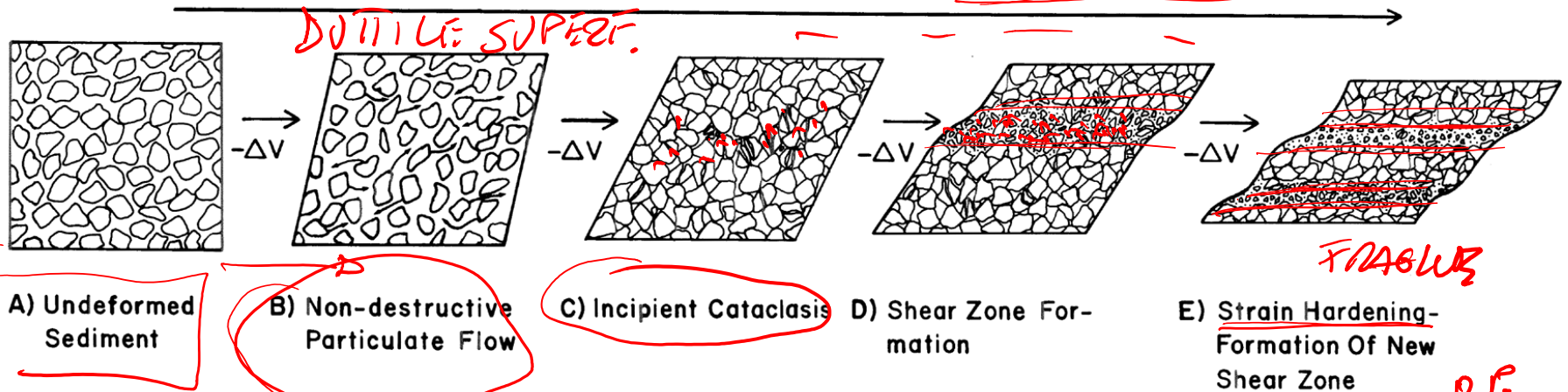
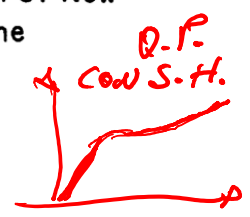


Figure 17. Model for cataclastic deformation and shear zone development in tectonically deformed sandstones. (A) Undeformed water-rich sediments. (B) Internal deformation with particulate flow. (C) Incipient cataclasis. Increasing confining stress inhibits grain boundary sliding and causes localized cataclasis where stress concentrations exceed grain strength (e.g. Sites 488 and 492). (D) Propagation of discrete shear zones. (E) Strain hardening of initial shear zone and development of a new shear zone in weaker adjacent material.



Da Moore et al., 1986

$$\sigma_R = C_0 + \tau_g \phi (\sigma_v - P_f)$$

\downarrow
 $C_0 \approx 0$

EFFECTIVE STRESS

Rocce di faglia

- 1) Duttile superficiali
- 2) **Fragili**
- 3) Duttile

- 1) *Bande di scorrimento granuli in arenarie-siltiti; clivaggio scaglioso*
 - *Transizione: da scorrimento indipendente granuli a grain breakage; aumento pervasività e diminuzione spaziatura clivaggio scaglioso*
- 2) *Rocce di faglia da: taglio (clivaggio scaglioso), dissoluzione da pressione (PSC+meso-faglie+eventuale clivaggio scaglioso); cataclasiti, pseudotachiliti*
 - *Transizione: da cataclasiti a miloniti; pseudotachiliti*
- 3) *Zone di taglio duttile: miloniti (S-C e S-C' miloniti, pseudotachiliti (?), indicatori cinematici)*

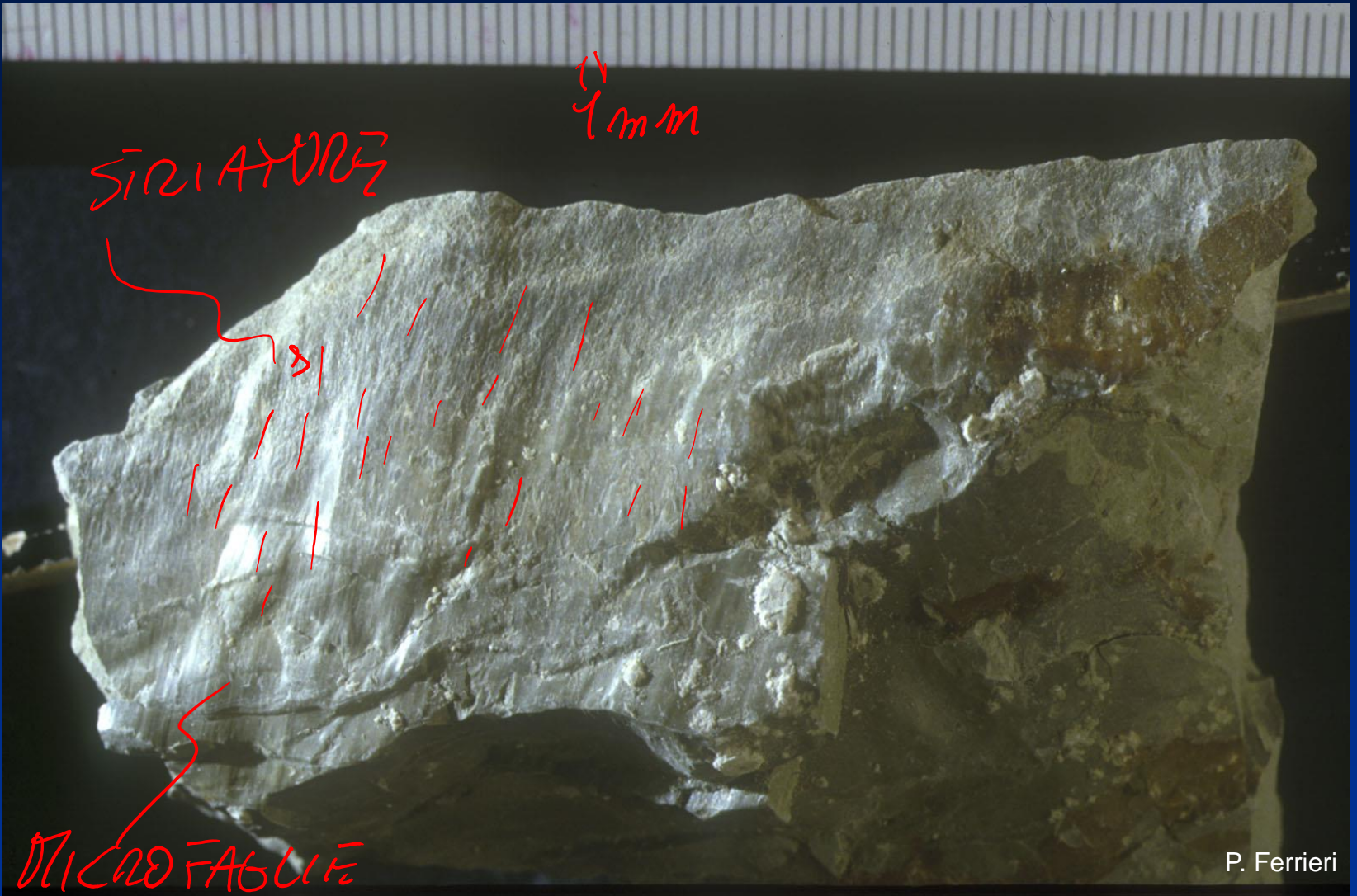


G.A. Pini

CLIVAGGIO SCAGLIOSO

G.A. Pini





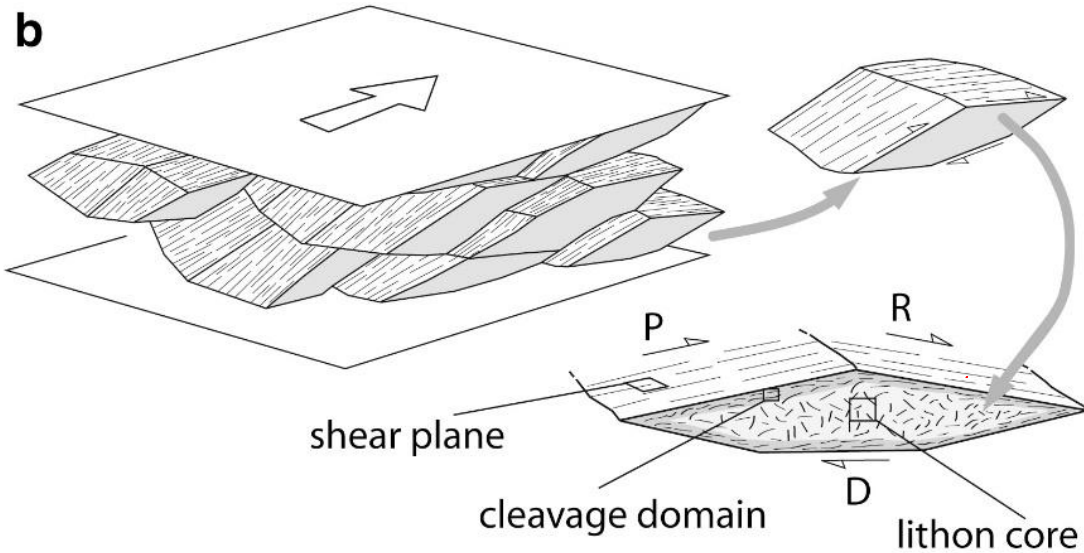
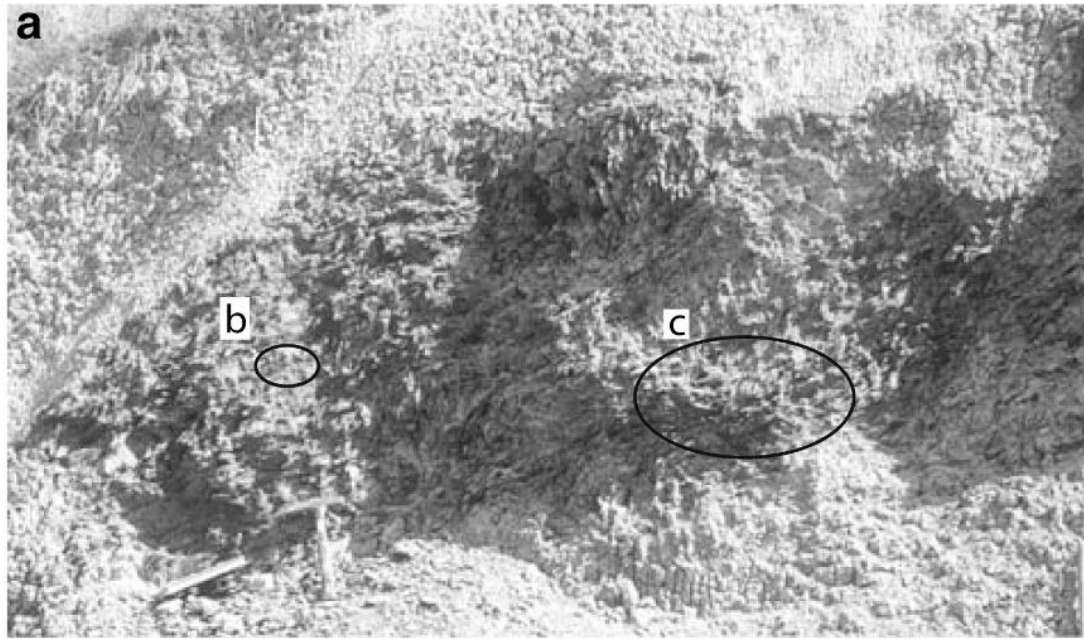
SICLIATONZ

