User friendly processing of sediment CT data:

Software and application in high resolution non-destructive sediment core data sets

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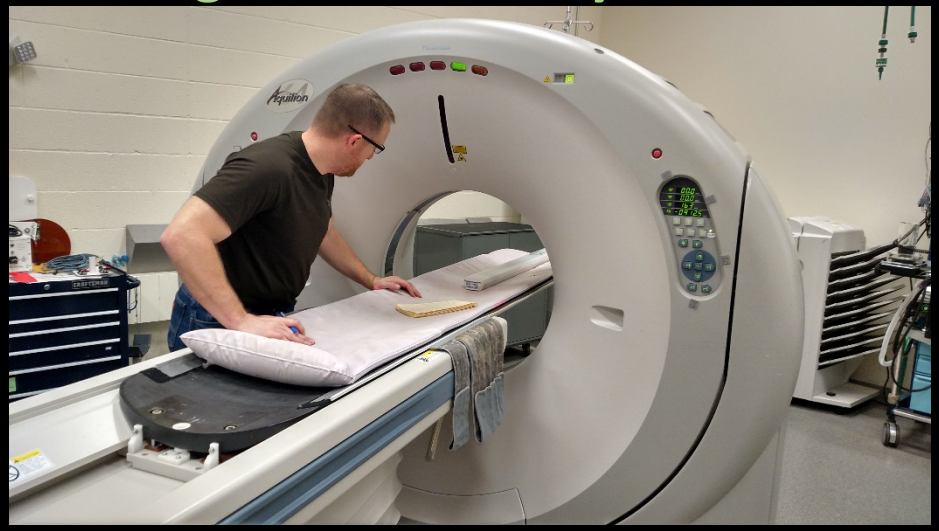
Sediment Computed Tomography

Medical CT Scanner at OSU College of Veterinary Medicine

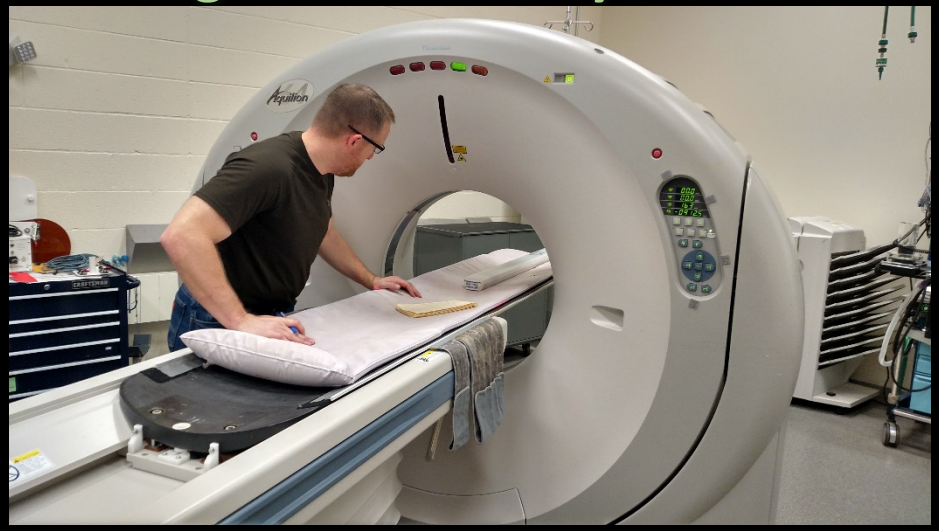
Sediment Computed Tomography

Medical CT Scanner at OSU College of Veterinary Medicine



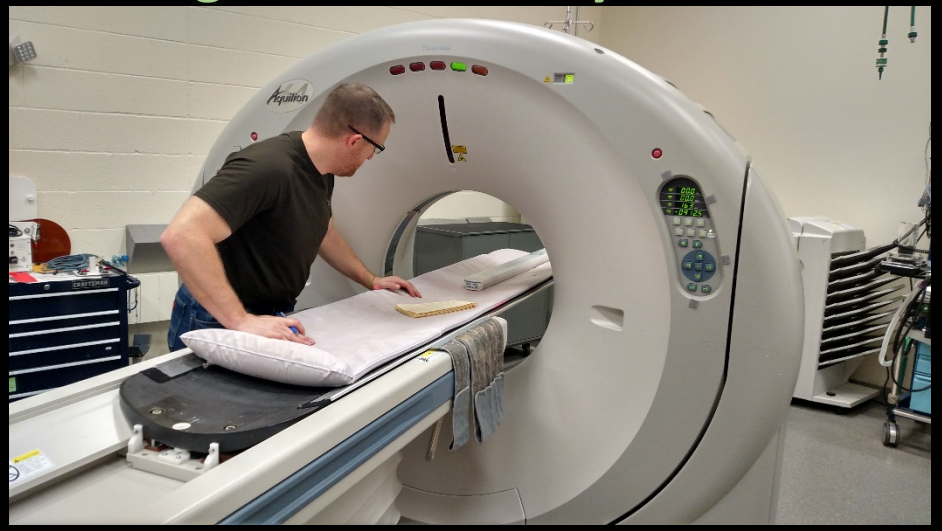
Sediment Computed Tomography

Medical CT Scanner at OSU College of Veterinary Medicine



Sediment Computed Tomography

Medical CT Scanner at OSU College of Veterinary Medicine



Why CT Scans?

- 3-D Volumes
- Quantitative HU scale
- Up to 0.5 mm resolution

HU values are relative to the attenuation coefficient of water

Air ~= -1000

Water = 0

Calcite ~= 2500

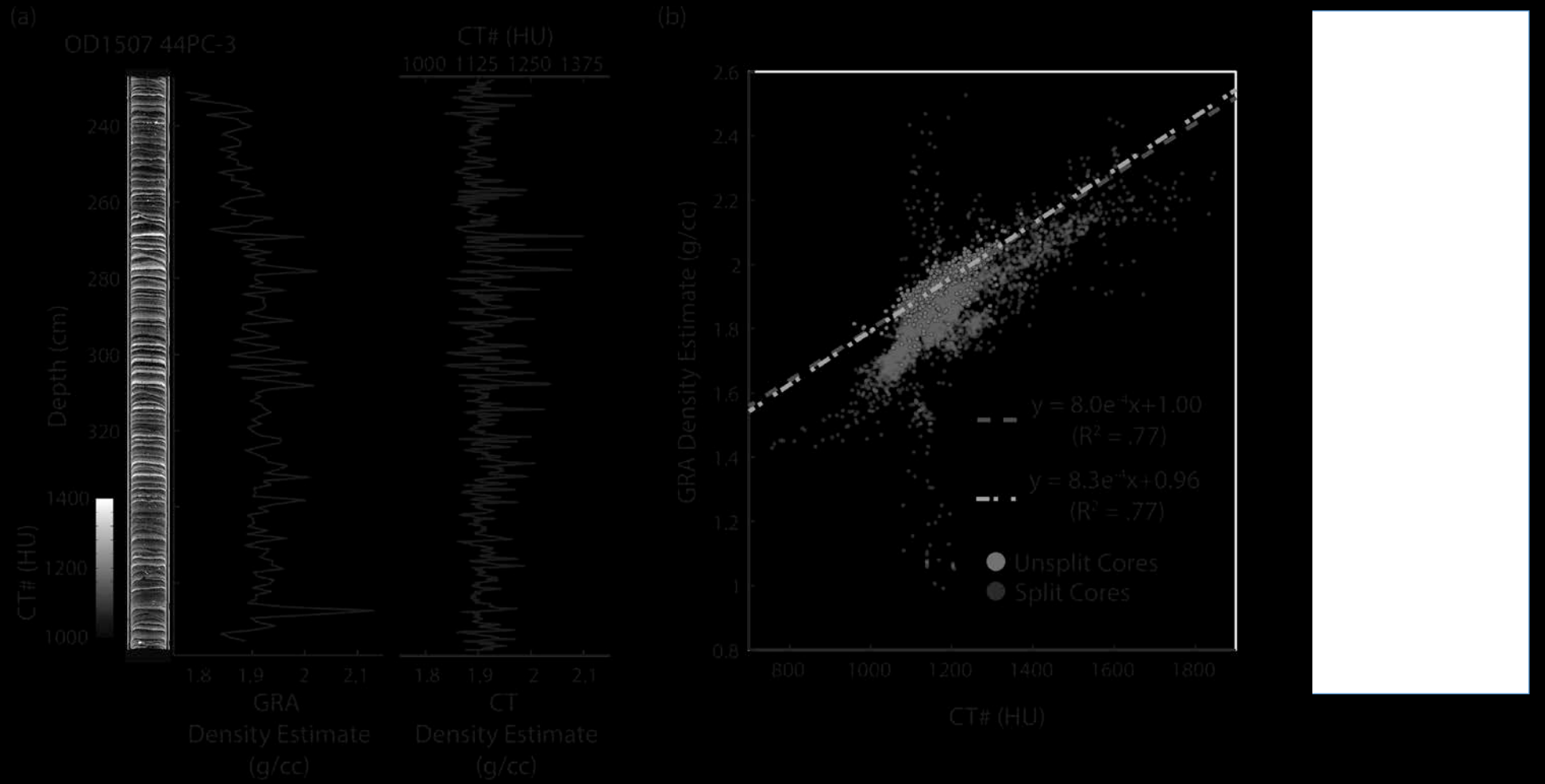
$$HU = (\mu/\mu_w - 1) \times 1000$$

HU = Hounsfield Unit

μ = attenuation coefficient of sediment

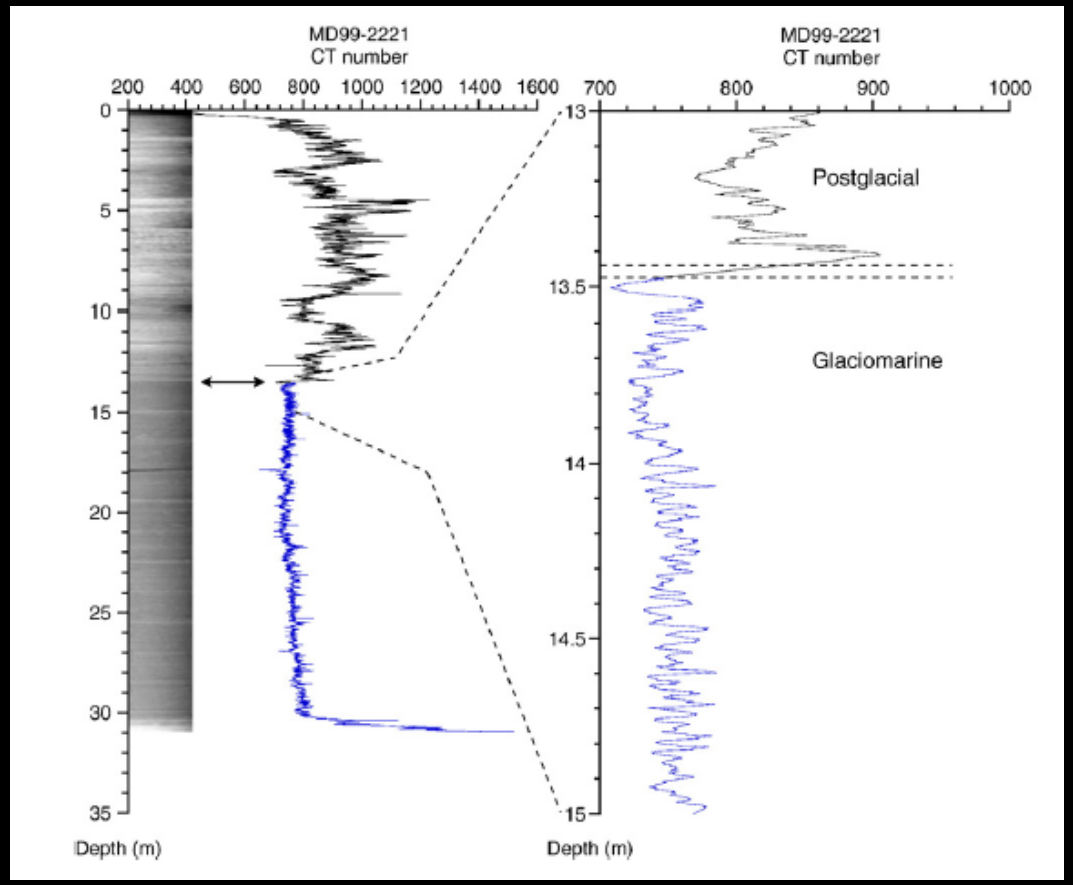
μ_w = attenuation coefficient of water

Comparison with GRA density



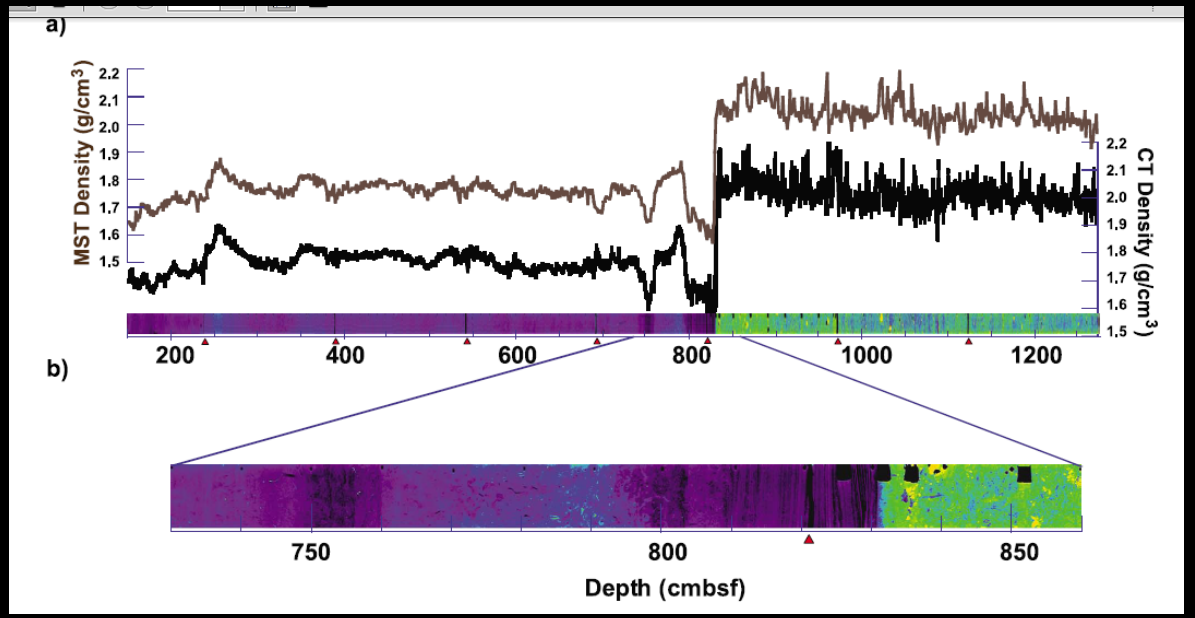
CT Scans are already demonstrated as useful in paleoclimate studies

