Battelle
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AECOM Imagine it. Delivered.

PRISM™
PRedictive Integrated Stratigraphic Modeling

Leveraging PRISM™ to Refine High Resolution Site Characterization (HRSC) Techniques at a Complex Geologic Site, Washington DC

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April 16, 2019

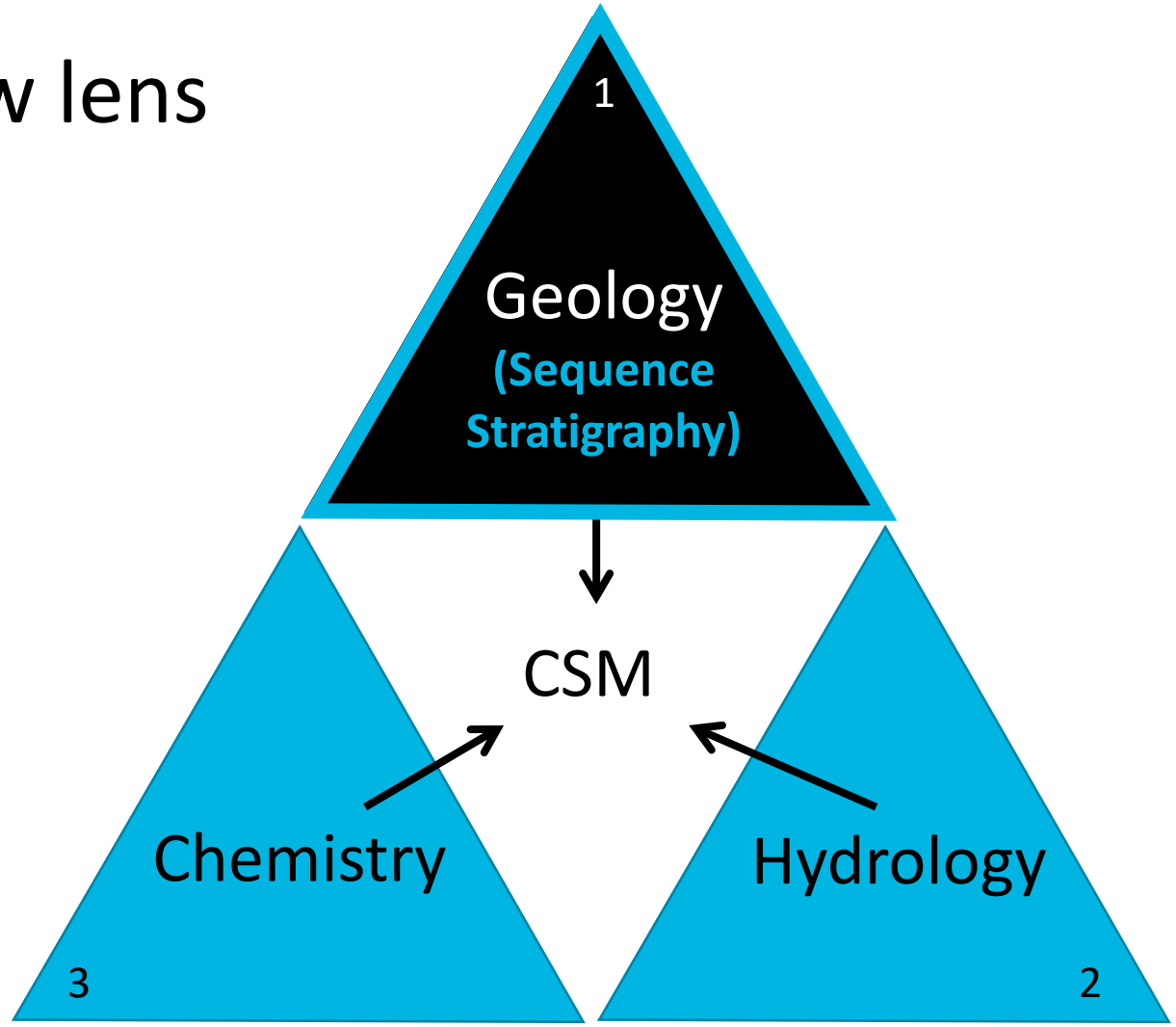
1. CIV NAVFAC Washington

PRISM™ – PRedictive Integrated Stratigraphic Modeling

The subsurface through a new lens

- Reduce Life-Cycle Costs:
  - Leverage pre-existing data
  - Streamline investigations
  - Optimize LTM & remediation
- Define and Manage Liability
- Build Stakeholder Trust
- Evaluate alternative endpoints

Deliver the industry's first fully integrated CSM



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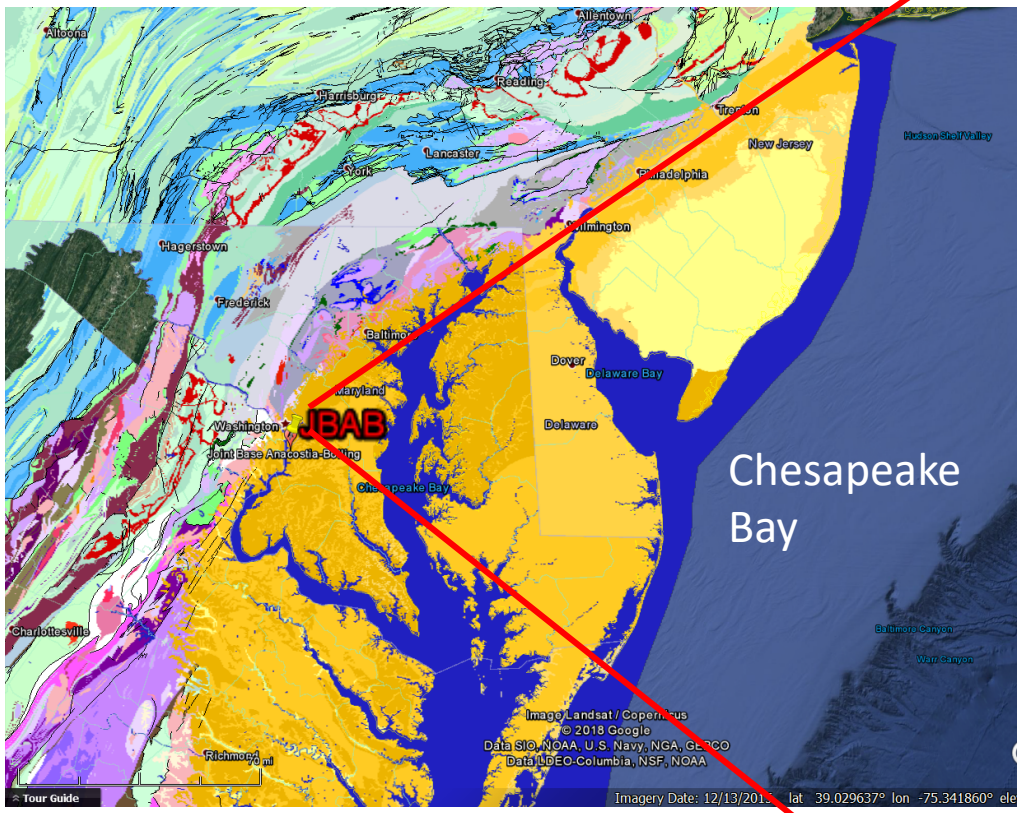
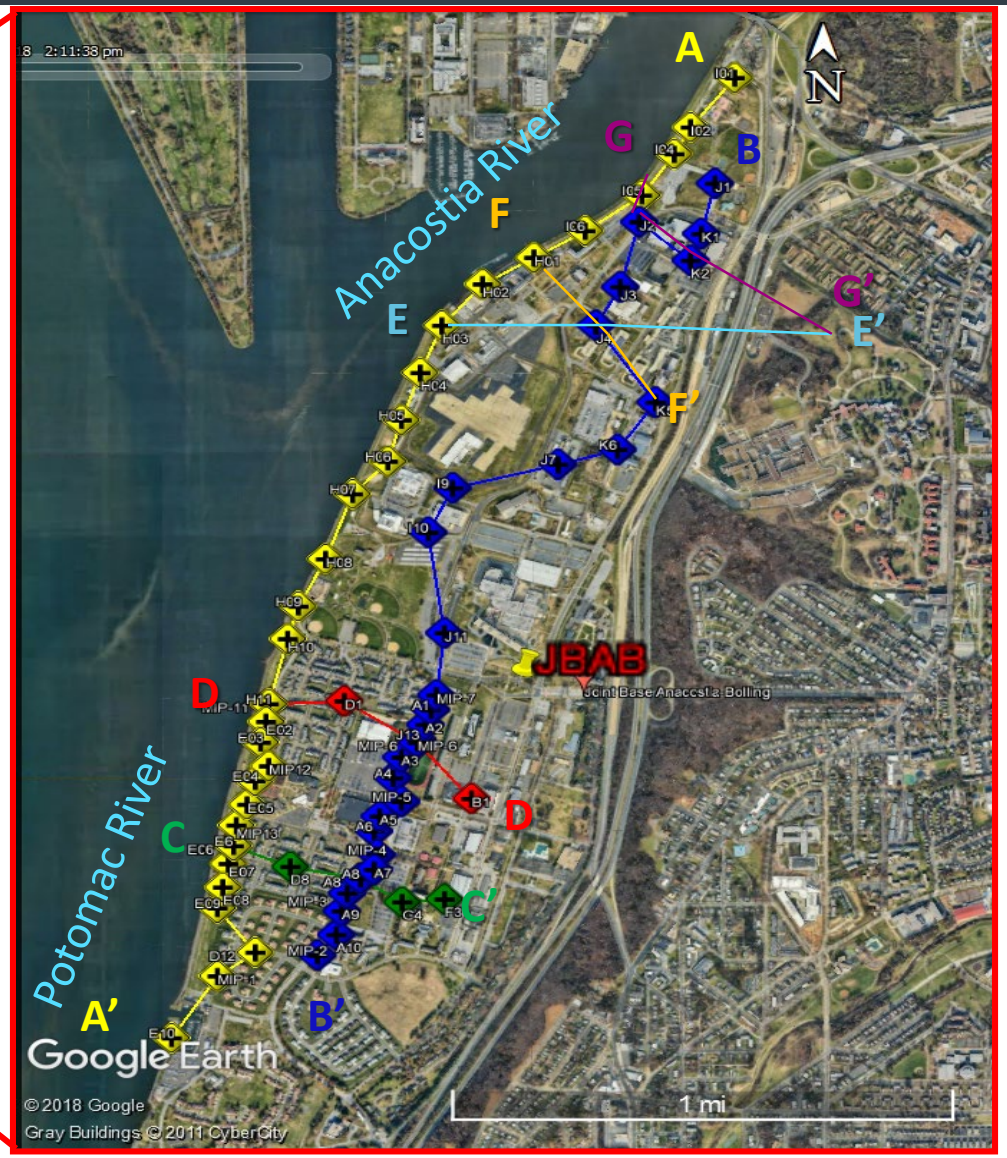
Objectives

