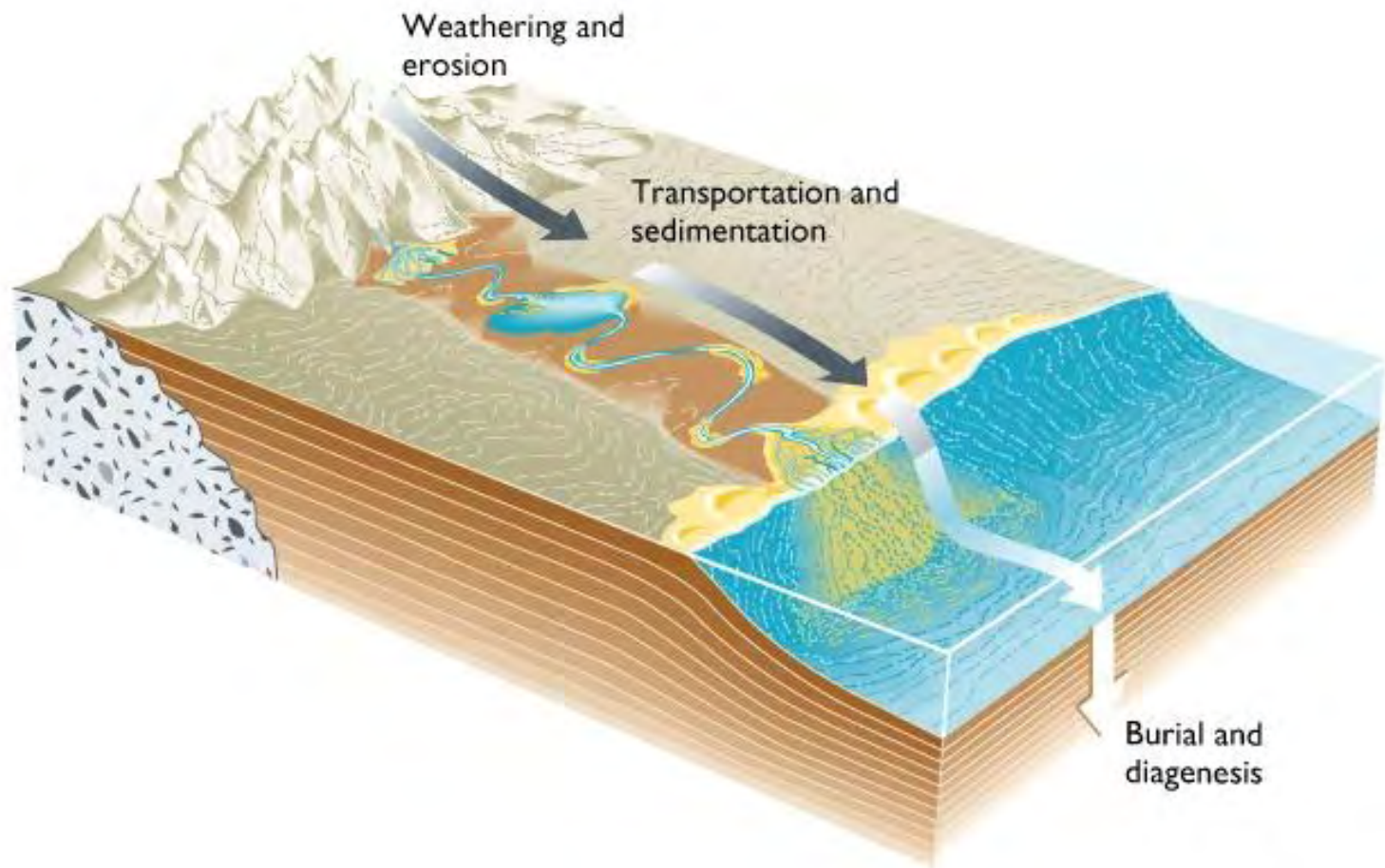
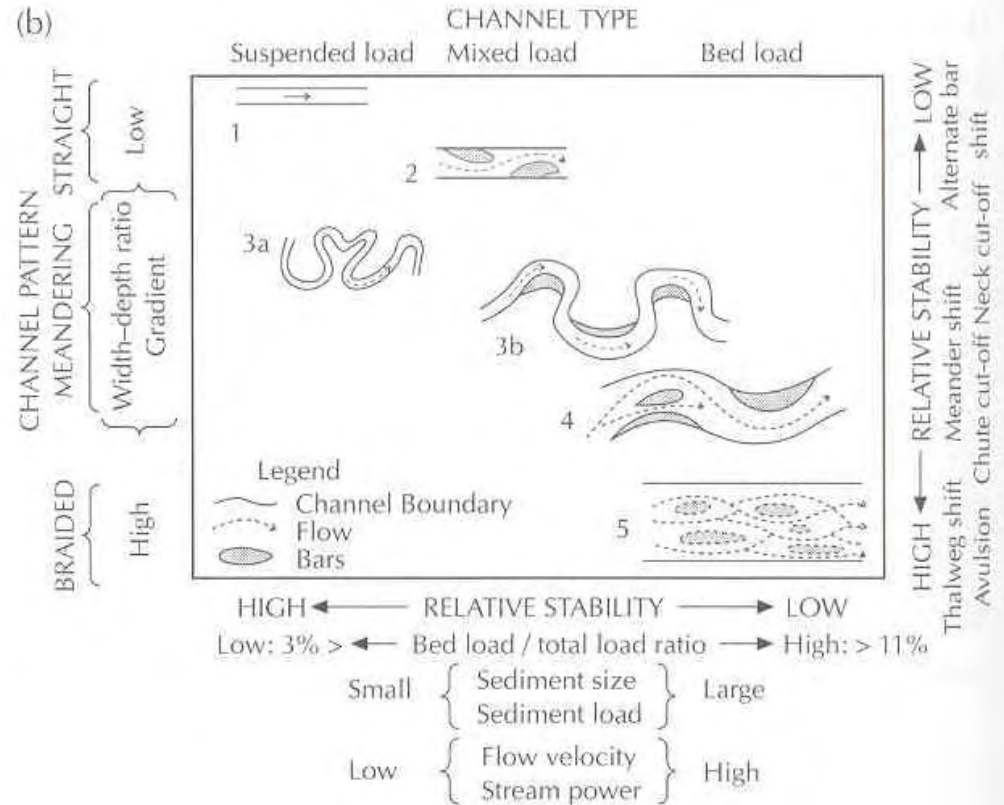
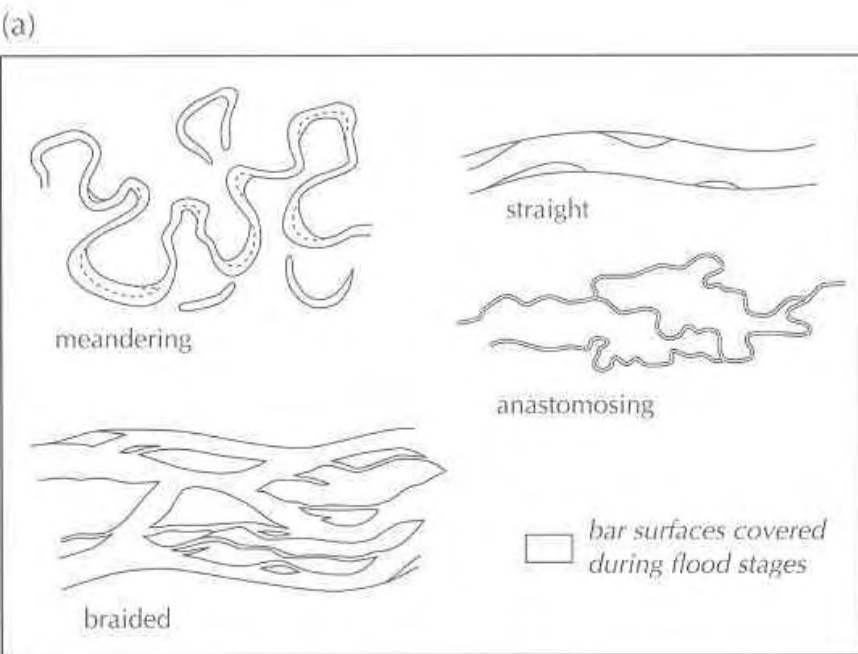


Ambiente alluvionale

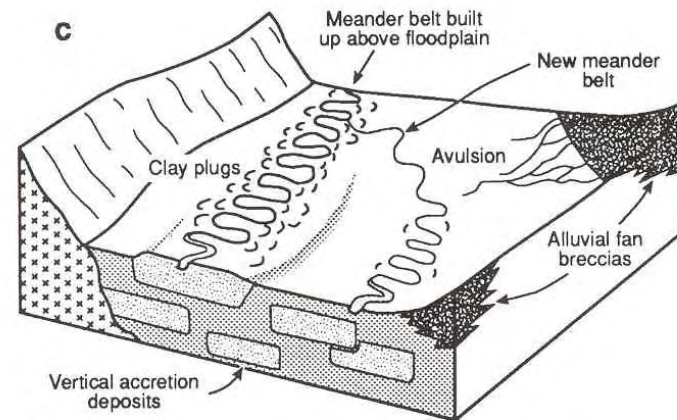
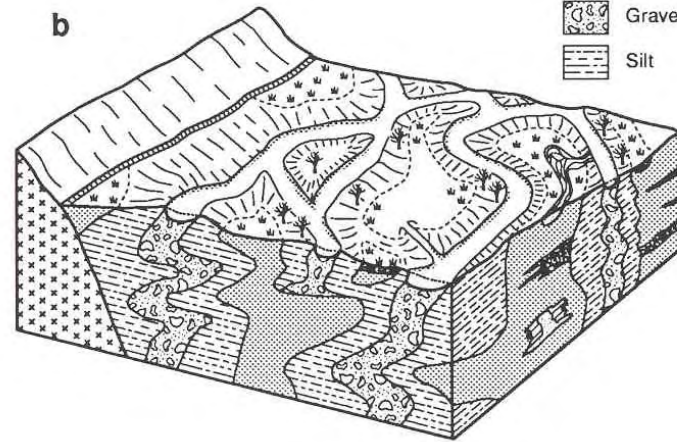
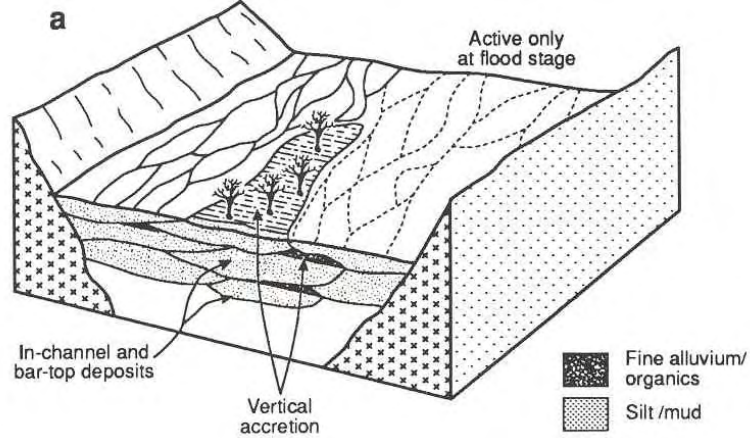
Stefano Lugli



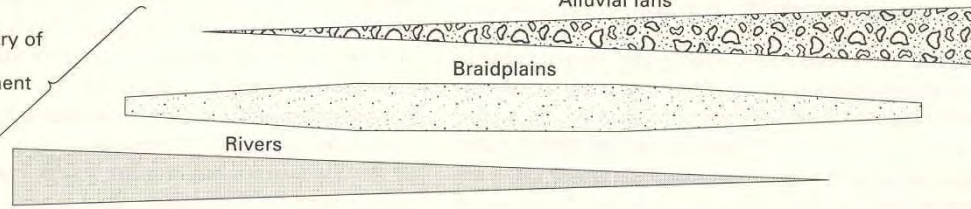
Classificazione canali



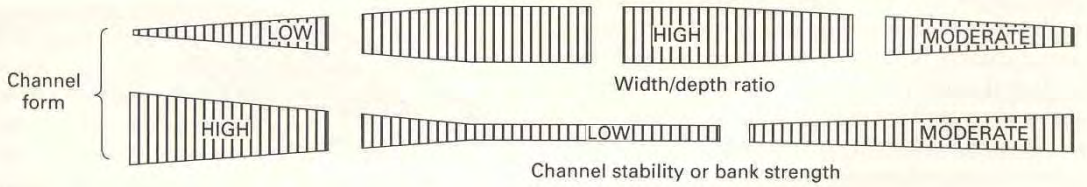
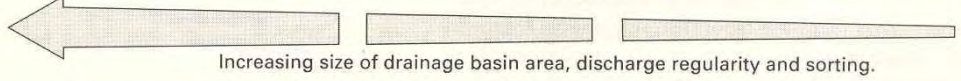
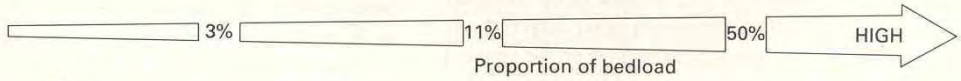
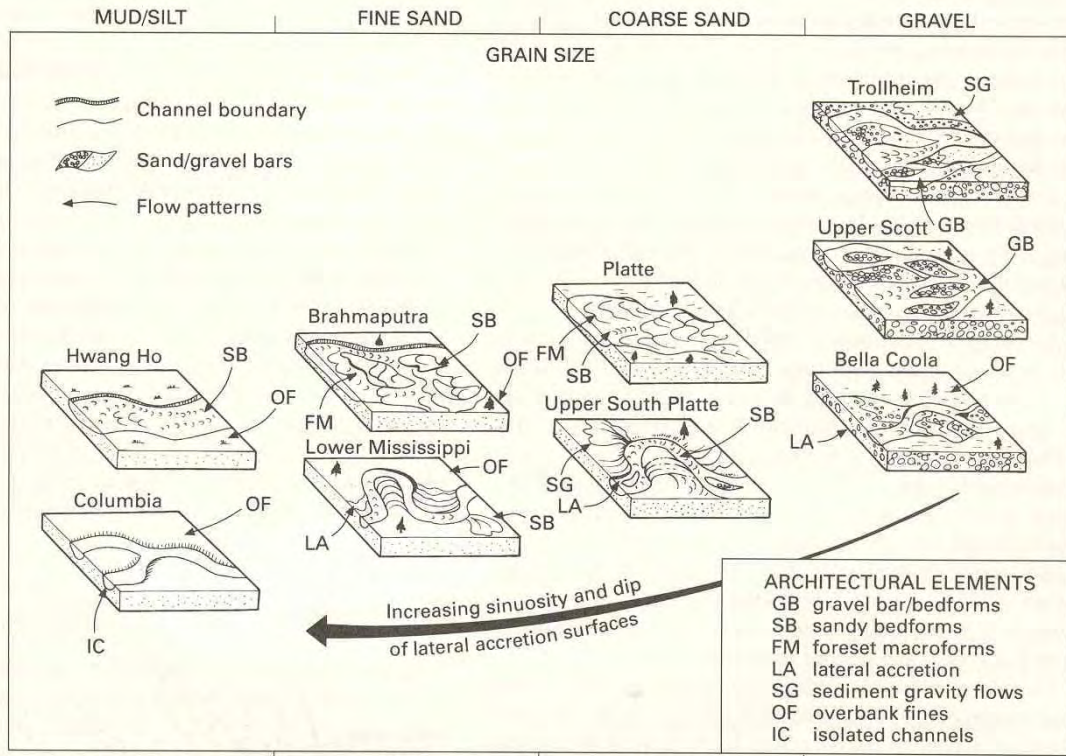
Classificazione canali



Geometry of alluvial component



Increase in stream power
Increase in sediment load relative to discharge capacity

