

STRUTTURE SEDIMENTARIE

Organizzazione geometrica e genetica delle rocce sedimentarie

PROCESSI



FISICI

CHIMICI

BIOLOGICI

STRUTTURE PRIMARIE

(Singenetiche)

STRUTTURE SECONDARIE

(Diagenetiche)

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

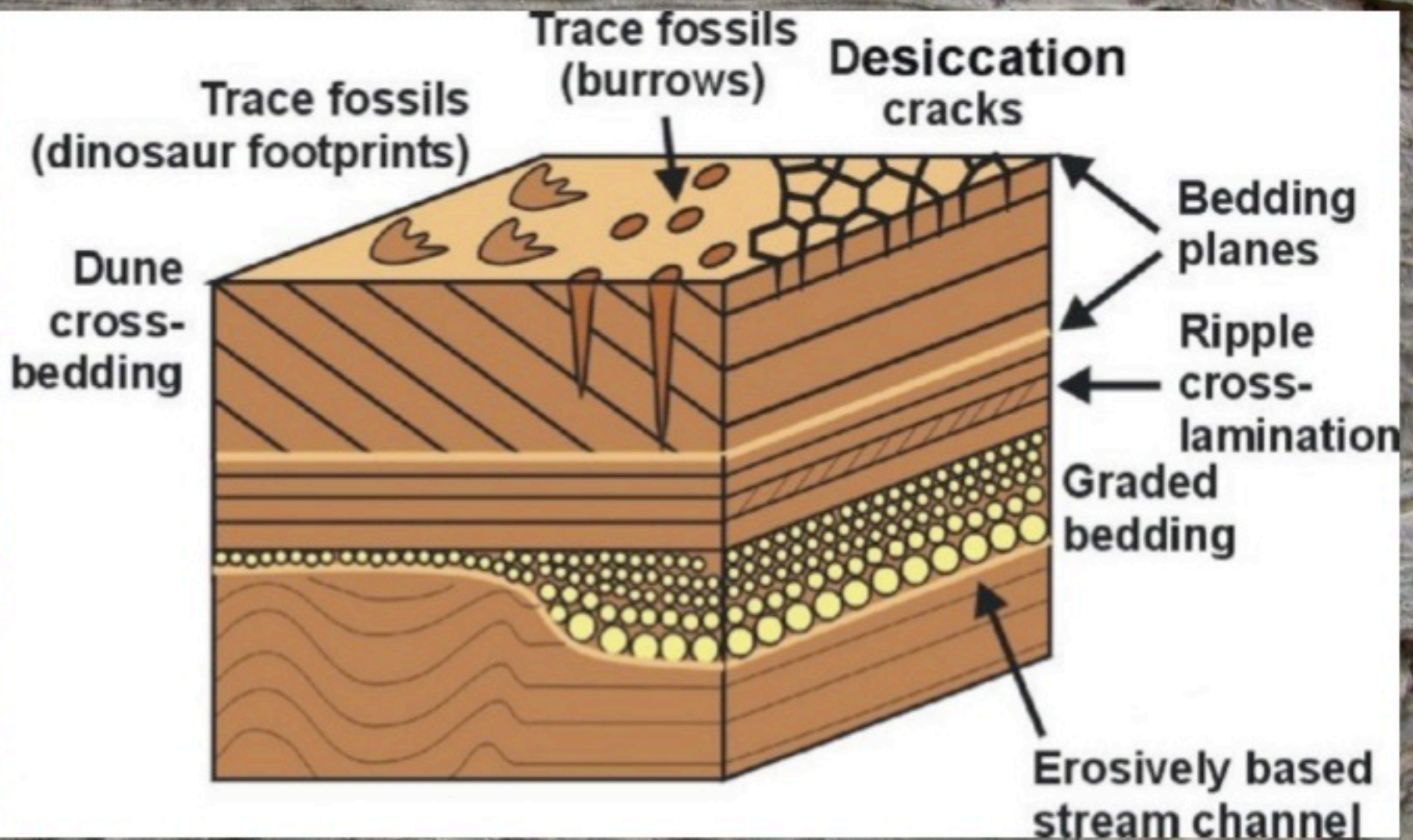
1. DEPOSIZIONALI

2. EROSIVE

3. BIOGENE

4. DEFORMATIVE - DIAGENETICHE

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE



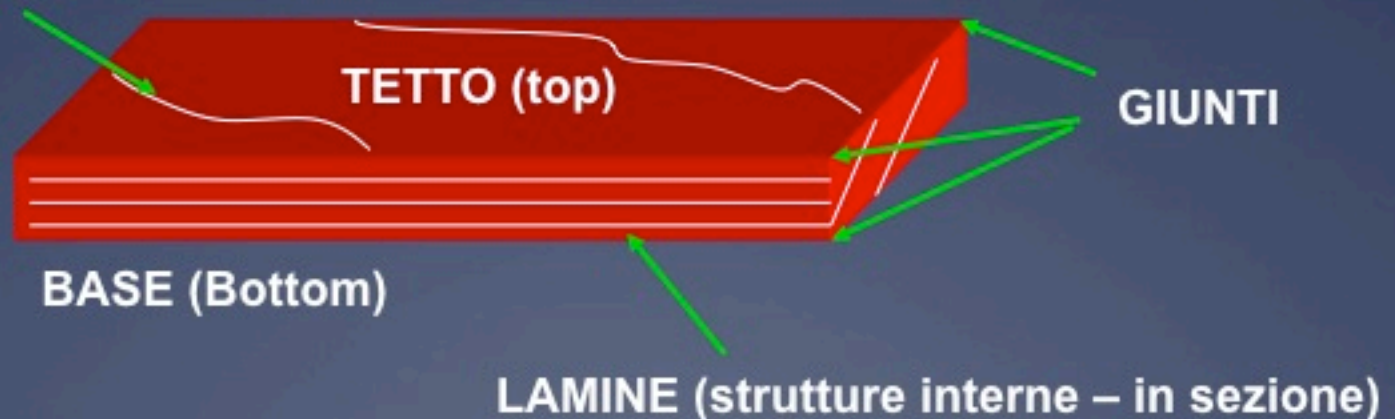
Lo STRATO

STRATO – intervallo di rocce sedimentarie o sedimenti delimitato da giunti di stratificazione (bedding surface) (Campbell, 1967)

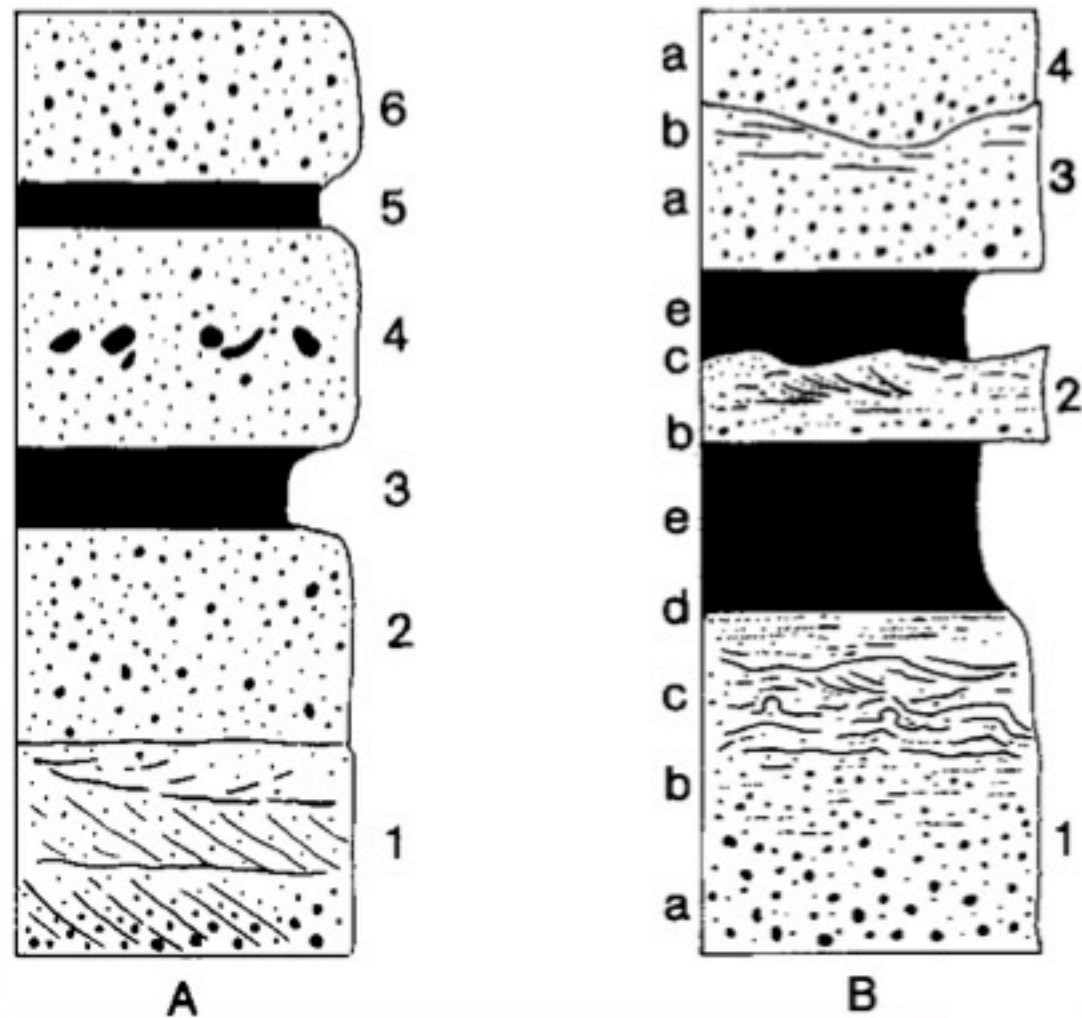
Luogo geometrico individuato da superfici ben definibili (giunti) - evento sedimentario legato ad un certo processo deposizionale, quindi unità deposizionale e non solo unità litologica (es. torbiditi).

LAMINA – episodio interno allo strato di spessore ridotto dato da piccole variazioni nella deposizione

IMPRONTE (strutture esterne – in pianta)



Lo STRATO



**DISTINZIONE
LITOLOGICA E
GENETICA**

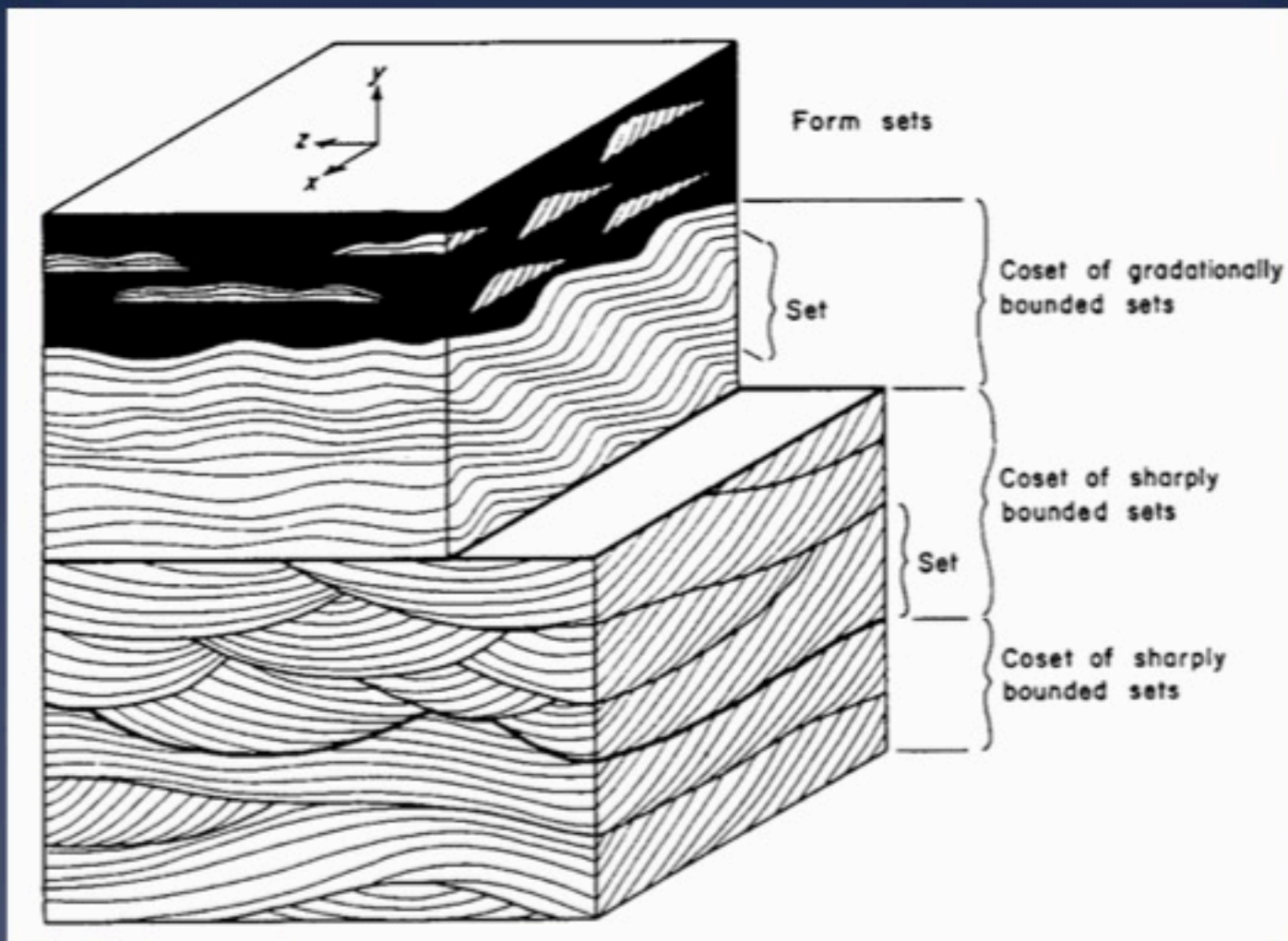
Ricci Lucchi, 1992

Spessore strati e lamine



Campbell, 1967

Gerarchia strati e lamine



Allen, 1982

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

1. DEPOSIZIONALI



STRATO
LAMINA



GIUNTI

Netti
graduali



GIUNTI

(Bedding surfaces)



Apporti

Processi

Energia

Tasso di
sedimentazione

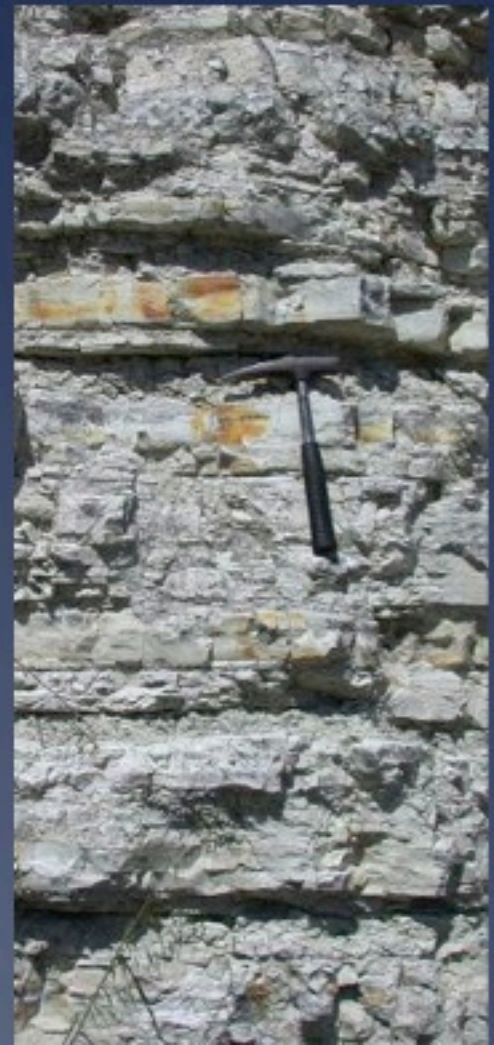


Litologia

Composizione

Tessiture

Formazione da variazioni



CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

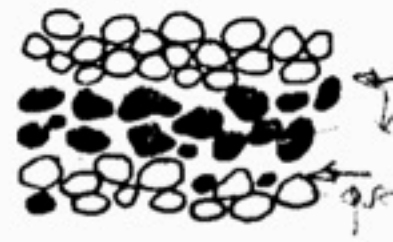
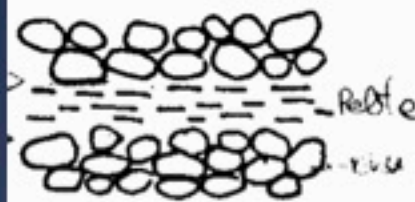
1. DEPOSIZIONALI

STRATO
LAMINA

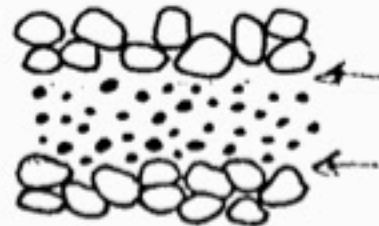
GIUNTI

GIUNTI
(Bedding surfaces)

