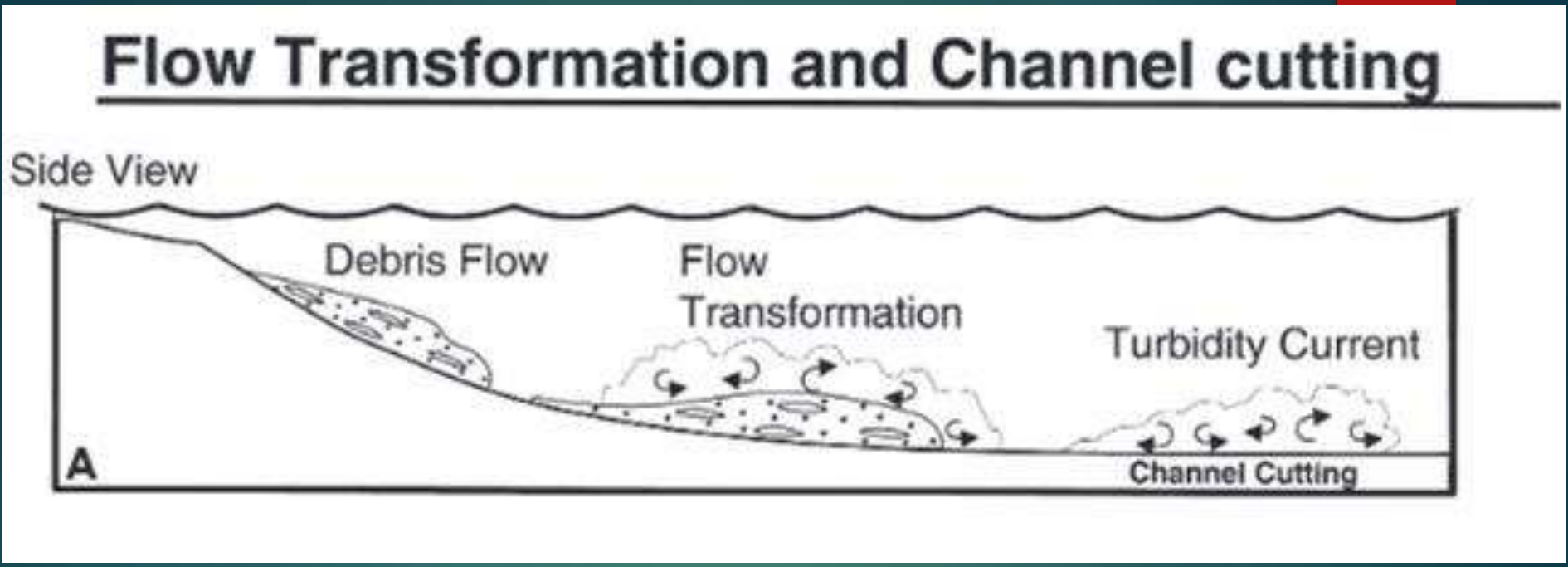
GGY 4031
LECTURE NOTES 4b

SEDIMENTOLOGY



SEDIMENTOLOGY

TURBIDITY CURRENTS

- **Turbidity currents** are gravity-driven turbid mixtures of sediment temporarily suspended in water. They are less dense mixtures than debris flows
- OR A **turbidity current** is a turbulent mixture of sediment and water that deposits a graded bed – a turbidite.
- OR Turbidity currents are gravity driven currents consisting of sediment-water mixture flowing over a sloping bottom.
- . The deposit of a turbidity current is a **turbidite.**

Turbidity currents, and hence **turbidites**, can occur in water anywhere that there is a supply of sediment and a slope.

