Contrasting Siliciclastic-Dominated Cores from the Middle Pennsylvanian (Desmoinesian) Strawn Group, East Kent County, TX: Wallace Ranch #1 and #2

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[1]Premier Corex

Abstract

The Wallace Ranch #1 and #2 cores (Kent County, Texas) span 90 feet of mudrocks, heterolithics, sandstones, conglomerates, and carbonates from the Strawn Group (Middle Pennsylvanian - Desmoinesian) on the Eastern Shelf of the Midland Basin. This short core workshop focuses on reservoir characterization of these two cores spanning the same reservoir interval by integrated detailed digital core description, thin section and scanning electron microscope petrography, X-ray fluorescence, and X-ray diffraction datasets. Reservoir properties vary across stratigraphy – and between the two cores - with depositional components and near-surface diagenetic features overprinted by burial diagenesis.

Both cores are largely comprised of heterolithic siltstone and sandstone that transition upwards into bioturbated sandstones, then back to heterolithic siltstone and sandstone. Burrows (*Asterosoma, Palaeophycus, Planolites, Skolithos, Scolicia,* etc.) are abundant and change in character across this transition. These sediments are interpreted as representing shifts upwards from prodelta, delta front, tidally influenced delta bar, and deltaic subtidal flat environments across 4th-order (cycles ~100-400ky) sea-level highstand. Deltaic sediments are capped with an erosional surface in both cores, however the Wallace Ranch #1 core contains conglomerates, sandstones, intraclast rudstones, and sandy skeletal grain-dominated packstones above this erosional surface. These sediments are interpreted to have formed as an incised valley fill deposited during sea-level lowstand. Both cores are capped with calcareous claystone rich in organic matter (OM), which are interpreted to have been deposited during transgression after deltaic and carbonate sedimentation drowned.

Porosity is most abundant in deltaic siliciclastics, especially in bioturbated fine- to medium-grained sandstones interpreted to have been deposited in tidally influenced sand bars. Pores are primarily interparticle, however moldic, clay-hosted, and intraparticle porosity is common as well. Poikilopic Fe-carbonate cements are common, especially under the incised valley fill in Wallace Ranch #1. Compaction through burial occluded large volumes of porosity, especially where ductile clay and mudrock grains are abundant. Quartz cement is common, less so in more argillaceous sands. Moldic porosity occurs predominantly where feldspars dissolved. Porosity is minimal in OM-rich mudrocks that cap the cores – occurring as sparse clay-hosted, moldic, and patchy OM-hosted pores in kerogen.

SWS-AAPG Annual Convention
May 6-9, 2023

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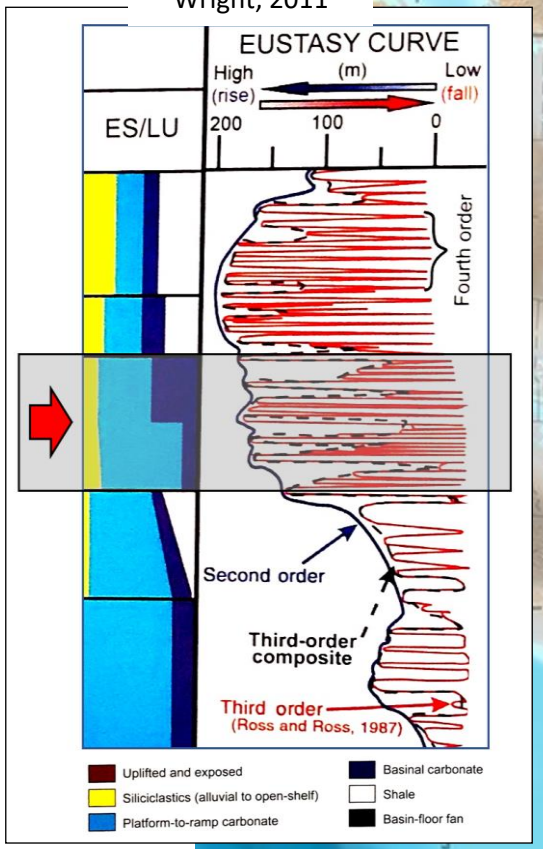
PREMIER COREX

Depositional Setting

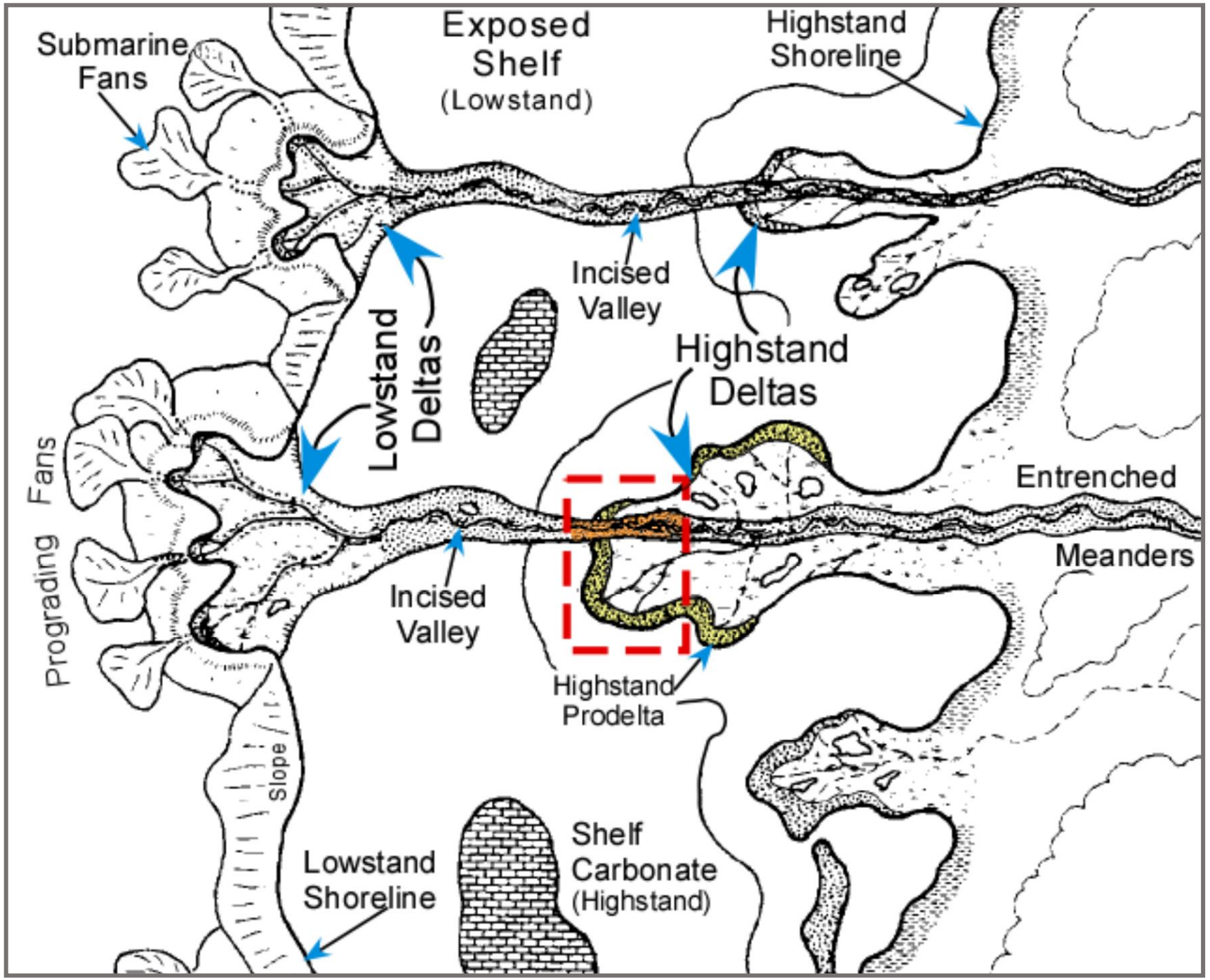
- Middle Pennsylvanian (Desmoinesian ~308-306.5 Ma) equatorial (~8 to 10°S) and tectonically active epicontinental basin
- Eastern shelf of the Midland Basin
- Overall 2nd-order cyclicity, pronounced high-frequency cyclicity (<~100-400ky) due to icehouse climate conditions
- Cyclic deposition of marginal marine, deltaic, and alluvial siliciclastics interbedded with carbonates and basinal mudrocks
- Siliciclastic sediments sourced from the East, prograded to the West

Modified from Wright, 2011



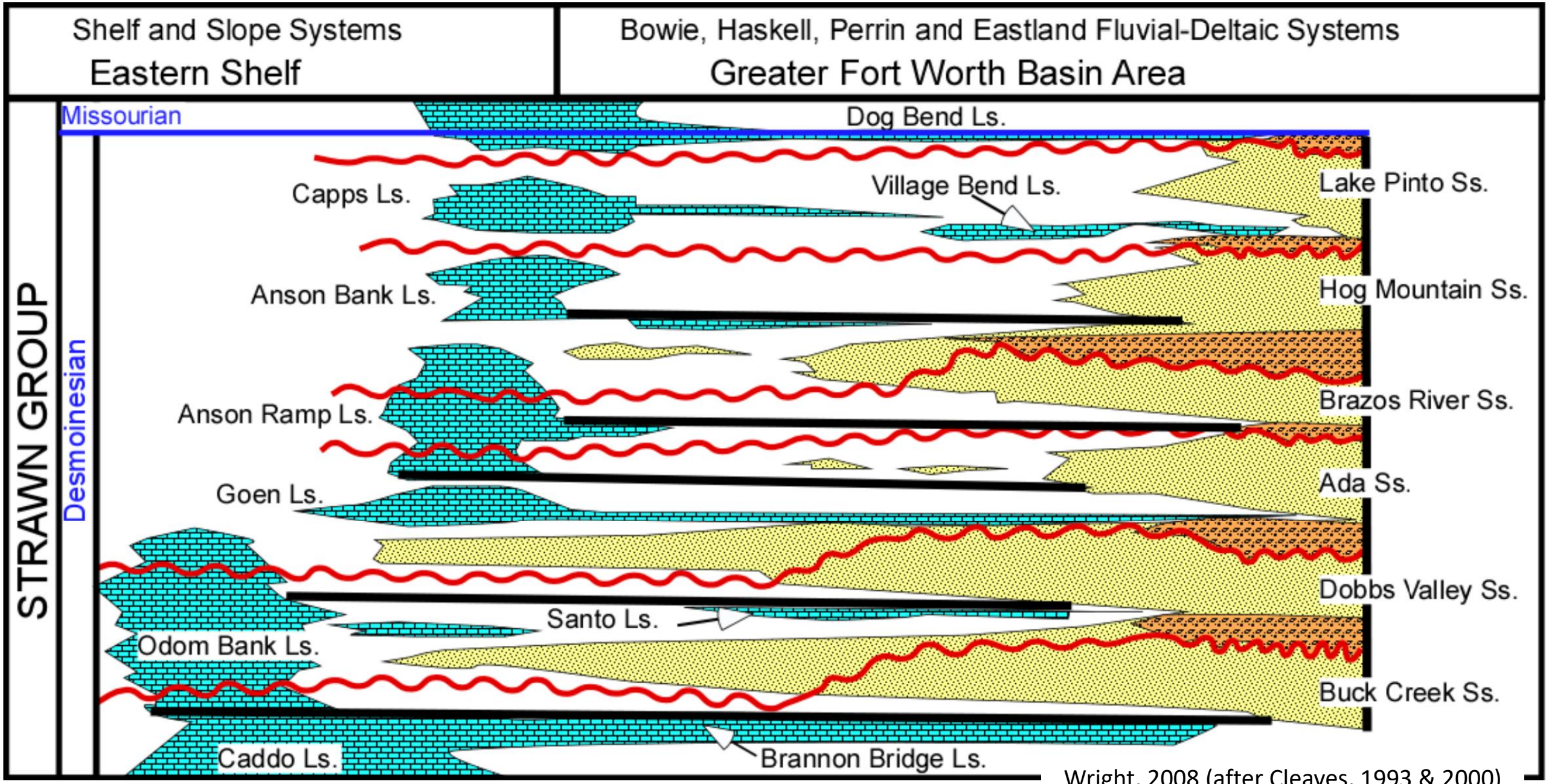
Blakey, 2020

Depositional System



- Marginal-marine and deltaic siliciclastics prograded to the W during SL highstand, commonly capped with lowstand incised valley fill
- Lowstand channel deposits incising into underlying prodelta & deltaic deposits.