St. Lawrence Estuary



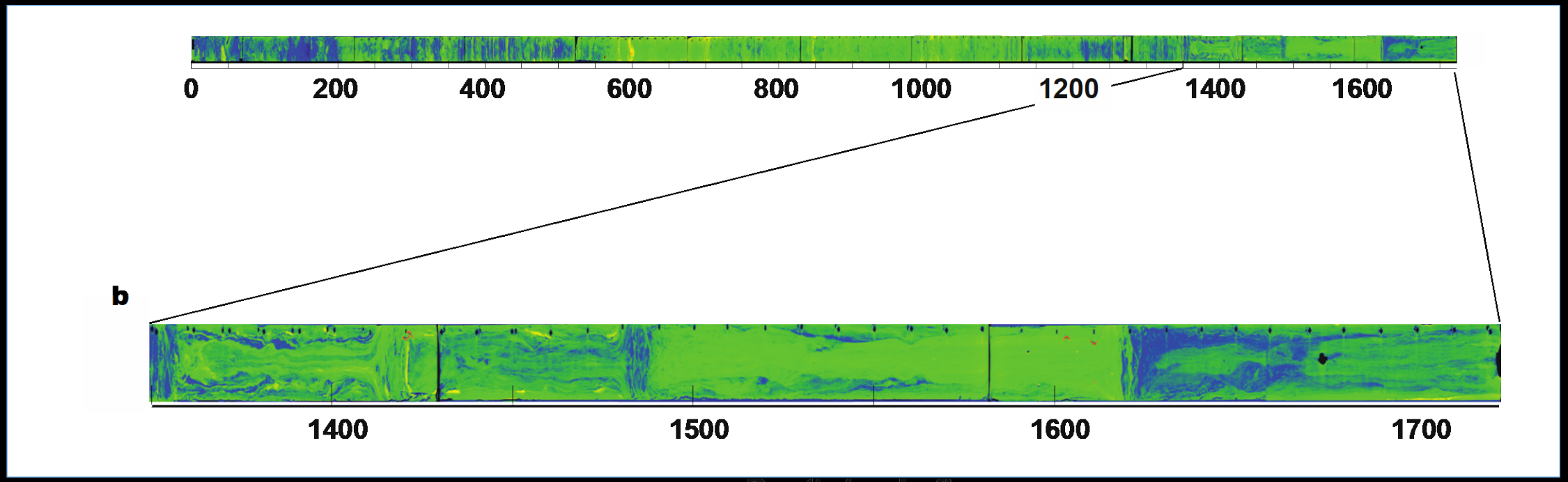
St-Onge & Long, 2009,
Engineering Geology

Gulf of Alaska



Davies et al., 2011,
Paleoceanography

CT Scans can facilitate identification of disturbances



Gulf of Alaska

Walczak (nee Davies) et al., in press, EPSL

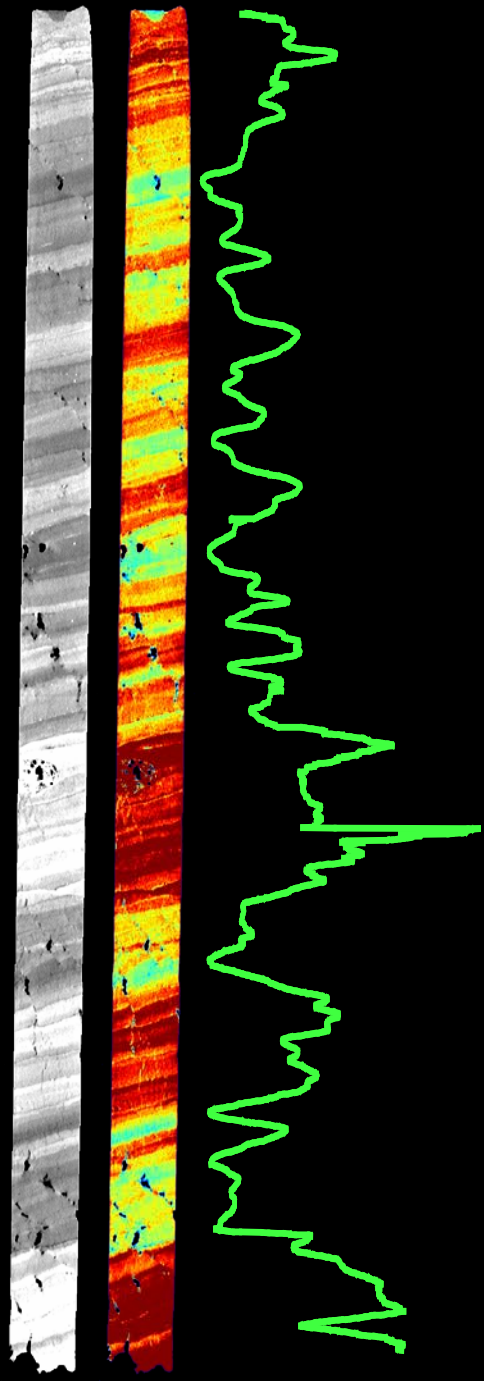
Motivation

Standardize CT Processing:

- Utilize entire 3-D volume and sets of DICOM files
- Interactive and simple tool
- Fast
- Direct comparison of large sediment core suites
- Preserves quantitative information (HU Scale)

Robustness to Normal Coring Imperfections

- Deformation
- Bowing
- Gas Expansion
- Gaps



Sed-CT: MATLAB Based Software

Graphical User Interface

Data Processing

Sed-CT: MATLAB Based Software

Graphical User Interface

Input Parameters

Data Processing

Sed-CT: MATLAB Based Software

Graphical User Interface

Processing Parameters

Data Processing

Sed-CT: MATLAB Based Software

Graphical User Interface

Data Viewer

Data Processing

Sed-CT: MATLAB Based Software

Graphical User Interface

Section Manager

Data Processing

Sed-CT: MATLAB Based Software

Graphical User Interface

Create Composite Record

Data Processing

Sed-CT: MATLAB Based Software

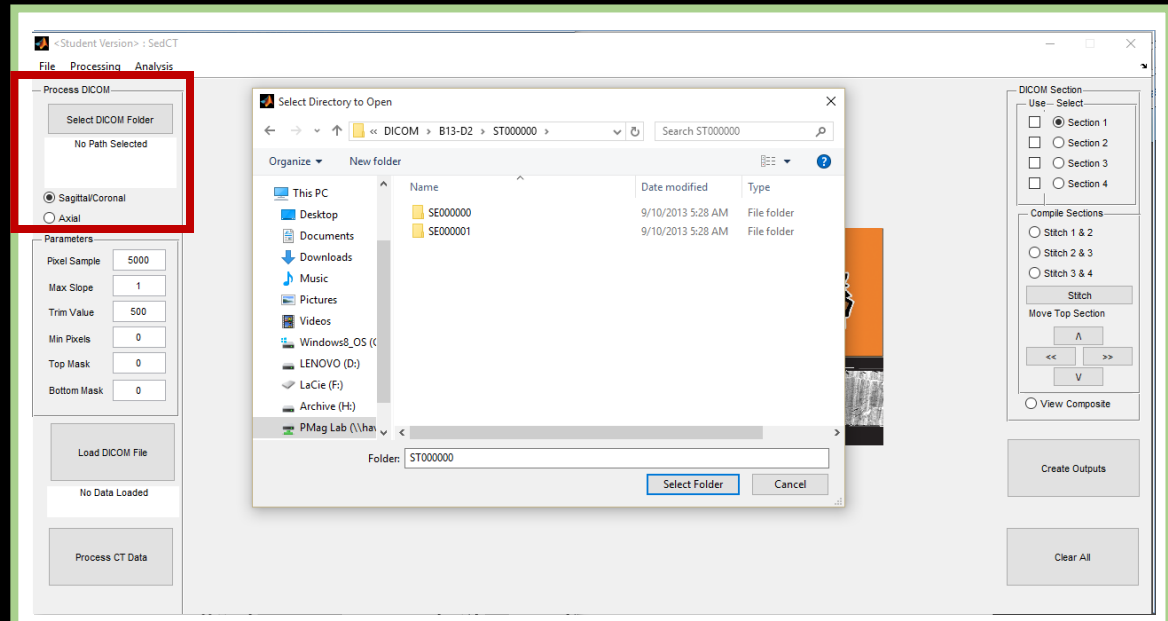
Graphical User Interface

Create Output of Results

Data Processing

Sed-CT: MATLAB Based Software

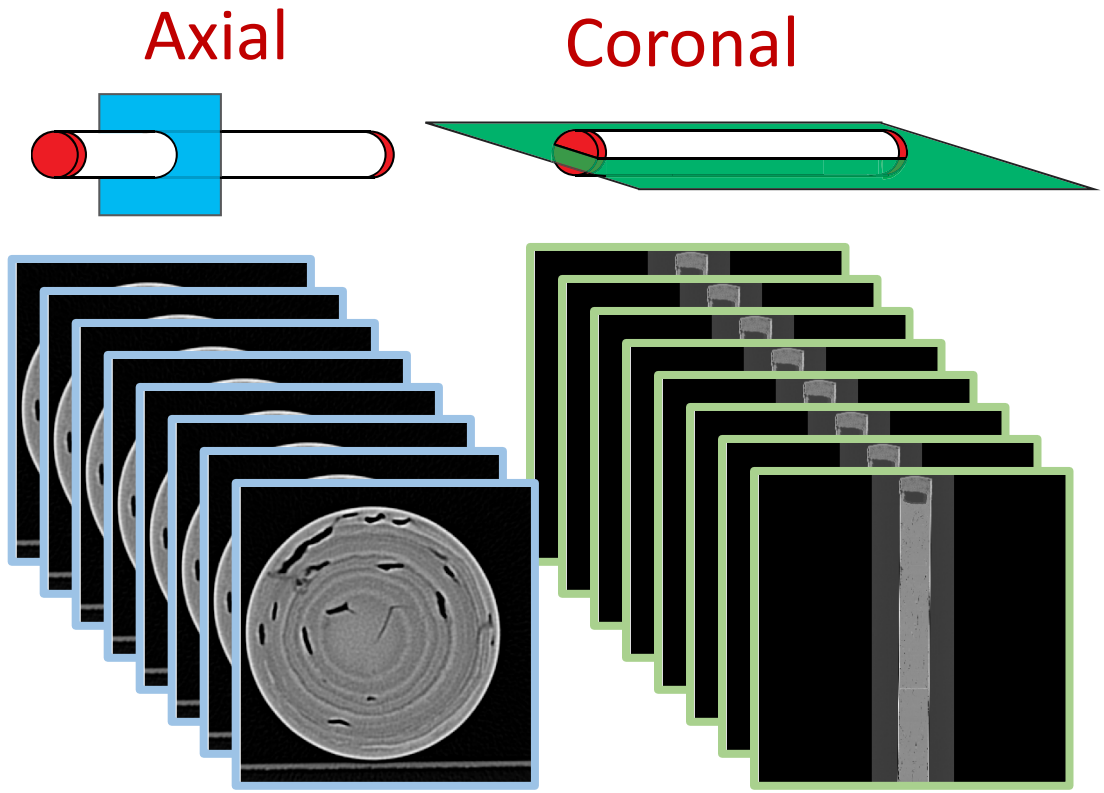
Graphical User Interface



Select Directory Containing DICOM (Digital Imaging and Communications in Medicine) Files

Choose Axial or Coronal Plane

Data Processing

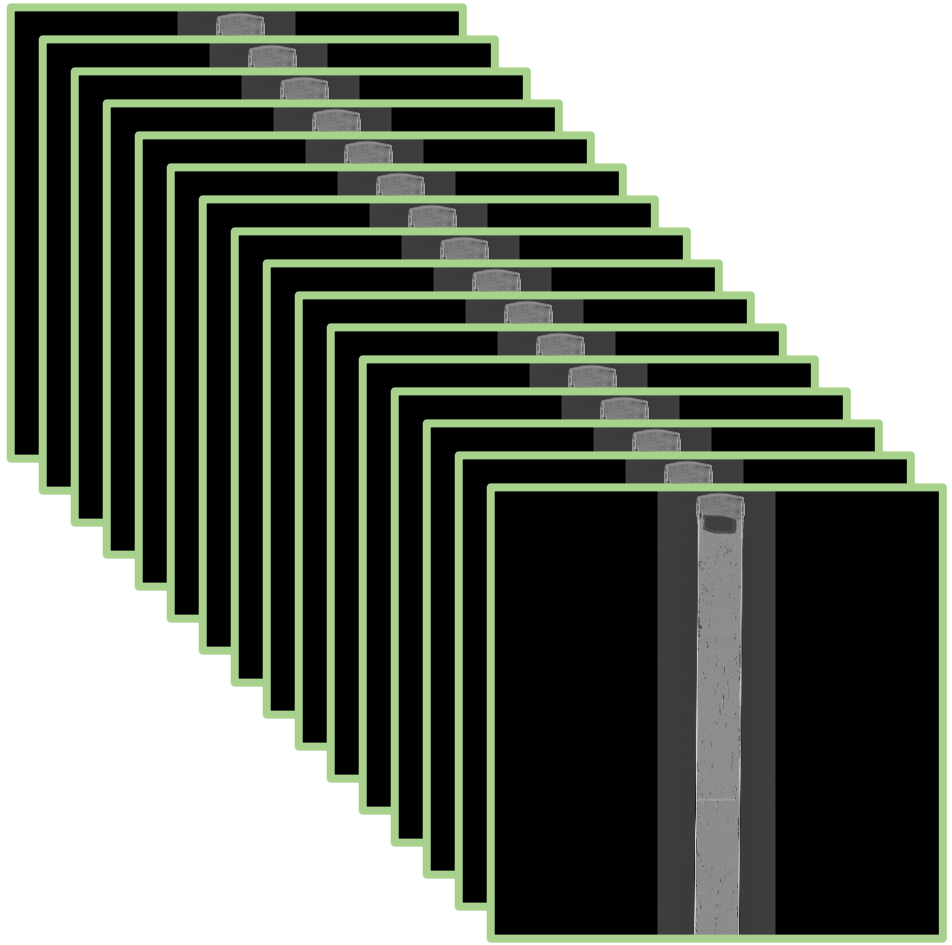


Sed-CT: MATLAB Based Software

Graphical User Interface

Load Data

Data Processing



Sed-CT: MATLAB Based Software

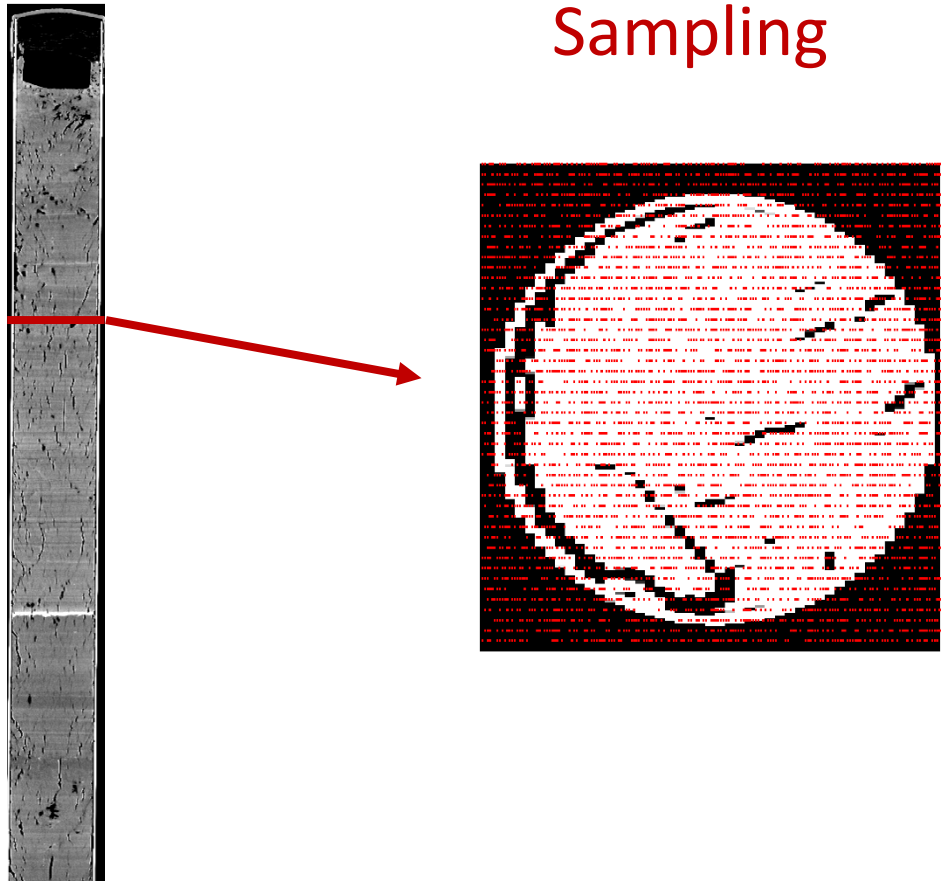
Graphical User Interface

Generate Image and Random Sampling of HU Values (Default = 5,000)

