

Fluid-Mud Deposits of the Lower Jurassic Tilje Formation, Offshore Mid-Norway

By

Aitor A. Ichaso and Robert W. Dalrymple¹

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¹Dept. of Geological Sciences and Geological Engineering, Queen's University, Kingston, ON, Canada (aitorichaso@hotmail.com)

Abstract

The Jurassic-aged Tilje Formation (120-300 m thick) consists predominantly of heterolithic deposits and is thought to have accumulated in tide-dominated estuarine and deltaic environments in an active rift setting. Individual mud layers that are anomalously thick (> 1 cm) and internally homogeneous are widespread. Bioturbation is generally absent from the mud layers and occurs only as a result of post-depositional, top-down colonization. These mud layers, which are interpreted to represent fluid-mud deposits, occur in several different environmental settings. (1) Tidal-fluvial channels contain sharp-based, 1-5 cm thick homogeneous and structureless mudstones, some of which contain disseminated organic matter. Thick fluid-mud layers are generally restricted to channel-bottom positions where they occur in association with cross-bedded and current-rippled sandstones and mud-pebble conglomerates. They are replaced upward in the channel successions by thinner mud layers. (2) Delta-front deposits and distal distributary channels contain sharp-based 0.5-2 cm thick homogeneous mudstones with rare internal lamination, accompanied by dispersed grains of silt to very-fine sand. They occur in association with anomalously coarse river-flood deposits composed of thin- to medium-bedded heterolithics that thin and fine upward as a result of decreasing river flow that was modulated by tidal activity. (3) Storm deposits consist of sharp-based 0.5-3 cm thick weakly laminated mudstones that contain dispersed very-fine sand grains. They occur in association with thick very-fine sand layers containing wave-generated ripples and HCS. The widespread presence of fluid-mud deposits within the Tilje Formation may have been favored by the tectonically active rift-basin setting. The diversity of environments in which fluid muds occur is consistent with recent observations in modern environments.

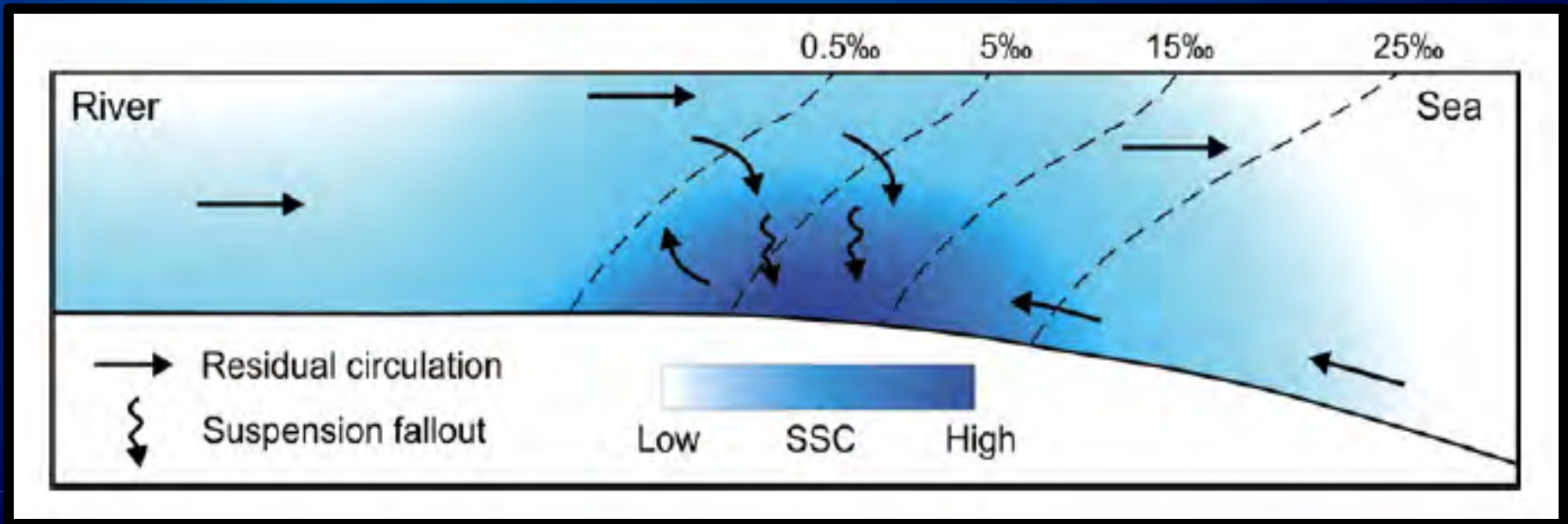
FLUID MUD DEPOSITS

of the Lower Jurassic Tilje Formation, offshore mid-Norway.