- Understand the impacts of stratigraphy on contamination plume migration
- Supplement an existing HRSC/EVS model with stratigraphic input
- Apply PRISM™ to:

  - Build a geologically-defensible framework of the subsurface
  - Predict contaminant flow pathways, and
  - Use geologic constraints to refine Kriging estimates and better characterize the extent of contamination

Site Location & Data





Purpose: to better understand and predict the contamination plume's flow-path at the site

Data used:

- HPT logs from 72 wells in 7 cross-section transacts
- Boring logs from Water Division
- 3-D CSM derived from EVS model without geological input

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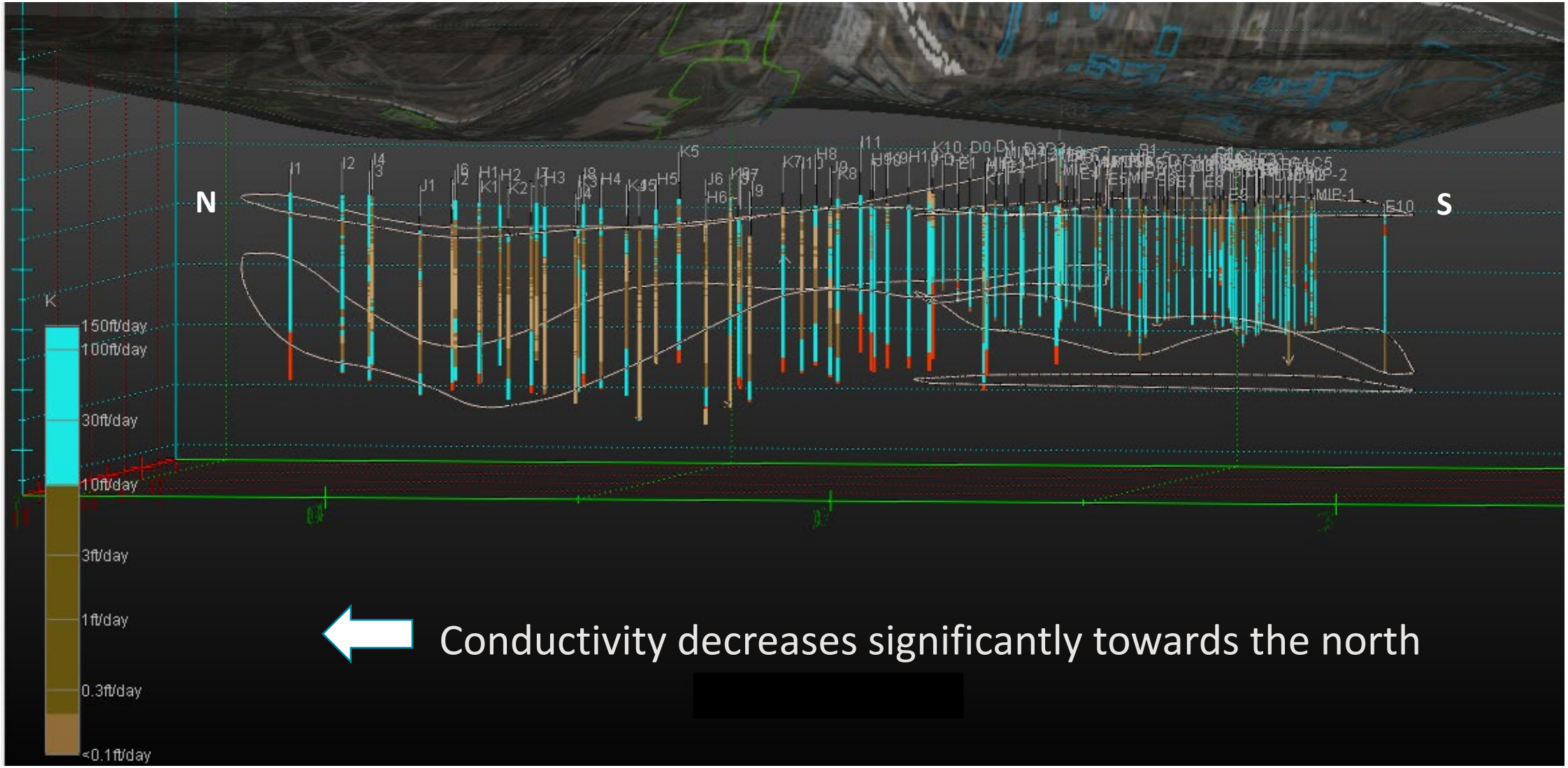
Hydraulic Conductivity from HPT Data in EVS