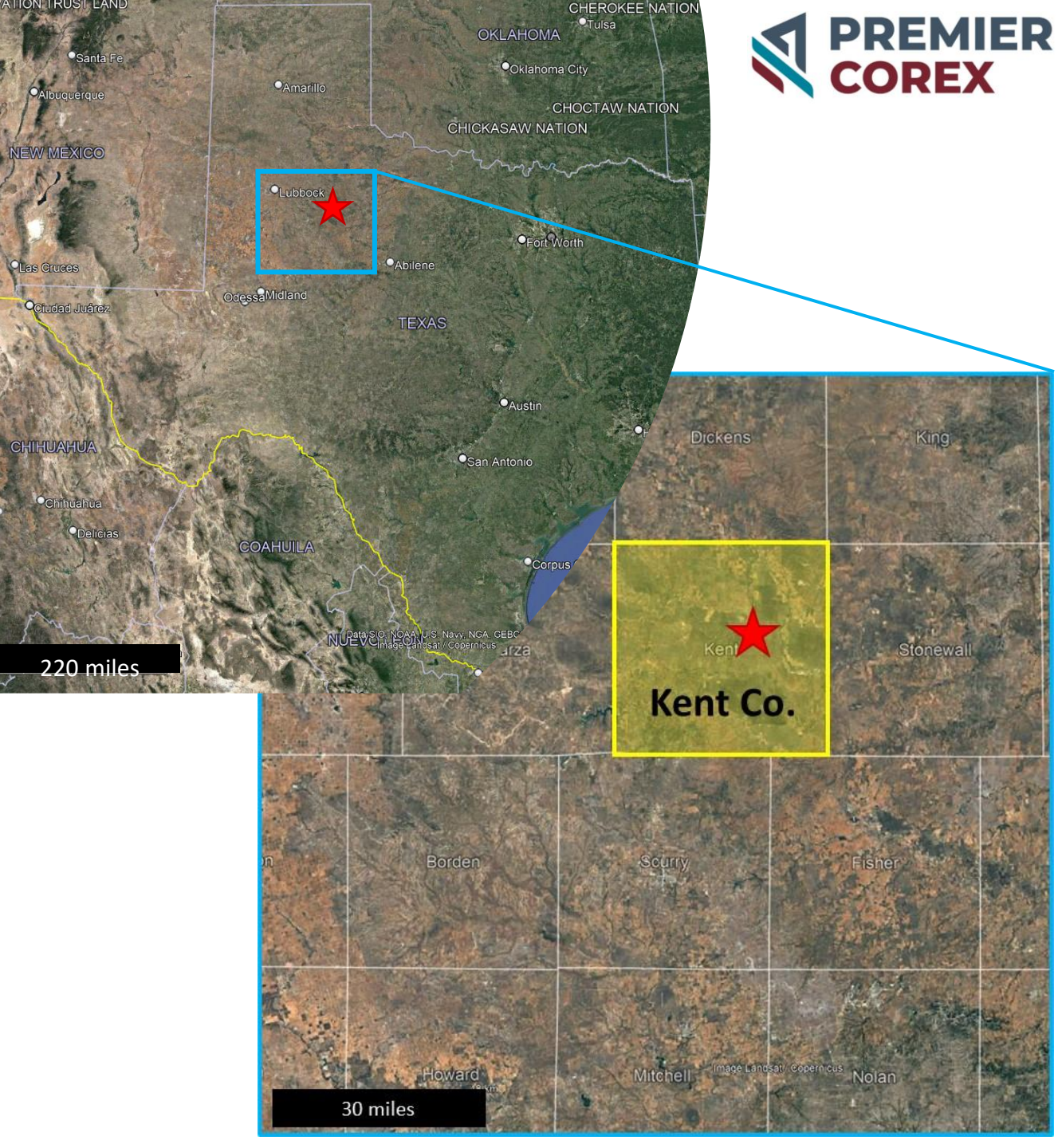
Wright, 2008 (after Cleaves, 1993)



Wright, 2008 (after Cleaves, 1993 & 2000)

PREMIER COREX

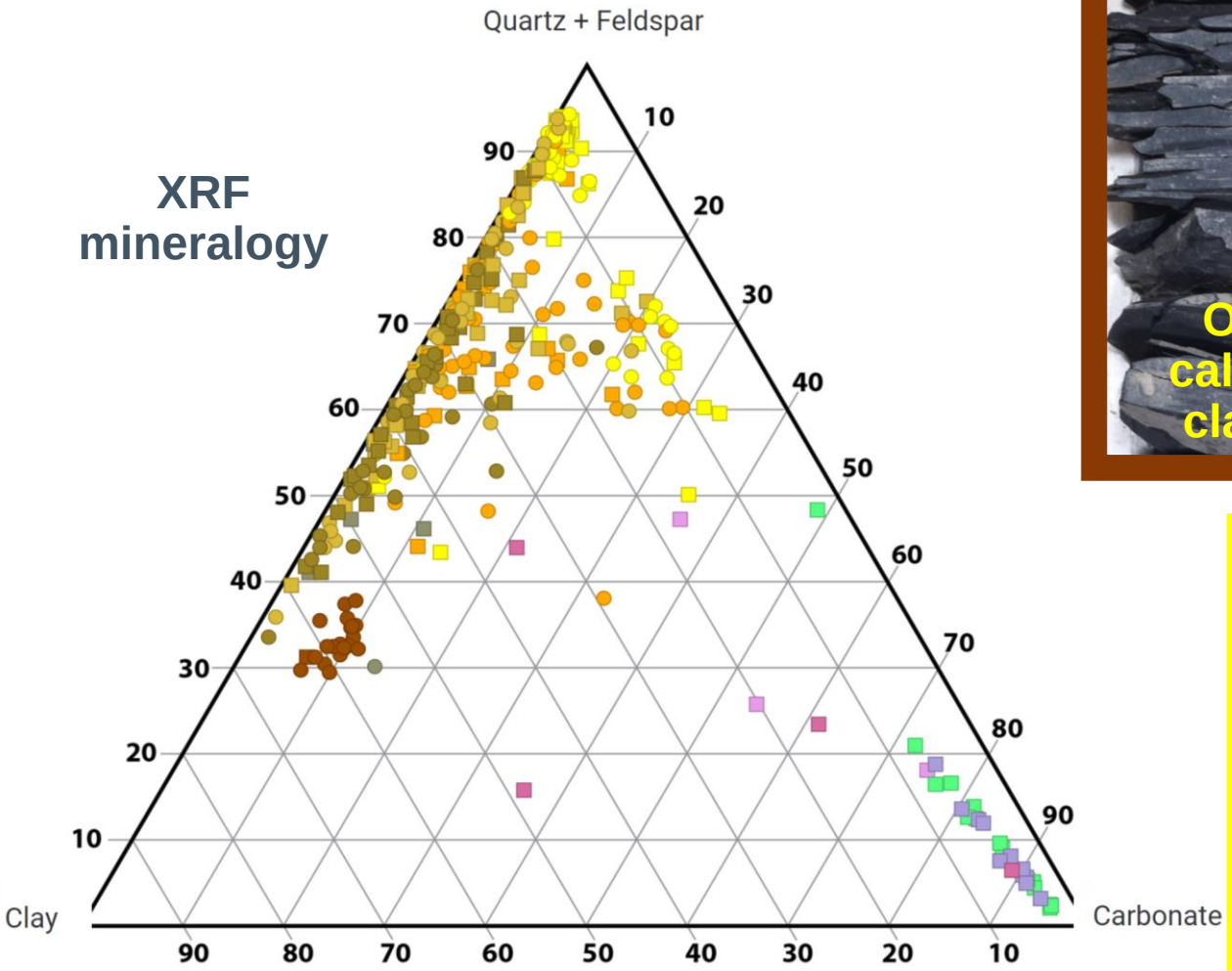
Dataset

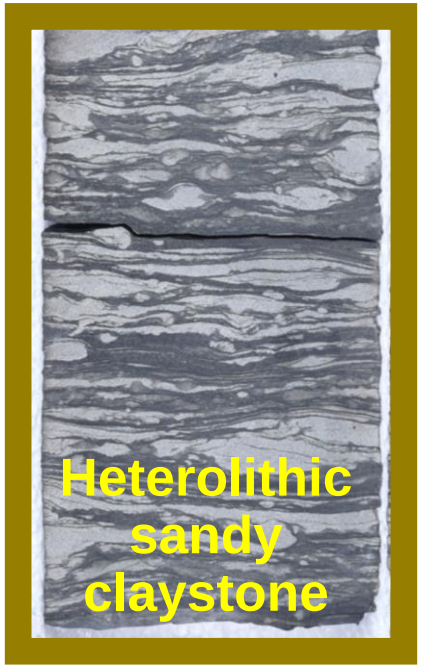


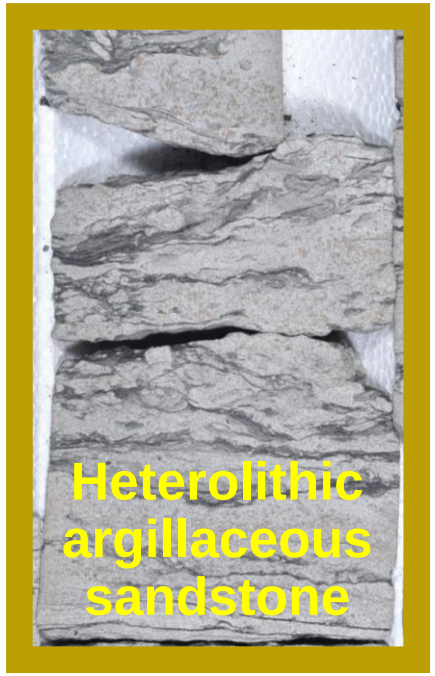
- Wallace Ranch #1 and Wallace Ranch #2 cores (1.5 miles apart) from Kent Co. Texas – about 90ft of section
- Detailed (1 to 24 scale) digital core descriptions with interpretation of sequence stratigraphy and depositional environments tied to literature
- 361x handheld XRF scans and modeled mineralogy (~4x per foot)
- 10x XRD spectra and modeled mineralogy
- 10x thin sections
- 10x ion-polished FE-SEM