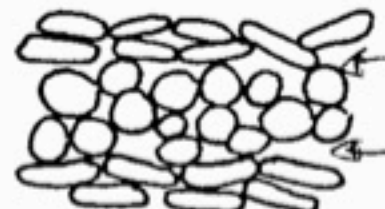
Litologia
Composizione
Tessiture



litologia e composizione



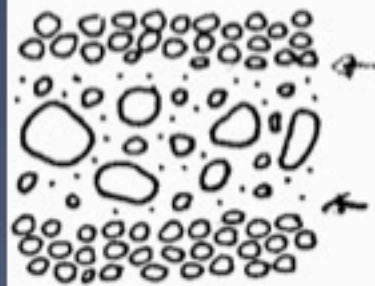
dimensioni



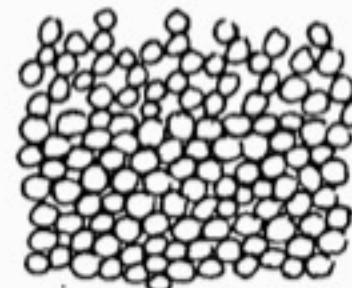
forma



orientamento



omogeneità



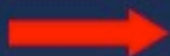
packing
tessiture

- addensato
+ addensato

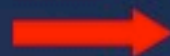
Ricci Lucchi, 1970

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

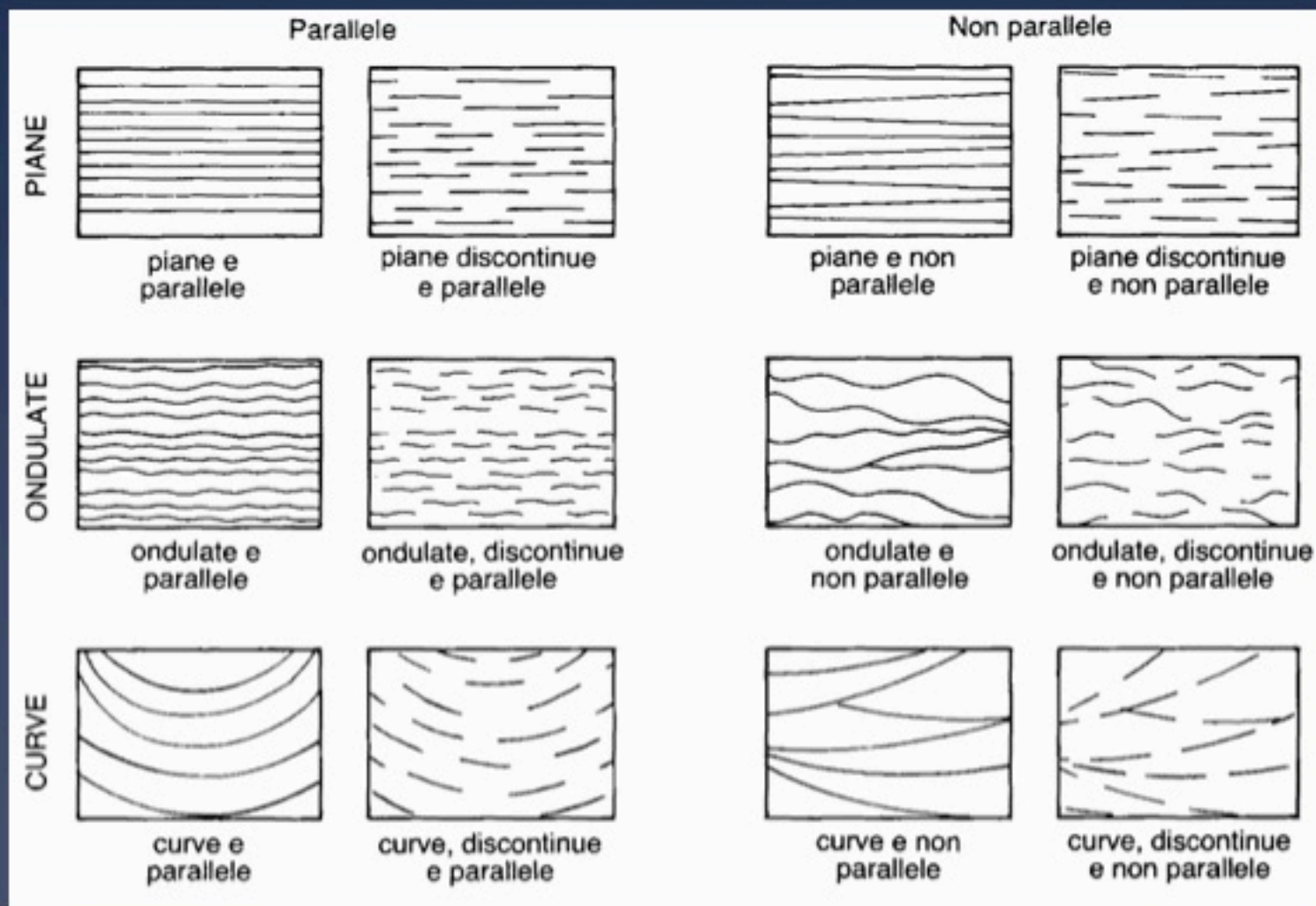
1. DEPOSIZIONALI



STRATO
LAMINA



FORMA GIUNTI



Ricci Lucchi, 1970

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

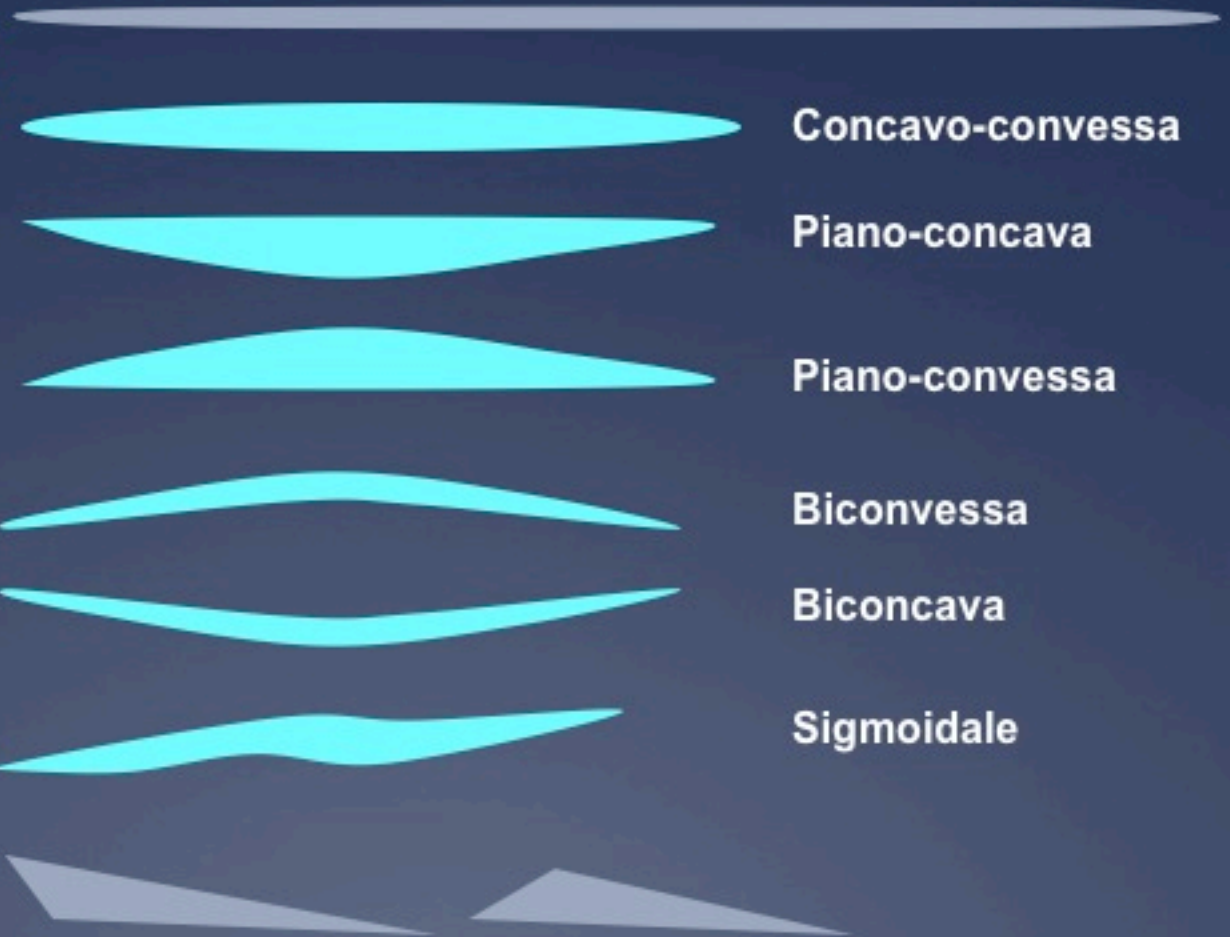
1. DEPOSIZIONALI → STRATO LAMINA → FORMA STRATI

FORMA STRATI (Bedding shape)

1. Tabulare

2. Lenticolare

3. Cuneiforme



Concavo-convessa

Piano-concava

Piano-convessa

Biconvessa

Biconcava

Sigmoidale

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE



TERMINAZIONE STRATI

1. Convergenza



2. Transizione



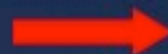
3. Troncatura

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

1. DEPOSIZIONALI

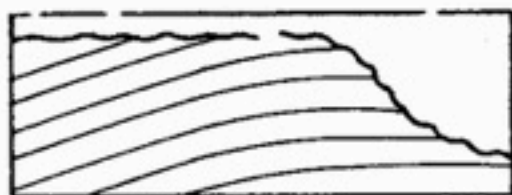


STRATO
LAMINA

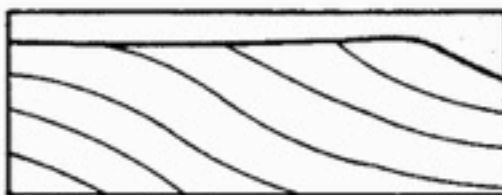


TERMINAZIONE
STRATI

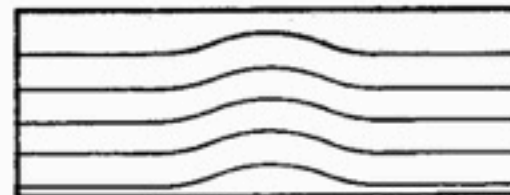
UPPER BOUNDARY



1. EROSIONAL TRUNCATION



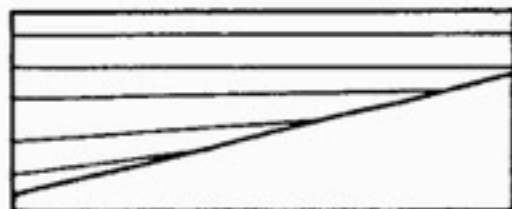
2. TOPLAP



3. CONCORDANCE

A.

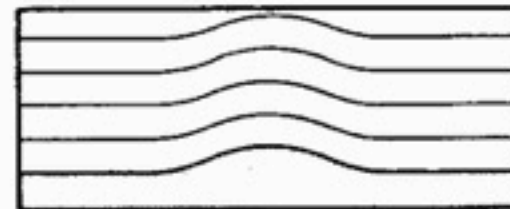
LOWER BOUNDARY



1. ONLAP



2. DOWNLAP



3. CONCORDANCE

B.

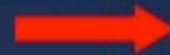
BASELAP

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

1. DEPOSIZIONALI



STRATO
LAMINA



SUDDIVISIONE
INTERNA

SUDDIVISIONE INTERNA

1. Massivo-omogeneo

2. Laminato

3. Gradato

4. Con intervalli

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

1. DEPOSIZIONALI



STRATO
LAMINA



SUCCESSIONI
VERTICALI

SUCCESSIONI VERTICALI

Spessore
strati

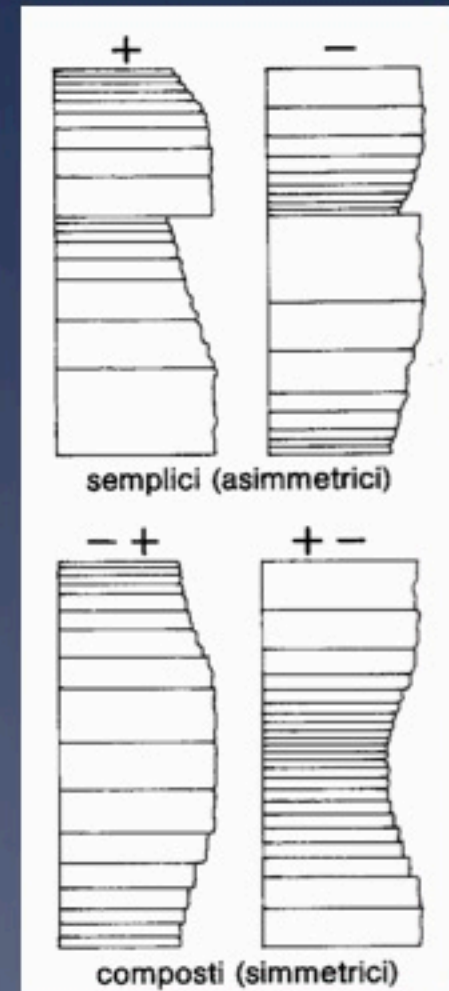
Positiva
(thinning)

Negativa
(thickening)

Granulometria
strati

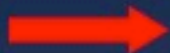
Diretta
(fining)

Inversa
(coarsening)

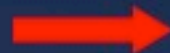


CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

1. DEPOSIZIONALI



STRATO
LAMINA

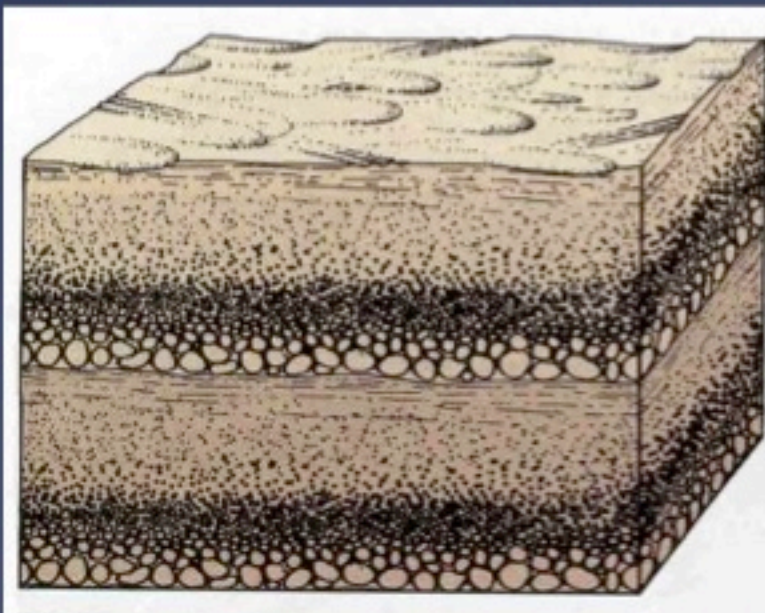


SUCCESSIONI
VERTICALI

Granulometria
strati

GRADAZIONE DIRETTA
(fining)

GRADAZIONE INVERSA
(coarsening)



CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

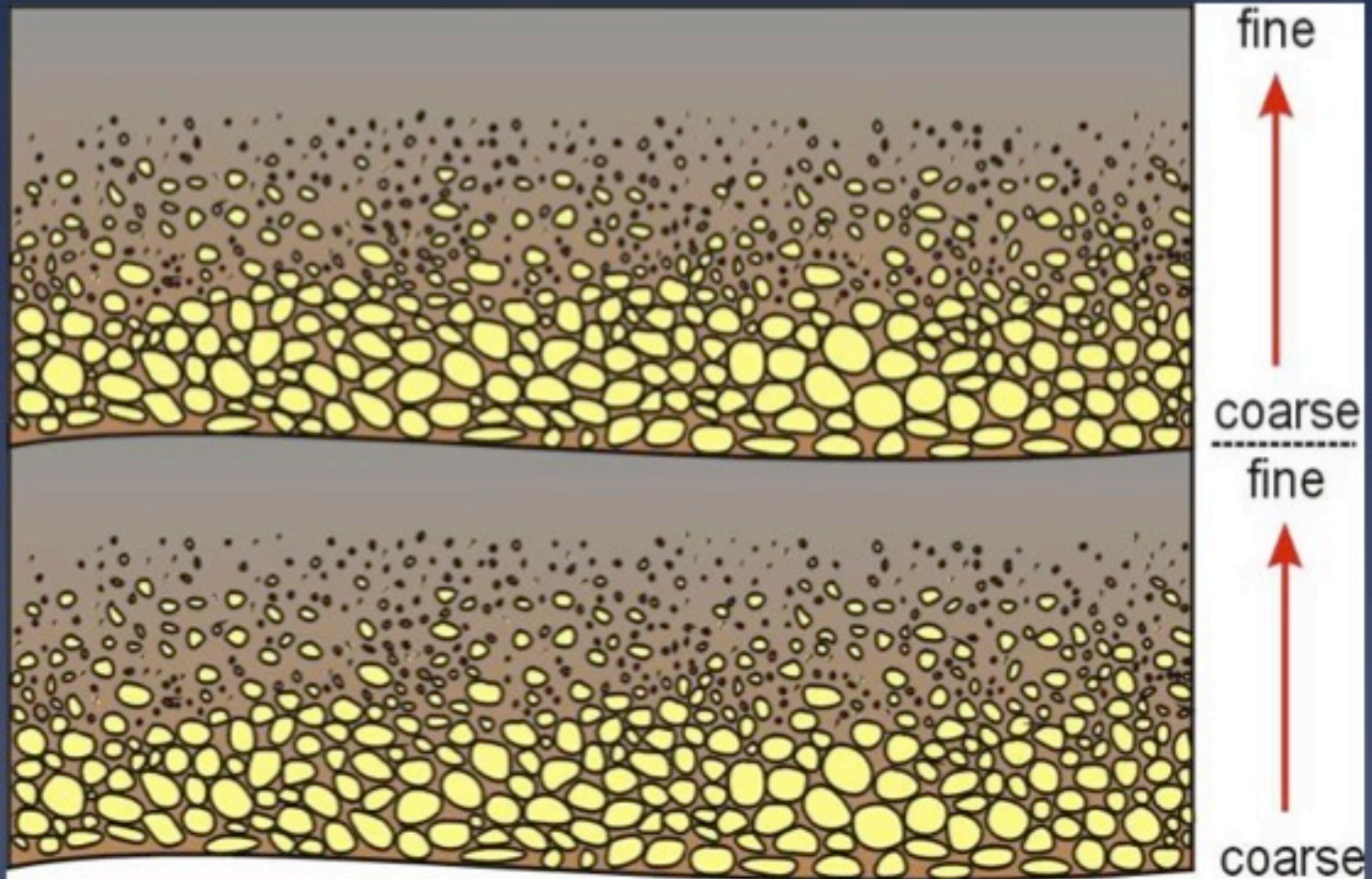
1. DEPOSIZIONALI



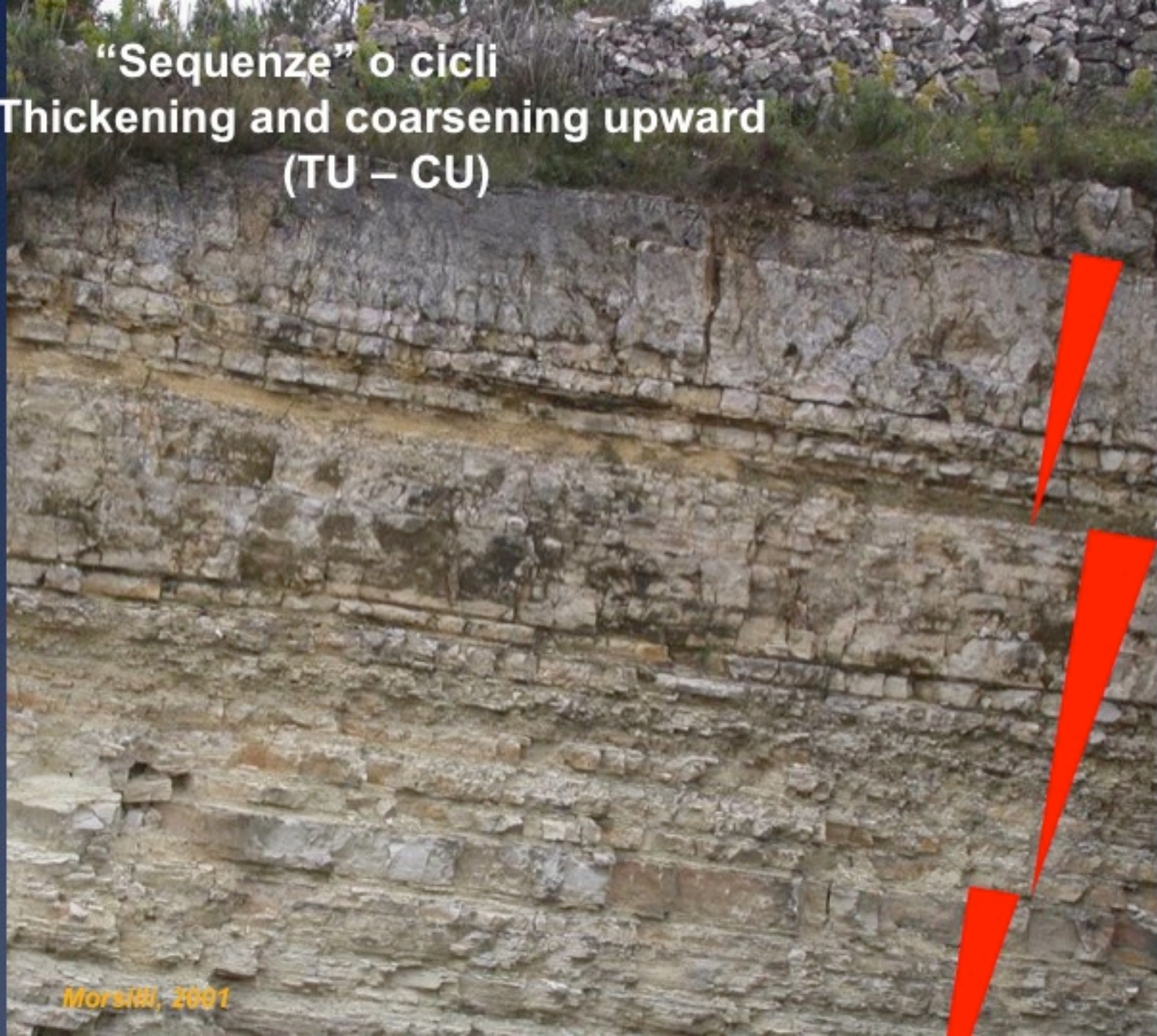
STRATO



SUCCESSIONI
VERTICALI



**“Sequenze” o cicli
Thickening and coarsening upward
(TU – CU)**



Morsilli, 2001

TIPI GEOMETRICI DI STRATIFICAZIONE

**STRATIFICAZIONE
PARALLELA**

**Piana
Ondulata**

**STRATIFICAZIONE
INCLINATA E INCROCIATA**

**Clinostratificazioni
Geometrie complesse
con contatti erosivi**

Stratificazione parallela (piana)