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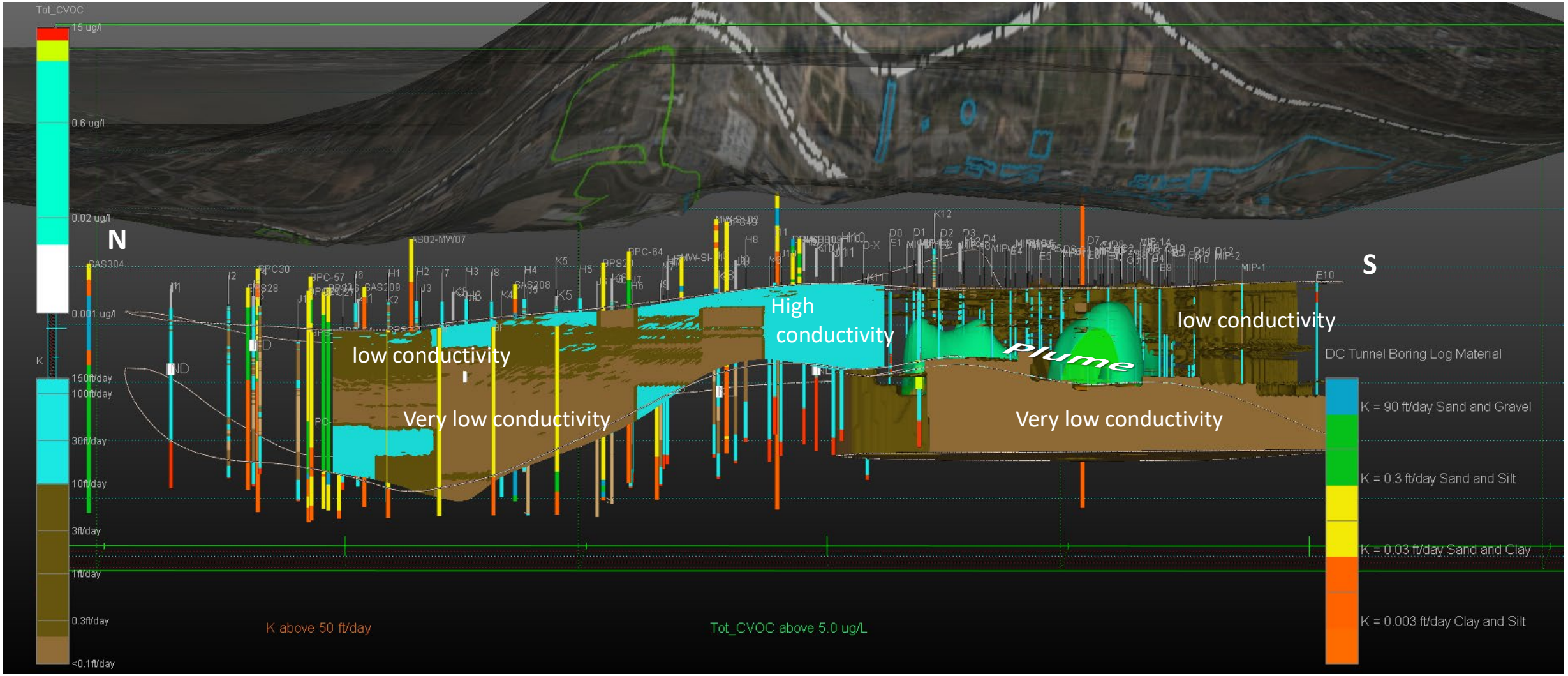
Original EVS Model (*K>50ft/Day*) - No Stratigraphic Input



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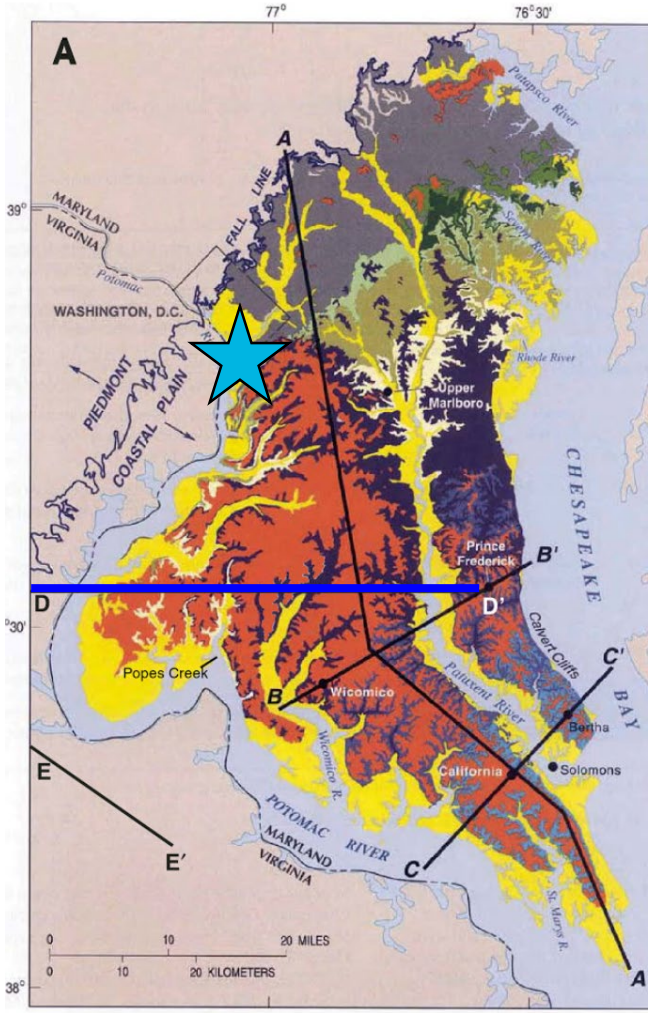
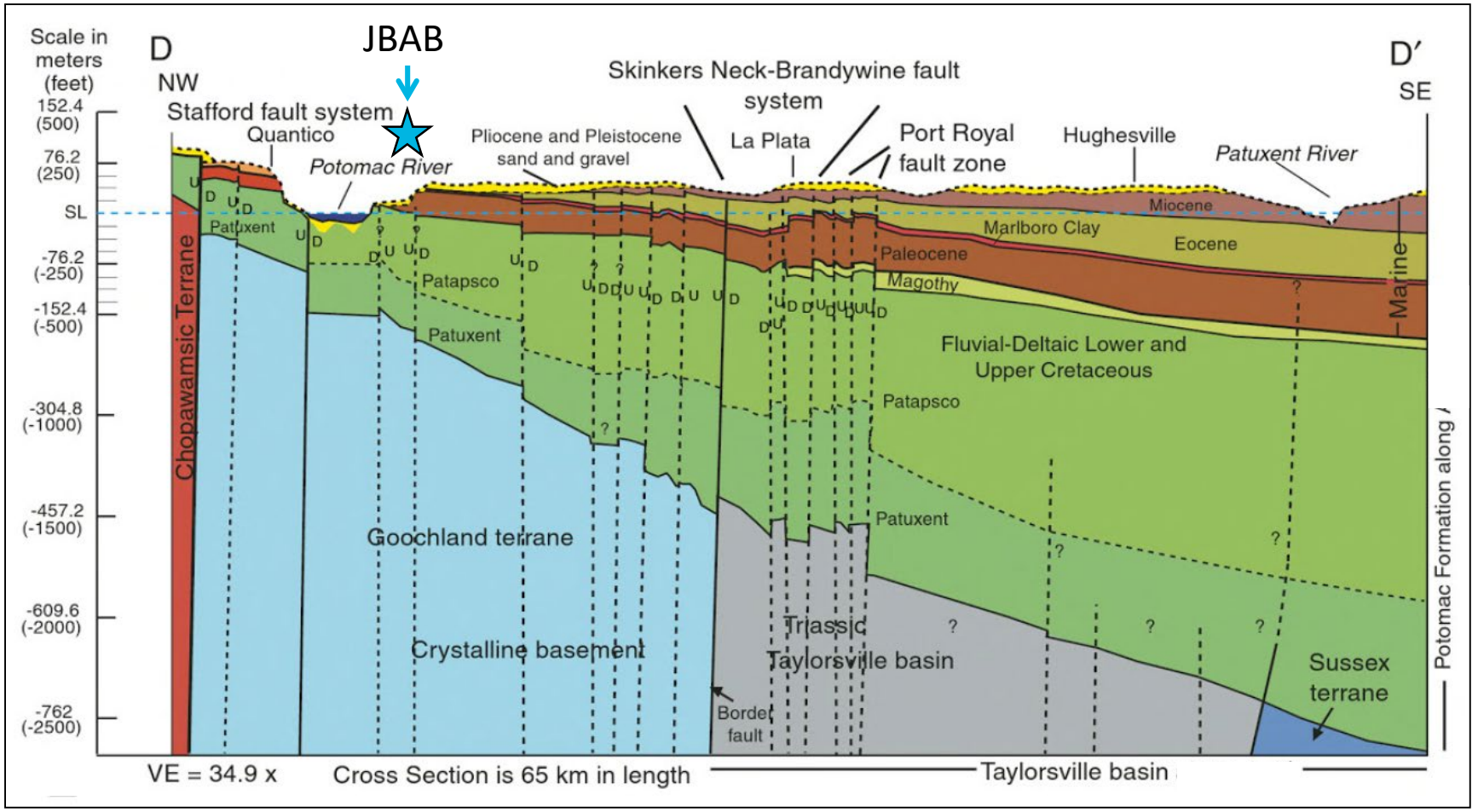
Regional Tectonic Setting





Numerous horst and graben structure with high angle normal and reverse faults across northern Virginia and southern Maryland.