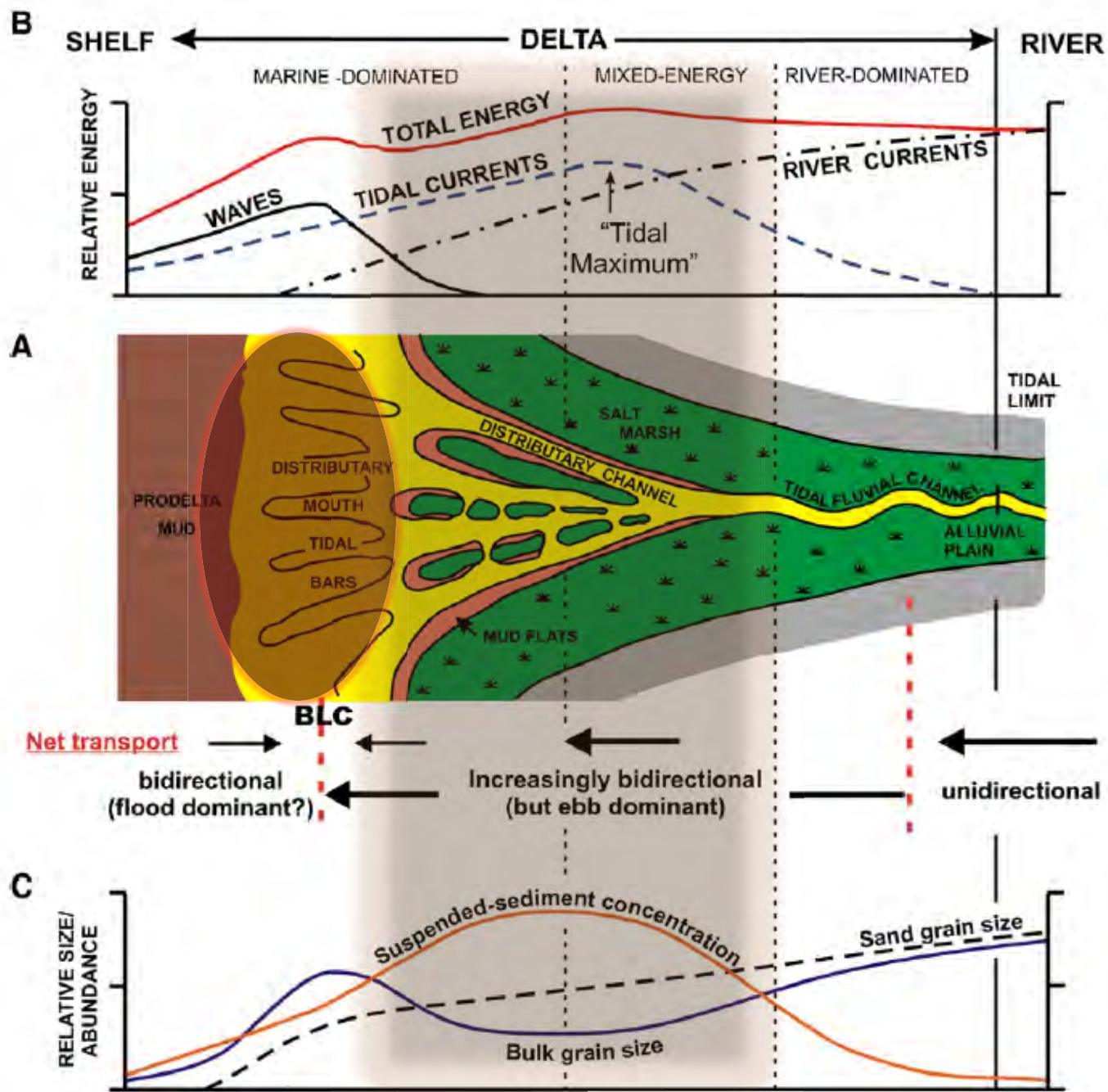
Ichaso, A. A.
Dalrymple, R. W.

FLUID MUD

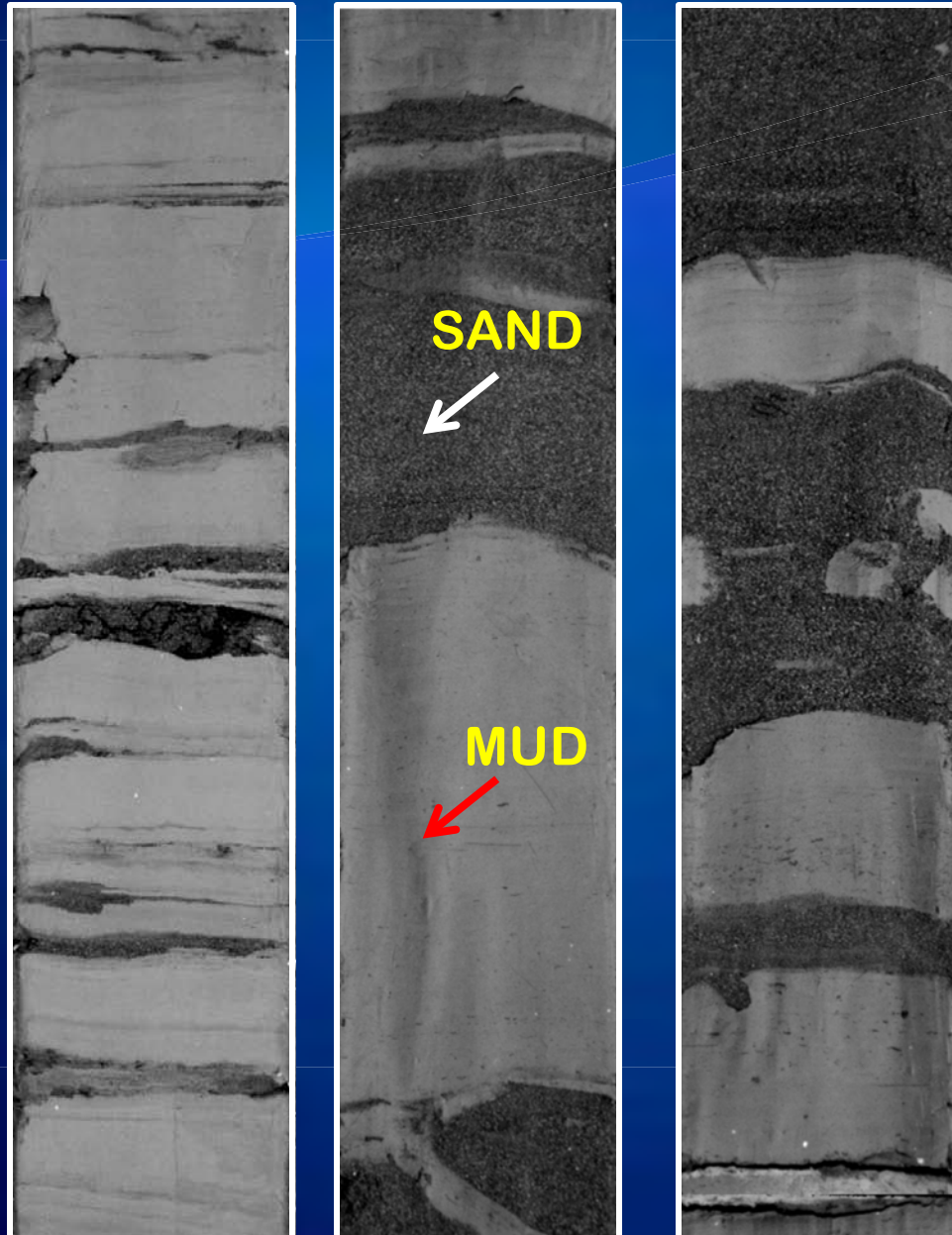
Dense, mobile, near-bed (fine-grained) suspended-sediment concentrations (SSCs) greater than 10 gL^{-1}