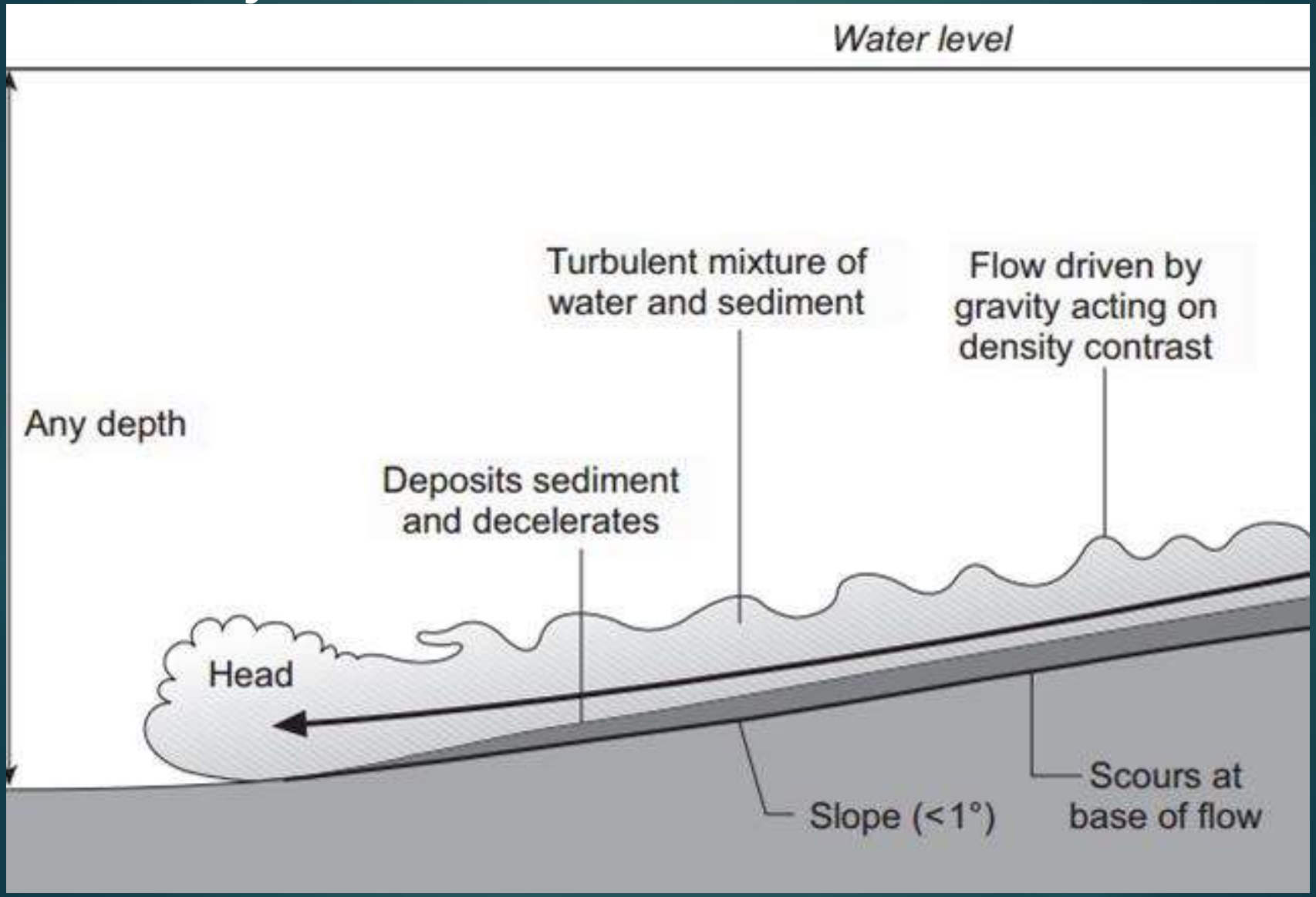
- Two types of **turbidity currents** can be distinguished:
  - Low velocity, low density
  - High velocity, high density

SEDIMENTOLOGY

Sediment that is initially in suspension in the turbidity current starts to come into contact with the underlying surface where it may come to a halt or move by rolling and suspension. In doing so it comes out of suspension and the density of the flow is reduced. Flow in a turbidity current is maintained by the density contrast between the sediment–water mix and the water, and if this contrast is reduced, the flow slows down.