Powars et al., GSA Field Guide 40, 2015

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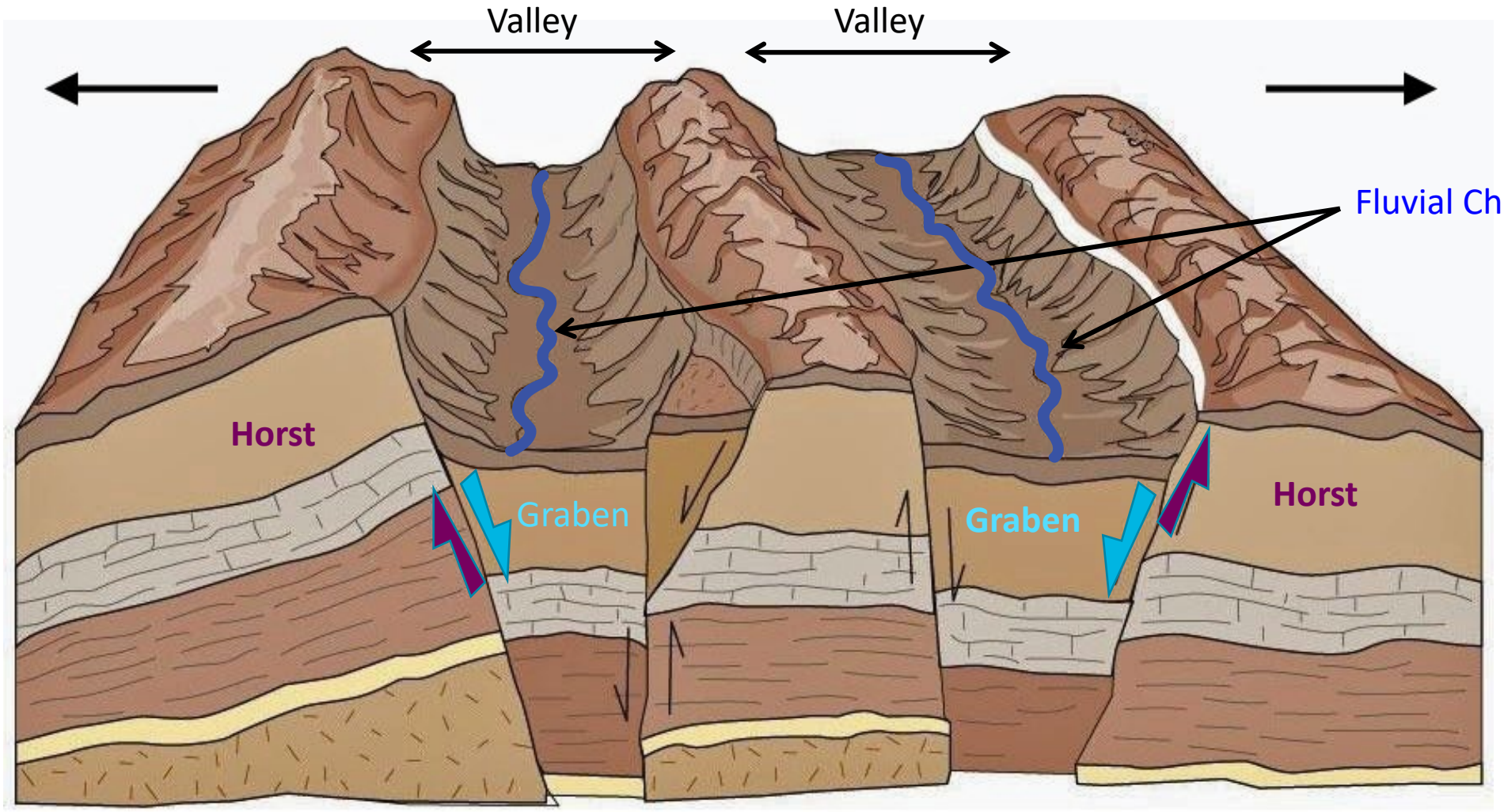
The Horst & Graben Model in Extensional Tectonics



– Modified from geoscience.wisc.edu

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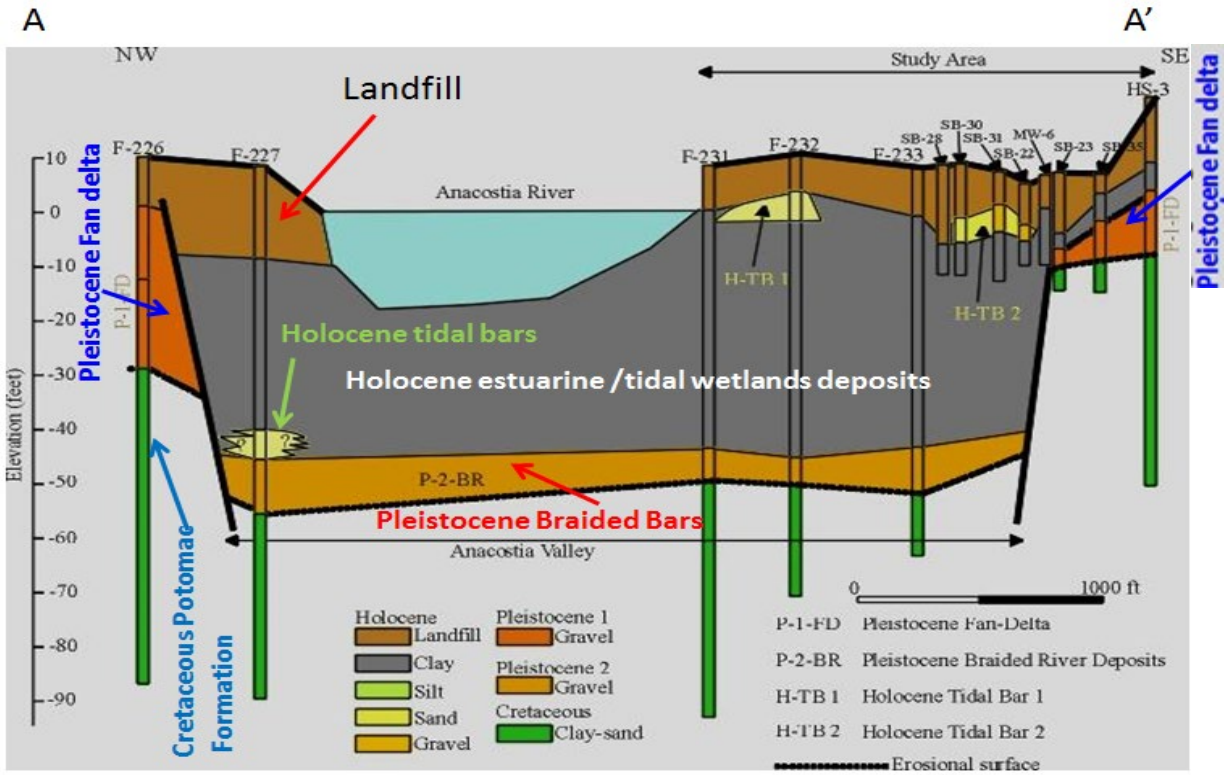
Stratigraphic Background



Stratigraphic Characterization and Ground Water Flow in the Poplar Point Area, Anacostia River Basin, Washington, D.C. From Csato et al., 2013

Poplar Point

Cross sections from Poplar Point show that the river valley formed under the influence of extensional tectonic activity. The Cretaceous basement is bounded by normal faults on both the northern and southern sides. These faults are thought to have controlled the location of the original Anacostia river valley.

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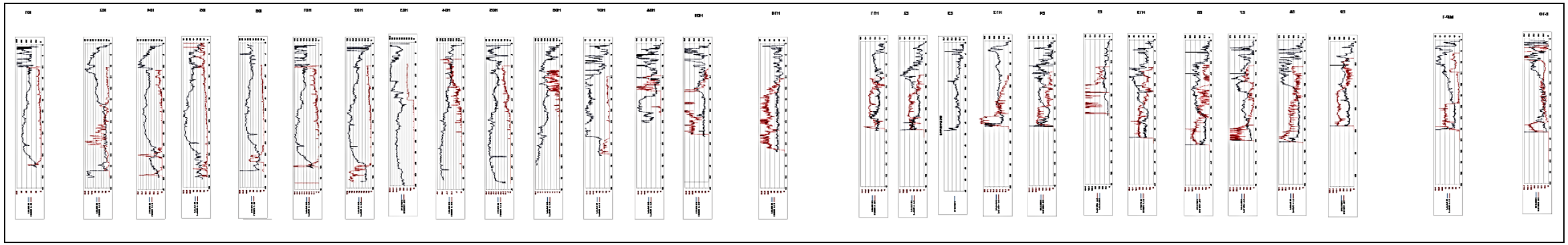
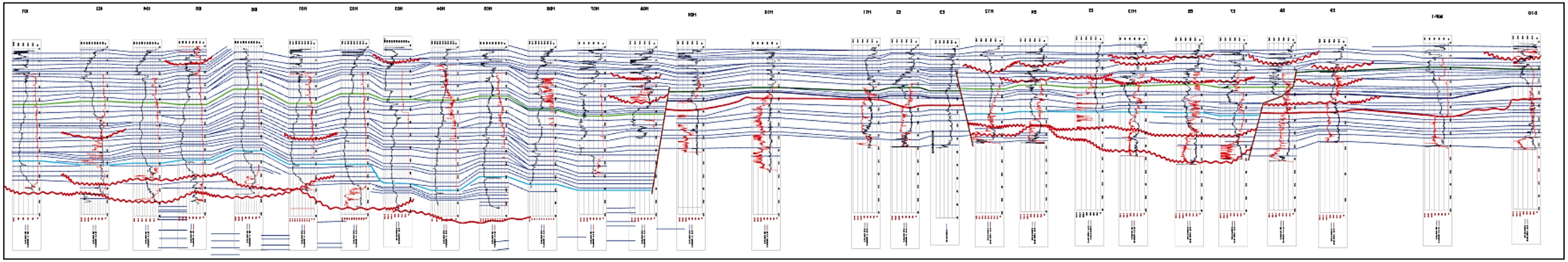
Correlation Technique Using Core & HPT Logs