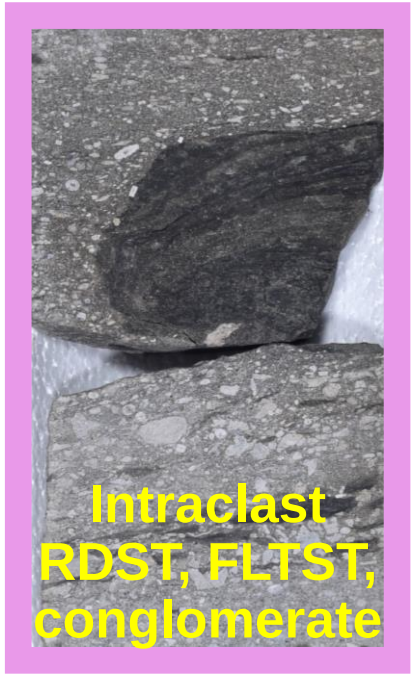
PREMIER COREX

XRF mineralogy

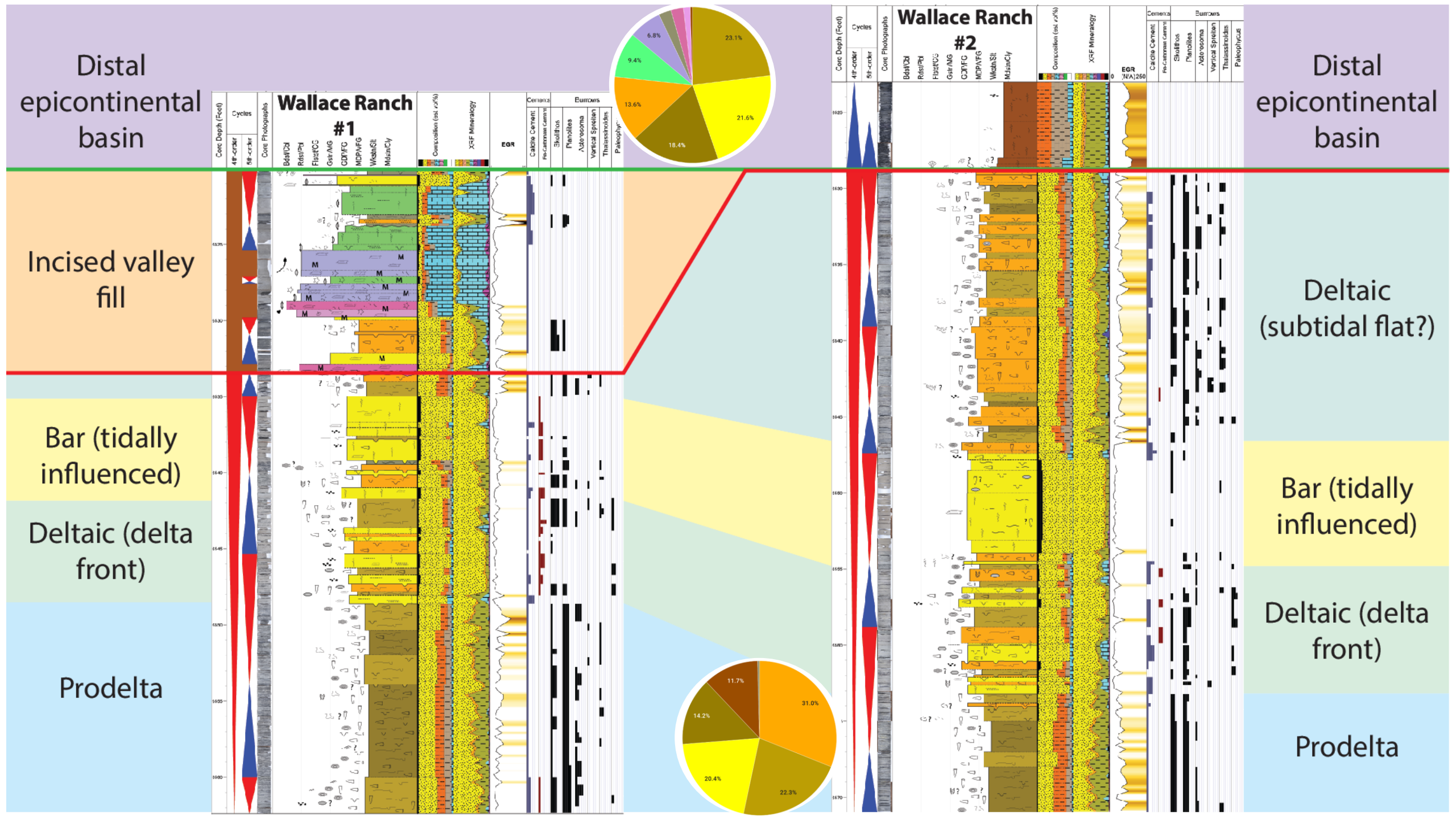


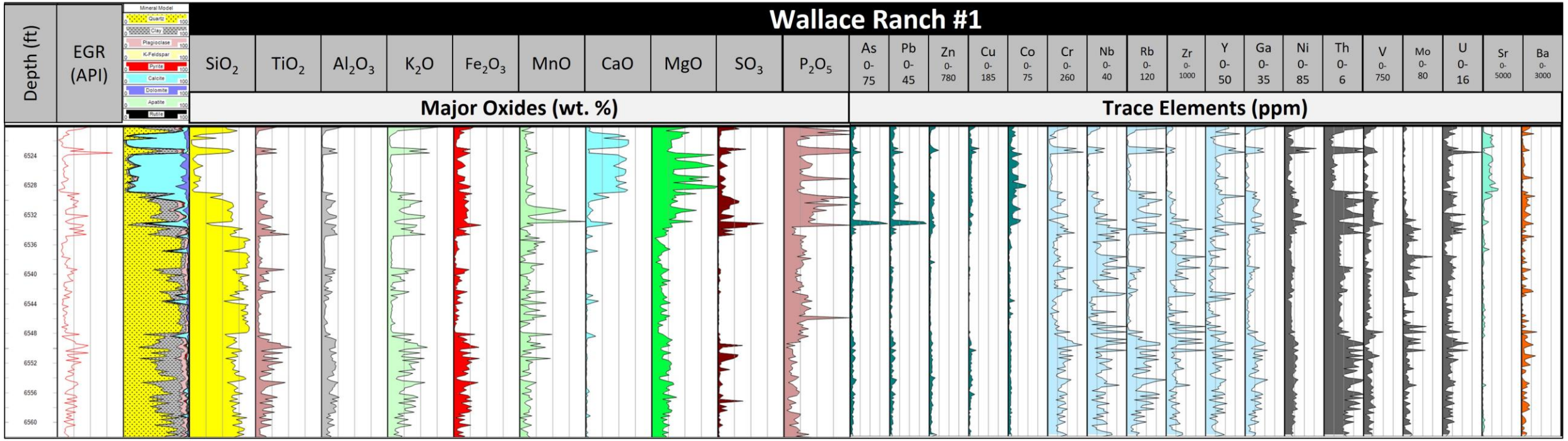


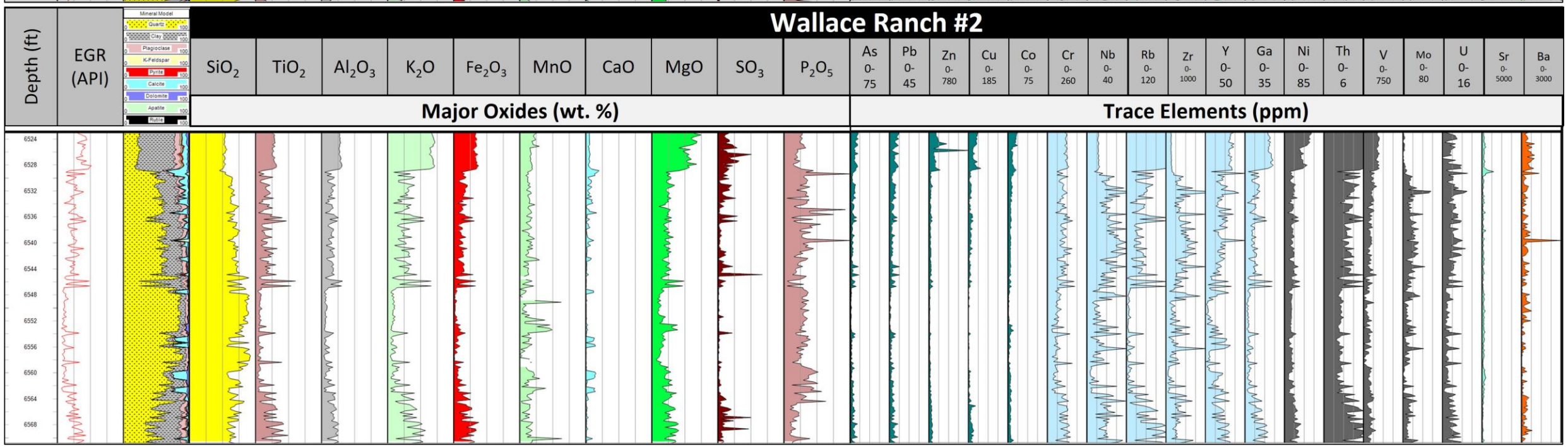




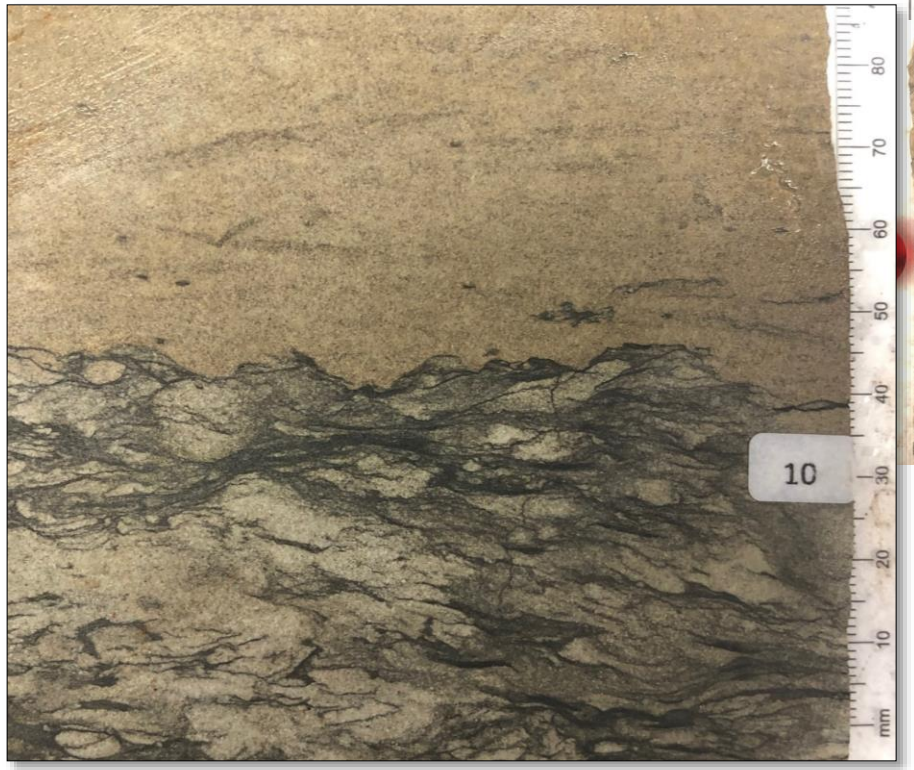
Key Facies

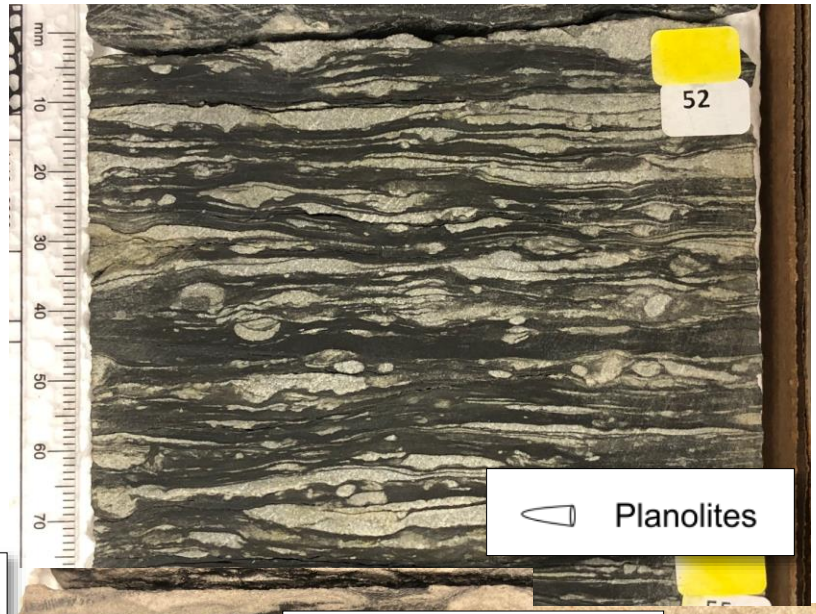

Distal epicontinental basin
Incised valley fill
Bar (tidally influenced)
Deltaic (delta front)
Prodelta
Wallace Ranch #1
Wallace Ranch #2
Core Depth (Feet)
Cycles
Core Photographs
Composition (est. wt%)
XRF Mineralogy
EGR
Cements
Burrows
Calcite Cement
Fe-Carbonate Cement
Skolithos
Planolites
Asterosoma
Vertical Spreiten
Thalassinoides
Paleophycus
6.8%
9.4%
13.6%
23.1%
21.6%
18.4%
11.7%
31.0%
14.2%
20.4%
22.3%
Distal epicontinental basin
Deltaic (subtidal flat?)
Bar (tidally influenced)
Deltaic (delta front)
Prodelta