Dalrymple and Choi, 2007

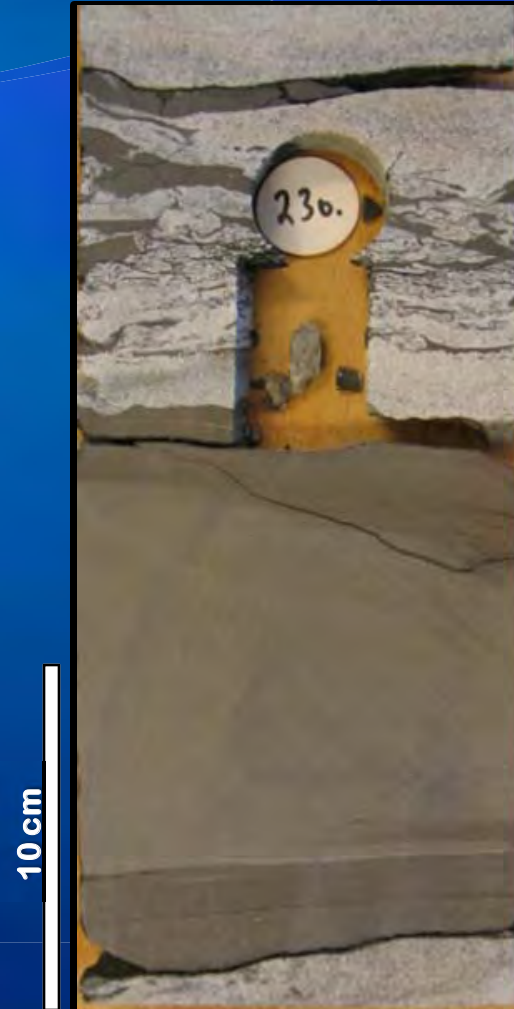


Fluid Mud Deposits: Characteristics

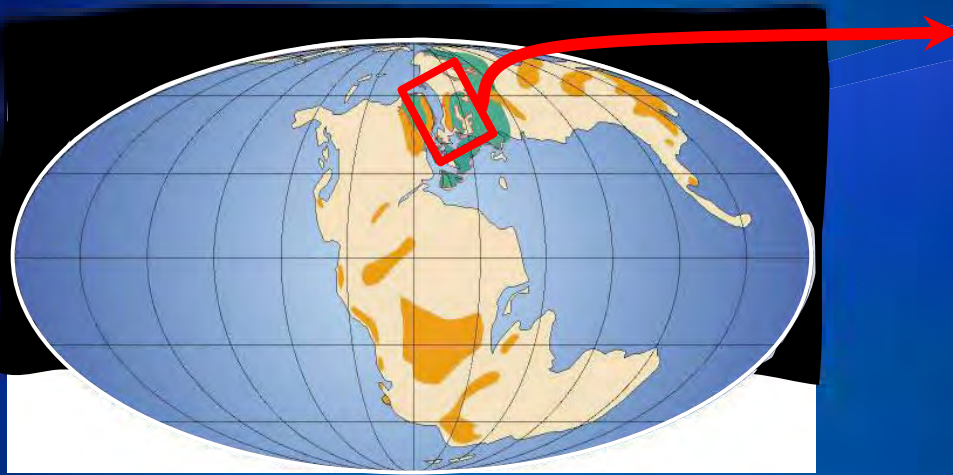


- Thick mud beds.
- Texturally homogeneous.
- Sharp or gradational basal contact.
- Dispersed organic matter, silt, and/or very fine sand.
- Bioturbation is absent (except post-depositional reworking).

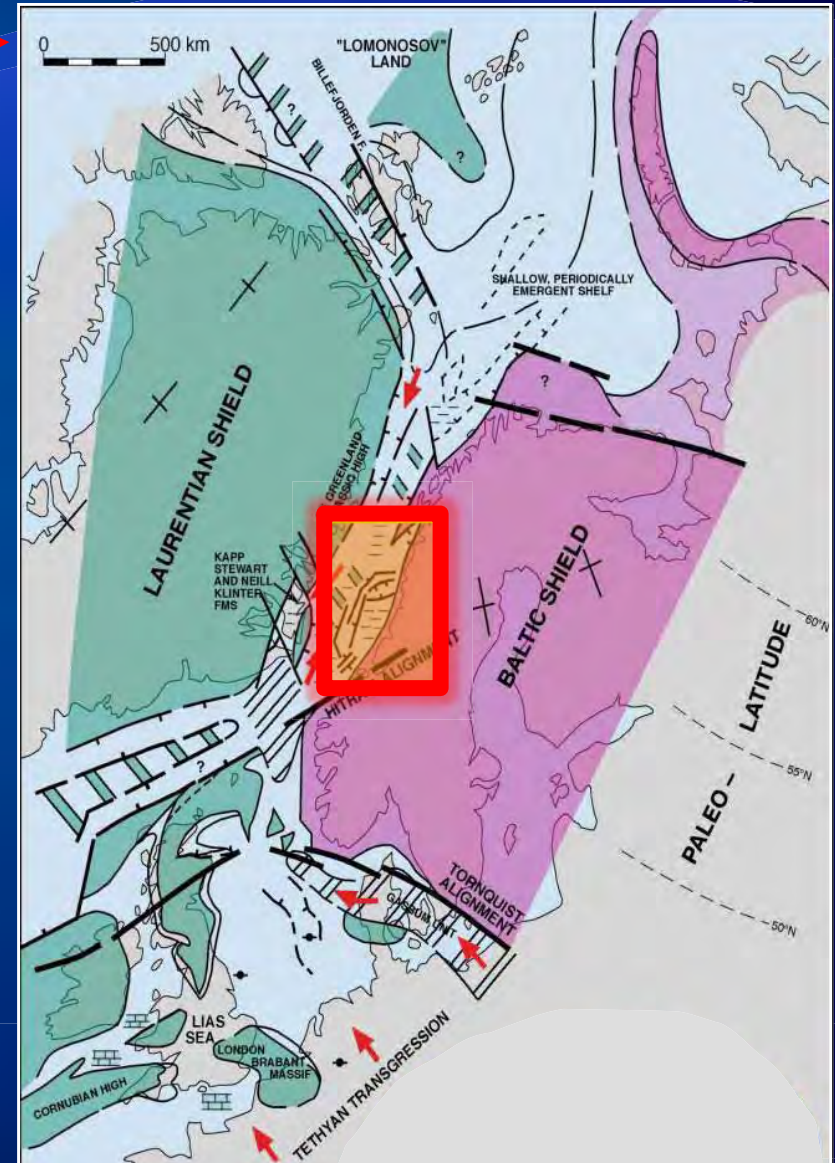
TILJE FORMATION MUD LAYERS



Tectonic Setting and Paleogeography



- Lower Jurassic
- Laurentia and Baltica break-up
- Arctic - Central Atlantic rifting
- NE – SW oriented rift basin