N



S

Organize Data : Develop cross-section transect based on EC & K information from HPT logs



Interpretation:

- Identify Continuous shale markers
- Identify discontinuous channel markers
- Determine sequences

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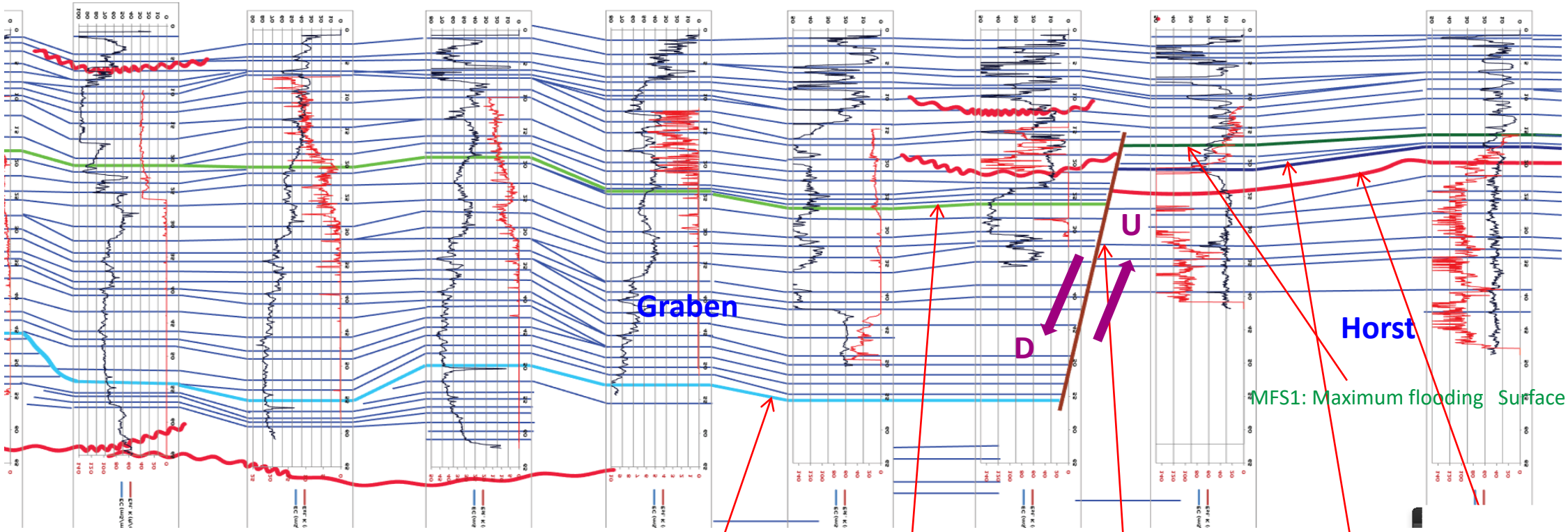
Correlation Technique Using Core & HPT Logs

North

South



Identify tectonics and all major sequence stratigraphic markers

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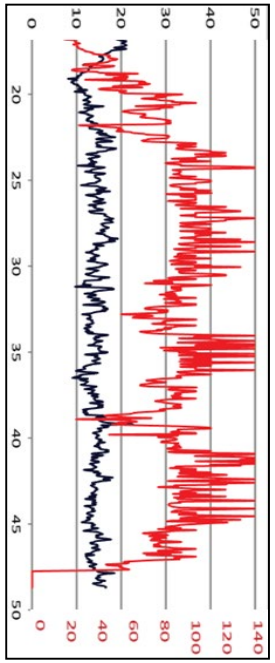
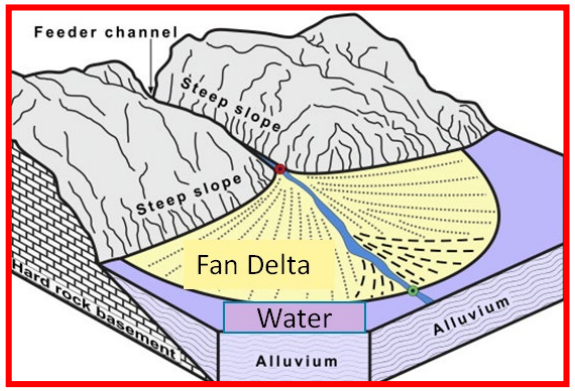
Depositional Facies of JBAB

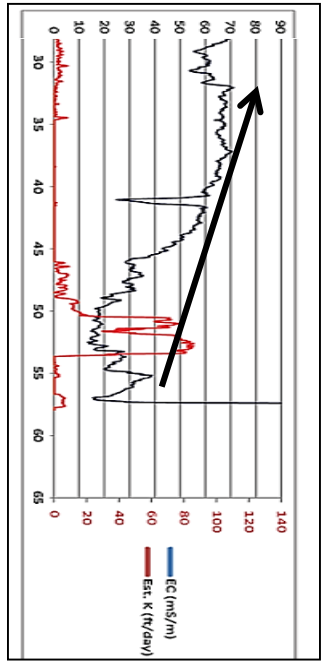
Fan Delta



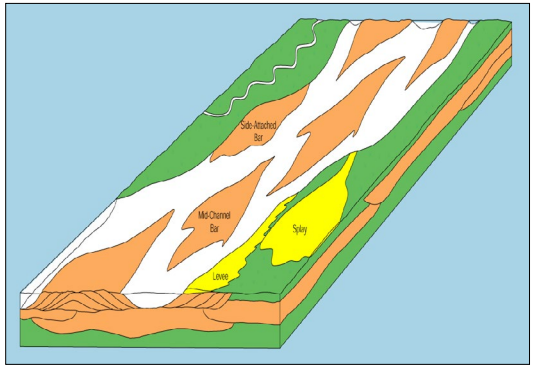
K value high (generally >80)



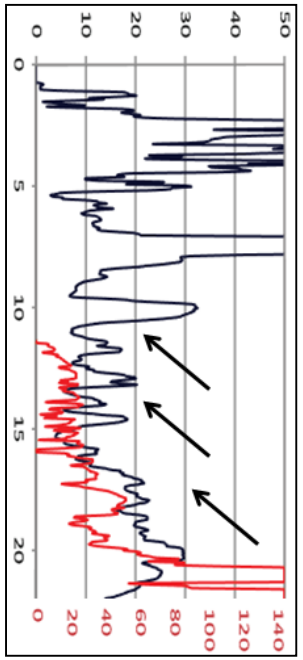
Channel Bar



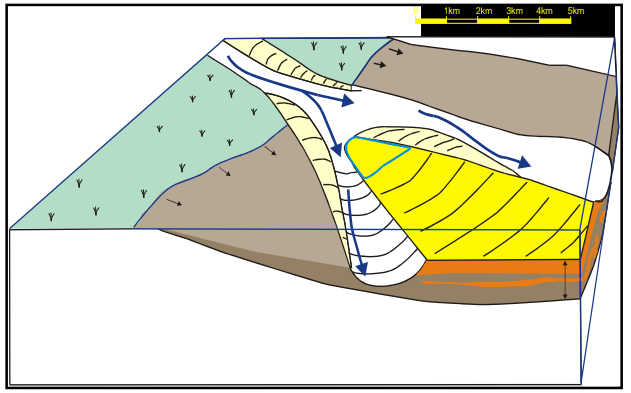
K value decreases upwards



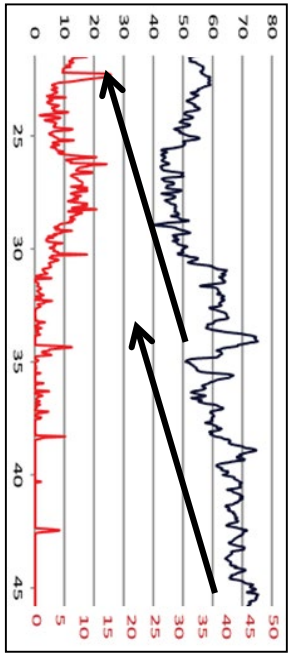
Bay-head Delta Mouthbar



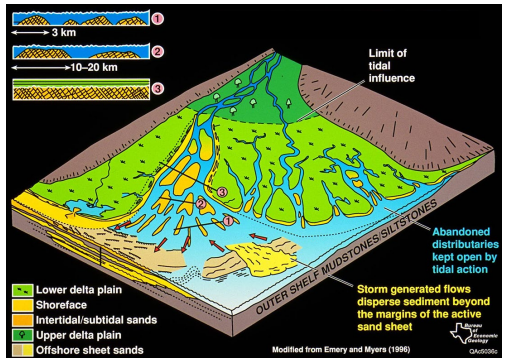
K value variable (~140 to <10), EC fining up