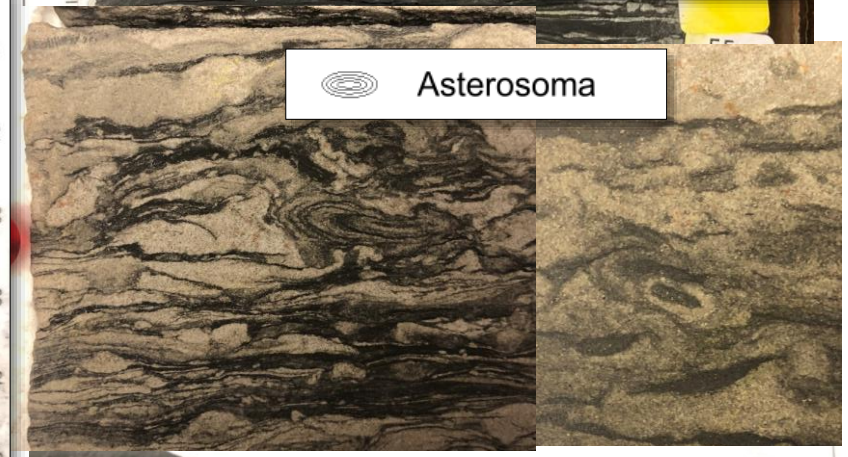

Wallace Ranch #1
Depth (ft)
EGR (API)
Mineral Model
Quartz
Clay
Plagioclase
K-Feldspar
Pyrite
Calcite
Dolomite
Apatite
Rutile
SiO2
TiO2
Al2O3
K2O
Fe2O3
MnO
CaO
MgO
SO3
P2O5
Major Oxides (wt. %)
As 0-75
Pb 0-45
Zn 0-780
Cu 0-185
Co 0-75
Cr 0-260
Nb 0-40
Rb 0-120
Zr 0-1000
Y 0-50
Ga 0-35
Ni 0-85
Th 0-6
V 0-750
Mo 0-80
U 0-16
Sr 0-5000
Ba 0-3000
Trace Elements (ppm)
6524
6528
6532
6536
6540
6544
6548
6552
6556
6560

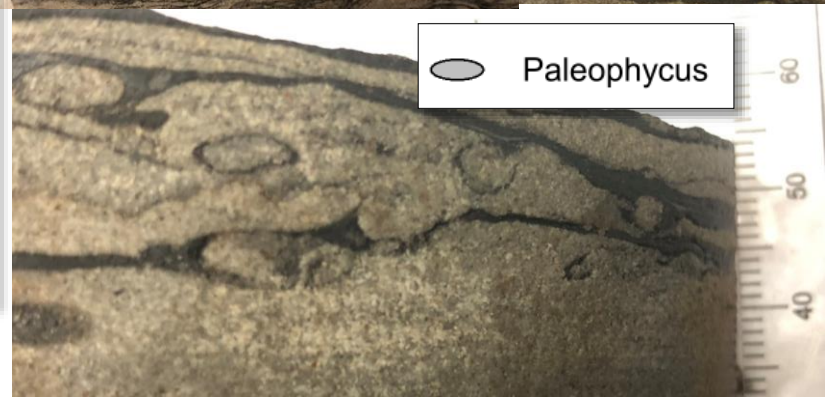

Wallace Ranch #2
Depth (ft)
EGR (API)
Mineral Model
Quartz
Clay
Plagioclase
K-Feldspar
Pyrite
Calcite
Dolomite
Apatite
Rutile
SiO2
TiO2
Al2O3
K2O
Fe2O3
MnO
CaO
MgO
SO3
P2O5
Major Oxides (wt. %)
As 0-75
Pb 0-45
Zn 0-780
Cu 0-185
Co 0-75
Cr 0-260
Nb 0-40
Rb 0-120
Zr 0-1000
Y 0-50
Ga 0-35
Ni 0-85
Th 0-6
V 0-750
Mo 0-80
U 0-16
Sr 0-5000
Ba 0-3000
Trace Elements (ppm)
6524
6528
6532
6536
6540
6544
6548
6552
6556
6560
6564
6568