Data Processing

Image

Random HU Value Sampling

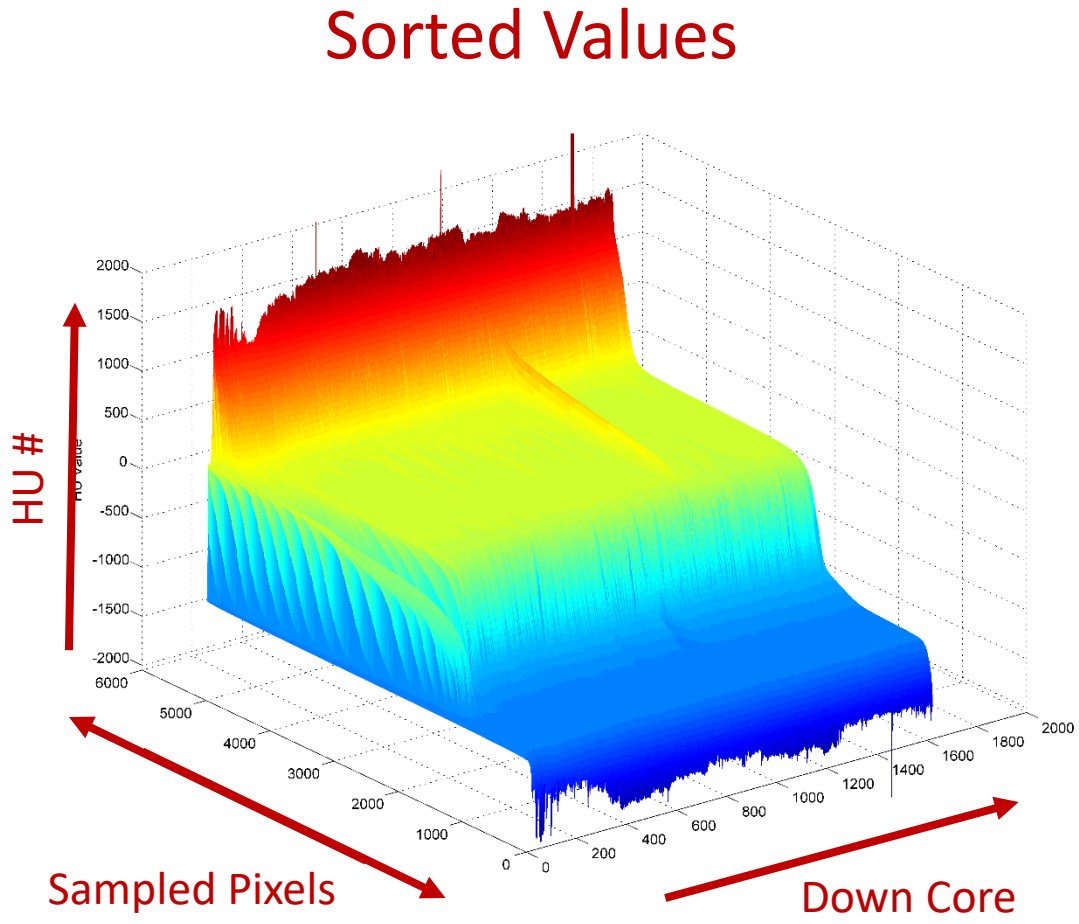


Sed-CT: MATLAB Based Software

Graphical User Interface

Process CT Data

Data Processing



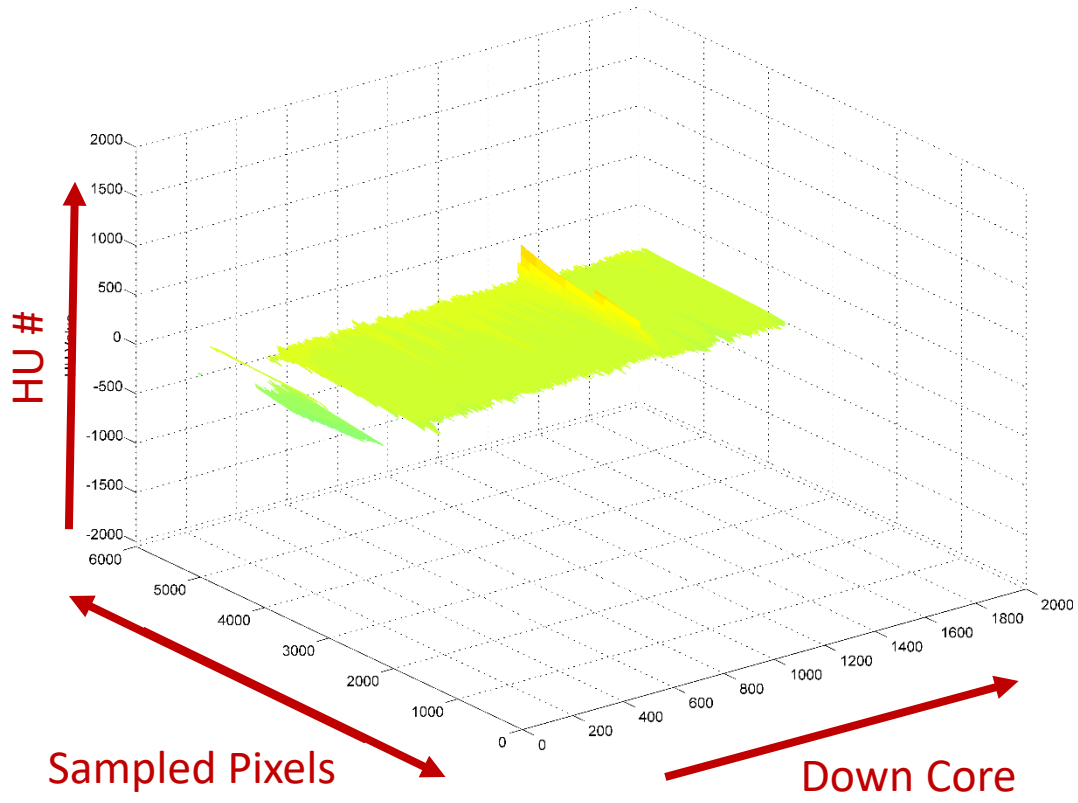
Sed-CT: MATLAB Based Software

Graphical User Interface

Processing Parameters to Adjust

Data Processing

Select Representative Values



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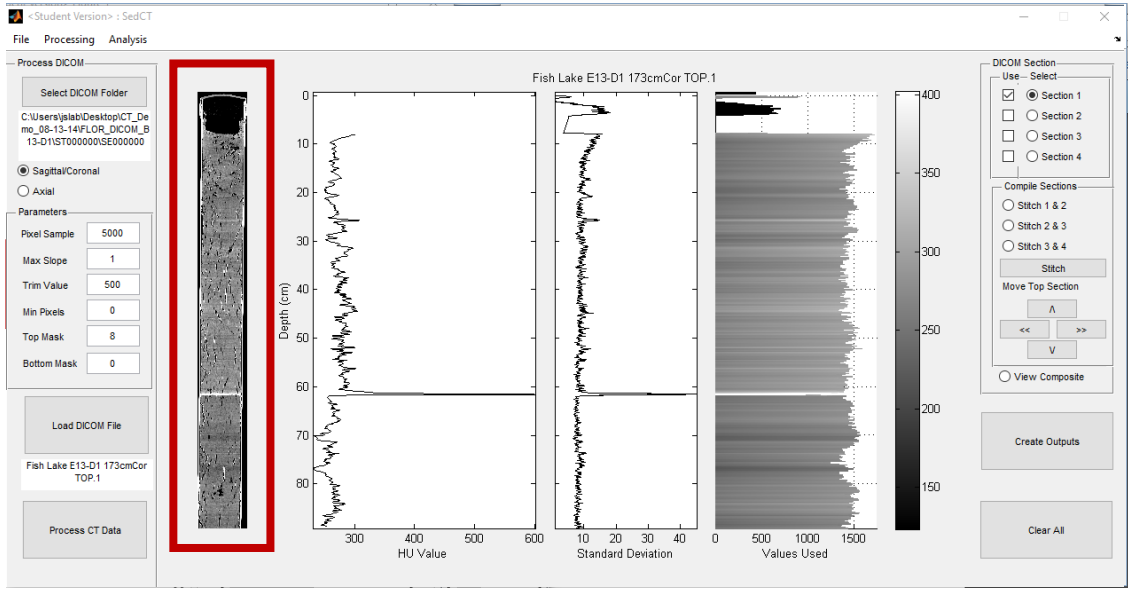
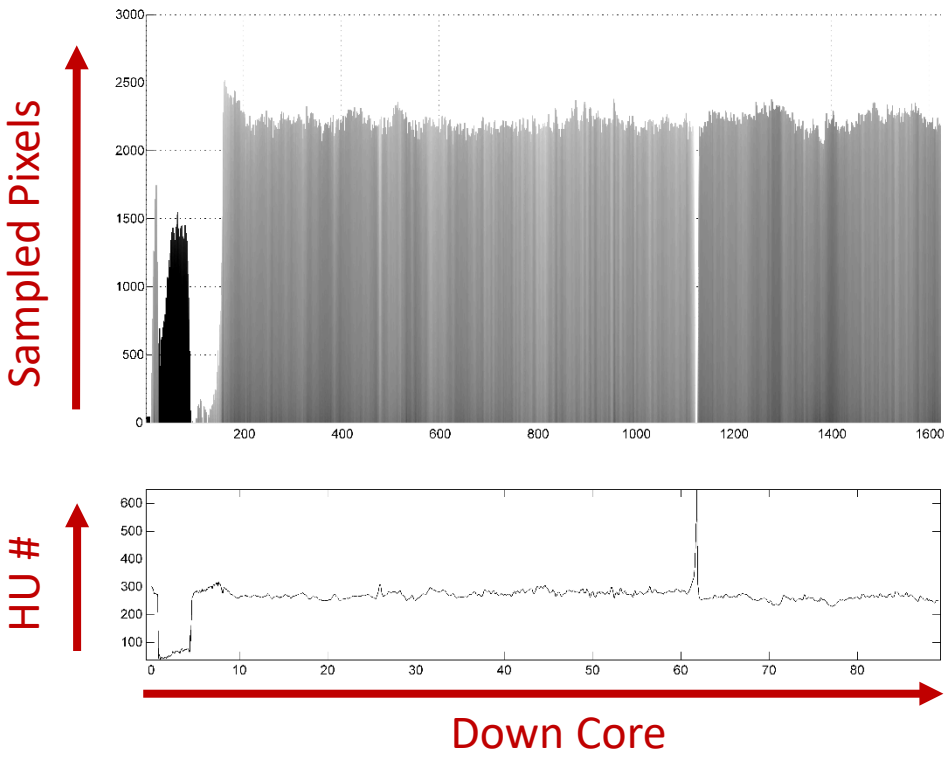
Graphical User Interface