Tidal Bar



K value increases upwards within very low values



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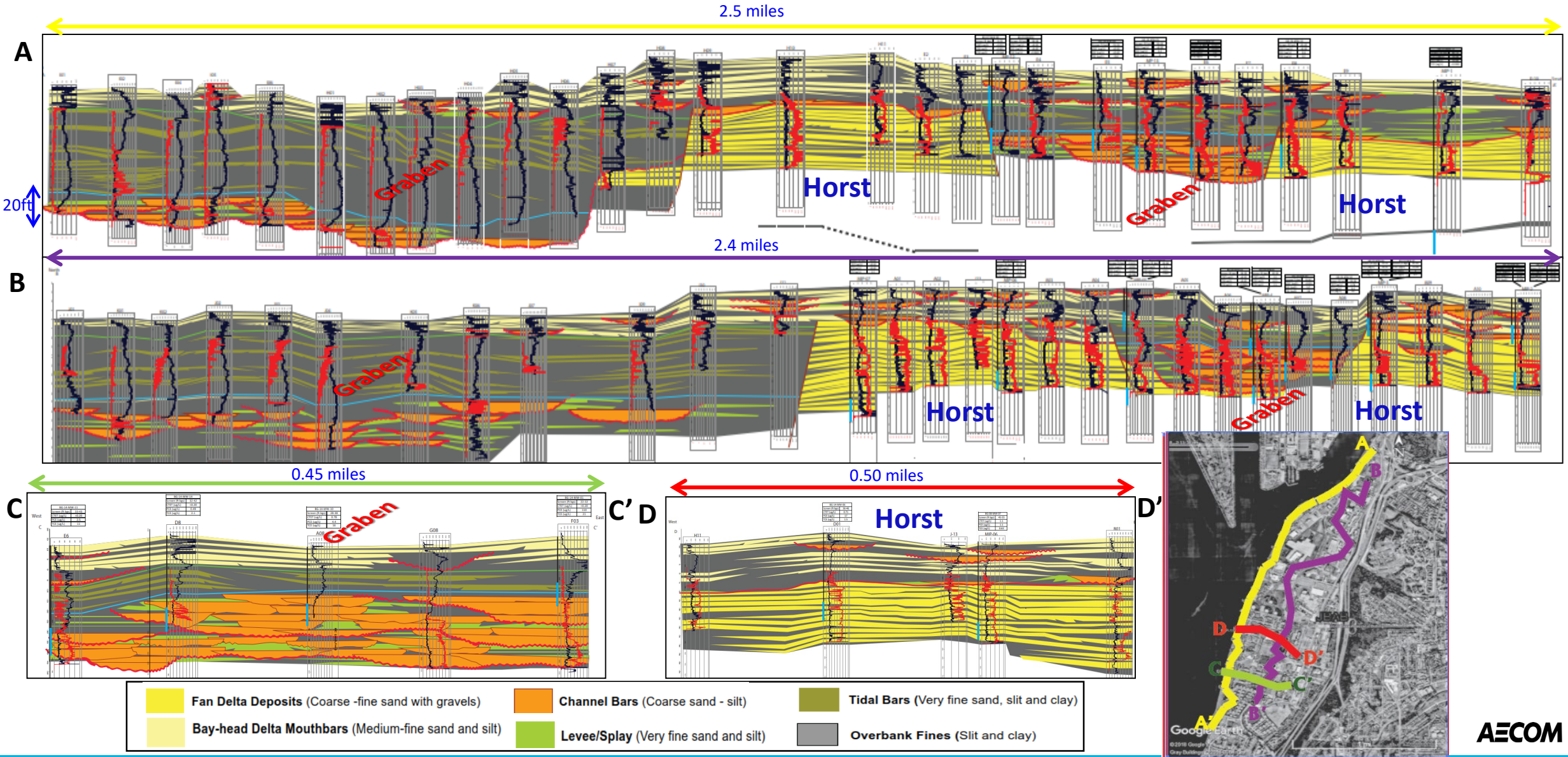
Example of Stratigraphic Cross-sections at the Site



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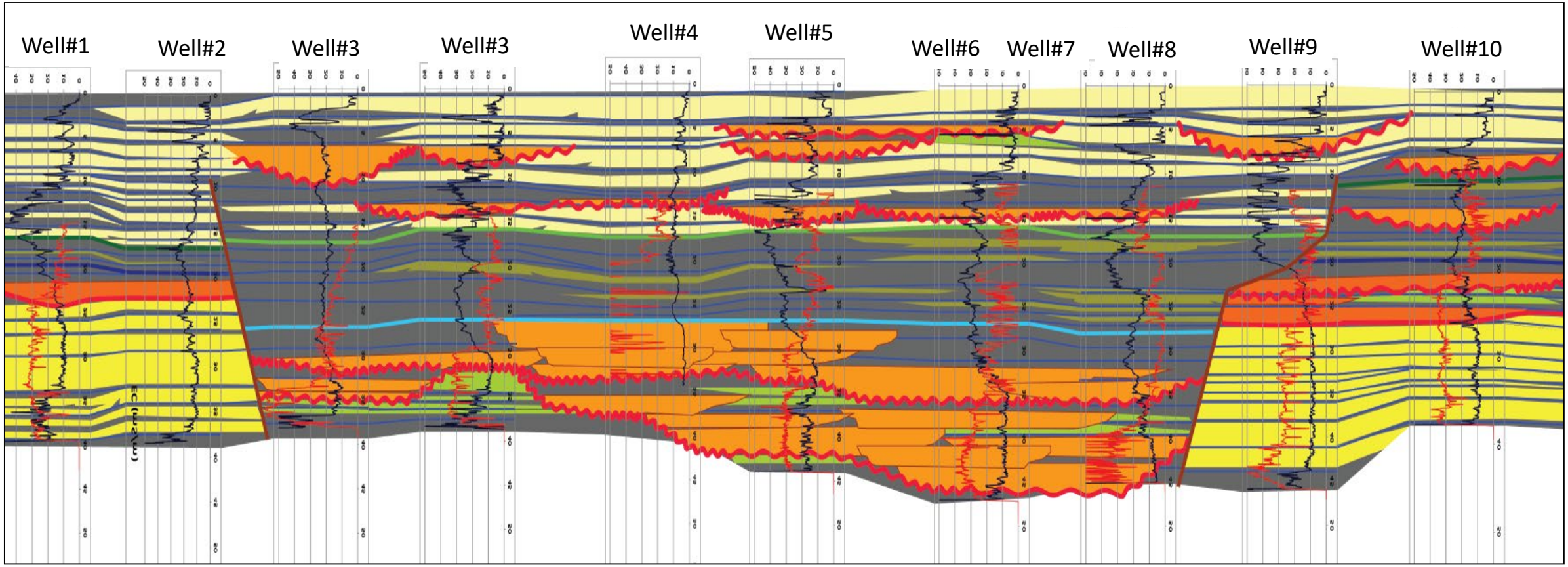
Interpretation: Horst & Graben 1(Example Section A-A')

North

Southern Part of Section A-A'

South



Fan Delta Deposits (Coarse -fine sand with gravels)

Channel Bars (Coarse sand - silt)

Tidal Bars (Very fine sand, slit and clay)

Bay-head Delta Mouthbars (Medium-fine sand and silt)

Levee/Splay (Very fine sand and silt)

Overbank Fines (Slit and clay)