1mm

MICROFABRILE

P. Ferrieri





CLEAVAGE
DOMAIN

CLOSE
SPACING
ANISOTROPY

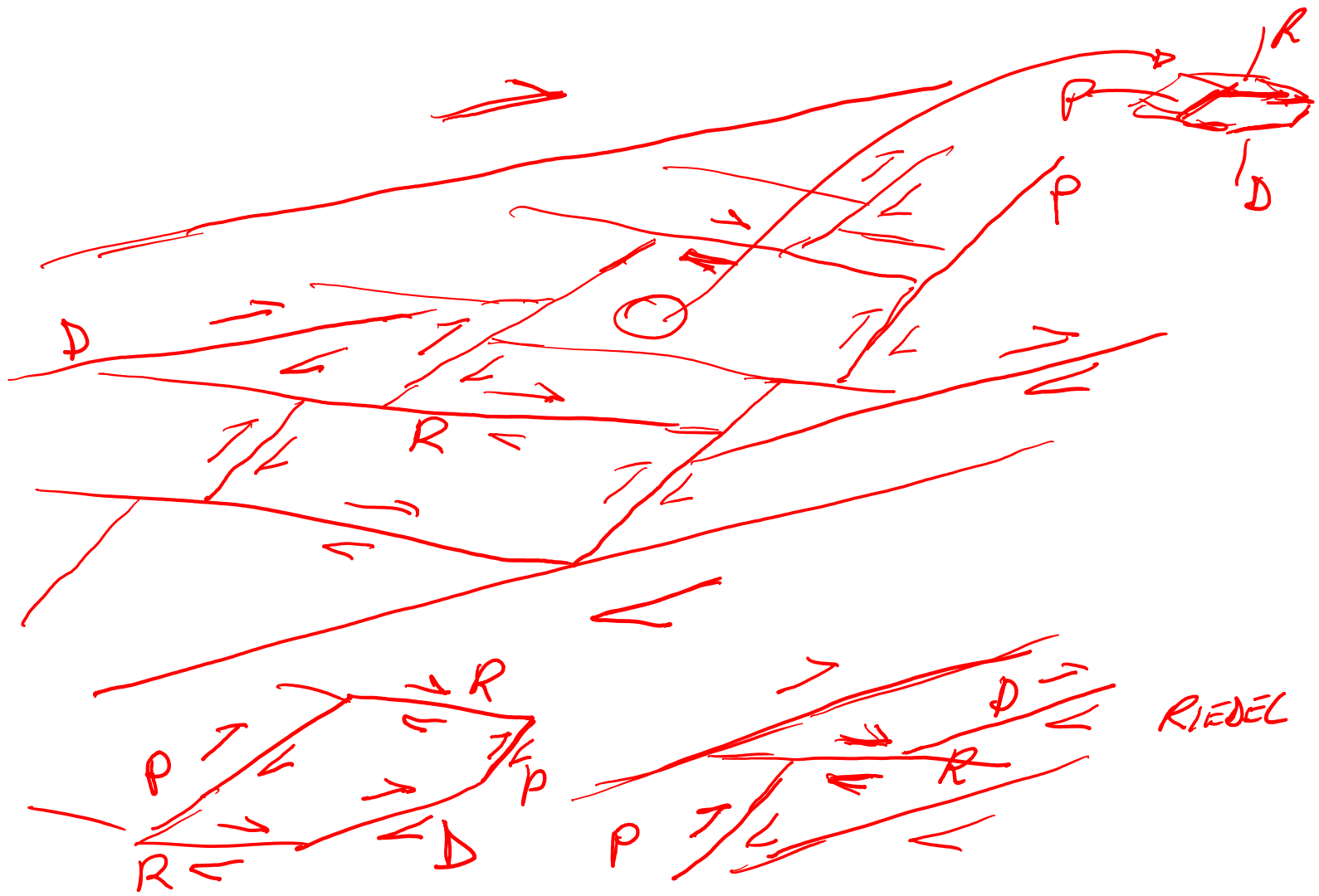
LITHON
CORE

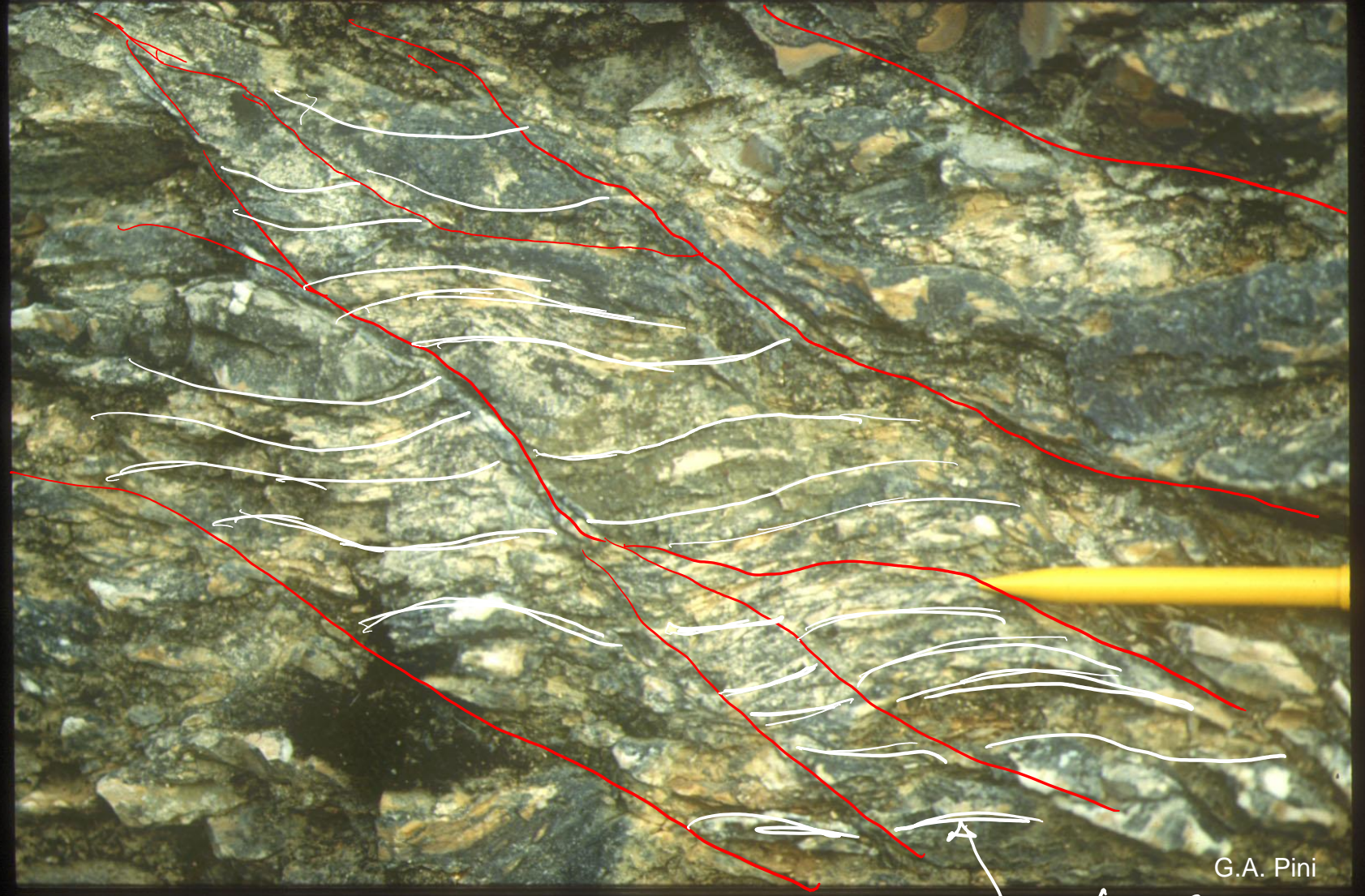
OPEN &
RANDOM



FILLOSILI-
CAT
(ARGILLE)

ROCCIA DI FAGUÀ

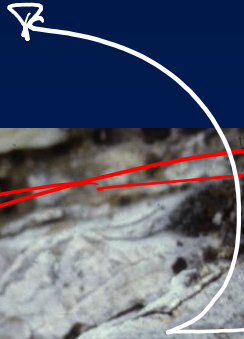




G.A. Pini

CLIVAGGIO
SILICITICO

massive layer of ...



CUVAGGIO
STILO
LITICO



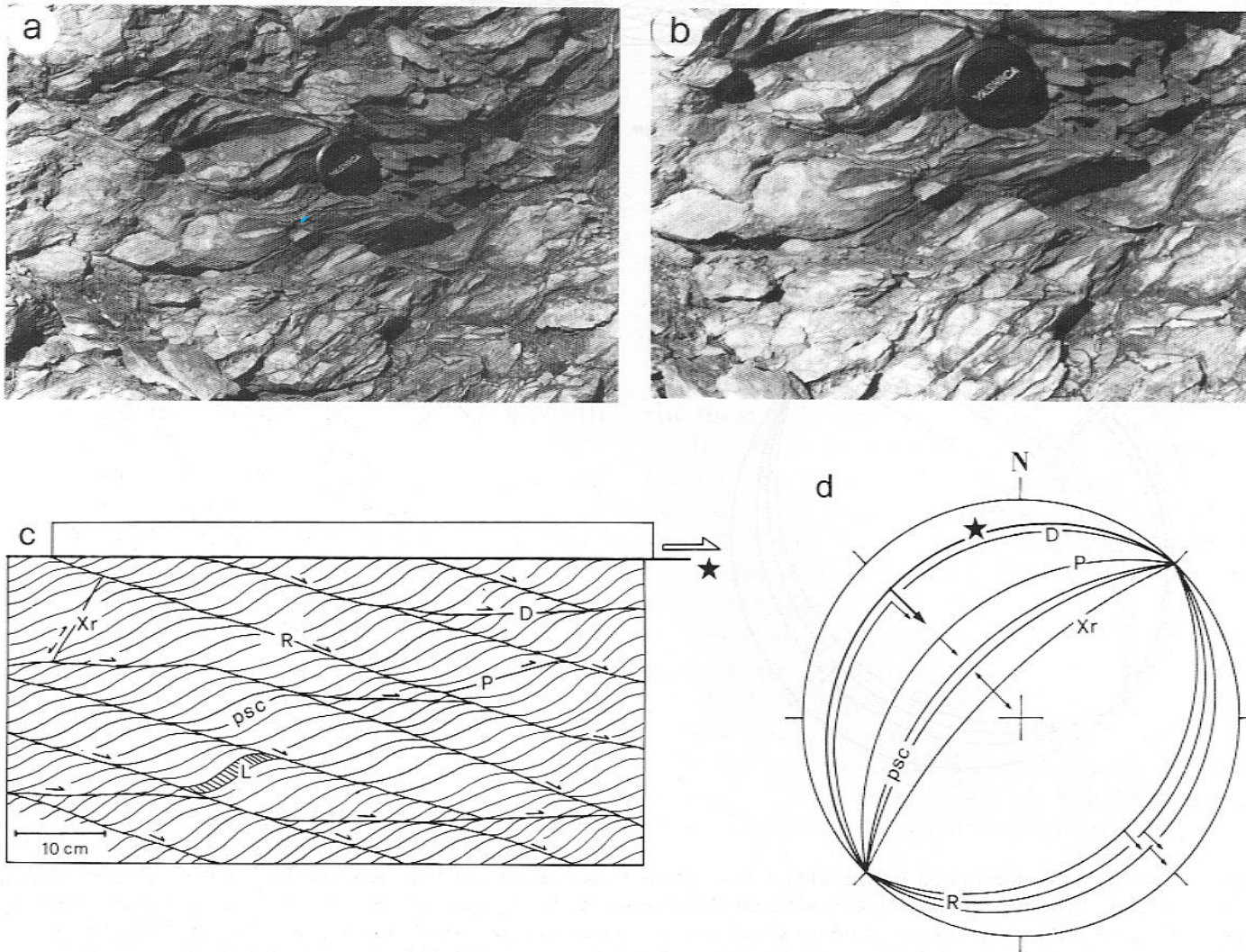
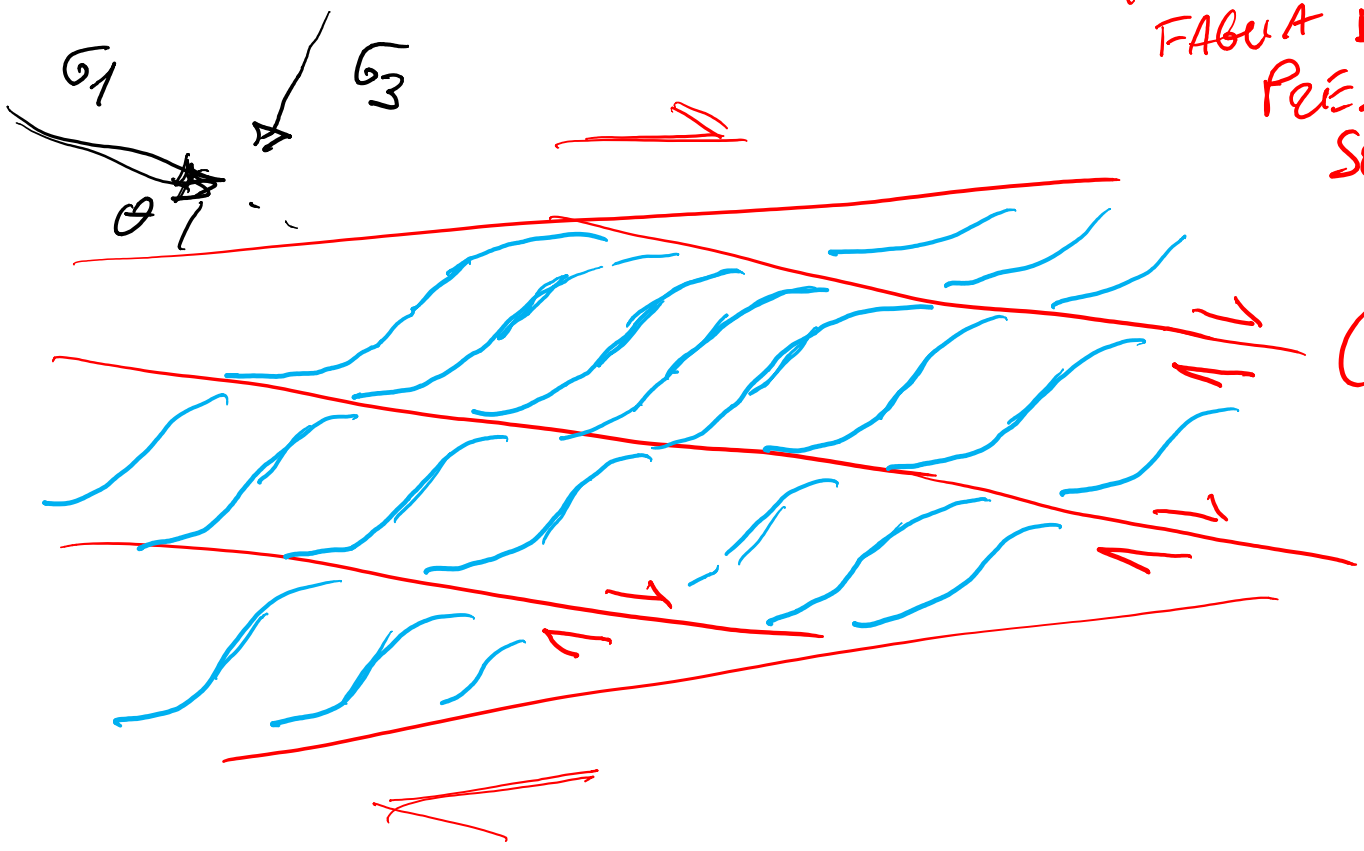


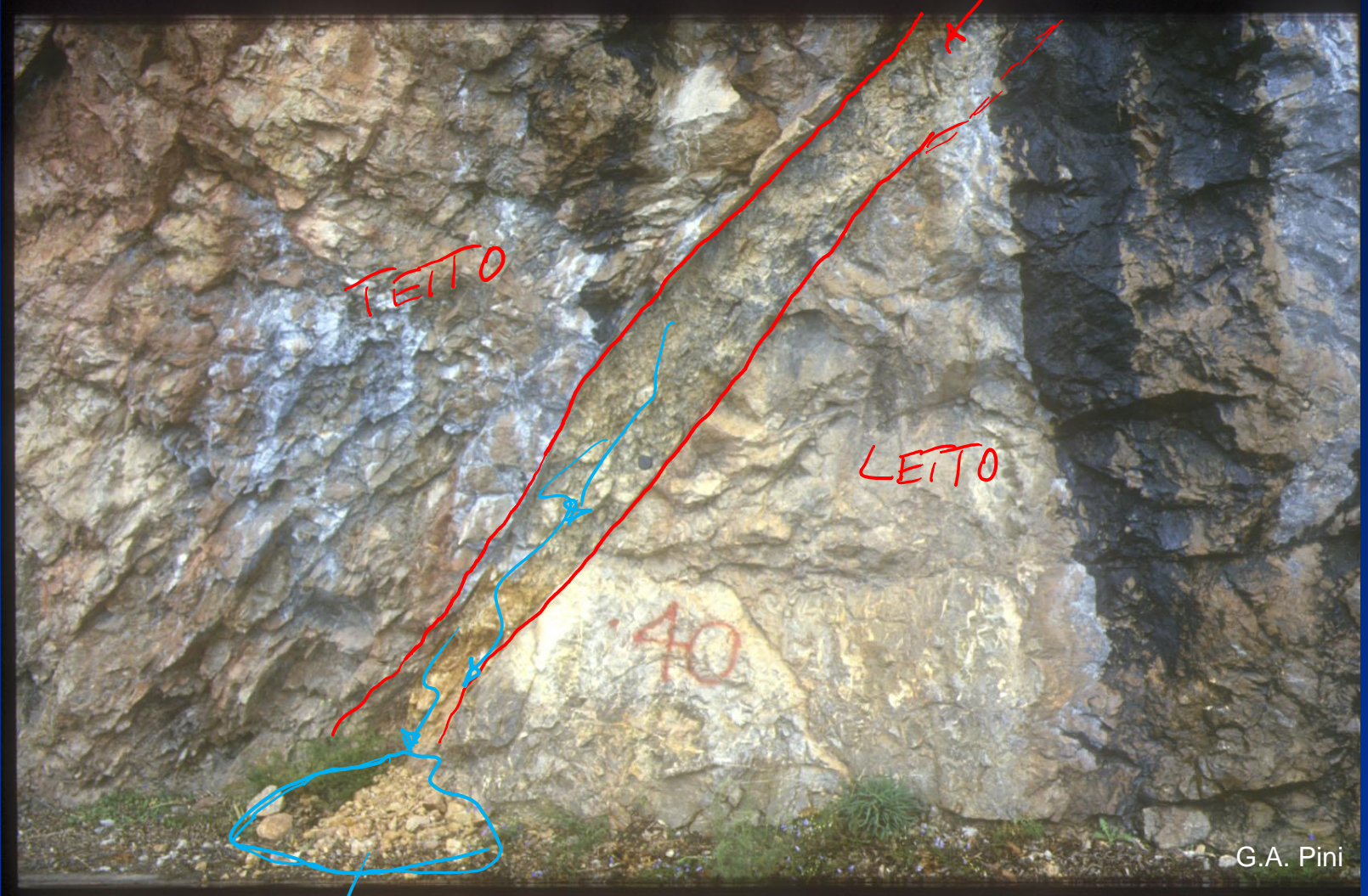
Fig. 5 - Photographs (a, b) and scheme (c) of the pressure solution cleavage and shear plane distribution in pressure solution fault rocks. Wulff net (d) show the idealized orientation of shear planes and psc. L = lithons; psc = pressure solution cleavage planes; R, D, P, Xr = shear planes (see fig. 4); ★ = principal contact surface.