**Stratificazione
parallela (piana)**

Morsilli, 2002



Morsilli, 2002

**Stratificazione inclinata
(clinostratificazione)**



Stratificazione obliqua

Morsilli, 2003

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

1. DEPOSIZIONALI → STRATIFICAZIONE - LAMINAZIONE OBLIQUA

FORME GEOMETRICHE DELLE LAMINE E STRATI

**Sezione
perpendicolare
alla corrente**

**Concava (festoni)
Tabulare
Cuneiforme
Convessa
Concavo-convessa**

**Sezione
parallela alla
corrente**

**Curva
Planare
Curva convessa
Curva concavo-convessa**

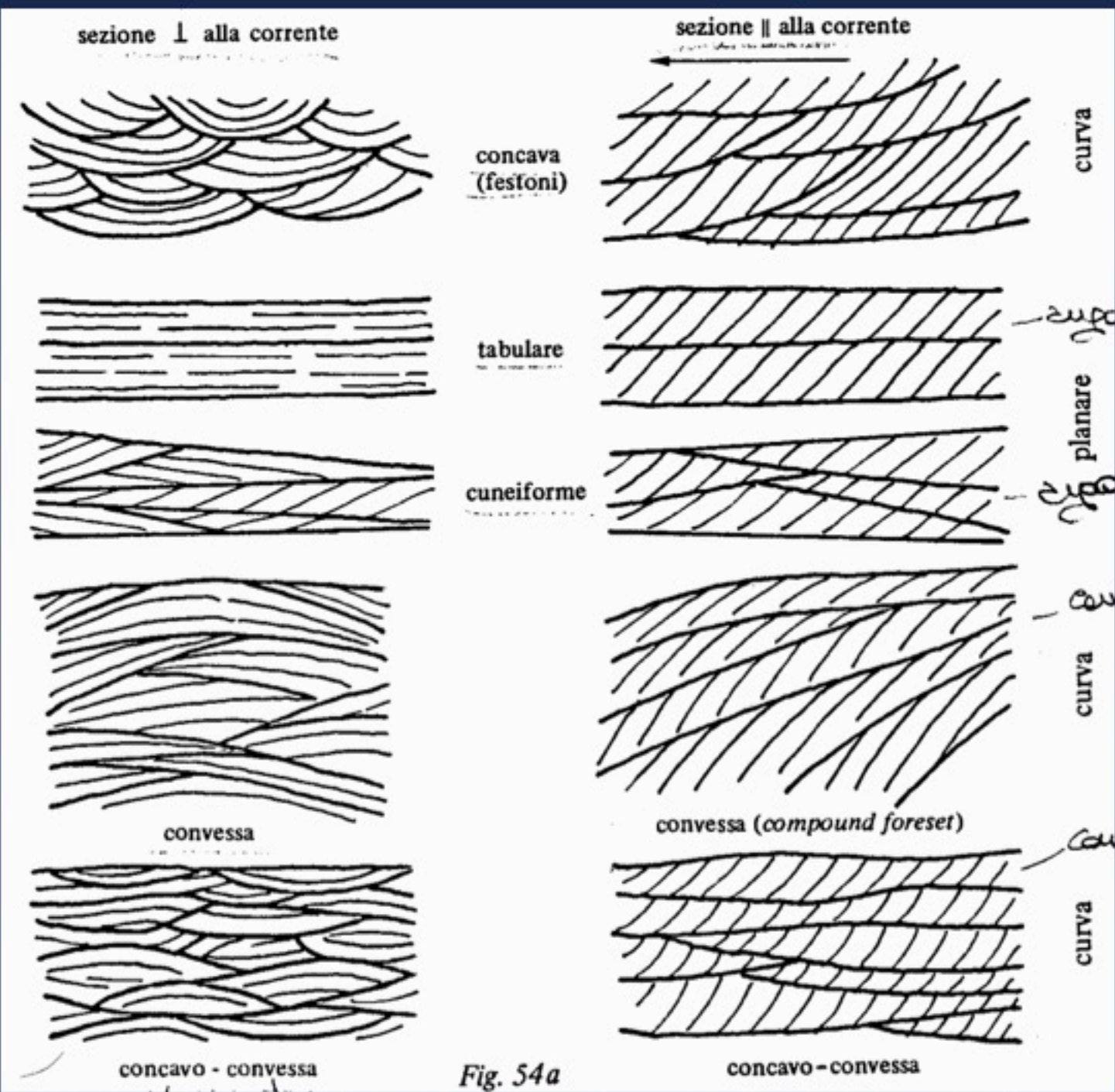
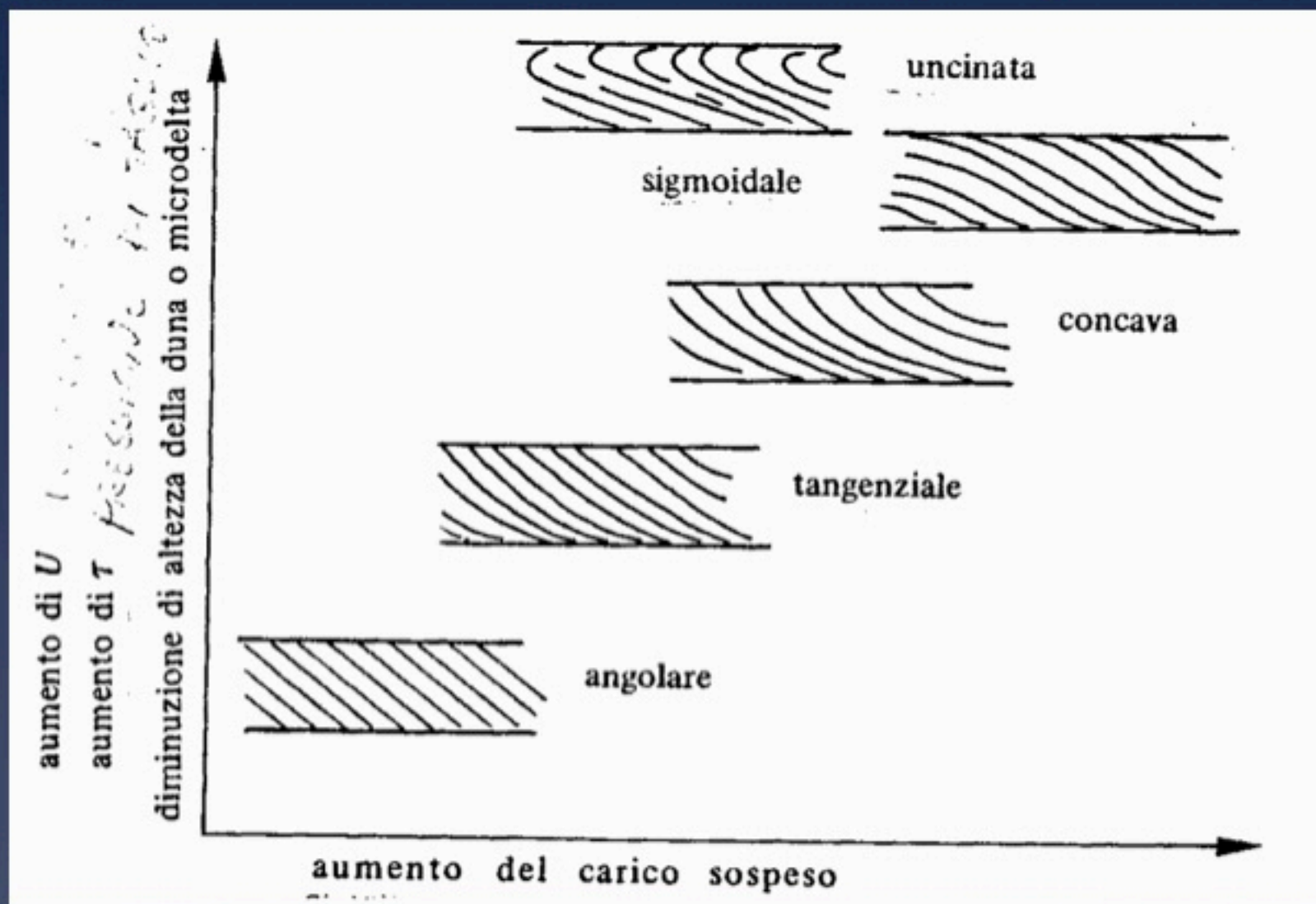


Fig. 54a

MORFOLOGIA LAMINE FRONTALI (foreset)



Ricci Lucchi, 1970

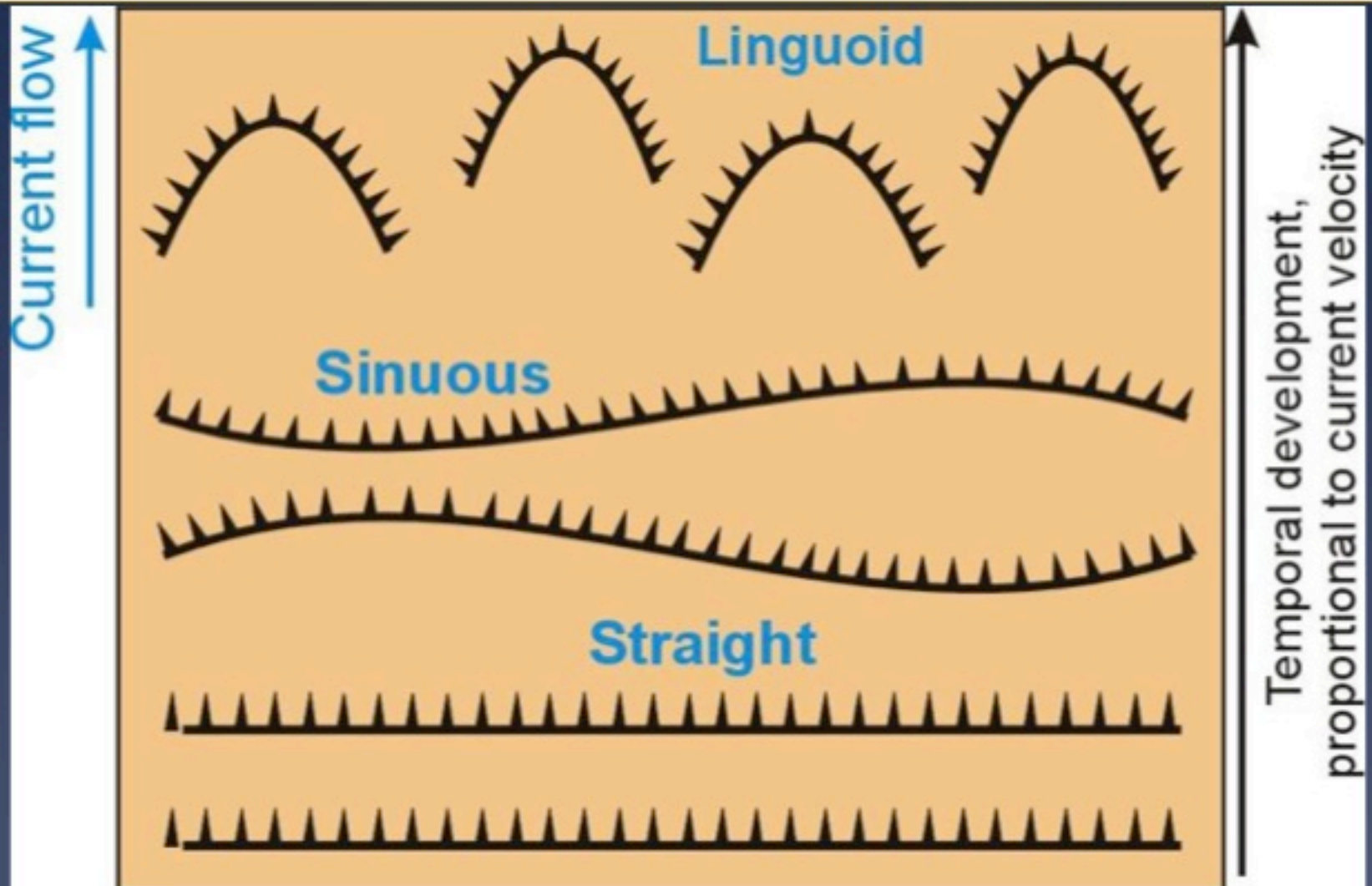
CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

MORFOLOGIA IN PIANTA DELLE FORME
DI FONDO

1. DEPOSIZIONALI



(Ripples and dunes)



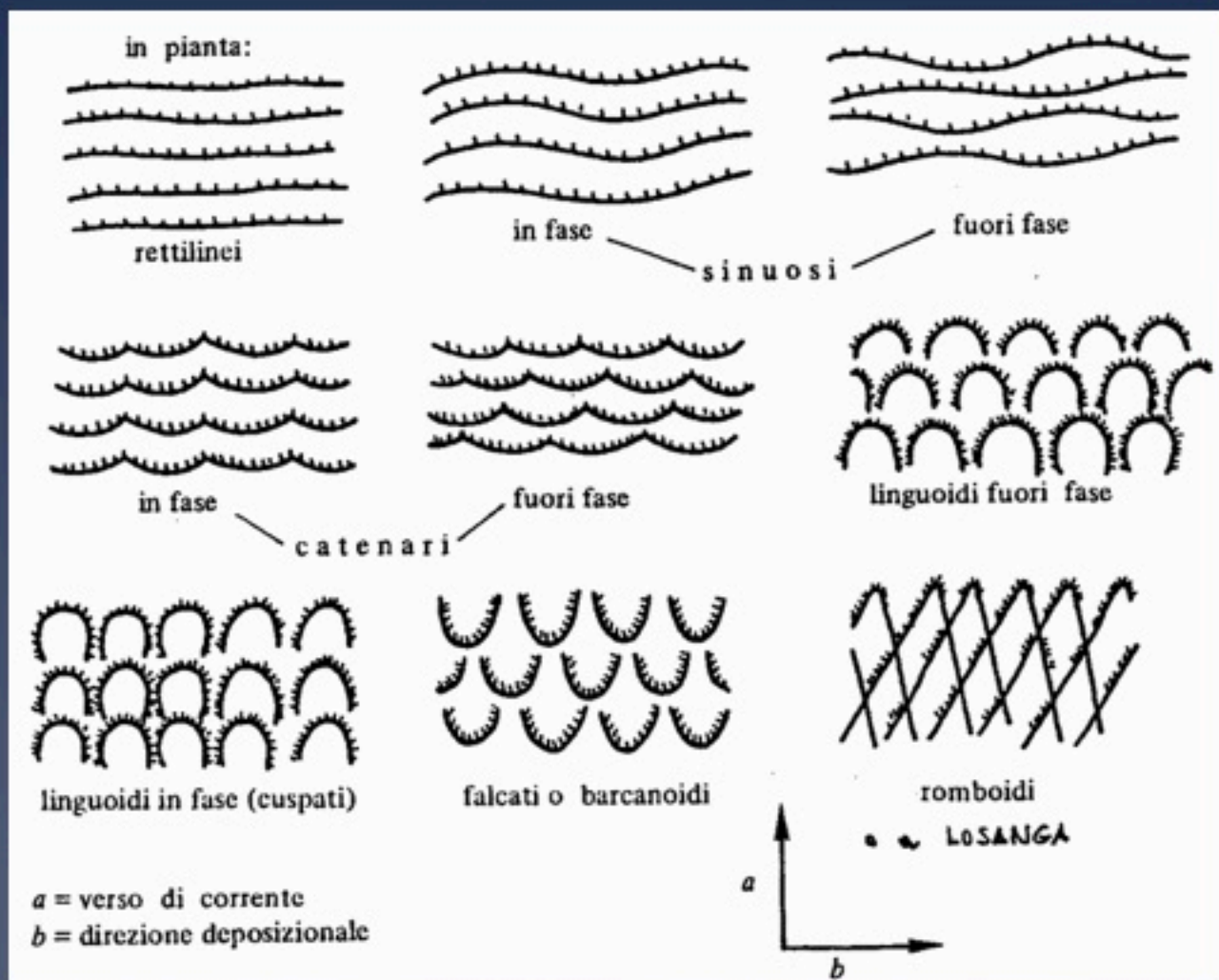
CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

1. DEPOSIZIONALI

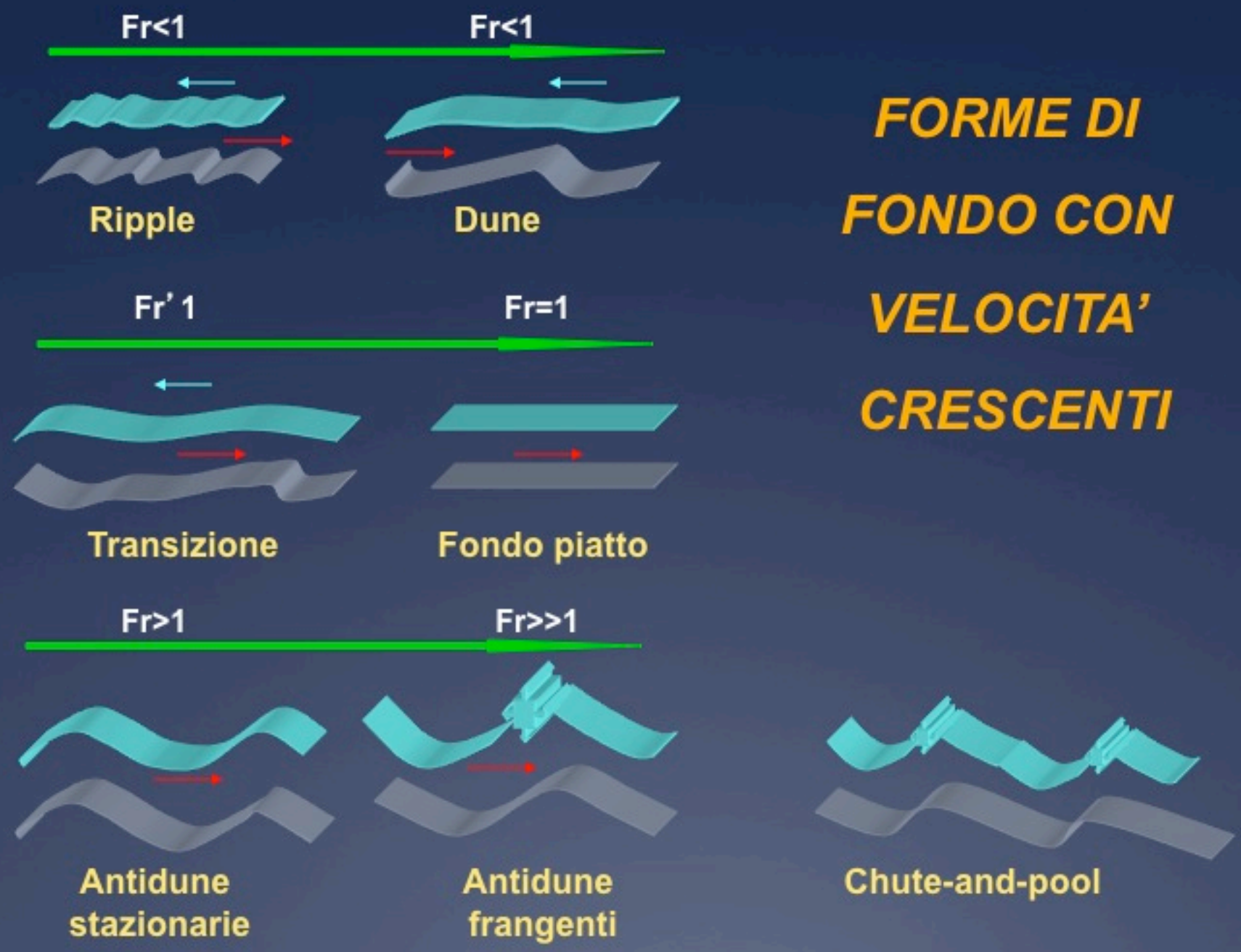


STRATIFICAZIONE - LAMINAZIONE INCROCIATA

MORFOLOGIA
IN PIANTA
DELLE FORME
DI FONDO
(Ripples e dune)