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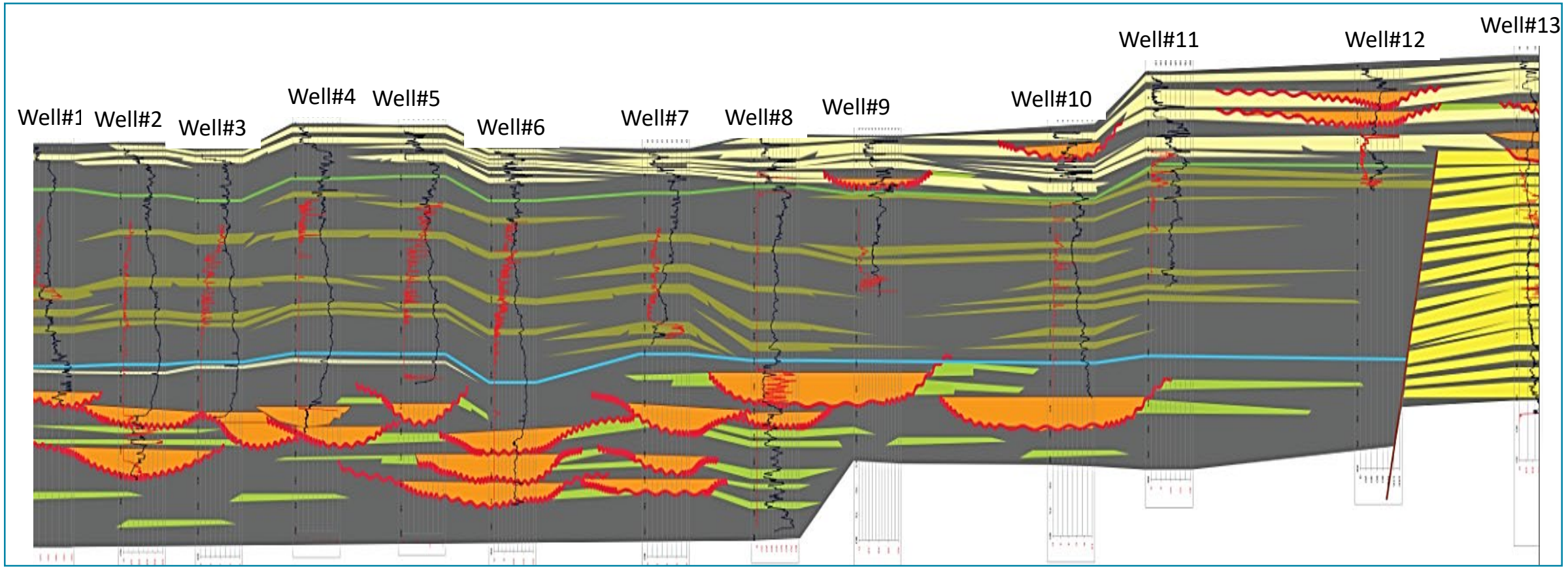
Interpretation: Horst & Graben 2 (Example Section B-B')

North

Northern Part of Section B-B'

South



Fan Delta Deposits (Coarse -fine sand with gravels)

Channel Bars (Coarse sand - silt)

Tidal Bars (Very fine sand, slit and clay)

Bay-head Delta Mouthbars (Medium-fine sand and silt)

Levee/Splay (Very fine sand and silt)

Overbank Fines (Slit and clay)

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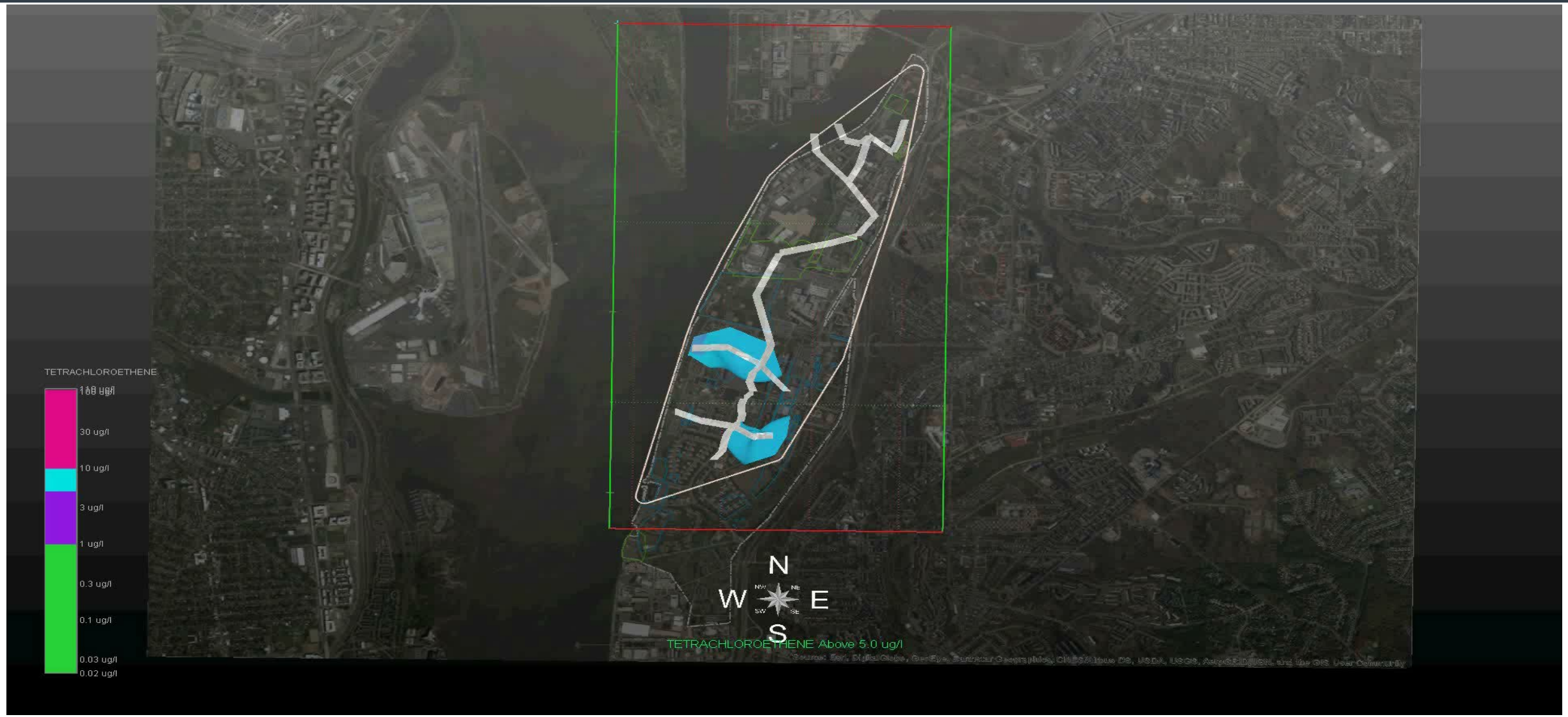
Stratigraphic Control on Plume Migration



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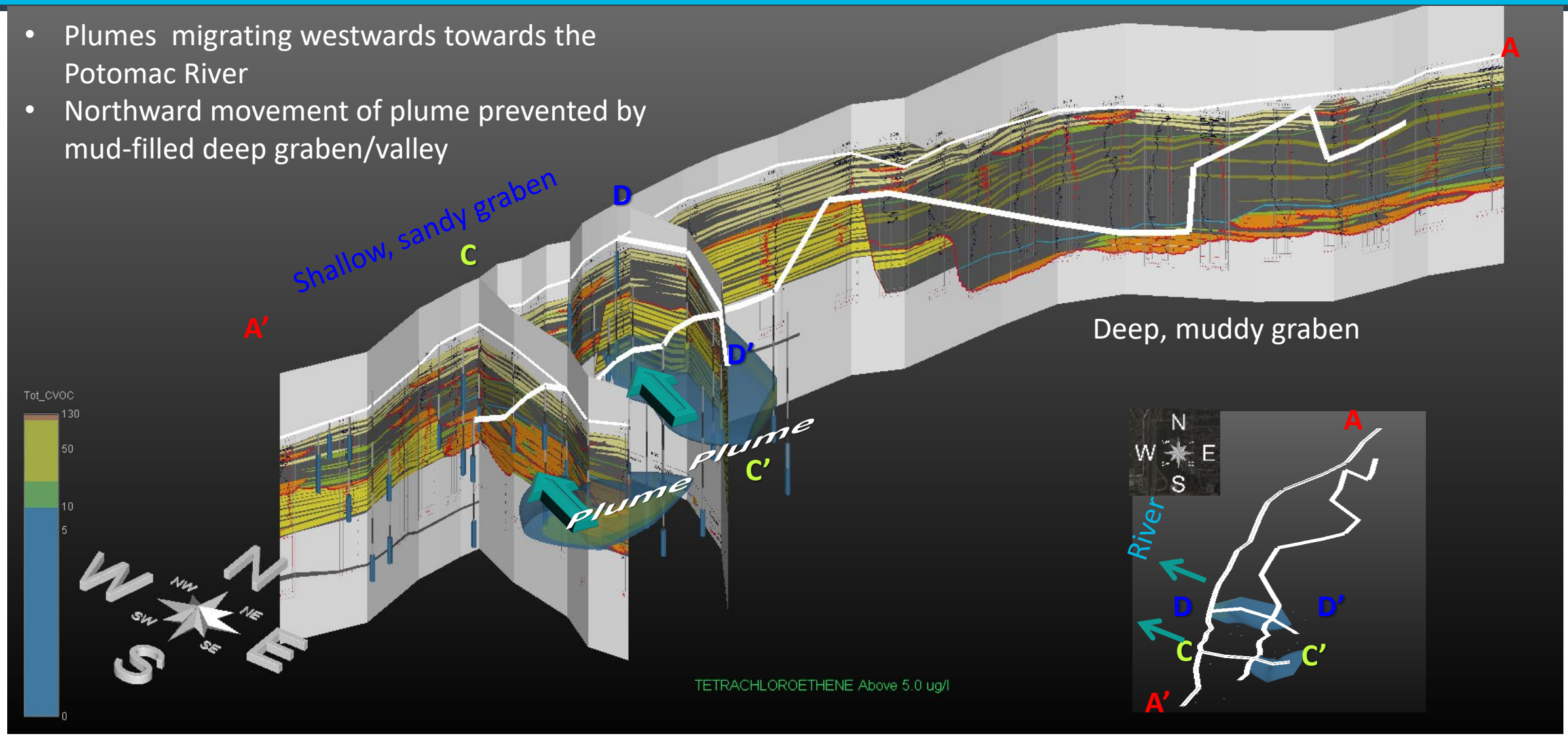
Stratigraphic Control on Plume Migration

