

# **Sedimentological and Ichnological Characteristics of the Inner Estuary, Fluvio-Tidal Transition and Riverine Reach of the Ogeechee River Estuary, Georgia, USA\***

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## **Abstract**

Recognition of differences in the sedimentological character of sediments deposited within the tidally influenced inner estuary and fluvio-tidal transition zone can significantly aid in subsurface facies identification. The Ogeechee River Estuary serves as an excellent modern analogue of a sand-dominated micro- to meso-tidal estuary. Sedimentological and ichnological characteristics and facies distribution of sand- and granule-rich deposits are presented. This research project is focused on the inner estuary, fluvio-tidal transition and fluvial part of the Ogeechee River Estuary, Georgia, USA.

The inner part of the estuary is characterized by oligohaline salinities (3-4 ppt), large meander belts with point bars covered by sinuous dunes and superimposed linguoid current ripples. Medium-to fine-grained sand and finely dispersed organic debris accumulate on bar surfaces. Vague surficial tracks and trails, produced by amphipods and insects, are present. Large- and small-scale trough cross-stratification with preserved tidal reversals, flaser bedding, mud rip-up clasts, and “cryptically” bioturbated sediment fabric likely passes into the rock record. The apparent “cryptic bioturbation” seems to reflect the activity of meiofauna or alternatively may have been caused by destruction of primary sedimentary structures by air bubbles. The fluvio-tidal transition is typified by freshwater to oligohaline salinities (0-3 ppt) and fluvially dominated point bars with tidal influence. Point bars are formed of coarse- to very coarse-grained sand and abundant organic debris. Reworked dunes with reactivation surfaces and superimposed shallow rhomboidal ripples will be preserved in the rock record as ebb-dominated, large- and small-scale trough cross-stratification, and planar horizontal lamination. Fine-grained material and mud clasts are sourced locally from

the surrounding marshes and swampy forests. Tracks of birds, trails of snails and dragonfly larvae, and burrows by blue crabs are observed on the point bars. Fiddler crab burrows and tunnels occur within firm substrates. The fluvial reach of the Ogeechee River Estuary exhibits extensive point bars occupying up to 80% of the river floor, consisting of coarse- to medium-grained sand with granules. It is characterized by freshwater salinities (0-1 ppt). The underwater point bars are covered by ebb-oriented sinuous dunes and superimposed current ripples. Fiddler crab burrows occur within the muddy firm ground.

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AAPG 2016, Calgary, AB, Canada

# Outline

- Study area
- Research goals
- Field and laboratory methods
- Results and observations
- Interpretation: facies model
- Conclusions





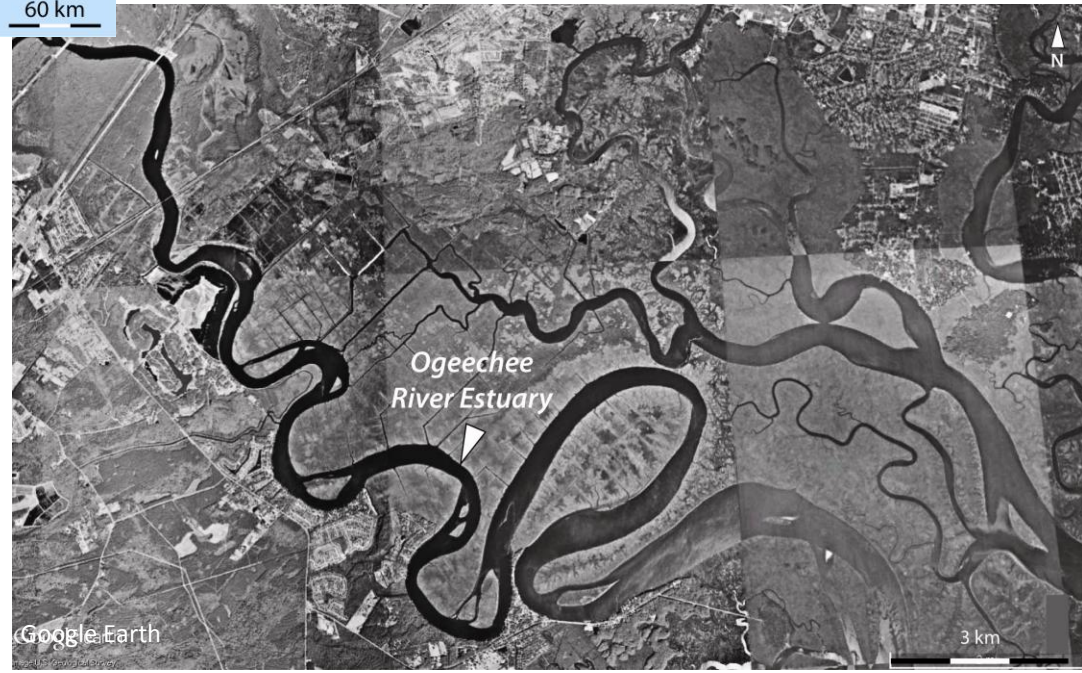
# Study Area

- Rises in the Piedmont area
- 400 km long
- 90% drainage from the coastal plain
- Erodes large sandy paleochannel deposits



<http://mapsof.net/georgia/georgia-rivers-and-lakes>

- Upper microtidal to lower mesotidal regime
- Extensive salt marshes and deciduous/cypress trees
- Blackwater river
- Subtropical climate





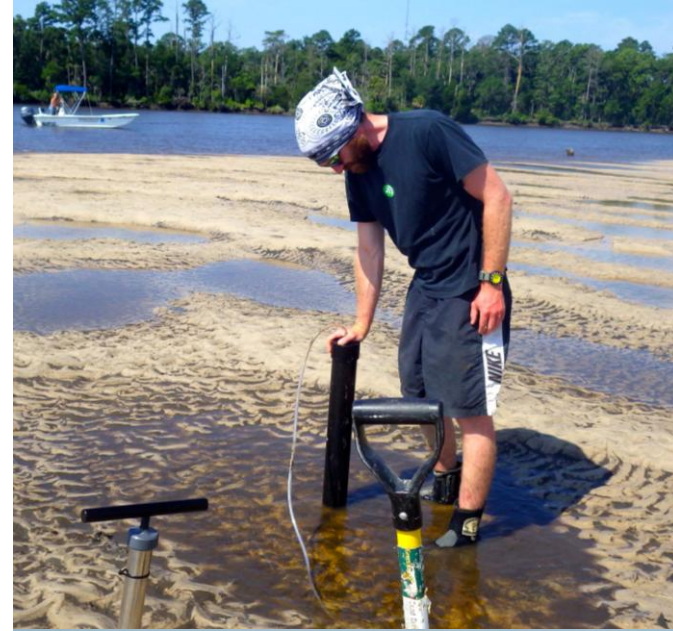
# Research goal

Establish a facies model of the inner estuary to the fluvial setting using detailed sedimentological and ichnological observations.



