

Deposition

Ways to hit the seafloor

Recent “review”:

Boudreau, B. and B.B. Jørgensen, Eds. 2001. *The Benthic Boundary Layer: Transport Processes and Biogeochemistry*.
Oxford Univ. Press, NY.

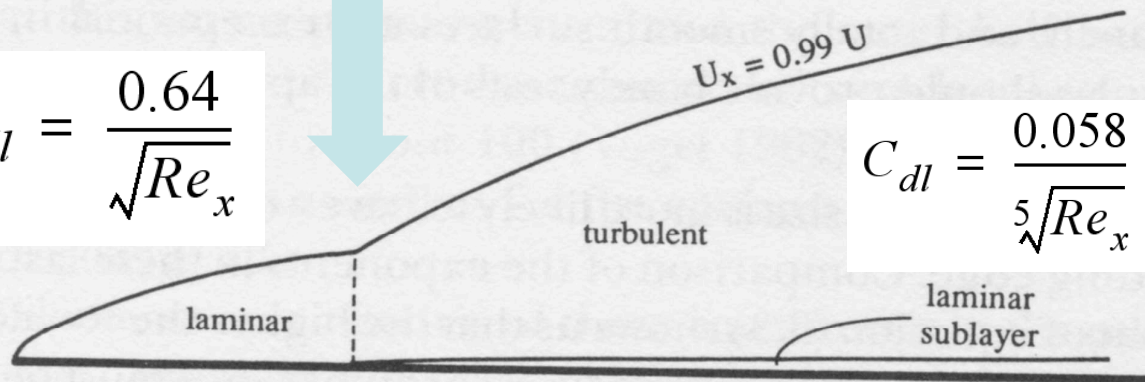
Please ask about specific
references of interest

Growing Boundary Layers

CHAPTER 8

What is missing here?
What really happens?

$$C_{dl} = \frac{0.64}{\sqrt{Re_x}}$$



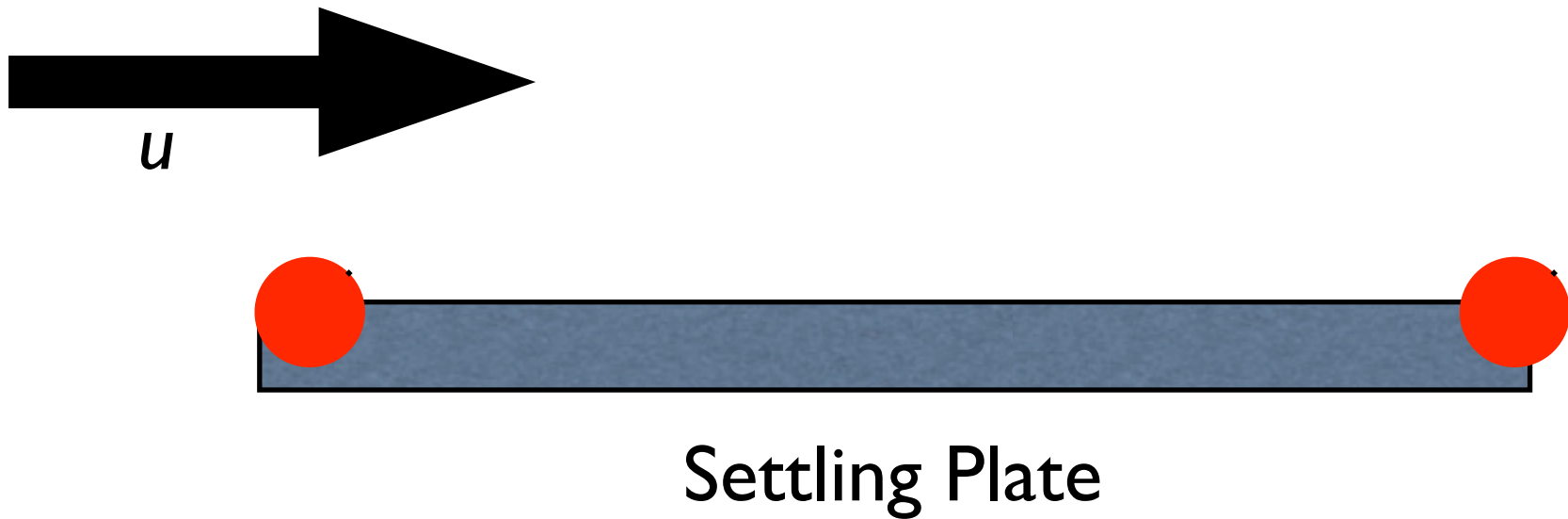
$$C_{dl} = \frac{0.058}{\sqrt[5]{Re_x}}$$

FIGURE 8.3. A boundary layer that's laminar upstream but becomes turbulent farther along, with a laminar sublayer in the latter region. Again the z -distances are greatly exaggerated.

$x \rightarrow$

$$Re_x = \frac{\rho U x}{\mu}$$

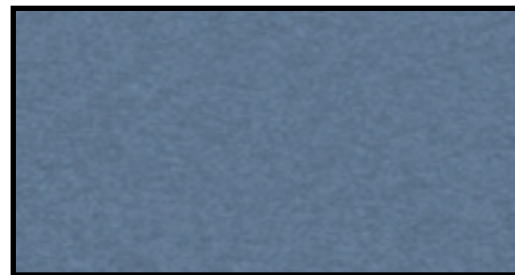
Sites of enhanced recruitment in a flow field