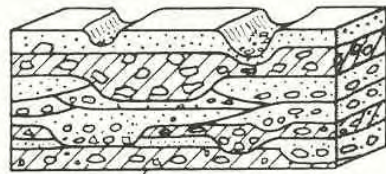






Po a Guastalla





ALLUVIAL FAN SYSTEM

longitudinal section

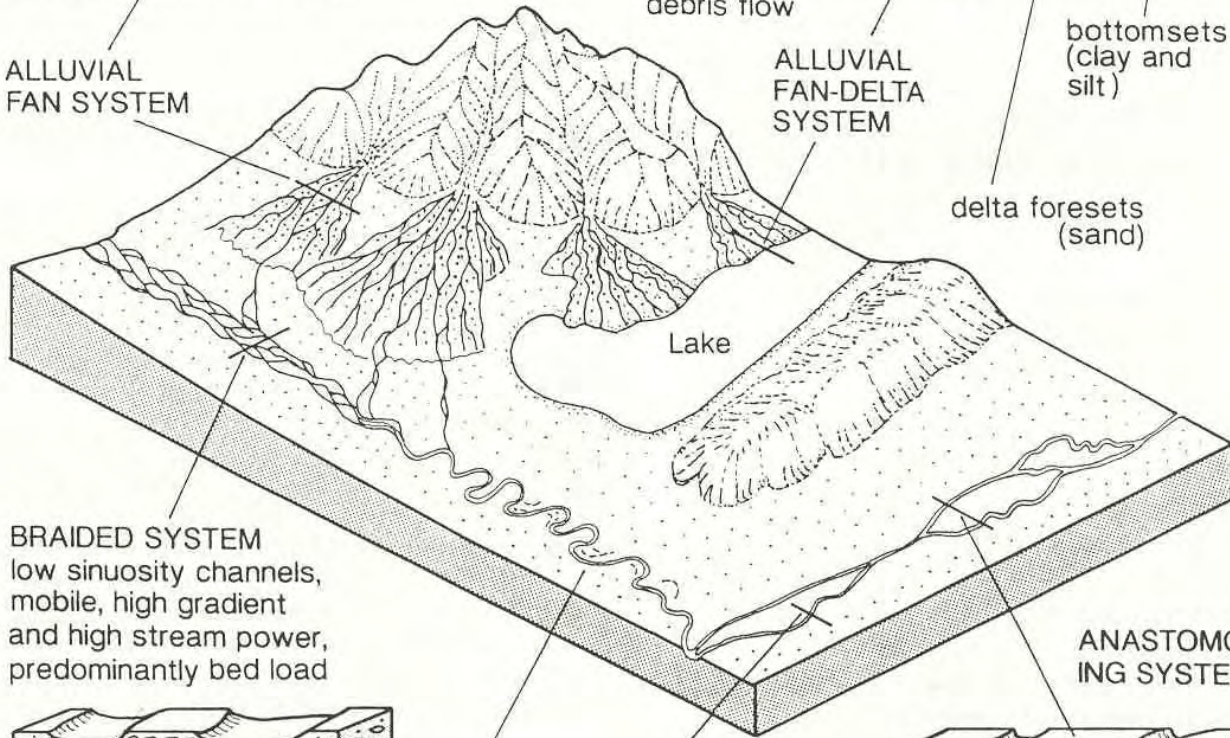


debris flow

ALLUVIAL FAN-DELTA SYSTEM

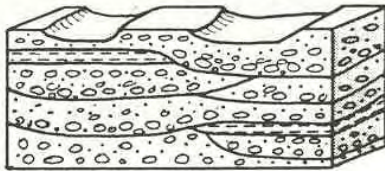
bottomsets (clay and silt)

delta foresets (sand)



BRAIDED SYSTEM
low sinuosity channels,
mobile, high gradient
and high stream power,
predominantly bed load

ANASTOMOS-
ING SYSTEM



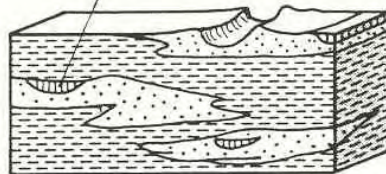
MUD-DOMINATED
LOW GRADIENT
SYSTEM
(±anastomosing)



channels partly straight,
partly sinuous, but
rather stable

MEANDERING SYSTEM
low gradient, low stream
power, mainly suspended
and mixed load (ratio
bed load/susp. load < 3)

OXBOW LAKE SEDIMENT



SAND MUD



Alluvial fans



Conoidi alluvionali (fig. 13)

Si sviluppano allo sbocco dei fiumi in pianura; comprendono una porzione apicale, una intermedia ed una basale.

Morfologia: canale principale incassato (apicale) da cui si diramano canali instabili verso la zona di raccordo con il livello di base (piana alluvionale o lacustre).

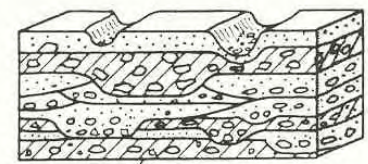
Processi: correnti torrentizie intermittenti, flussi concentrati ricchi di materiale grossolano, colate di fango e detriti (*debris flows*).

Corpo sedimentario: in pianta si sviluppa una forma a ventaglio, corrispondente ad un tronco di cono con sezione trasversale a forma di lente. Limiti inferiori erosionali, con passaggio netto a depositi alluvionali o lacustri (delta-conoide).

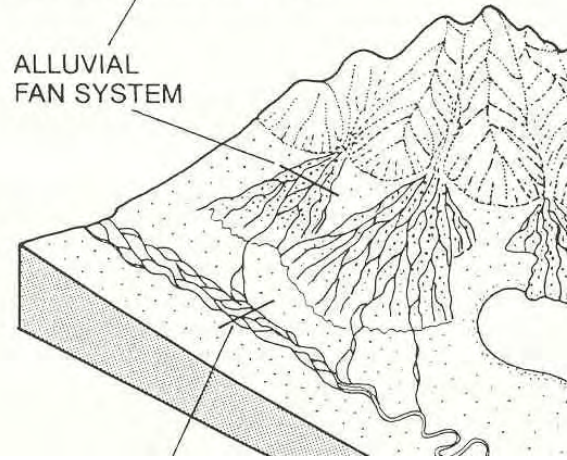
Organizzazione interna: insieme di corpi allungati a stratificazione spessa e mal definita. Non si sviluppano sequenze positive o negative.

Associazioni di facies: ghiaie disorganizzate, molto mal selezionate, raramente con gradazione inversa e ricche di blocchi e massi, alternate a depositi ghiaiosi fango-sostenuti nella regione apicale. Sequenze di argine dei canali costituite da ghiaie e argille ciottolose. Ghiaie a stratificazione massiva e sabbie a stratificazione incrociata tabulare e concava nella regione basale. Assenza di fossili.

Paleocorrenti: radiali, uni- o bimodali.



ALLUVIAL
FAN SYSTEM



Braided streams



b. *Piane alluvionali a canali intrecciati* (fig. 15)

Sono caratterizzate dallo sviluppo di canali a media o alta sinuosità. Si differenziano dalle piane a canali anastomosati per la frequente tracimazione di sedimenti fini ed il conseguente sviluppo di ampie piane di inondazione sabbioso-fangose; forme relativamente stabili nel tempo.

Morfologia: reticolo di canali sinuosi o rettilinei tra loro intersecati e connessi, relativamente stretti e profondi, con argini e piane di inondazione fittamente vegetate.

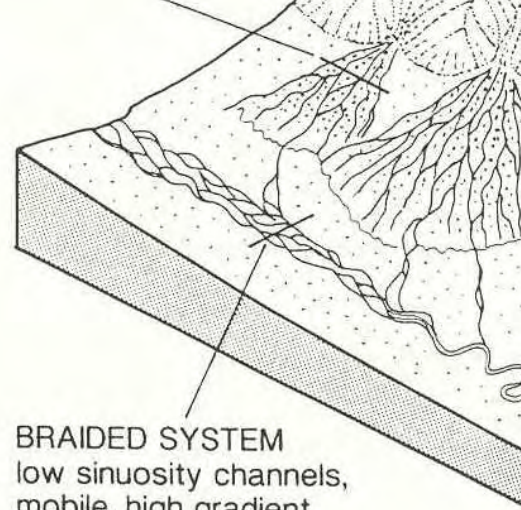
Processi: trazione di sabbie al fondo, decantazione di sedimenti fini in specchi d'acqua effimeri.

Corpo sedimentario: nastri sabbiosi di sedimenti limo-argillosi e sabbie fini.

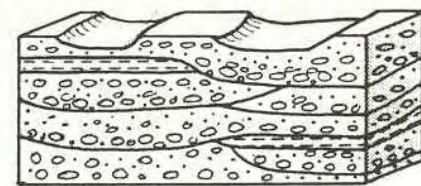
Organizzazione interna: lenti sabbiose piano-concave, interdigitate e ritagliate entro sedimenti fini.

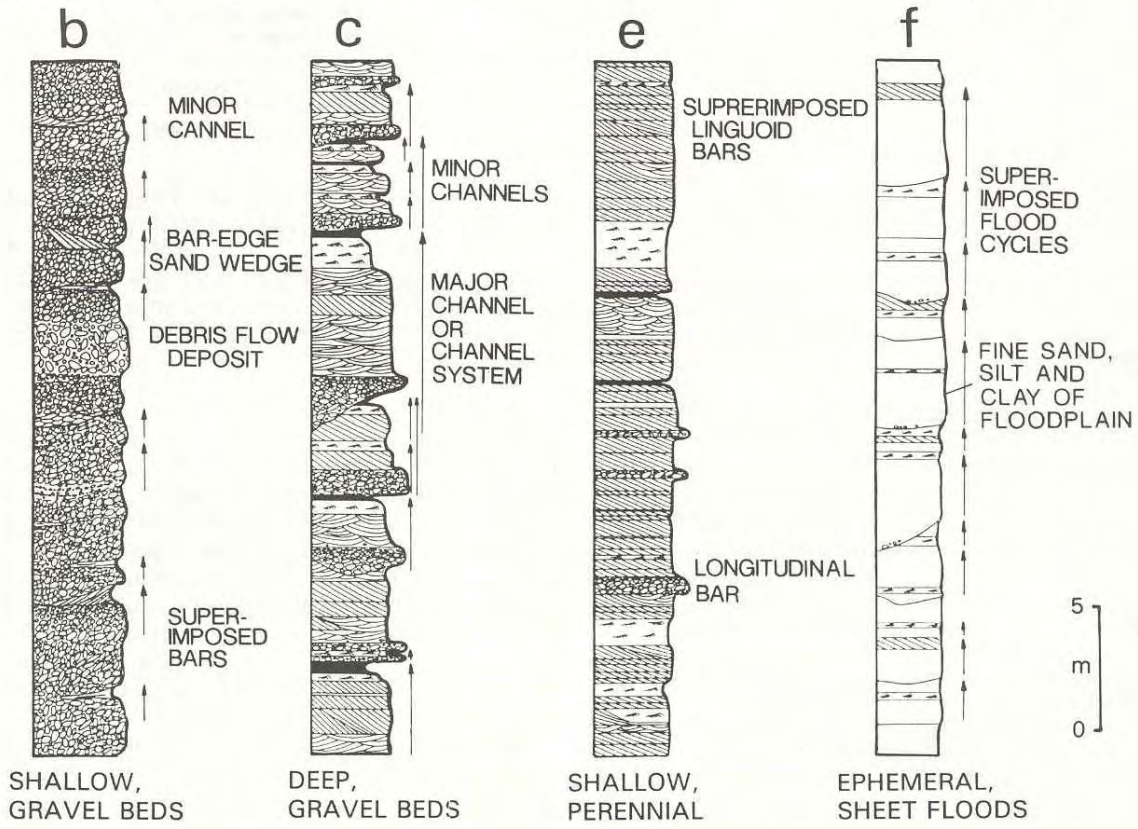
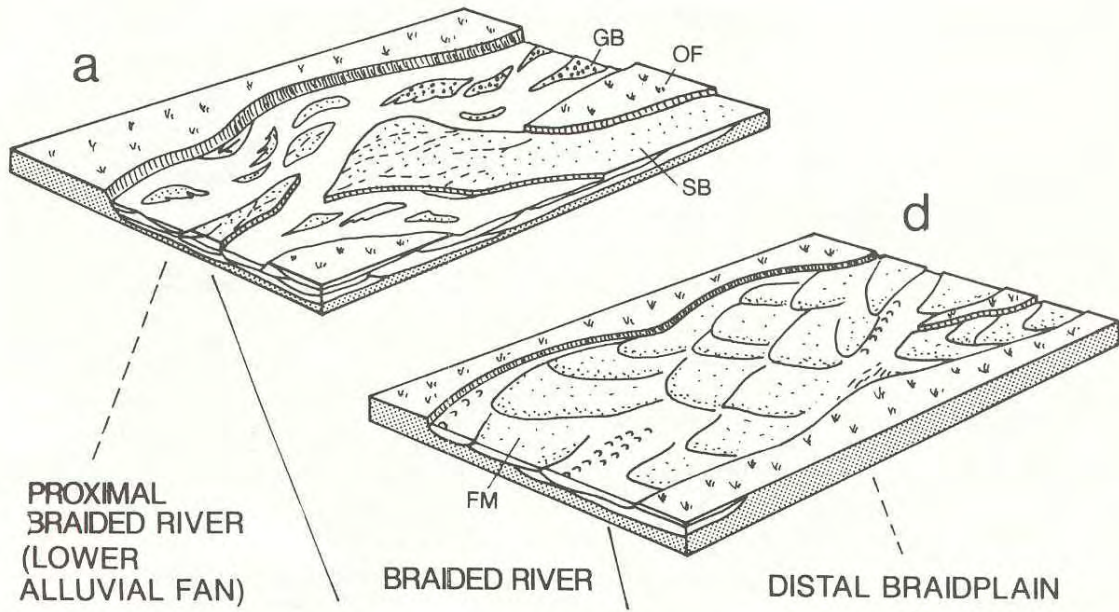
Associazione di facies: sabbie e ghiaie massive o stratificate nei canali. Stratificazioni incrociate concave. Limi e argille nelle sequenze di argine. Sabbie fini, limo e argille con livelli a ligniti e/o carboni nelle piane di intercanale fangose. Bioturbazione frequente. Rari fossili continentali.

Paleocorrenti: uni- o bimodali, dispersione entro i 60°.