ROCCIA DI
FABUA DA
PRESSURE
SOLUTION
+
TRAGUR
(RIEDEL
SHEAR)

ROCCIA DI FAGLIA, CATACLASTICA

SIMMETRICA



CATACLASITE
NON COESIVA

DETRITI CADUTI
DALLA CATACLASITE

CATACLASITE
SIMMETRICA

CATACLASITE COESIVA

A GRANULOMETRIA INFERIORE AI 2/3 mm

TETTO:

JULCANITI

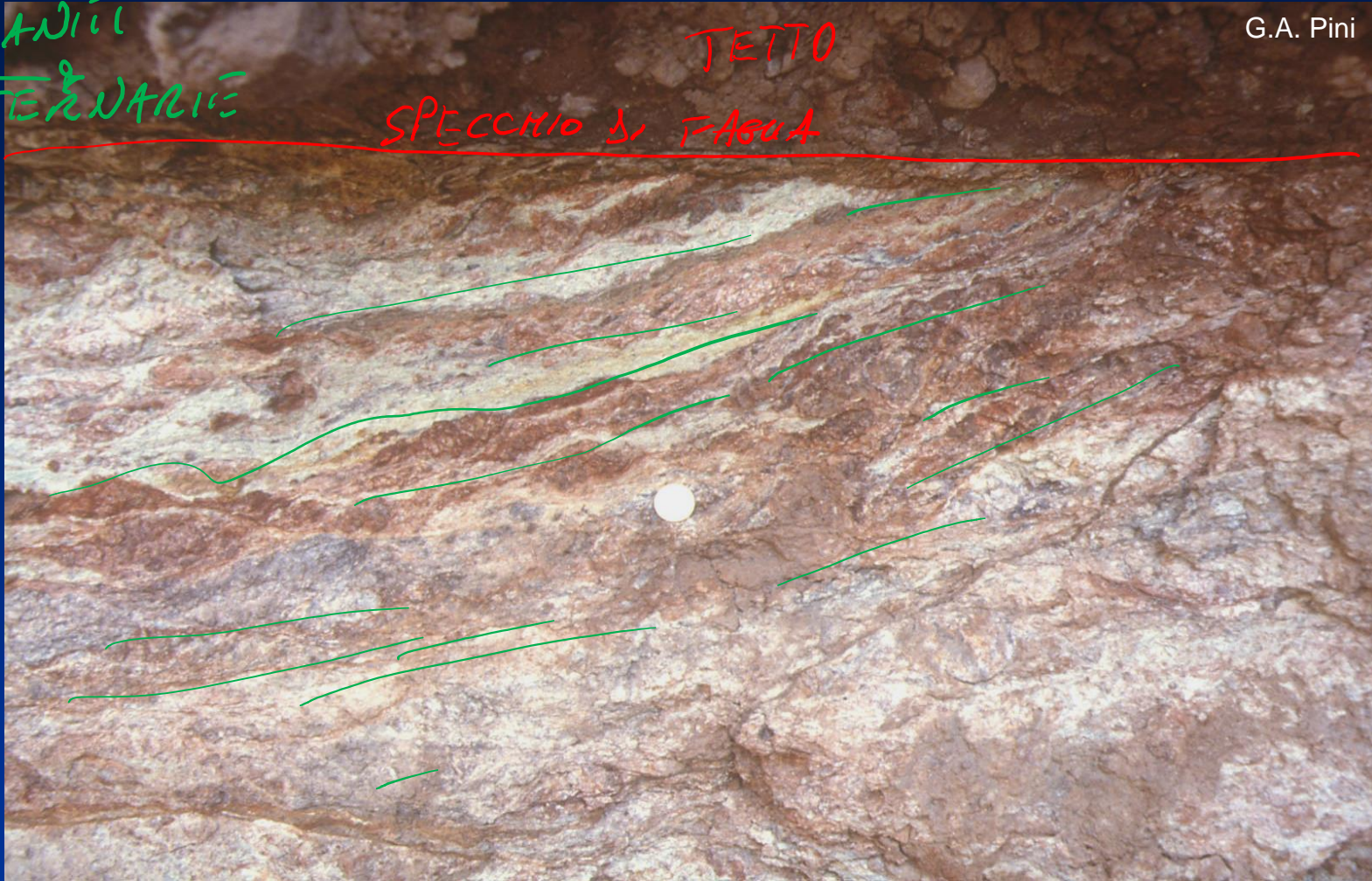
QUATERNARIE

TETTO

SPECCHIO DI FAGLIA

G.A. Pini

TRANS.
NETTA



FAGLIA
NORTH-
LE
DEATH
VALLEY

LETTO:
ROCCHE
META-
MORFICHE

TRANSIZIONE
GRADUALE

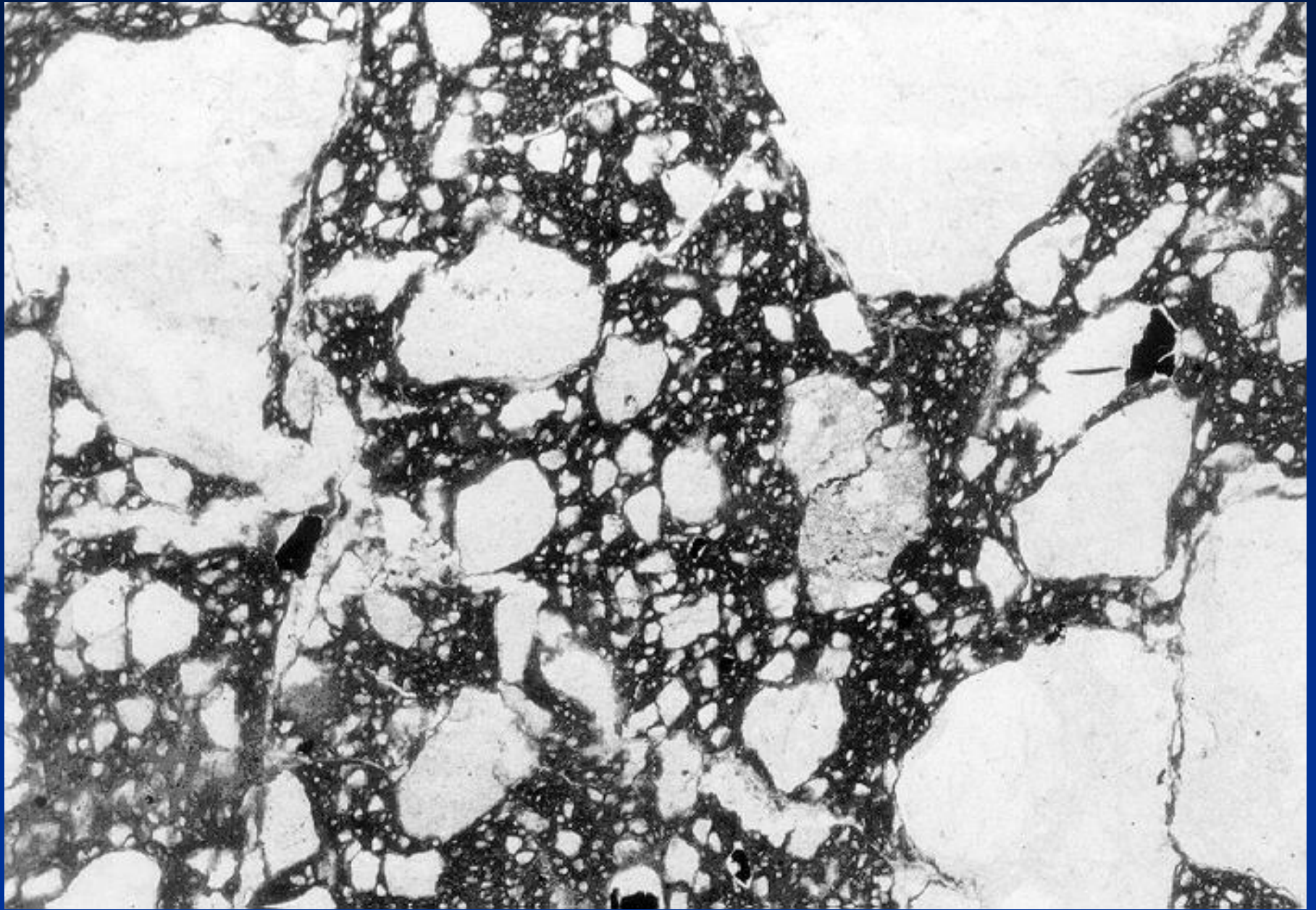
LETTO

ULTRA-CATACLASITE
ASIMMETRICA

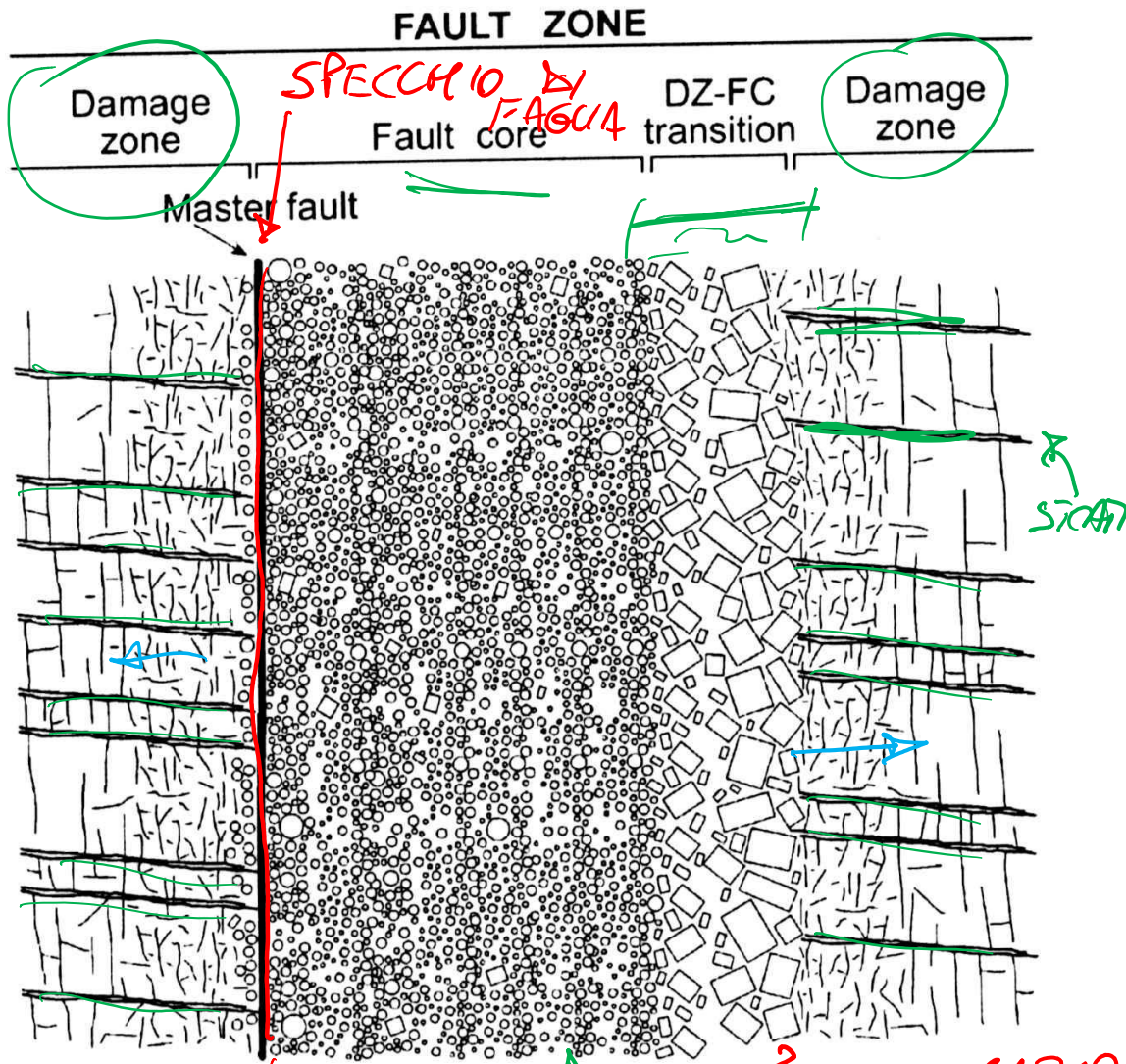
PRE-
CAMBRIANE



Da Ramsay & Huber, 1987

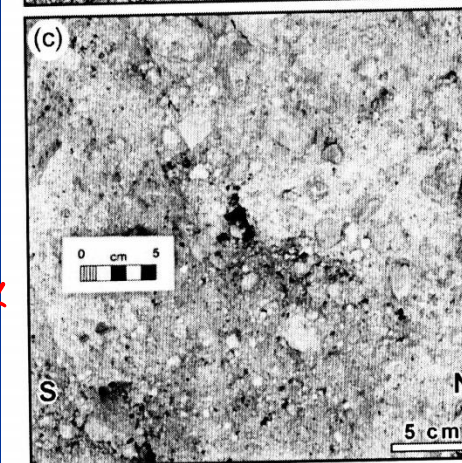
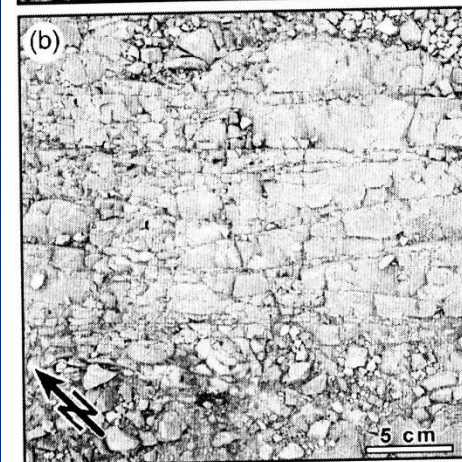
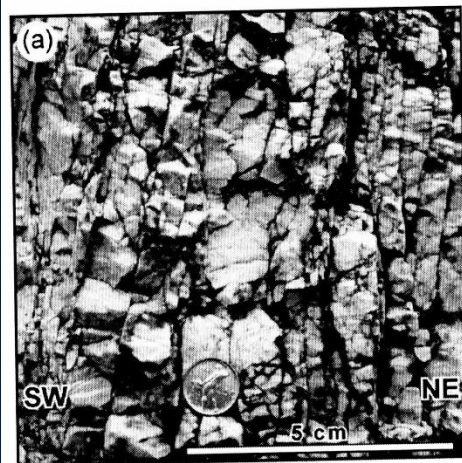


Da Passchier & Trouw, 1996



ZONA DI FAGLIA
ASIMMETRICA

DEFORMAZIONE
CATACLASTICA
ROCCIA DI FAGLIA
(FAULT CORE)



Rocce di faglia

- 1) Duttile superficiali
- 2) Fragili
- 3) Duttile

- 1) *Bande di scorrimento granuli in arenarie-siltiti; clivaggio scaglioso*
 - *Transizione: da scorrimento indipendente granuli a grain breakage; aumento pervasività e diminuzione spaziatura clivaggio scaglioso*
- 2) *Rocce di faglia da: taglio (clivaggio scaglioso), dissoluzione da pressione (PSC+meso-faglie+eventuale clivaggio scaglioso); cataclasiti, pseudotachiliti*
 - *Transizione: da cataclasiti a miloniti; pseudotachiliti*
- 3) *Zone di taglio duttile: miloniti (S-C e S-C' miloniti, pseudotachiliti (?), indicatori cinematici)*

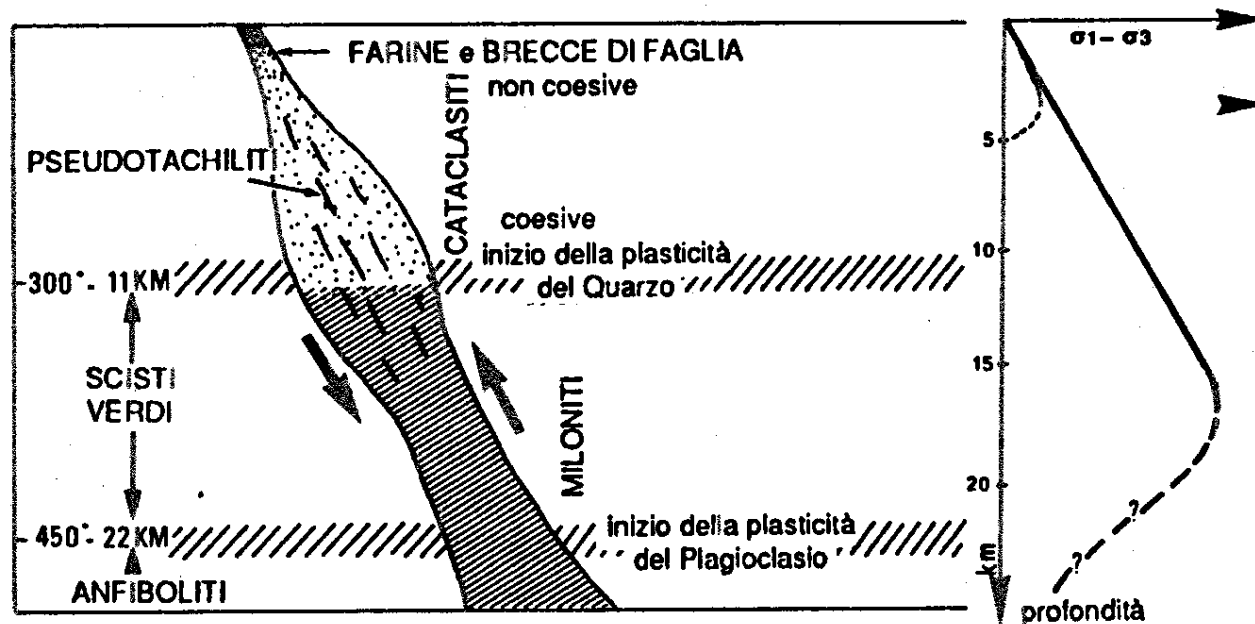


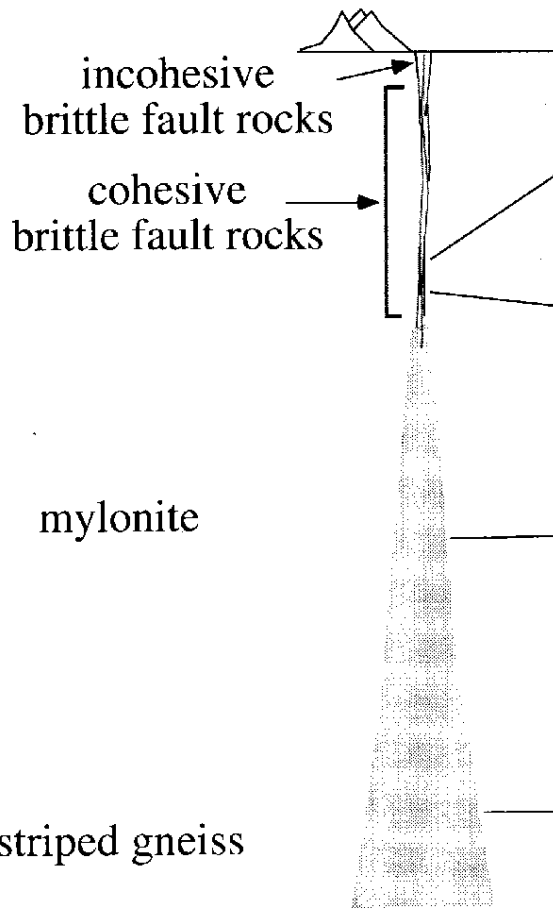
Figura 5.5. I diversi tipi di rocce deformate associate ad una faglia principale (da Sibson, 1977, *J. Geol. Soc. London*, 133, 191, e Scholtz, 1988, *Geol. Rund. Stuttgart*, 77, 319, modificato). Lo sforzo differenziale ($\sigma_1 - \sigma_3$) decresce quando la deformazione duttile aumenta; il tratto puntinato corrisponde alle condizioni dei bacini sedimentari (vedi Fig. 4.16).