Image

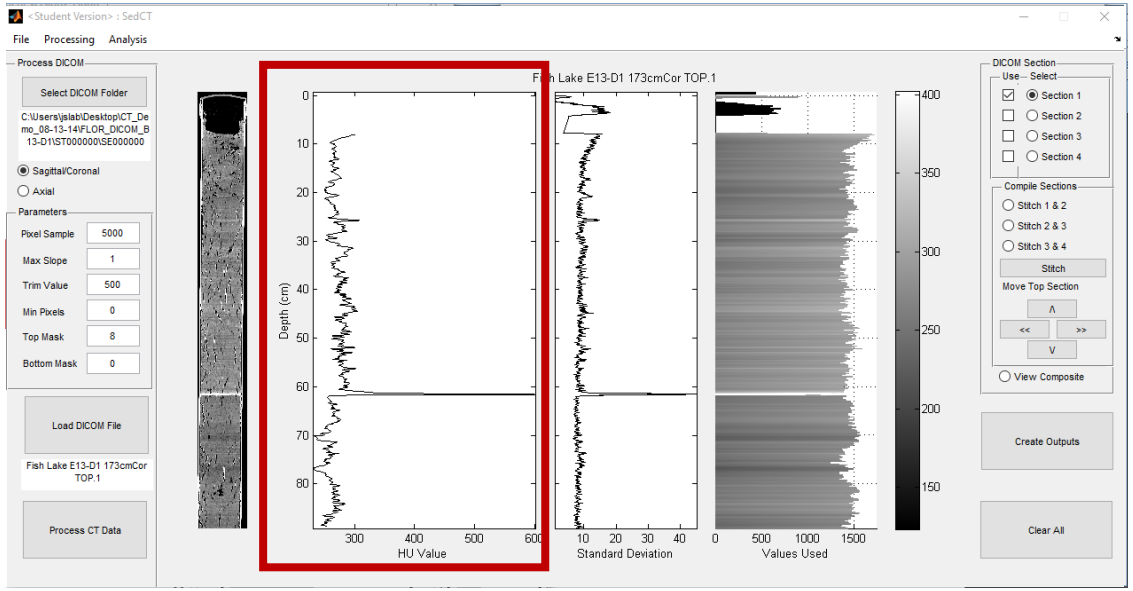
Data Processing

Calculate Mean and Convert to Depth



Sed-CT: MATLAB Based Software

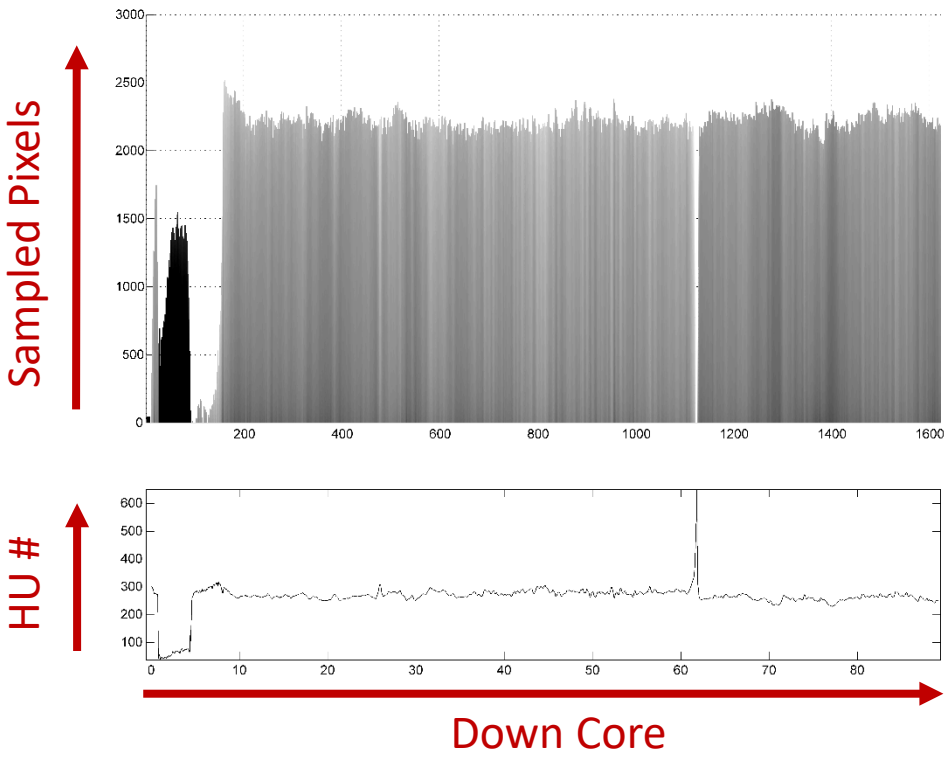
Graphical User Interface



HU Down Core Profile

Data Processing

Calculate Mean and Convert to Depth



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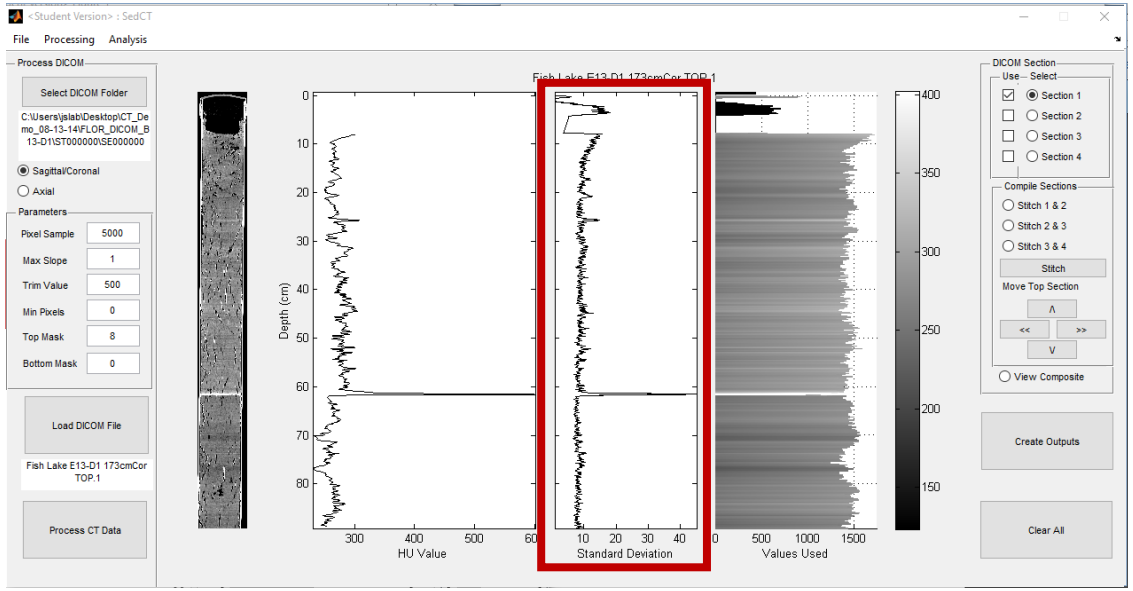
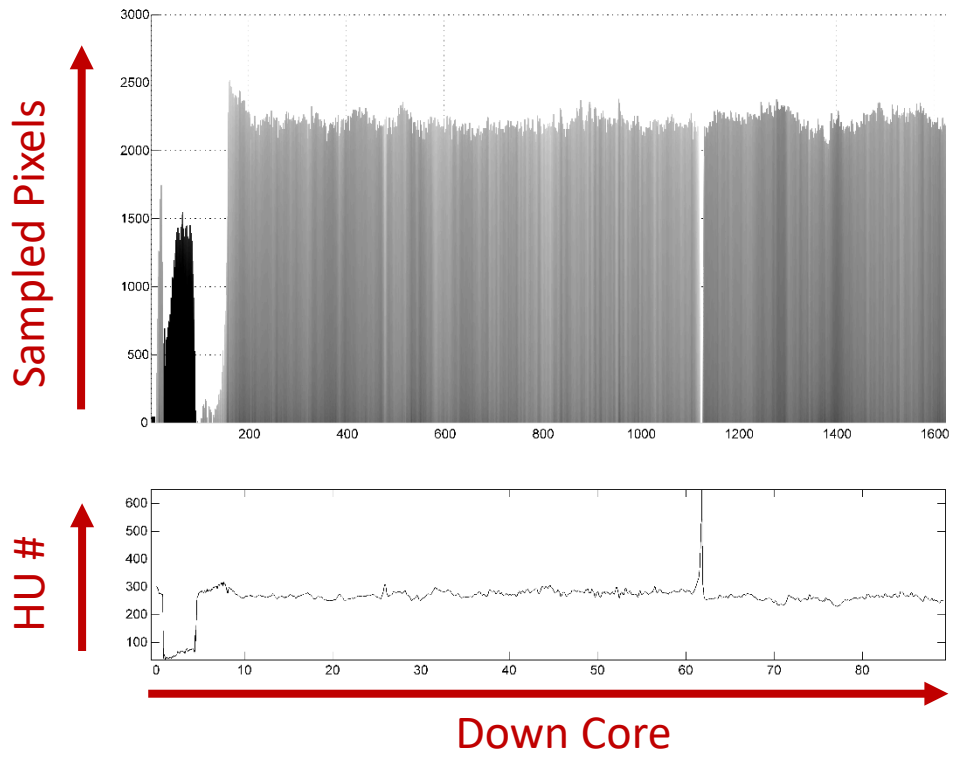
Graphical User Interface



Standard Deviation

Data Processing

Calculate Mean and Convert to Depth



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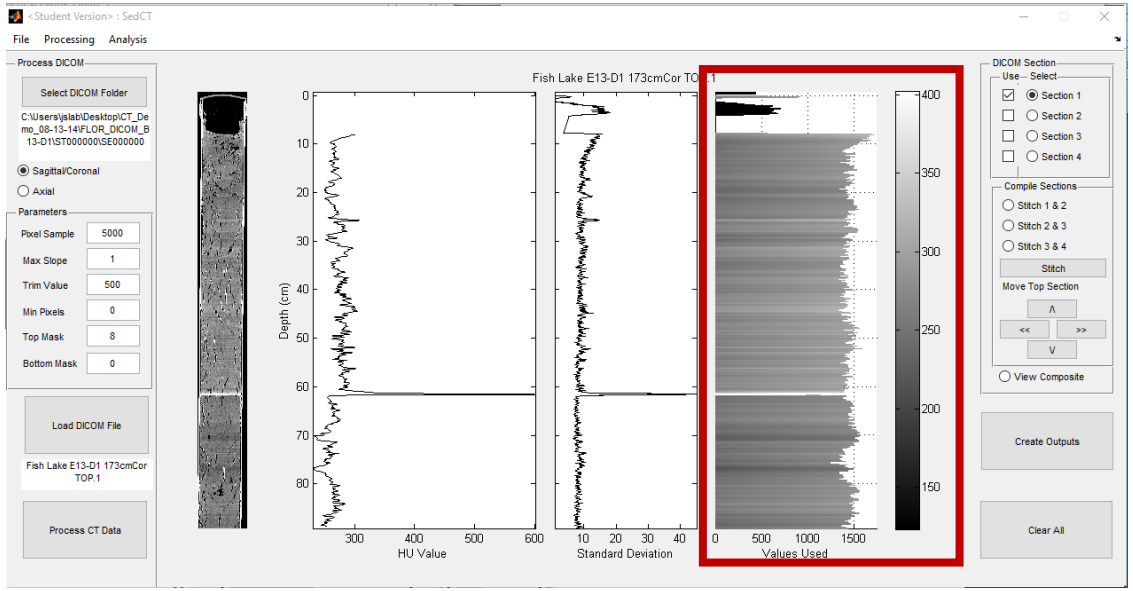
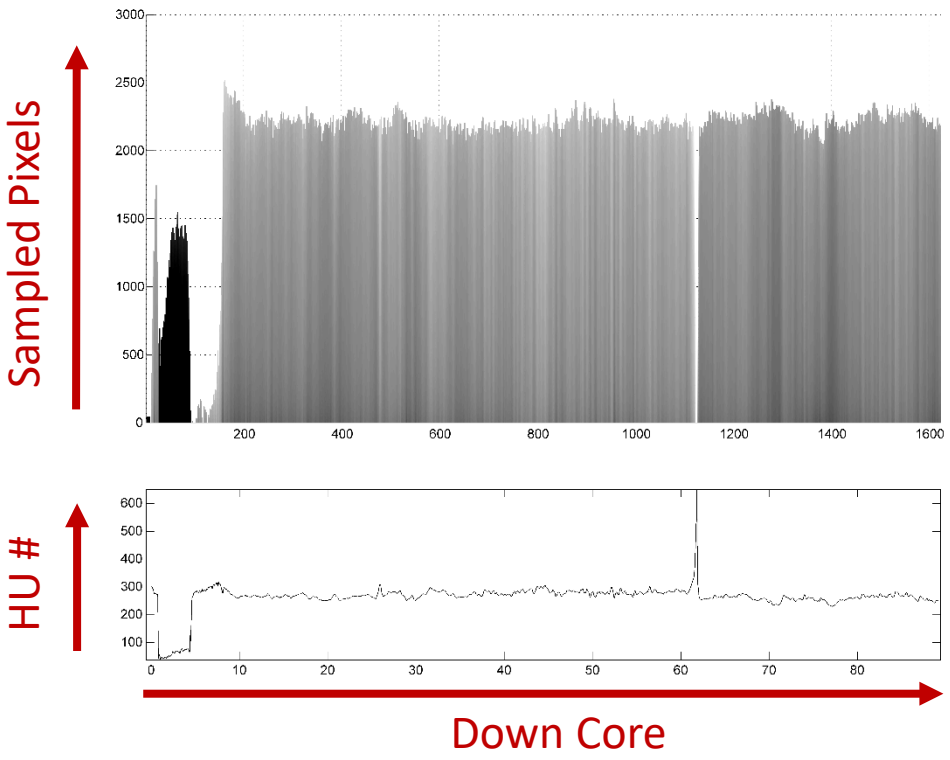
Graphical User Interface



Pixels Isolated and Used

Data Processing

Calculate Mean and Convert to Depth



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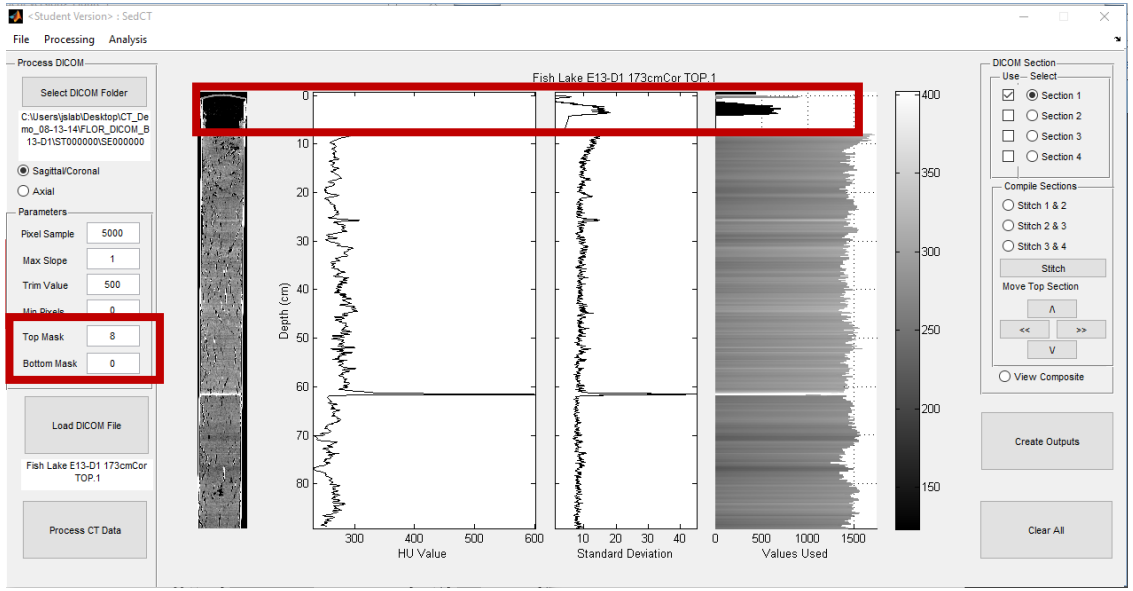
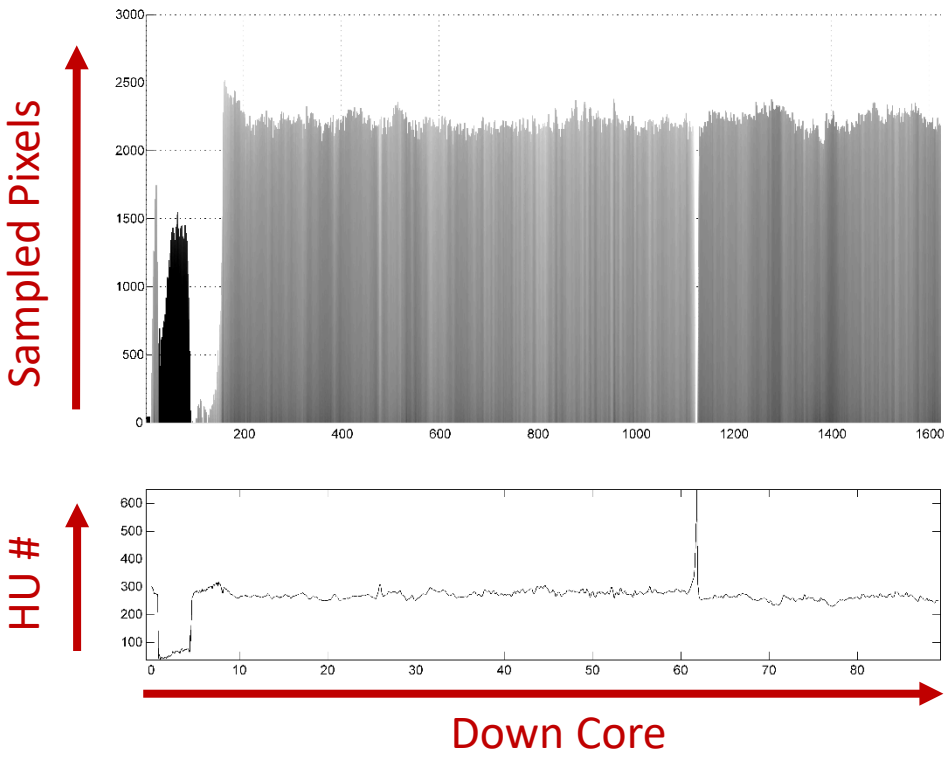


User defines regions to mask

Data Processing

Calculate Mean and Convert to Depth



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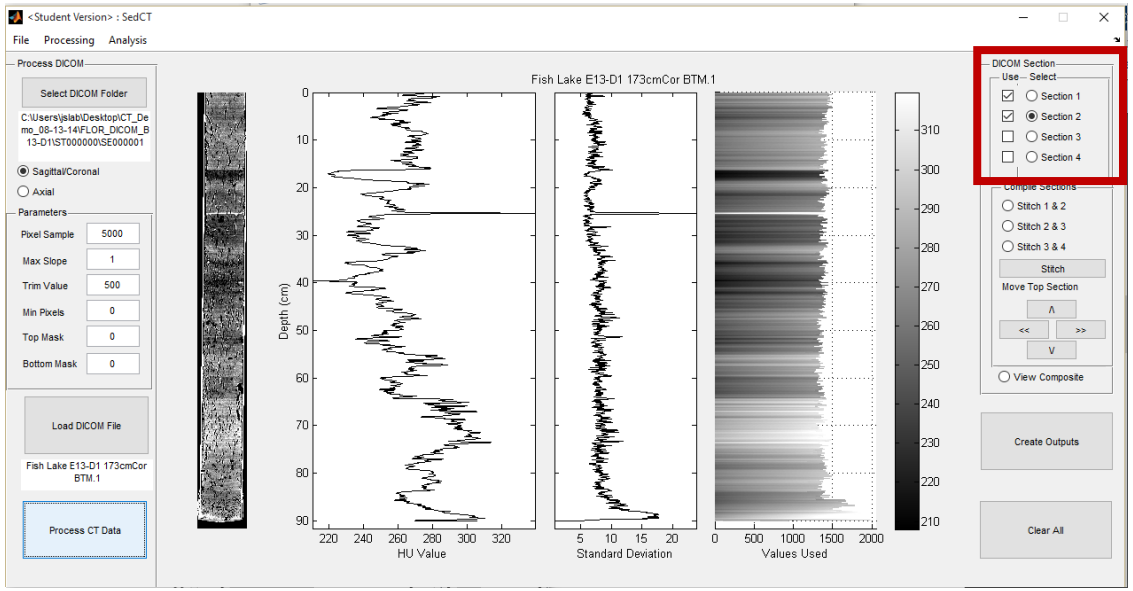
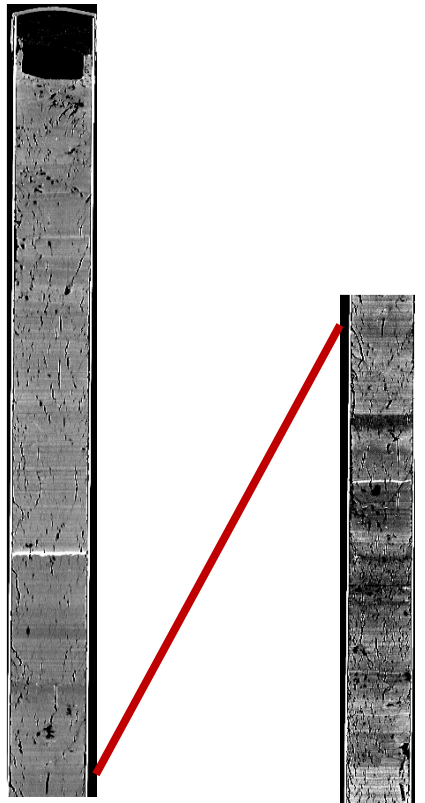
Graphical User Interface