The Big Picture



Stuff comes in



The ocean
or the BBL



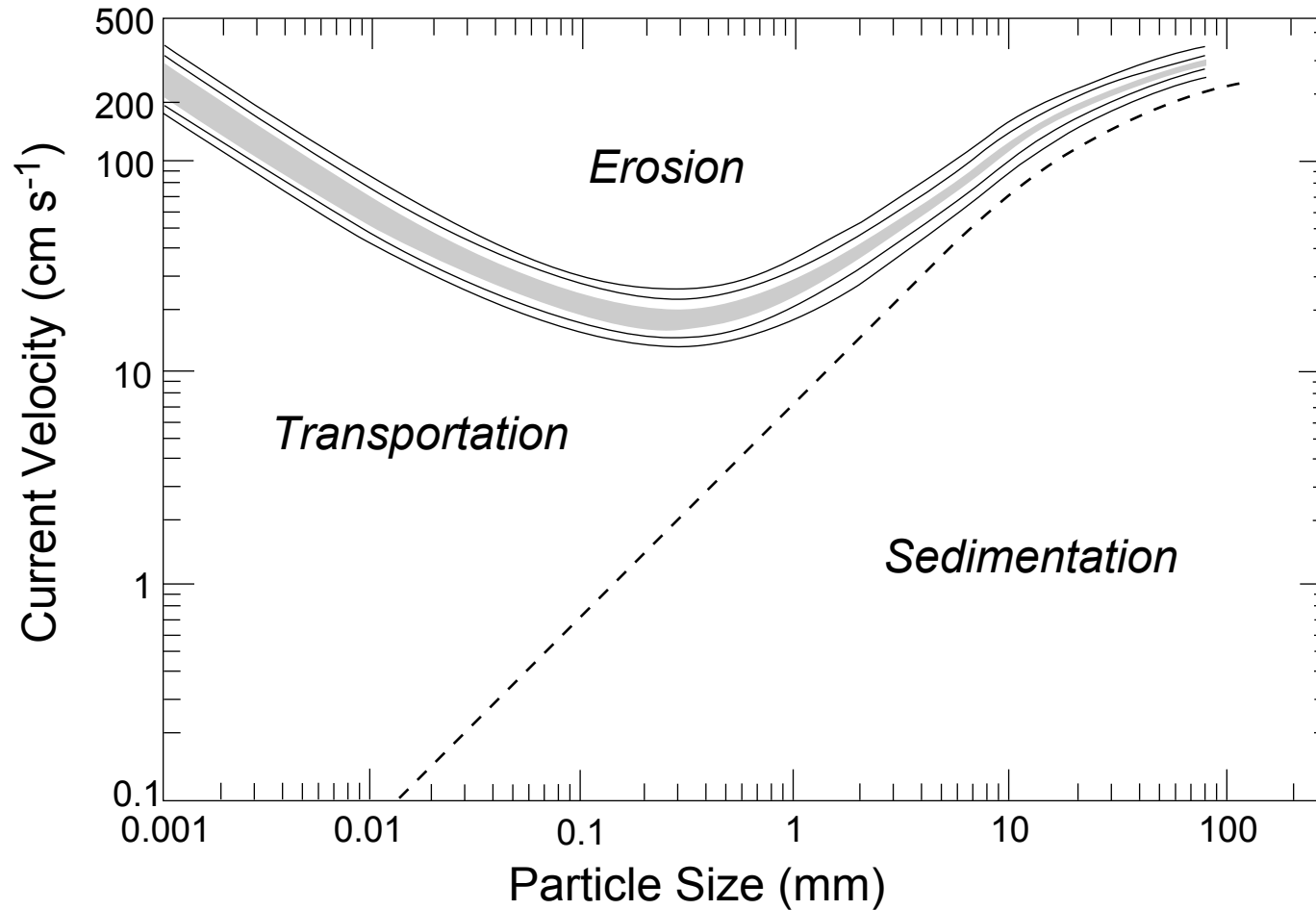
Stuff deposits out

But there are areas
and times of no
deposition

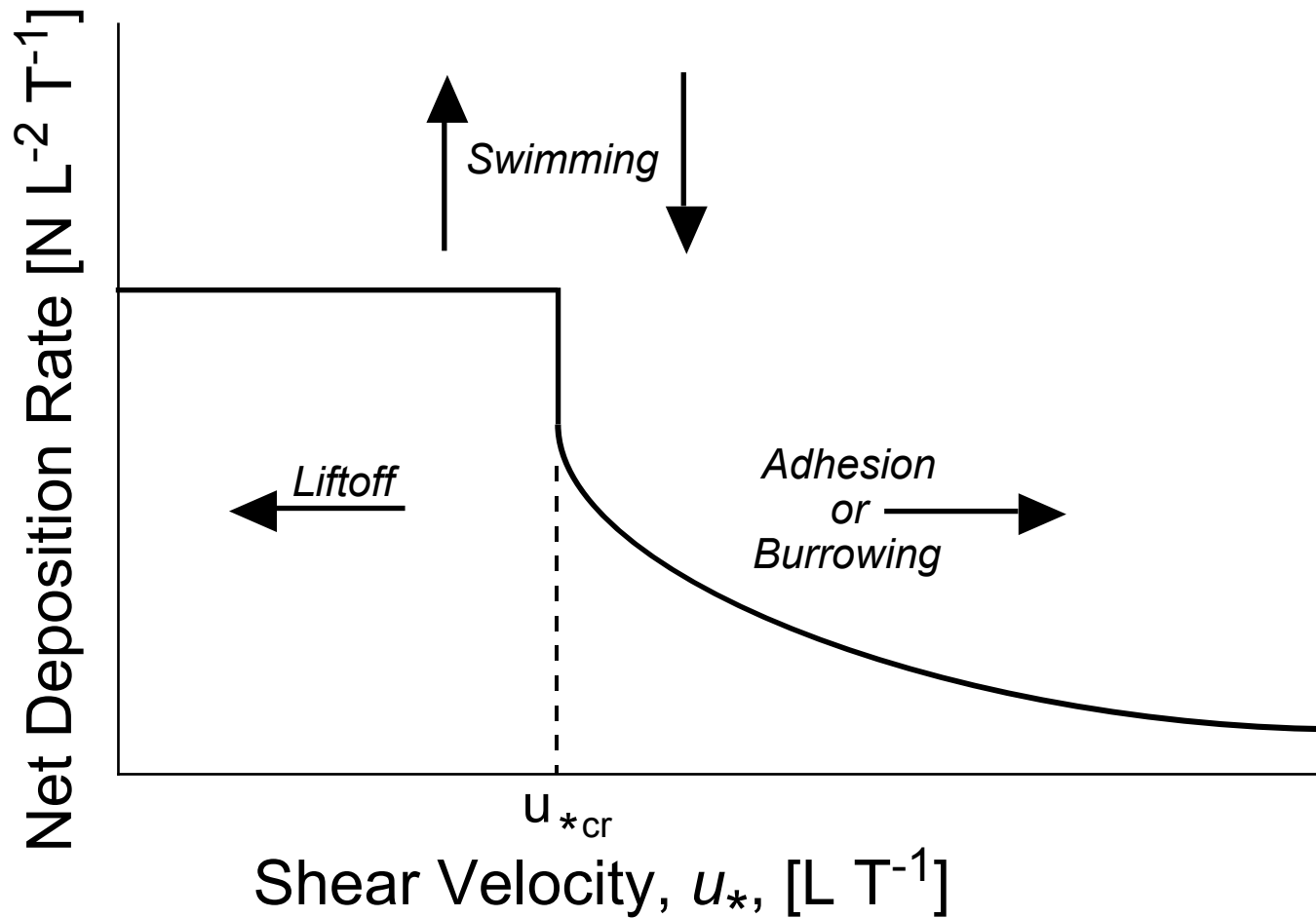
Organism's perspective:
Within reach?

Often enough to keep the stomach full?