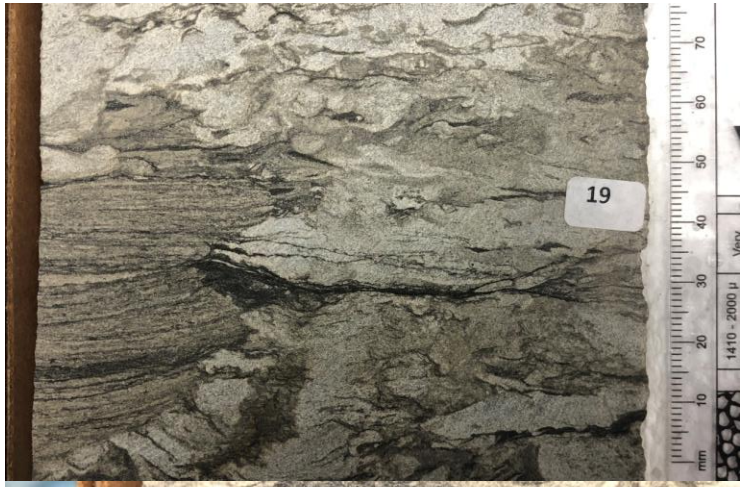
Trace Fossils



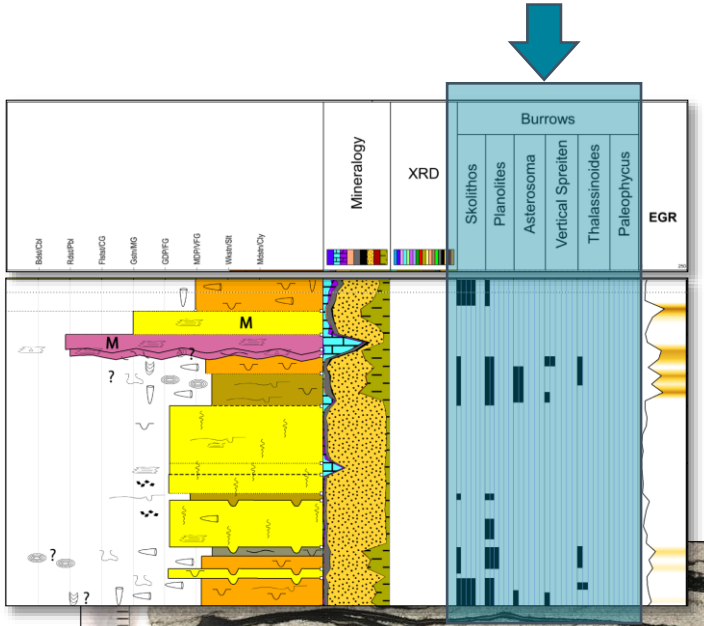


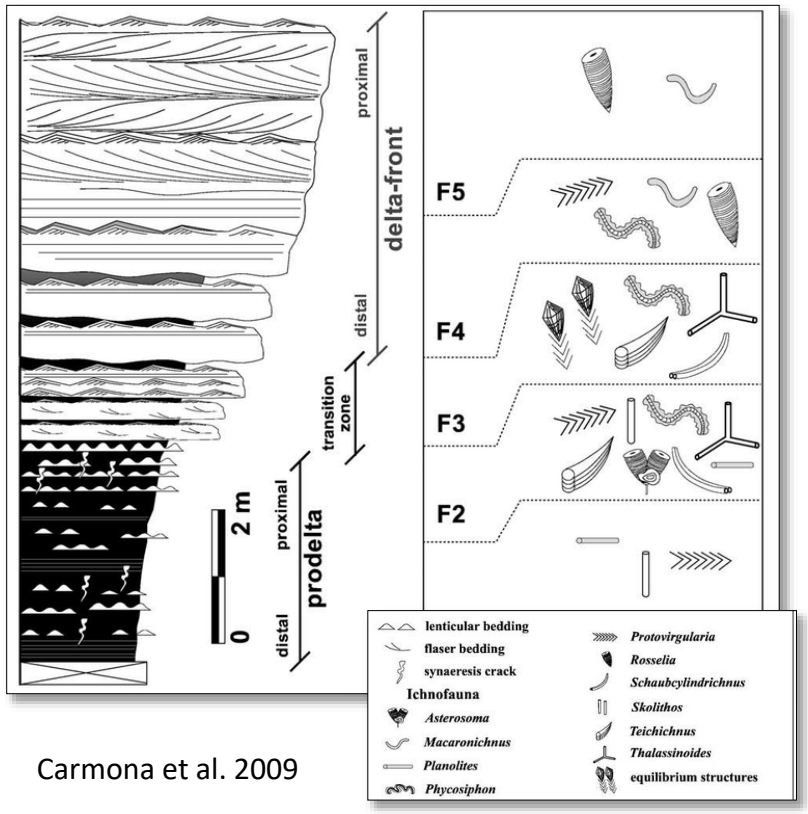




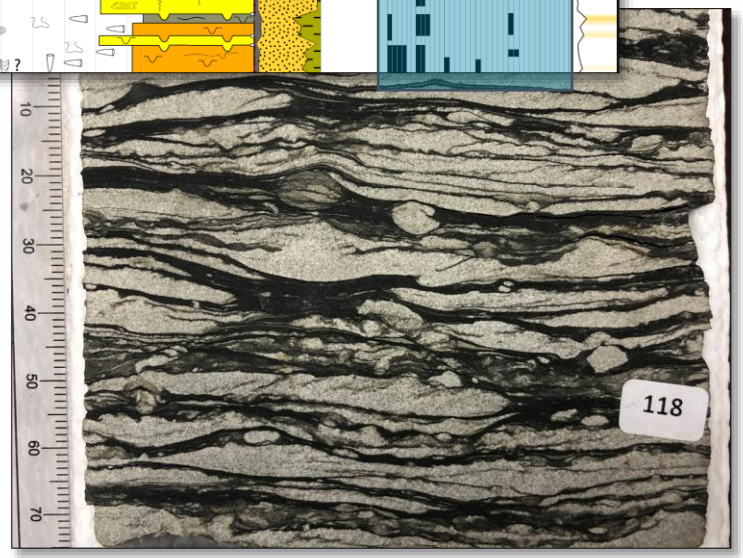


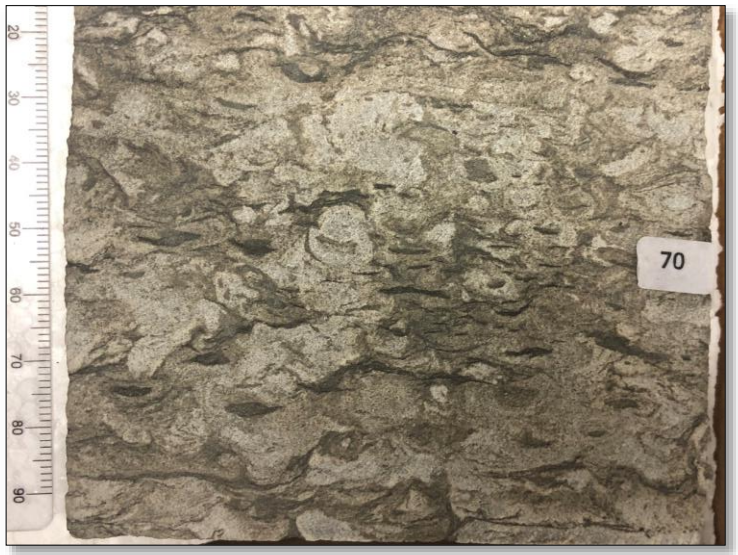
Trace Fossils & Depositional Setting

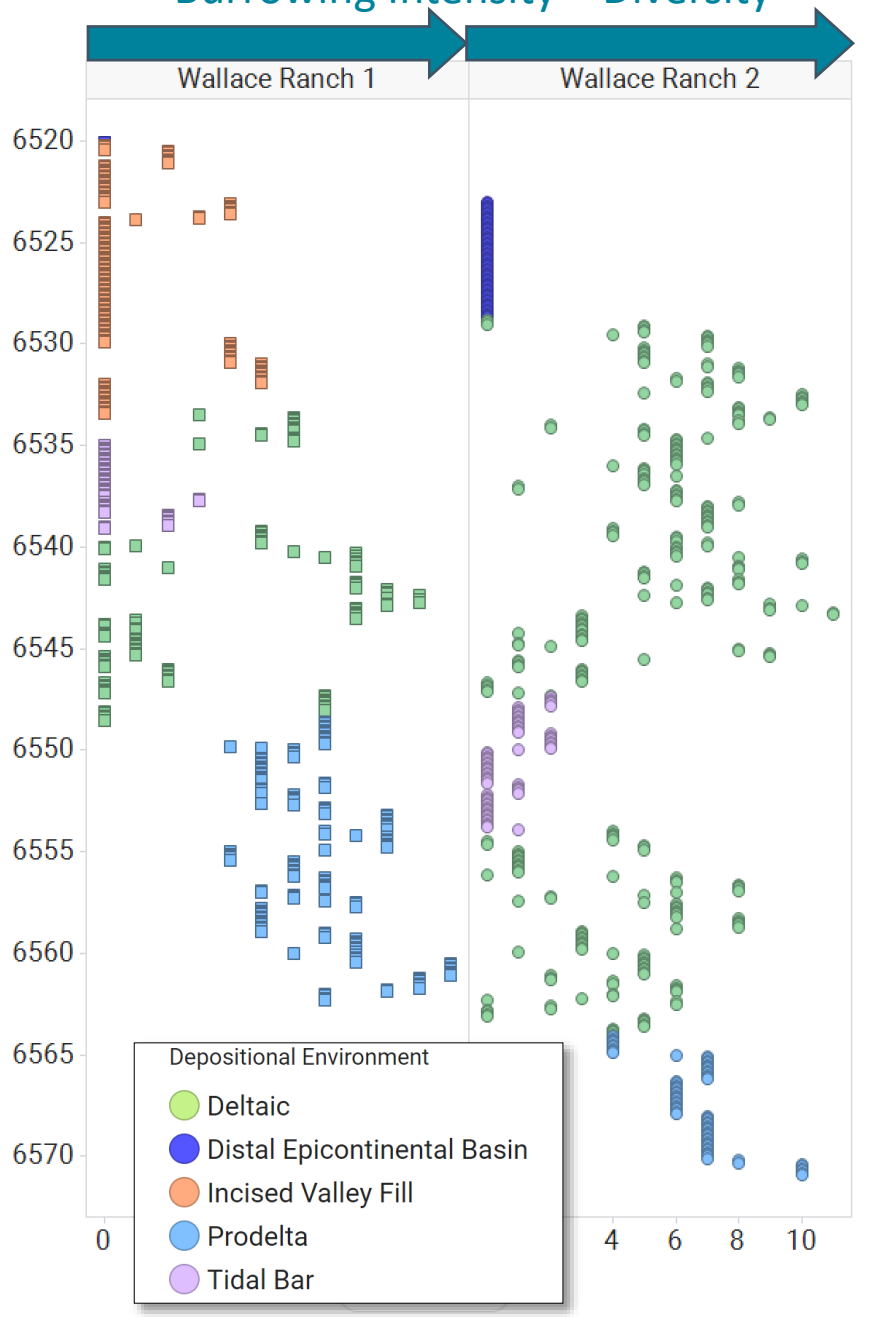




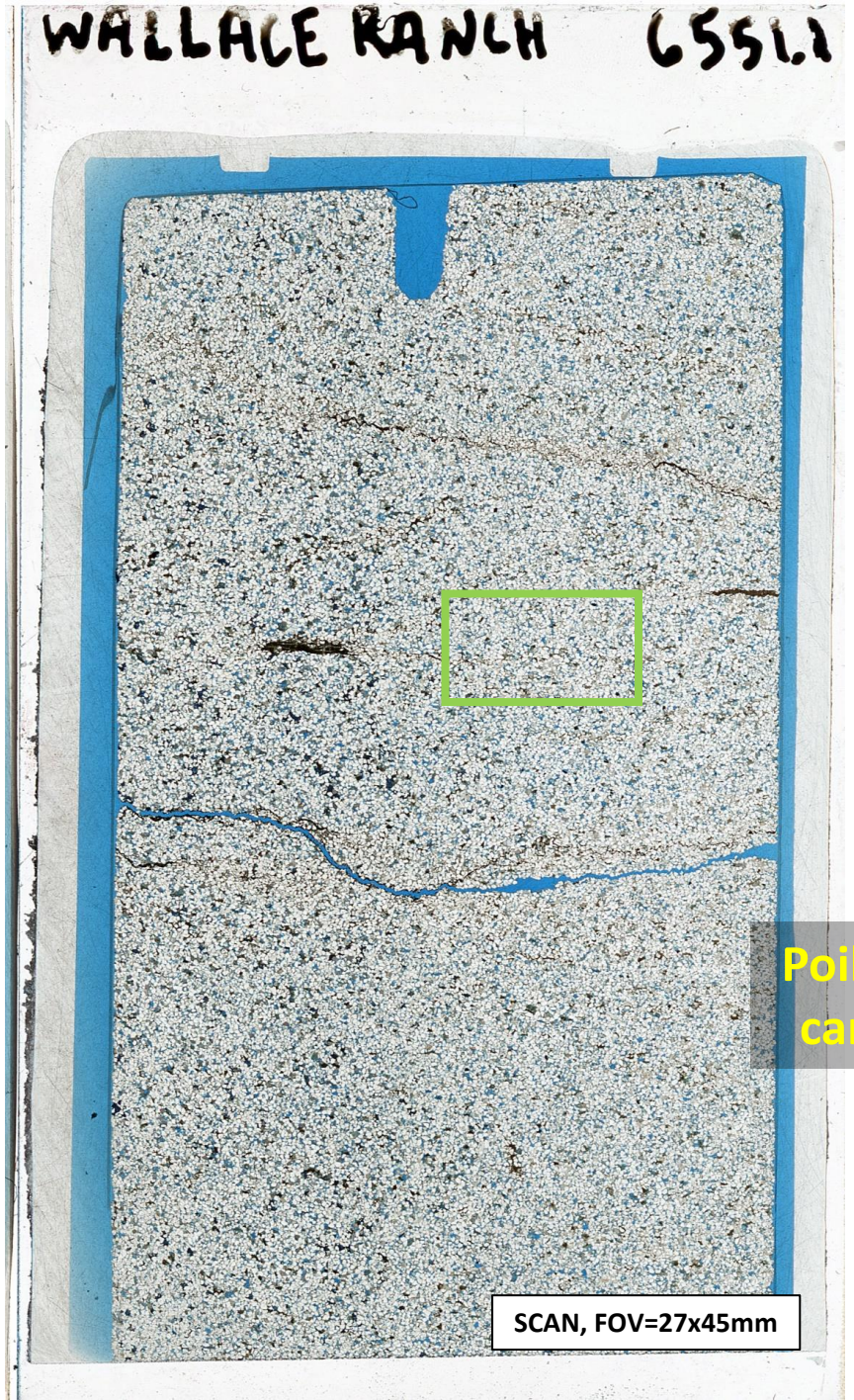
Carmona et al. 2009

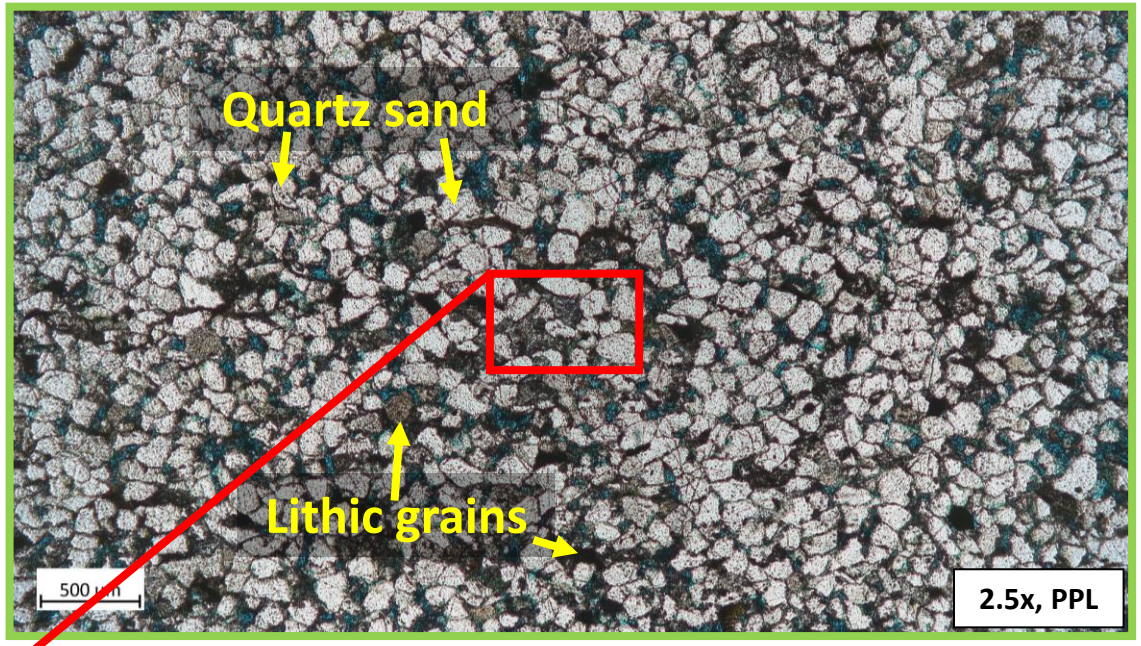


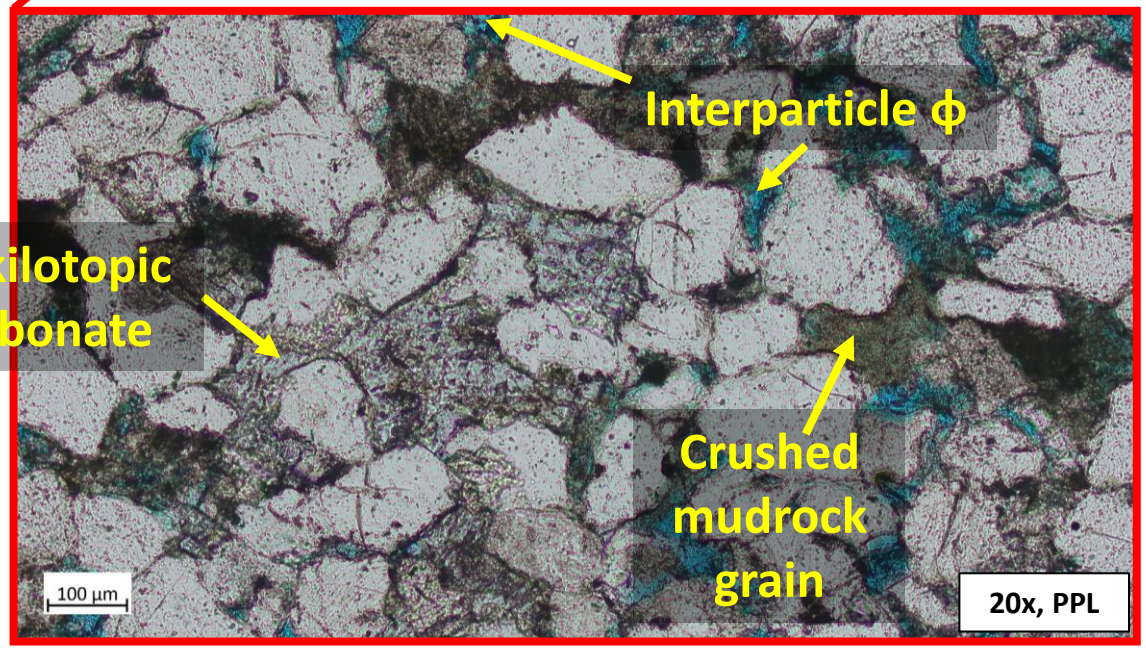