# Field methods

1. Observations of physical and biological sedimentary structures.
2. Measurements of water salinity using a refractometer.
3. Collection of surficial samples.
4. Suction and box coring.
5. Observations of physical sedimentary structures in trenches.



# Laboratory methods

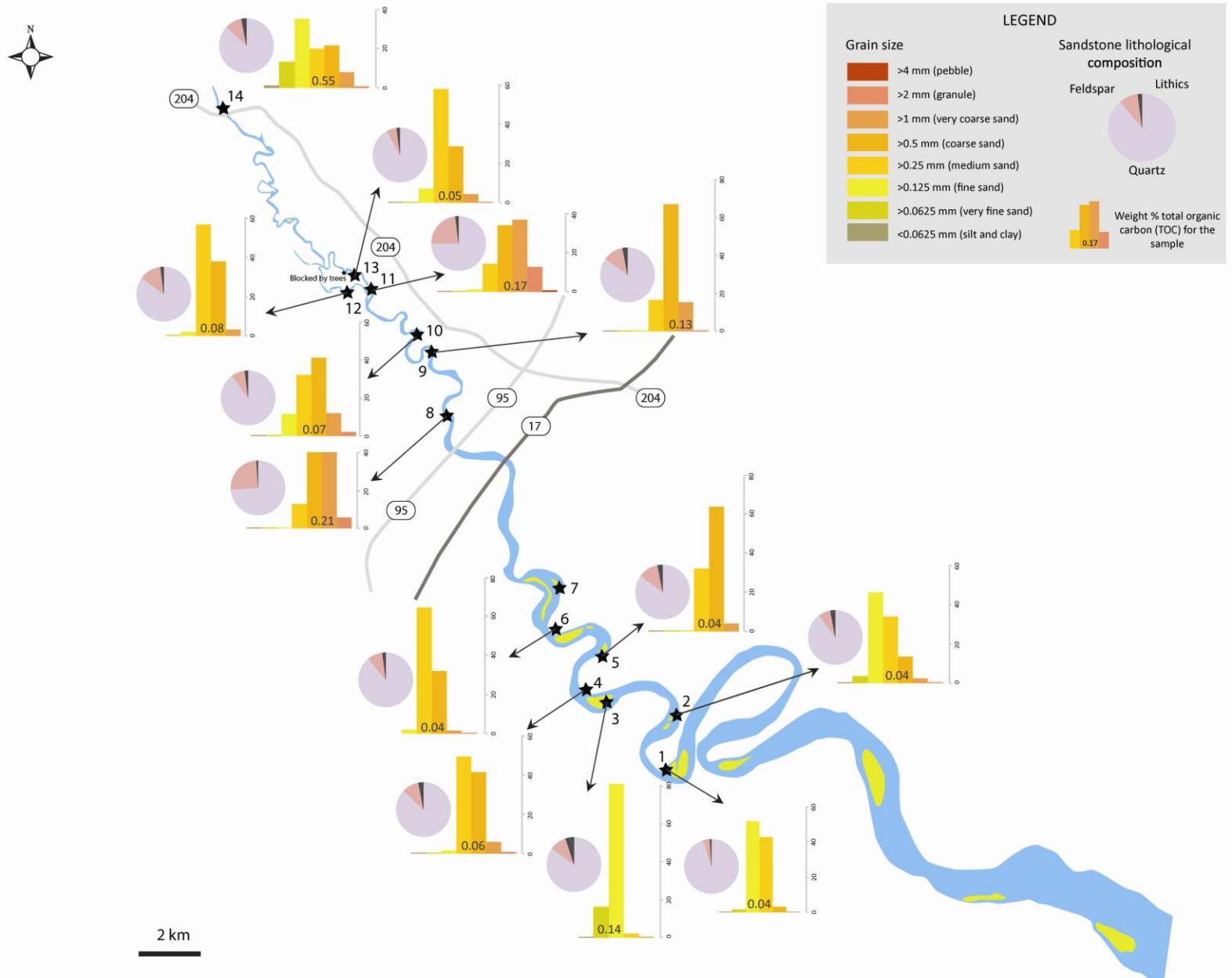
Samples were transported to U of A

1. Grain-size analyses of the samples.
2. Measurements of total organic carbon (TOC).
3. Optical microscopy for determination of the mineralogy.
4. Core logging.
5. Daylight photography.