SEDIMENTOLOGY

Turbidity Currents



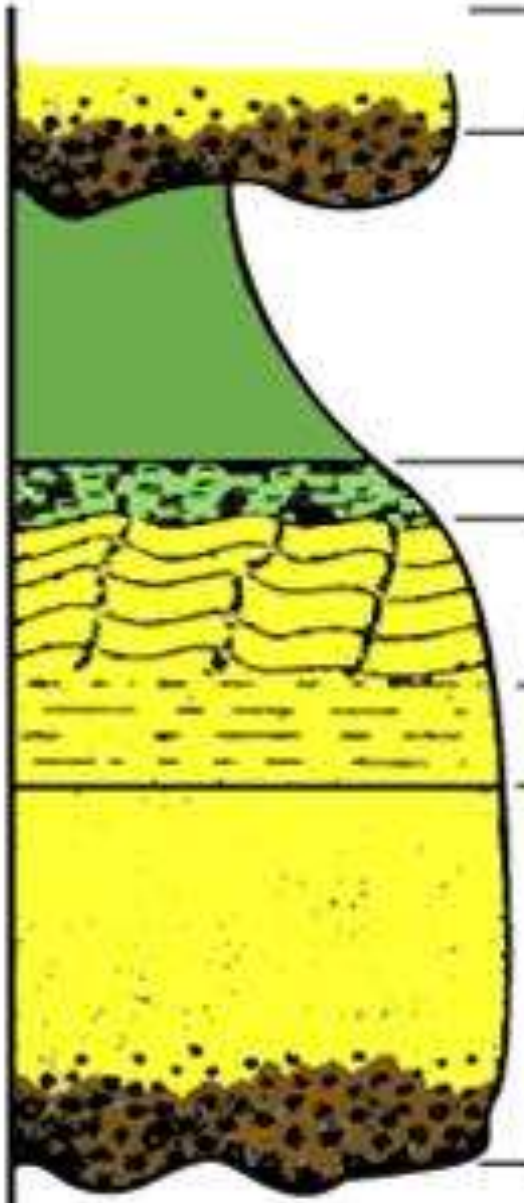
SEDIMENTOLOGY

Low- and medium-density turbidity currents

- The first material to be deposited from a turbidity current will be the coarsest as this will fall out of suspension first. Therefore a turbidite is characteristically normally graded.

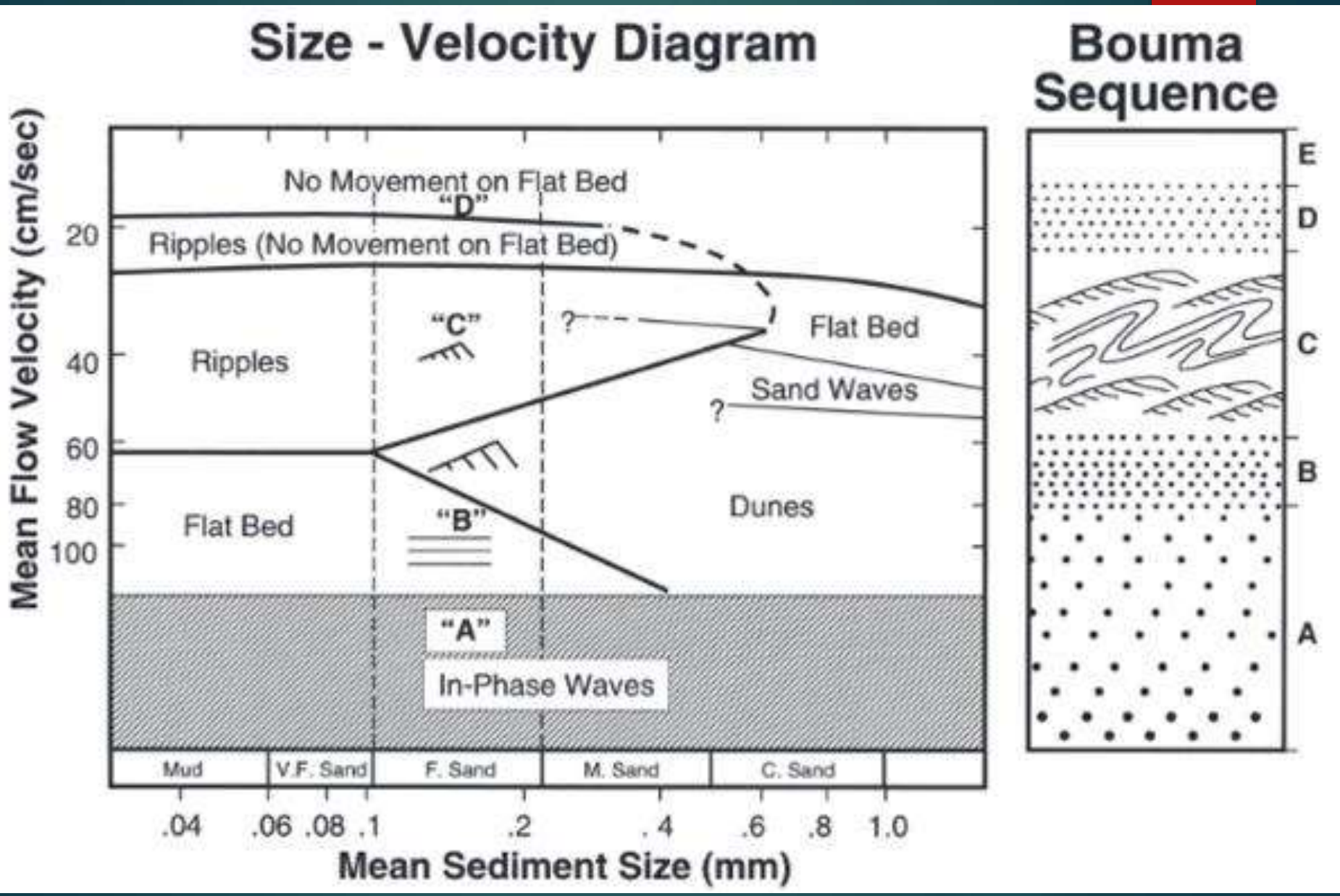
Other sedimentary structures within the graded bed reflect the changing processes that occur during the flow and these vary according to the density of the initial mixture. Low- to medium-density turbidity currents will ideally form a succession known as a **Bouma sequence**, named after the geologist who first described them (Bouma 1962).