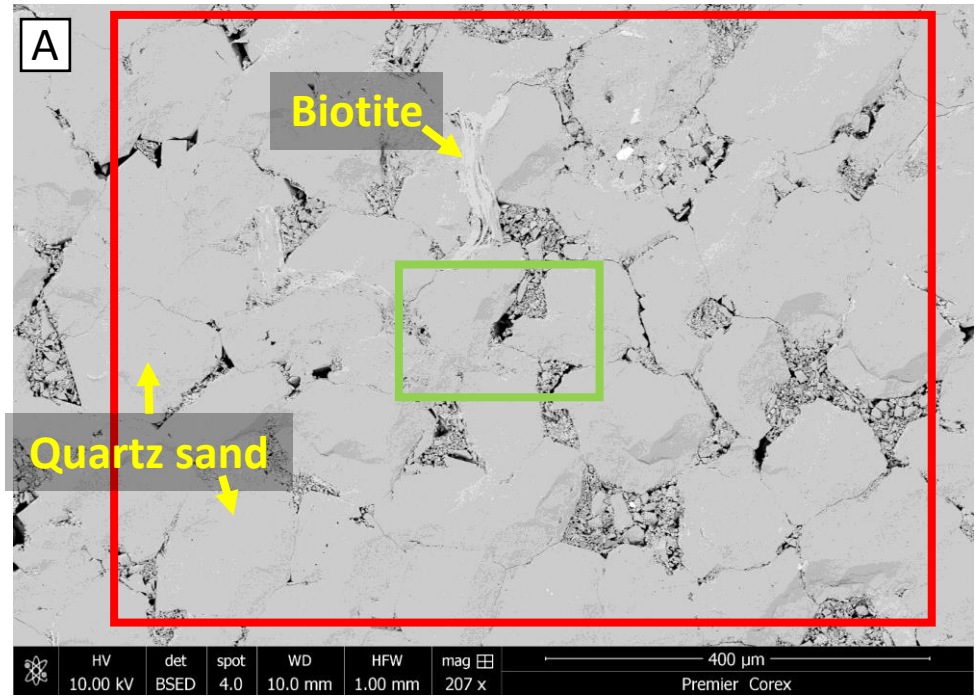
Cryptic lithic LFG sandstone – Facies 3

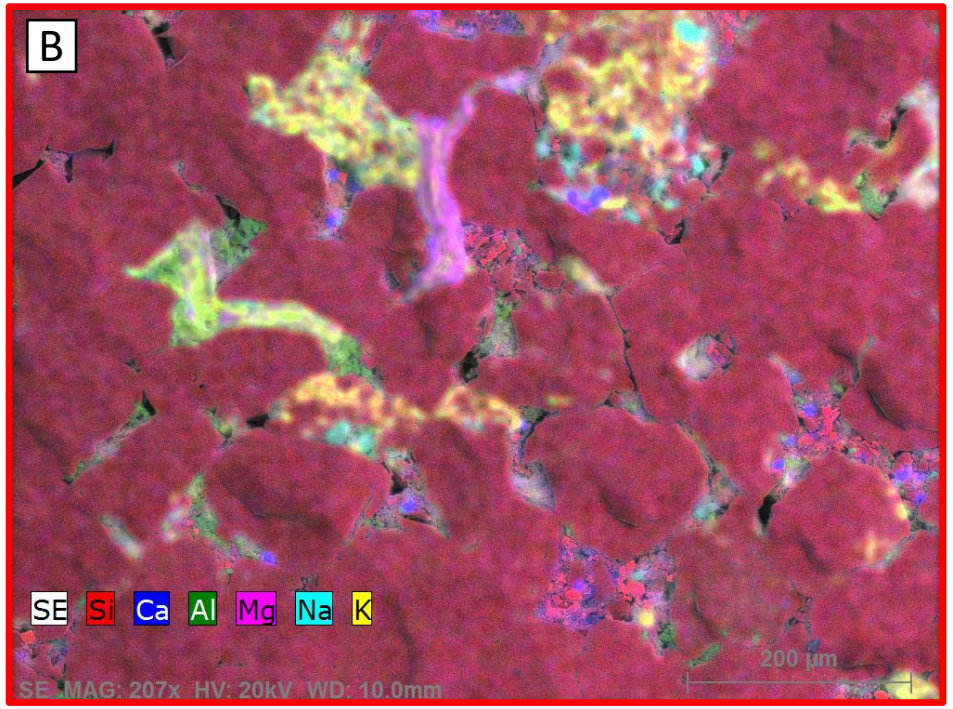




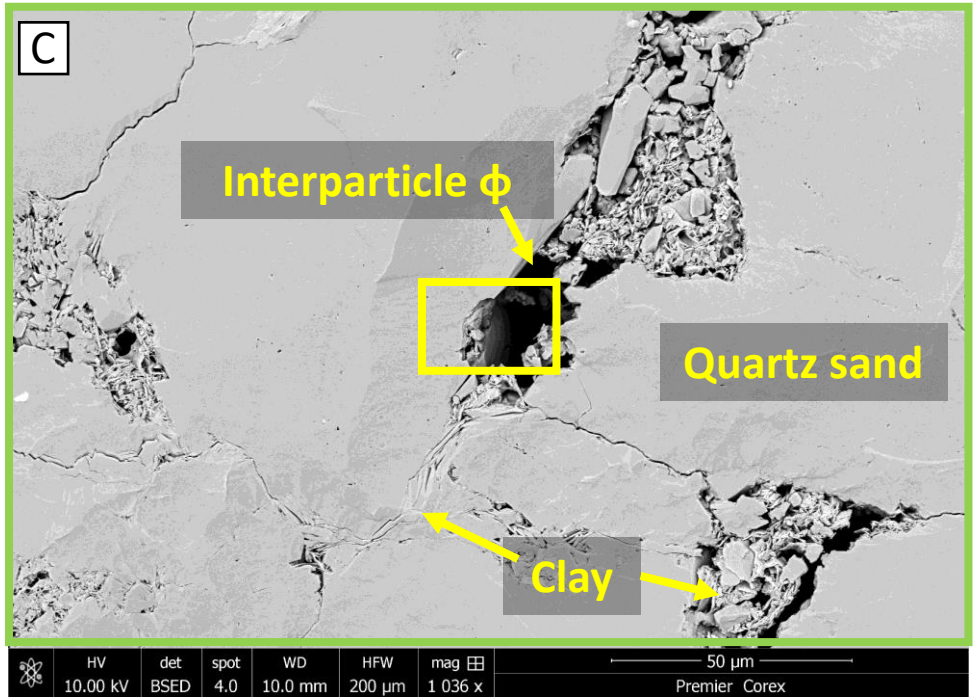


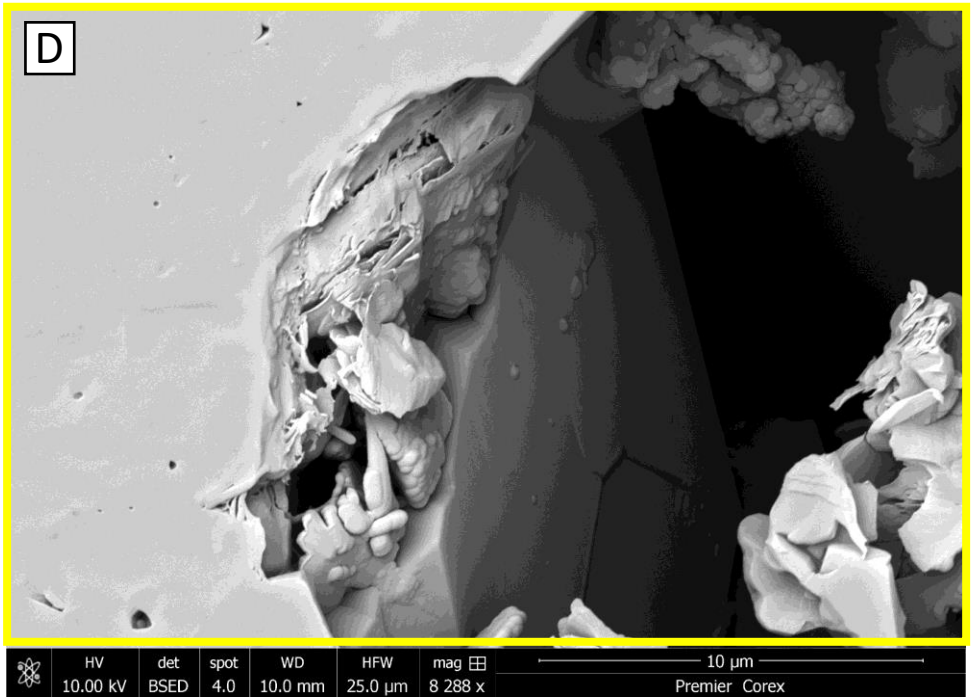
PREMIER COREX



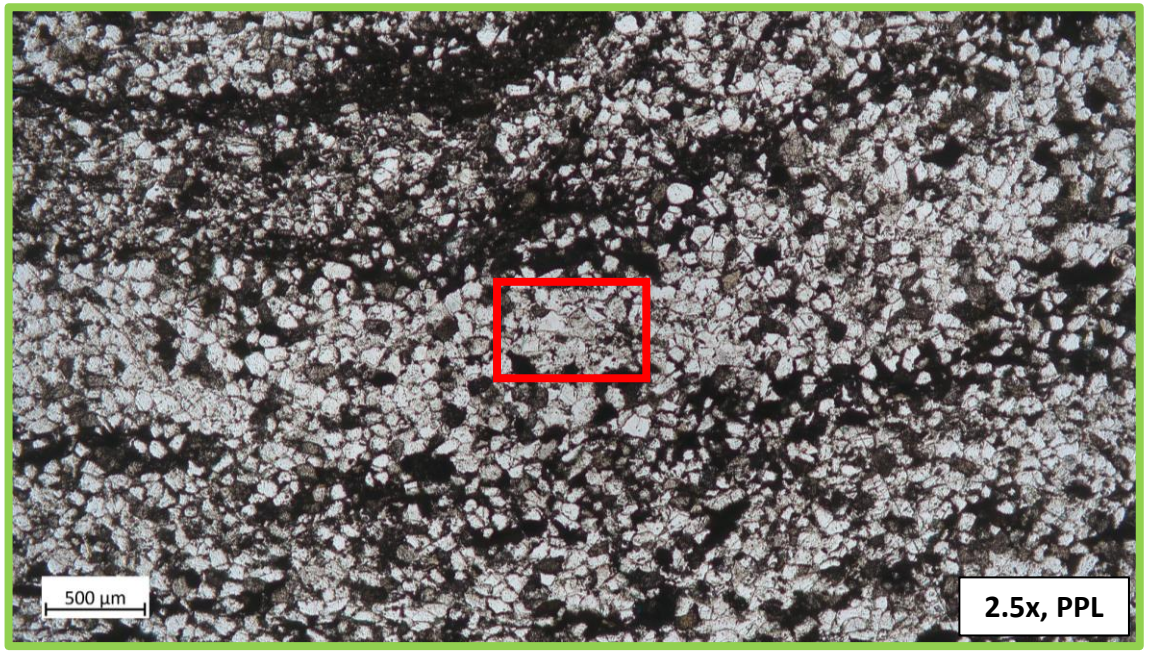


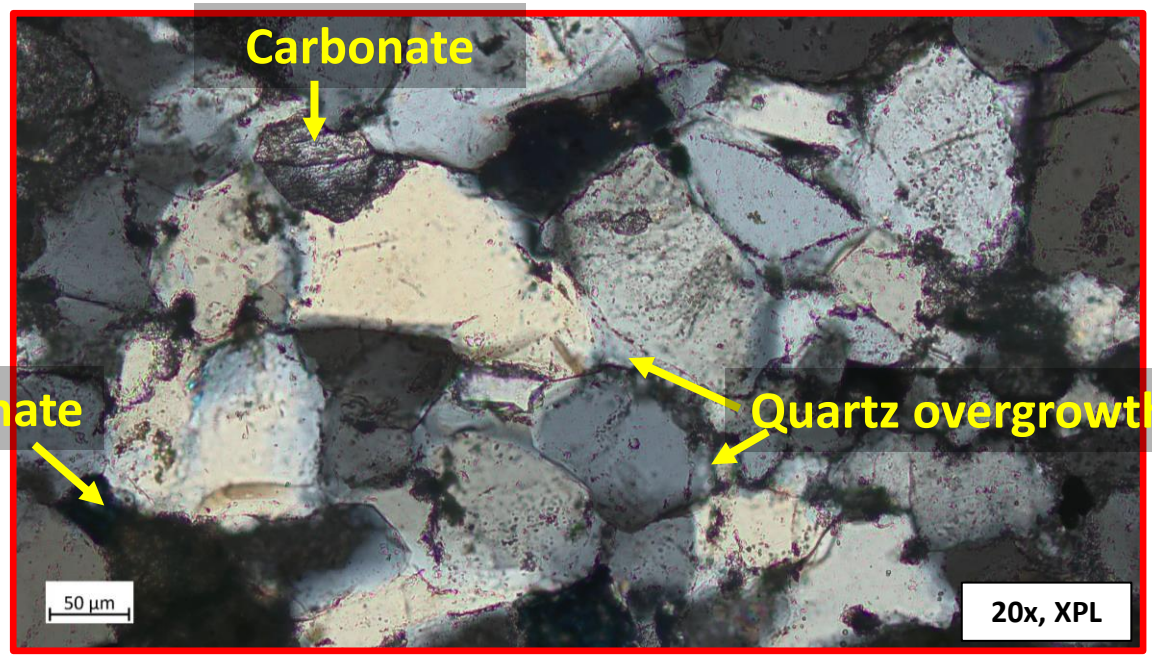
SEM images (A, C-D) & EDS (B) map of "Area 2" from 6551.1 feet in the Strawn Formation in the #1 Wallace Ranch core.