In Ricci Lucchi, 1970



FORME DI FONDO CON VELOCITA' CRESCENTI

CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

1. DEPOSIZIONALI

STRUTTURE TRATTIVE

CORRENTE

Ripple

Dune

Antidune

creste

rettilinee

ondulate

linguoidi

Strat. X

Planare

Concava

Onde di sabbia (sandwaves)

Accrezione laterale (epsilon)



Barra di meandro (Point bar)

Tidale

Herringbone

Flaser

Ondulata

Lenticolare

ONDA

Ripple

Dune

MISTE

Tempestiti

Tsunamiti

VENTO

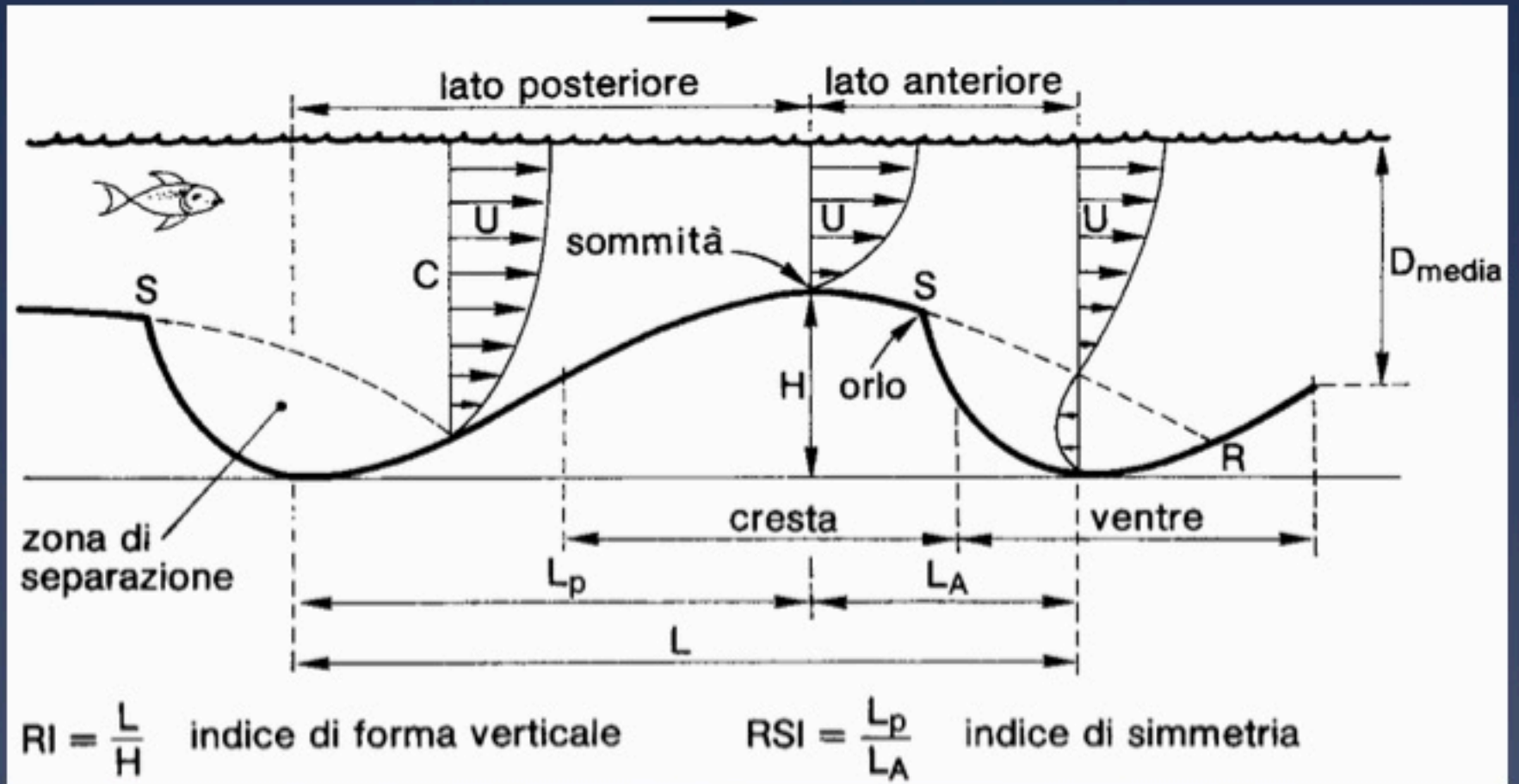
Ripple

Dune

Draas

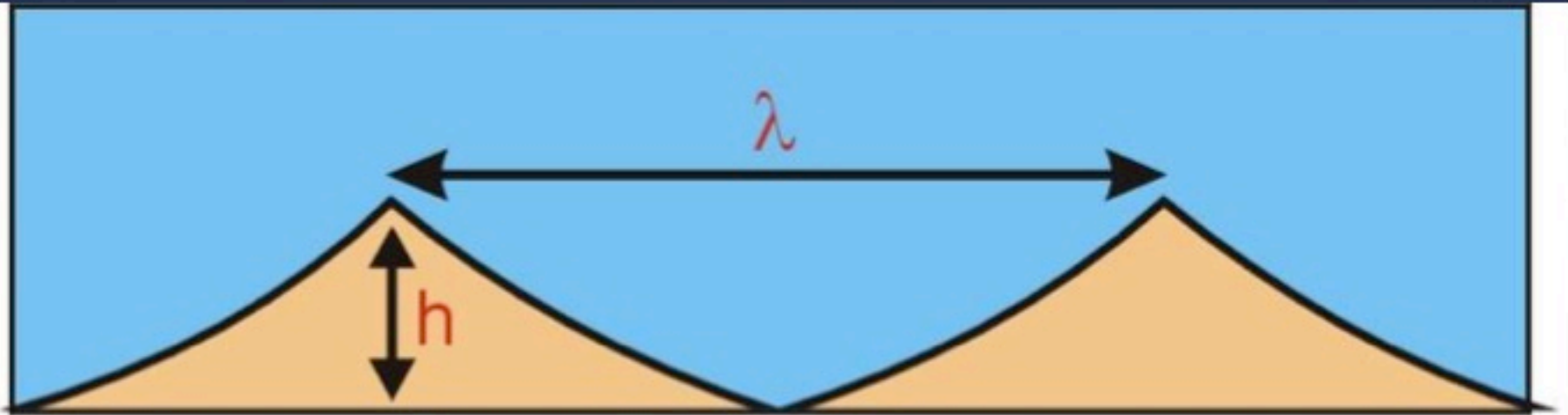
CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

MORFOLOGIA RIPPLES - DUNE



CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

MORFOLOGIA RIPPLES - DUNE



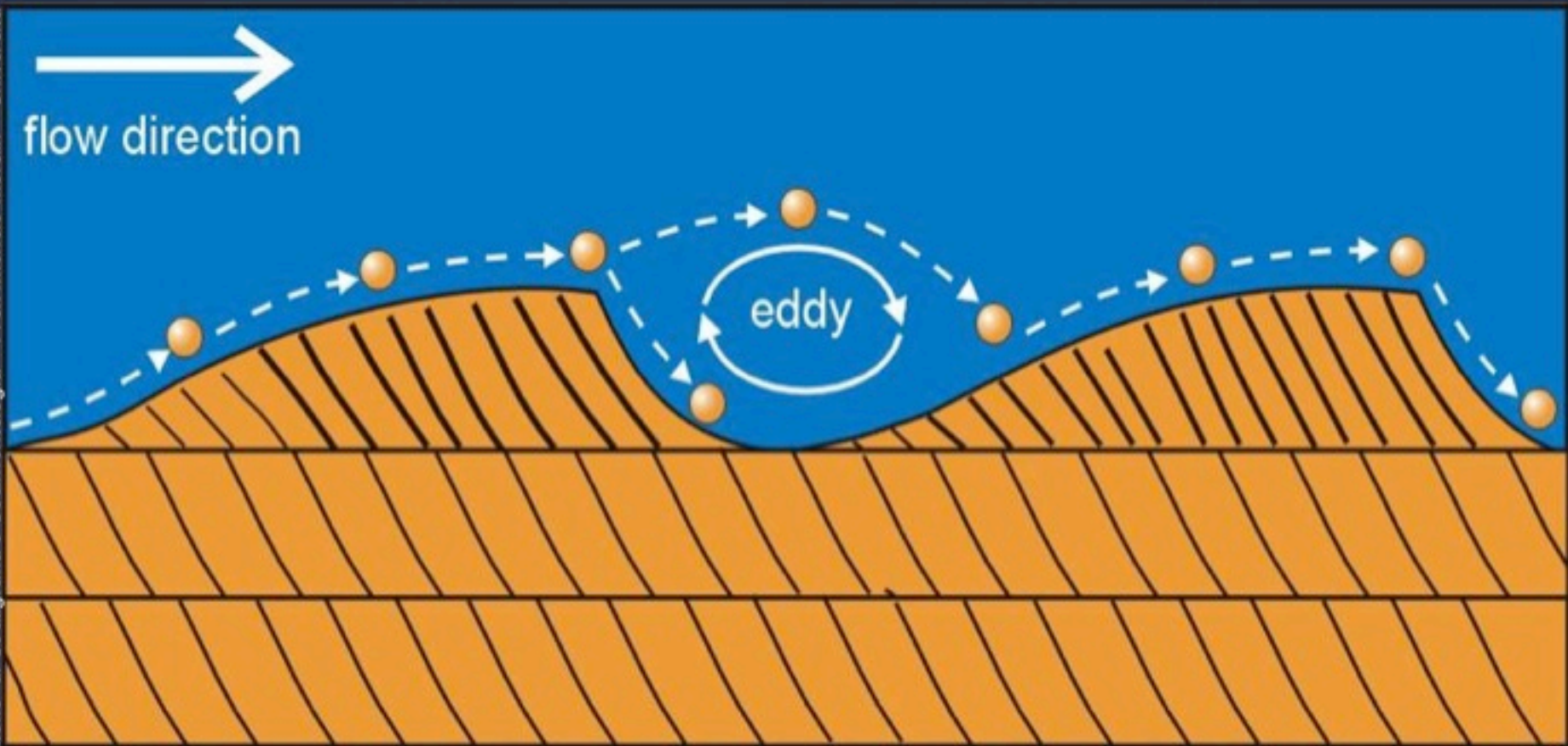
$$\text{Ripple index} = \frac{\lambda}{h}$$

Current ripples 10 - 40

Oscillation ripples 4 - 8

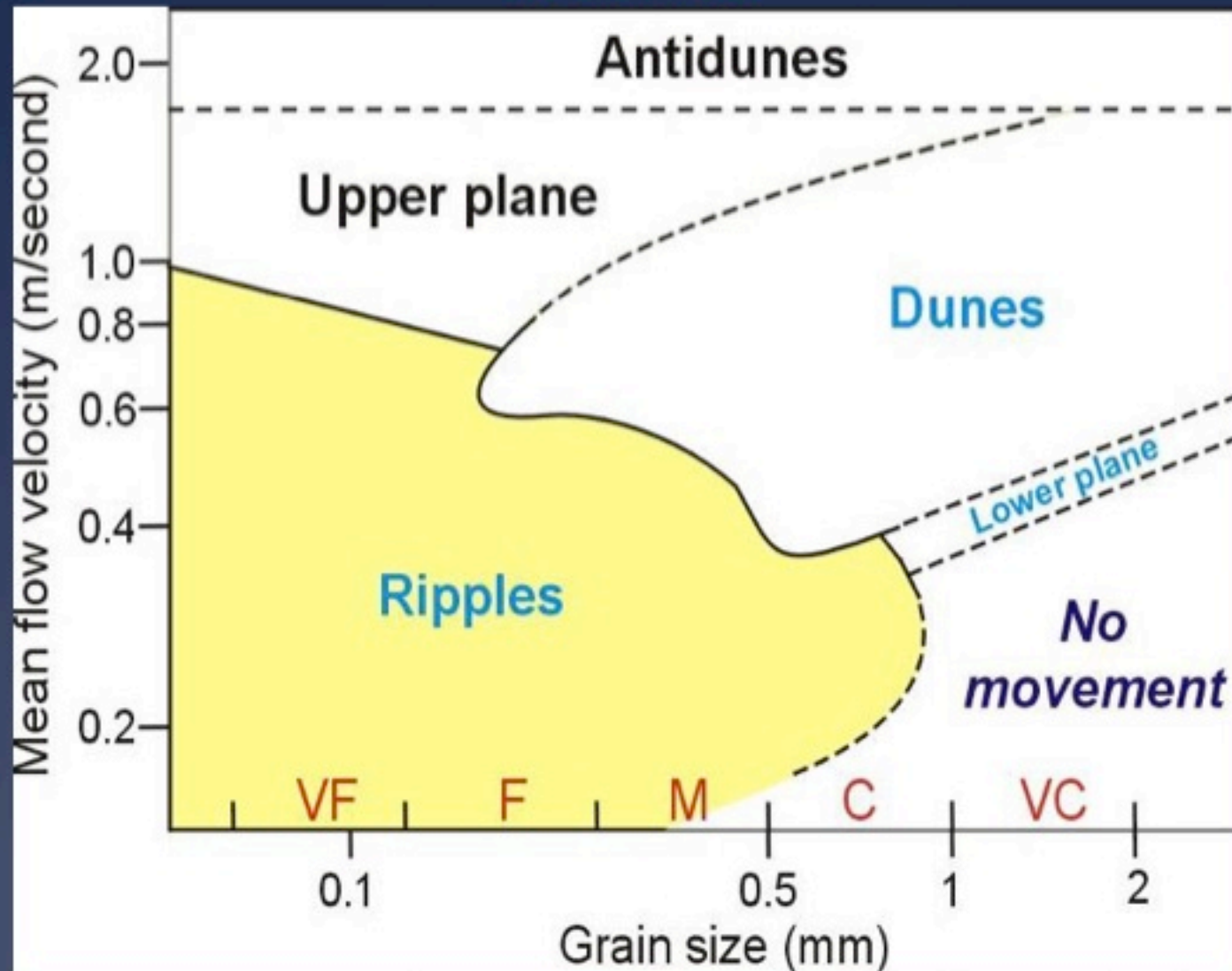
CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