SEDIMENTOLOGY



Grain Size		Bouma (1962) Divisions	Interpretation
Mud	T_{ep}	Pelite	Pelagic sedimentation
Mud	T_{ef}	Massive or graded Turbidite	fine grained, low density turbidity current deposition
		Upper parallel laminae	? ? ?
Sand Silt	T_c	Ripples, wavy or convoluted laminae	Lower part of Lower Flow Regime
	T_b	Plane parallel laminae	Upper Flow Regime Plane Bed
Sand (to granule at base)	T_a	Massive graded	(?) Upper Flow Regime Rapid deposition and Quick bed (?)

SEDIMENTOLOGY



SEDIMENTOLOGY

Five divisions are recognised within the Bouma sequence, referred to as ‘a’ to ‘e’ divisions and annotated **Ta,Tb, Tc, Td and Te.**

- **Ta**

➢This lowest part consists of poorly sorted, structureless sand: on the scoured base deposition occurs rapidly from suspension with reduced turbulence inhibiting the formation of bedforms.

- **Tb**

➢Laminated sand characterises this layer, the grain size is normally finer than in ‘a’ and the material is better sorted: the parallel laminae are generated by the separation of grains in upper flow regime transport.

SEDIMENTOLOGY

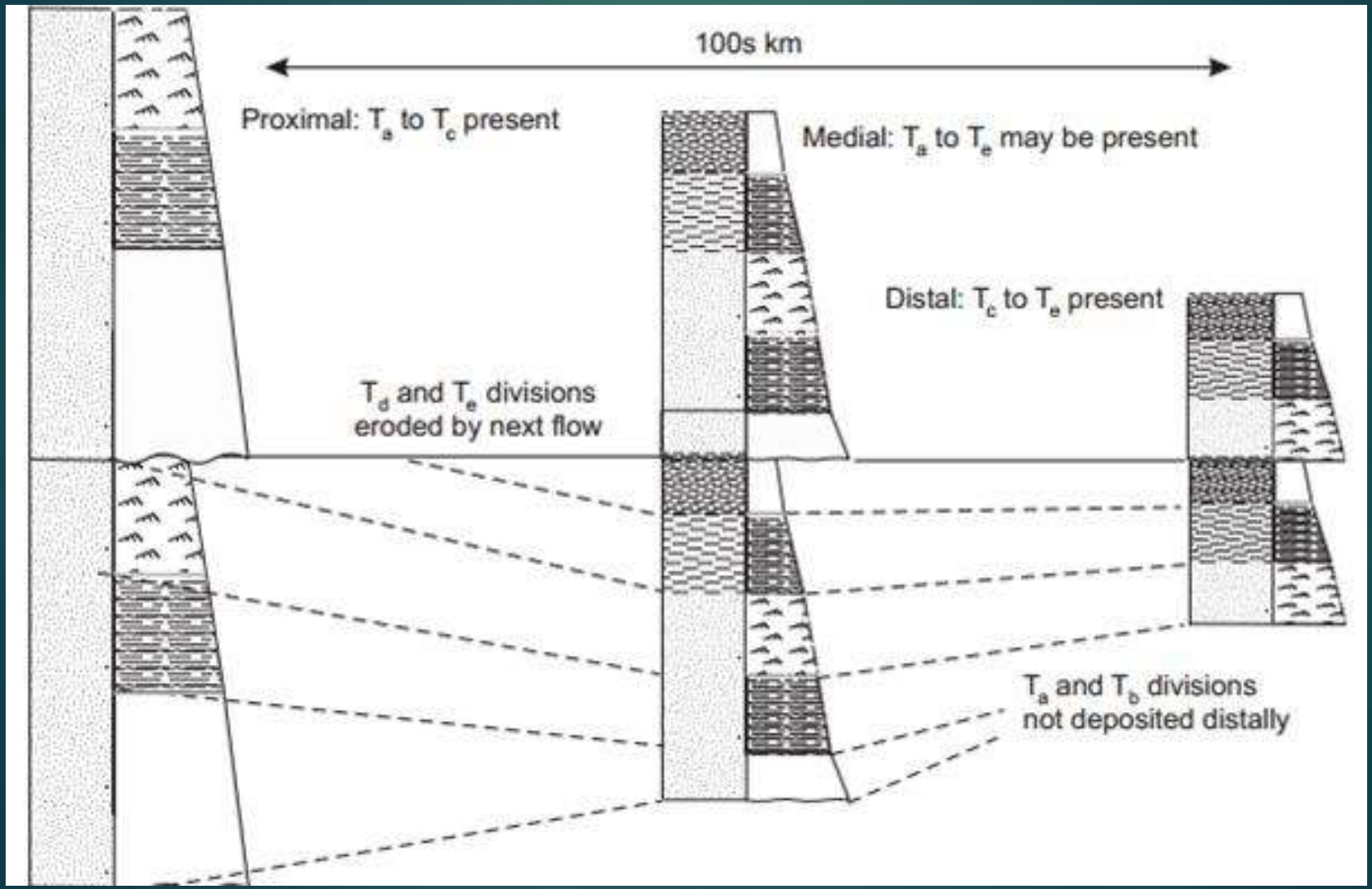
- **Tc**
  - Cross-laminated medium to fine sand, sometimes with climbing ripple lamination, form the middle division of the Bouma sequence: these characteristics indicate moderate flow velocities within the ripple bedform stability field and high sedimentation rates. Convolute lamination can also occur in this division.
- **Td**