Heterolithic argillaceous VFG sandstone - Facies 6





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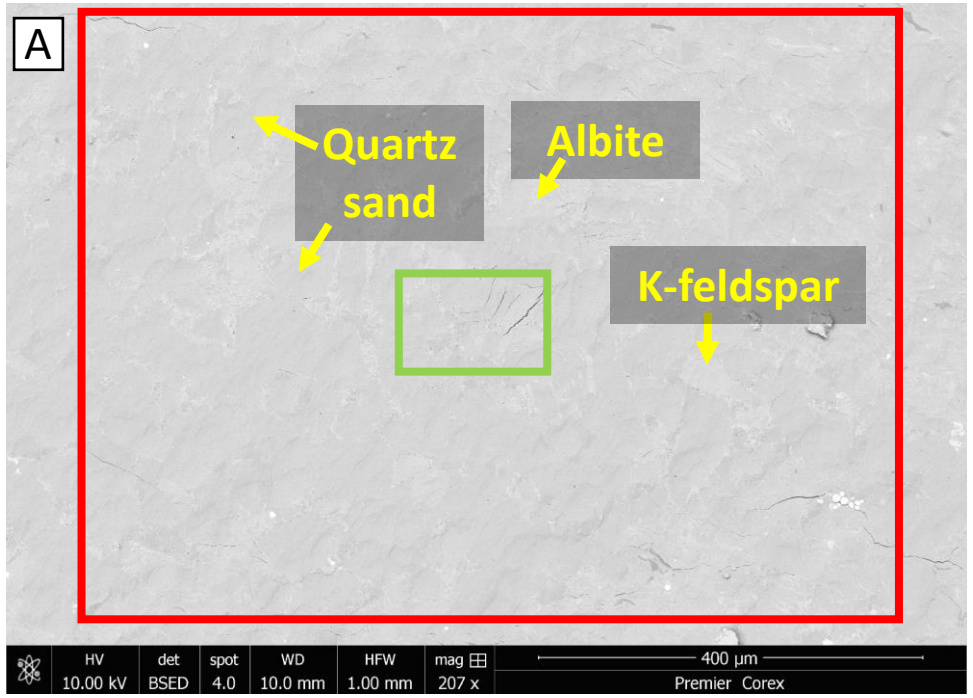
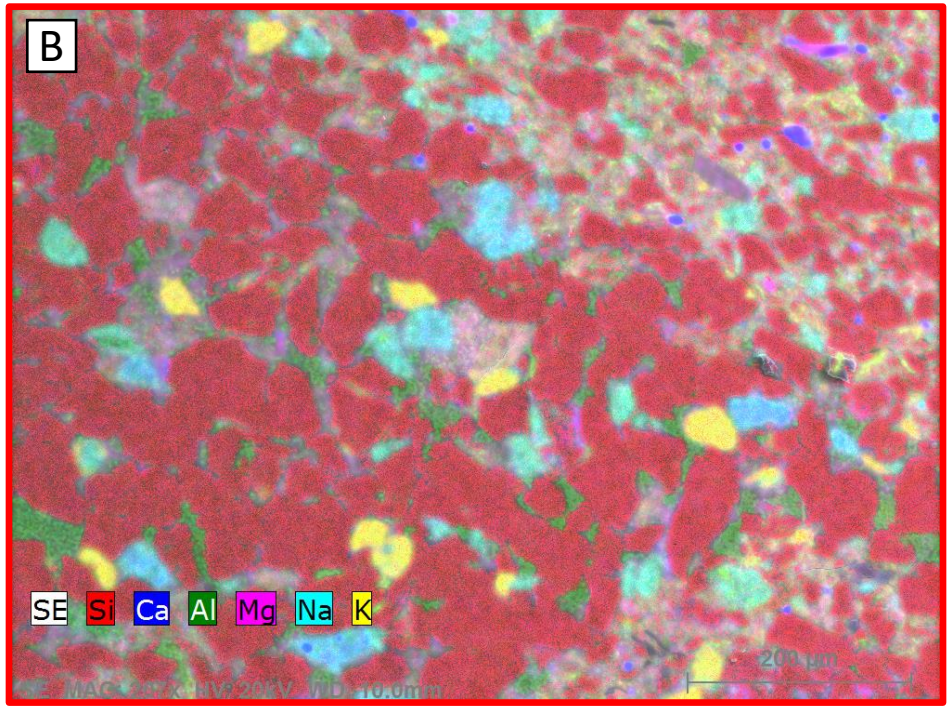
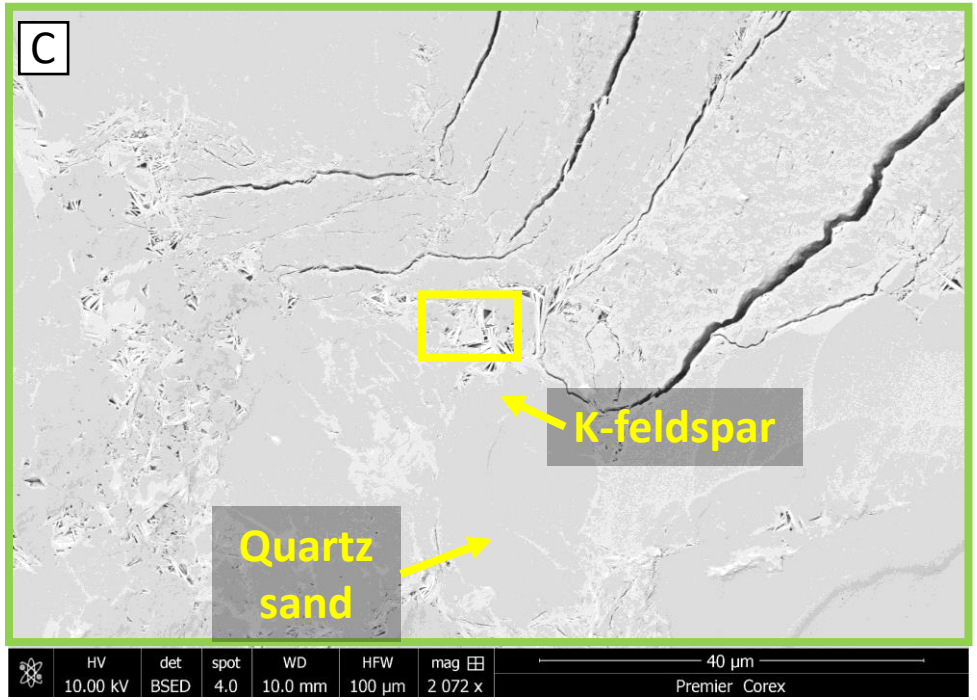
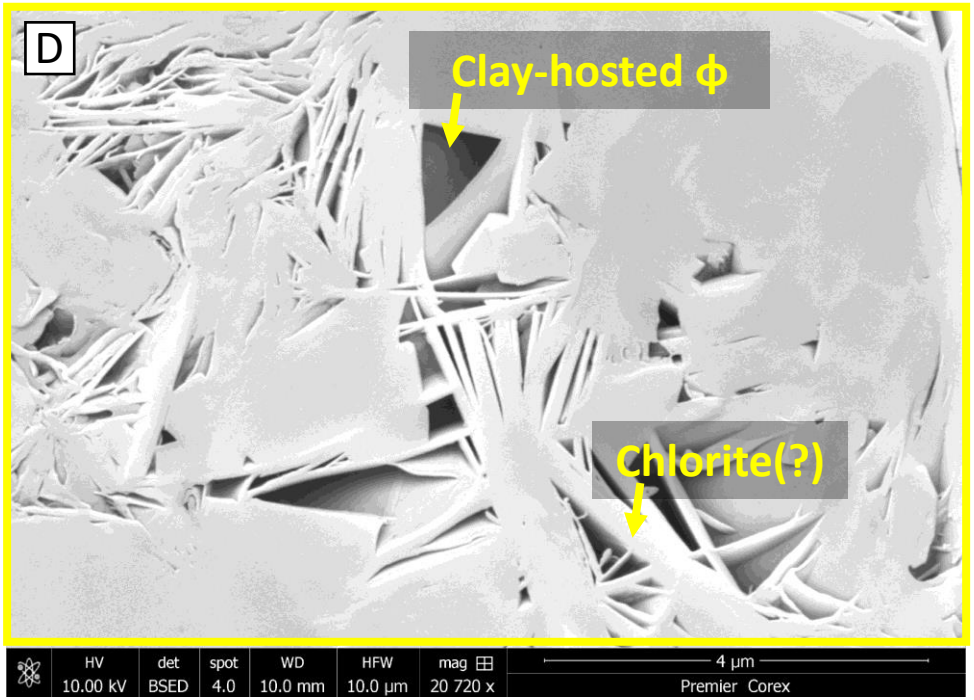




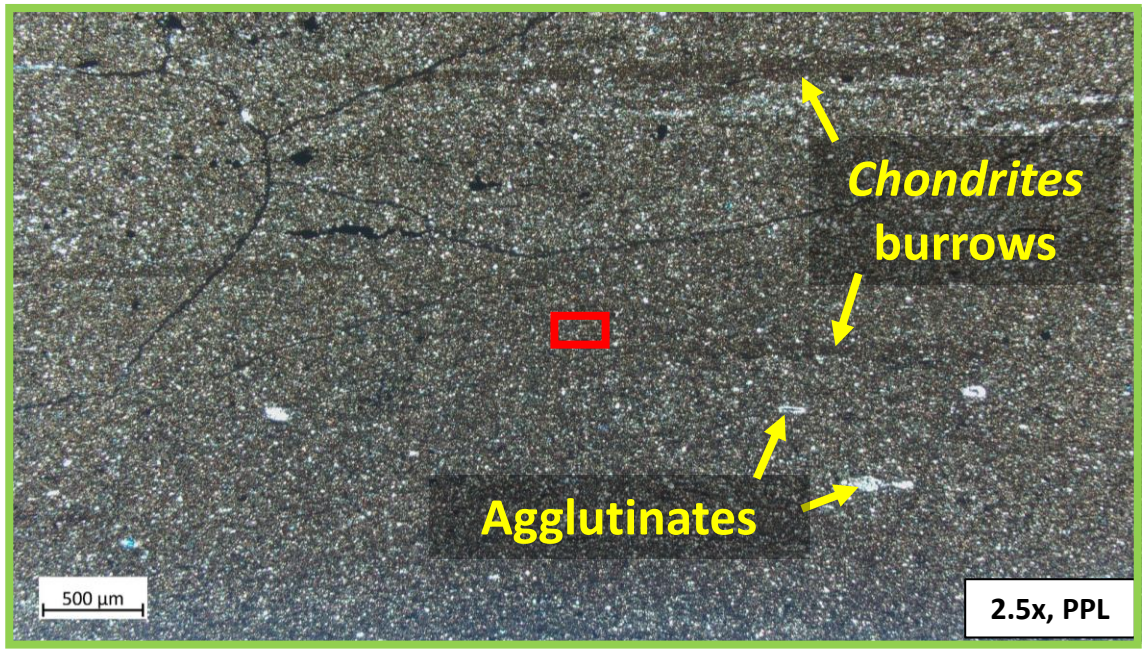
SEM images (A, C-D) & EDS (B) map of "Area2" from 6569.1 feet in the Strawn Formation in the #1 Wallace Ranch core.