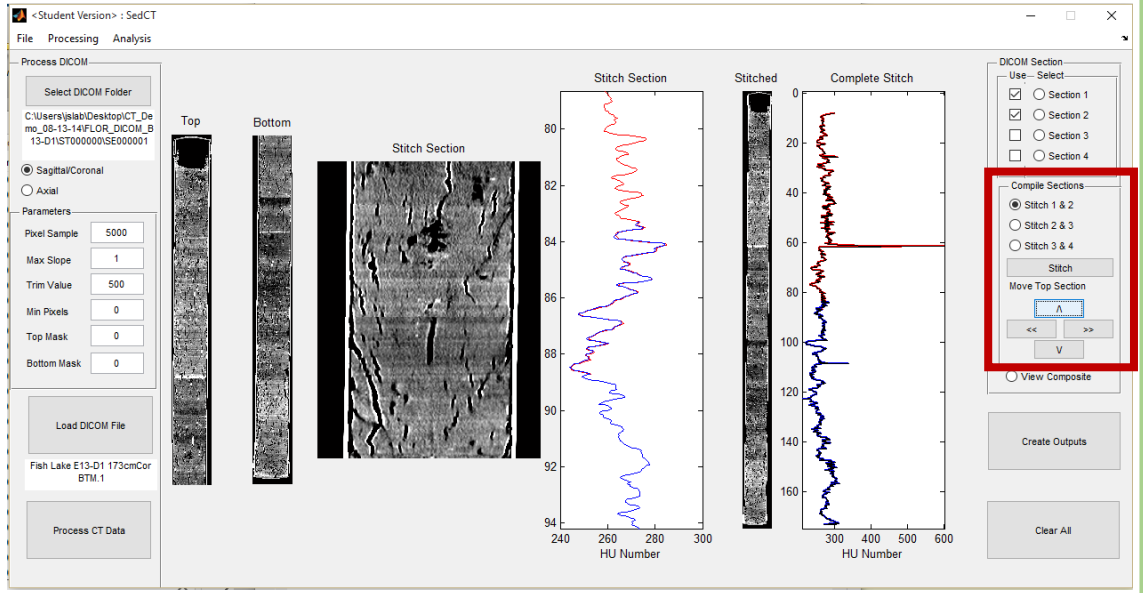
If core is run in multiple sections, load in all sections

Data Processing



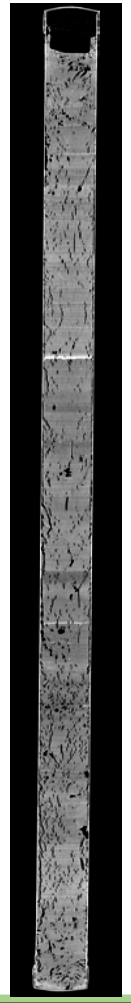
Sed-CT: MATLAB Based Software

Graphical User Interface



Stitch sections together to make composite core

Data Processing

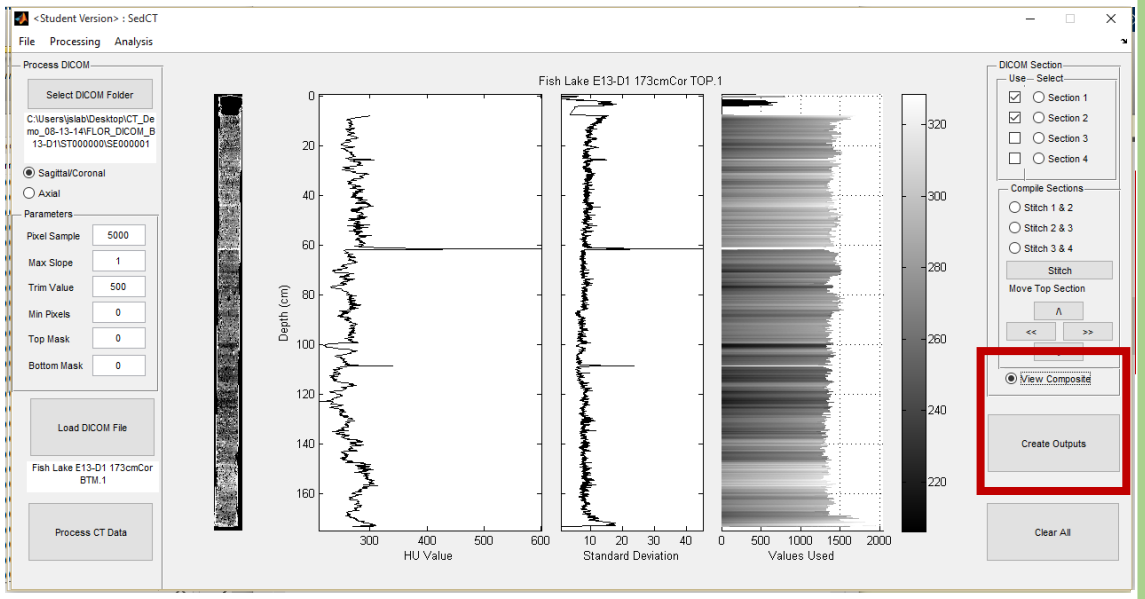


Software makes a best guess

User refines the composite

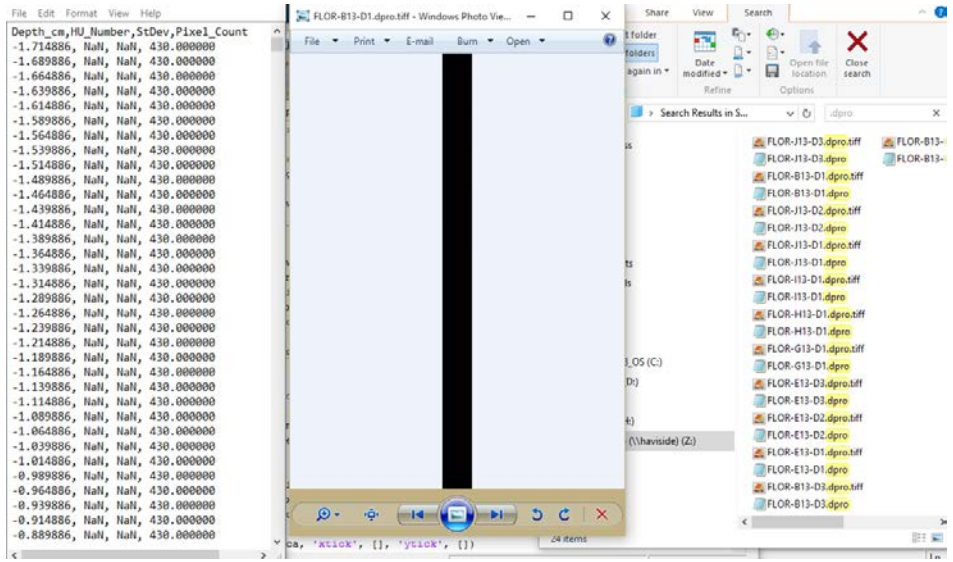
Sed-CT: MATLAB Based Software

Graphical User Interface



View and export the results

Data Processing



Comma delimited ‘*.dpro’
Unscaled ‘*.tiff’

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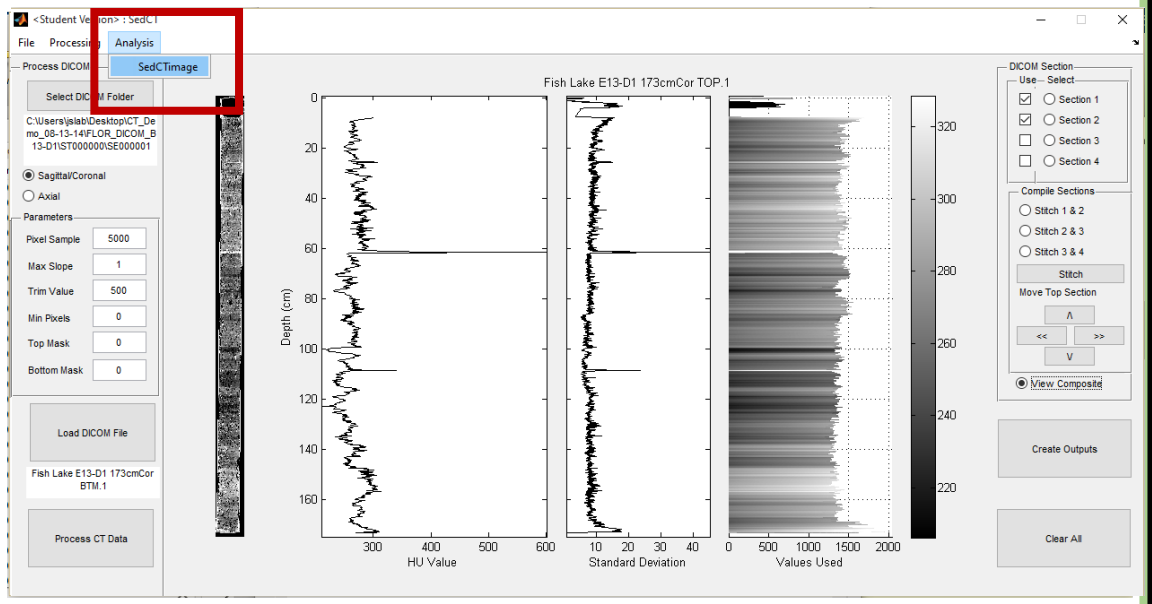
Graphical User Interface

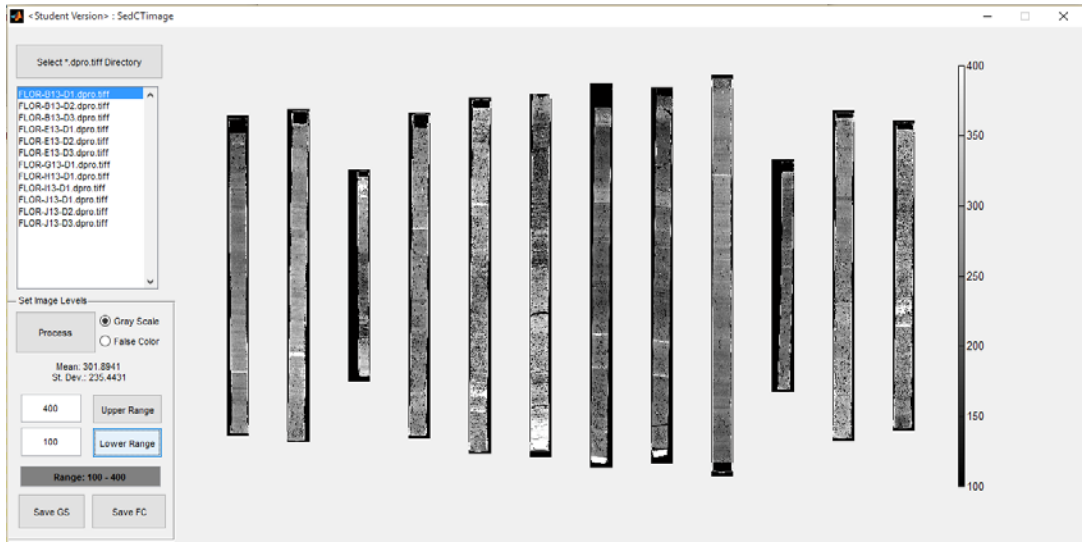


Batch process image files using SedCTimage (add on package)

Data Processing

Sed-CT: MATLAB Based Software

Graphical User Interface



Scale all cores in suite to same, quantitative grayscale

Data Processing

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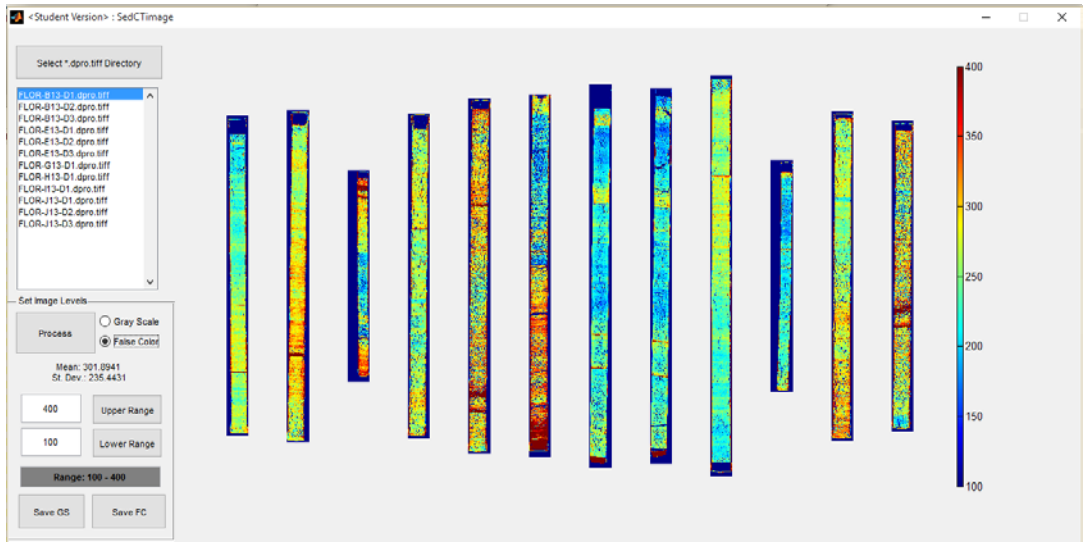
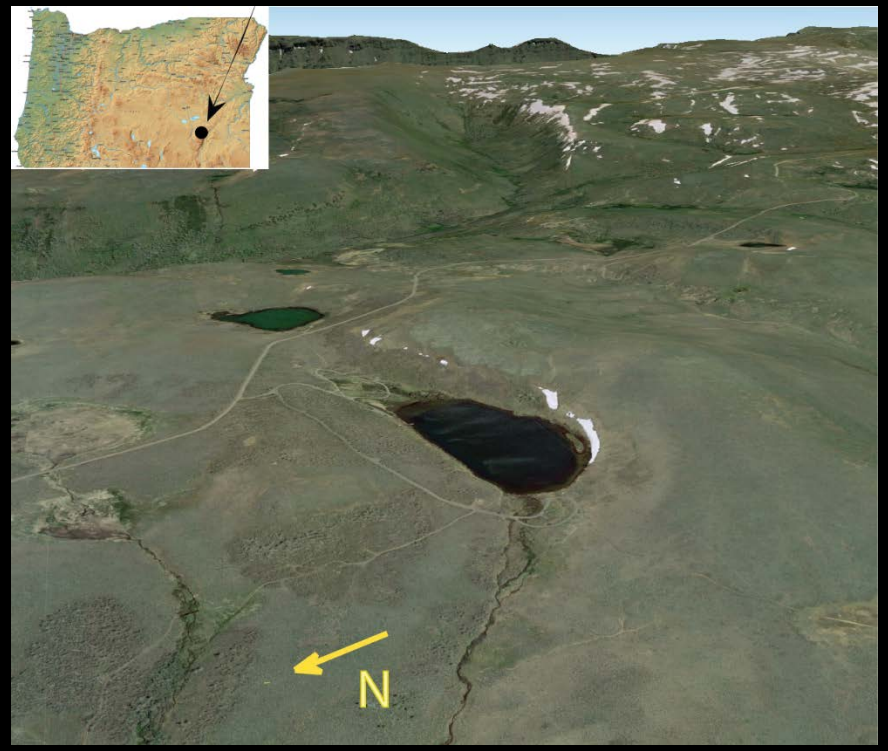
Graphical User Interface