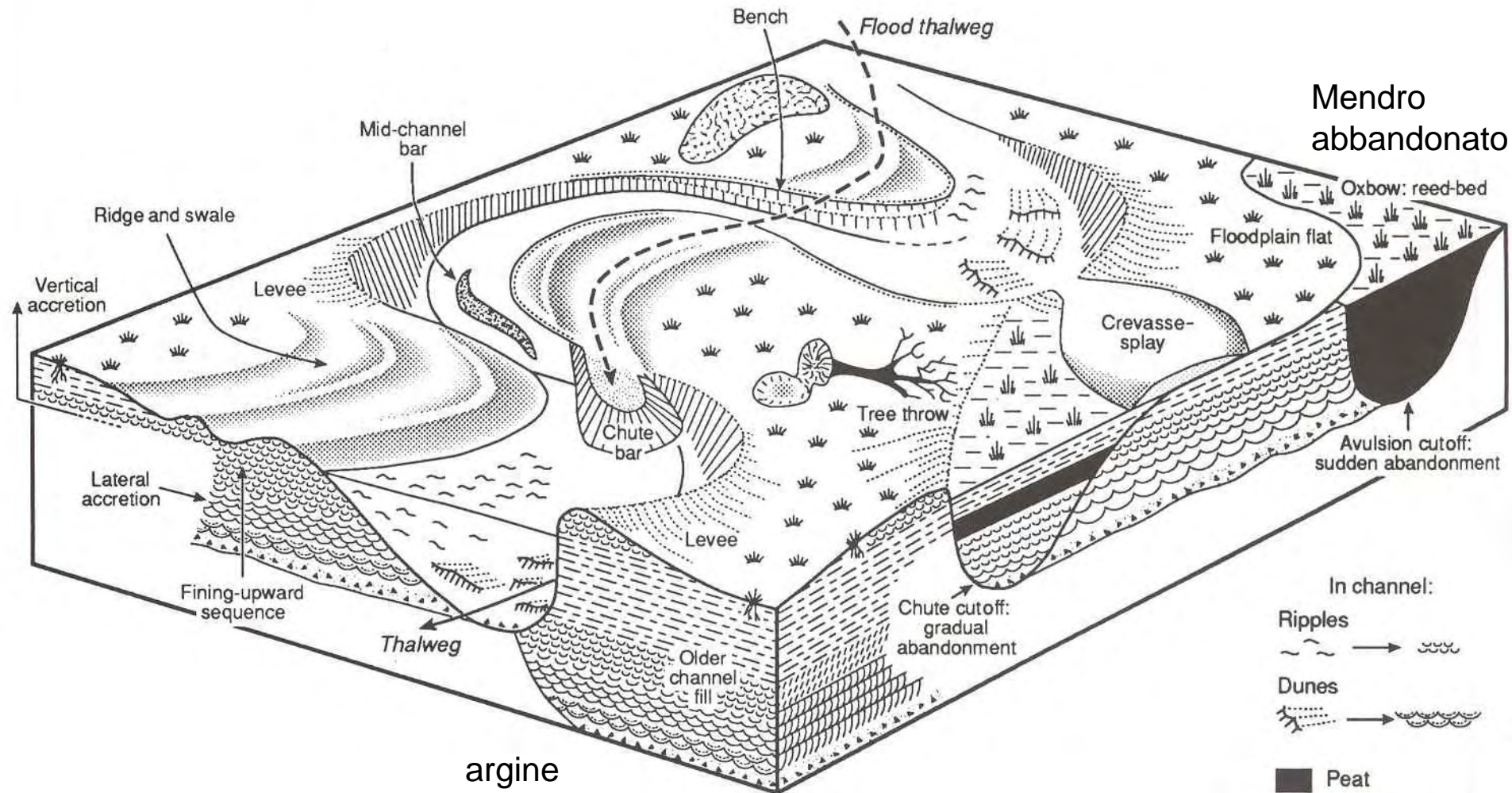


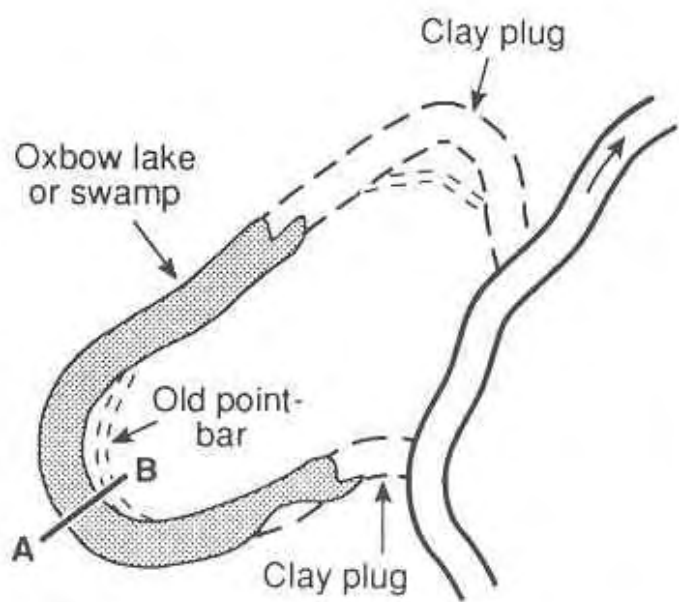
BRAIDED SYSTEM
low sinuosity channels,
mobile, high gradient
and high stream power,
predominantly bed load







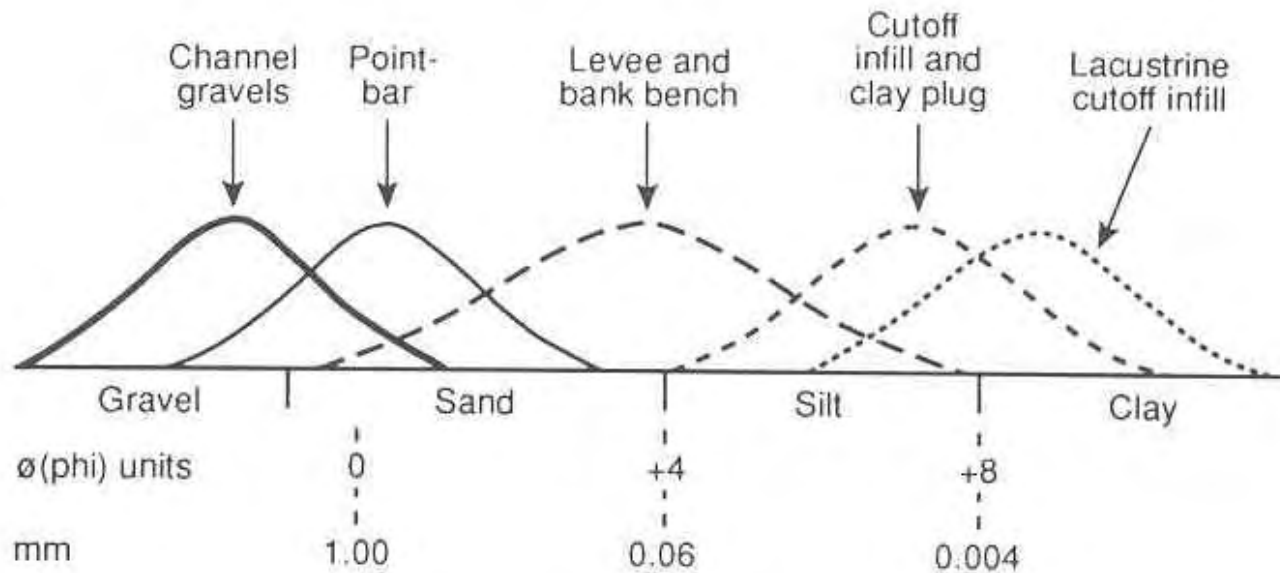
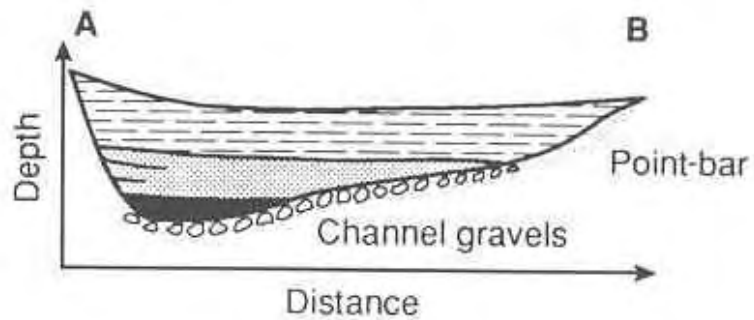


Forme

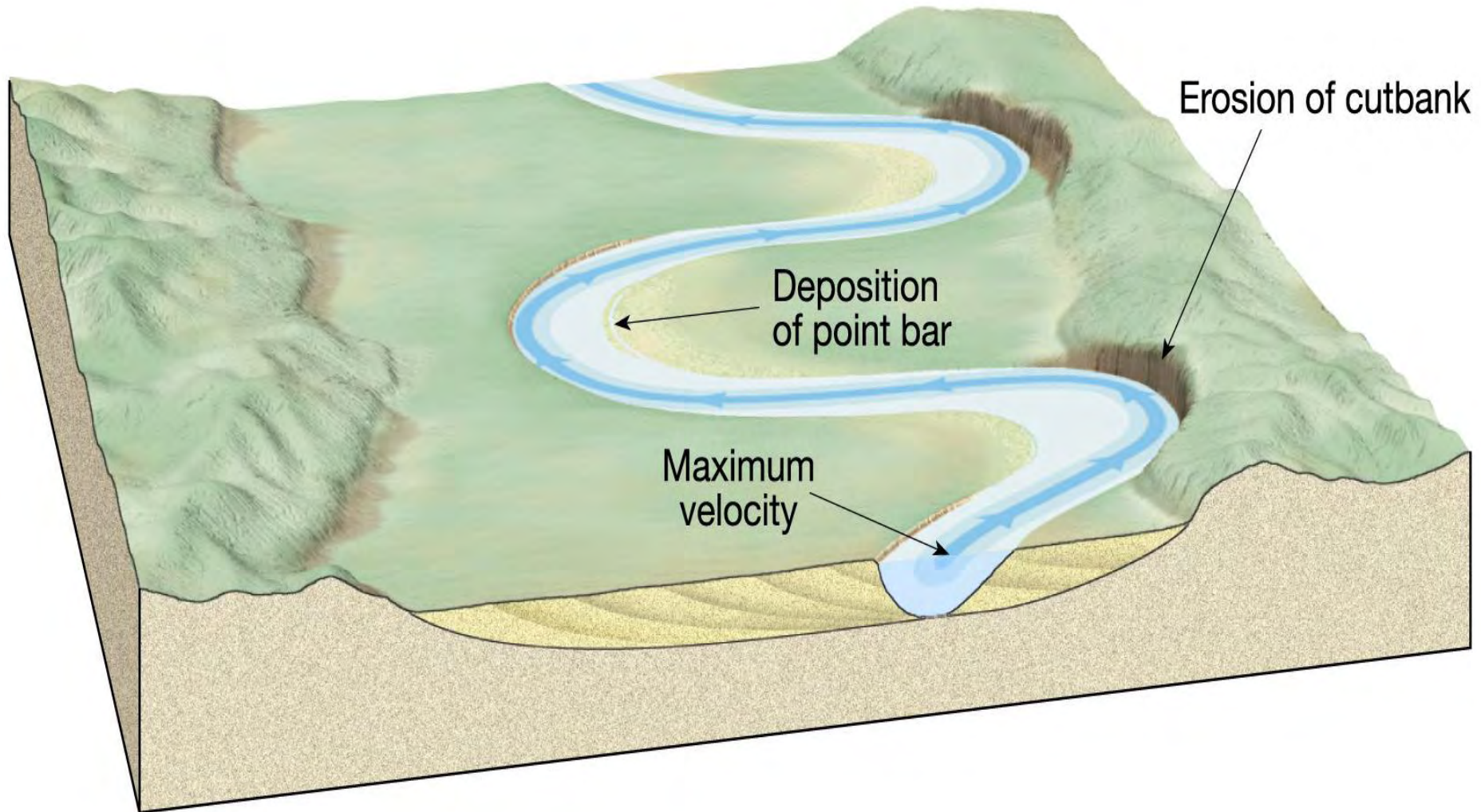


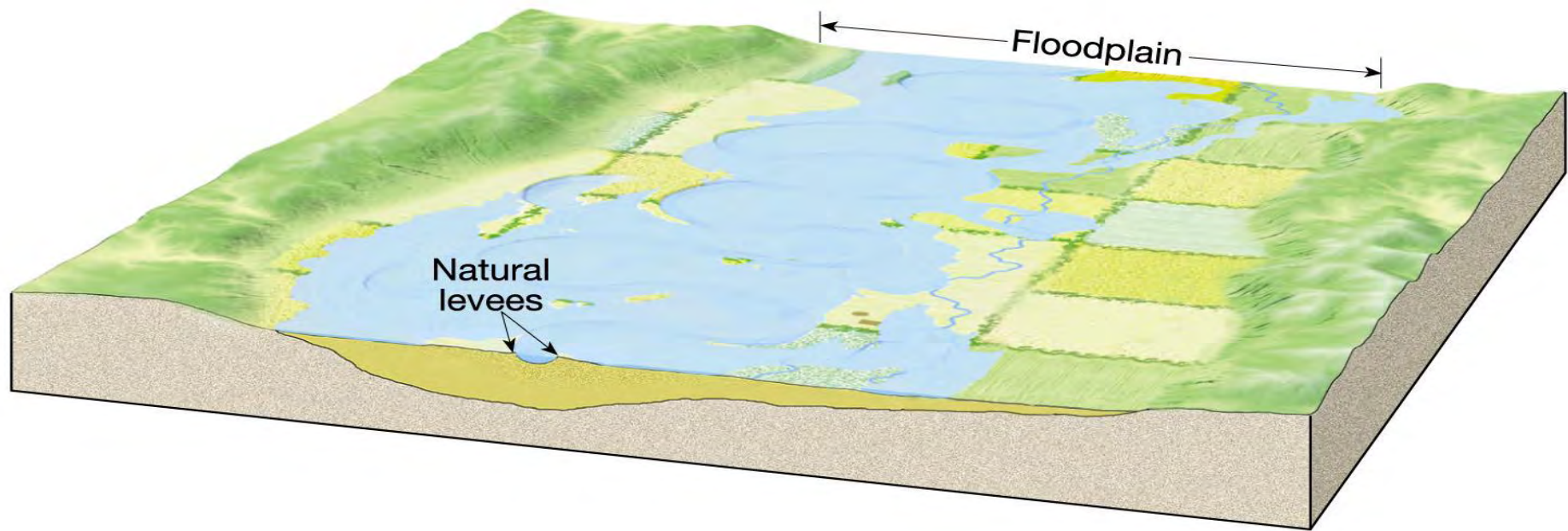
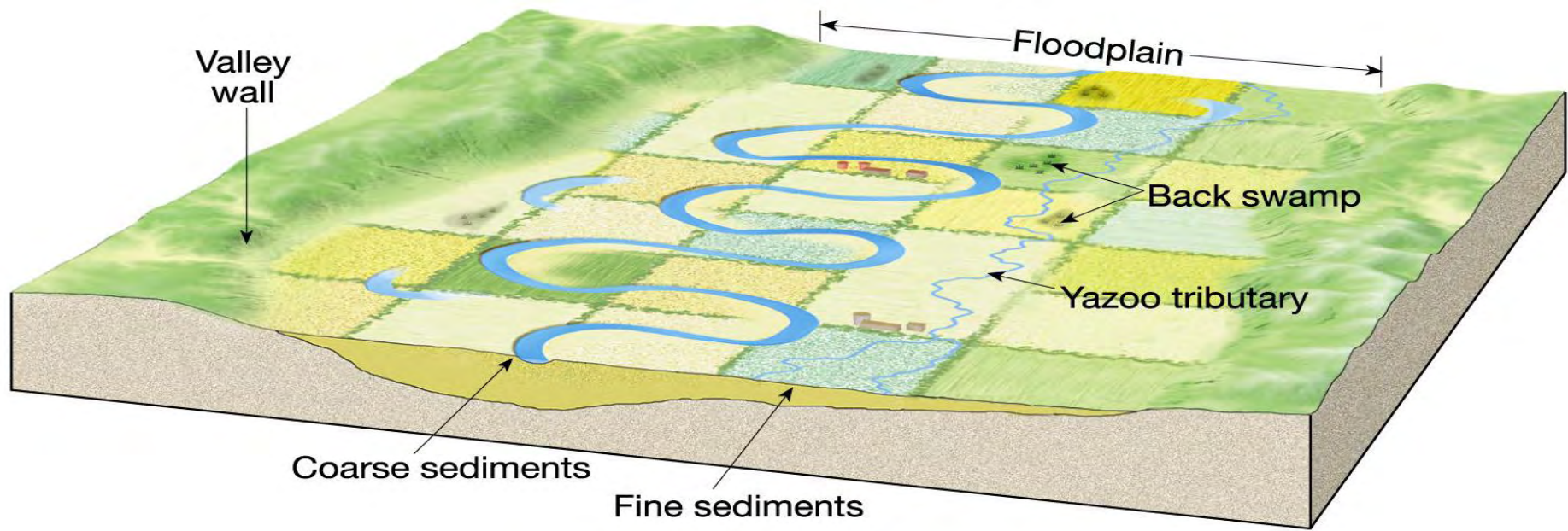