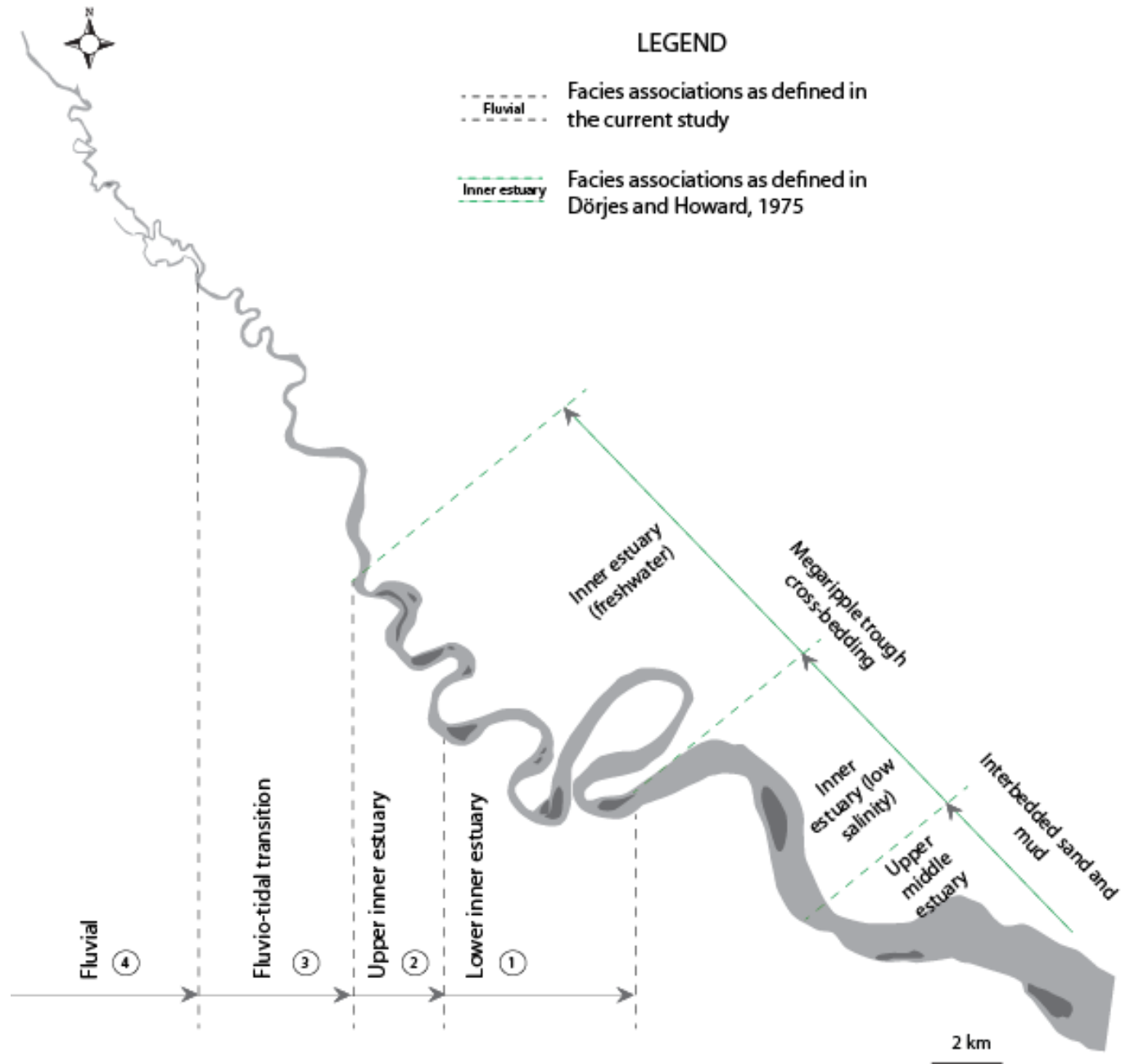




# Results and observations



# Results and observations



# Results and observations

## *Grain-size trends:*

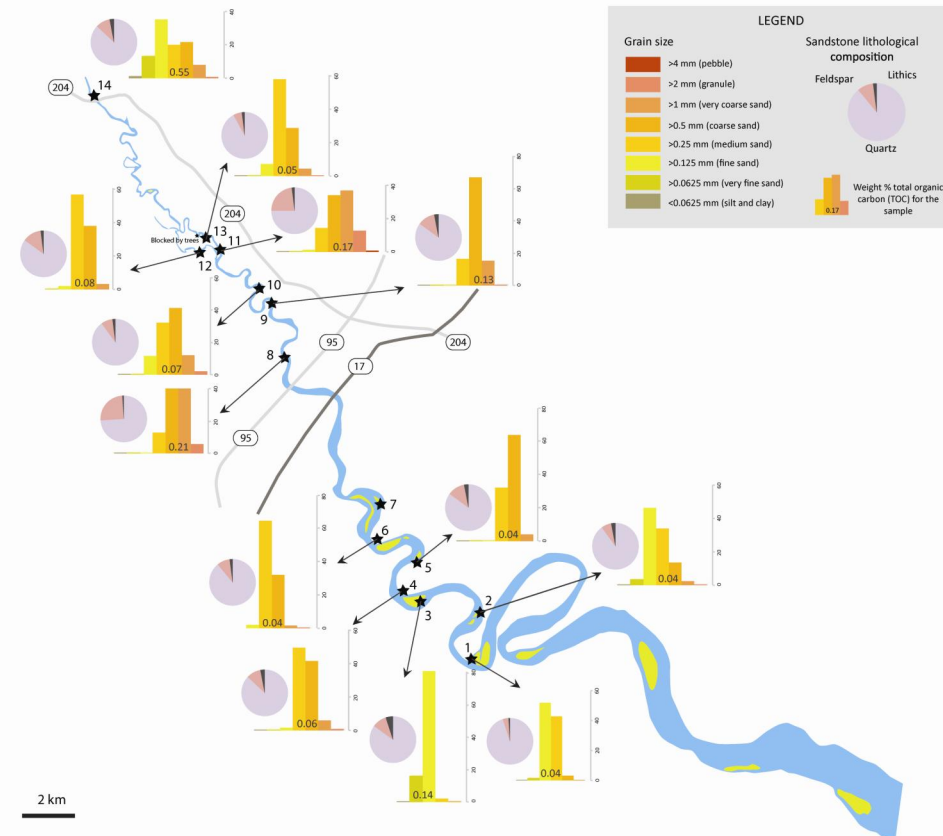
- Lower inner estuary: medium-fine sand (80.6-95.3%)
- Upper inner estuary: coarse-medium and medium-coarse sand (91.5-96.6%)
- FTZ: very coarse to coarse sand (70.9-82.5%) with more equitable distribution
- Fluvial: coarse-medium sand (92.3-95.1%)

## *TOC trends:*

- Inner estuary: 0.04-0.14% in sst, <16% in mud
- FTZ: 0.07-0.21% in sst, 7.6-9.3% in mud
- Fluvial: 0.05-0.08% in sst, <4.9% in mud