  - Fine sand and silt in this layer are the products of waning flow in the turbidity current: horizontal laminae may occur but the lamination is commonly less well defined than in the ‘b’ layer.

SEDIMENTOLOGY

- **Te**
  - The top part of the turbidite consists of finegrained sediment of silt and clay grade: it is deposited from suspension after the turbidity current has come to rest and is therefore a hemipelagic deposit

SEDIMENTOLOGY

Proximal to distal changes in the deposits formed by turbidity currents.



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NOTE: The lower parts of the Bouma sequence are only present in the more proximal parts of the flow. With distance the lower divisions are progressively lost as the flow carries only finer sediment and only the ‘c’ to ‘e’ or perhaps just ‘d’ and ‘e’ parts of the Bouma sequence are deposited.

In the more proximal regions the flow turbulence may be strong enough to cause scouring and completely remove the upper parts of a previously deposited bed. The ‘d’ and ‘e’ divisions may therefore be absent due to this erosion and the eroded sediment may be incorporated into the overlying deposit as mud clasts.

SEDIMENTOLOGY

The complete **Ta to Te sequence** is therefore only likely to occur in certain parts of the deposit, and even there intermediate divisions may be absent due, for example, to rapid deposition preventing ripple formation in Tc. Complete Ta–e Bouma sequences are in fact rather ***rare.***

SEDIMENTOLOGY

High-density turbidity currents