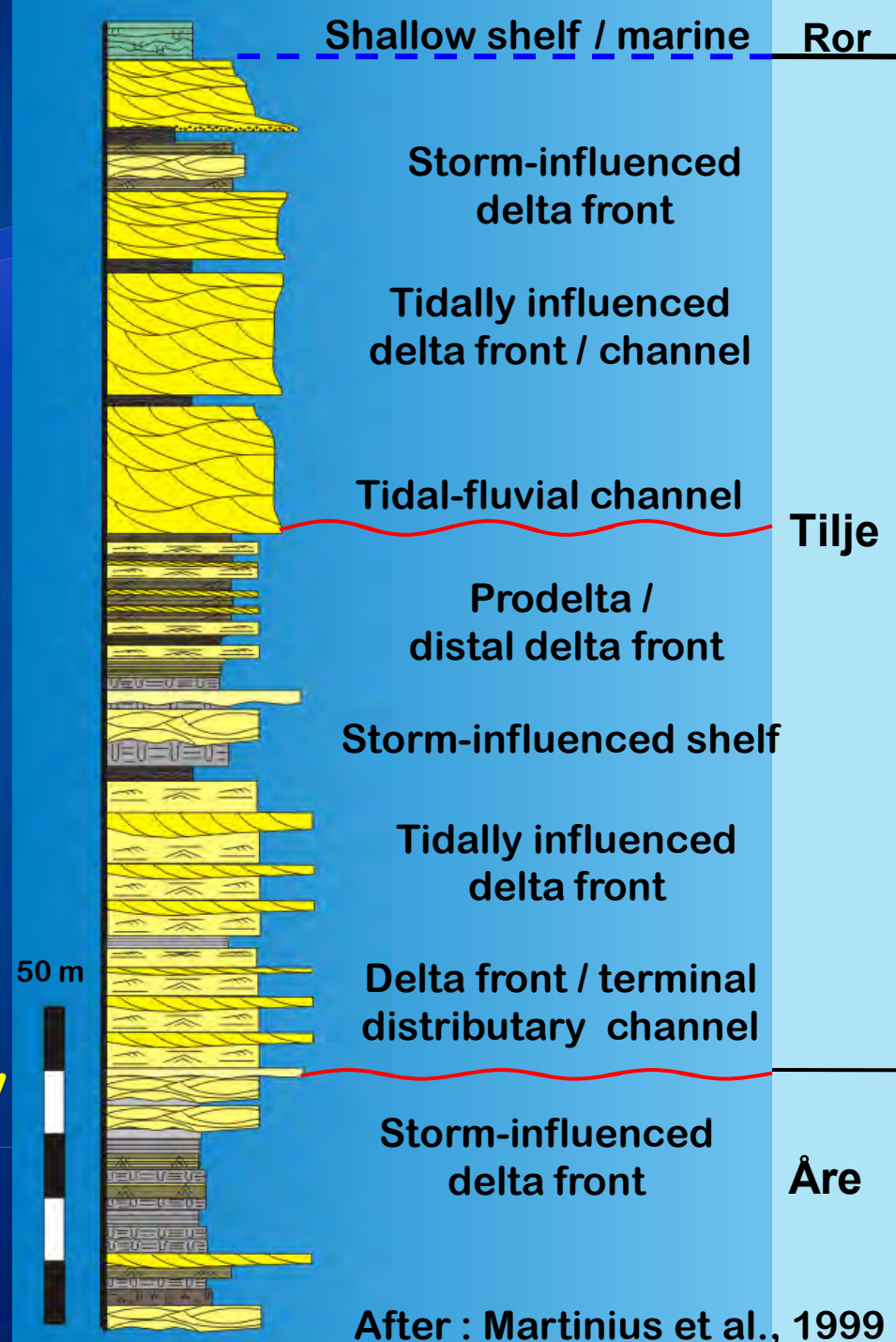


Depositional Environments

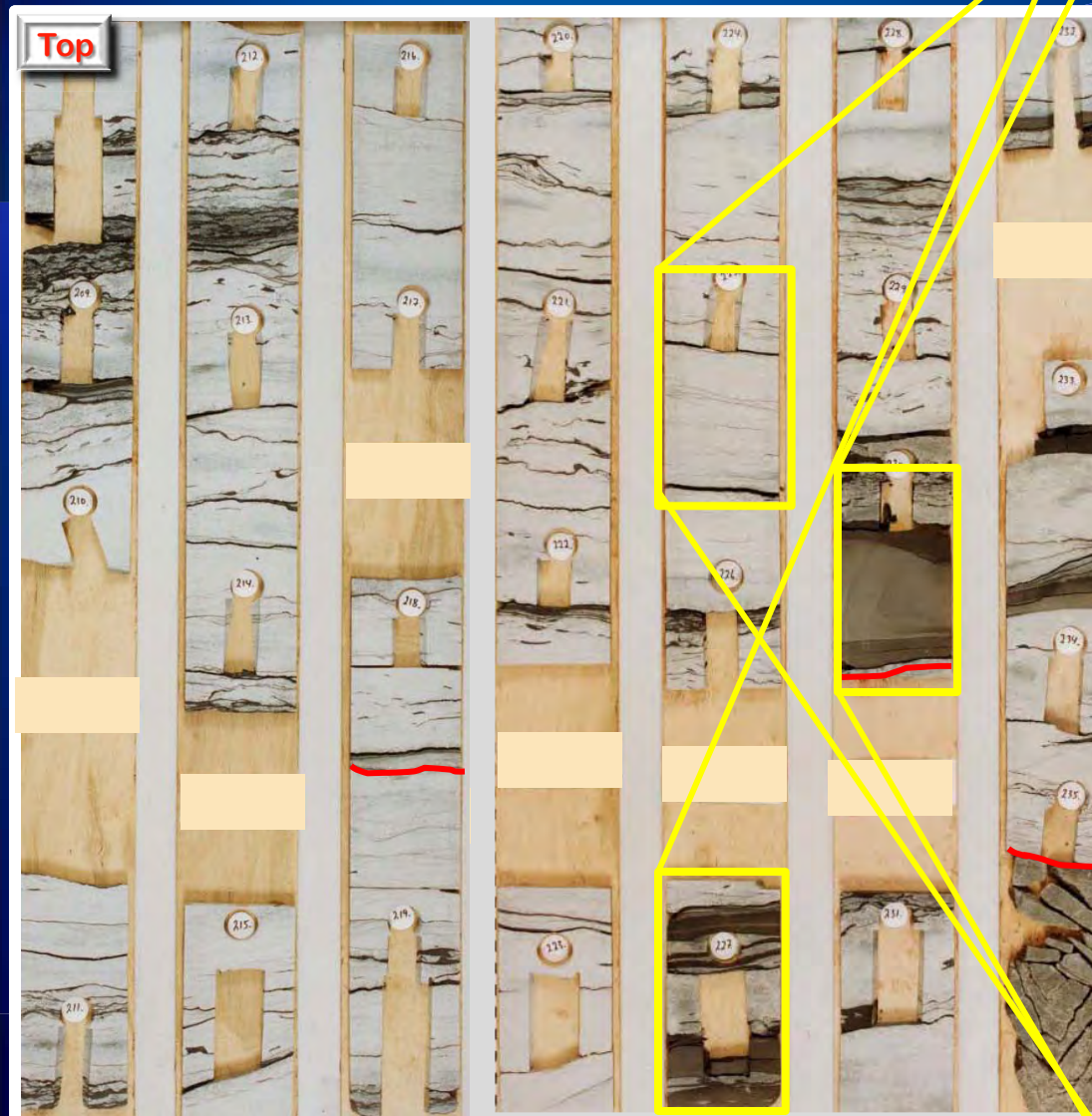
| | | | |
|----------|------------|---------------|--------------------------|
| Jurassic | Late | Volgian | SPEKK |
| | | Oxfordian | |
| | | Kimmeridgian | |
| | Middle | Callovian | Intra-Melke Unconformity |
| | | Bathonian | |
| | | Bajocian | |
| | | Aalenian | |
| | | Toarcian | |
| | Early | Phleisbachian | TILJE |
| | | Sinemurian | |
| | Hettangian | Hettangian | ARE |
| | | Hettangian | |