MORFOLOGIA RIPPLES - DUNE



CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

RIPPLES

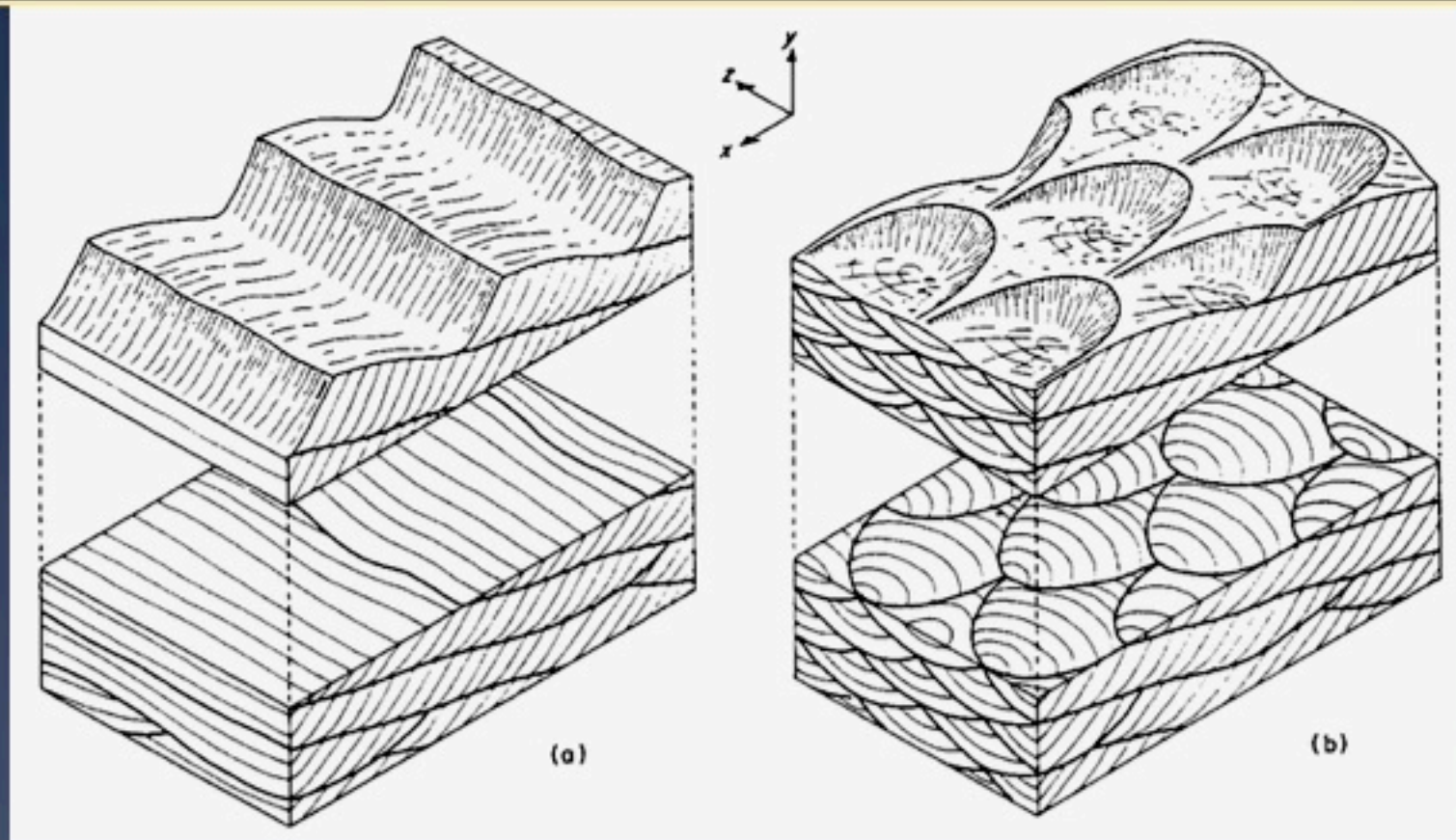


CLASSIFICAZIONE STRUTTURE SEDIMENTARIE

1. DEPOSIZIONALI



STRATIFICAZIONE - LAMINAZIONE INCROCIATA



Creste rettilinee

Stratificazione tabulare

Creste falcate

Stratificazione concava

Allen, 1982

1. DEPOSIZIONALI



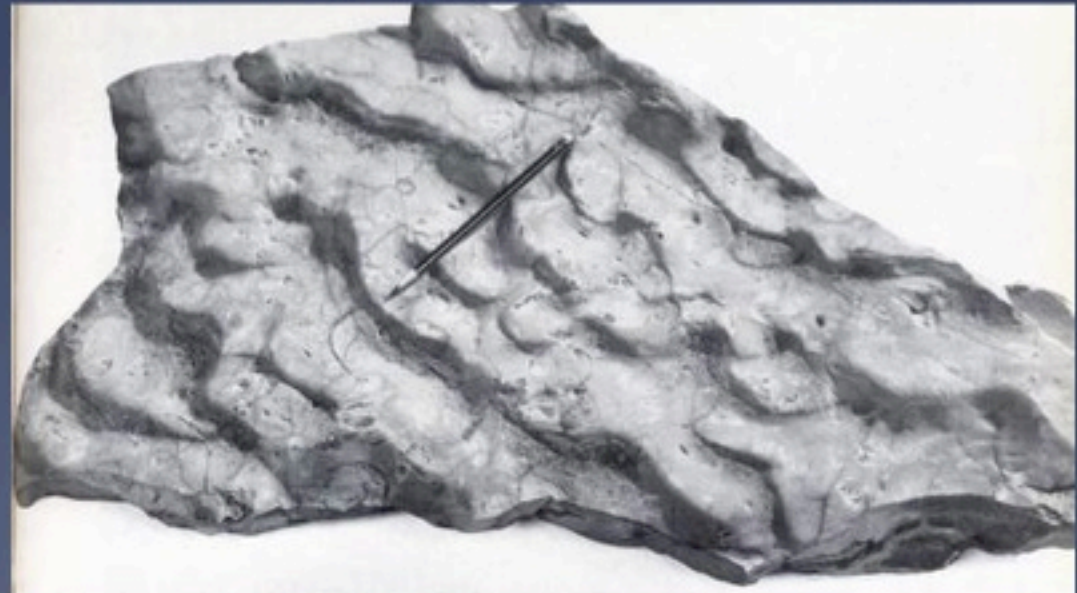
Strutture da corrente



RIPPLES

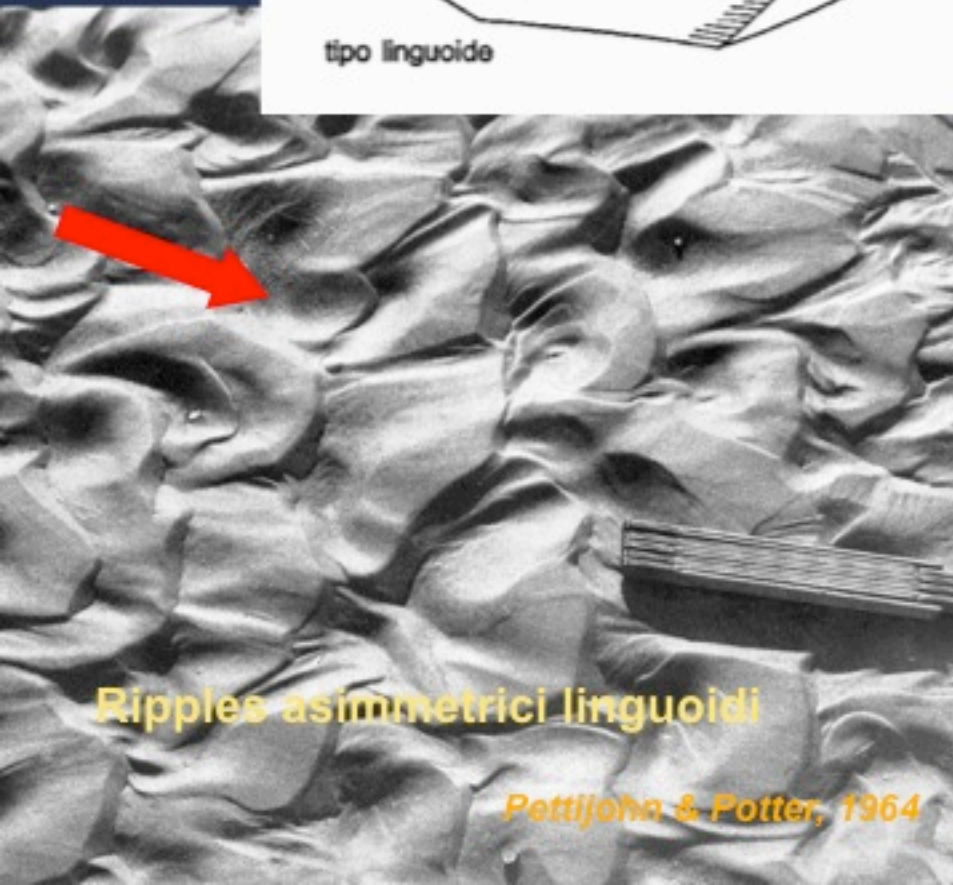
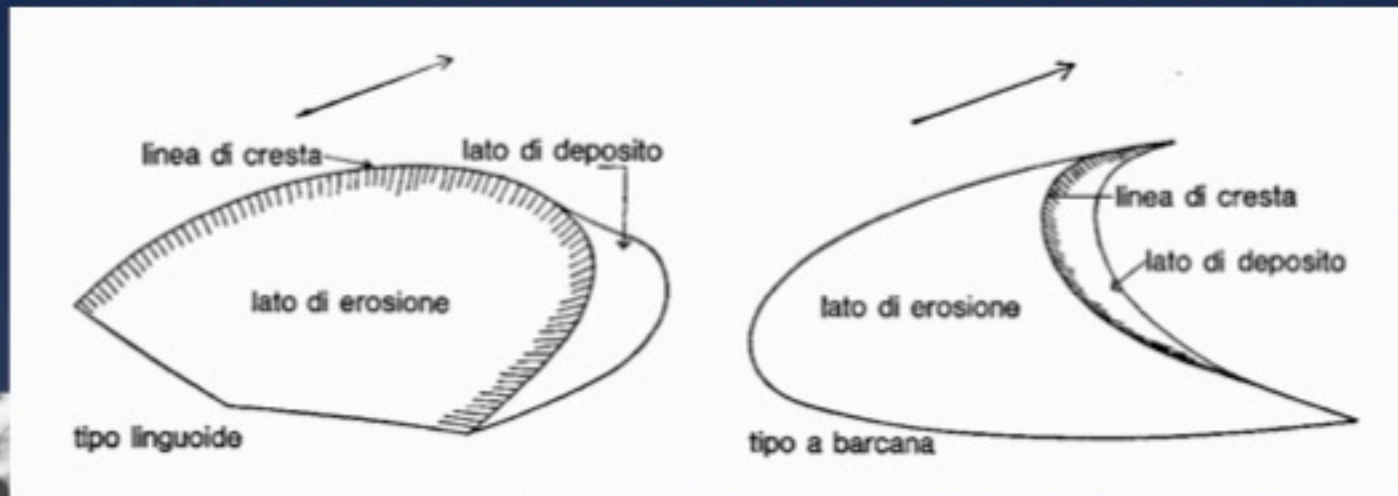


Ripples asimmetrici trasversali



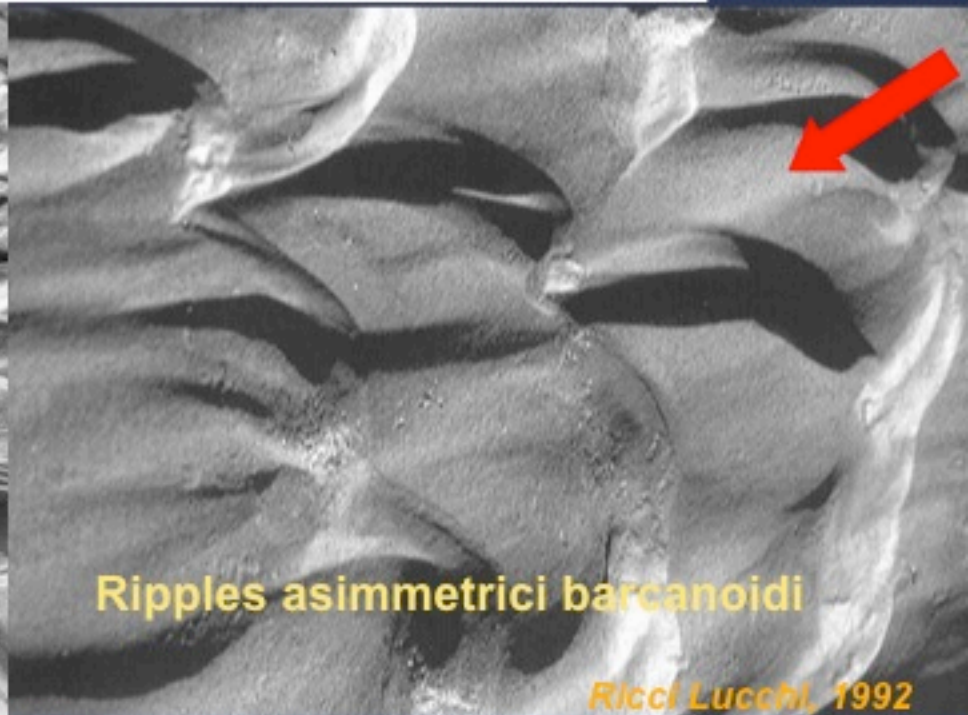
Pettijohn & Potter, 1964

DIFFERENZE TRA RIPPLES LINGUODI E BARCANOIDI



Ripples asimmetrici linguoidi

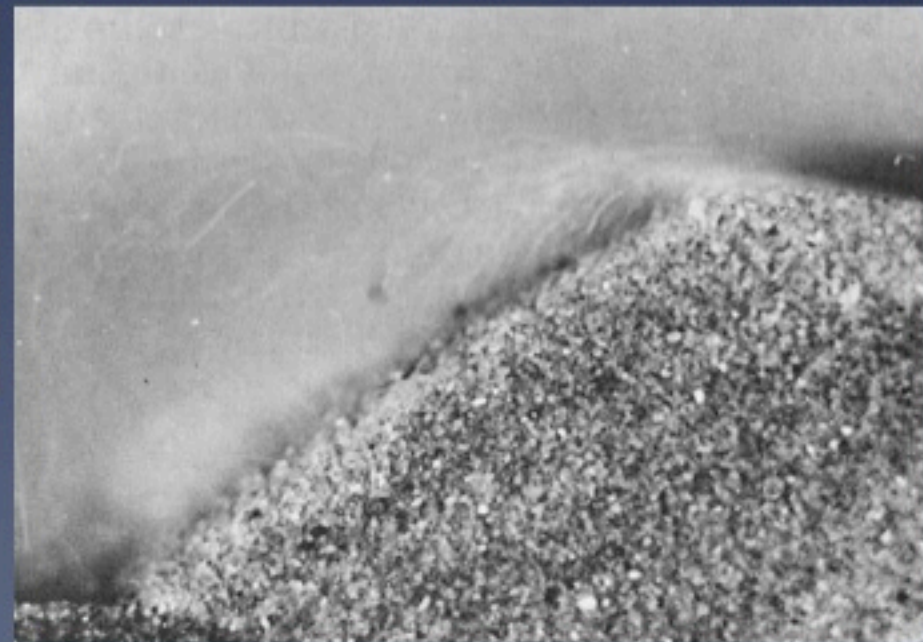
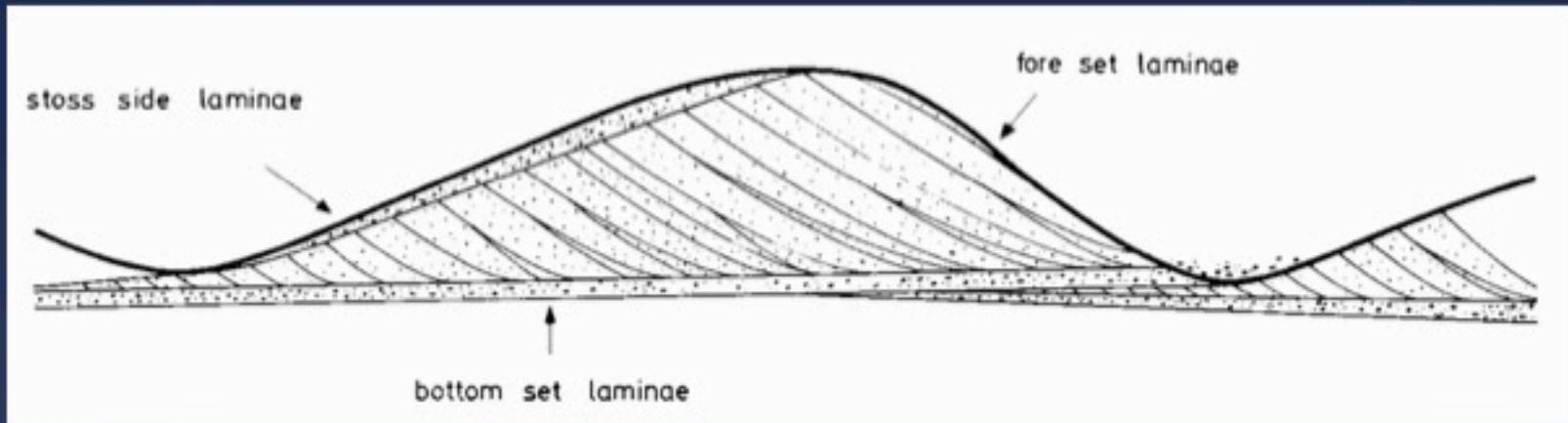
Pettijohn & Potter, 1964