Hjulström Diagram



Deposition Rates

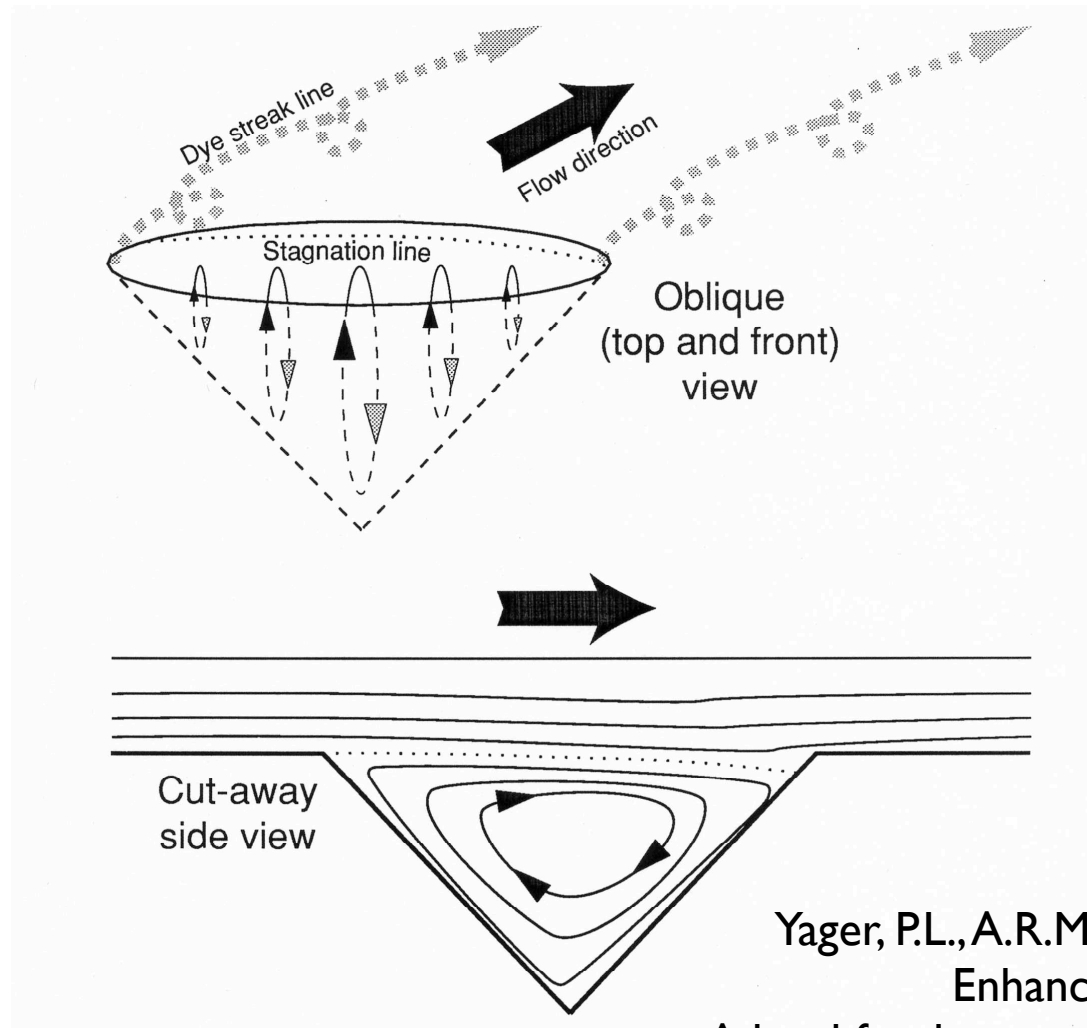


Mechanisms of Deposition

- Gravitational deposition
- Direct interception
- Inertial impaction
- Brownian diffusion
- Electrostatic deposition

Haven't I seen these somewhere before?

Pits



Multiple mechanisms of deposition

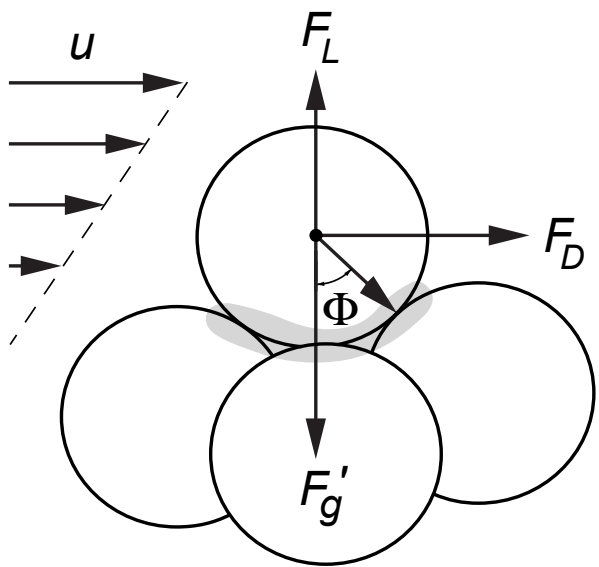
Water is exchanged in pulses, when a large eddy impinges.

Yager, P.L., A.R.M. Nowell and P.A. Jumars. 1993.


Enhanced deposition to pits:

A local food source for benthos. *J. Mar. Res.* **51**: 1-28.

Biogenic effects



Biological Effects

Secrete or degrade adhesives ()

Alter $u(z)$

Alter grain exposure

Impart or extract particle momentum

Consequences

Alter restraining force added to F_g'