Fluid-mud occurrences:

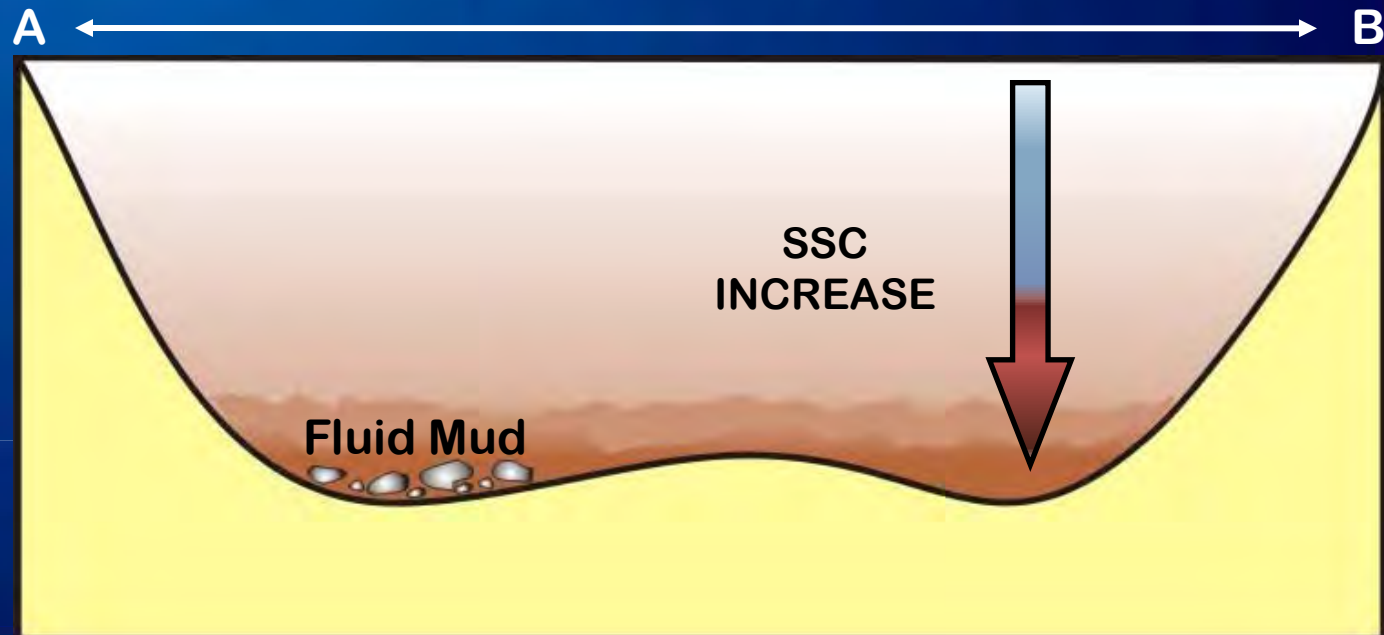
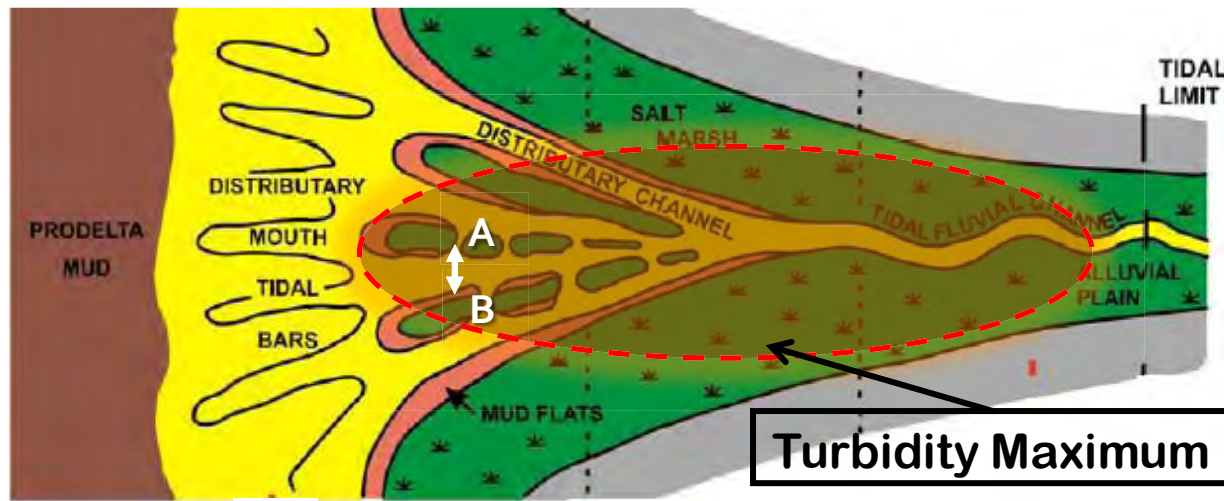
- 1) Tidal – fluvial channel
- 2) Mouth bar / terminal distributary channel
- 3) Storm influenced delta front