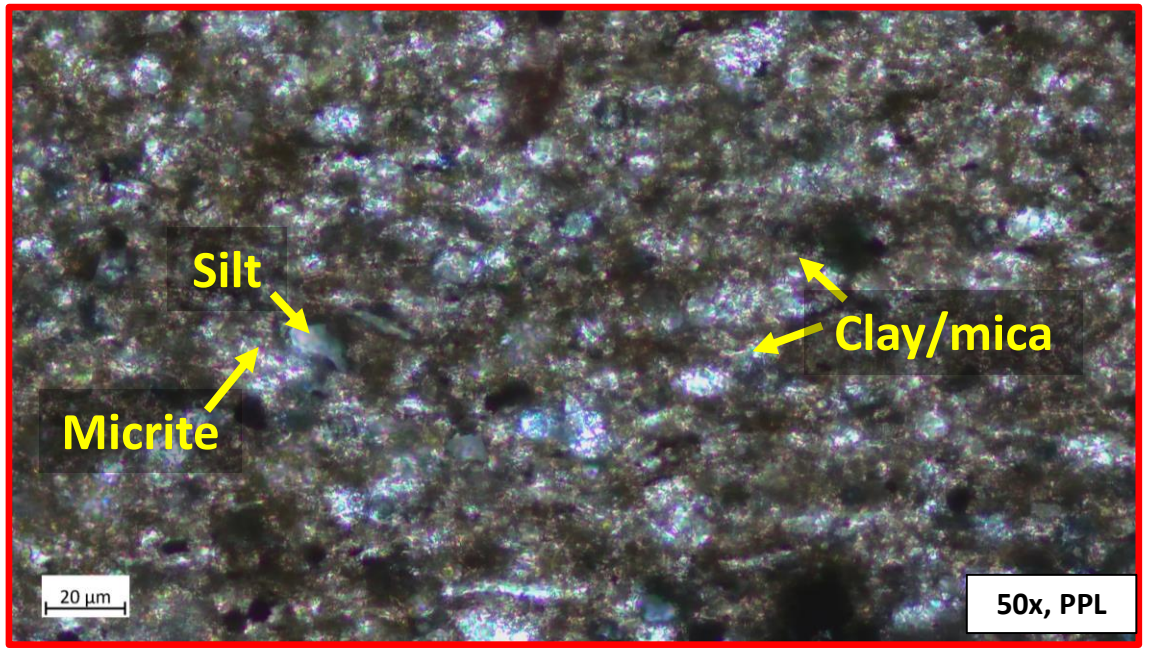




PREMIER COREX

Bioturbated OM-rich calcareous silty claystone – Facies 8





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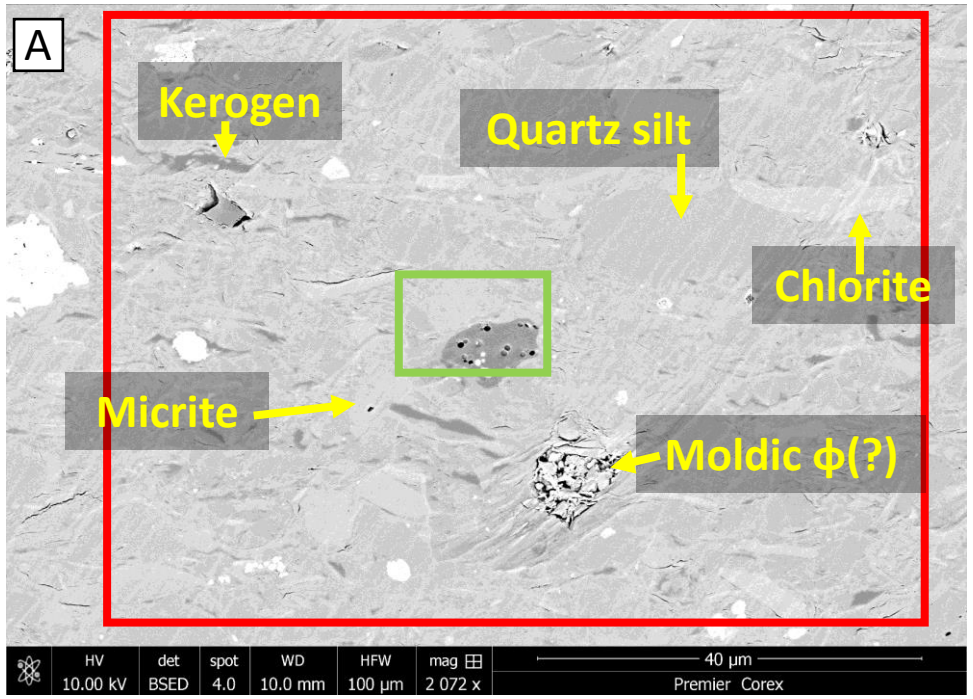
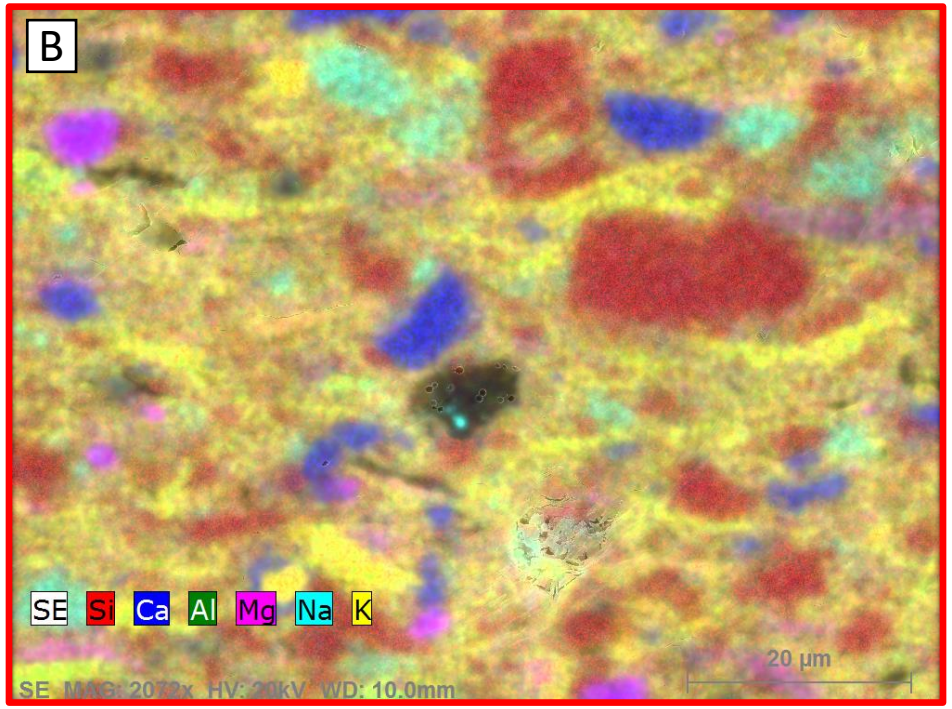
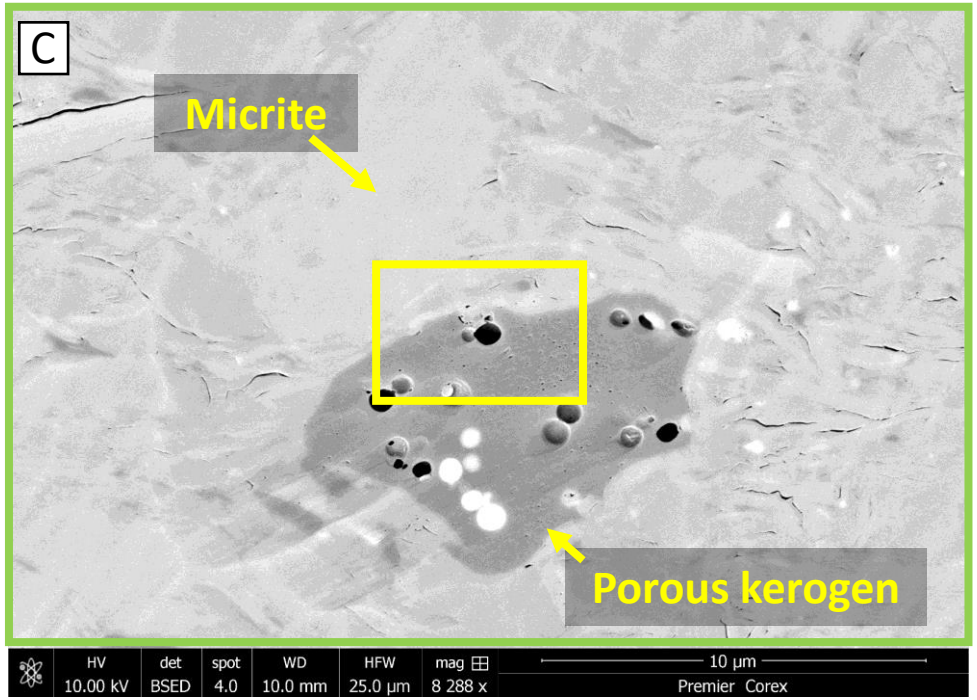
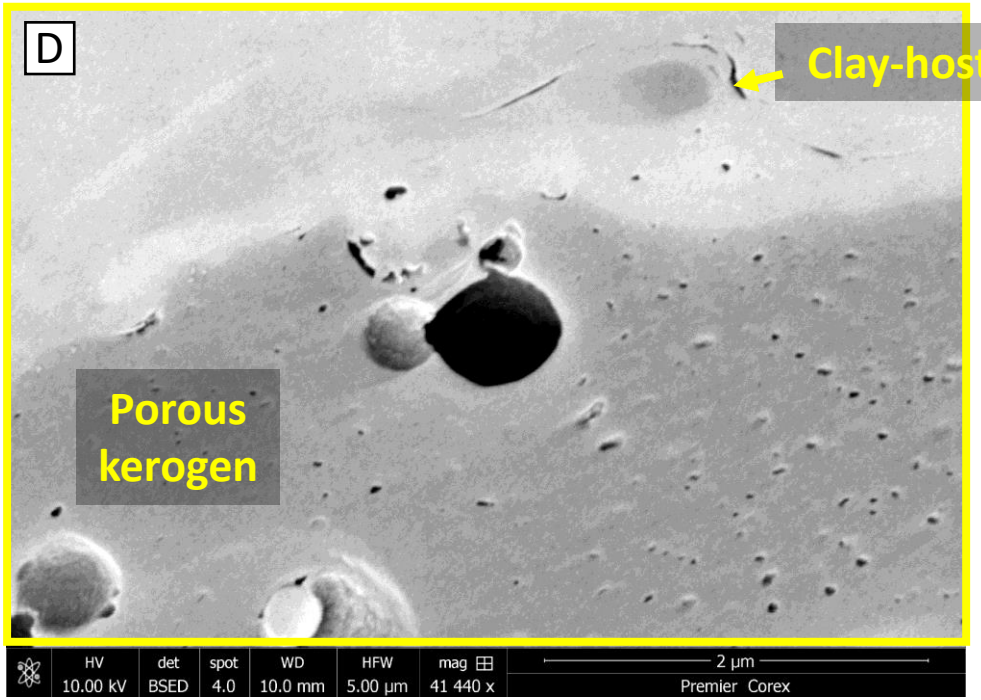




SEM images (A, C-D) & EDS (B) map of "Area 1" from 6524.6 feet in the Strawn Formation in the #1 Wallace Ranch core.





Summary

- Two cores (Wallace Ranch #1 and #2) 1.5 miles apart from a sand body in the Middle Pennsylvanian (Desmoinesian) Strawn Group on the Eastern Shelf
- High-frequency (4th-order ~100-400ky) cyclicity strongly influenced the system resulting in:
  - Marginal-marine tidally-influenced deltaics during highstand
  - Erosion and incised valley fill during lowstand
  - OM-rich calcareous claystone during transgression
- Sandstones contain common to abundant interparticle meso- micro-porosity and clay-hosted micro-porosity
  - Strongly impacted by compaction of clay and lithic grains; carbonate, clay, and quartz mineralization
- OM-rich calcareous claystones contain sparse clay-hosted, moldic, and patchy OM-hosted micro- and nano-porosity

PREMIER COREX

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PREMIER COREX

Let’s look at the rocks!

PREMIER COREX