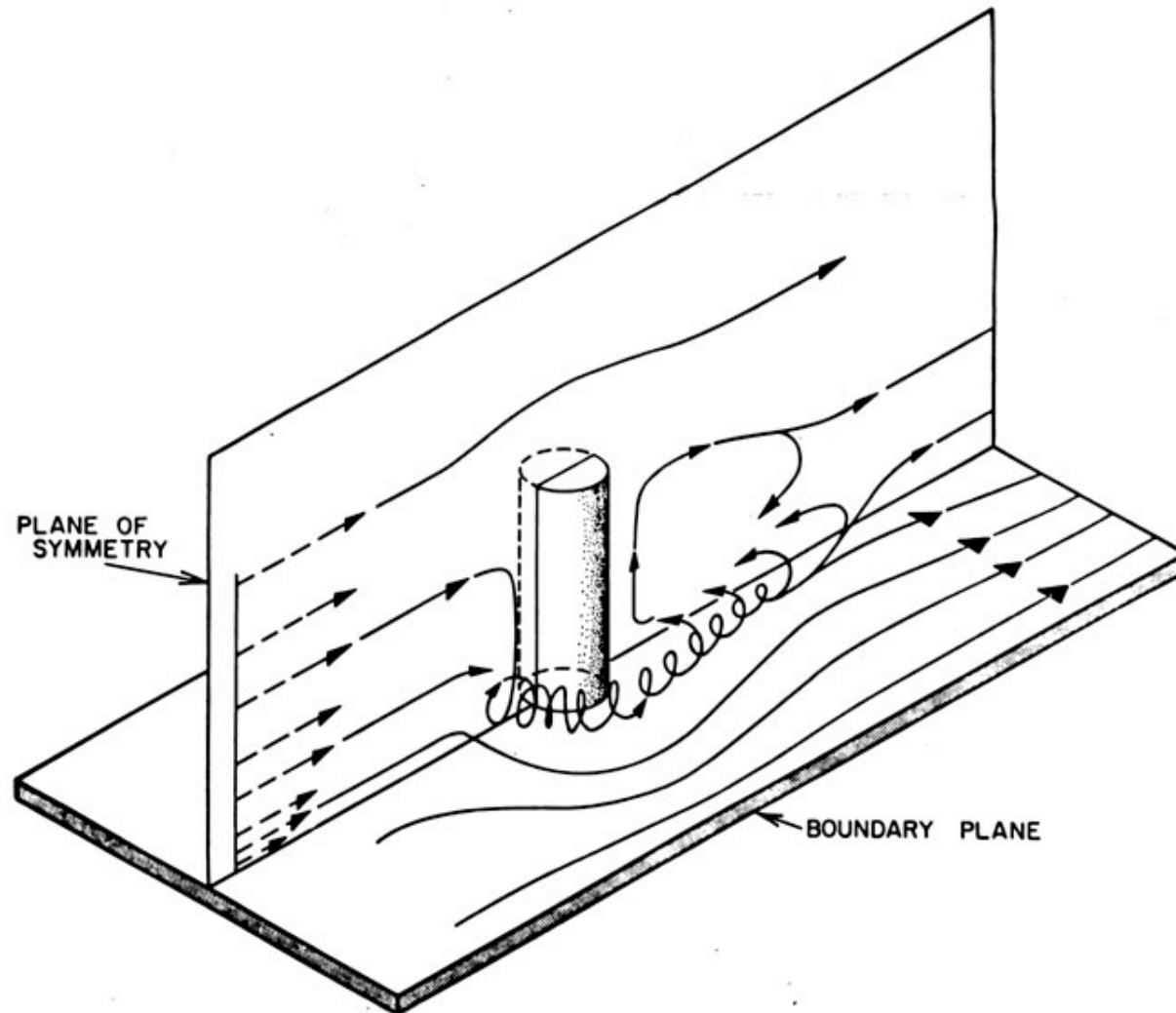
Alter F_L and F_D

Alter Φ , F_L and F_D

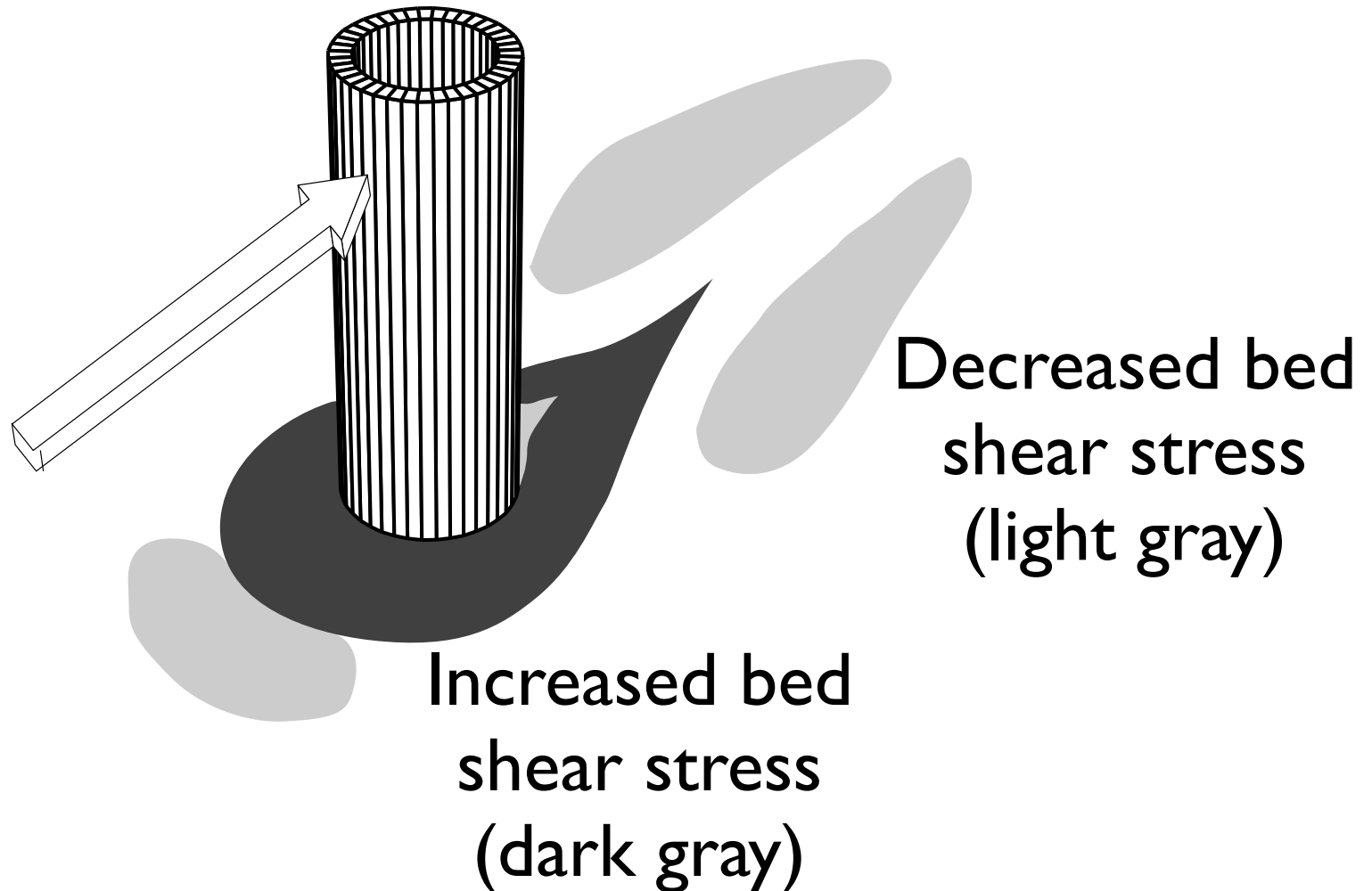
Alter u_{*cr}

Biodeposition in oyster and mussel beds can double local net deposition rates.