...or false color

Data Processing

Fish Lake, Steens Mountain, Oregon, USA

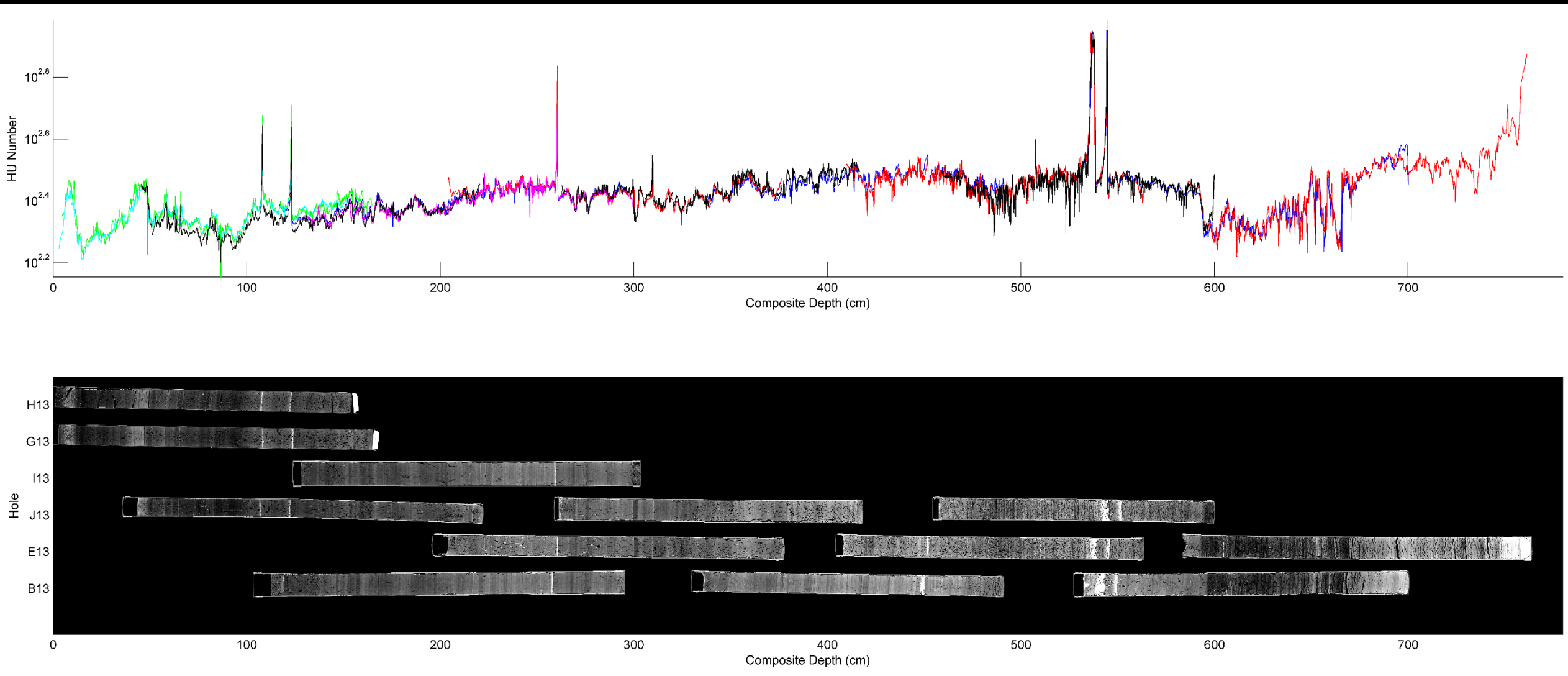


- Re-cored in 2013 (UWITEC, Livingston, Surface)
- Brown, faintly laminated mud with tephra layers
- Recovered in (at least) triplicate entire Holocene (Basal date ~ 13,000 cal yrs BP)
- Classic paleomagnetic site (Verosub et al., 1986, JGR)

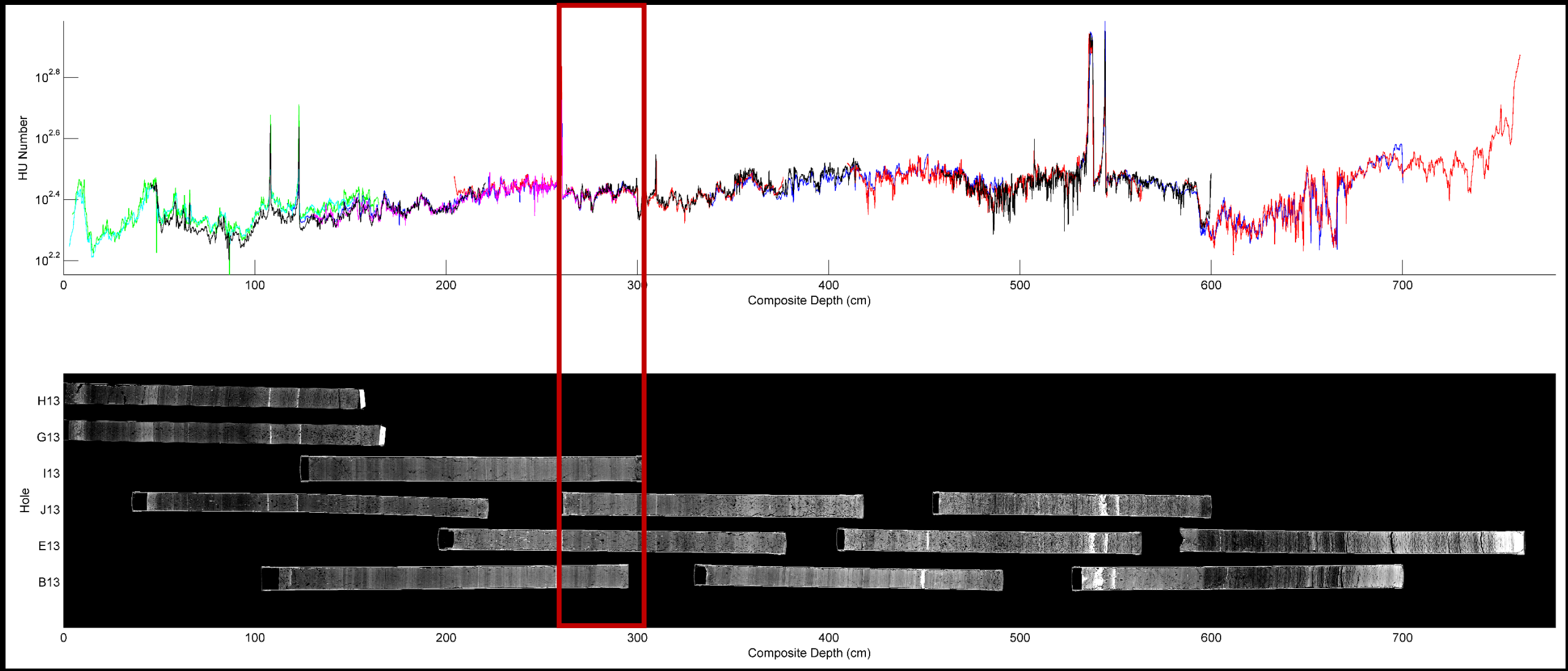
Learn about the Fish Lake, Oregon paleomagnetic record

J. Stoner, M. Abbott, L. Zeigler, et al.
The Holocene history of the North American flux lobe: New constraints from Fish Lake, Harney County, Oregon
in *Advances in Environmental Magnetism, Bio-Geomagnetism, and High Resolution Paleomagnetism Studies*
Thursday, 11:20 a.m.
Moscone South – 300

Fish Lake, Steens Mountain, Oregon, USA



Fish Lake, Steens Mountain, Oregon, USA



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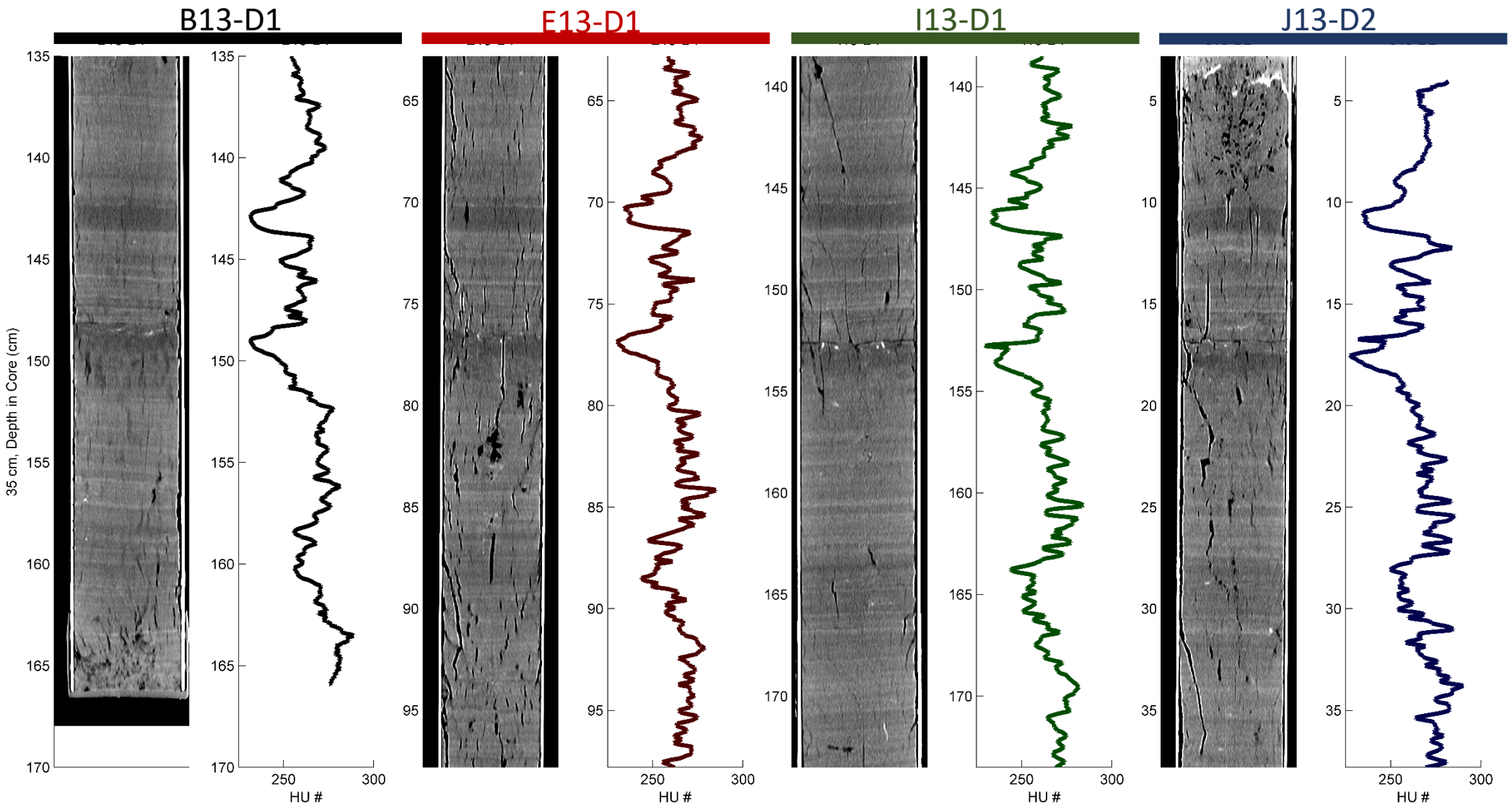
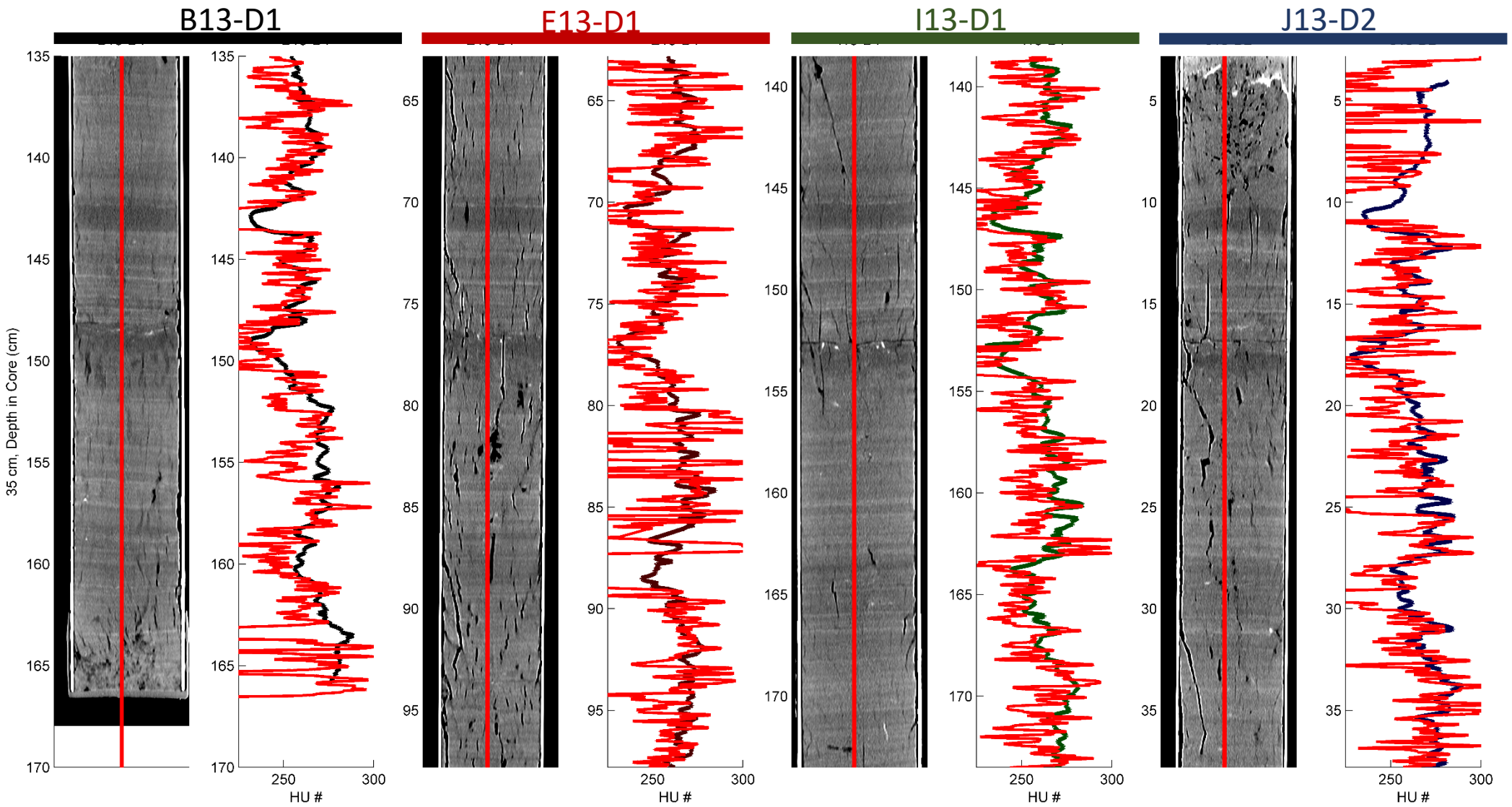