- Plumes migrating westwards towards the Potomac River
- Northward movement of plume prevented by mud-filled deep graben/valley



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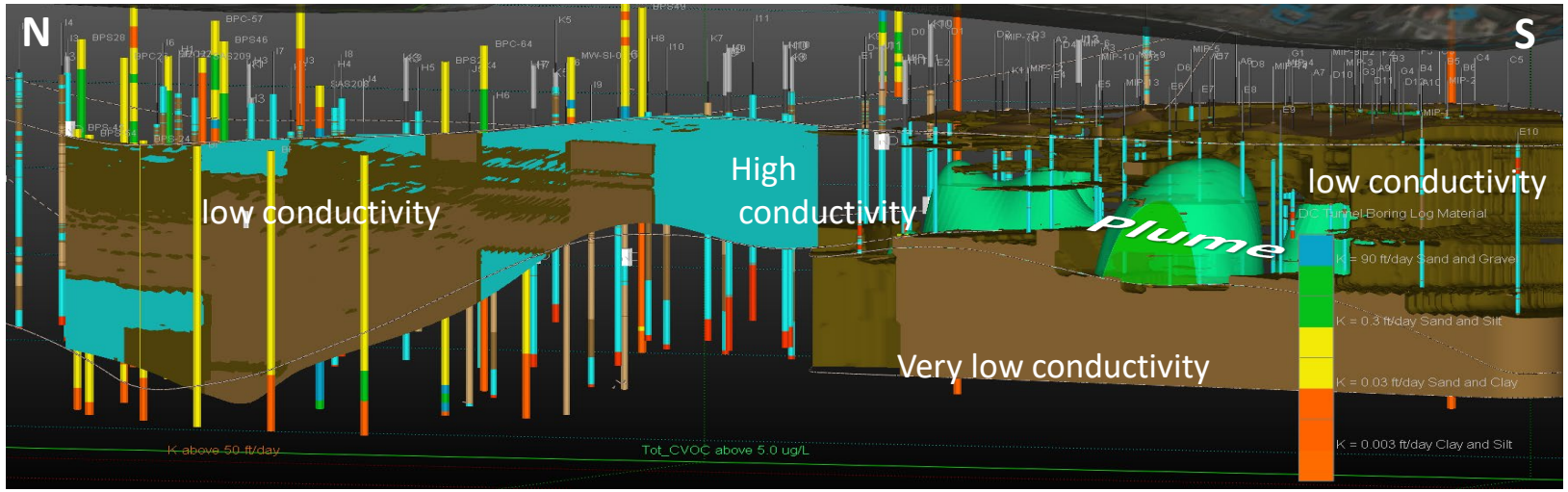
Impact of Integrating Stratigraphy in EVS Model

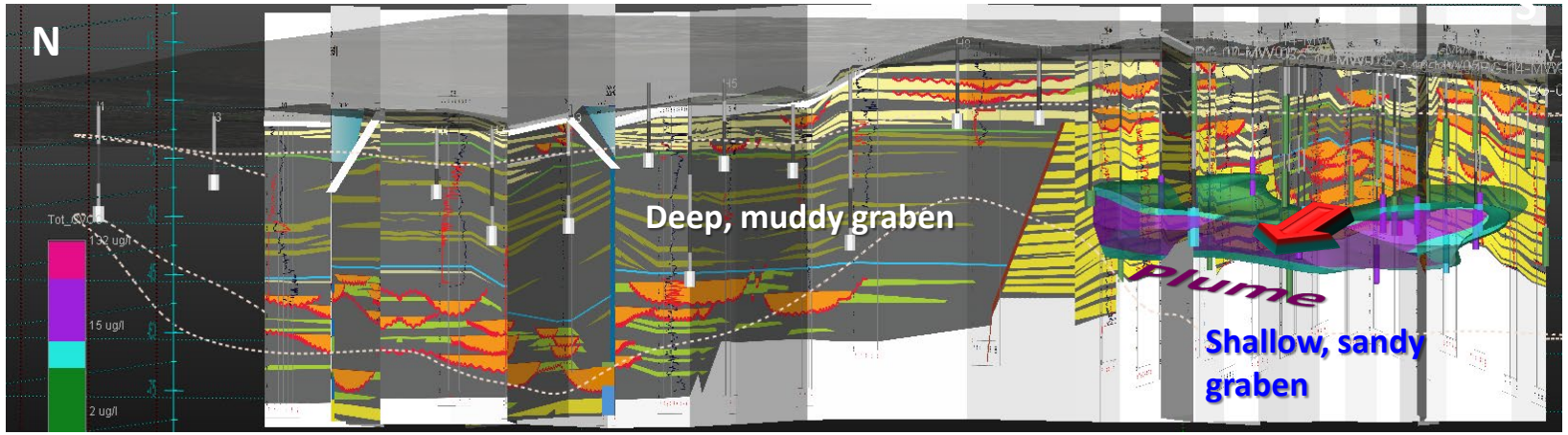
Before:



Typical EVS-generated CSM

- EVS model gives general ideas of plume migration based on HRSC data points
- Low predictive ability outside data points
- Kriged plume shape determined by statistics alone (high uncertainty)

After:



PRISM

- More specific understanding of plume migration
- High predictive ability outside data point through stratigraphy
- Kriged plume shape determined with the aid of geological constraints (low uncertainty)

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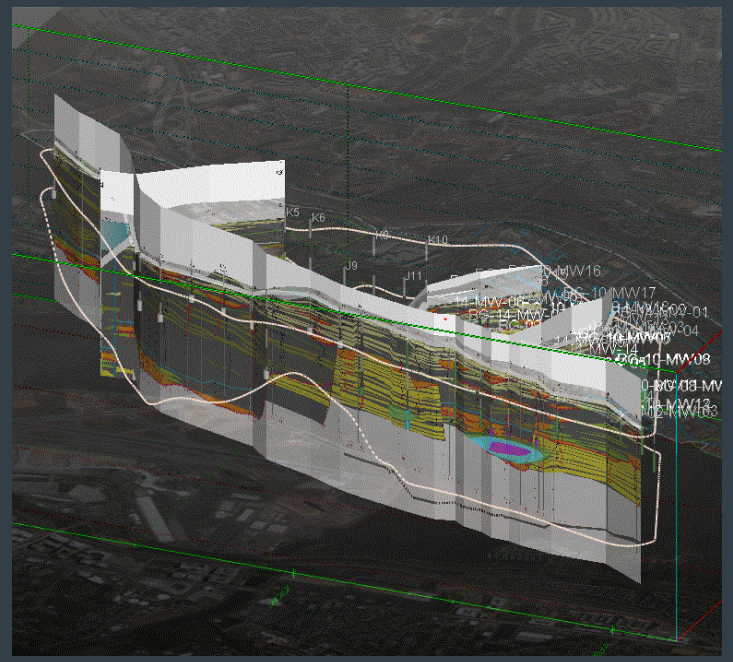

Thank You!

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