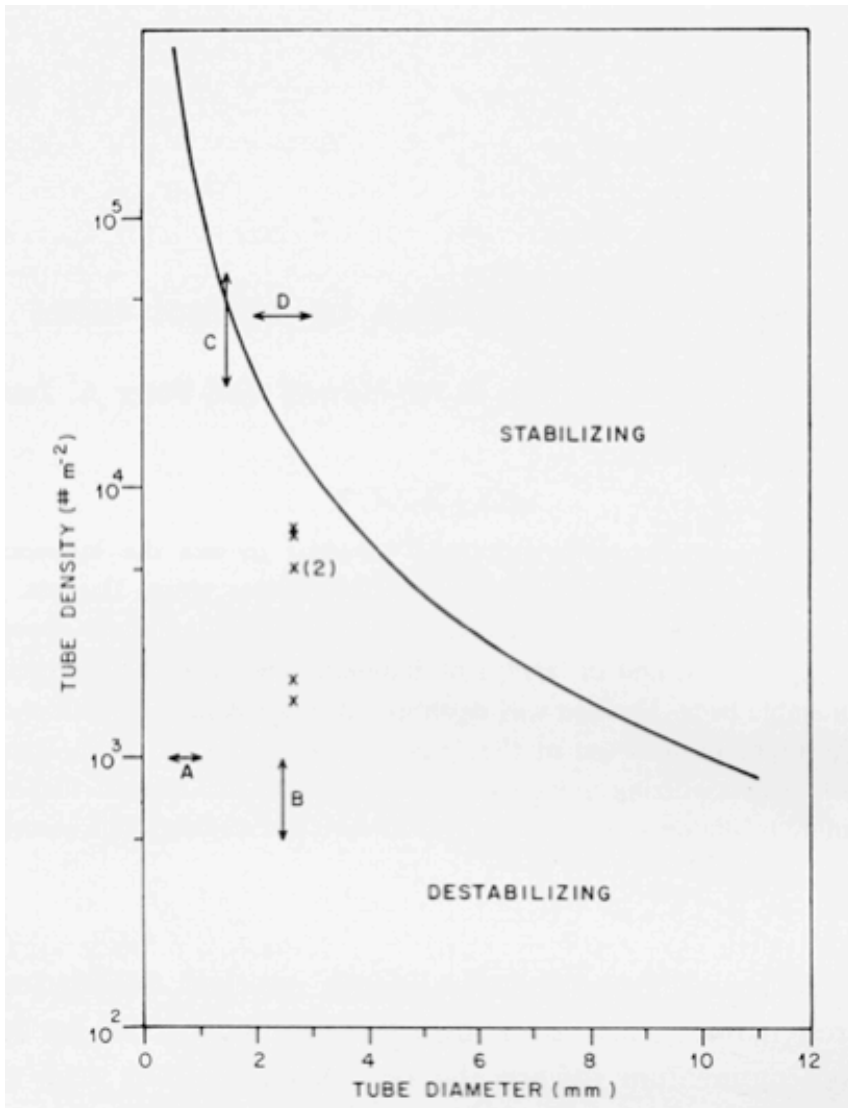
A horseshoe vortex



Flow about a tube

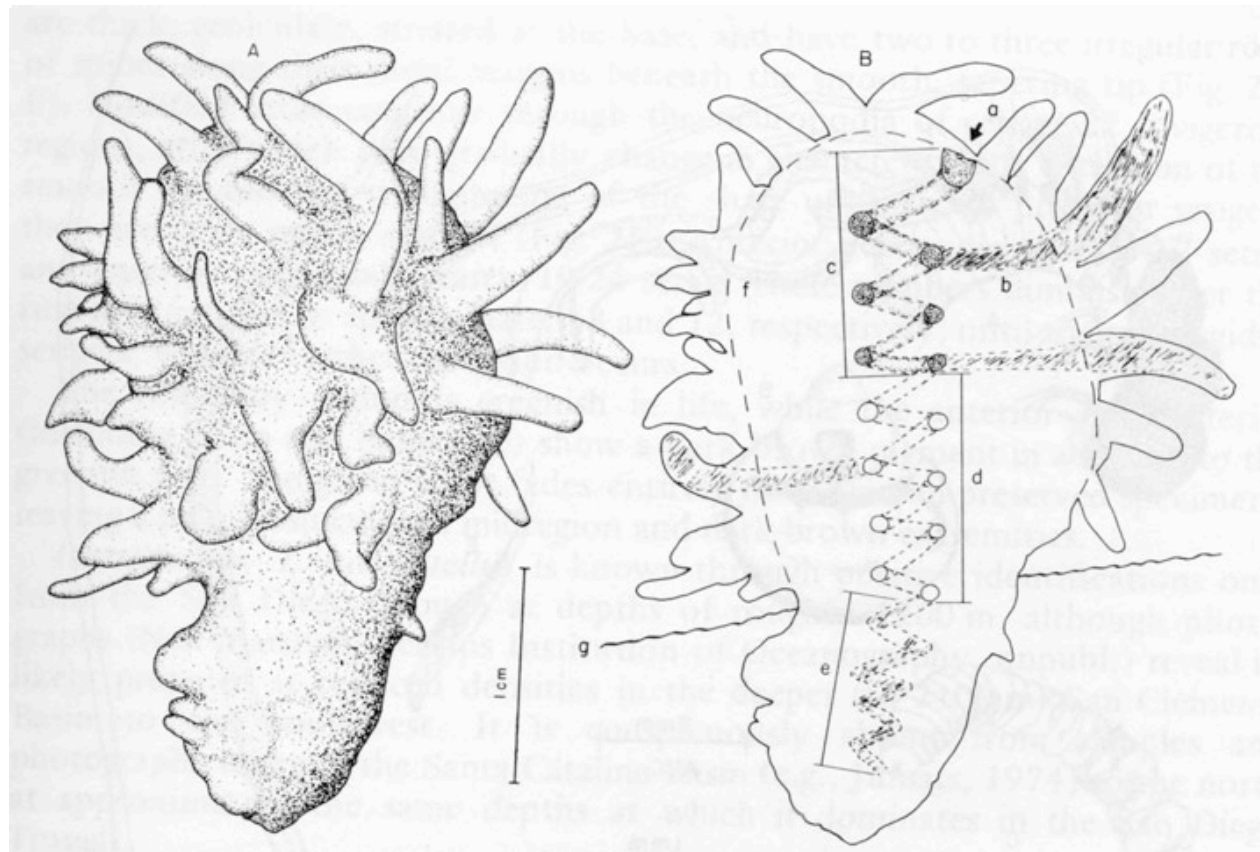


Tubes often occur in groups



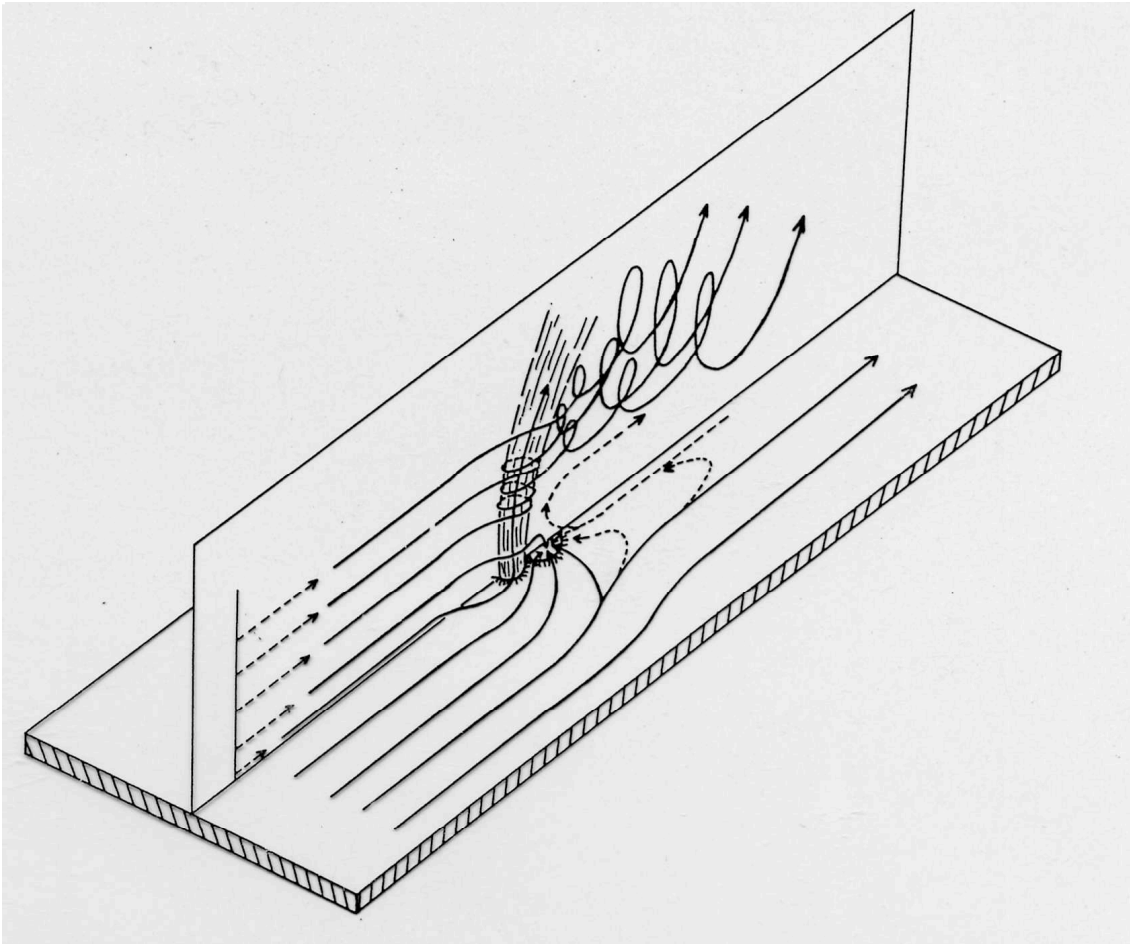
“Skimming flow” starts at ~16% coverage

A frilly deposition inducer?