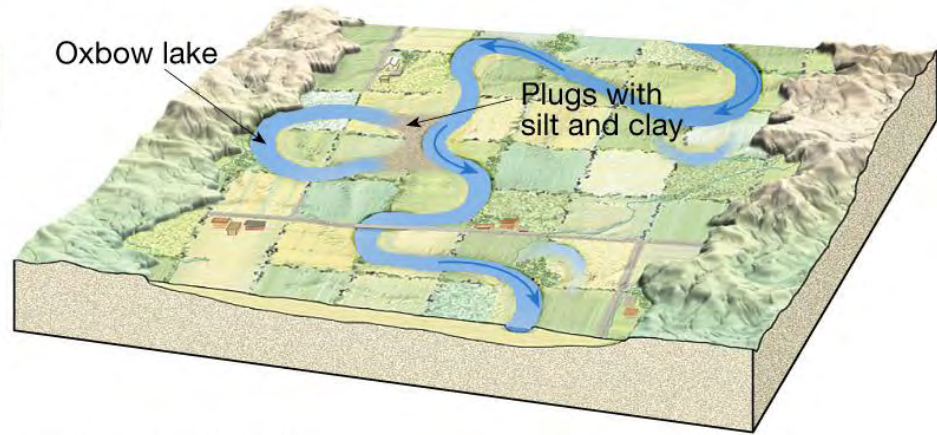
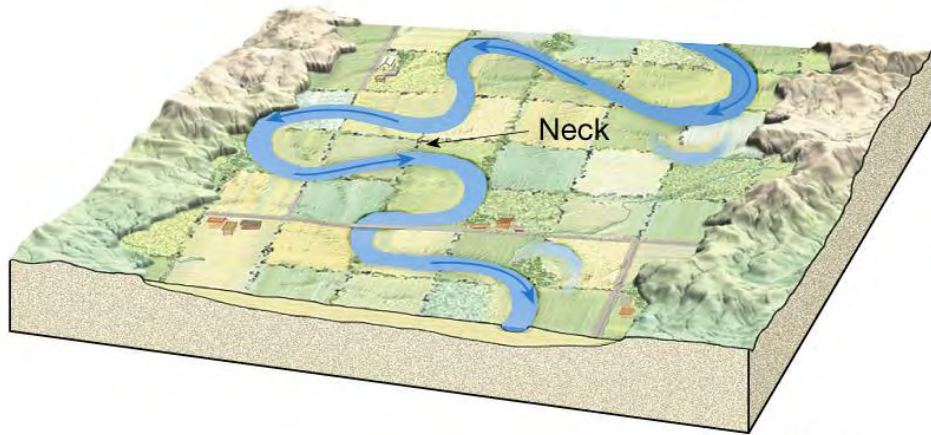
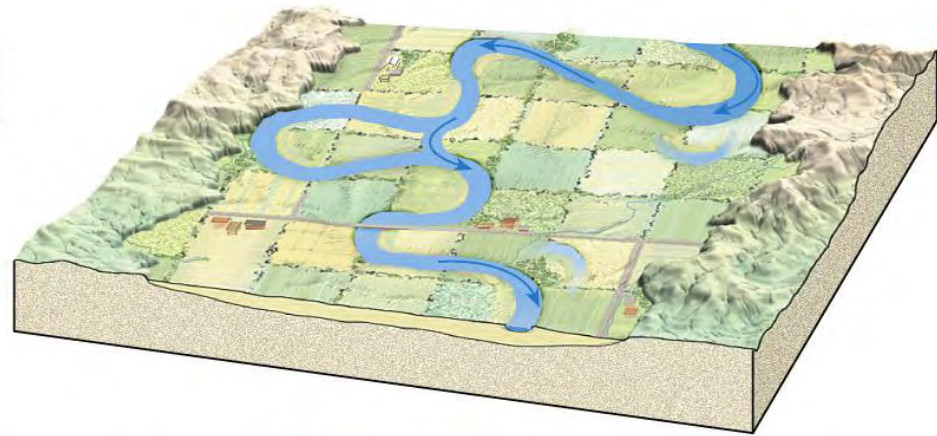
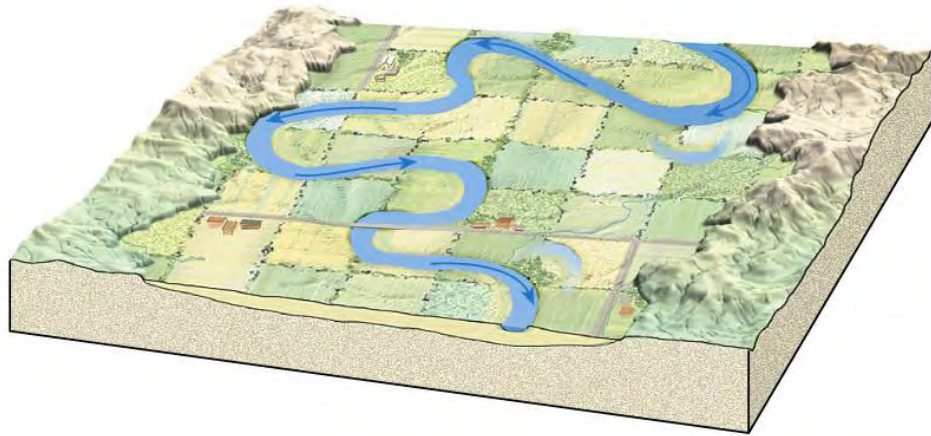
-  Silt/clay infill
-  Sandy/silt inwashes
-  Peat or silty peat infill
-  Lacustrine clay



Erosion and deposition along a meandering stream





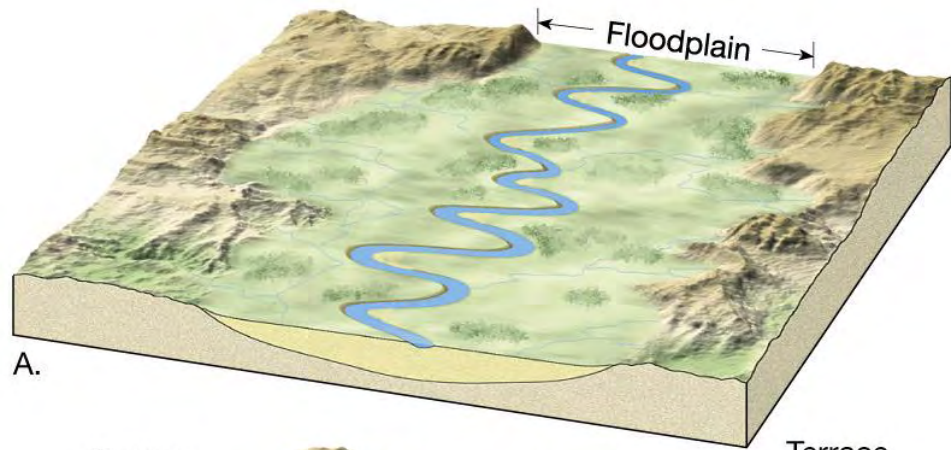


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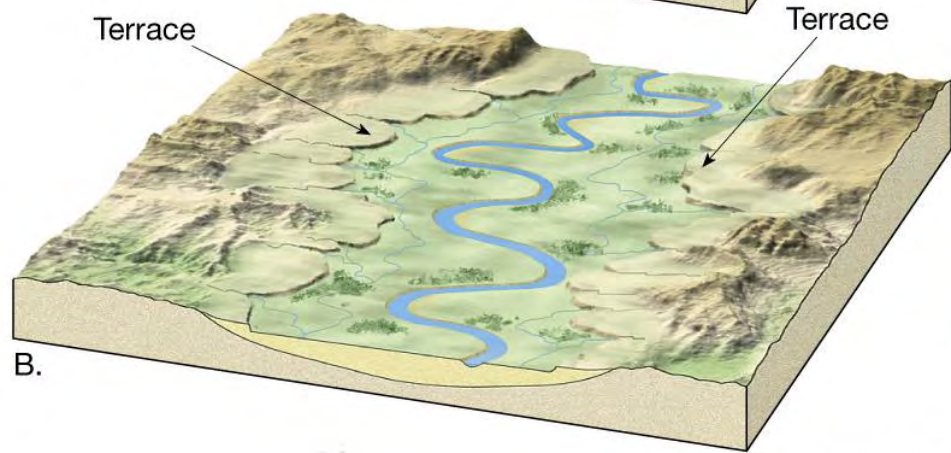
meandering stream



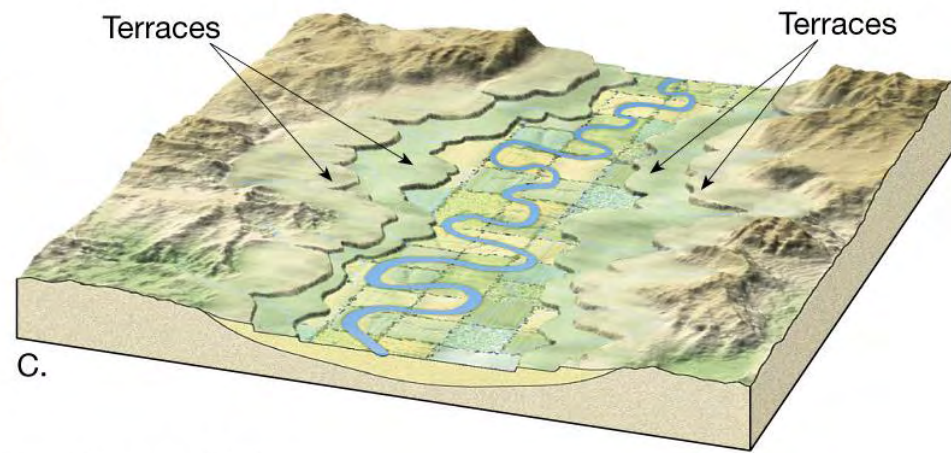
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A.



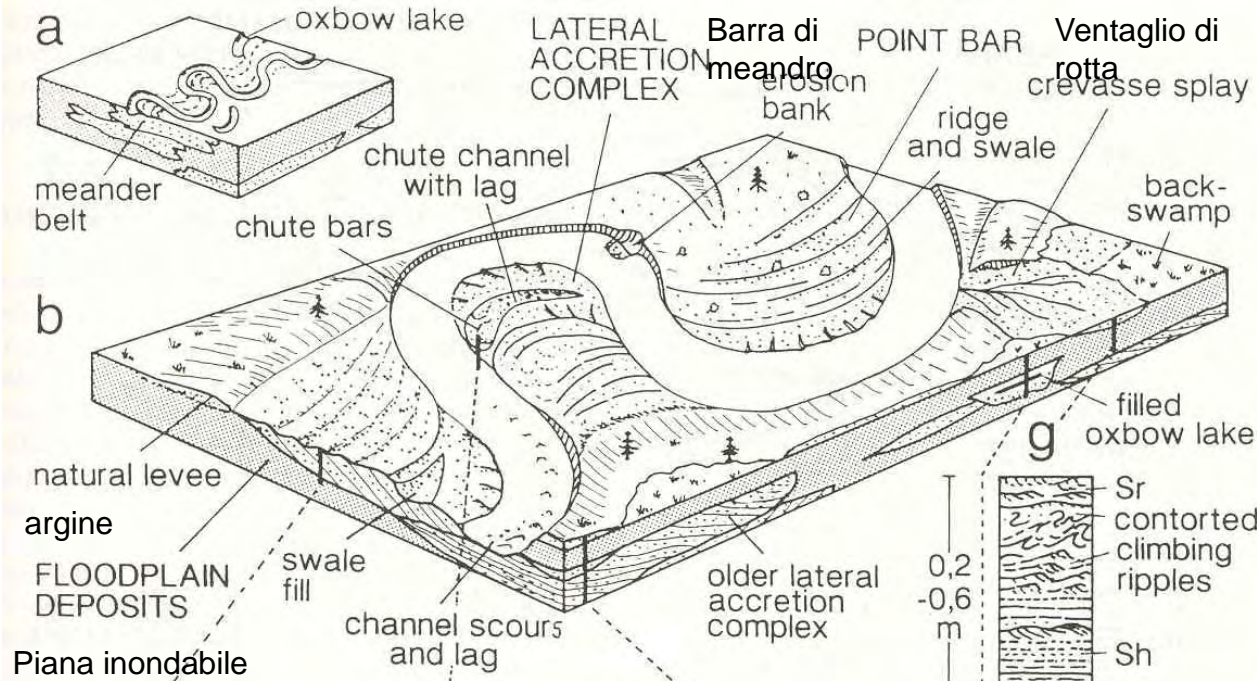
B.



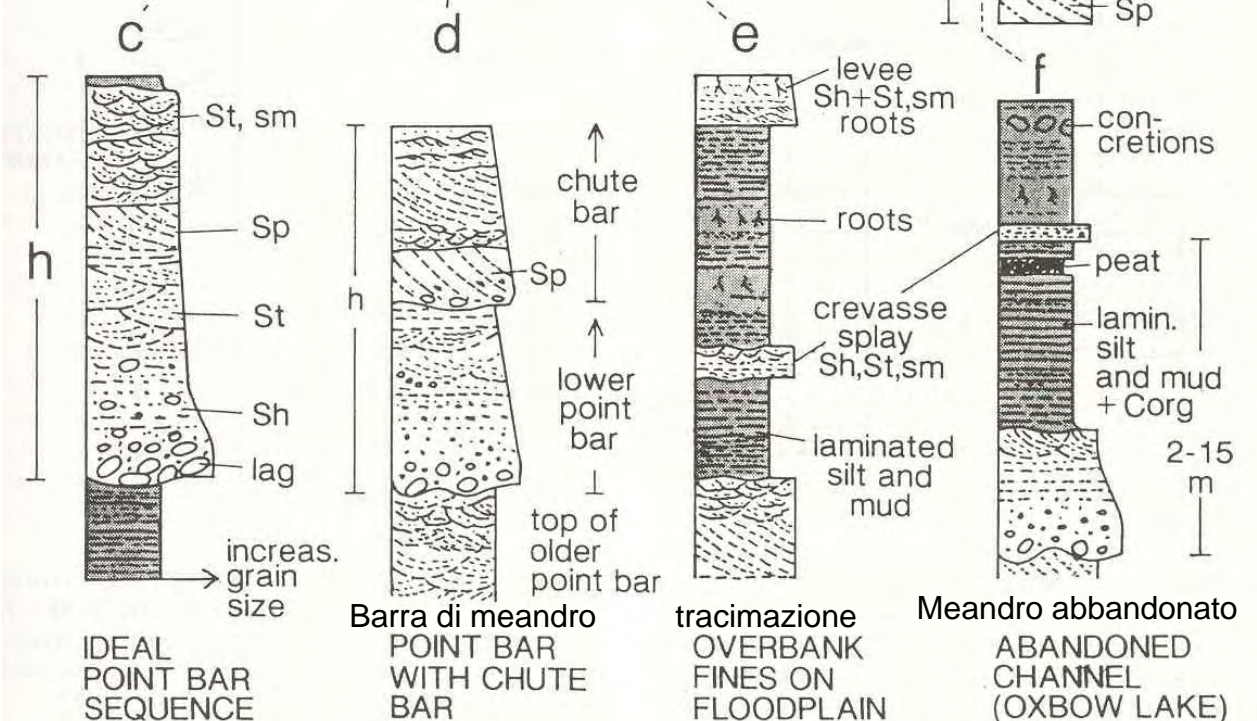
C.

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Terraces



Piana inondabile



increas. grain size

IDEAL POINT BAR SEQUENCE

Barra di meandro POINT BAR WITH CHUTE BAR

tracimazione OVERBANK FINES ON FLOODPLAIN

Meandro abbandonato ABANDONED CHANNEL (OXBOW LAKE)

c. *Piane alluvionali a canali meandrici* (fig. 16)

Sono caratterizzate dallo sviluppo di canali altamente sinuosi.