## *Mineralogy trends:*

- Quartz: 74-95%
- Feldspar: 3-12%, up to 25% in coarse sand
- Lithics: 1-5%



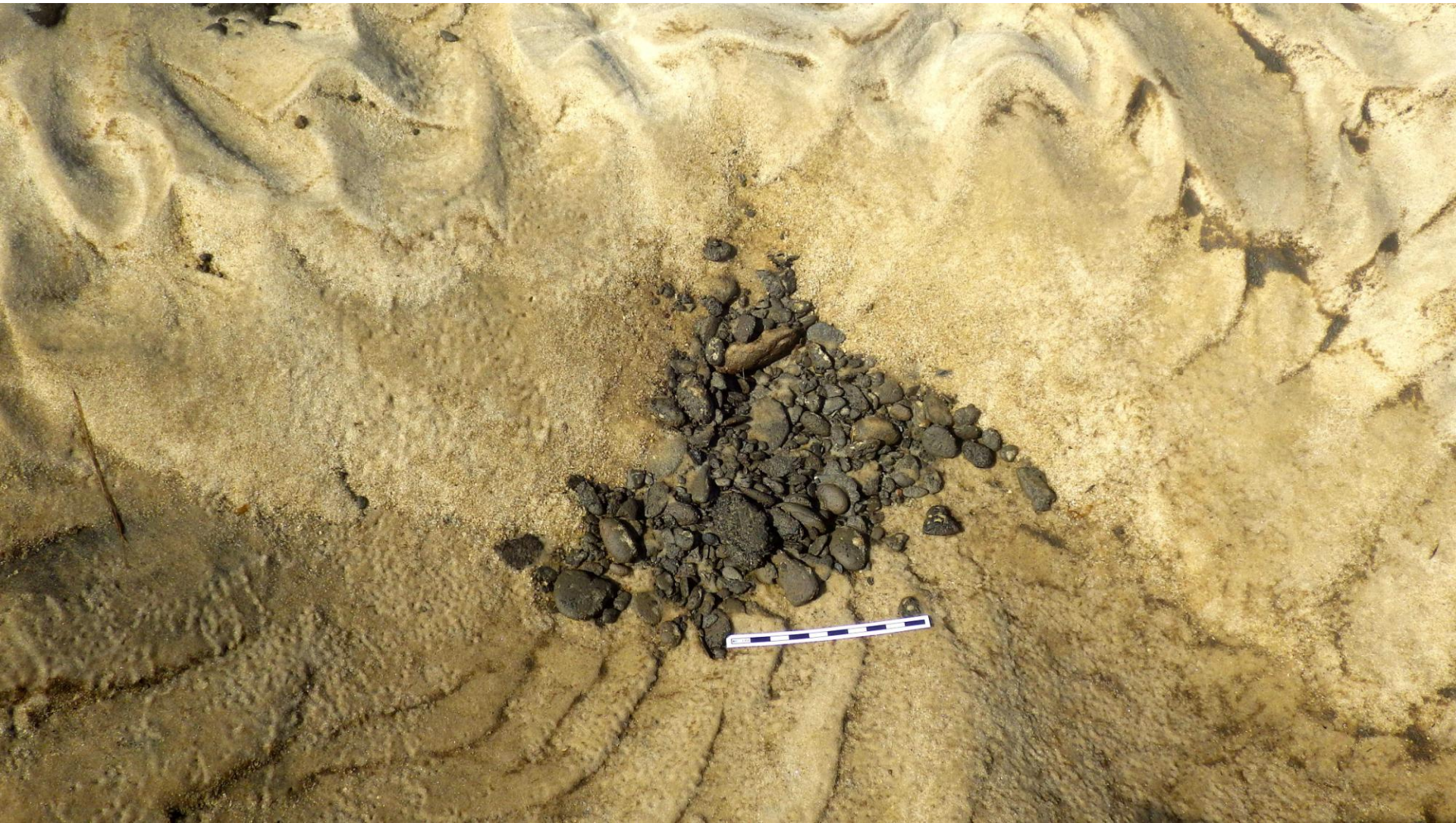
# Lower inner estuary



Sinuuous and straight-crested dunes overprinted by linguoidal current ripples.



# Lower inner estuary



Silty clay, phytodetrital material, and mud rip-up clasts in the dune troughs.



# Lower inner estuary



The amount of organic material increases towards the channel margins.



# Lower inner estuary



Flaser and wavy bedding, mud rip-up clasts.



# Lower inner estuary



Structureless: activities of meiofauna (amphipods) and air bubbles trapped in the sediment.



# Lower inner estuary





# Upper inner estuary



Composite ebb-oriented dunes covered by sinuous and straight-crested dunes; capped by swash marks / rhomboidal current ripples.



# Upper inner estuary



Organic debris collected at the dune troughs.



# Upper inner estuary



Trough cross-bedding and planar tabular bedding with superimposed ripple cross-stratification. Scarce organics. Bedding contacts marked by concentrated organic debris.



# Fluvio-tidal transition



Dunes are reworked by ebb-tidal currents that generate reactivation surfaces. Organic debris is abundant.



# Fluvio-tidal transition



Ebb-oriented sinuous dunes covered in rhomboidal or straight-crested current ripples. Organics collected at the dune troughs.



# Fluvio-tidal transition



Salt marsh sources mud rip-up clasts into the channel.



# Fluvio-tidal transition



Large-scale trough and planar cross-stratification, abundant layers and lenses of phytodetritus, and rip-ups.



# Fluvial zone



Sinuuous dunes with superimposed linguoidal current ripples and organic material collected at the dune troughs.



# Fluvial zone



Ebb-dominated dunes covered by swash marks and rhomboidal ripples.



# Fluvial zone



Mud rip-up clasts sourced into the channel thalweg from the adjoining floodplain area.



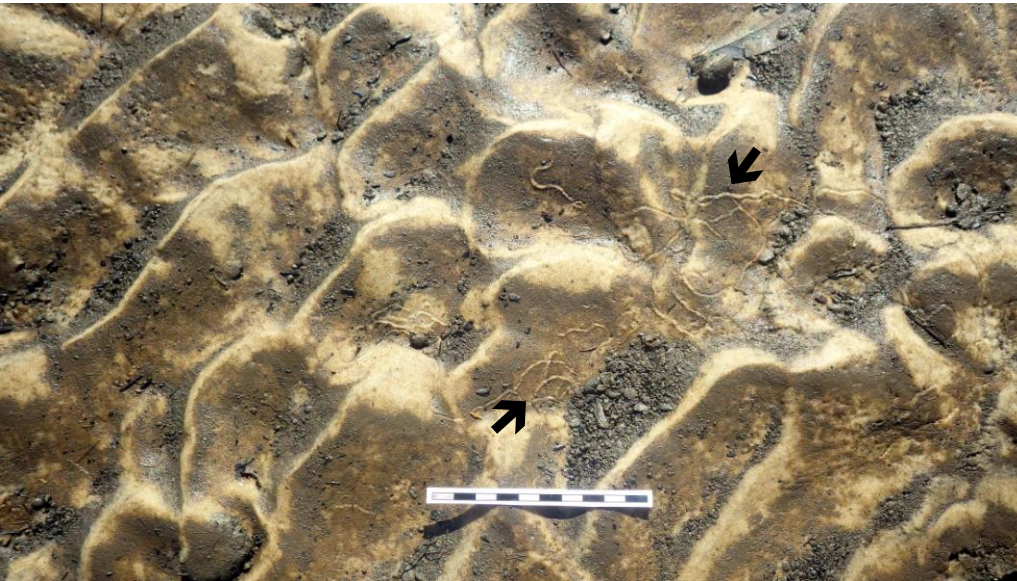
# Fluvial zone



Structureless to large-scale trough and planar cross-stratification with current ripples. Layers of organic mud.



# Neoichnology of point bars



Amphipod trails



Bird-foot tracks



Freshwater mussel (*Corbicula fluminea*)



Blue crab (*Callinectes sapidus*)