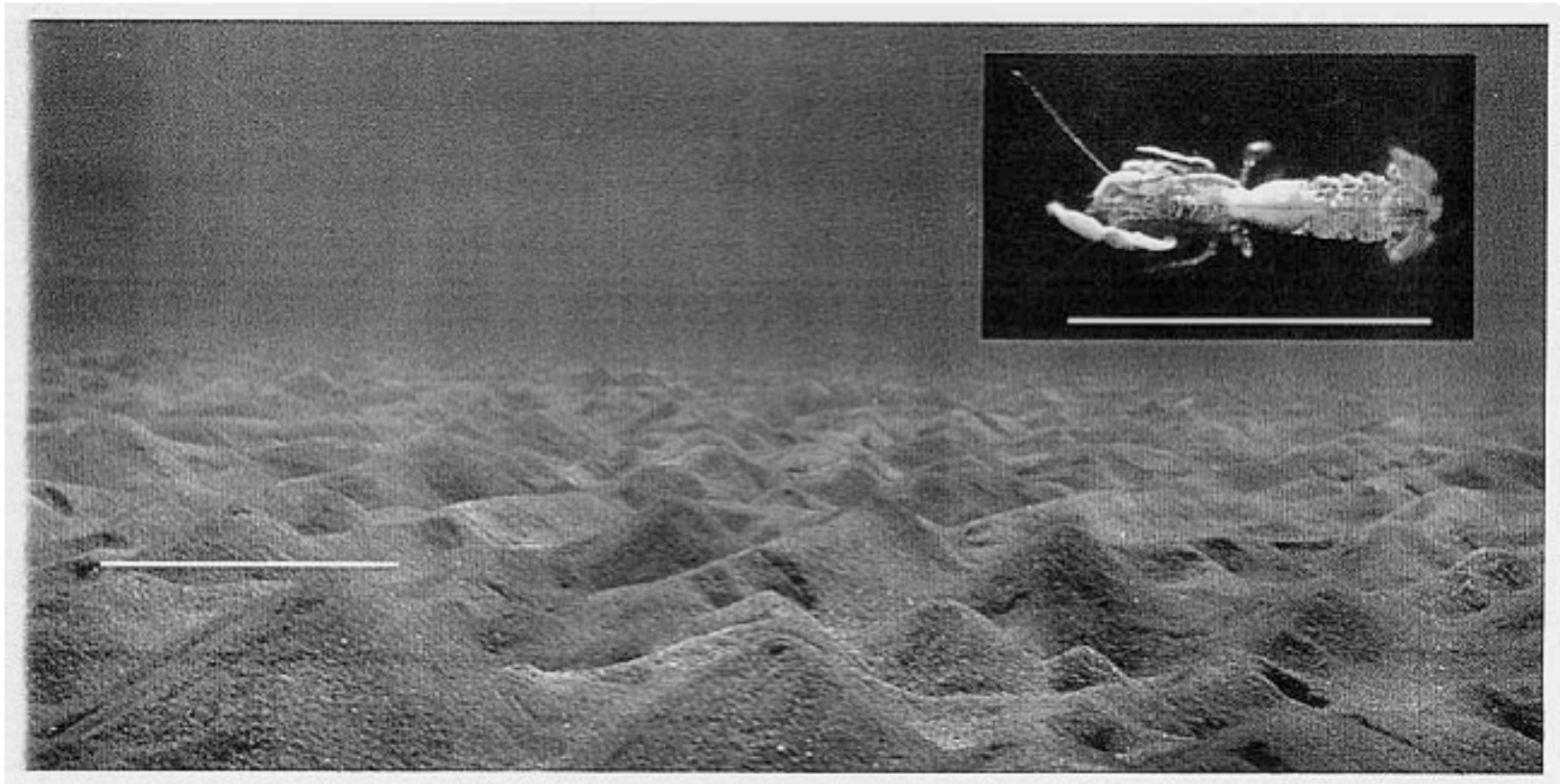
Tharyx luticastellus

And a structure is not required

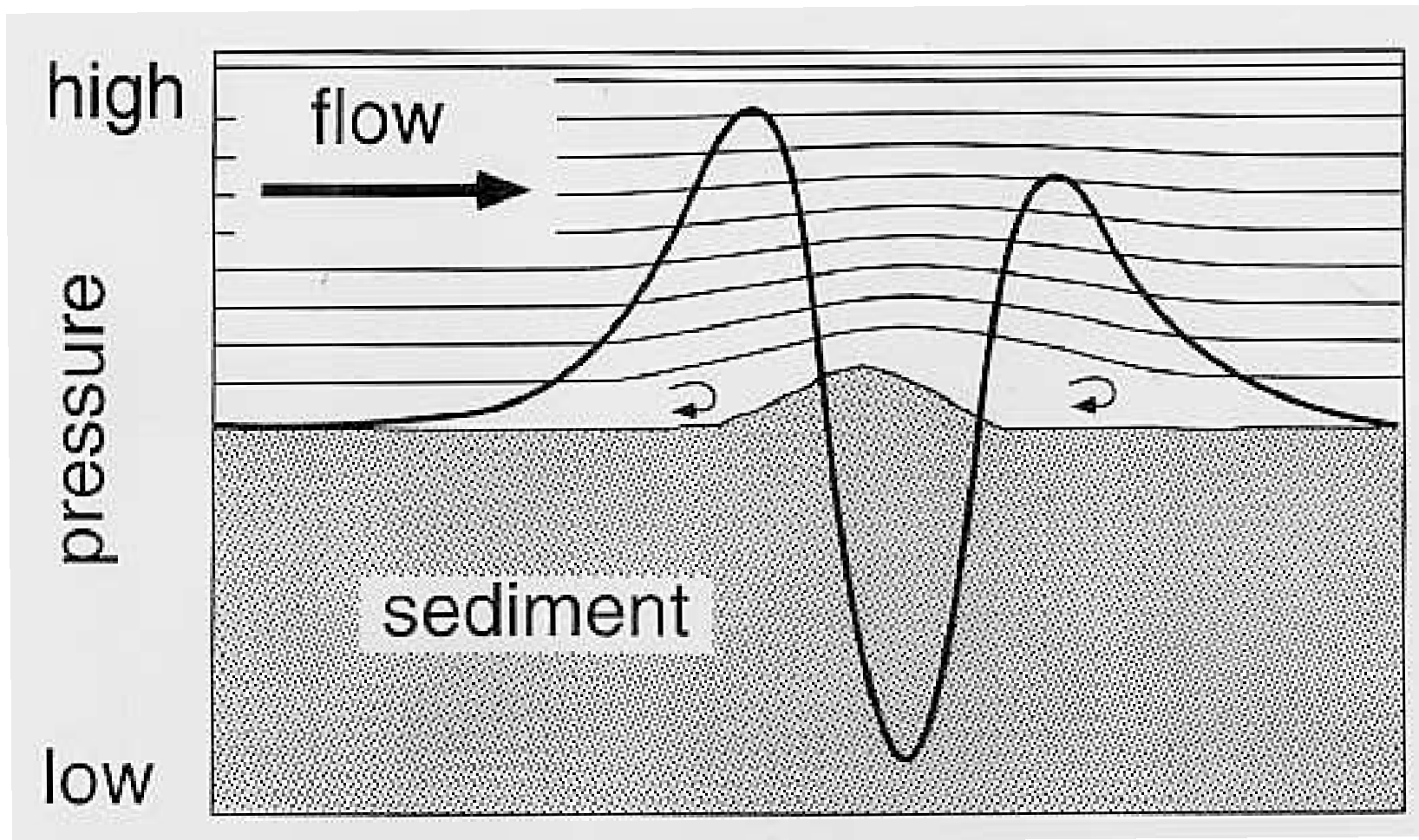


Siphonal jet
of a bivalve