Morfologia: canale meandrico, profondo ed asimmetrico, migrante in una fascia lievemente rilevata e separata con argini dalle piane inondabili. Elementi fondamentali: canale attivo, canali abbandonati e laghi, argini e ventagli di rotta d'argine (*crevasse*), barre di meandro e piane inondabili.

Processi: correnti trattive incanalate, trasporto al fondo e in sospensione, correnti libere per rotte di argine e tracimazione, decantazione nei canali abbandonati nei laghi e nelle piane d'inondazione. Accrezione laterale della barra di meandro (riva convessa del canale attivo); erosione della sponda concava e accrezione verticale degli argini per tracimazione. Chiusura con peliti dei canali abbandonati (tappo di argilla).

Corpo sedimentario: l'intera piana costruisce un corpo tabulare al cui interno la fascia di meandro costituisce prismi nastriformi sabbiosi, a sezione lenticolare, singoli o dendrici, inquadrati da peliti di piana inondabile.

Organizzazione interna: lenti e nastri sabbioso-ghiaiosi interdigitati con siltiti e peliti.

Associazione di facies: sequenze di canale, caratterizzate da gradazione da ghiaia ad argille, pavimento di ciottoli su superficie erosionale, sabbie a stratificazione incrociata a grande scala passanti verticalmente a sabbie fini a laminazione obliqua a scala media e piccola, peliti a tetto; sequenza di barra: accrezione laterale a base ghiaiosa, gradante a sabbie a stratificazione incrociata concava a scala decrescente verso l'alto; sequenze di argine: sabbie fini e peliti alternate con intercalati livelli ciottolosi o a clasti d'argilla; sequenze di tracimazione e di rotta: sequenze positive di sabbie a stratificazione incrociata a piccola scala e sabbie a laminazione parallela passanti ad argille, sabbie fini a stratificazione sottile e lenticolare; sequenze di piana: alternanze di argille e limi, frequentemente interrotte da livelli di tracimazione e di rotta, sabbiosi ed associati a livelli a ligniti o carboni. Rari fossili continentali. Frequenti bioturbazioni.

Paleocorrenti: unimodali con dispersione molto ampia (fino a 270°).

a. *Piane alluvionali a canali anastomosati* (fig. 14)

Morfologia: reticolo di canali intrecciati scarsamente sinuosi, a fondo piatto e poco profondo, separati da barre longitudinali che passano sottocorrente a barre trasversali.

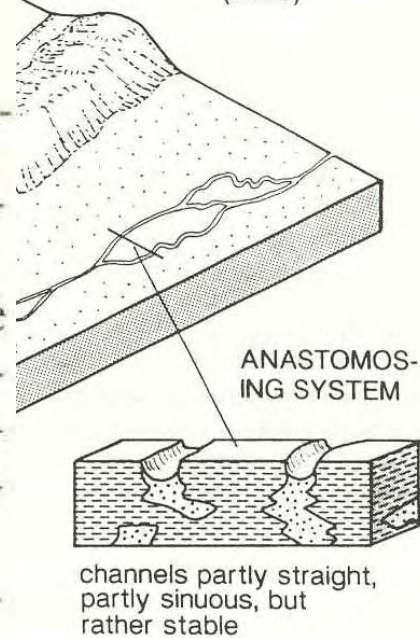
Processi: correnti trattive incanalate, intermittenti, con prevalente trasporto di fondo. Migrazione di forme al fondo a scale diverse; frequente avulsione (abbandono e migrazione laterale dei canali), decantazione di sedimenti fini nelle limitate piane di inondazione, frequente asportazione erosionale di sedimento.

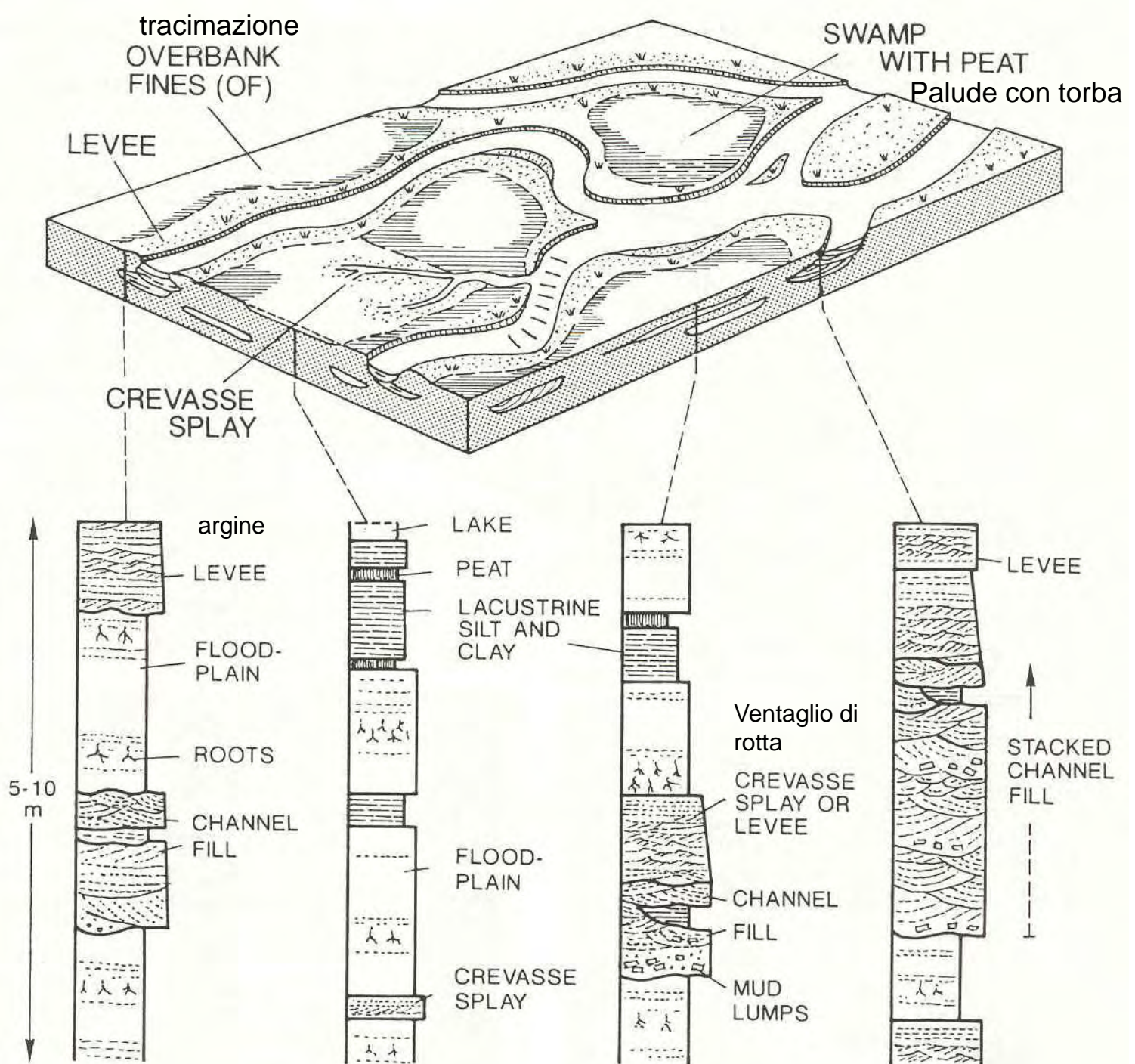
Corpo sedimentario: corpo prismatico o tabulare delimitato da superfici di erosione.

Organizzazione interna: lenti a base concava erosionale, interdignate, solitamente prive di sequenze o con sequenze positive appena accennate.

Associazione di facies: ghiaie e sabbie grossolane passanti a sabbie più fini e rare argille e limi. Sequenze di abbandono di canale: ghiaie disorganizzate su superficie erosionale tappezzata da pavimento di ciottoli con inclusi argillosi, passanti a sabbie a laminazione obliqua concava o massive e peliti. Sequenze di barra longitudinale: ghiaie a stratificazione massiccia e sabbie a stratificazione piana orizzontale o incrociata, tabulare, a grande scala. Sequenze di barra trasversale: sabbie a stratificazione incrociata concava, passanti a sabbie fini a laminazione obliqua concava (*ripple marks*). Assenza di fossili.

Paleocorrenti: unimodali, dispersione entro 60° circa.







River

Break in Levee

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**Levee failure
Monroe county Illinois, 1993**



Rhine-Meuse delta: crevasse splay



S. Matteo (MO), 20-21 gennaio 2014



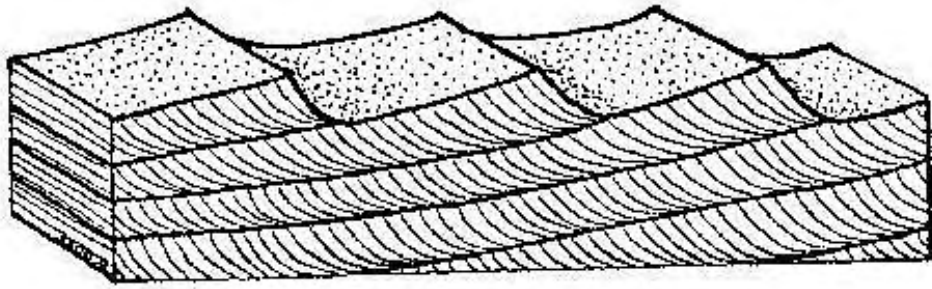
S. Matteo, 26/1/2014



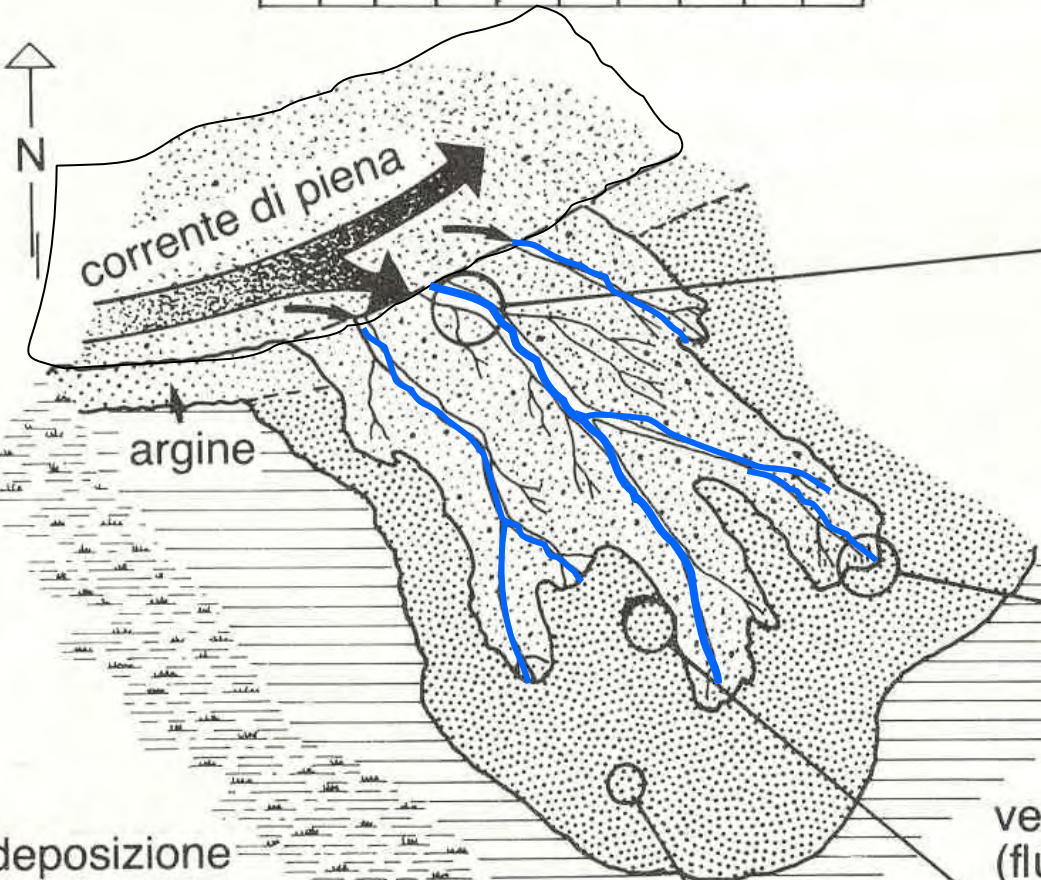
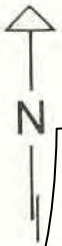
Concordia MO,
via Chiaviche, 26/1/2014



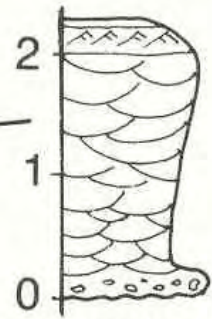
corrente →



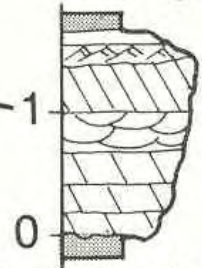
0 5 10 m



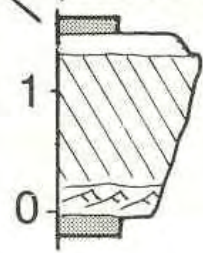
canale di rotta proximale





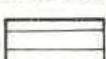
canale distale e ventaglio intermedio

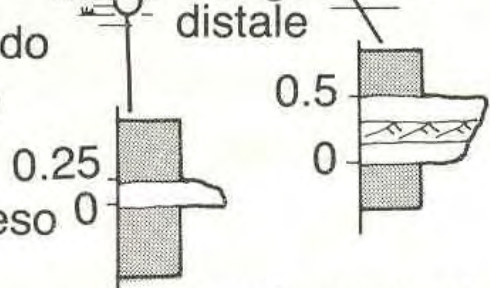


ventaglio intermedio (flusso libero)


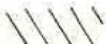



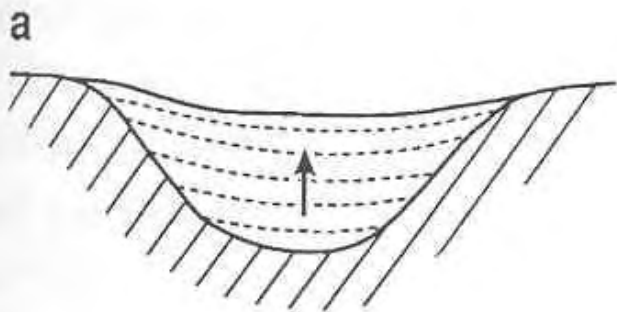
deposizione dominante

-  carico di fondo
-  carico misto e sospeso
-  carico sospeso

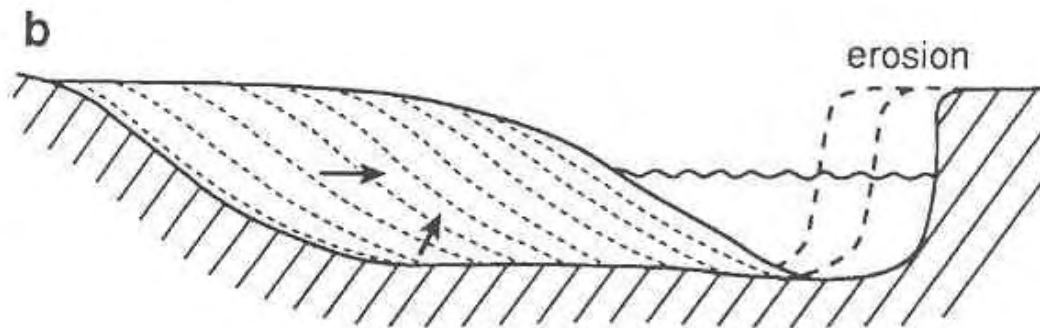


scala verticale in m

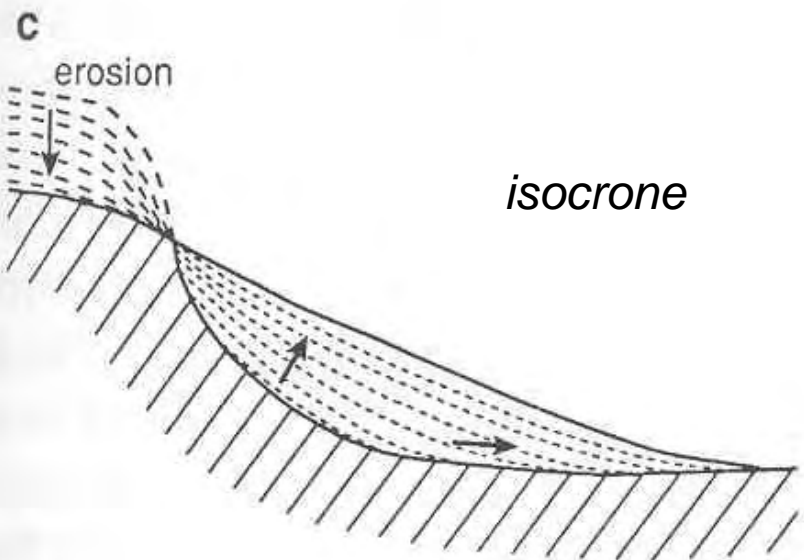
-  stratif. incr. concava
-  stratif. incr. tabulare
-  ripple