Ripples asimmetrici barcanoidi

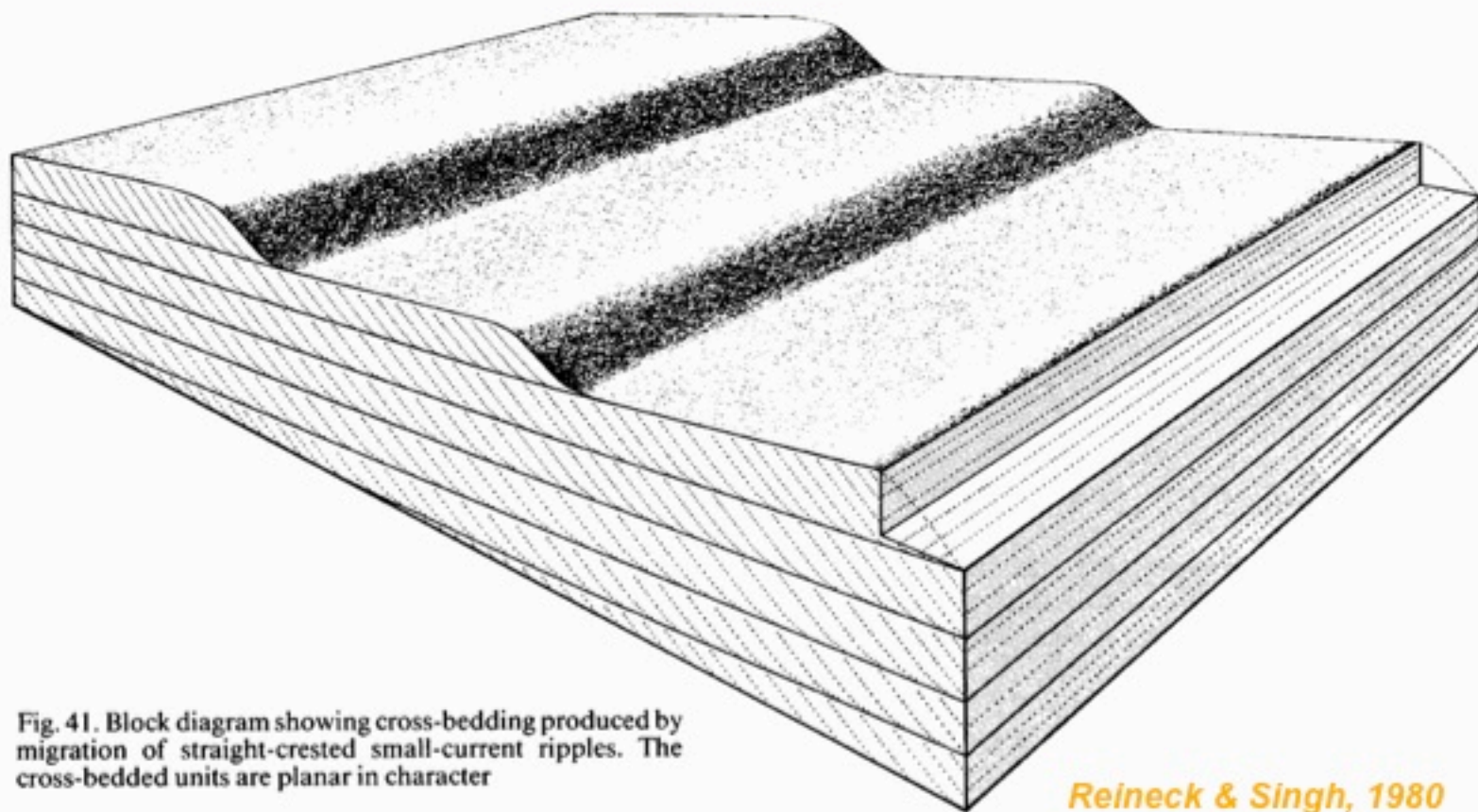
Ricci Lucchi, 1992

STRUTTURA INTERNA RIPPLES

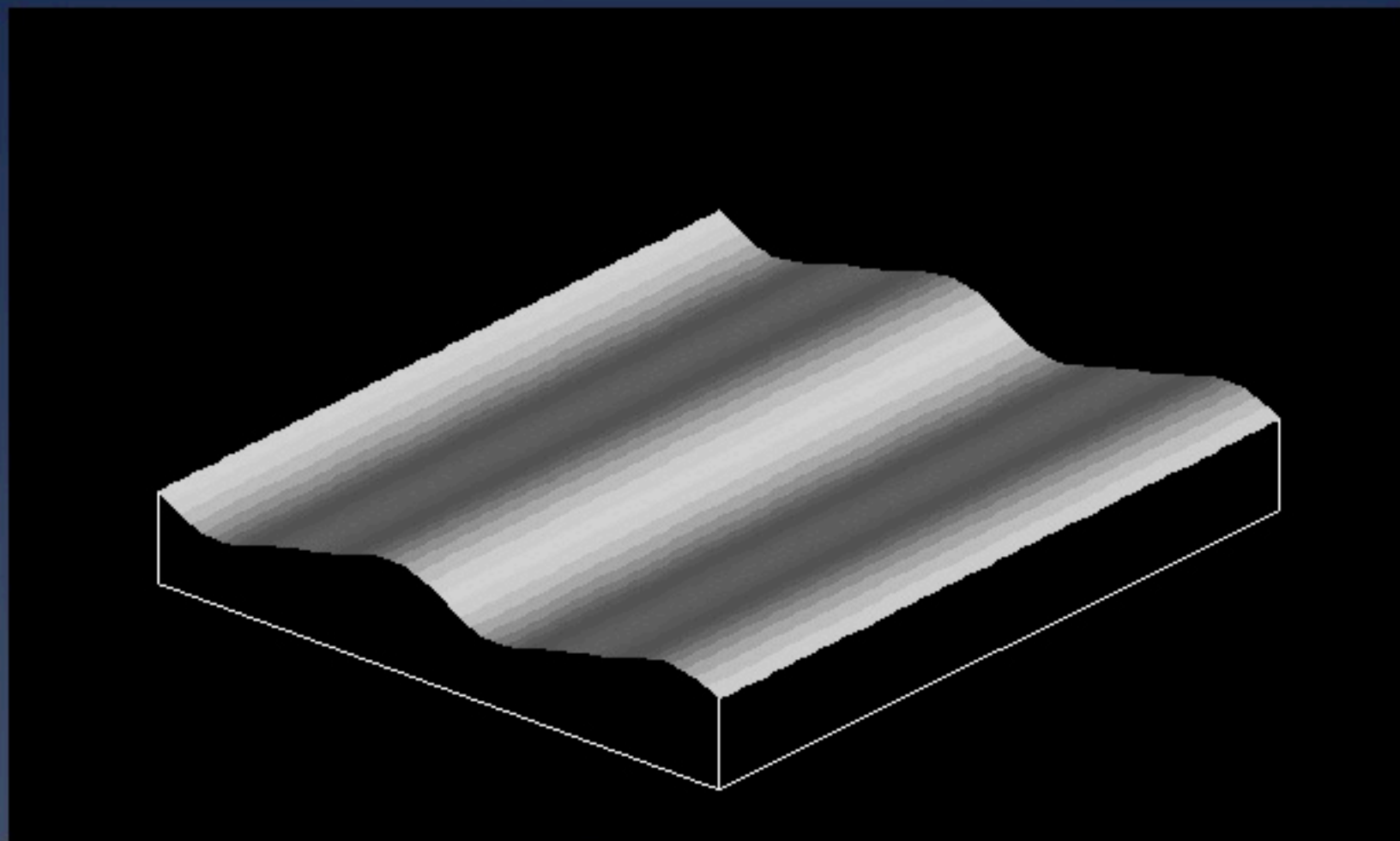


Reineck & Singh, 1980

Stratificazione incrociata da migrazione di ripples con creste rettilinee



Stratificazione incrociata da migrazione di ripples con creste rettilinee



Stratificazione incrociata da migrazione di ripples con creste ondulate

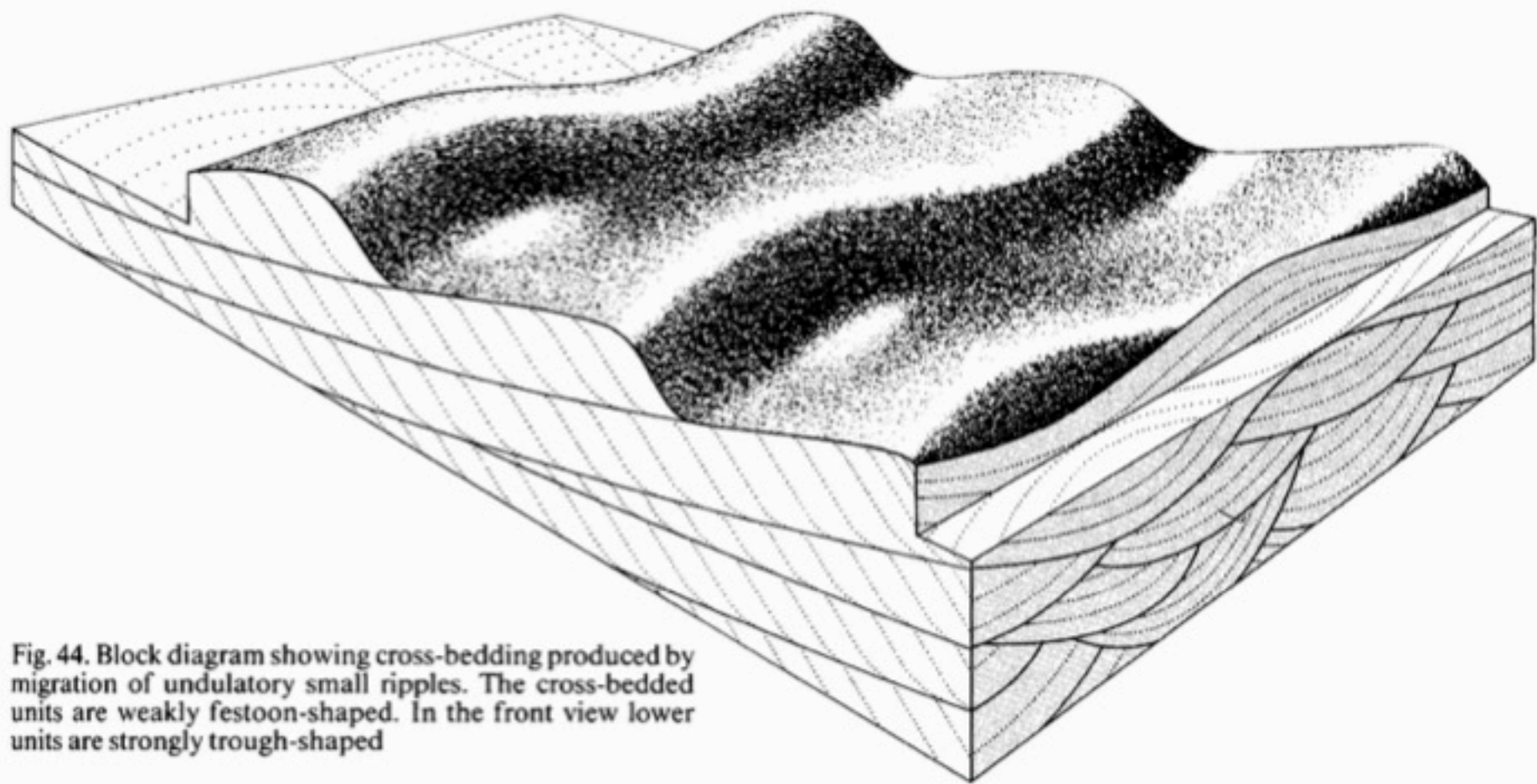
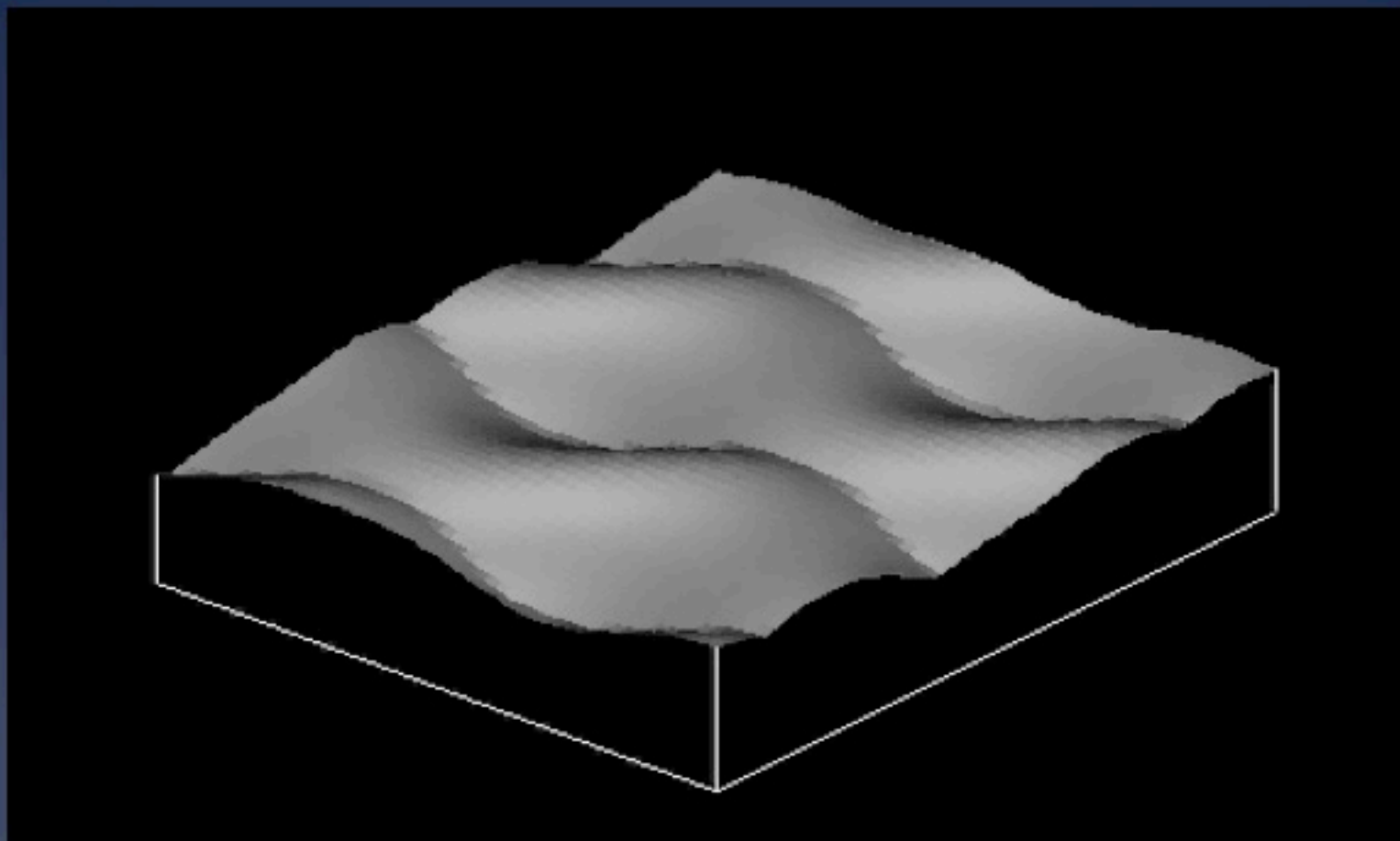


Fig. 44. Block diagram showing cross-bedding produced by migration of undulatory small ripples. The cross-bedded units are weakly festoon-shaped. In the front view lower units are strongly trough-shaped

Stratificazione incrociata da migrazione di ripples con creste ondulate



Stratificazione incrociata da migrazione di ripples con creste linguoidi

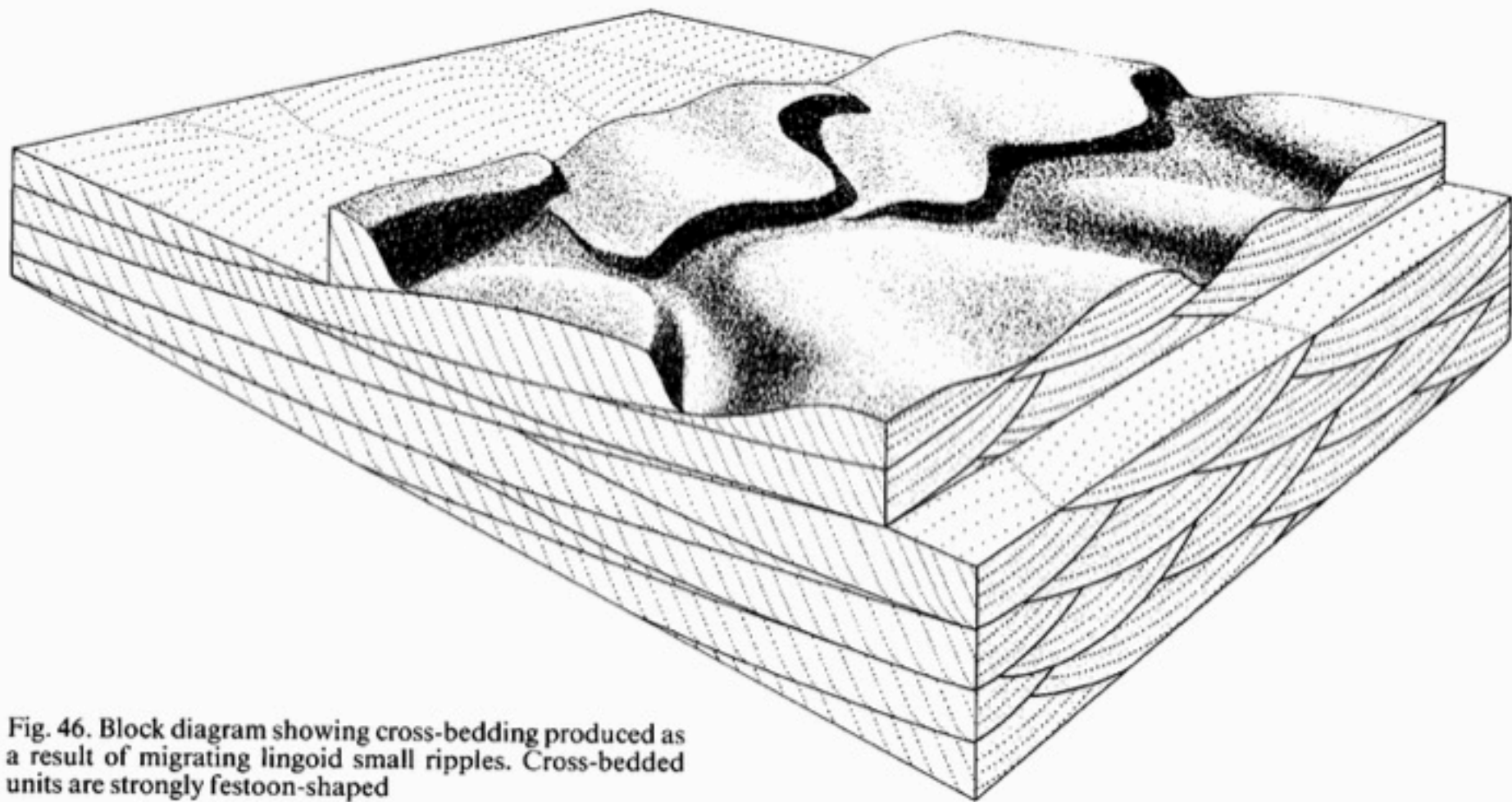
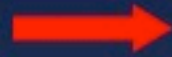


Fig. 46. Block diagram showing cross-bedding produced as a result of migrating lingoid small ripples. Cross-bedded units are strongly festoon-shaped

1. DEPOSIZIONALI



Strutture da corrente



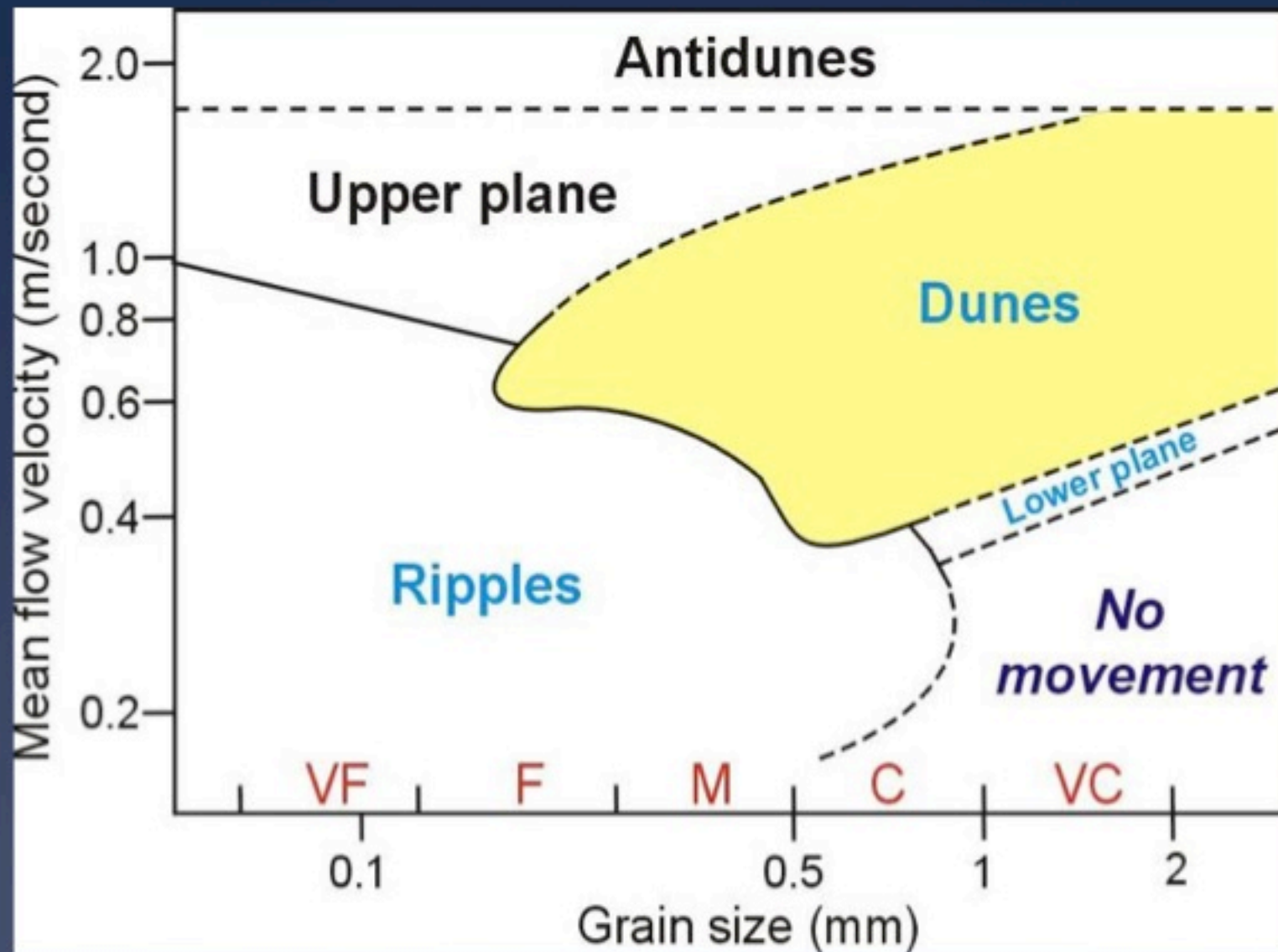
RIPPLES

Laminazione incrociata in gessareniti



Pettijohn & Potter, 1954

Classificazione dune



Classificazione dune

TABLE 6. — Classification scheme recommended by the SEPM Bedforms and Bedding Structures Research Symposium

Subaqueous Dune				
First Order Descriptors (necessary)				
Size: Spacing =	small 0.6–5 m;	medium 5–10 m;	large 10–100 m;	very large > 100 m
Height* =	0.075–0.4 m;	0.4–0.75 m;	0.75–5 m;	> 5 m
Shape: 2-Dimensional				
3-Dimensional				
Second Order Descriptors (important)				
– Superposition: simple or compound (sizes and relative orientation)				
– Sediment characteristics (size, sorting)				
Third Order Descriptors (useful)				
– Bedform profile (stoss and lee slope lengths and angles)				
– Fullbeddedness (fraction of bed covered by bedforms)				
– Flow structure (time-velocity characteristics)				
– Relative strengths of opposing flows				
– Dune behavior-migration history (vertical and horizontal accretion)				

* Height calculated using the equation $H = 0.0677L^{0.8098}$ (Flemming 1988).