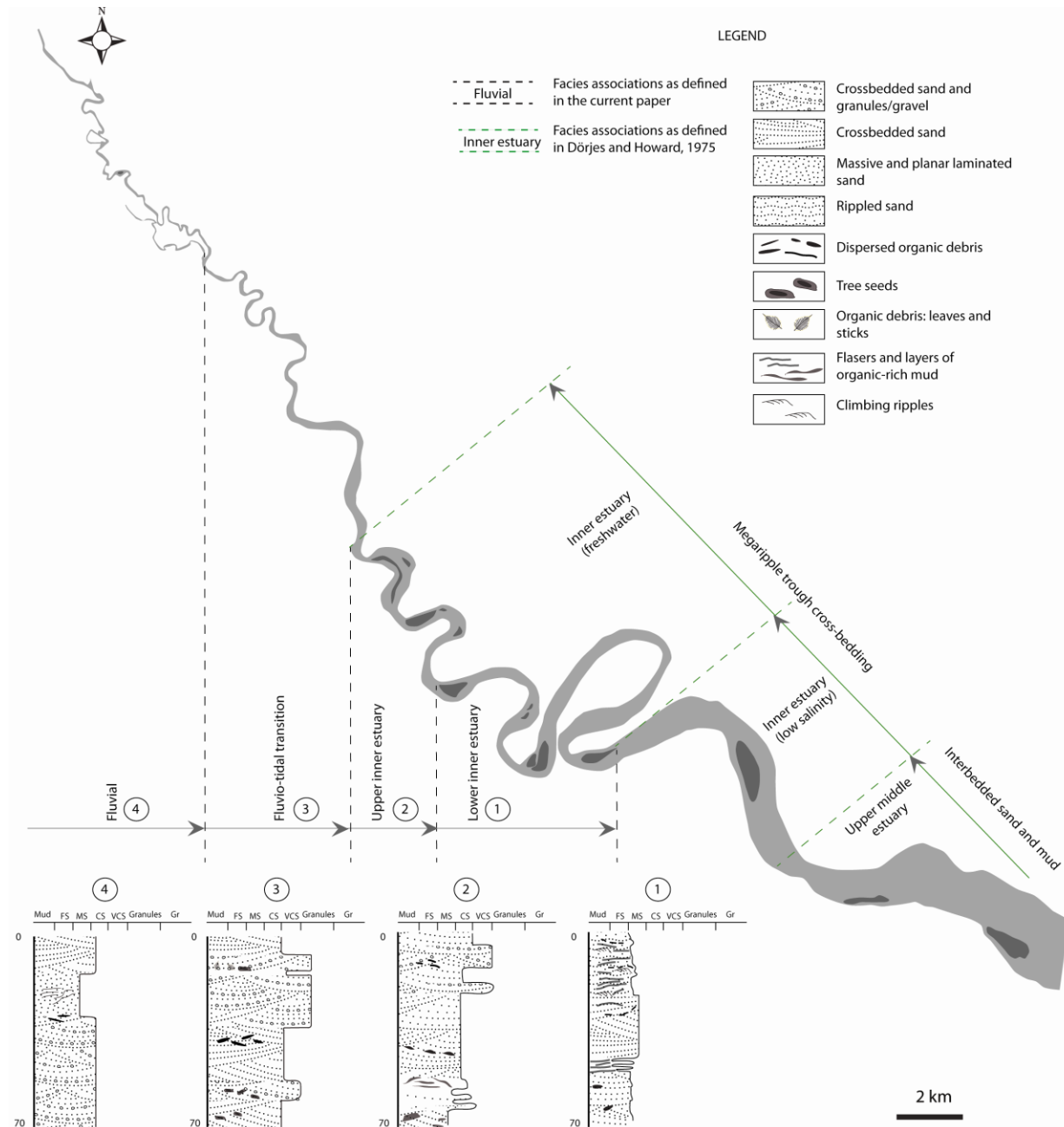


# Neoichnology of marsh and floodplain





# Interpretation: Facies Model





# Conclusions

- The Ogeechee River estuary - excellent example of the upper microtidal, sand-dominated estuary.
- Ichnological dataset is subordinate to physical sedimentary structures.
- Physical sedimentary structures, grain size, and TOC still permit separation of estuarine from fluvio-tidal and fluvial deposits.