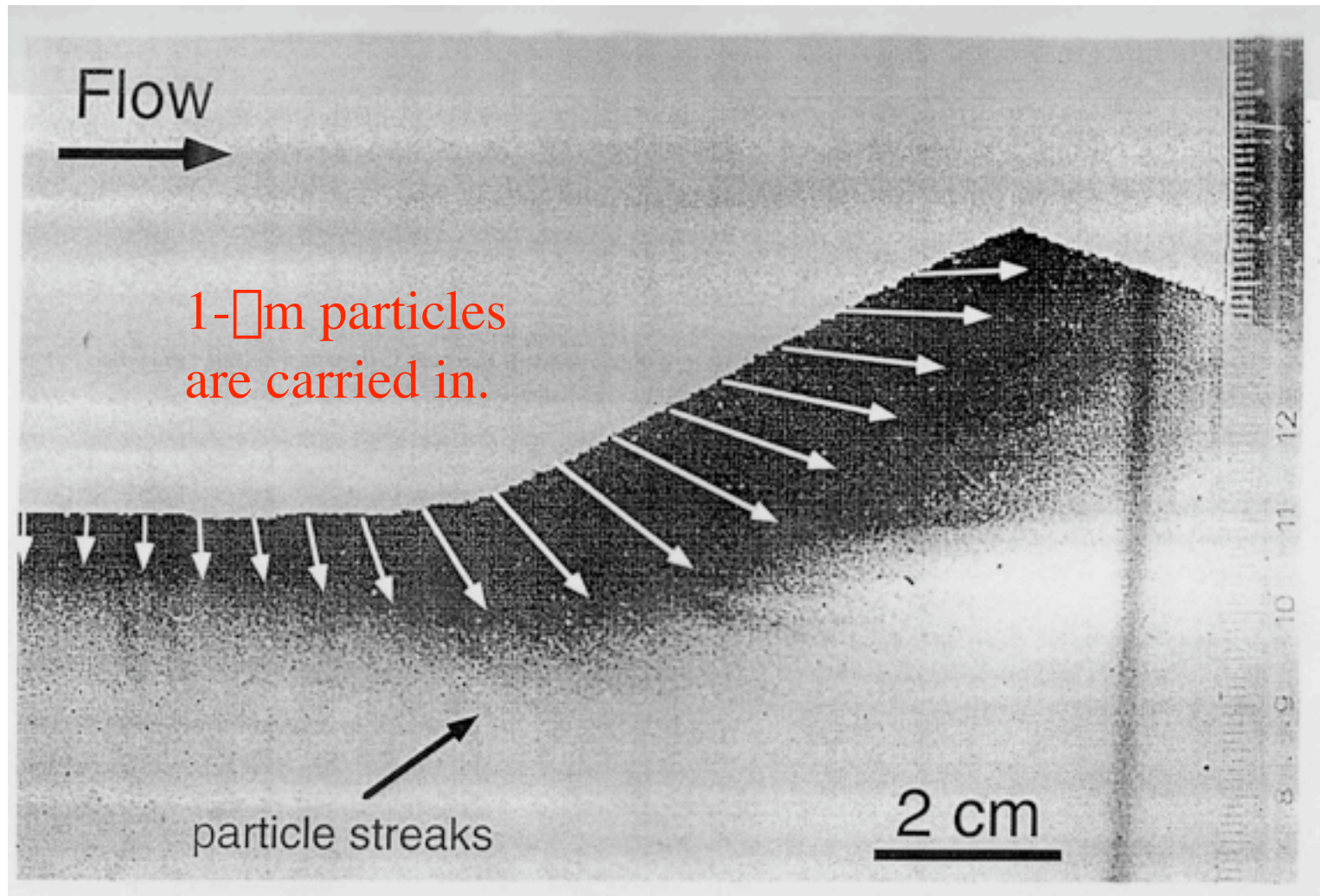
Burrowing shrimp



Pressure distribution

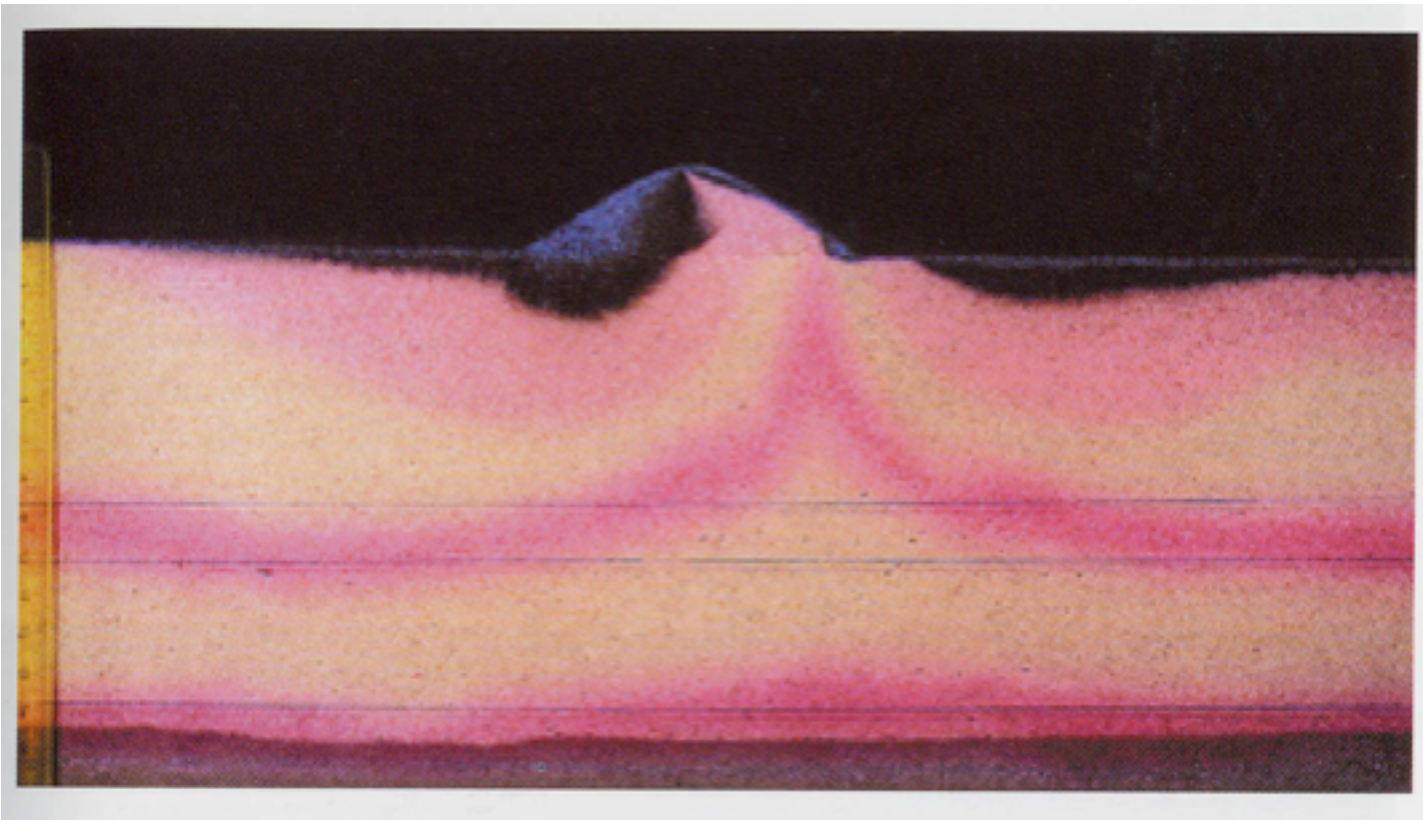


Carbon-black visualization



Solutes move, too

(M. Hüttel 1996)