Lago, meandro abbandonato

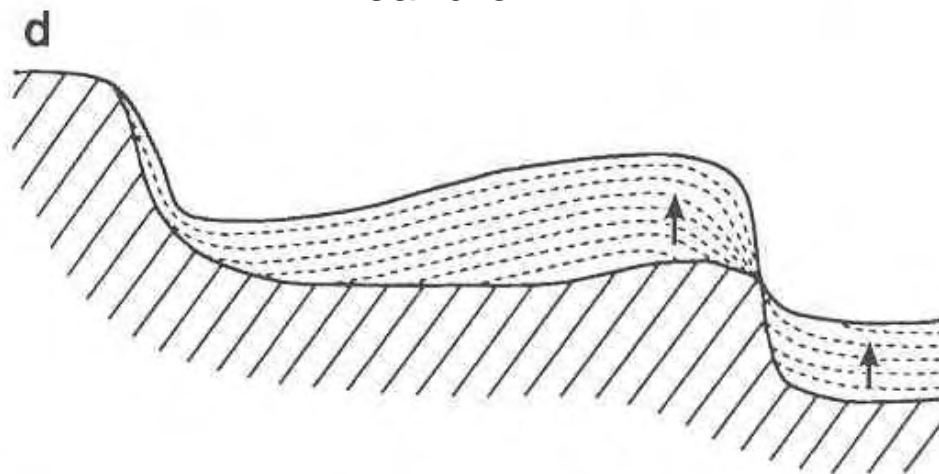


meandro

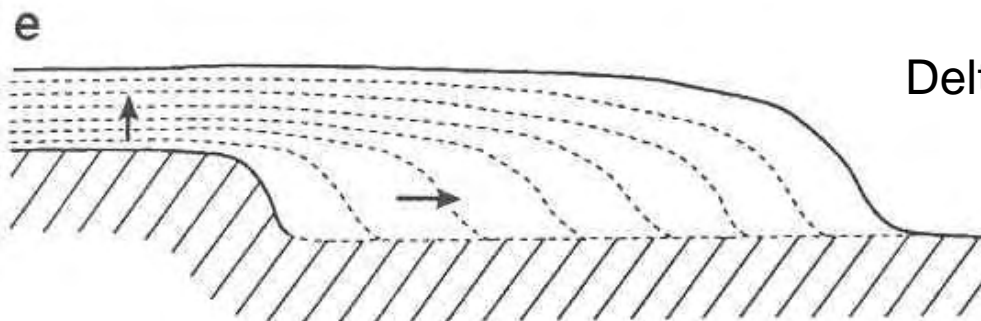


isocrone

Colluvio



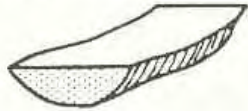
Tracimazione e canale fluviale



Delta

FLUVIAL CHANNELS

NARROW ISOLATED

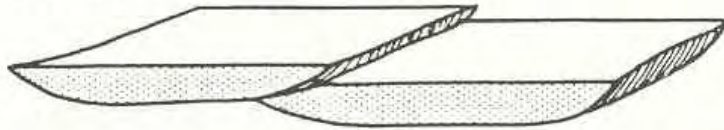


a

BROAD ISOLATED RIBBON



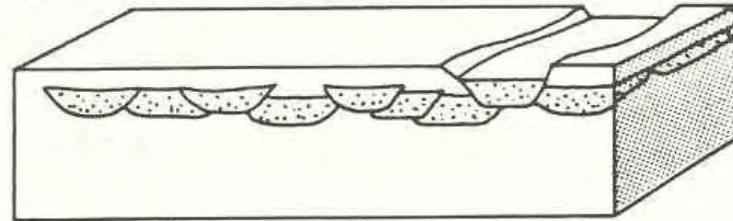
OVERLAPPING RIBBONS



SAND SHEET

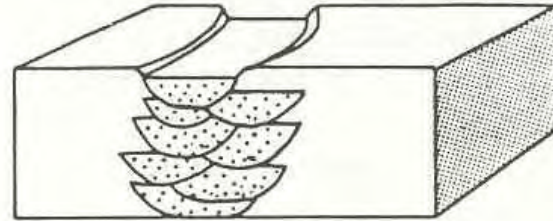


LATERAL CHANNEL MIGRATION
(LITTLE CONTEMPORANEOUS SUBSIDENCE)

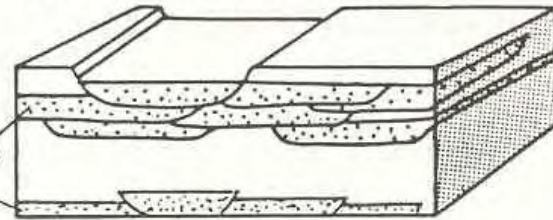


b

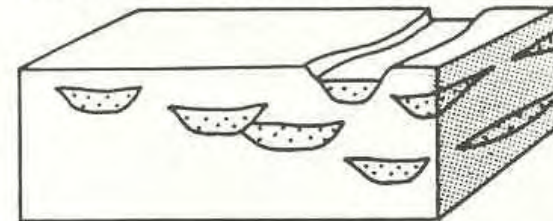
VERTICAL STACKING
(RAPID SUBSIDENCE)



LATERAL STACKING
(SLOW SUBSIDENCE)

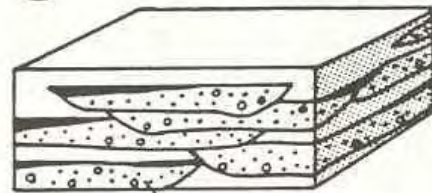


ISOLATED STACKING



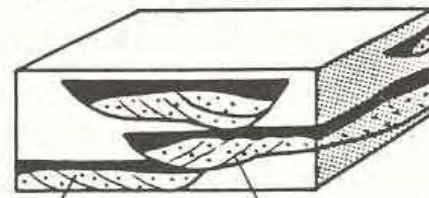
c

BEDLOAD CHANNELS



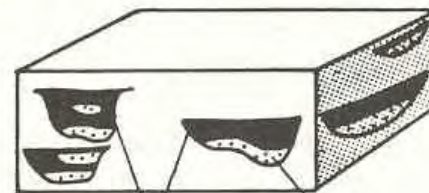
SAND AND GRAVEL

MIXED LOAD CHANNELS



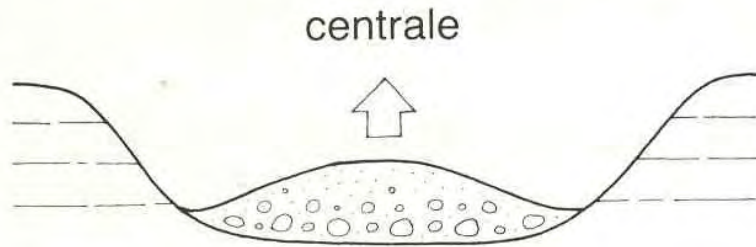
SAND LATERAL ACCRETION

SUPENDED-LOAD CHANNELS

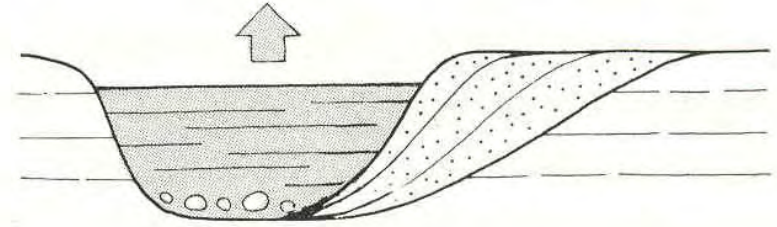
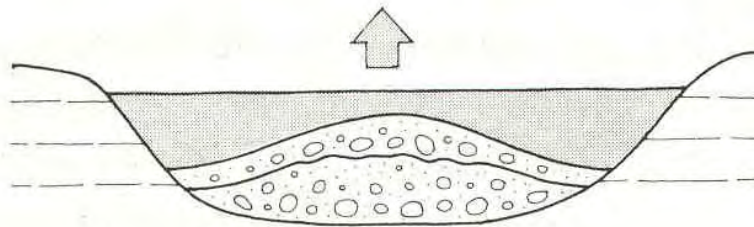


MUD SAND

a) **CANALE IN FASE ATTIVA:**
deposizione grossolana = crescita di barre e occlusione

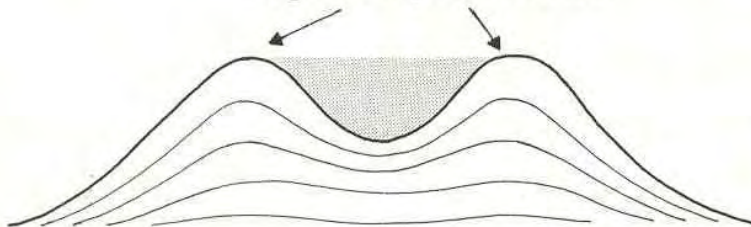


b) **CANALE IN ABBANDONO:**
decantazione (aggradazione)