# Acknowledgements

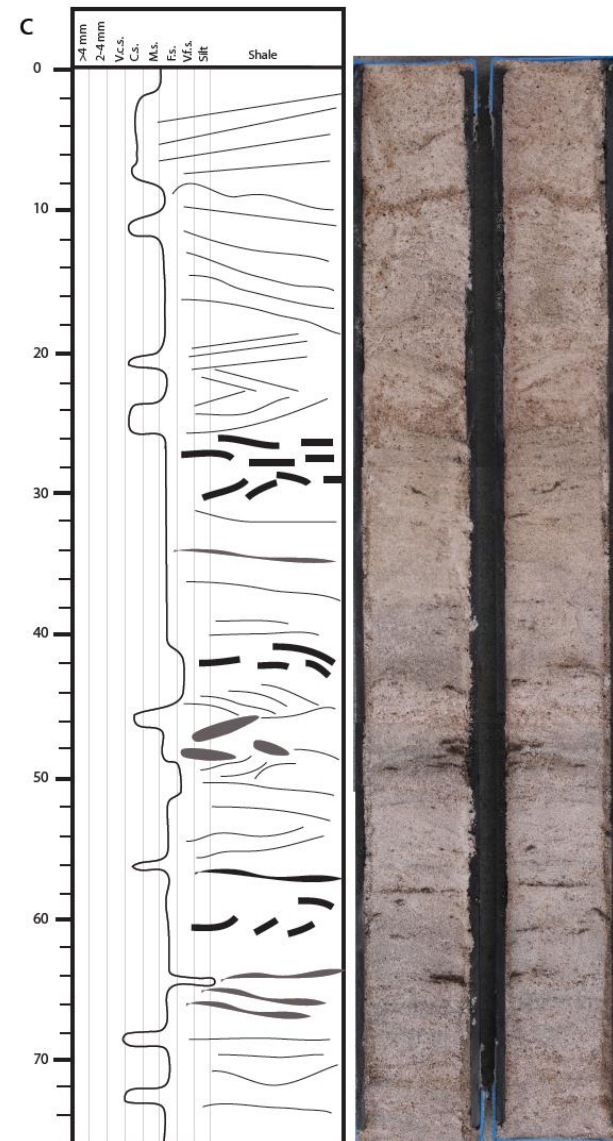
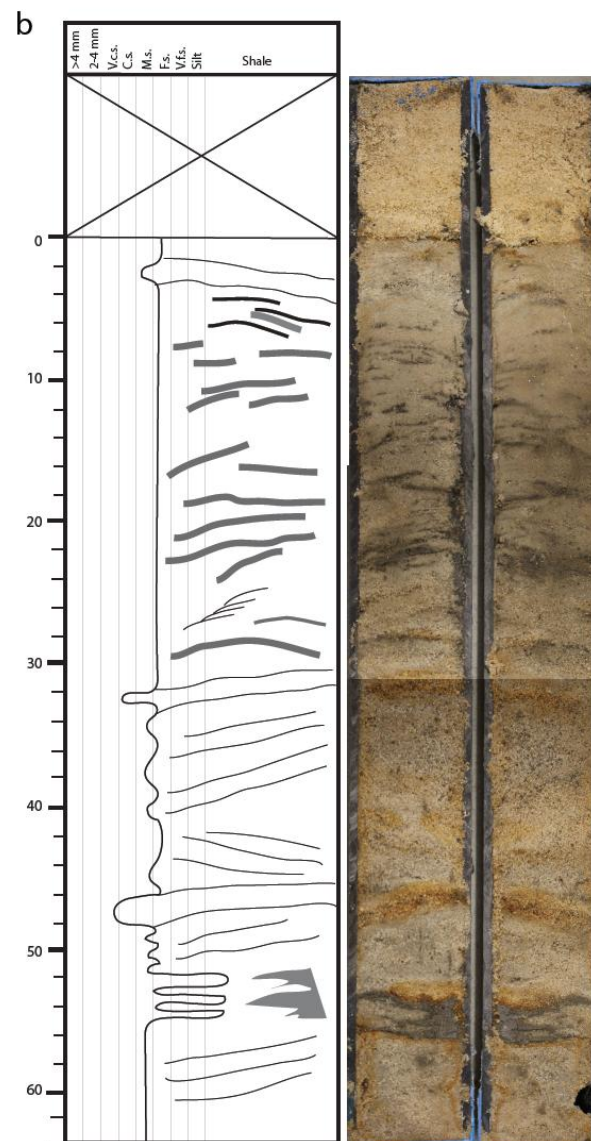
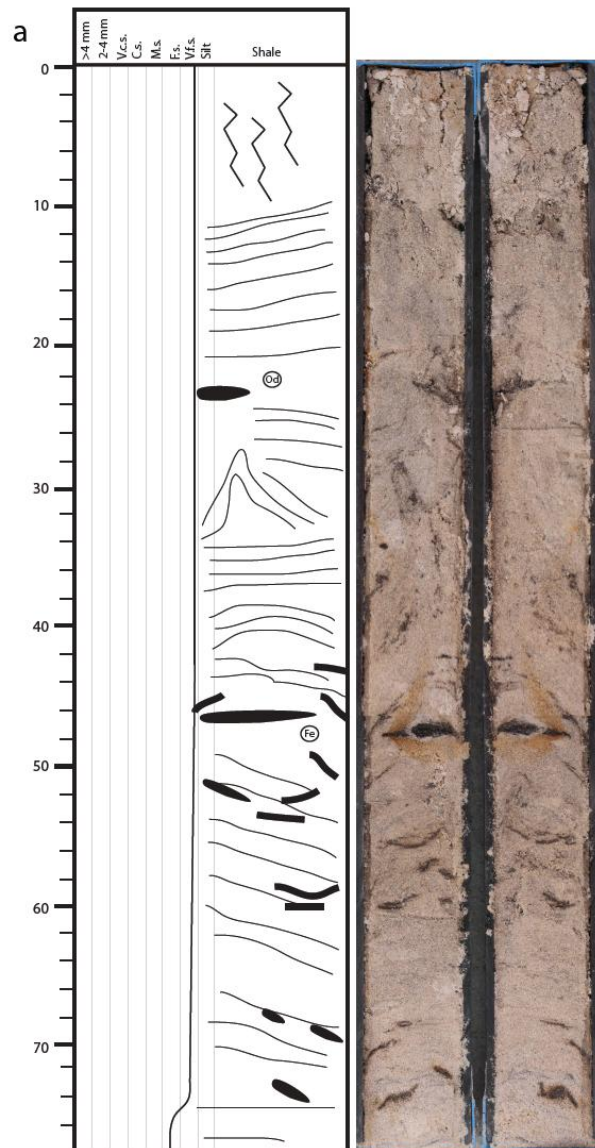
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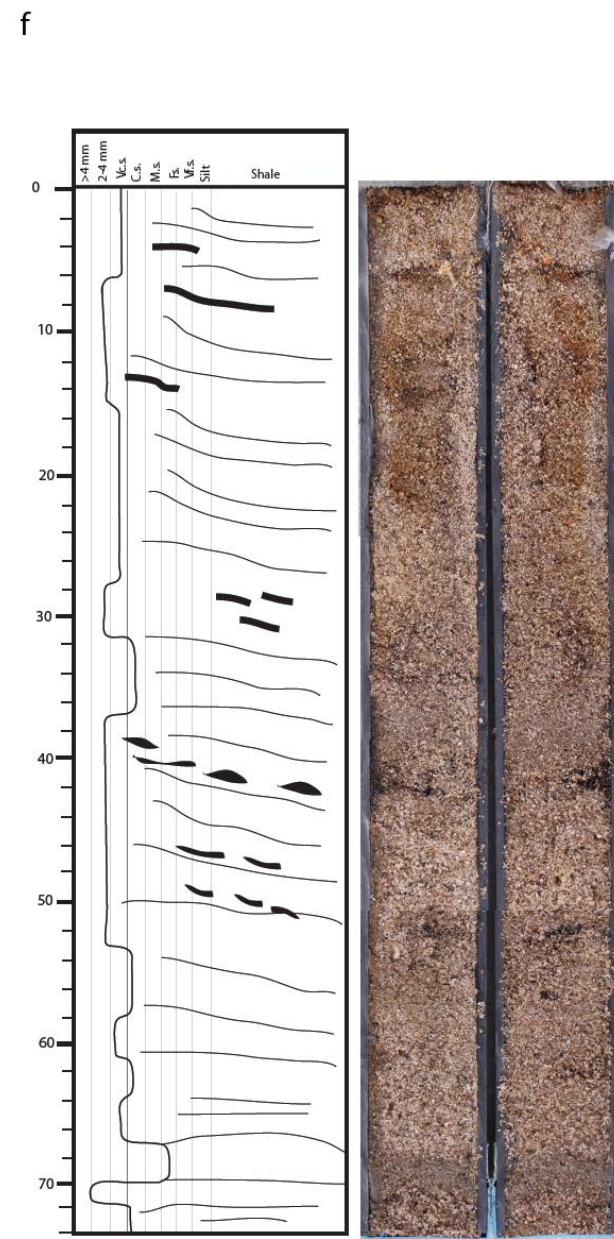
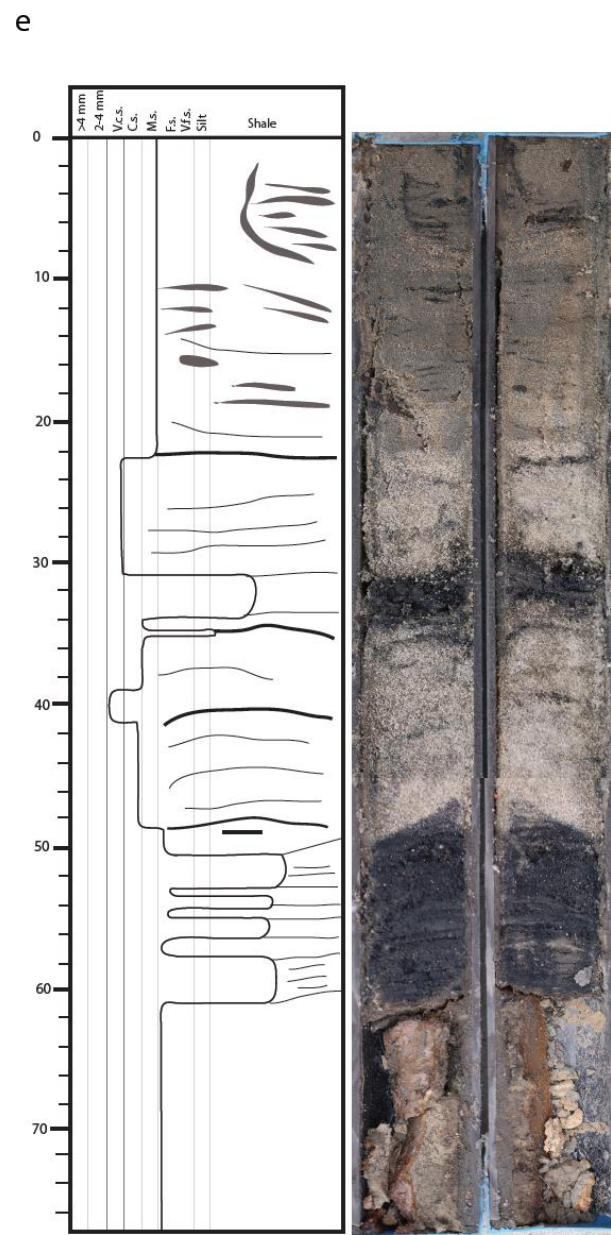
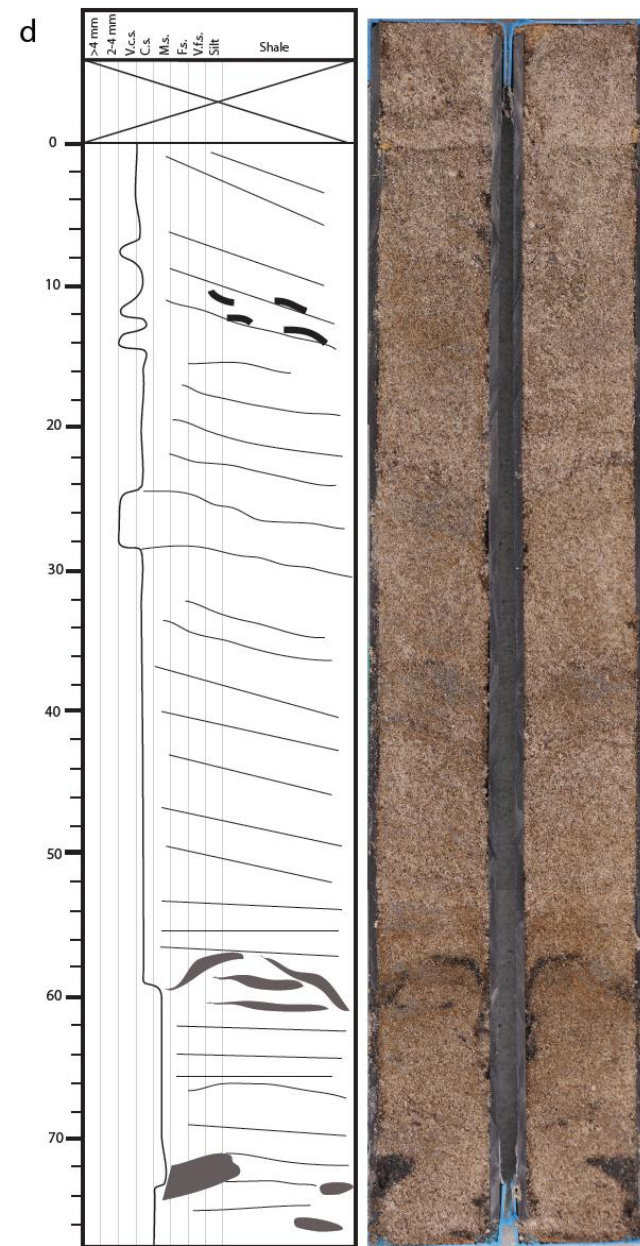