a

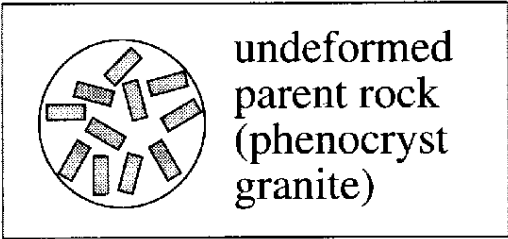
dominant brittle fracturing



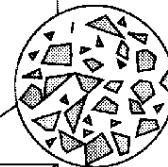
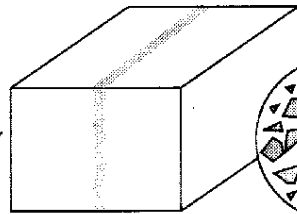
dominant ductile deformation



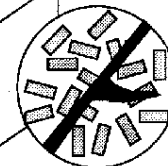
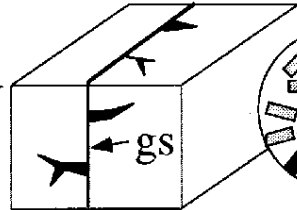
b



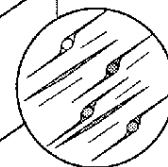
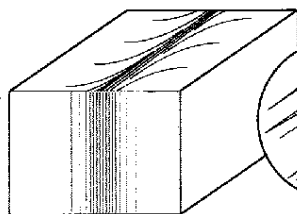
undeformed parent rock (phenocryst granite)



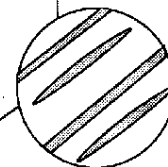
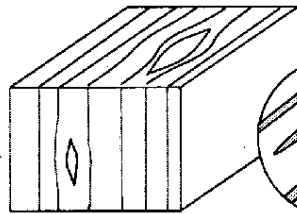
brittle fault with cohesive cataclasite



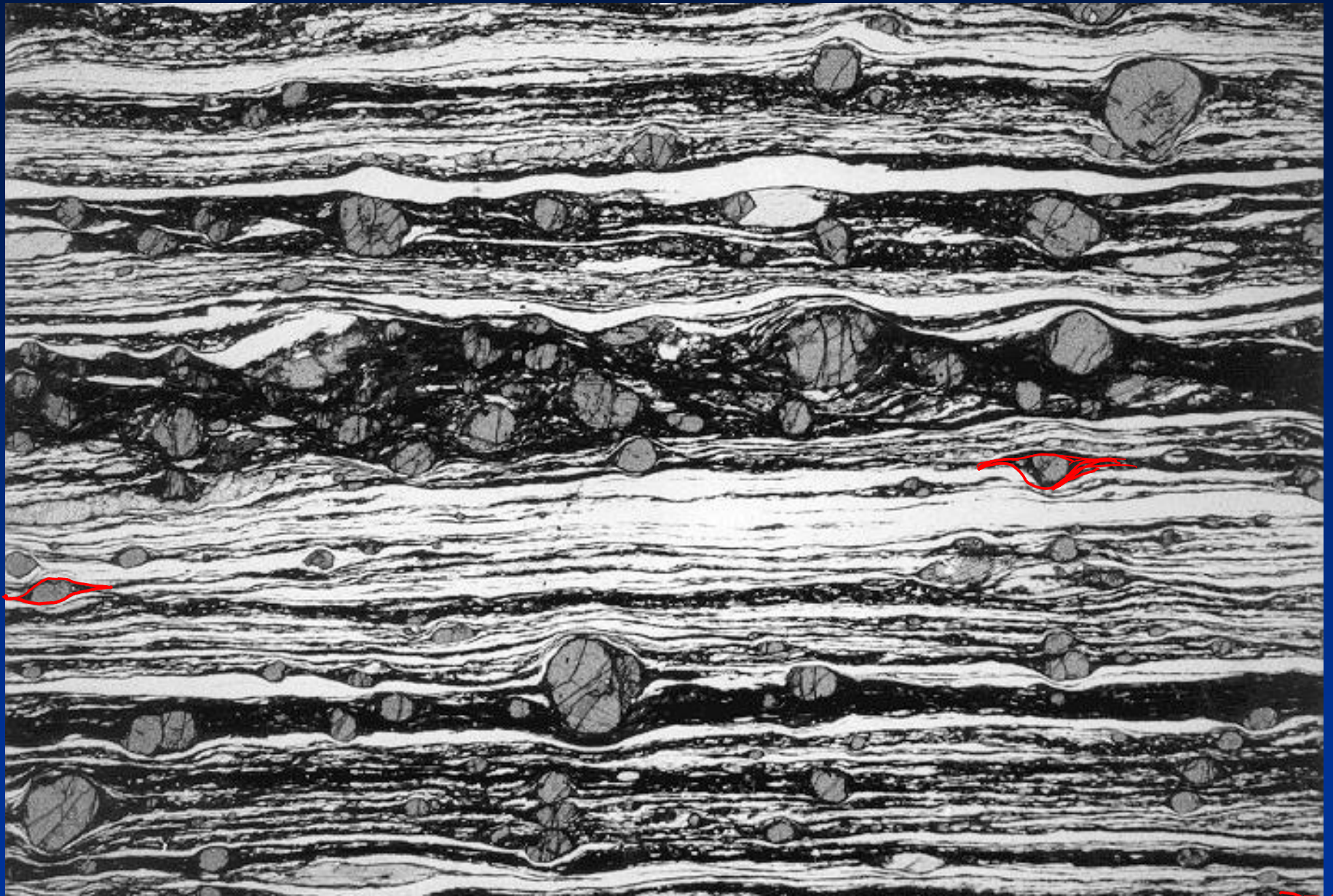
brittle fault with pseudotachylite



narrow ductile shear zone with mylonite

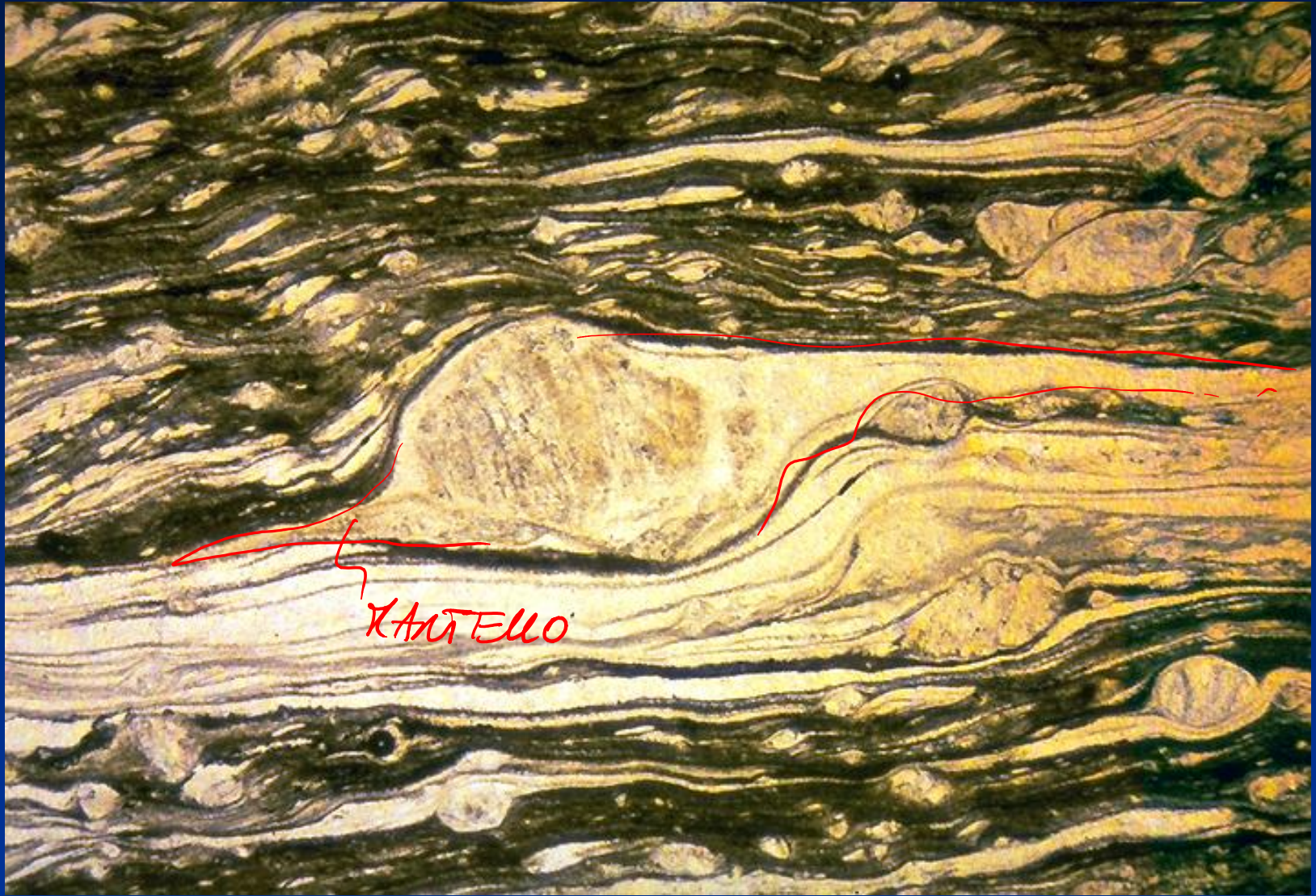


wide ductile shear zone with striped gneiss

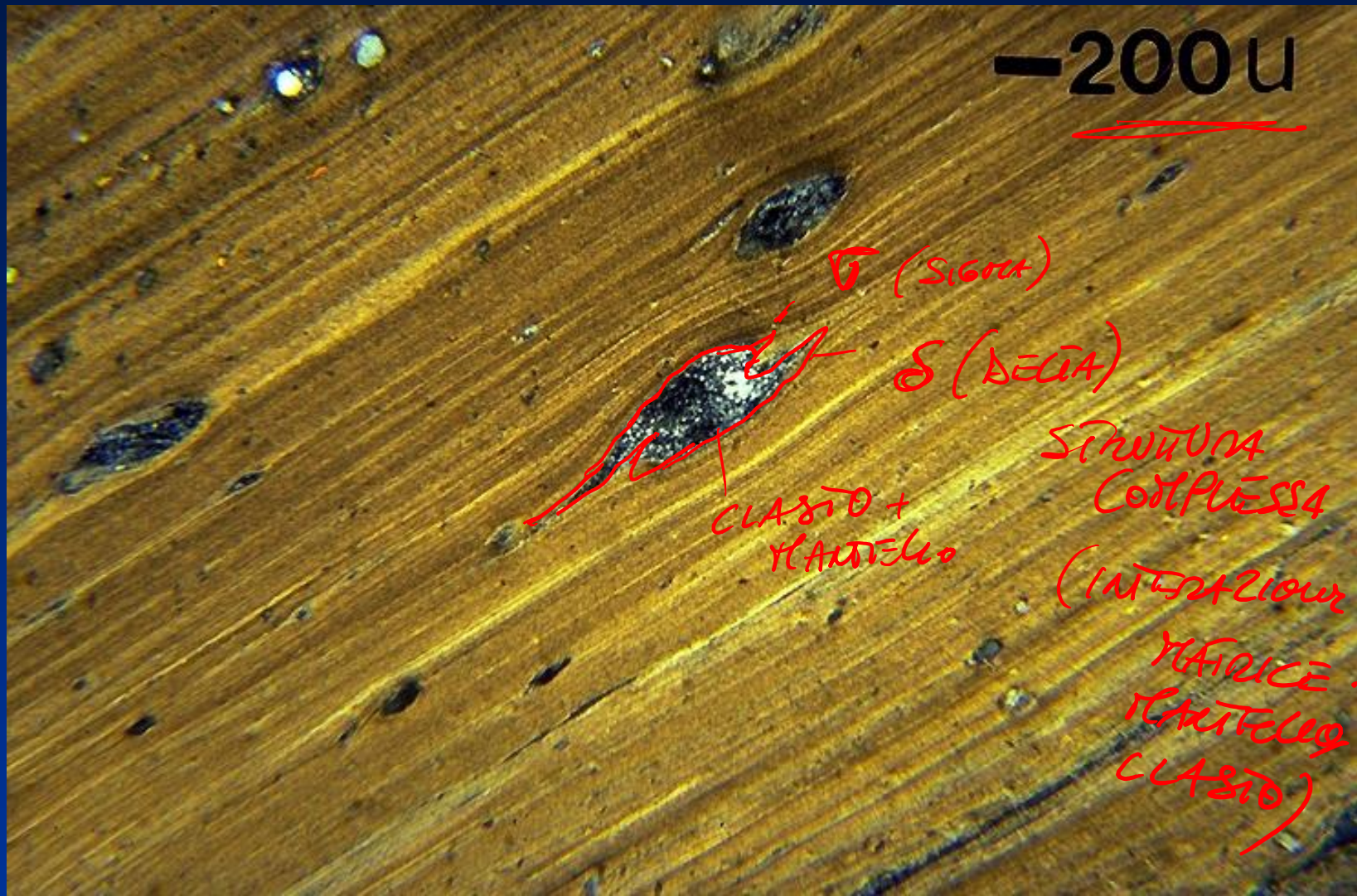


Da Passchier & Trouw, 1996

CLASTI, BLASTI, STATICE (FOLIAROUS), PLANIFLO



Da Passchier & Trouw, 1996



200 u

δ (SICCA)

δ (DECA)