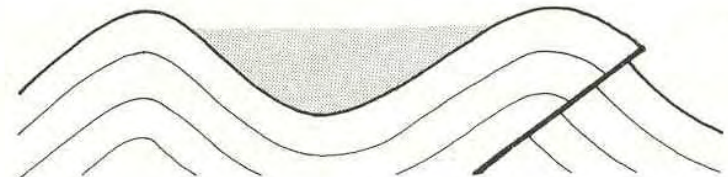


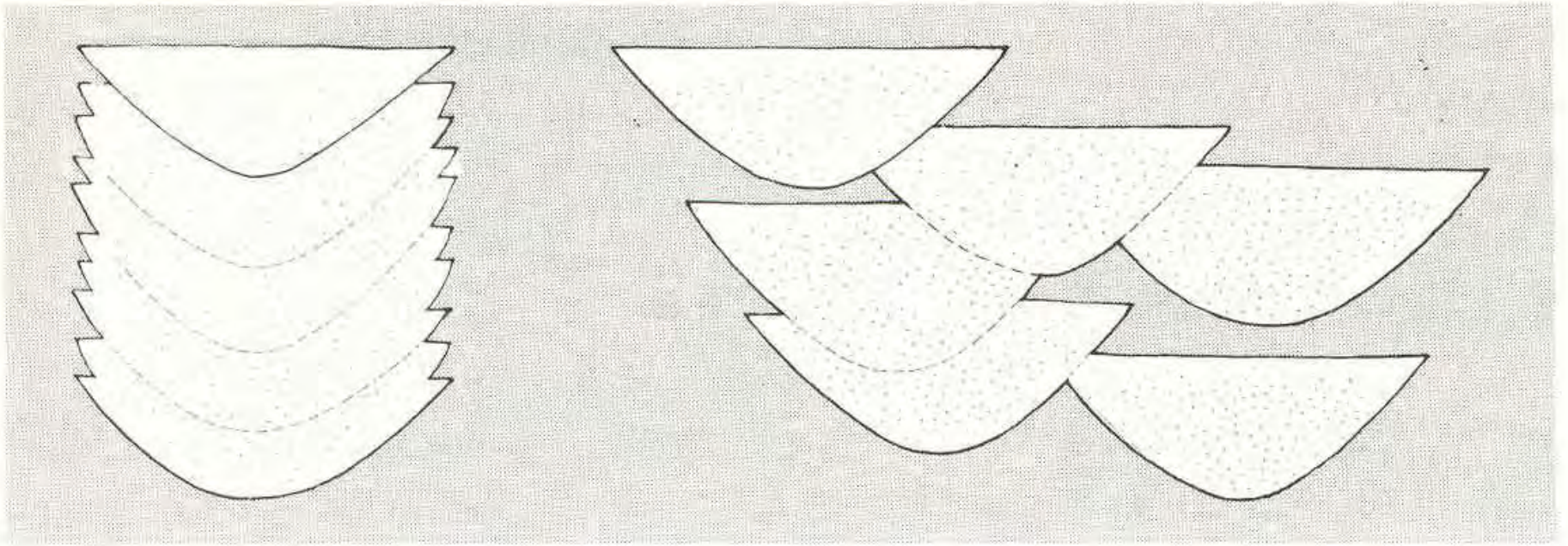
c) **CANALI NON EROSIVI:**

argini deposizionali



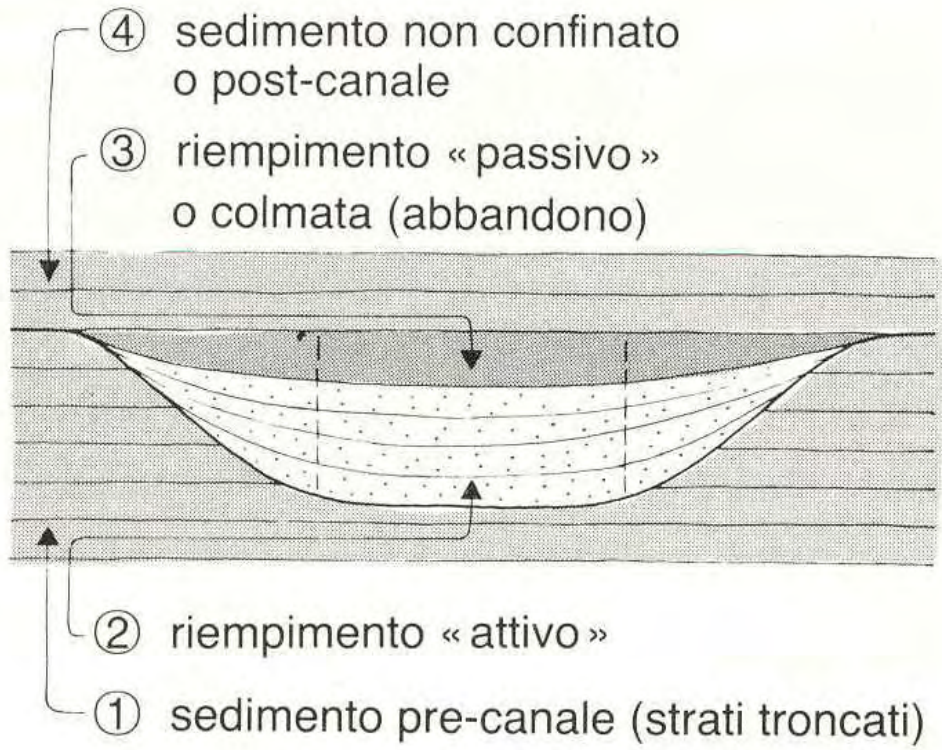
strutture tettoniche



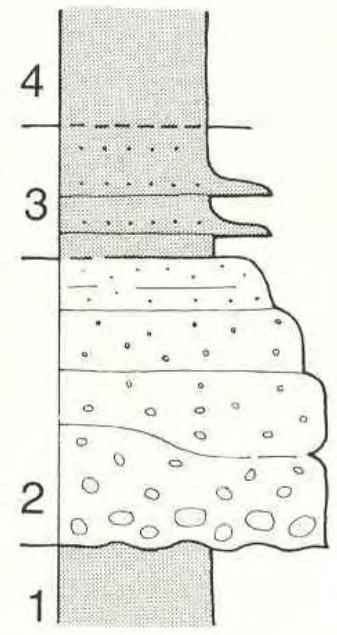


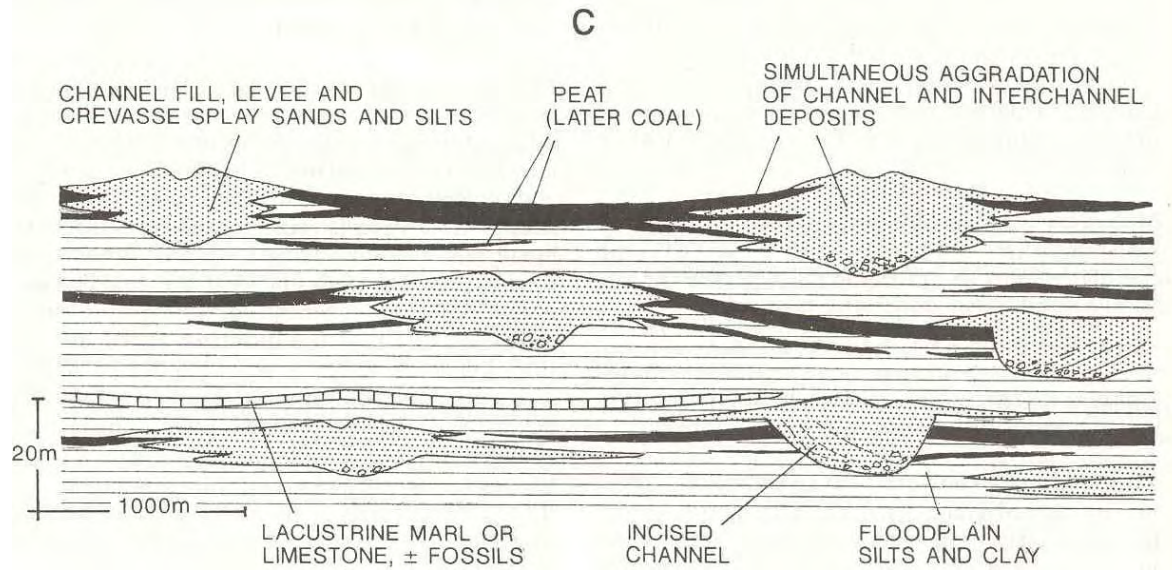
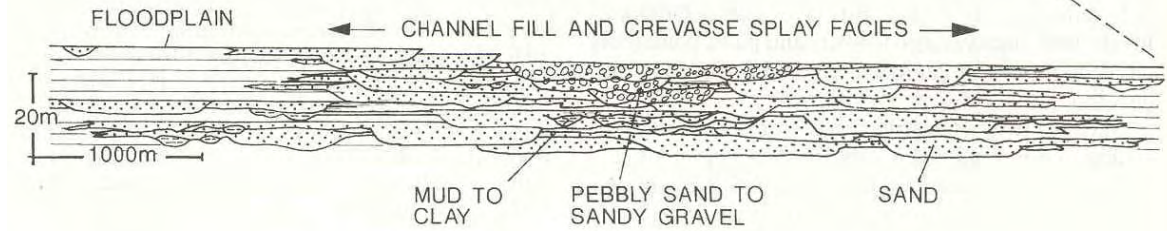
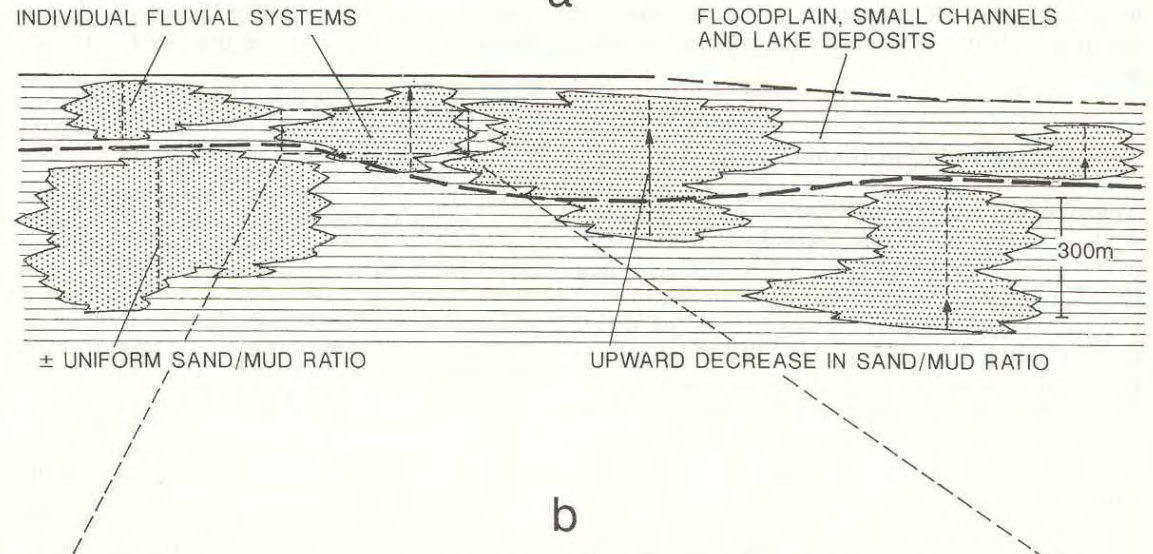
↓
subsidenza

↓ + ← →
subsidenza + divagazioni



sequenza complessiva (FU o positiva)











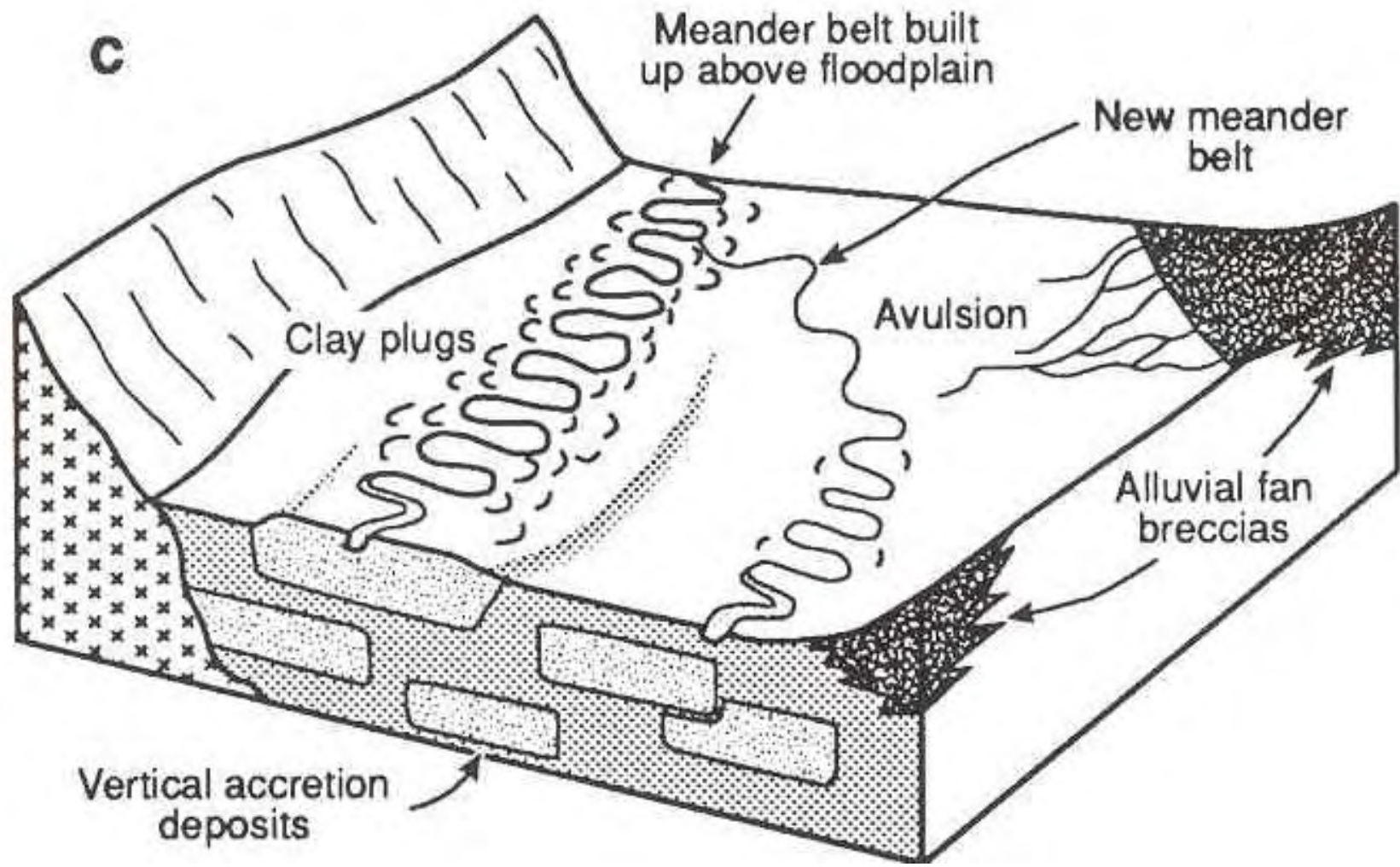




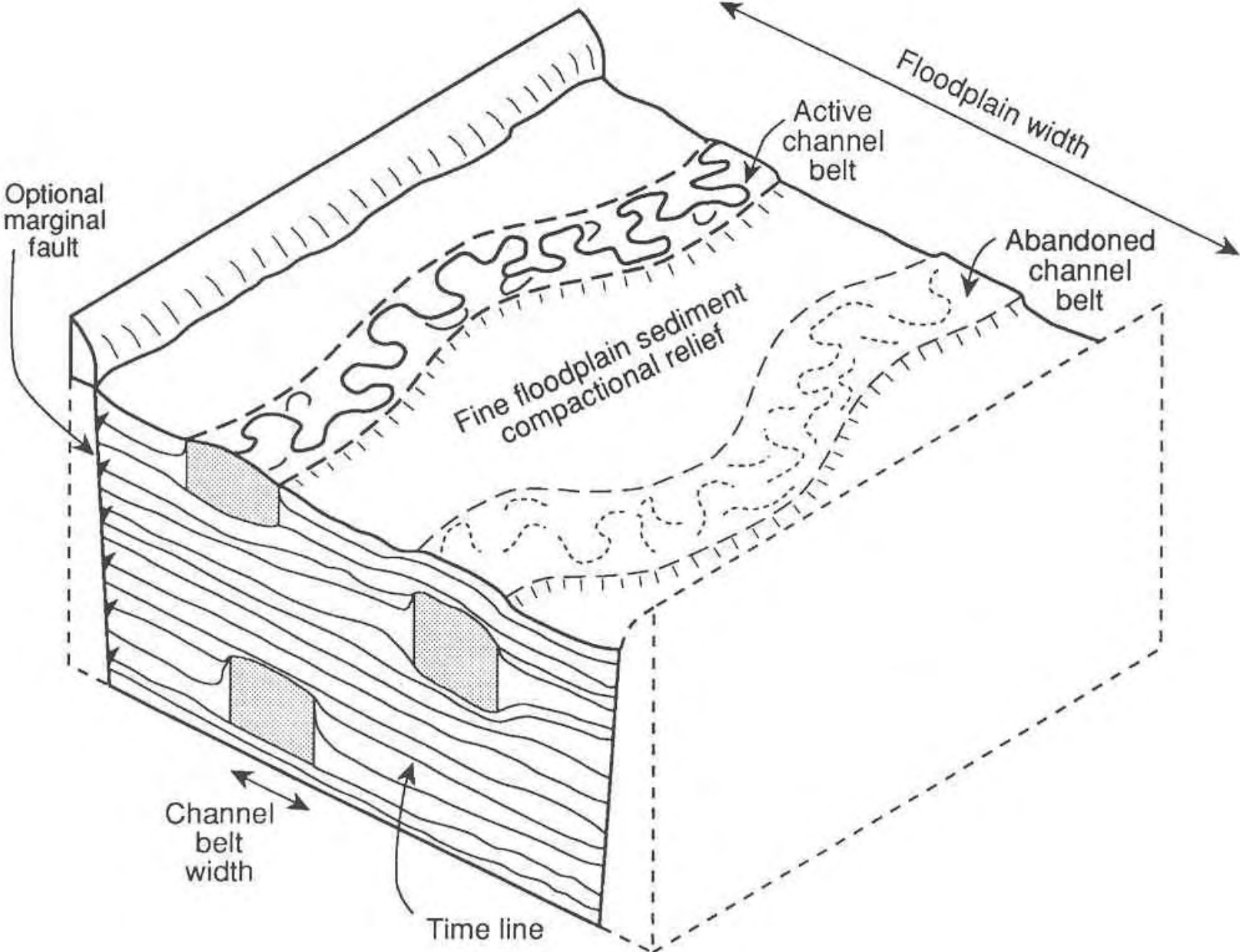




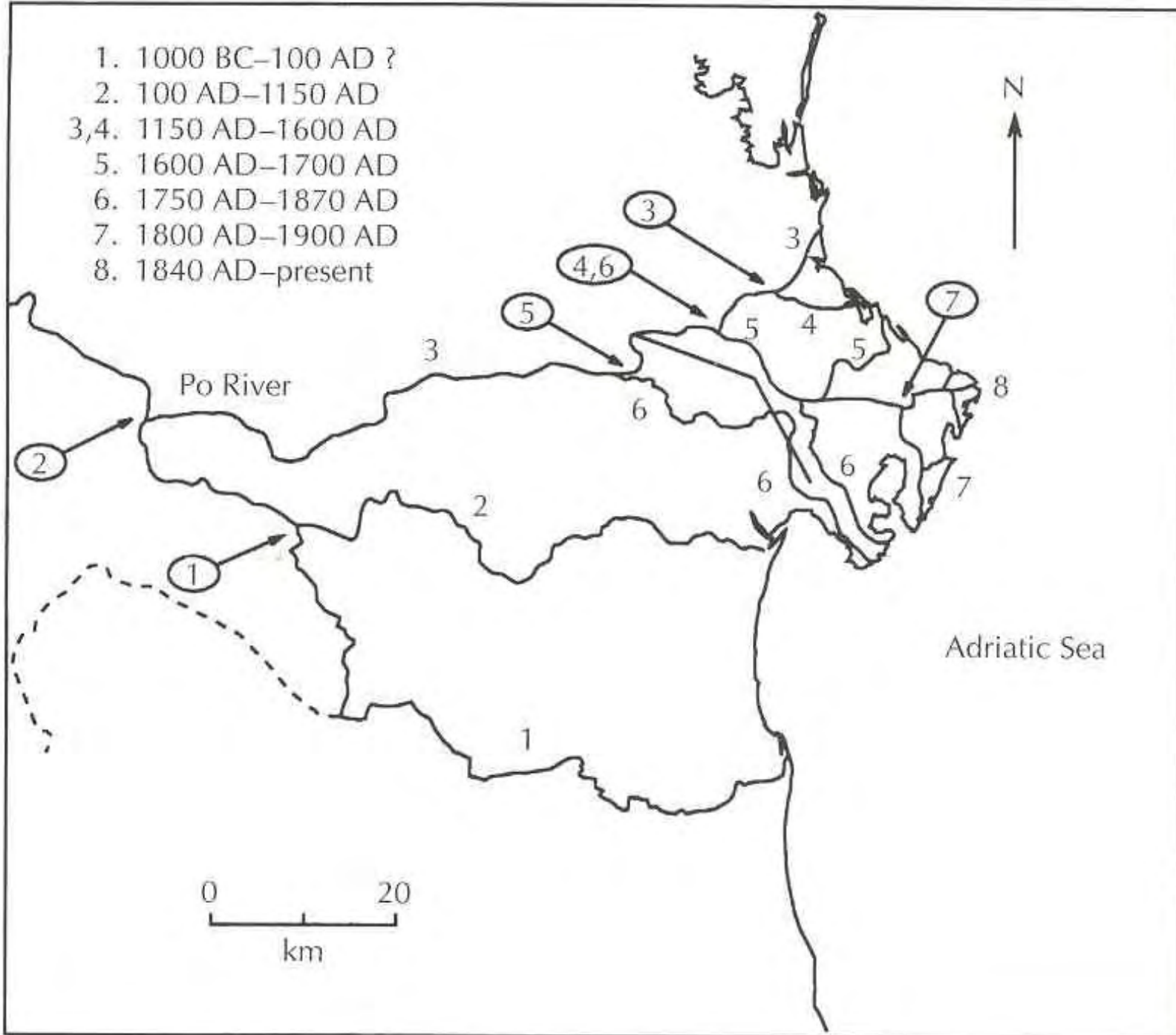




Avulsione



1. 1000 BC–100 AD ?
2. 100 AD–1150 AD
- 3,4. 1150 AD–1600 AD
5. 1600 AD–1700 AD
6. 1750 AD–1870 AD
7. 1800 AD–1900 AD
8. 1840 AD–present