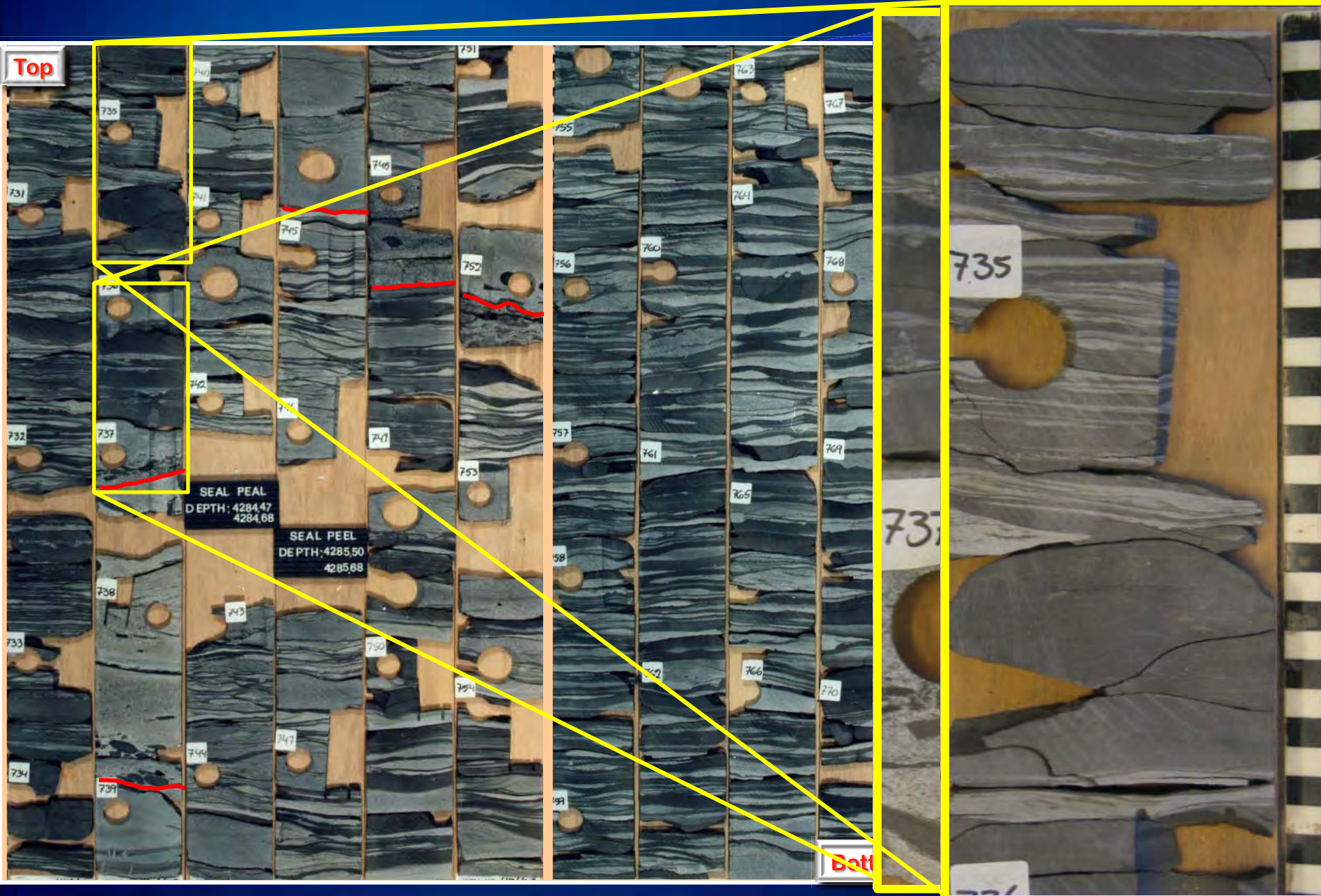
1) Tidal - fluvial channel



Origins of fluid mud in tidal-fluvial channels



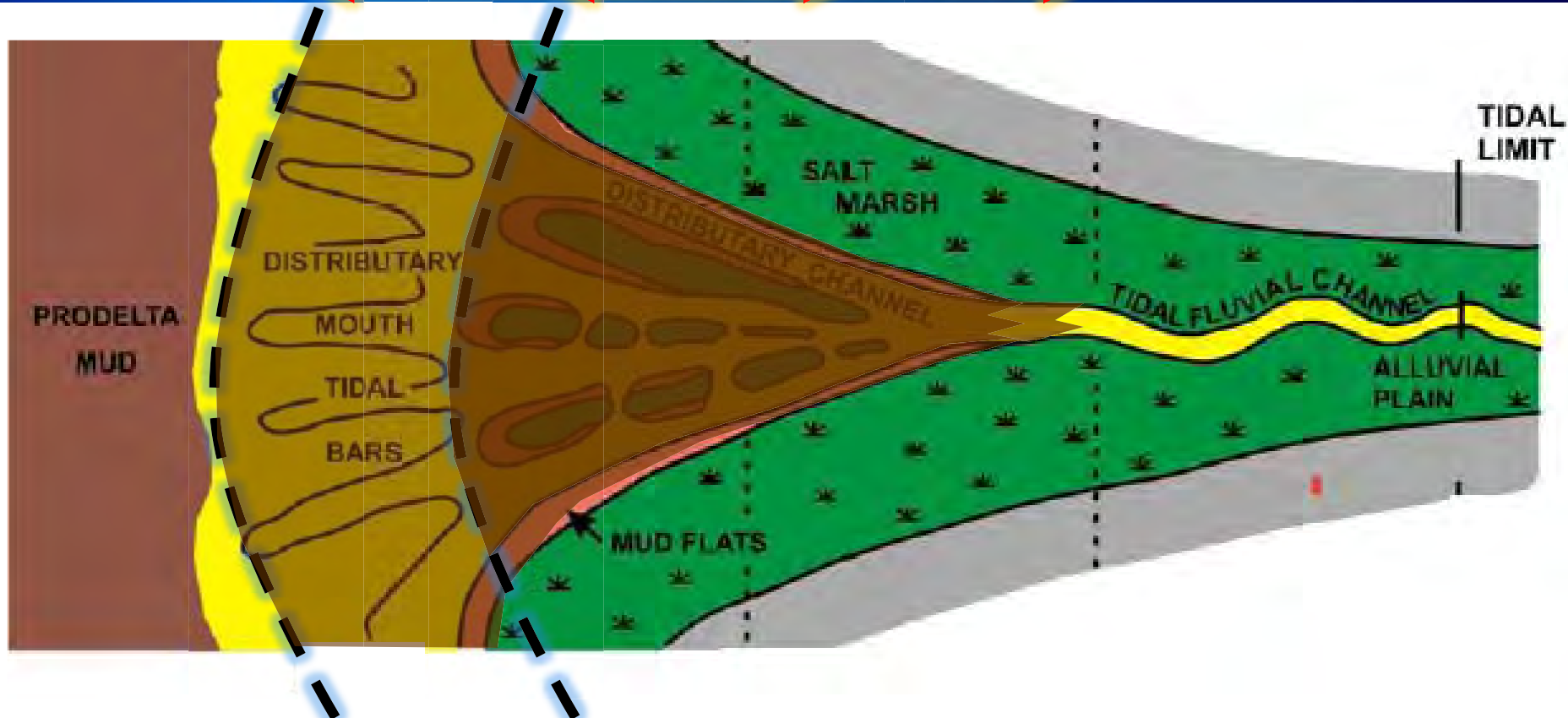
2) Mouth bar / terminal distributary channel