CLASTO +
MANTELLO

STRUTTURA
COMPRESSA

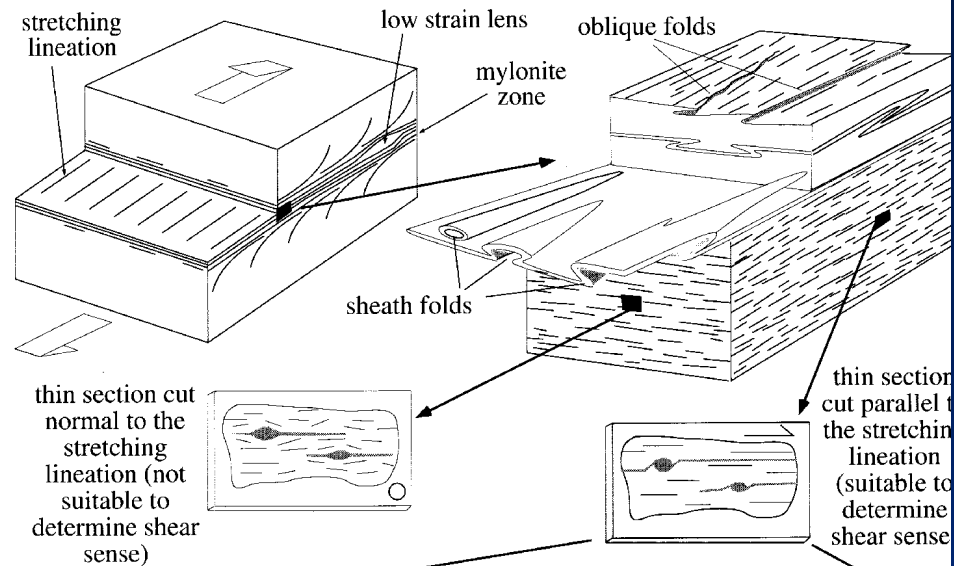
(INTERAZIONE

MAFICE -
MANTELLO
CLASTO)

ULTRAMILONITE

Da Passchier & Trouw, 1996

FOGLIA 21007



STRUTTURA
 DUTTA
 DA
 DEFORM.
 DISOGENEA
 ↓
 INDICATORI
 CINETICI

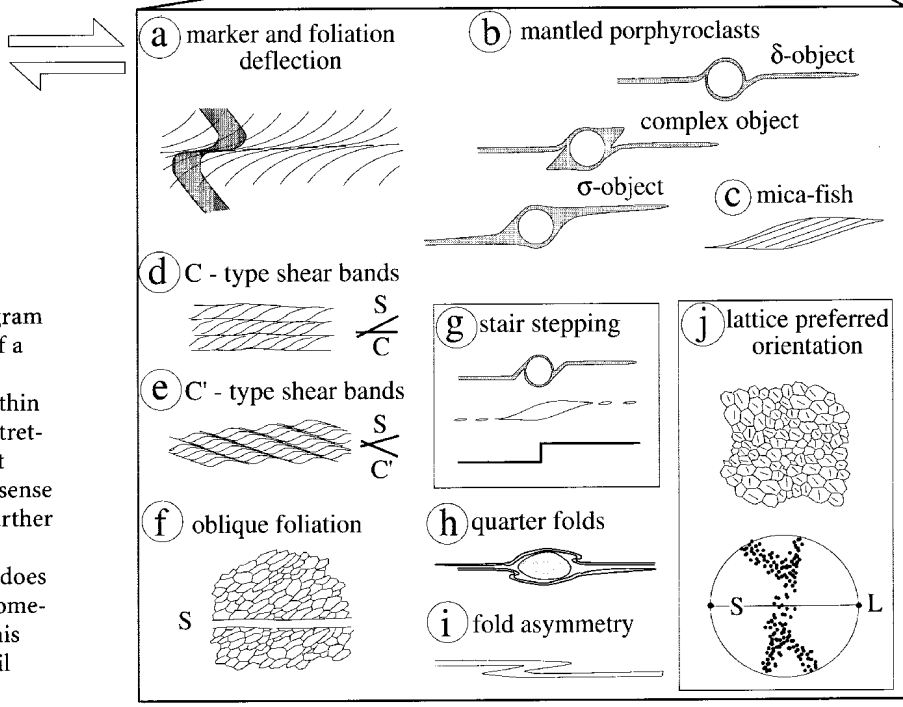


Fig. 5.9. Schematic diagram showing the geometry of a mylonite zone and the nomenclature used. For thin sections parallel to the stretching lineation, the most common types of shear sense indicators are shown. Further explanation in text. This Figure is schematic and does not show all possible geometries. Other Figures in this chapter show more detail

Indicatori cinematici: strutture σ

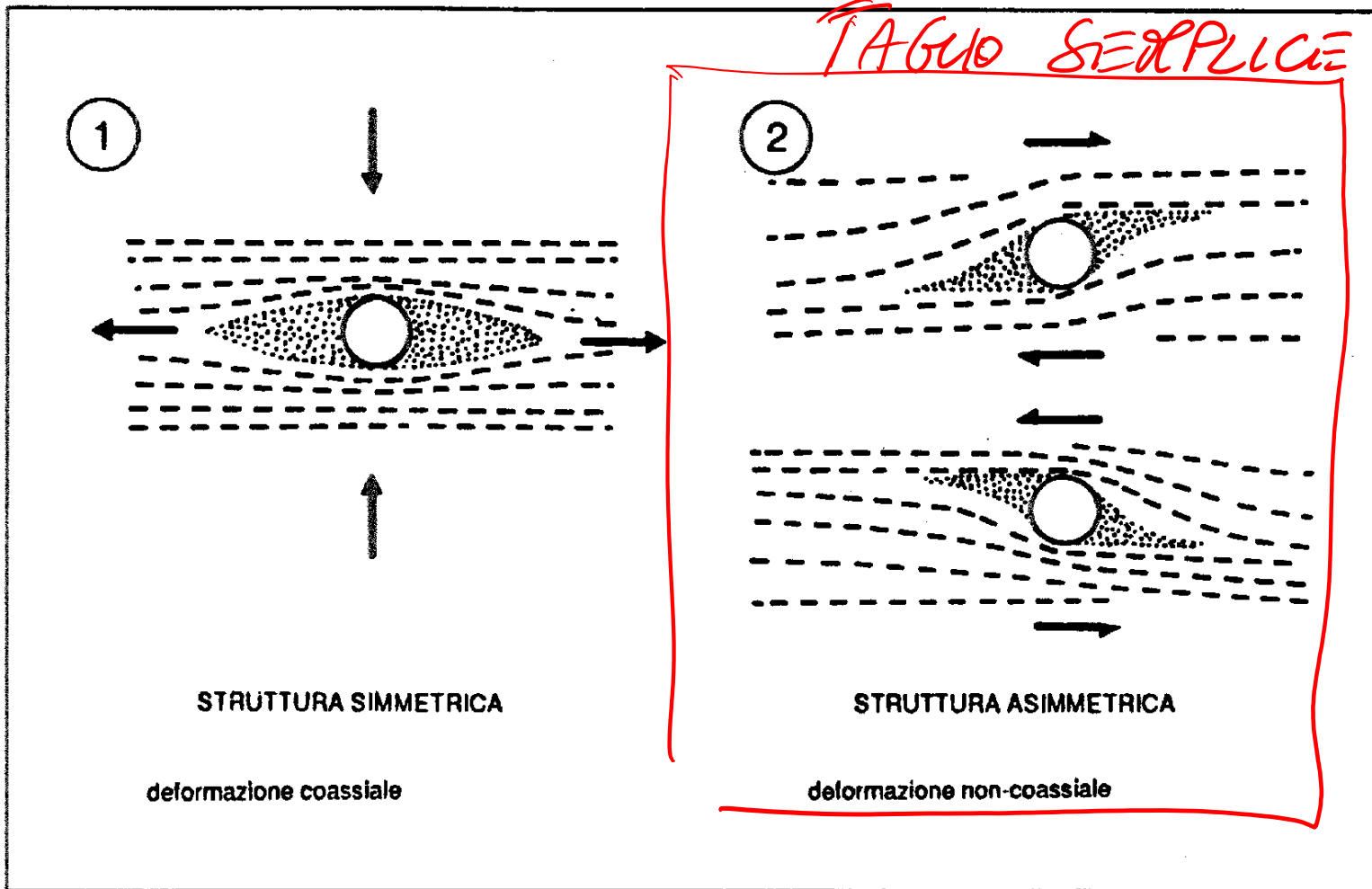
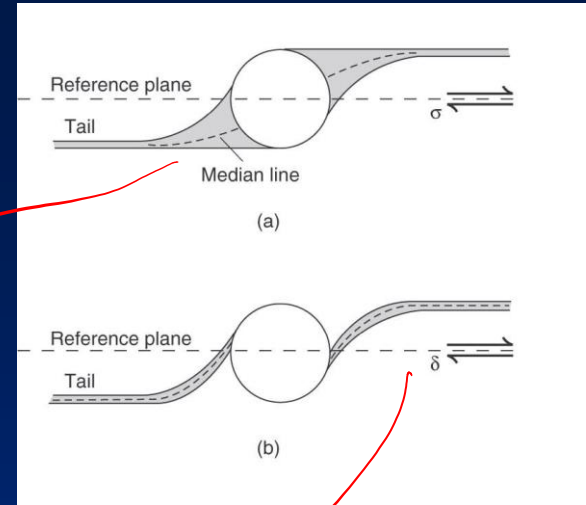


Figura 7.20. Relazioni tra simmetria delle strutture e modalità deformativa.

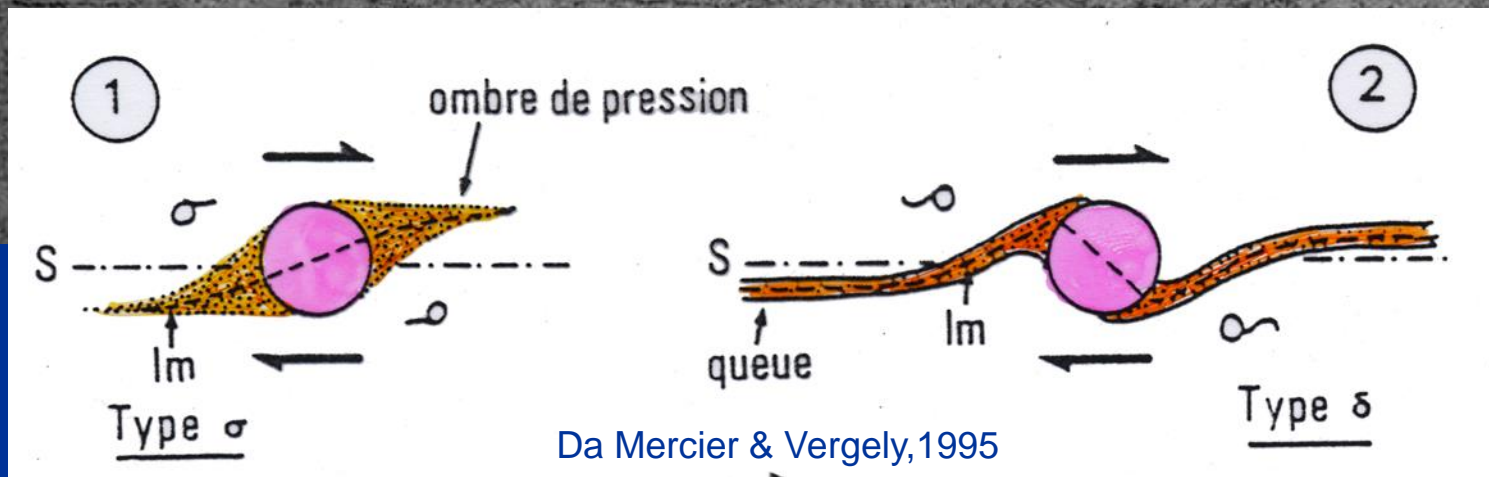
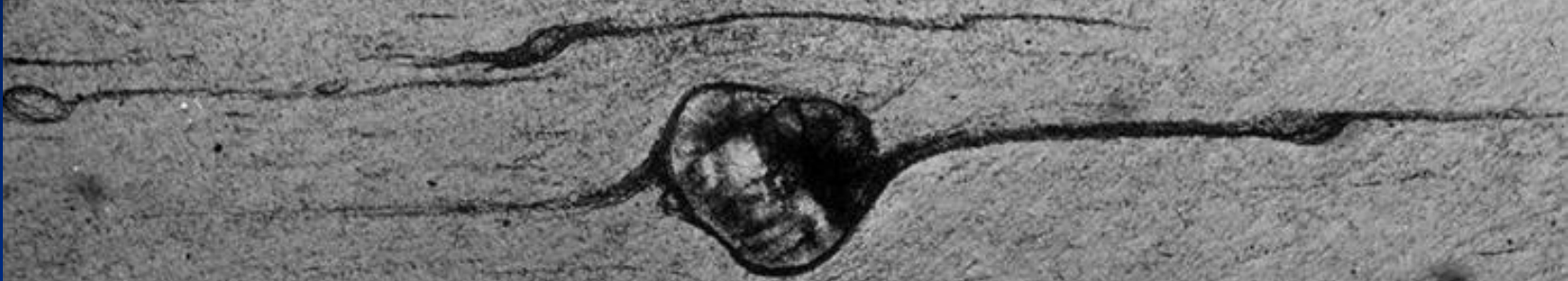
strutture σ e δ



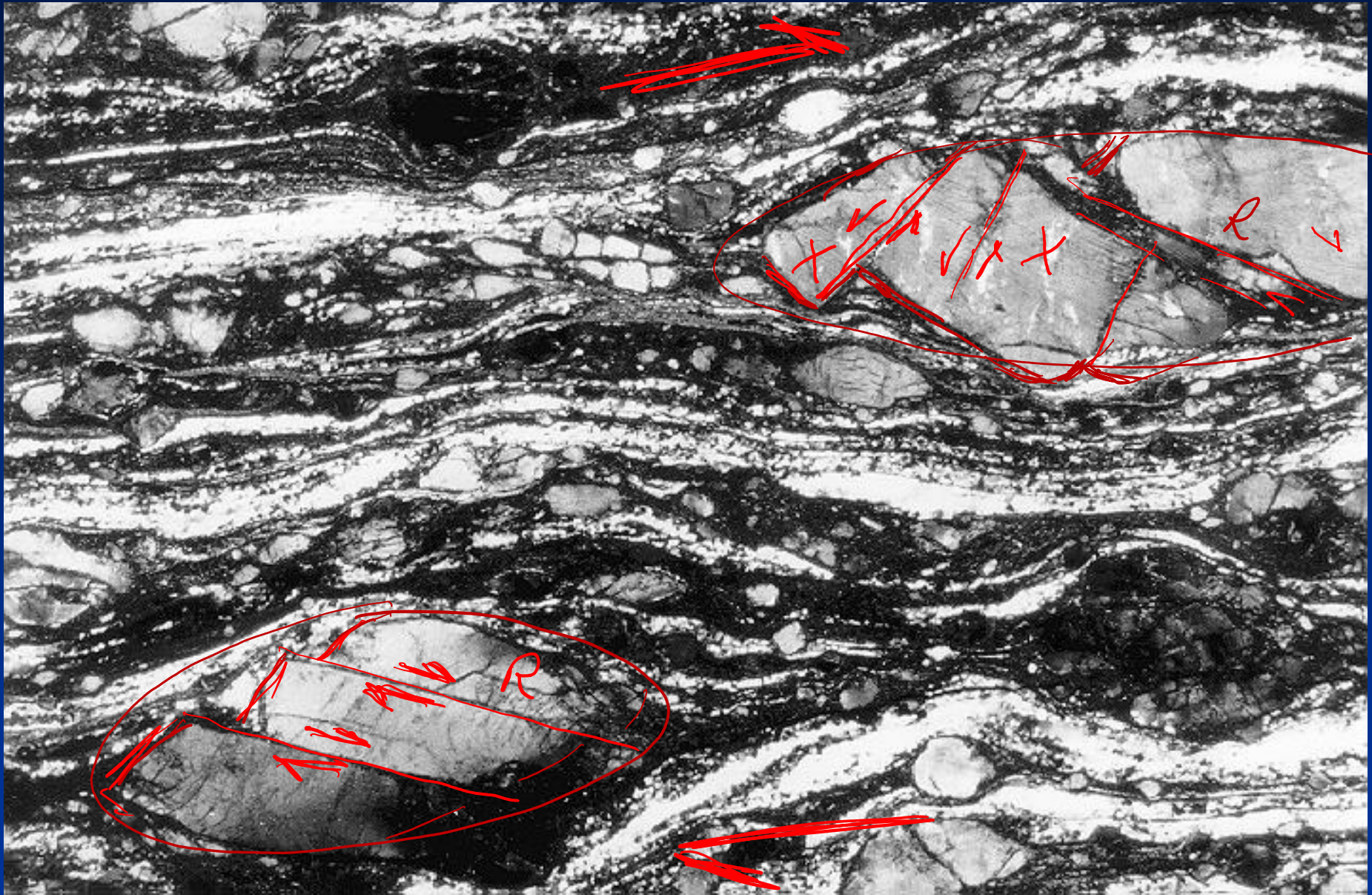
Da van der Pluijm B., Marshak S., 2004, 2010