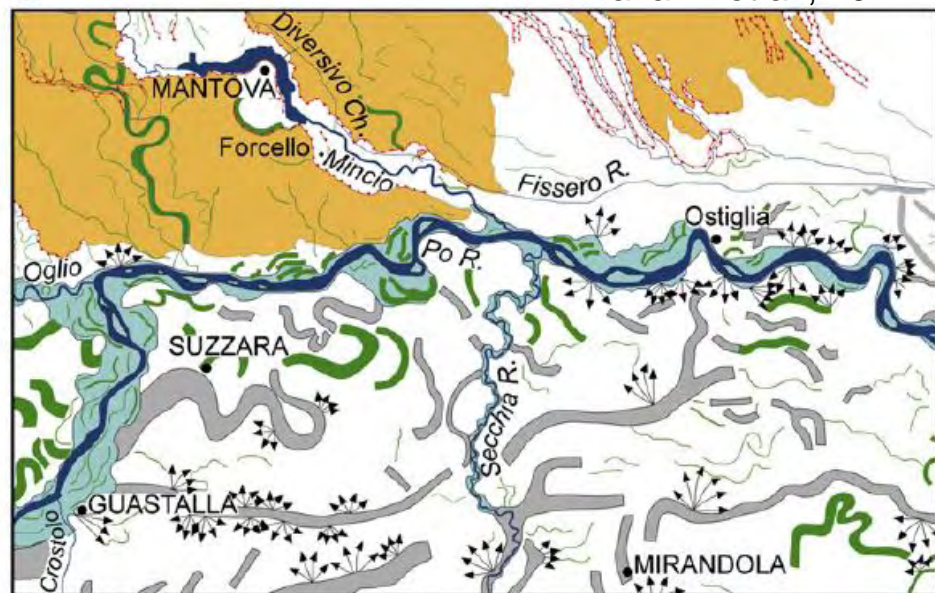




c

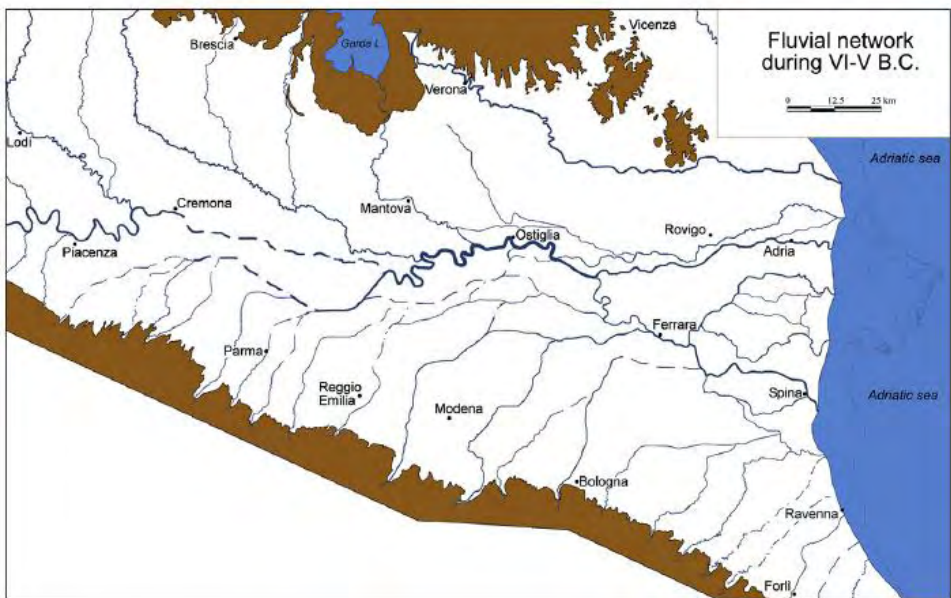
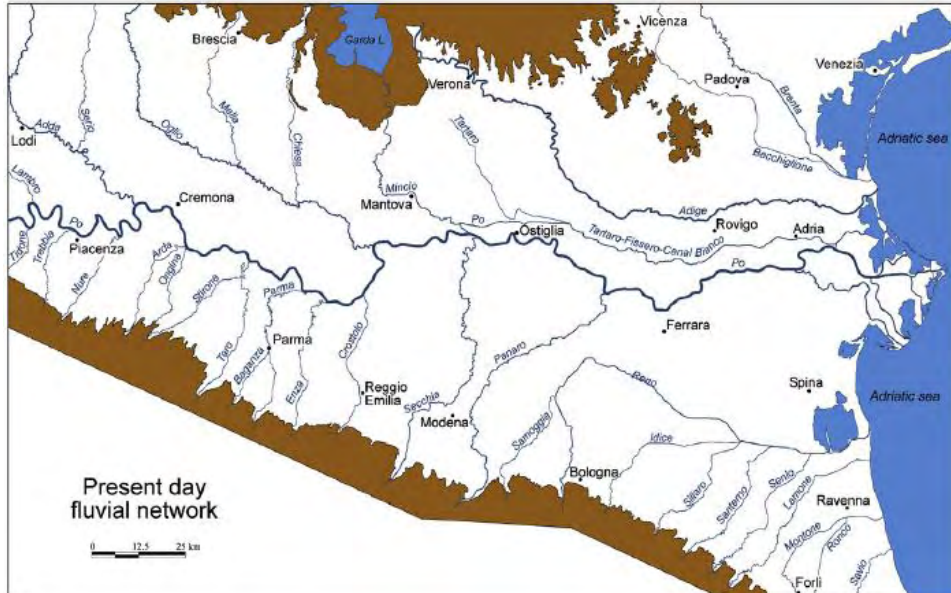


d



Ravazzi et al., 2012

Fig. 6. Geomorphological maps of the lower Mantova plain (central Po Plain). a. Late Bronze Age hydrography and location of Bronze Age settlements; b. 5th century BC hydrography; c. 3rd century AD hydrography; d. Present day hydrography. Legend: 1) Rivers and lakes (dashed lines depict presumed fluvial tracks), 2) High water fluvial bed, mostly between main levees, 3) Poorly drained lowland, 4) Alluvial ridge, 5) Abandoned fluvial course, 6) Main fluvial scarp, 7) Crevasse splay area, 8) Main Plain Level (surface marking the last aggradation phases, before the beginning of deglaciation). 9–12) Location of Middle to Late Bronze Age archaeological settlements. 9) Sites smaller than 1 ha, not buried; 10) From 1 to 4 ha, not buried; 11) Over 4 ha, not buried; 12) Smaller than 1 ha, buried; 13) From 1 to 4 ha, buried; 14) Over 4 ha, buried.



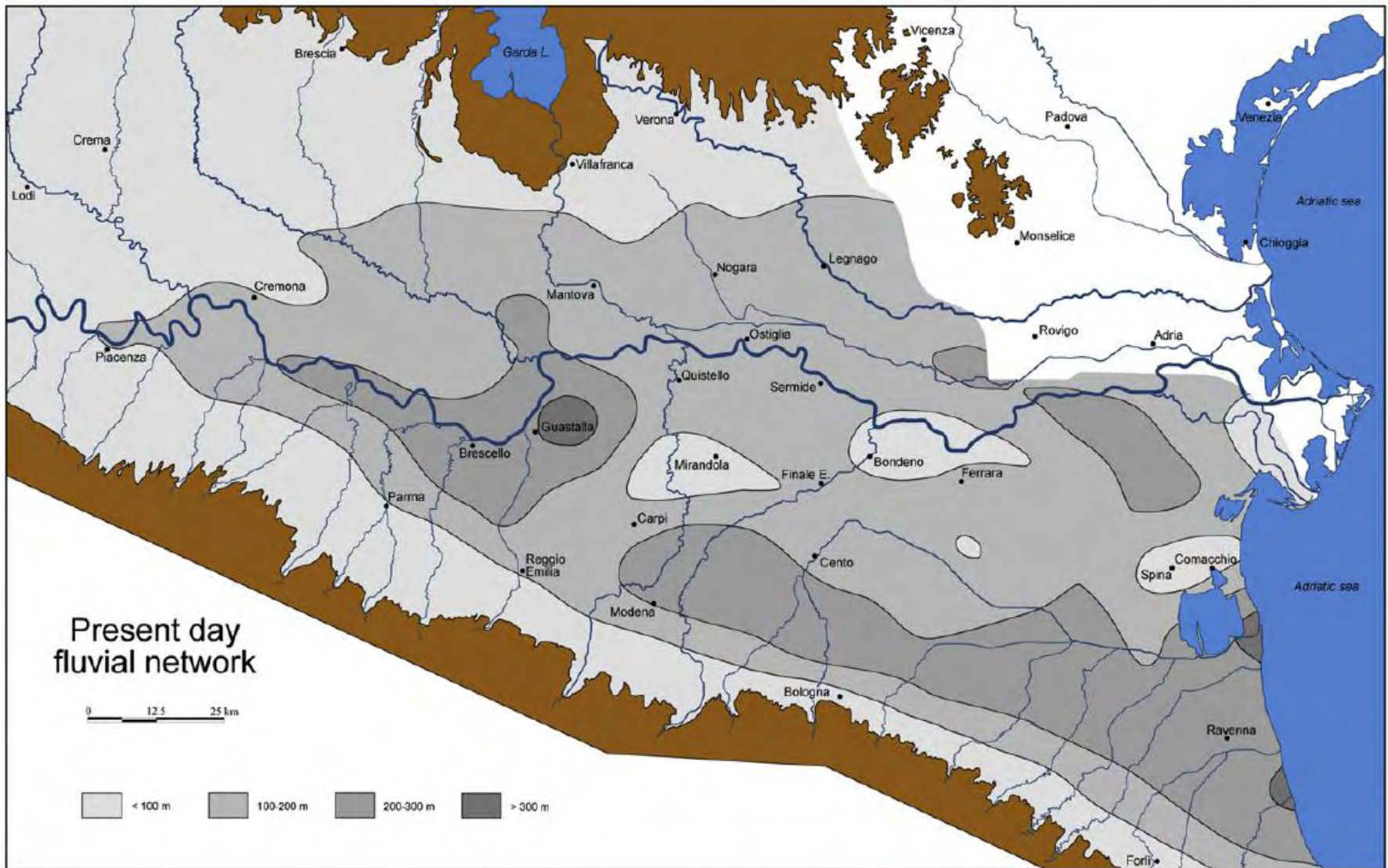
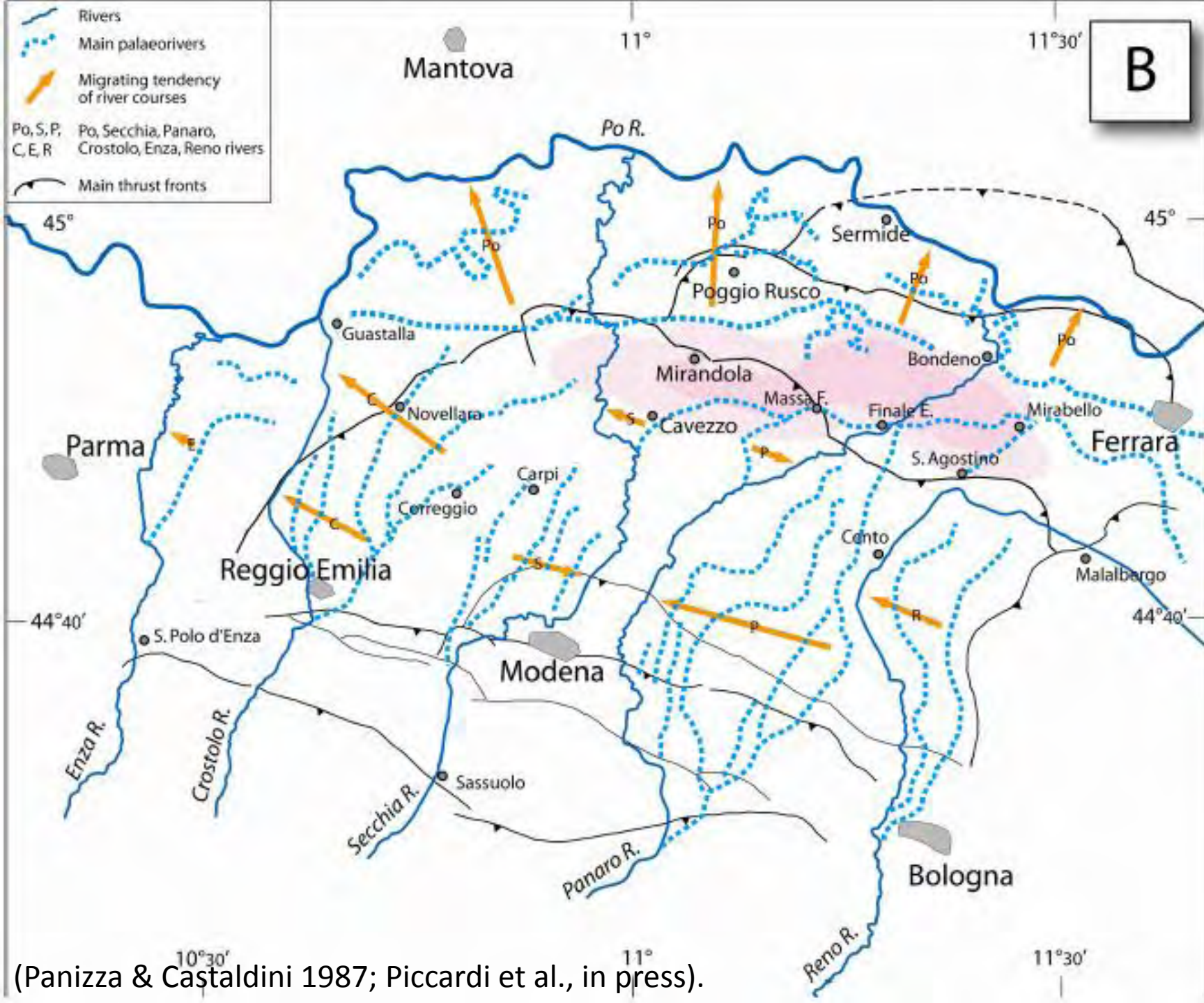


Fig. 9. Subsidence and accumulation rates along the central and eastern Po plain during the last 0.45 ma. The modern fluvial pattern is associated with four classes representing the isopachs of the 0.45 Ma stratigraphic surface (data from Carcano and Piccin, 2002).



(Panizza & Castaldini 1987; Piccardi et al., in press).