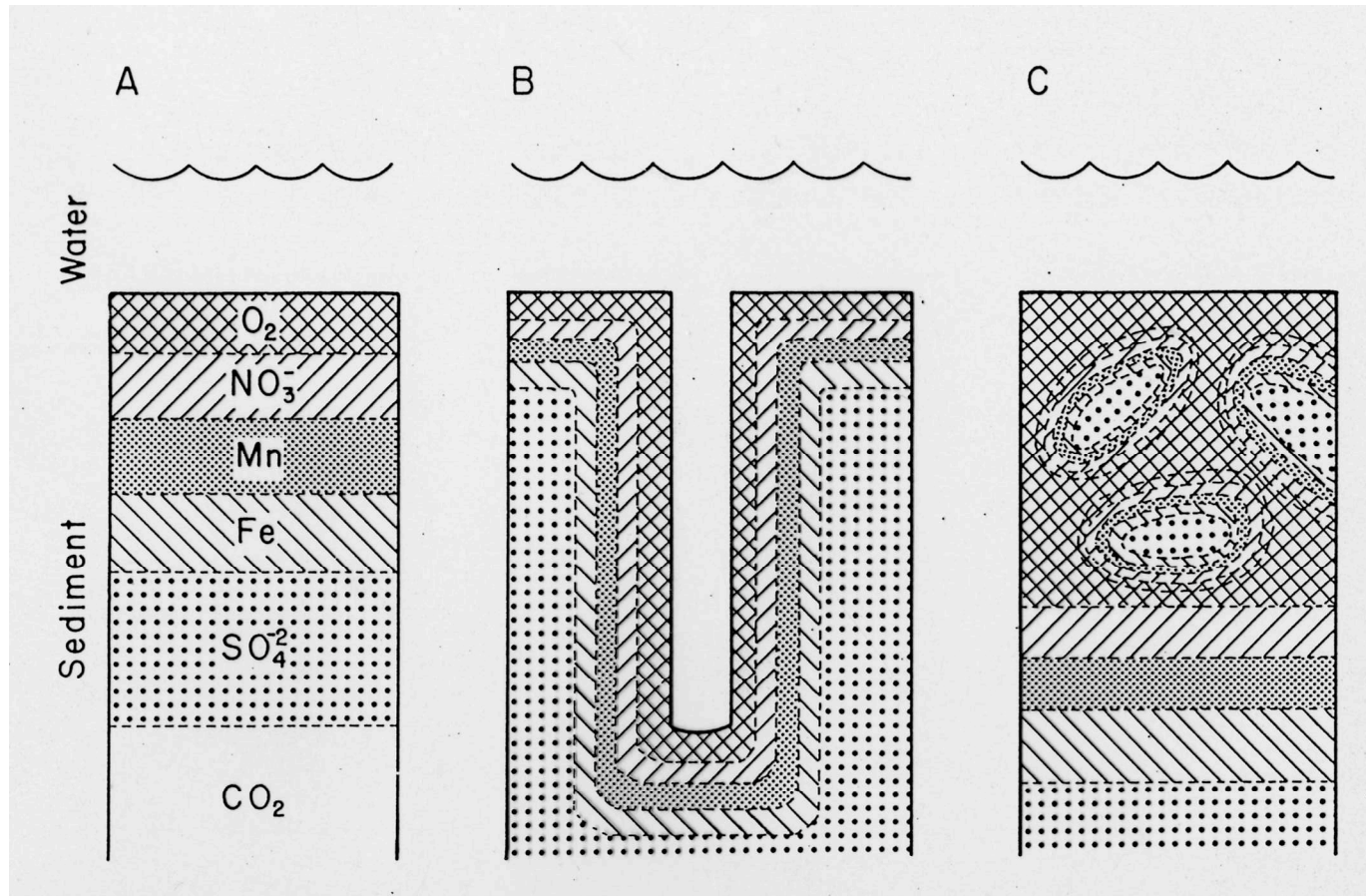
1- μm black
particles +
10- μm blue

Original dye layer

Original dye layer

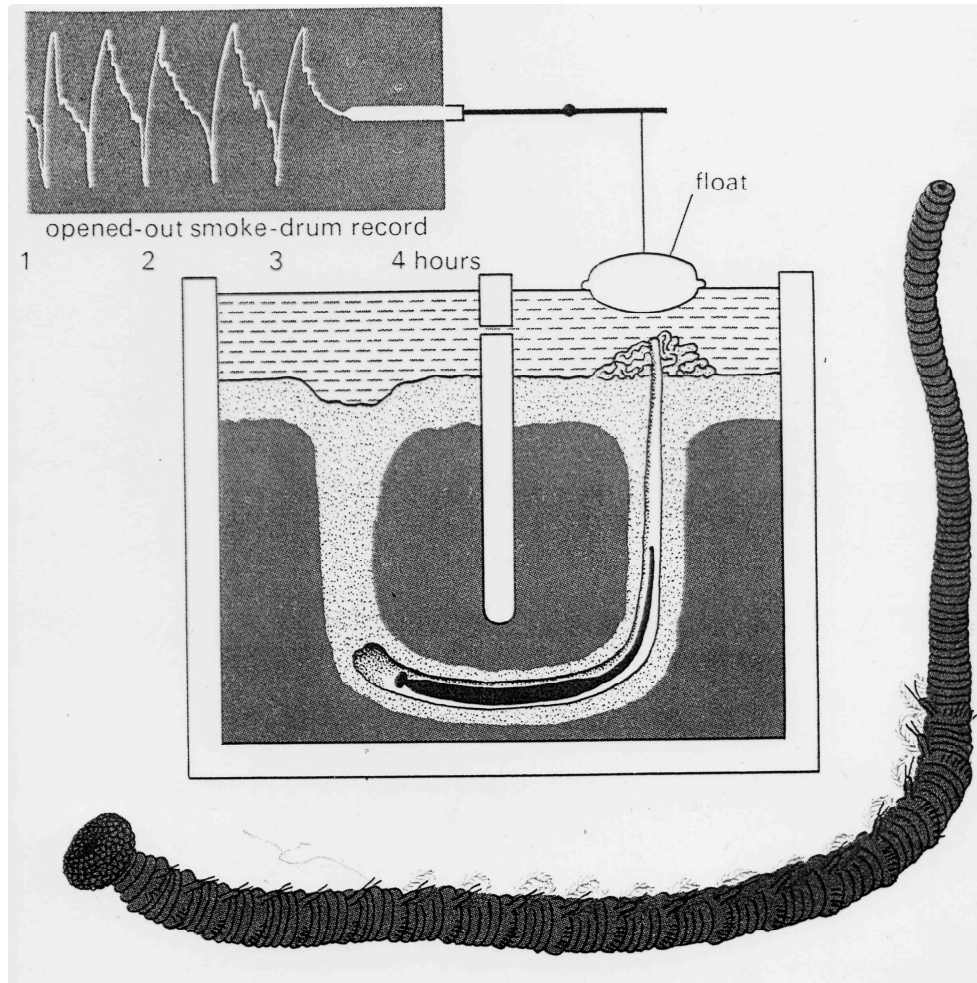
250 μm sand; Free-stream $u = 10 \text{ cm s}^{-1}$; run for 16.5 h

Redox sequence in sediments



Aller (1982)

Animals also pump



Wells (1950)