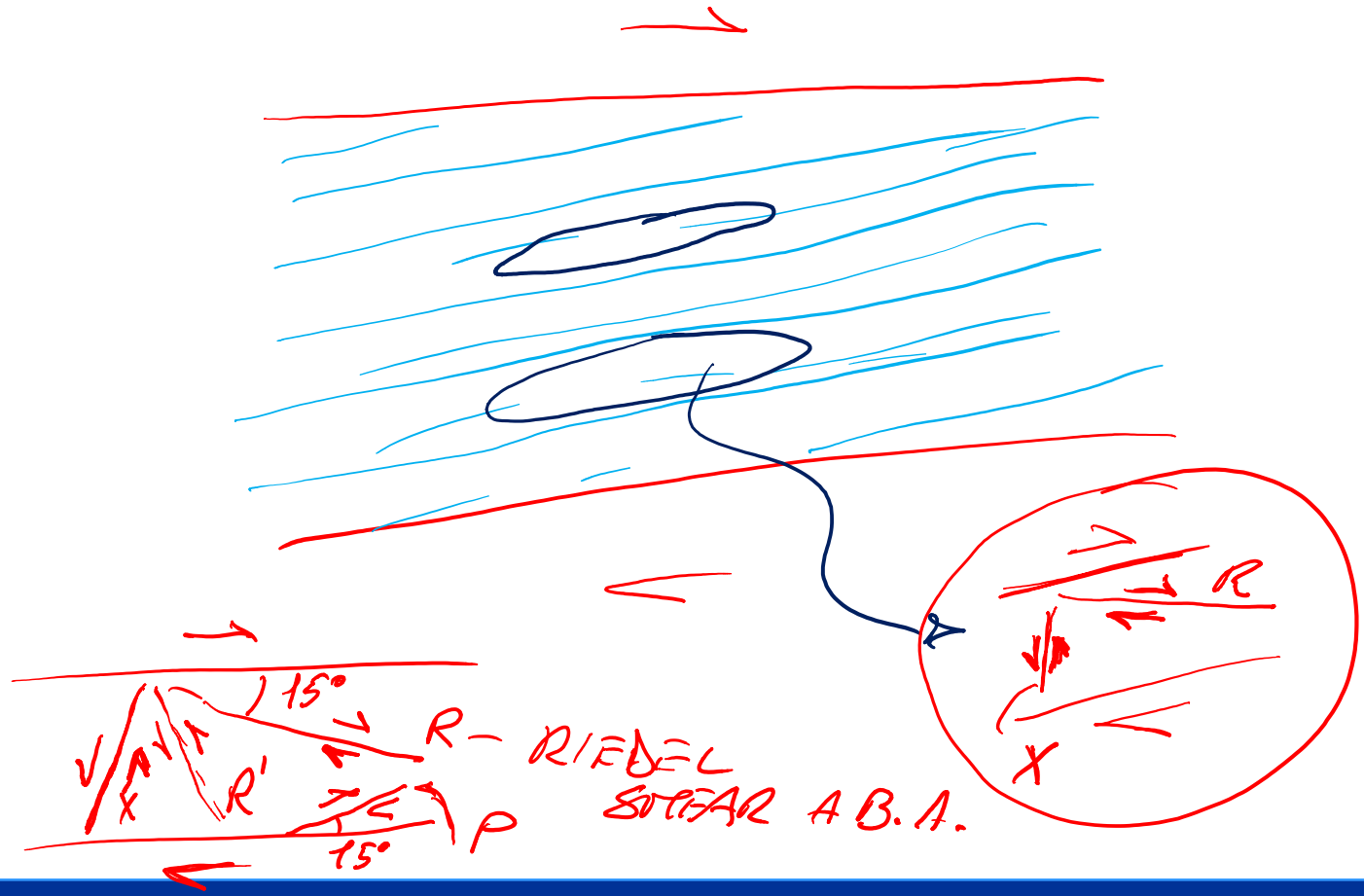
Da Fossen, 2010



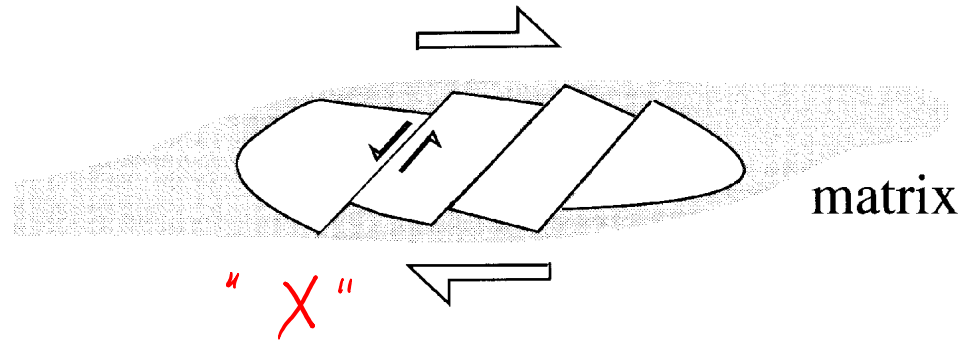
Da Mercier & Vergely, 1995



Passchier & Trouw, 2006



antithetic microfaults or shear zones in grains



synthetic microfaults or shear zones in grains

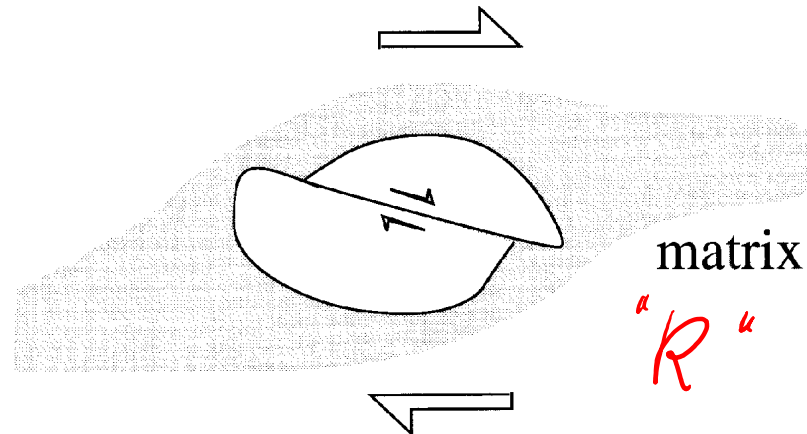
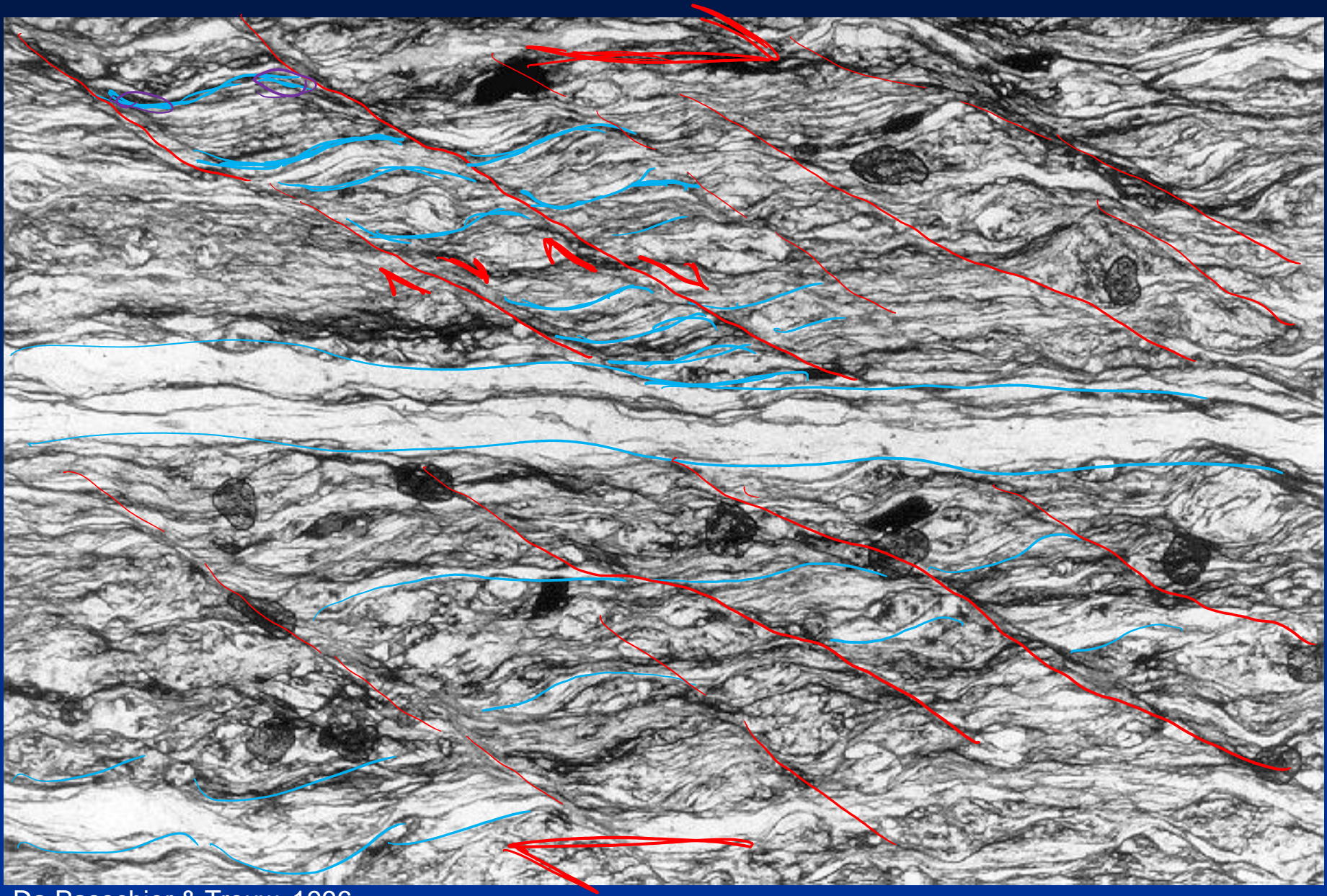


Fig. 5.31. Illustration of the two mechanisms of formation of stepped fragmented grains at similar bulk shear sense (*large arrows*)



Da Passchier & Trouw, 1996

Indicatori cinematici: strutture S-C e S-C'

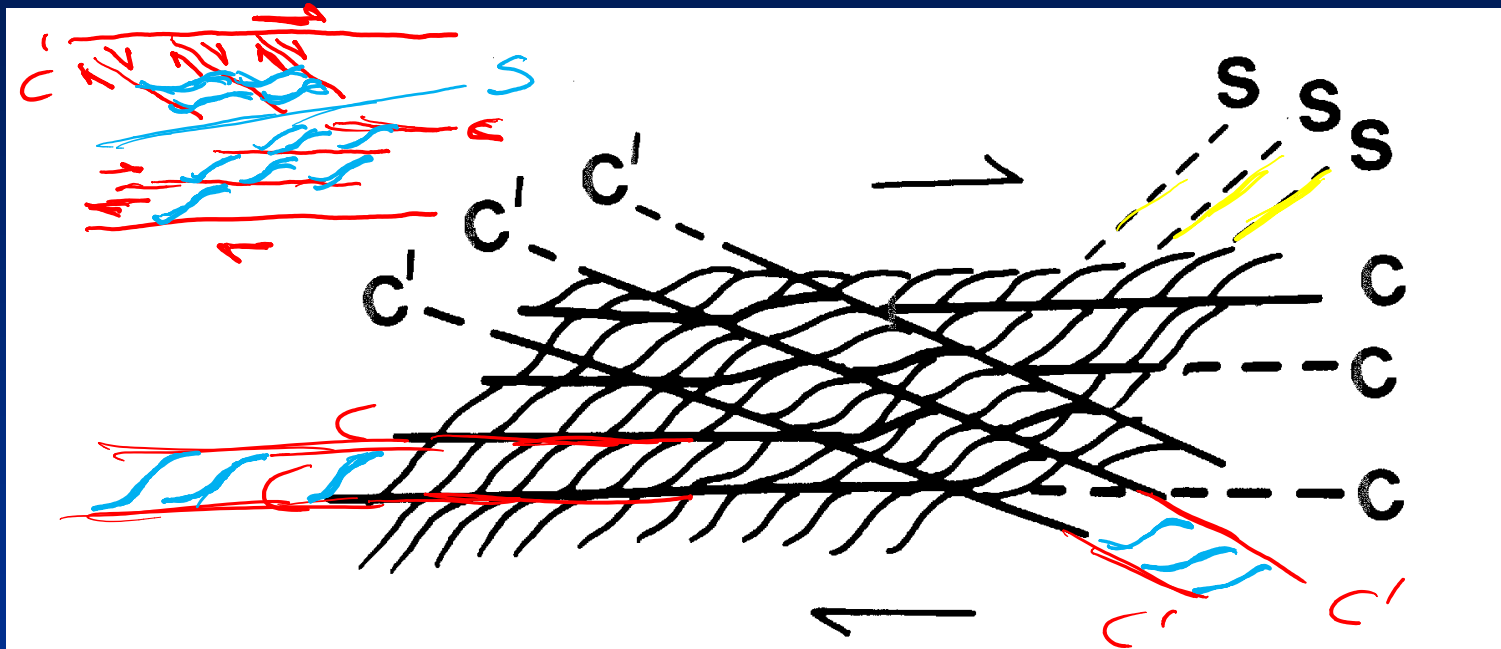
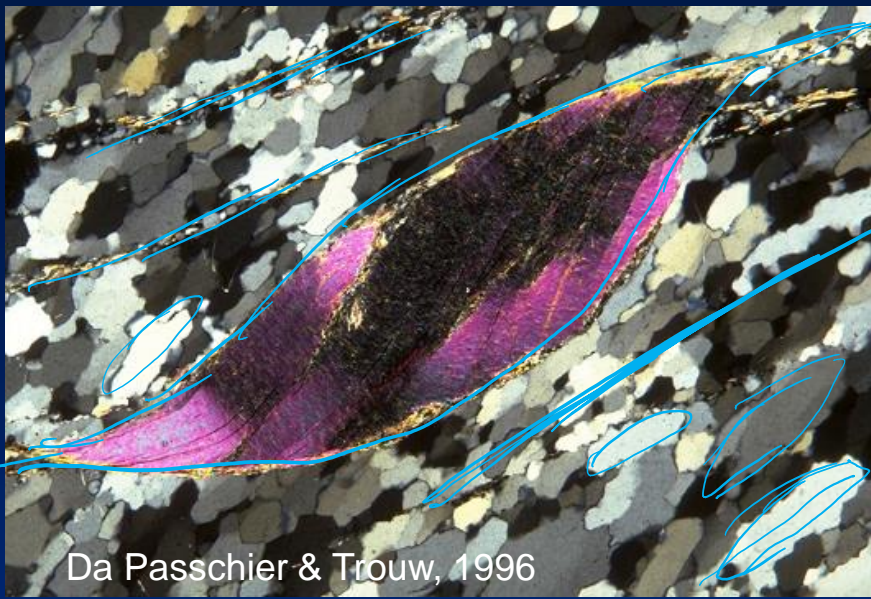
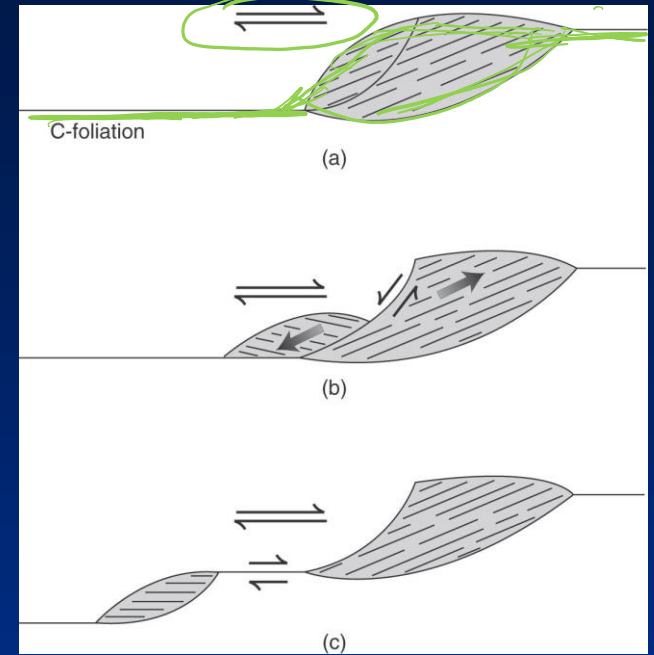
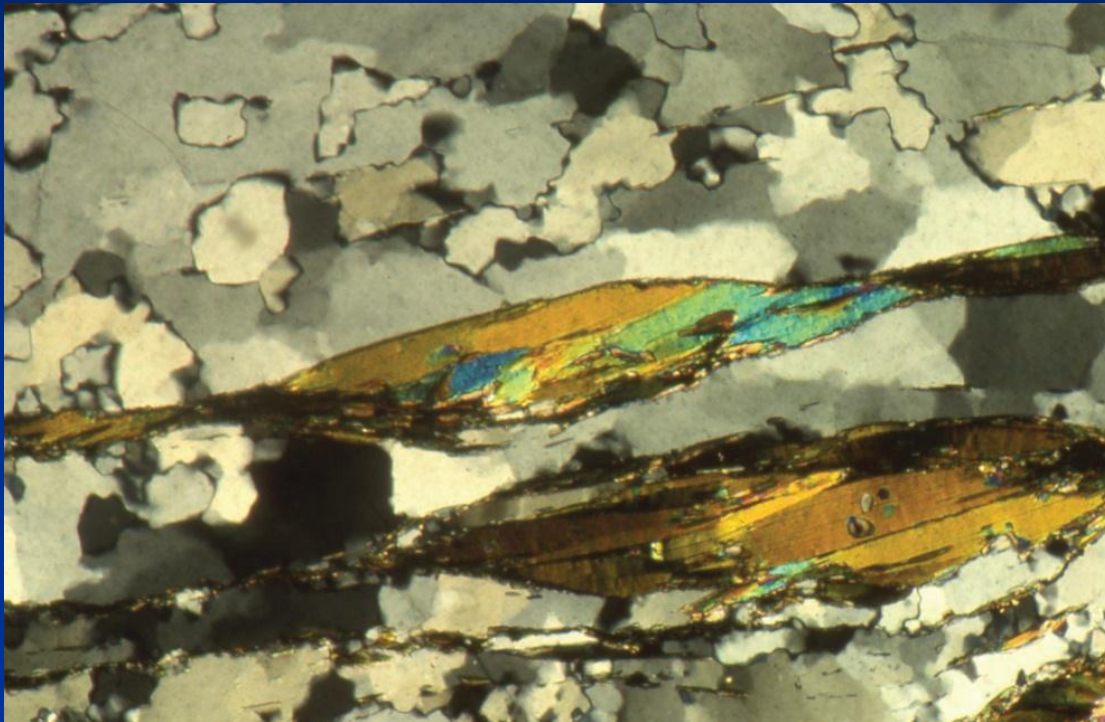