Fish Lake, Steens Mountain, Oregon, USA



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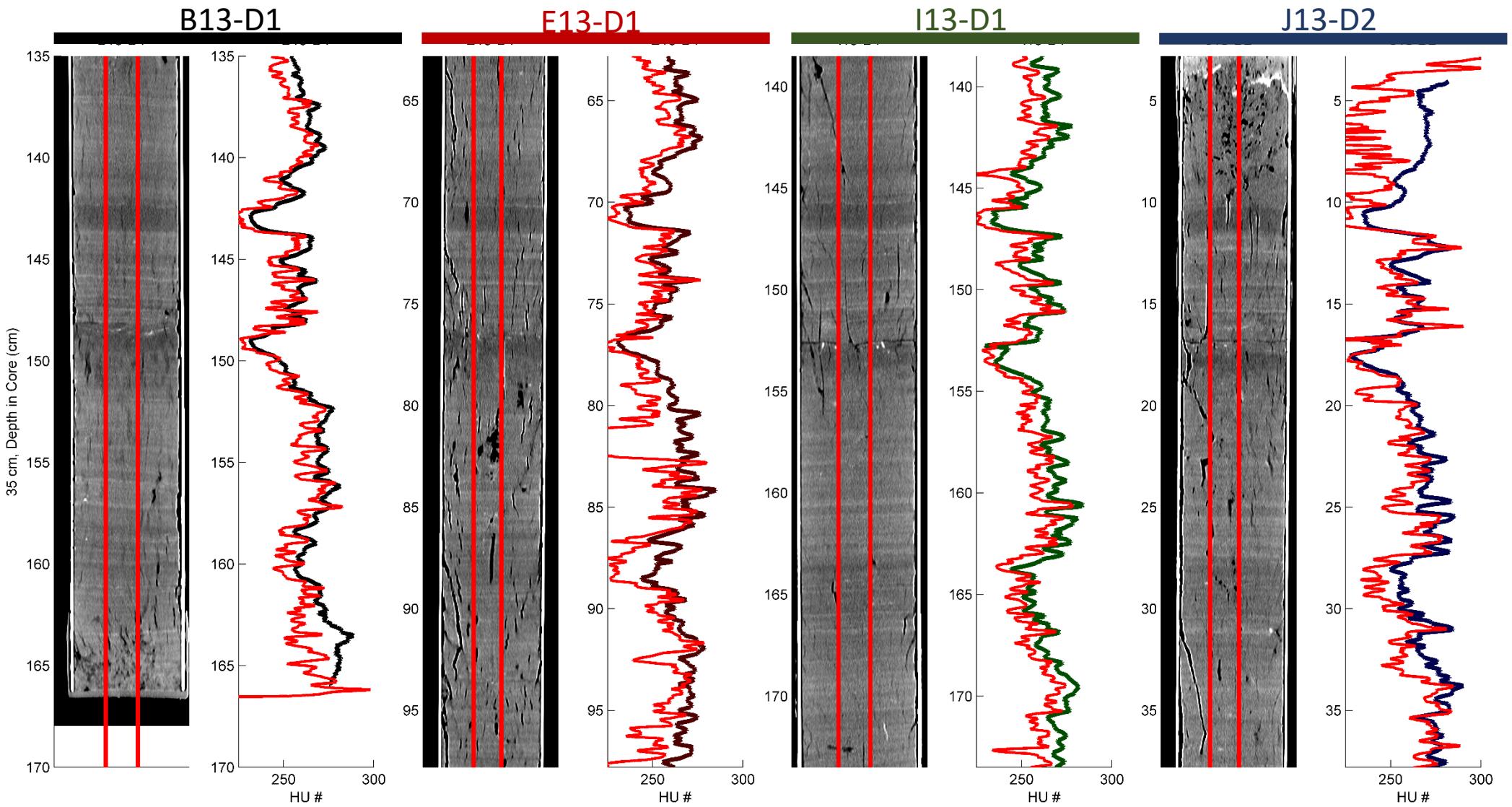
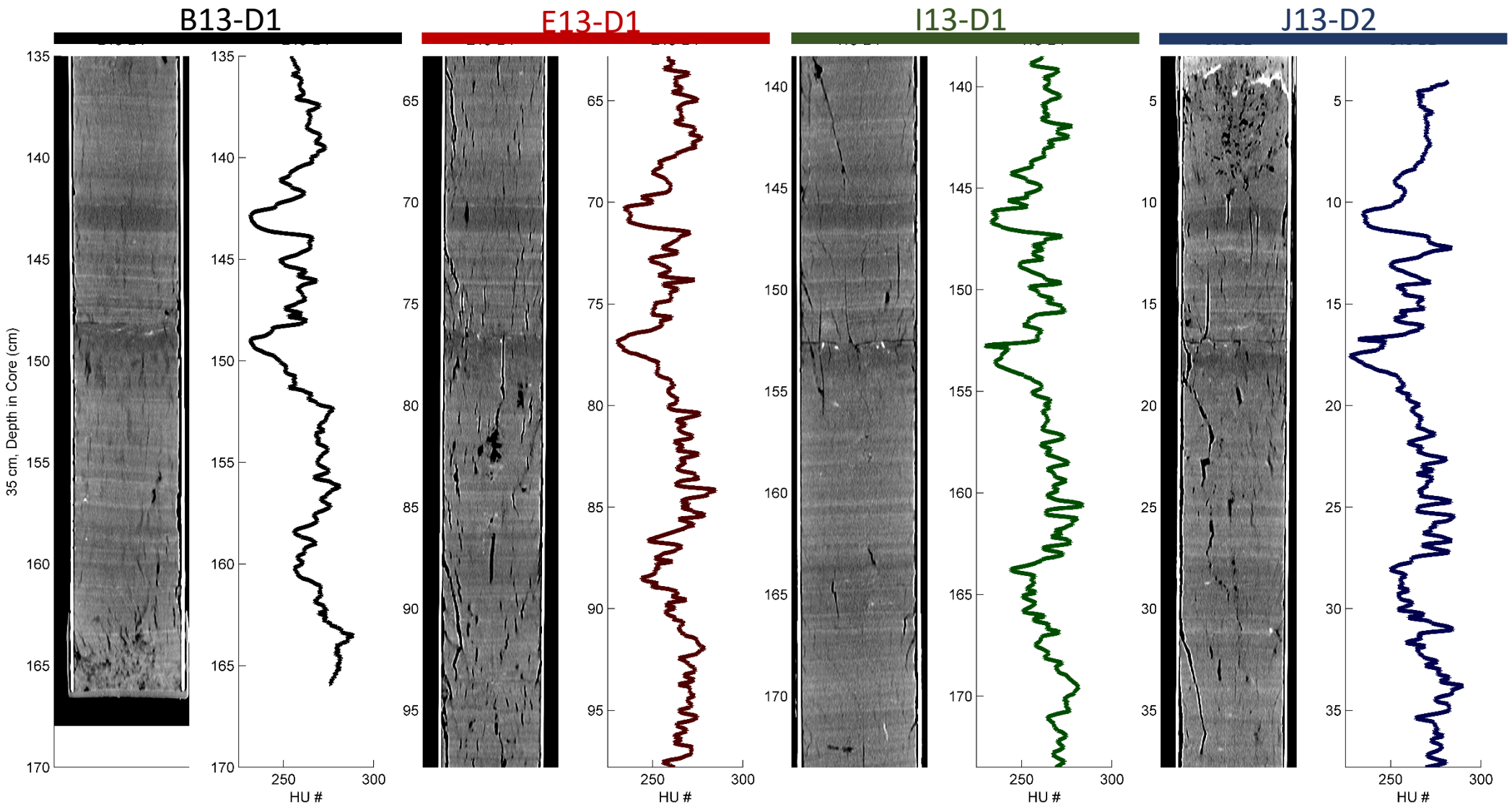
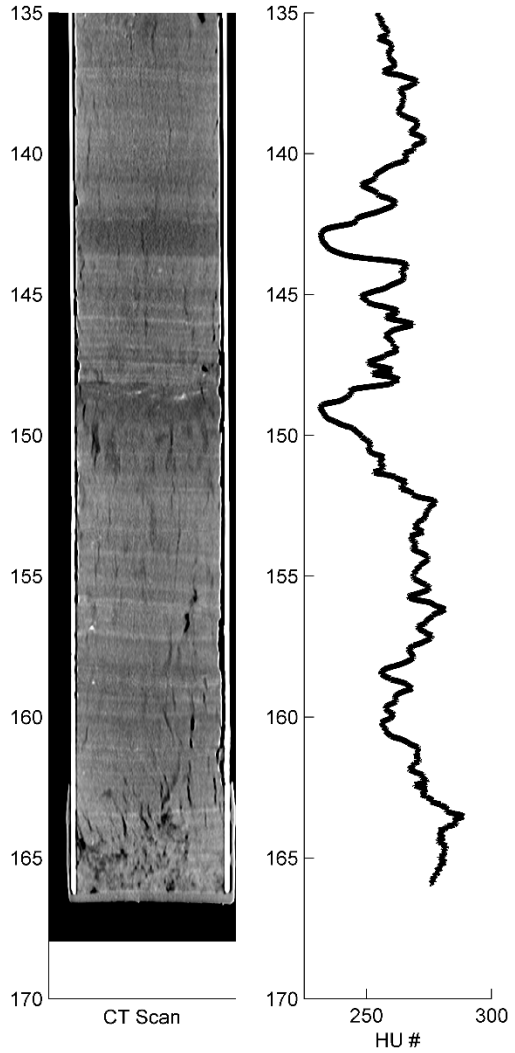