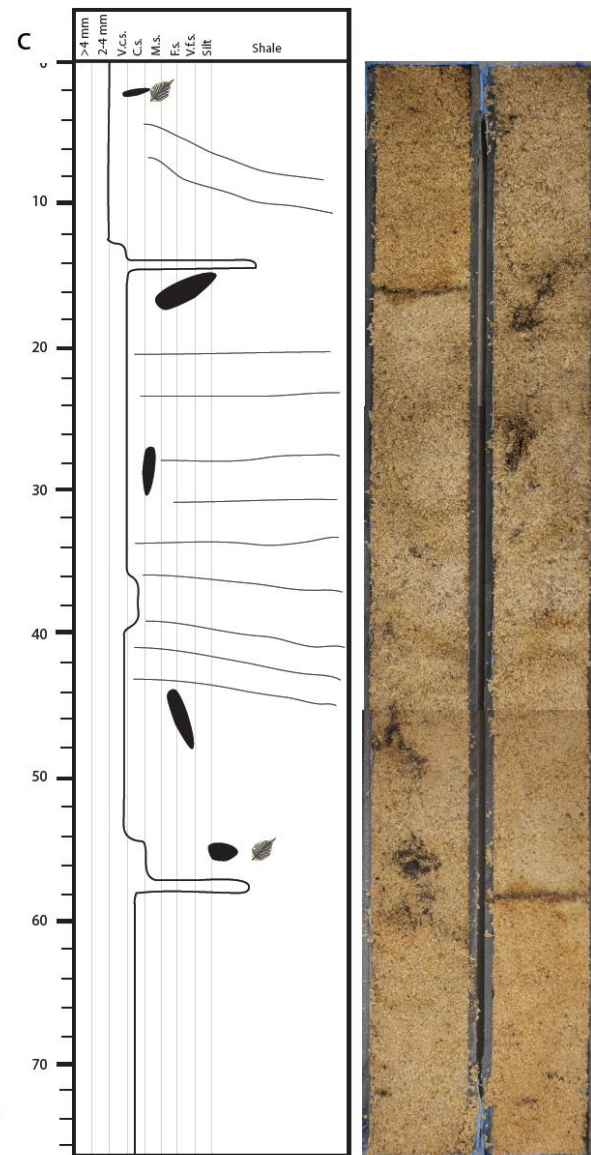
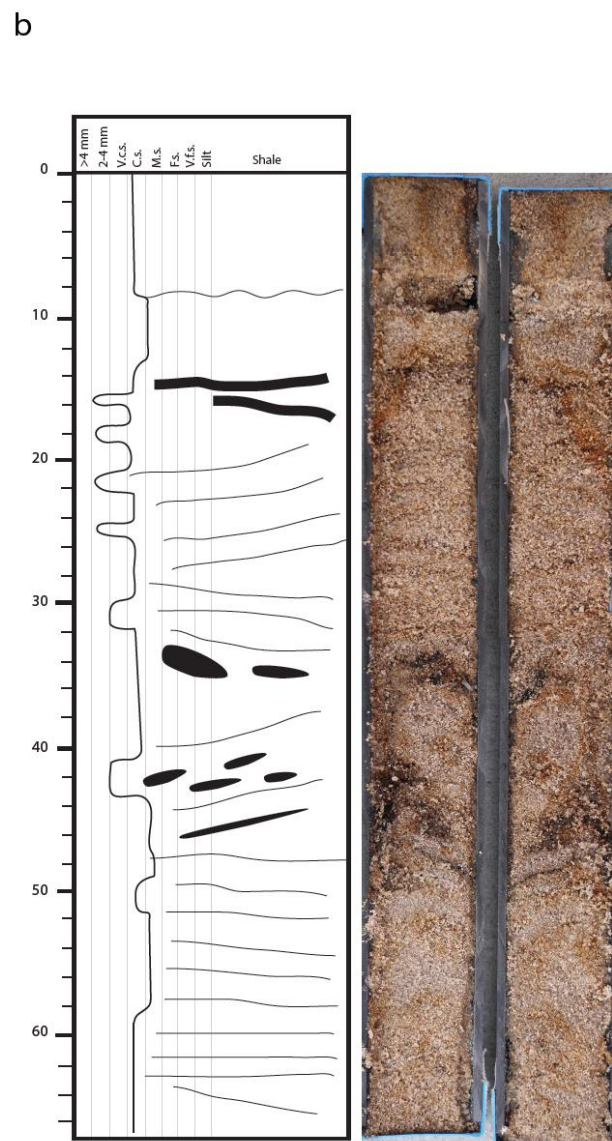
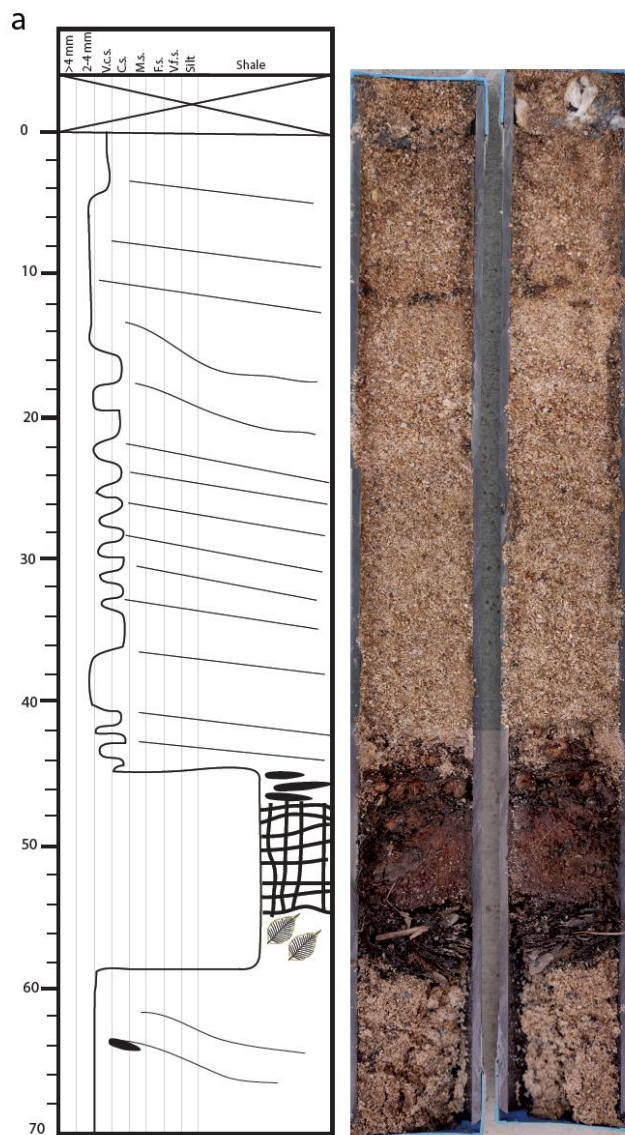
Lower inner estuary