Figure 10.18 Schematic illustration of C' fabrics in relation to S and C fabrics.

Indicatori cinematici: «mica fish»



Da Passchier & Trouw, 1996

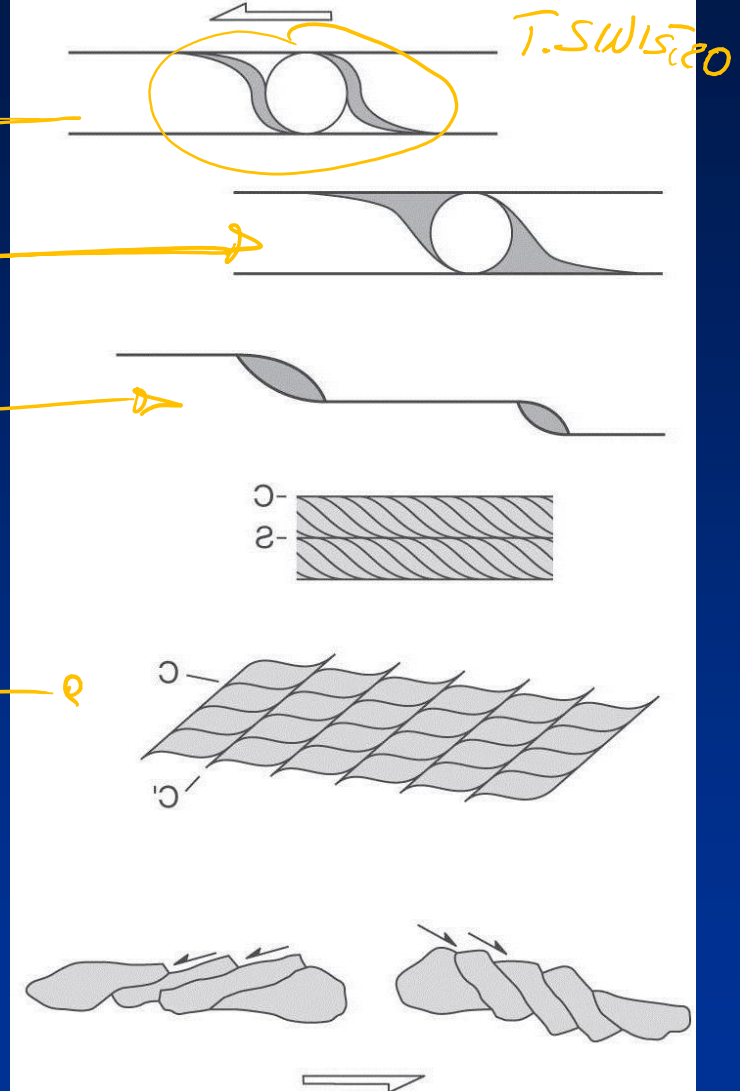
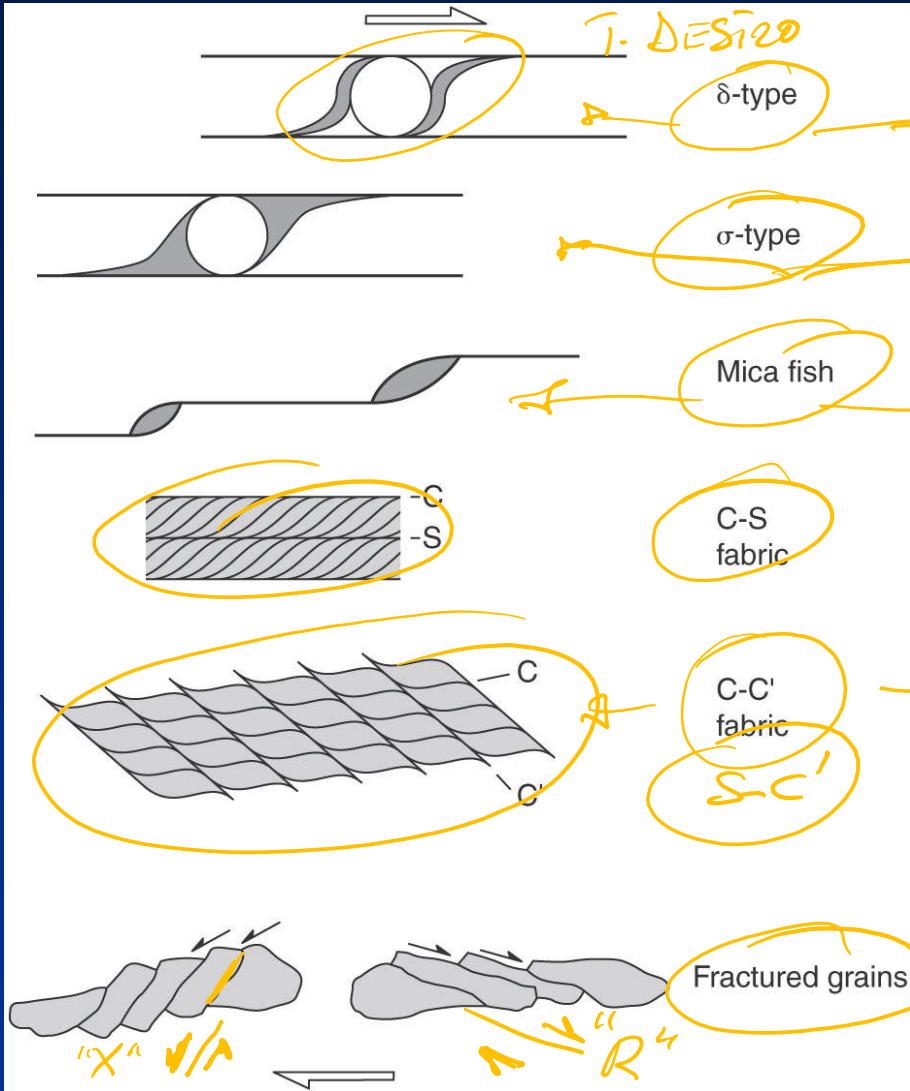


Da van der Pluijm B., Marshak S., 2004, 2010



Figure 10.21 Trails and stair-stepping between mica-fish.

Da Barker, 1990



Indicatori cinematici, strutture complesse: code δ , evoluzione da

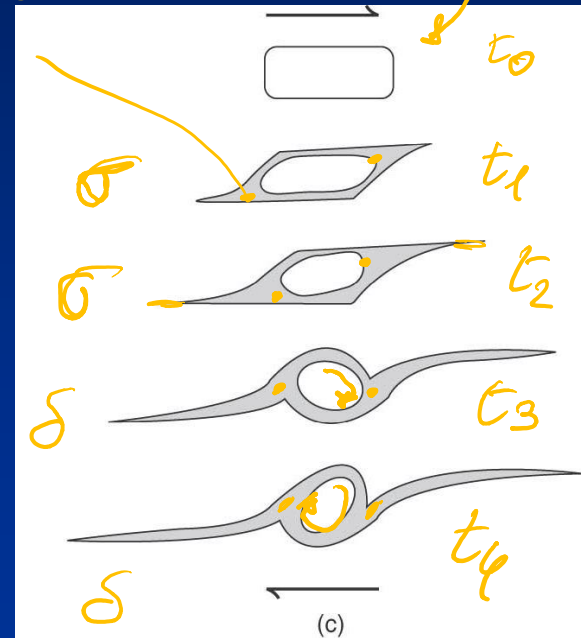


Da van der Pluijm B., Marshak S., 2004, 2010

σ

NO DEF.
NO RAUDELLO

RAUDELLO



Da van der Pluijm B., Marshak S., 2004, 2010

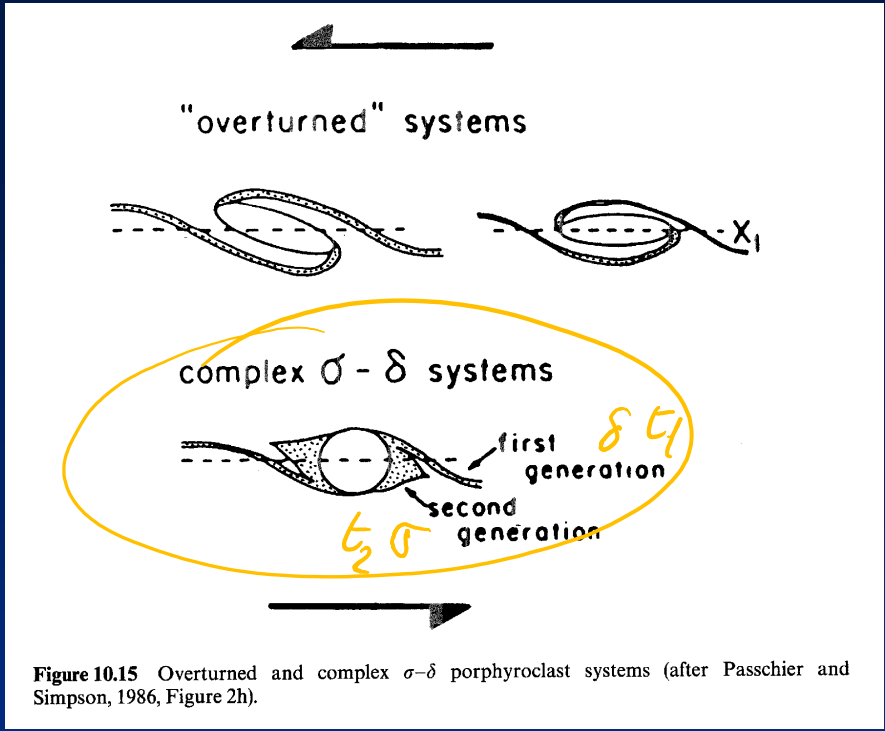
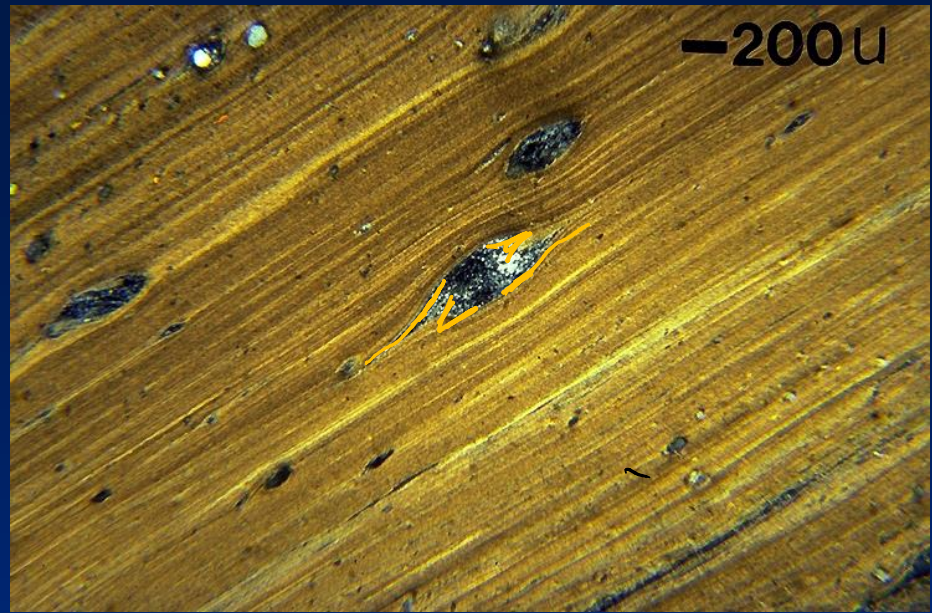
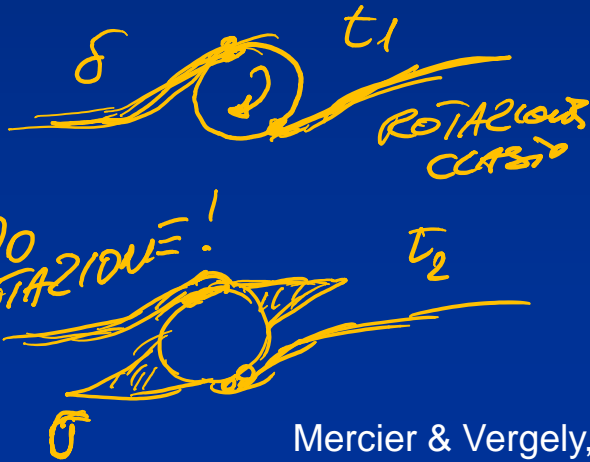


Figure 10.15 Overturned and complex σ - δ porphyroclast systems (after Passchier and Simpson, 1986, Figure 2h).