Origins of fluid mud in mouth bar / terminal distributary channels

Turbidity maximum at:

High Discharge Low Discharge



3) Storm influenced delta front

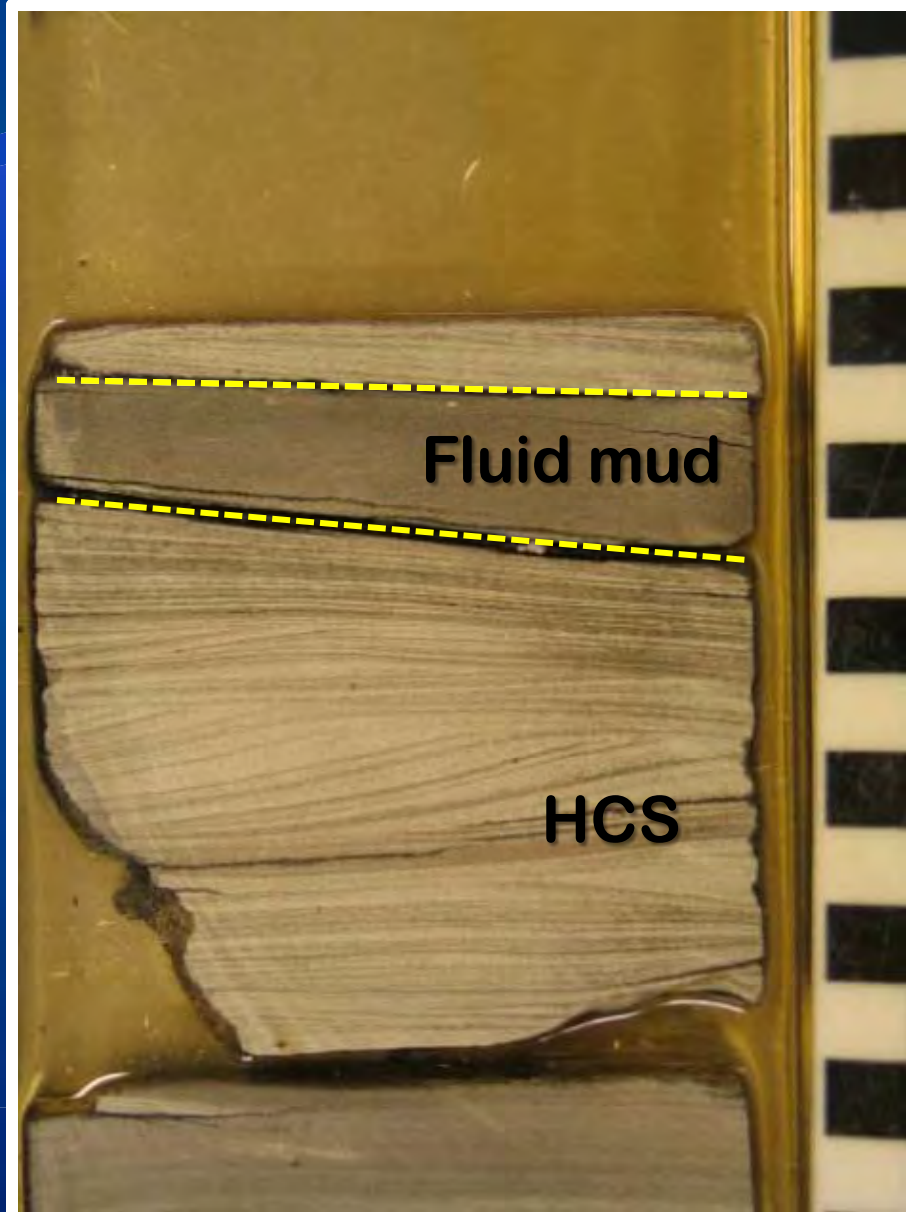
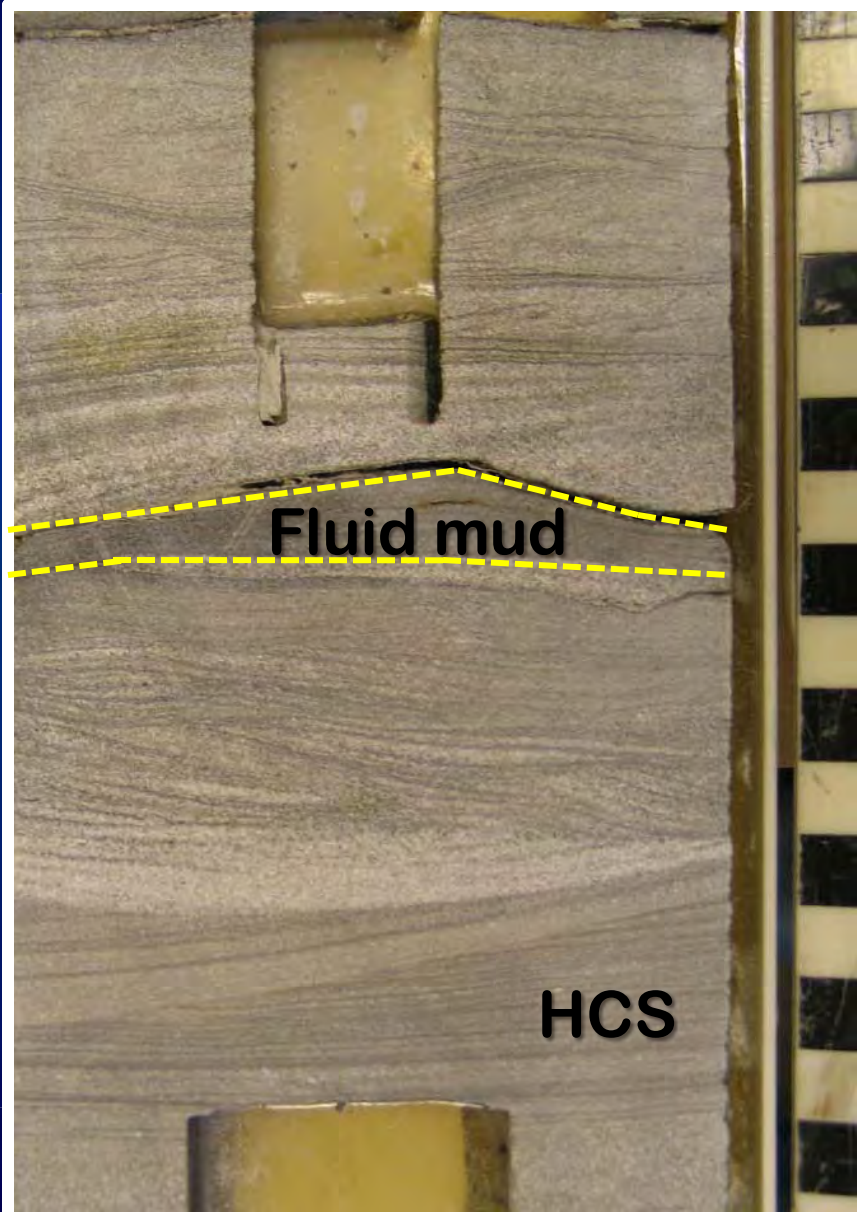