Ashley et al., 1990

1. DEPOSIZIONALI



Strutture da corrente



DUNE

Dune con sovrapposti ripple da corrente



Orl, 1992

Animated Gif

-

***Bedding
Plane
Development***

-

***Christopher
Kendall***

-

2005

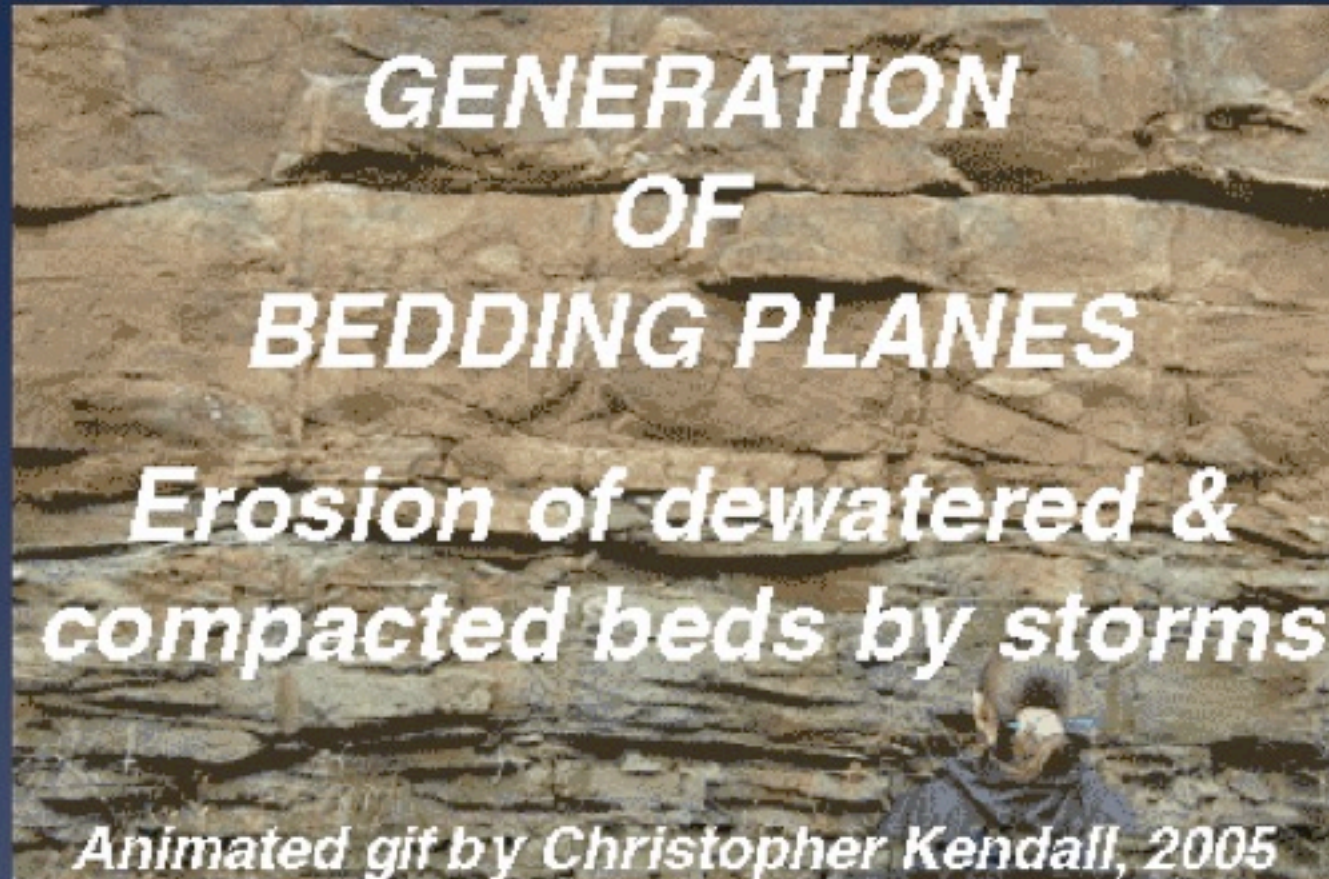
1. DEPOSIZIONALI



Strutture da corrente



DUNE



1. DEPOSIZIONALI



Strutture da corrente



DUNE

Dune in sezione



Pettijohn & Potter, 1964

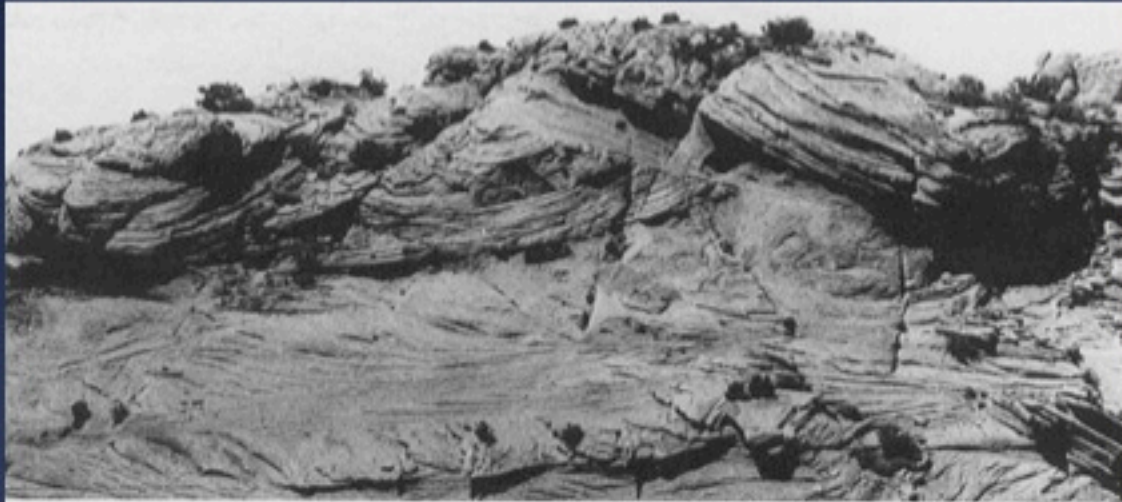
1. DEPOSIZIONALI



Strutture da corrente



DUNE



**Stratificazione incrociata
concava
(A festoni)**

**Sezione
trasversale**



**Sezione
longitudinale**

Orl, 1992

1. DEPOSIZIONALI

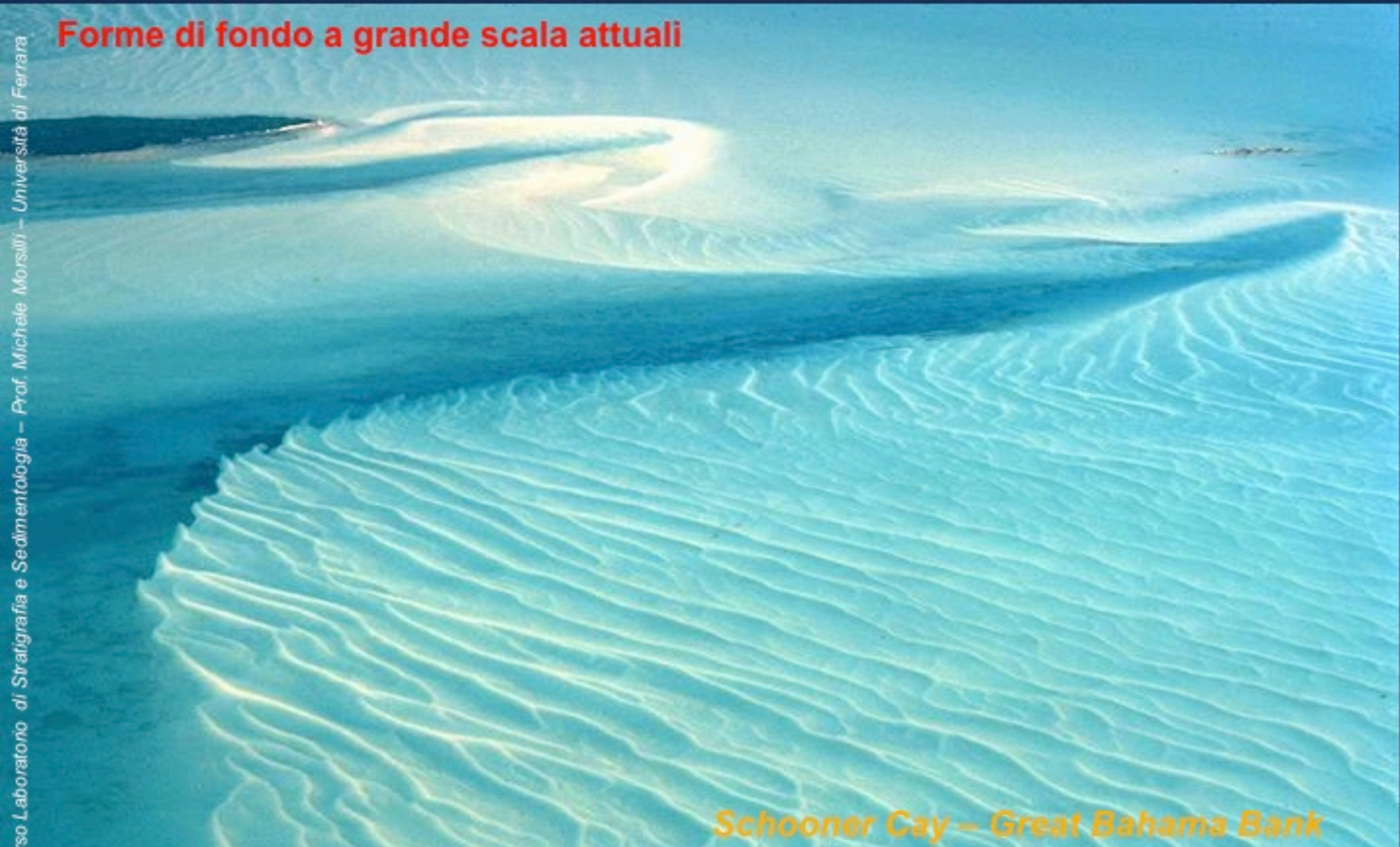


Strutture da corrente

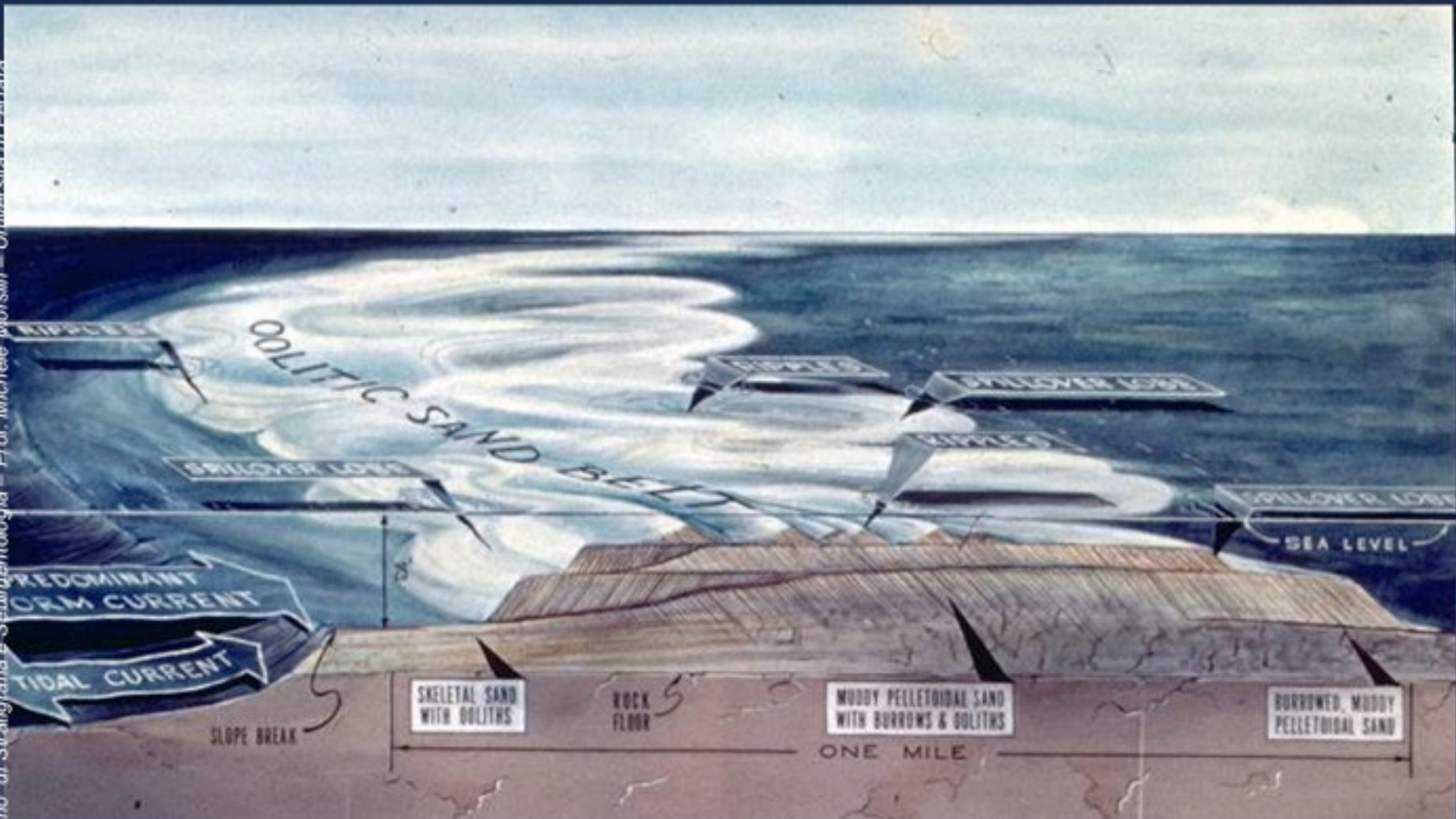


SANDWAVES

Forme di fondo a grande scala attuali



Schooner Cay – Great Bahama Bank



Ball, 1967

1. DEPOSIZIONALI



Strutture da corrente



SANDWAVES



1. DEPOSIZIONALI

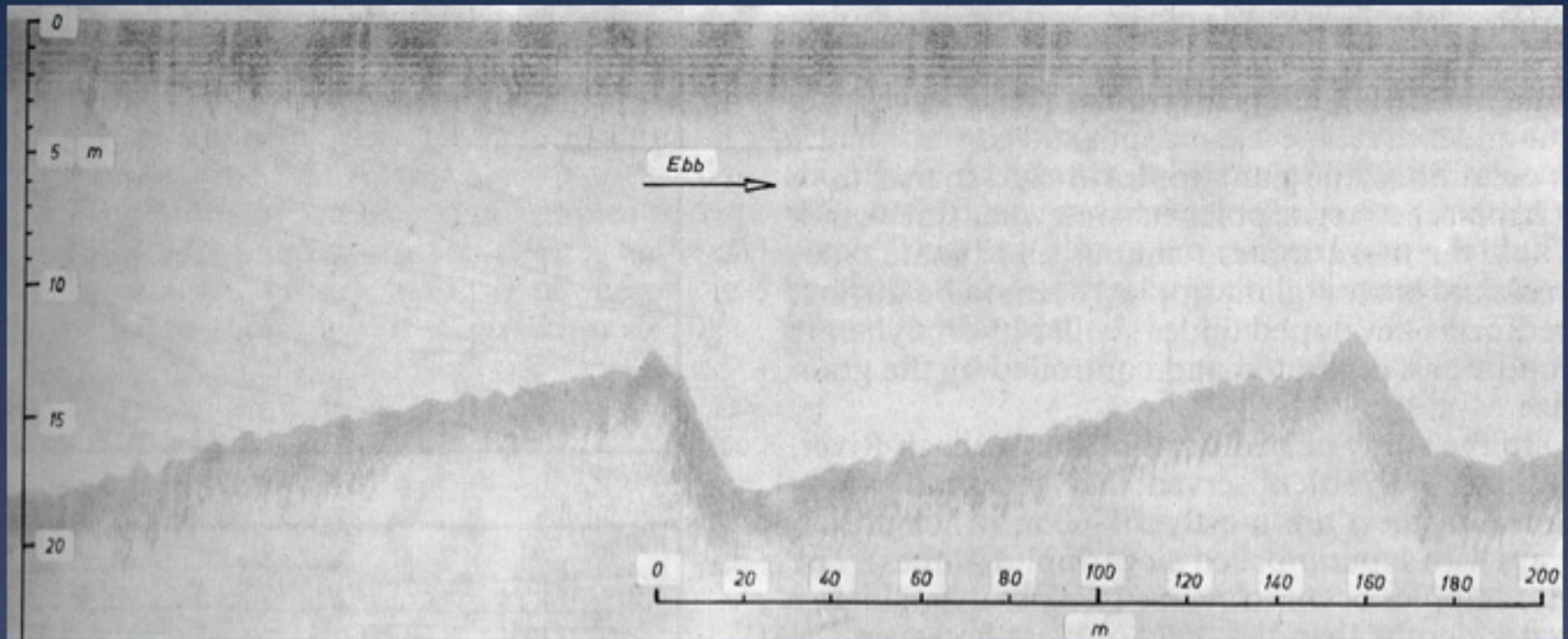


Strutture da corrente



SANDWAVES

Forme di fondo a grande scala attuali (profilo da ecoscandaglio)



Reineck & Singh, 1980

1. DEPOSIZIONALI



Strutture da corrente



SANDWAVES

Stratificazione incrociata a grande scala



Orl, 1992

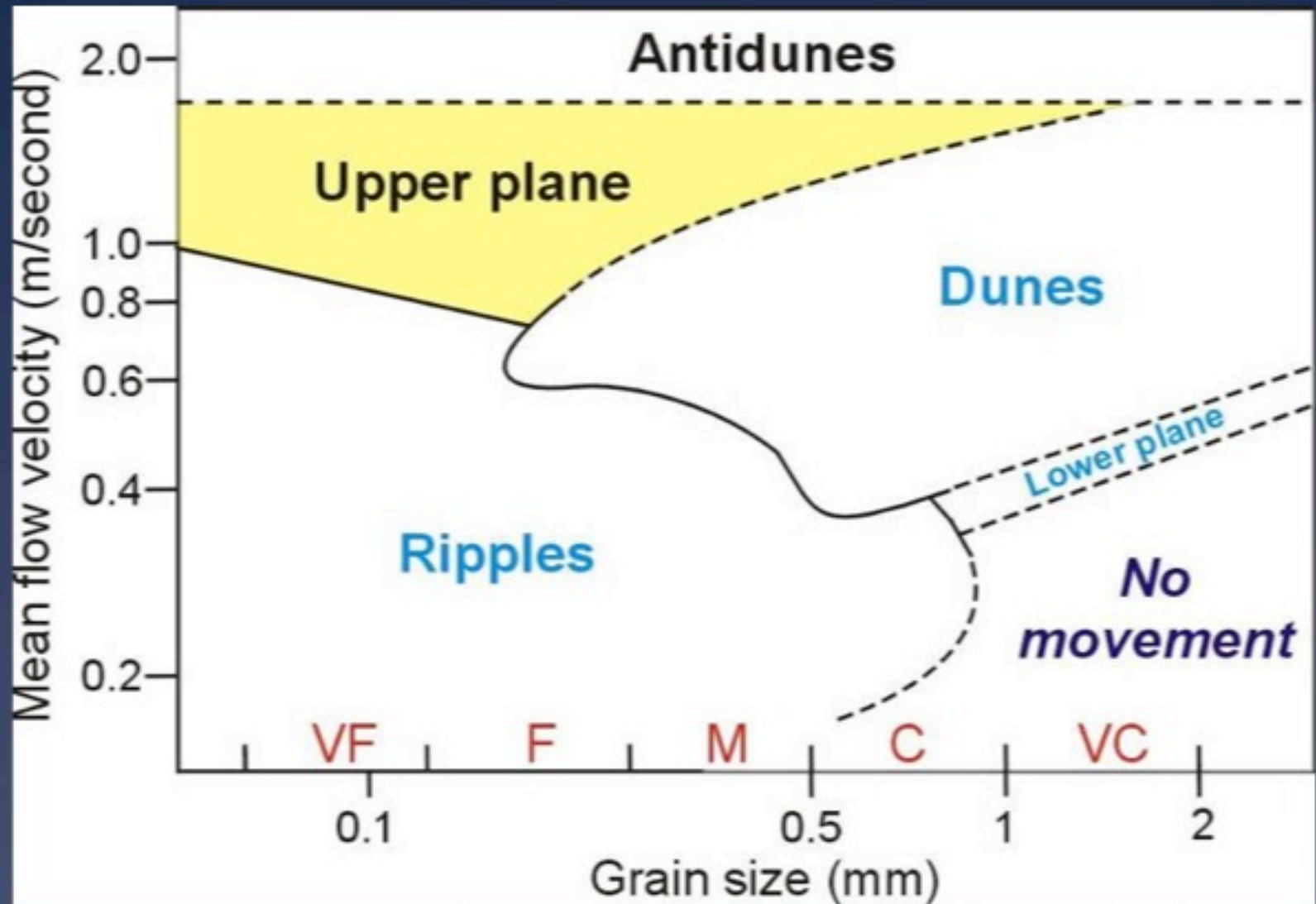
1. DEPOSIZIONALI



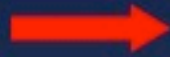
Strutture da corrente



STR. PIANE



1. DEPOSIZIONALI



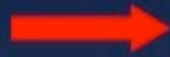
Strutture da corrente



STR. PIANE



1. DEPOSIZIONALI



Strutture da corrente



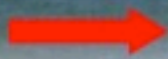
ANTIDUNE

Strutture tipo antiduna
sulla battigia

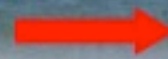


Ricci Lucchi, 1992

1. DEPOSIZIONALI



Strutture da corrente



ANTIDUNE





ANTIDUNES

Provided by: Nikki Strong, St. Anthony Falls Laboratory

Description: Shows upper plane bed to antidune transition in two views. Flume is 30 cm high, 30 cm wide and is 5.1 m long. Flow is from the right to left. Note antidunes grow out of upper plane bed transport. They migrate upstream as they grow and steepen, eventually collapsing back to upper plane bed.