Upper inner estuary

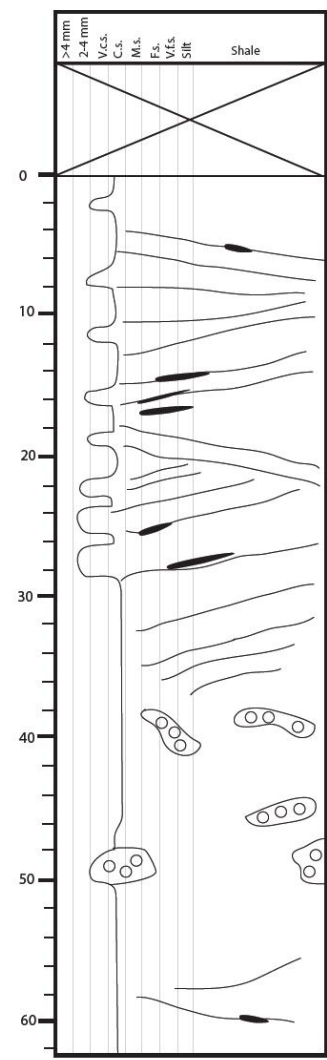




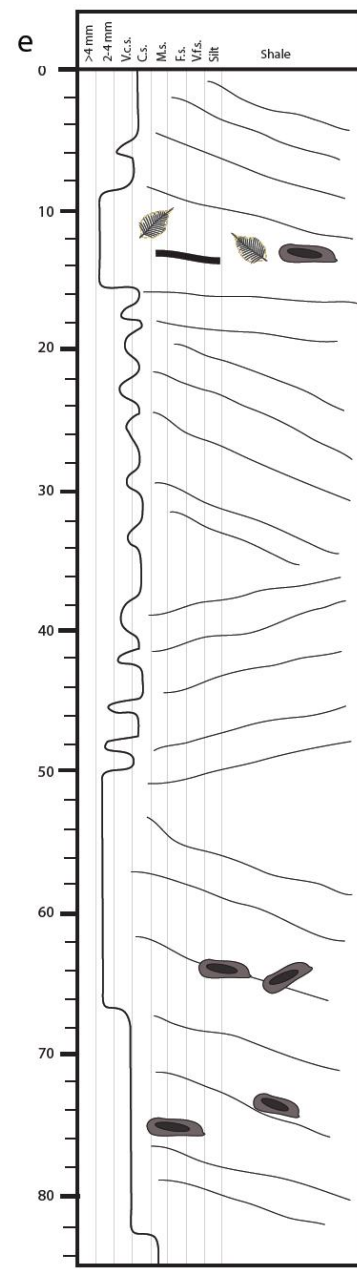
FTZ



d

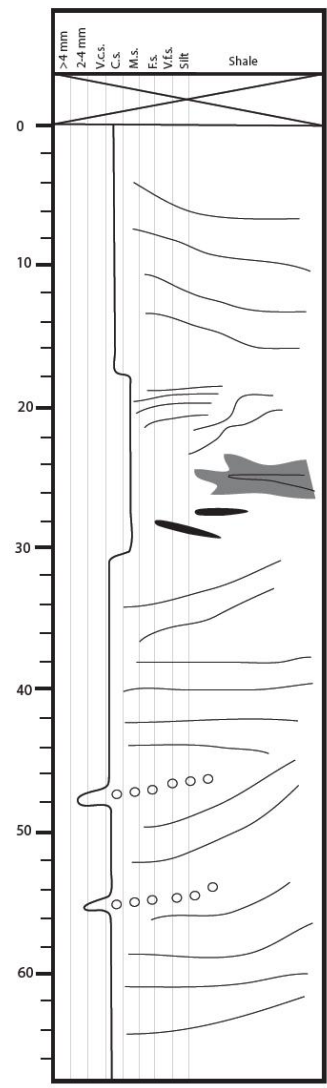


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FTZ

f



Fluvial