Thick vf-grained sandstones
with basal erosive surface

Fining-up sandstones

Low-angle inclined
lamination, HCS, and wave
ripples

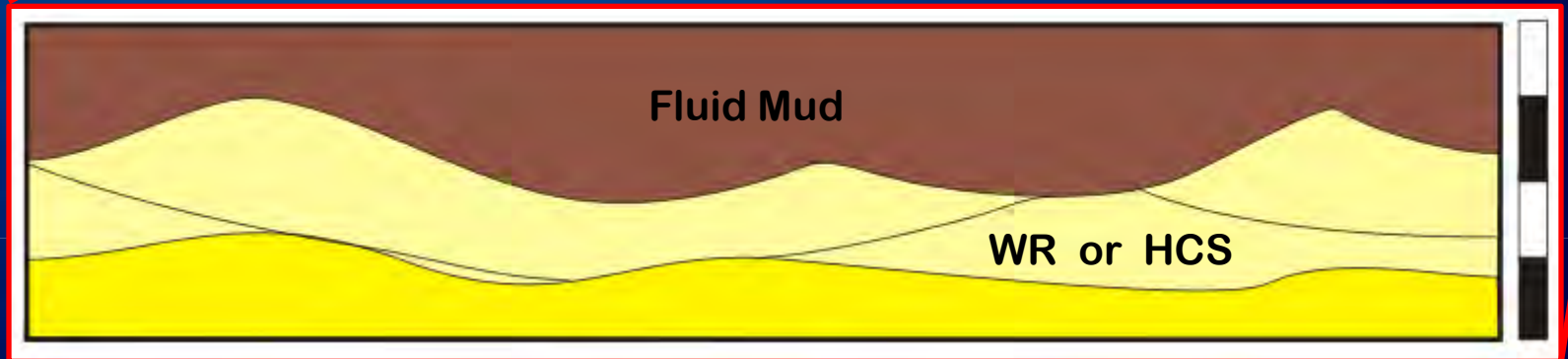
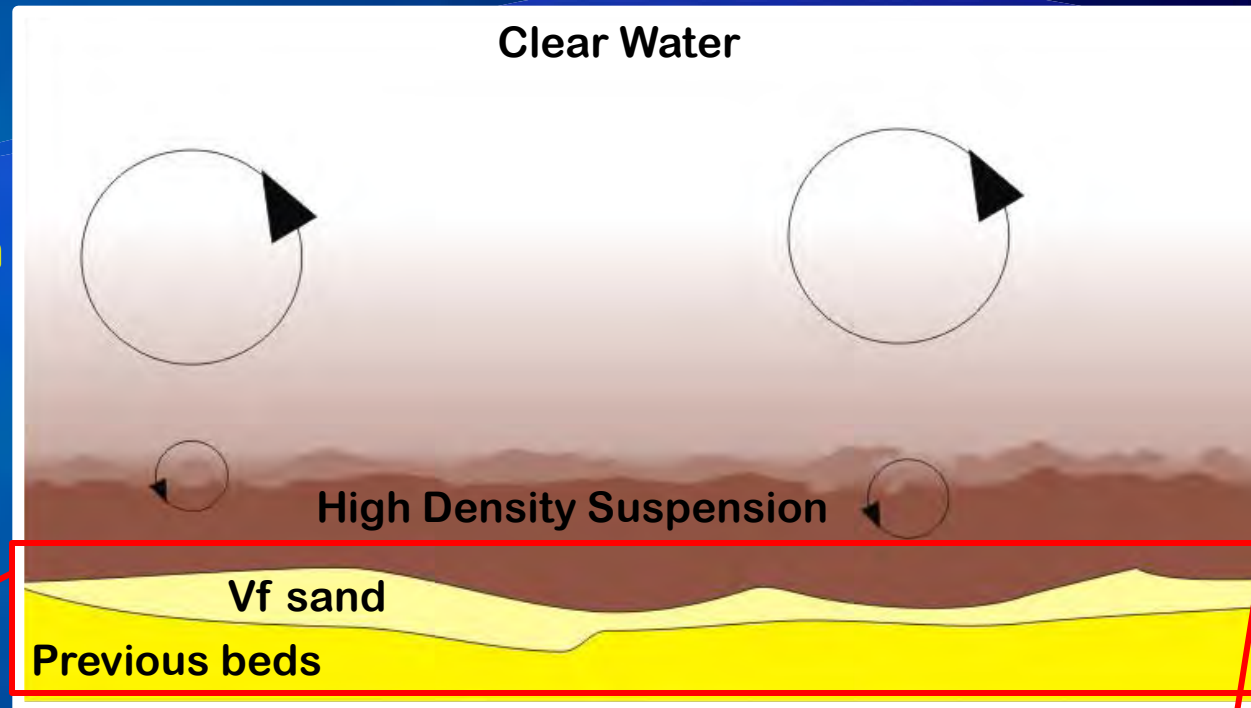
Thick mud layers above
wave-generated event beds



Origins of fluid mud in storm influenced delta fronts

Near-bed coarse-fraction concentration forms HCS and wave ripples

Followed by HDS deposition



Modified from Lamb and Parsons, 2005

Conclusions

Fluid muds are internally homogeneous mud layers thicker than 1 cm.

Bioturbation is generally absent, except for post-depositional, top-down colonization.

In the Tilje Formation, fluid muds occur in 3 settings : 1) Tidal-fluvial channels, 2) Mouth bar / terminal distributary channels, and 3) Storm influenced delta fronts .

The diversity of environments and conditions in which fluid mud occurs is consistent with flume experiments and recent observations in modern environments dominated or influenced by tidal and wave processes.

Thanks.