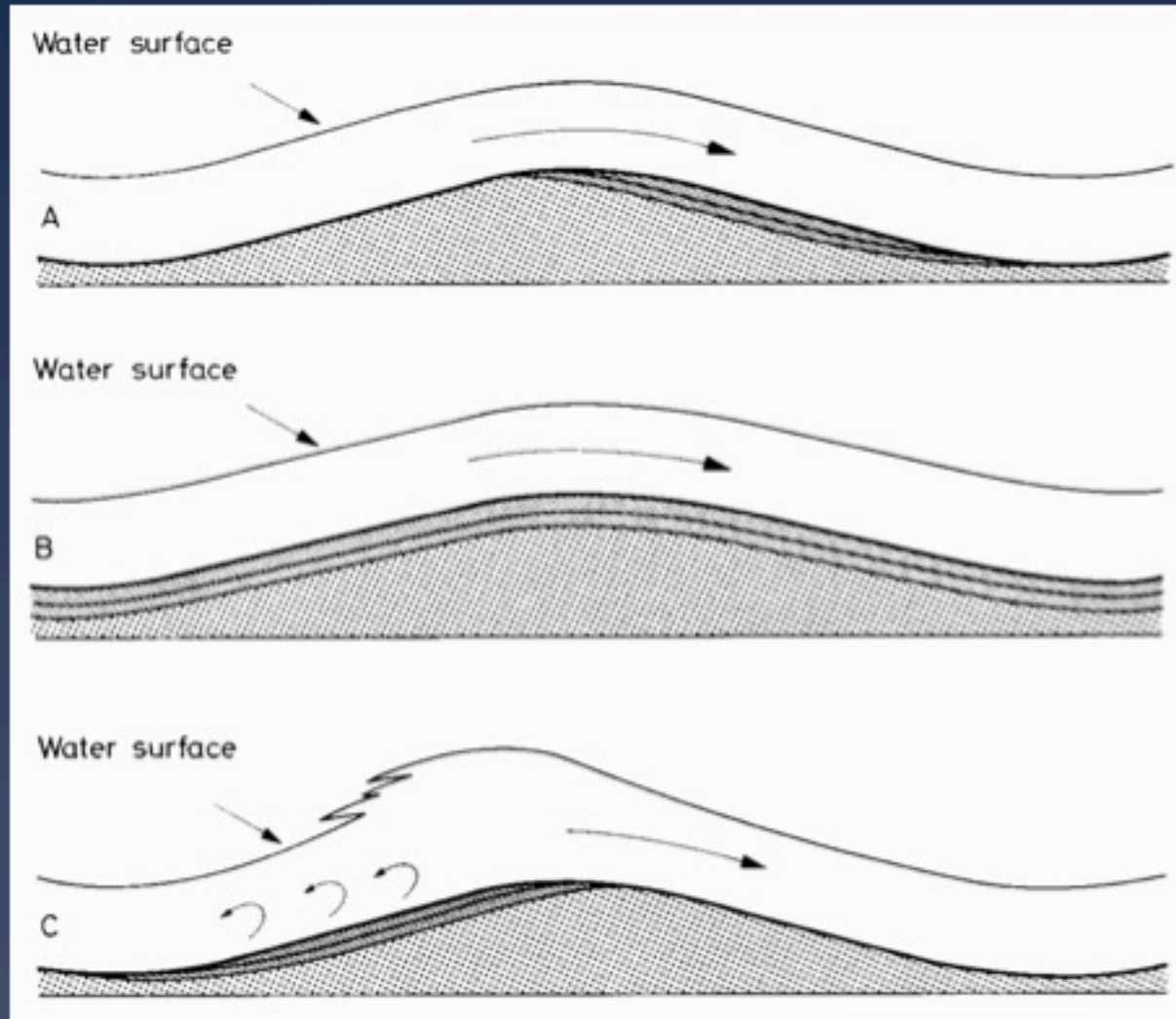
1. DEPOSIZIONALI



Strutture da corrente



ANTIDUNE



Tipi di laminazioni interne

Reineck & Singh, 1980

FORME DI FONDO DA ONDA - RIPPLES

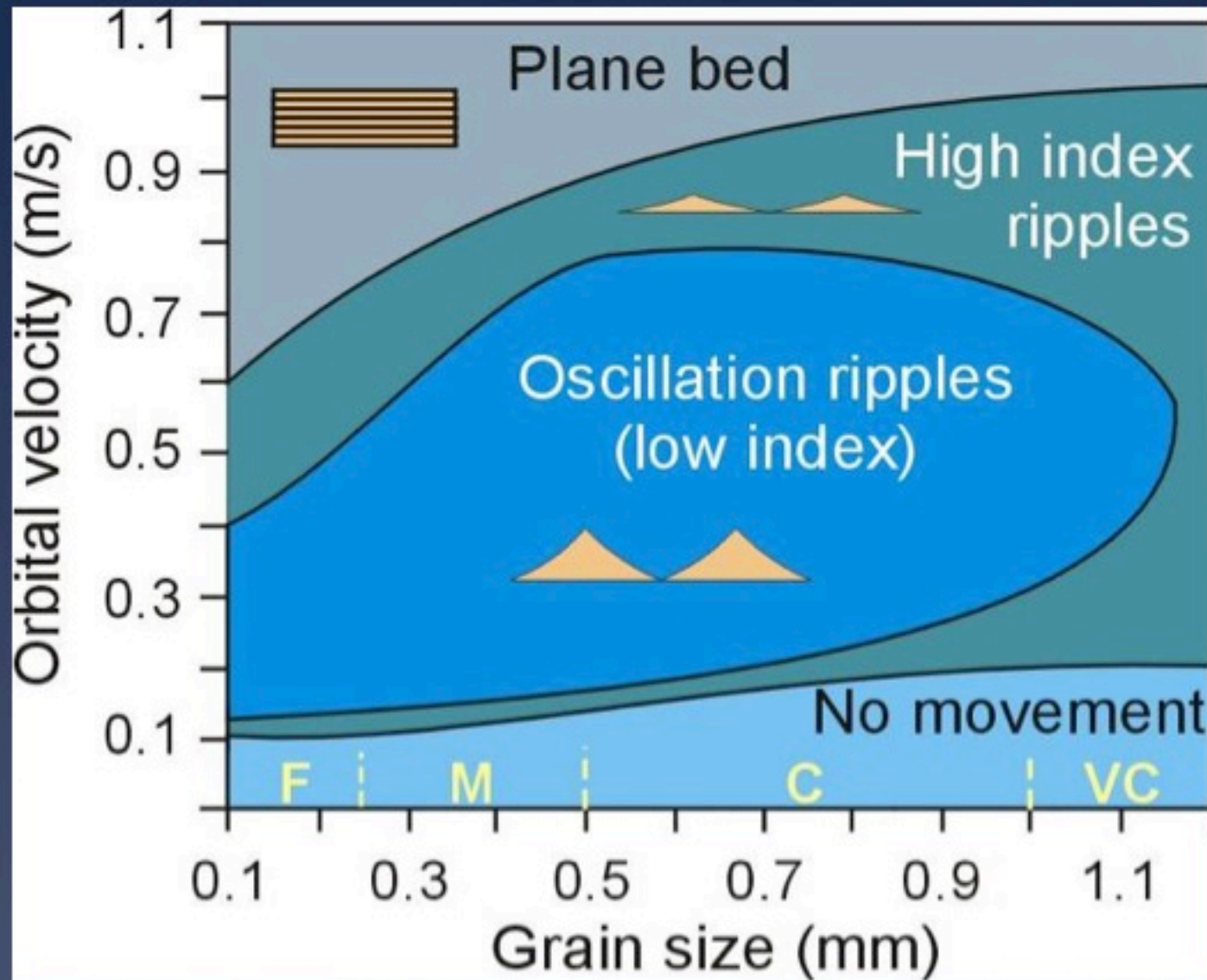
1. DEPOSIZIONALI



Strutture da onda



RIPPLES



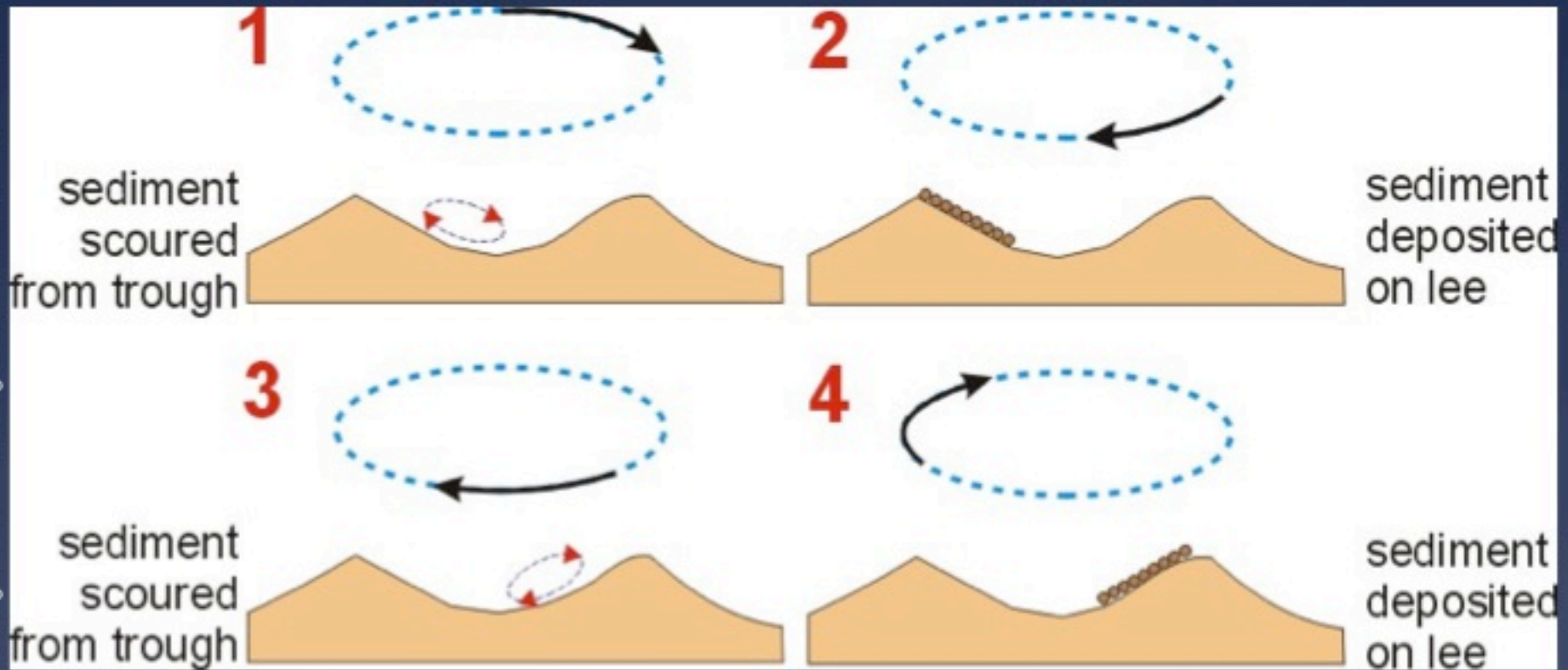
1. DEPOSIZIONALI



Strutture da onda



RIPPLES



1. DEPOSIZIONALI



Strutture da onda



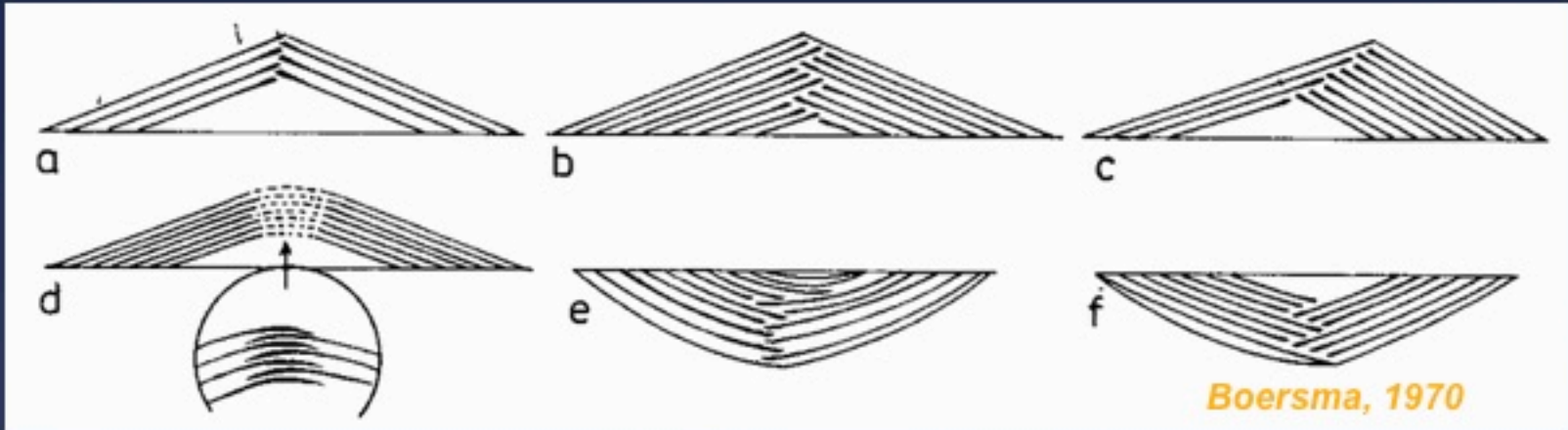
RIPPLES

*Wave ripples in Cretaceous sandstone.
San Juan Basin, New Mexico.*

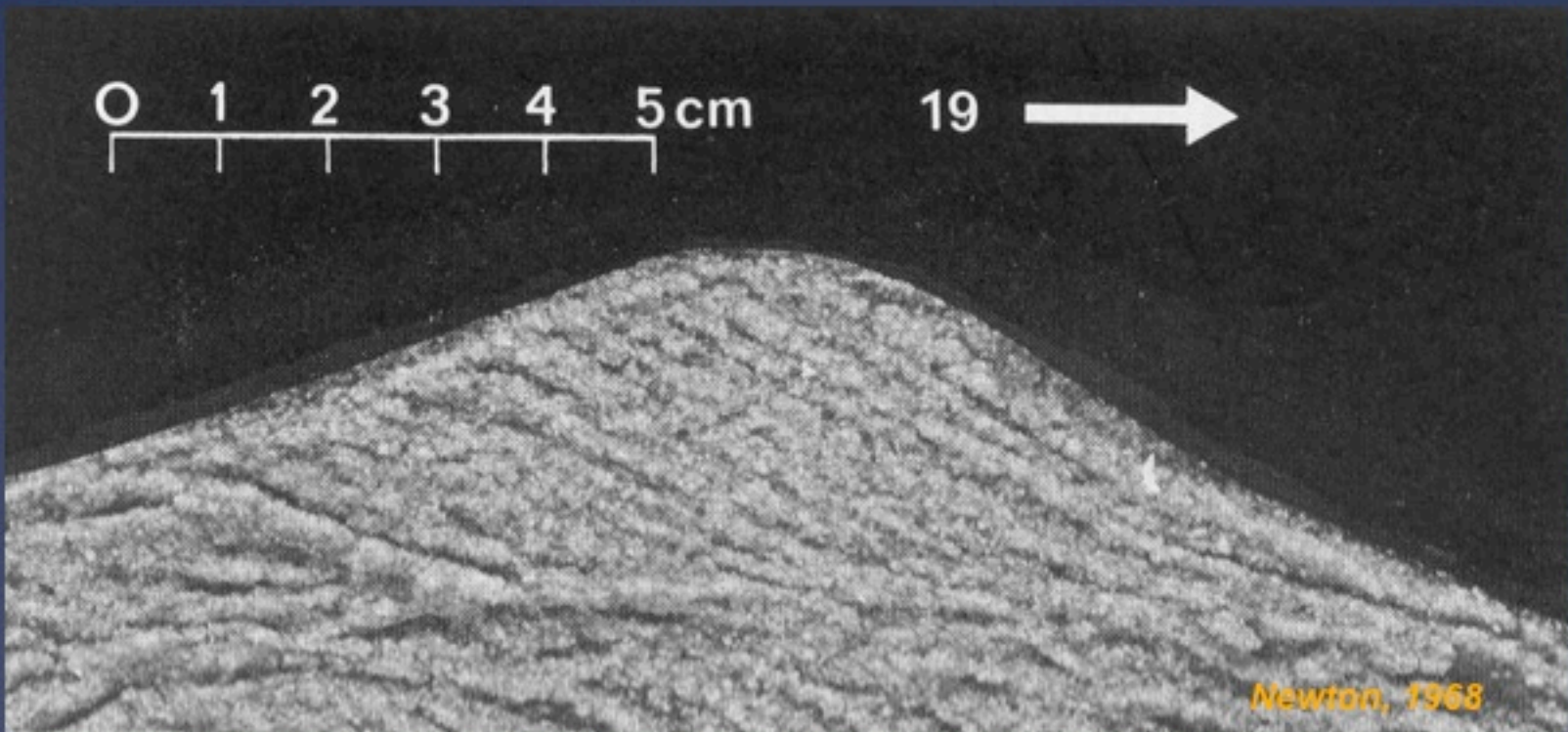


<http://www.geo.duke.edu:80/ss/answers1.htm>

STRUTTURE INTERNE RIPPLES DA ONDA

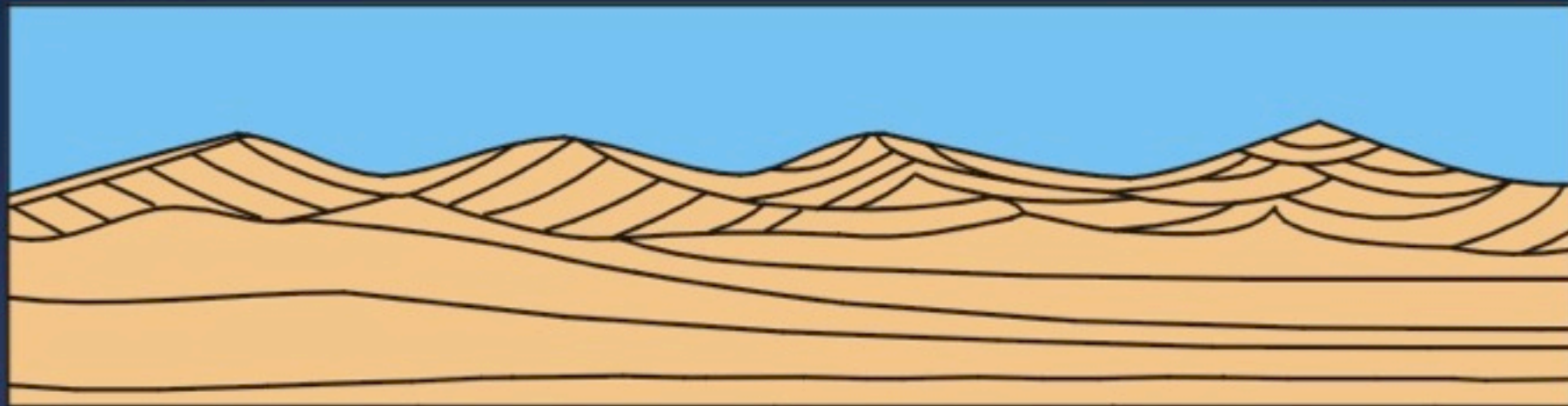


Boersma, 1970



Newton, 1968

Stratificazione incrociata da ripples da onda



Demicco & Hardie, 1994

Ripples da onda



Entrada Formation