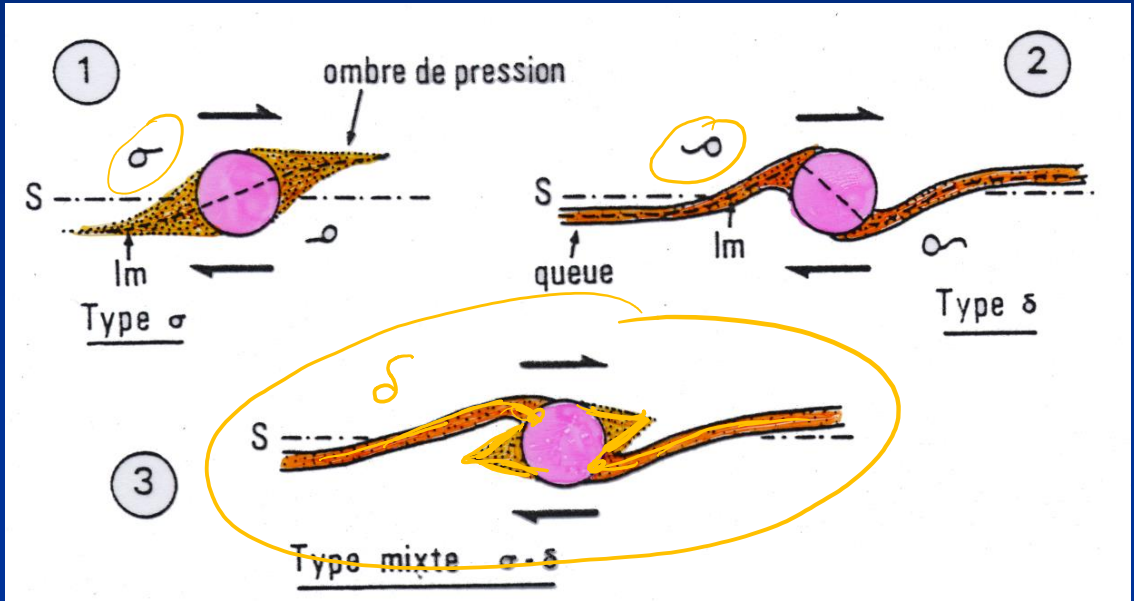


Da Passchier & Trouw, 1996

Da Barker, 1990



Mercier & Vergely, 1995



Rocce di faglia

- 1) Duttile superficiali
- 2) Fragili
- 3) Duttile

- 1) *Bande di scorrimento granuli in arenarie-siltiti; clivaggio scaglioso*
 - *Transizione: da scorrimento indipendente granuli a grain breakage; aumento pervasività e diminuzione spaziatura clivaggio scaglioso*
- 2) *Rocce di faglia da: taglio (clivaggio scaglioso), dissoluzione da pressione (PSC+meso-faglie+eventuale clivaggio scaglioso); cataclasiti, pseudotachiliti*
 - *Transizione: da cataclasiti a miloniti; pseudotachiliti*
- 3) *Zone di taglio duttile: miloniti (S-C e S-C' miloniti, pseudotachiliti (?), indicatori cinematici)*



Da Ramsay & Huber, 1987

VETRIFICAZIONE
 DELLA
 ROCCIA
 !!!
 ...

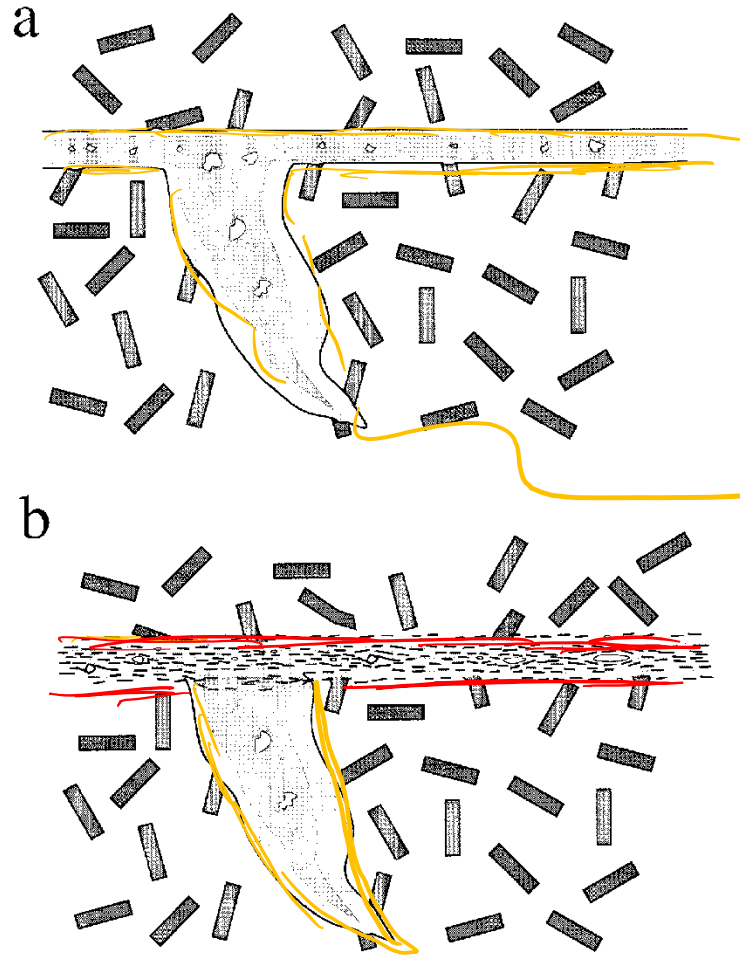


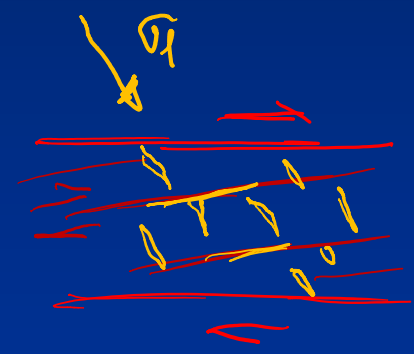
Fig. 5.3. **a** Schematic drawing of a typical pseudotachylyte with generation surface, injection vein, internal compositional banding and typical inclusions. The boundary with the wall rock is sharp. Mica grains in the wall rock show corrosion along the contact with pseudotachylyte. **b** Pseudotachylyte in which the generation surface has been reactivated as a mylonite zone. The mylonite can be recognised as a former pseudotachylyte by its fine-grained homogeneous nature and the presence of injection vein relics

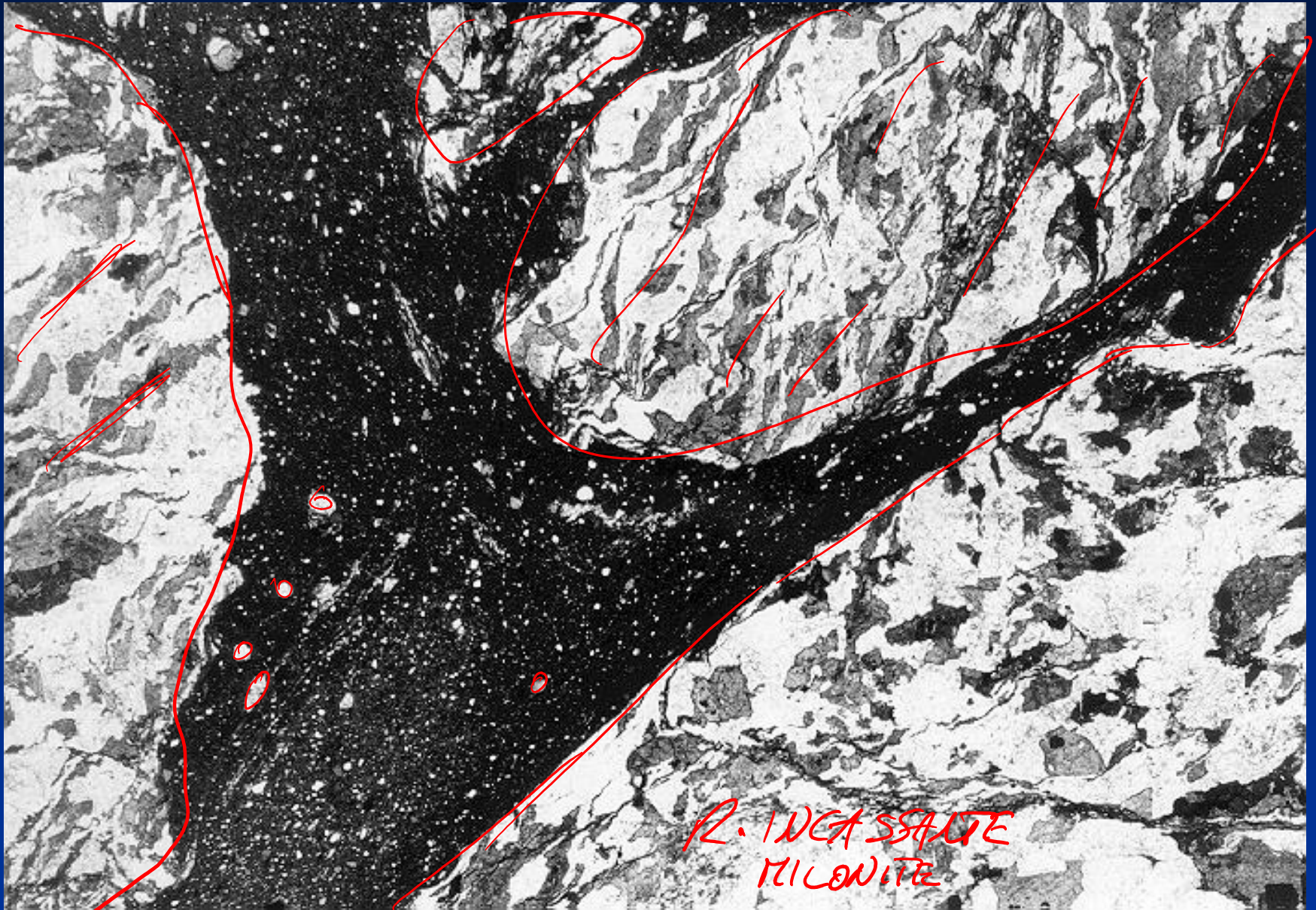
PSEUDOTACH.

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 FOLIAZIONE

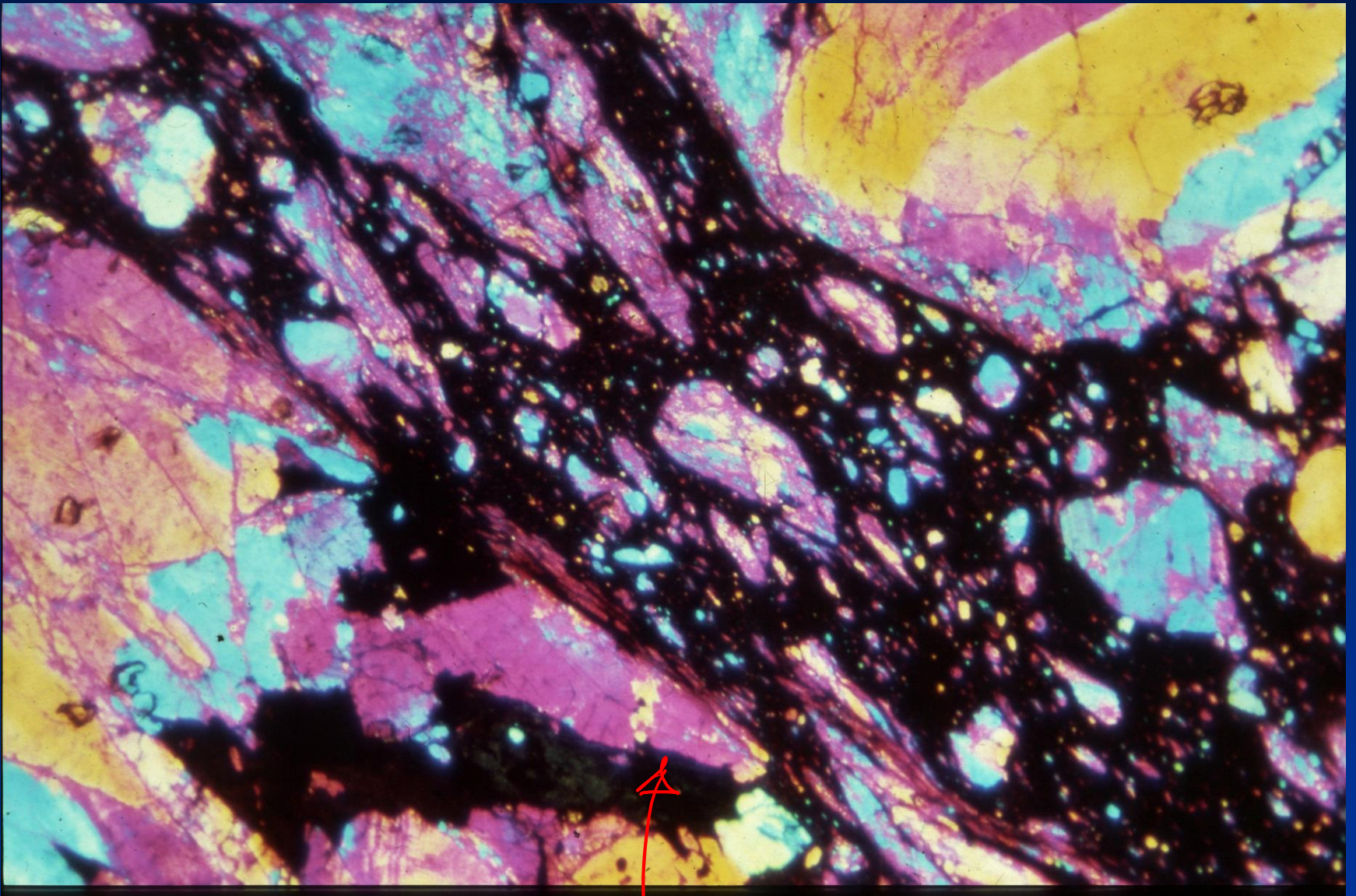
PSEUDOTACH

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 FOLIAZIONE





Da Passchier & Trouw, 1996



Da Ramsay & Huber, 1987

VERRO = OUTRE CA T.
SI FUSIONE

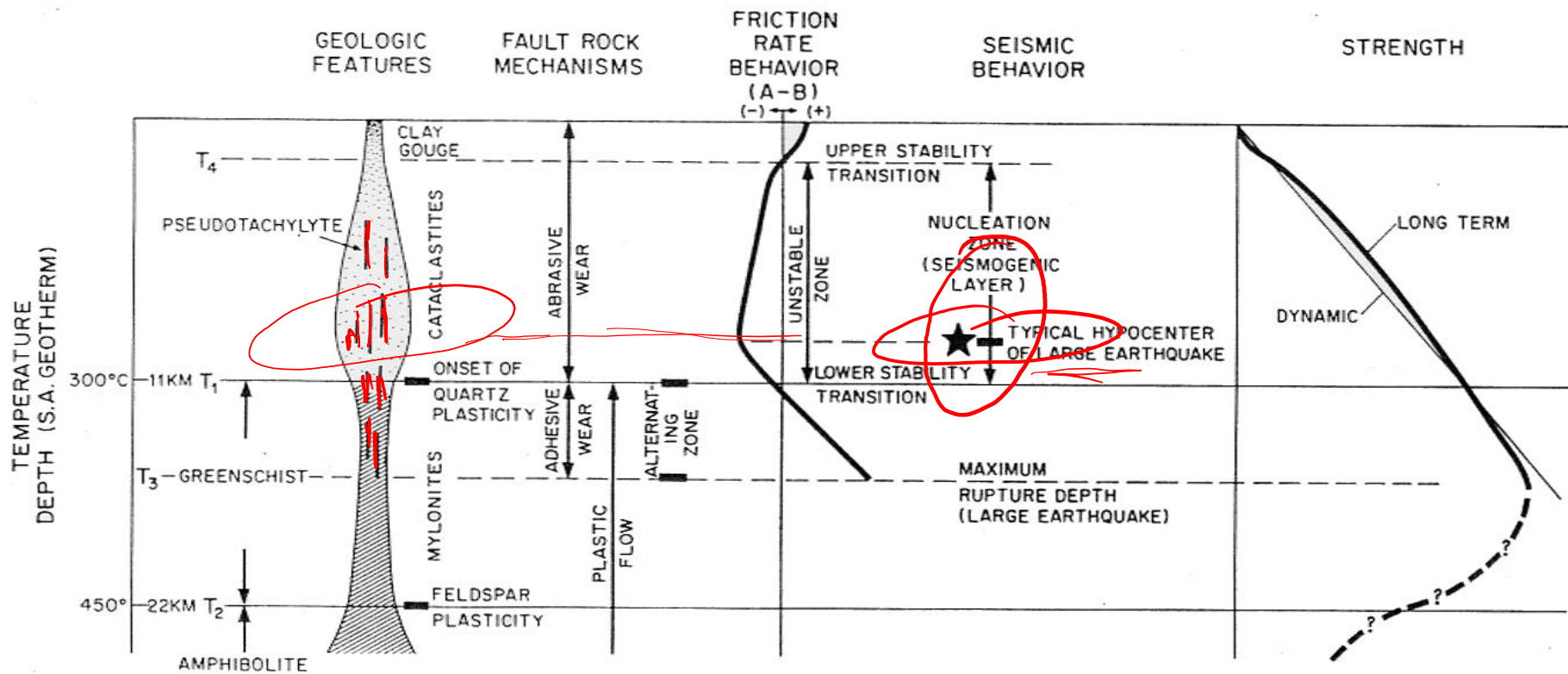


Fig. 3.19 Synoptic model of a shear zone. See the text for explanation. (From Scholz, 1988).

Da Scholz, 2002

↳ ONDE ELASTICHE SISMICHE
 ↳ CALORE
 ↳ RICASCIO ENERGIA PSEUDOTACHILITI