Fish Lake, Steens Mountain, Oregon, USA

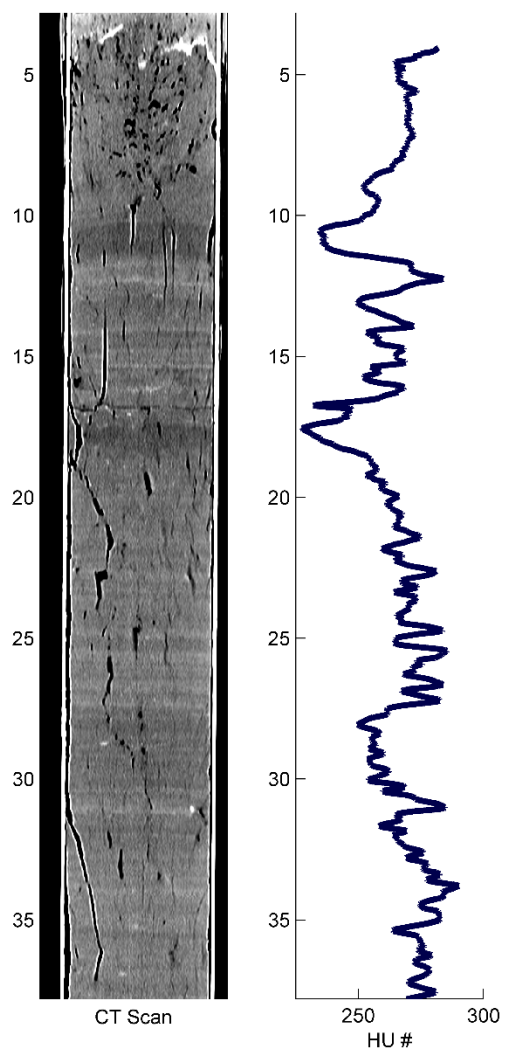


Fish Lake, Steens Mountain, Oregon, USA

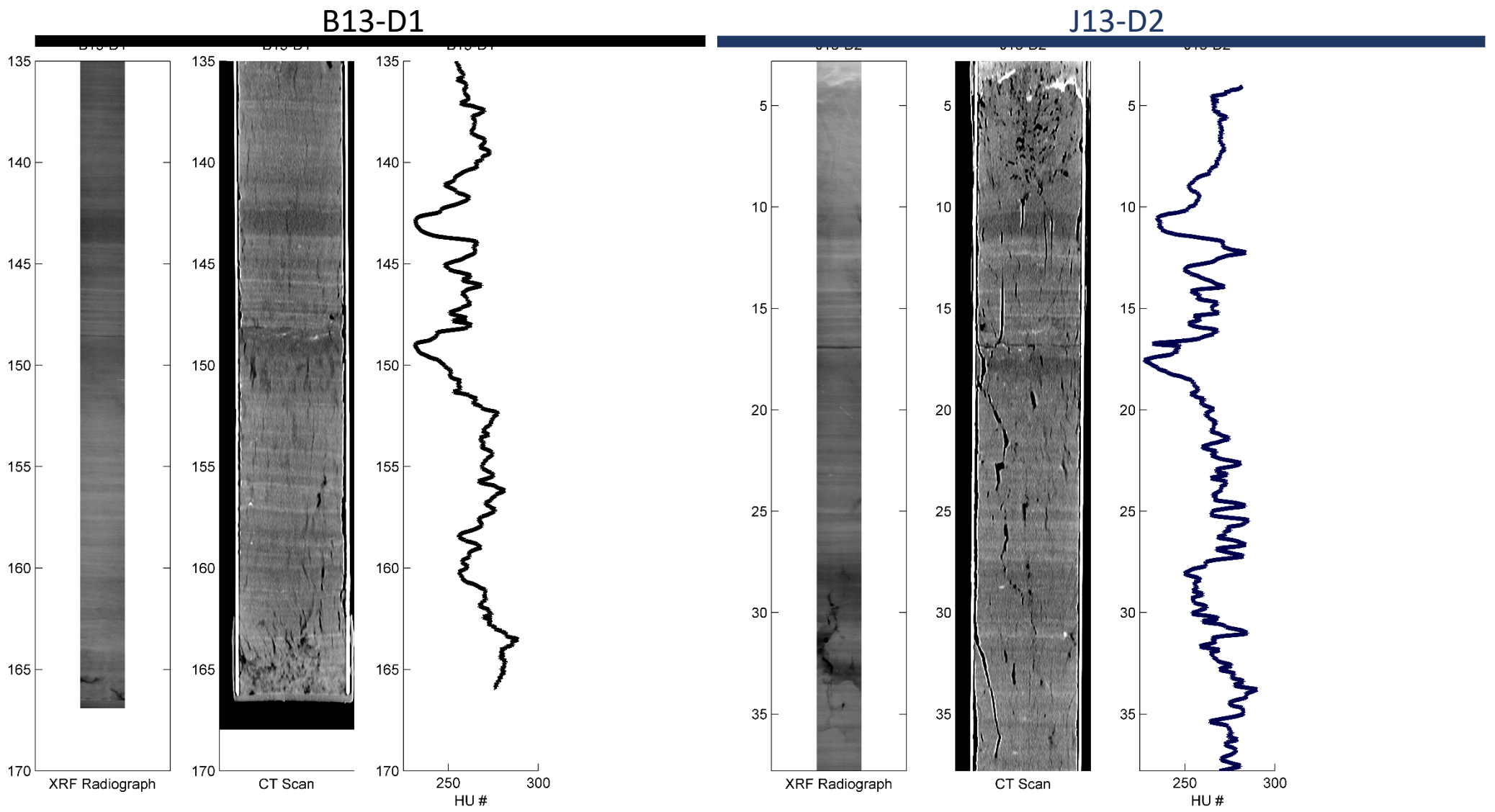
B13-D1



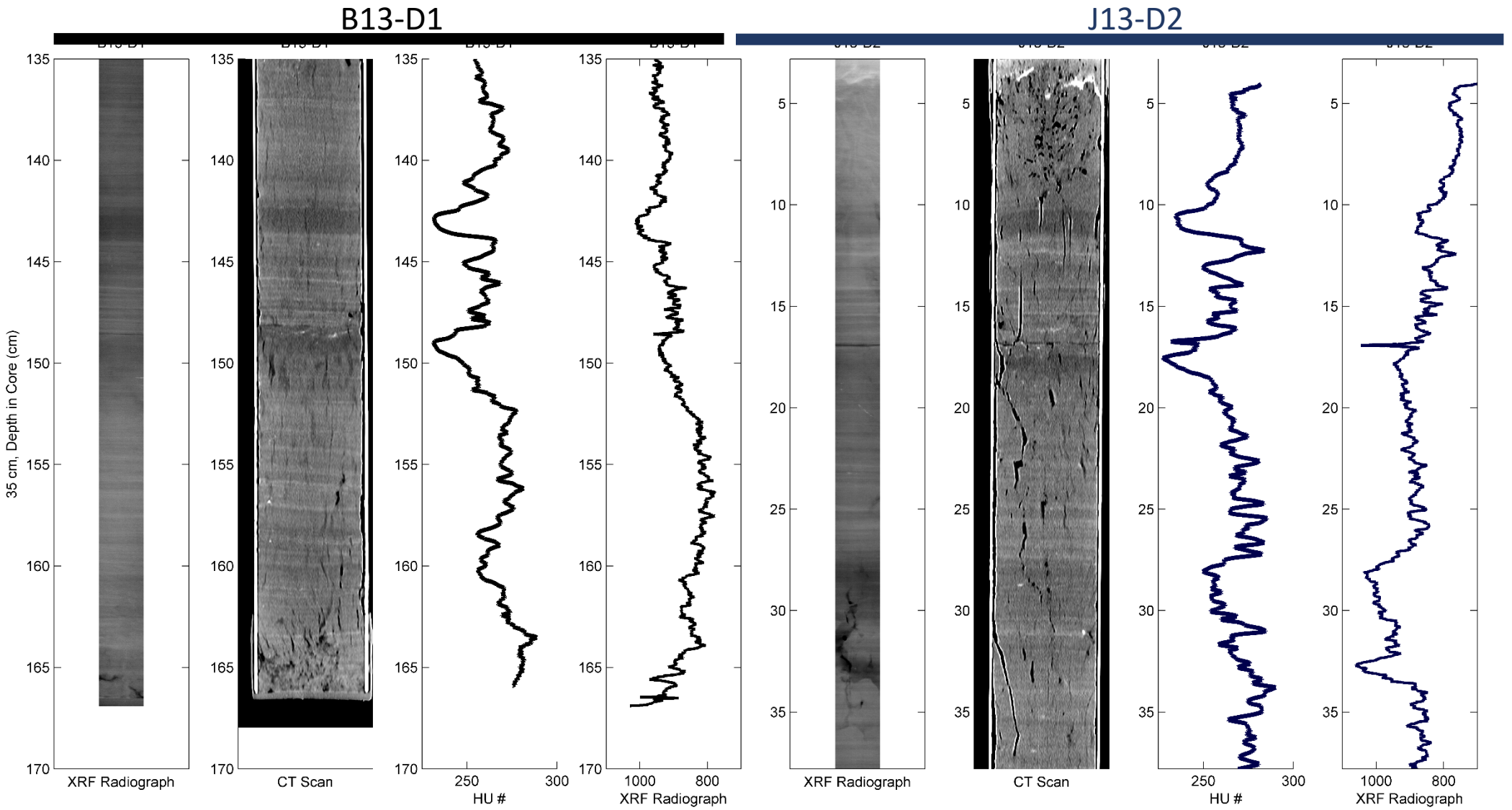
J13-D2



Fish Lake, Steens Mountain, Oregon, USA



Fish Lake, Steens Mountain, Oregon, USA



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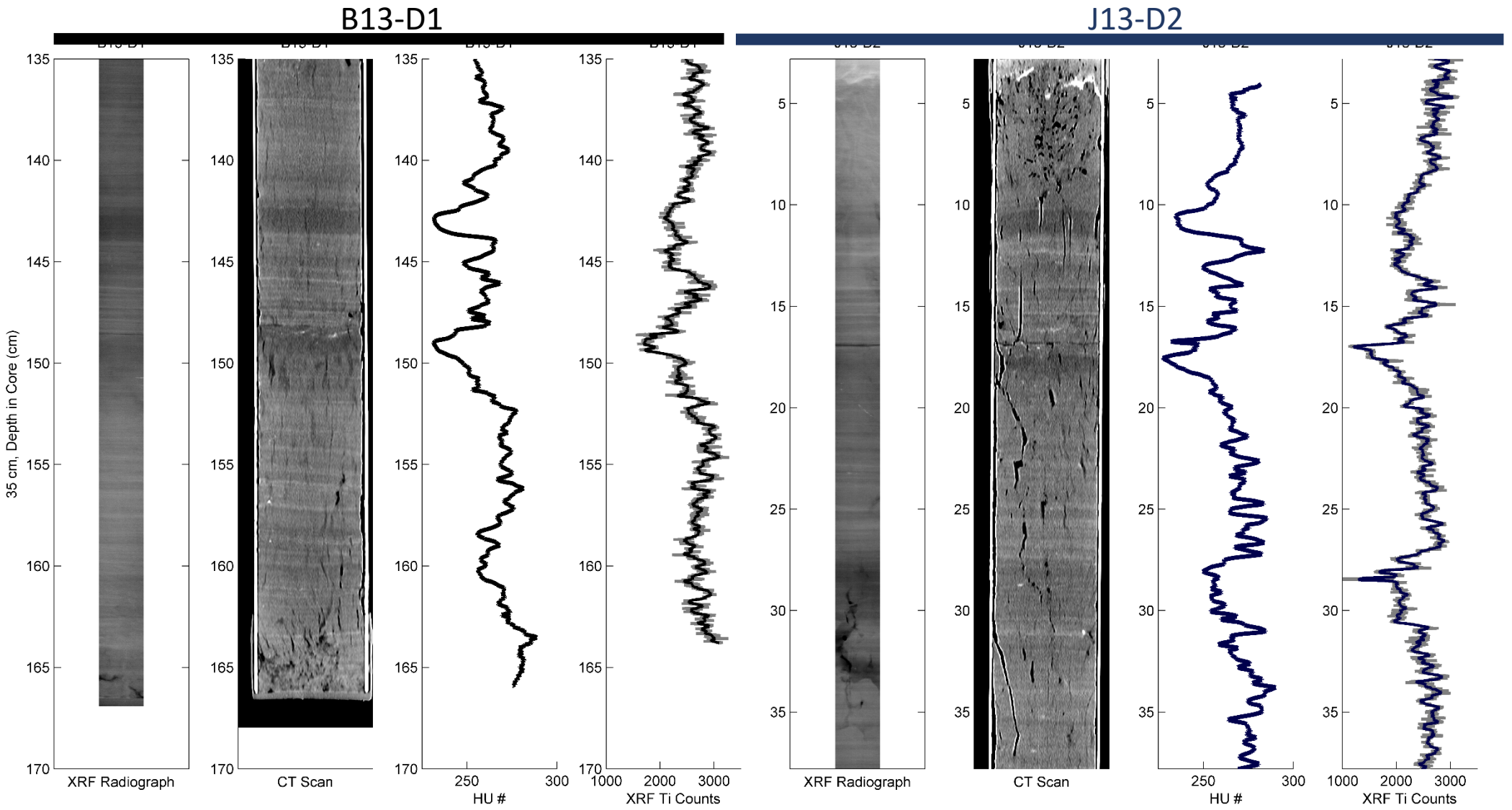

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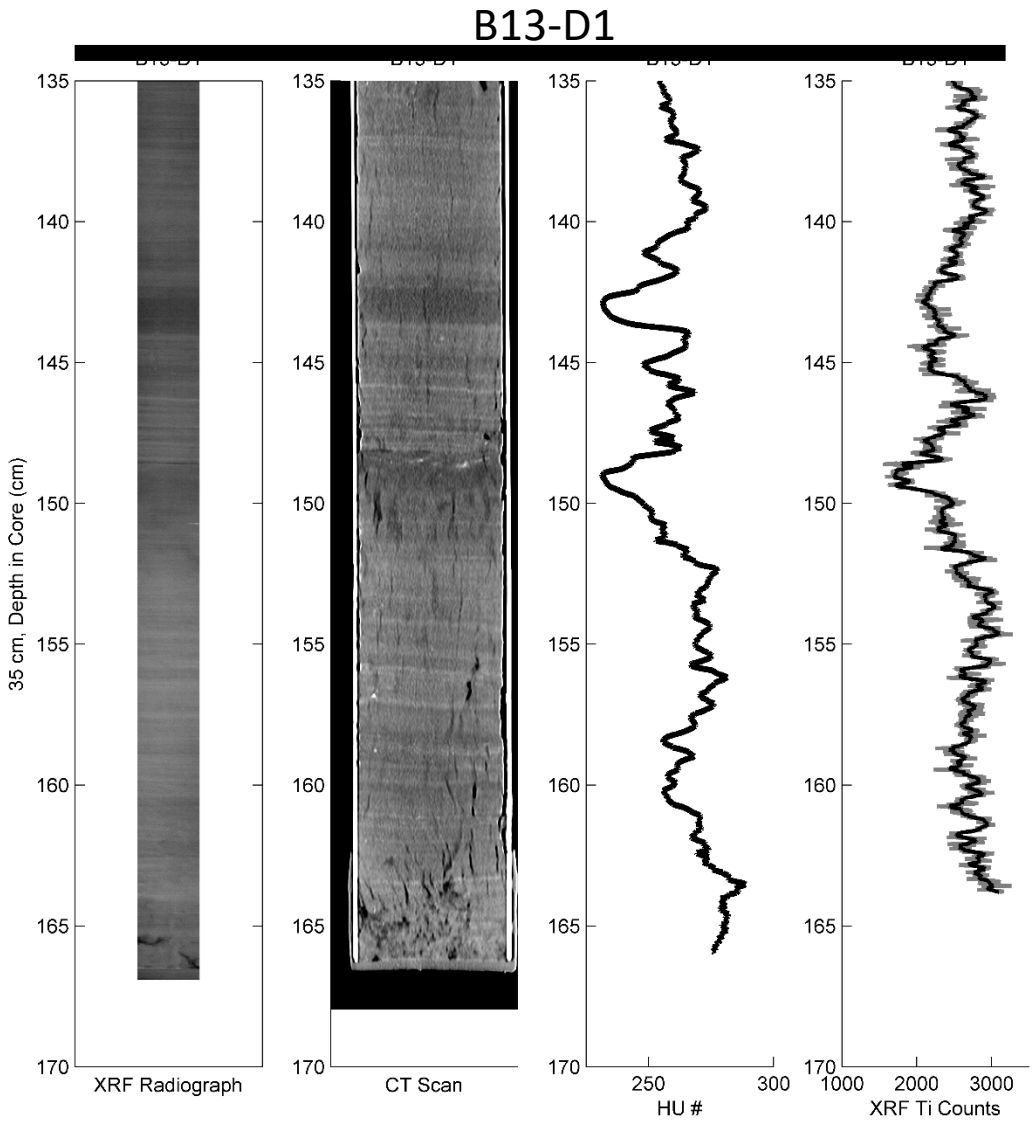

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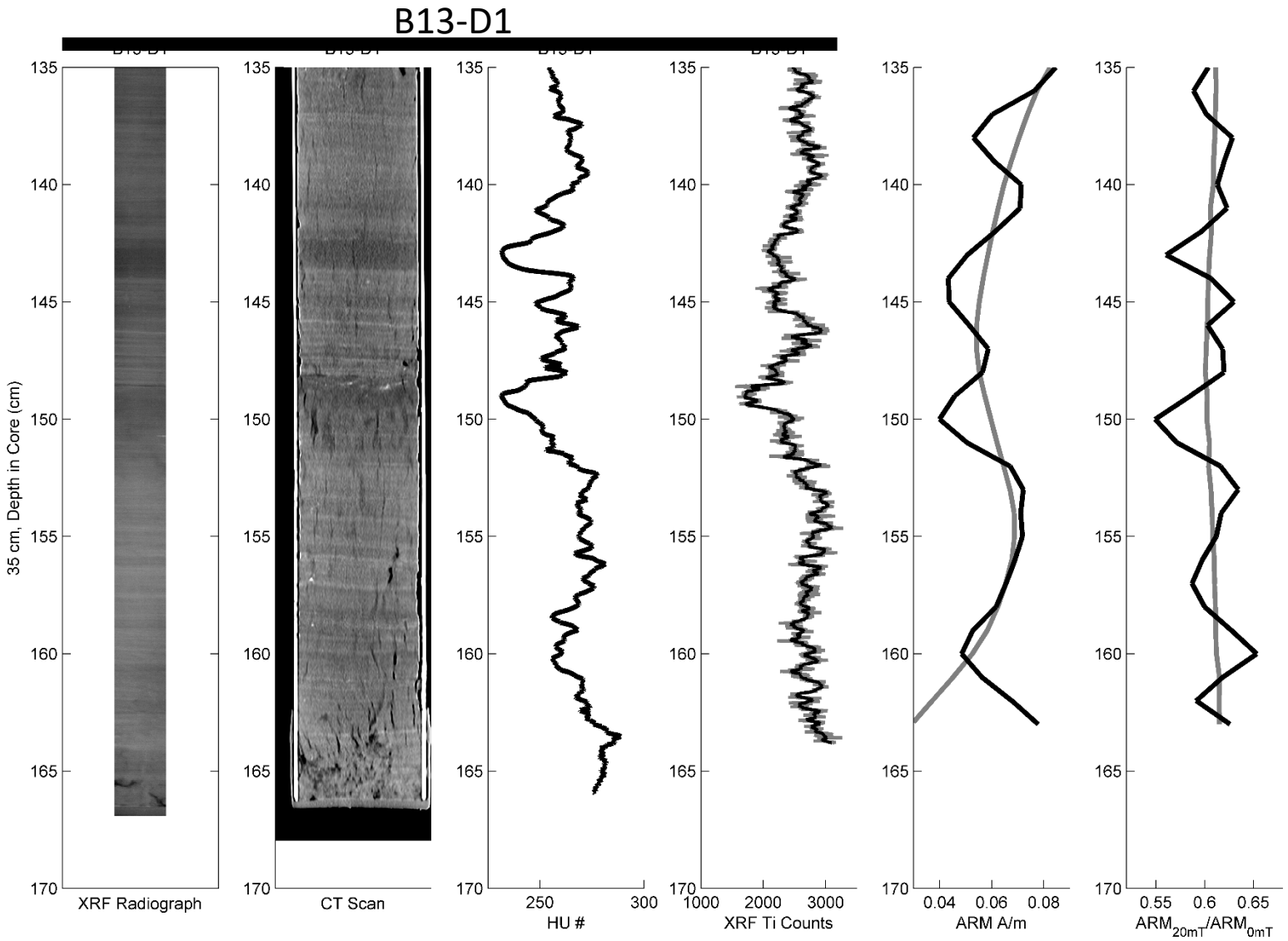
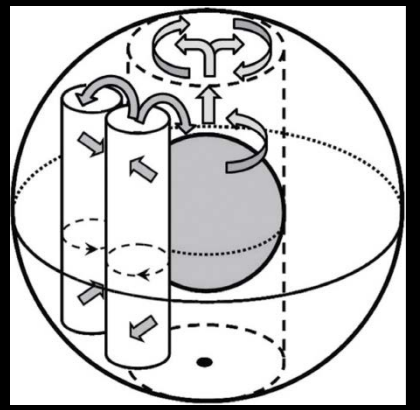


U-channel deconvolution of Oda & Xuan, 2014, G^3

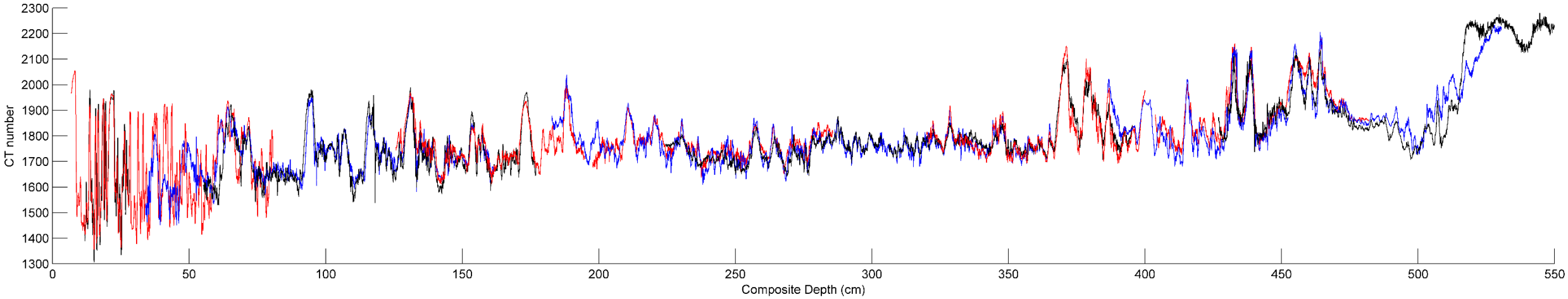
Sawtooth Lake, Ellesmere Island

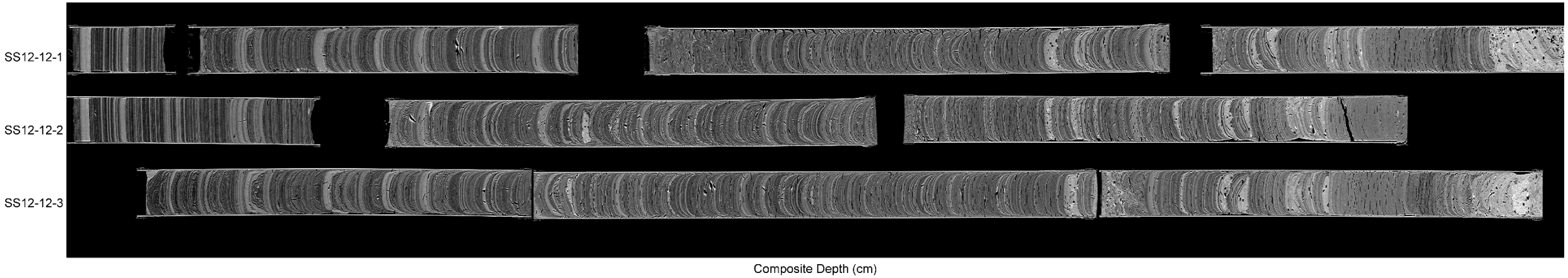
- Re-cored in 2012 (UWITEC)
- High sedimentation rates (~150 cm/ka)
- Clastic varves
- Varved based chronology back to ~ 3ka
- Paleomagnetic record could provide valuable insight to the high latitude geomagnetic field
- More info: (Francus et al., 2008, J Paleolimnol)



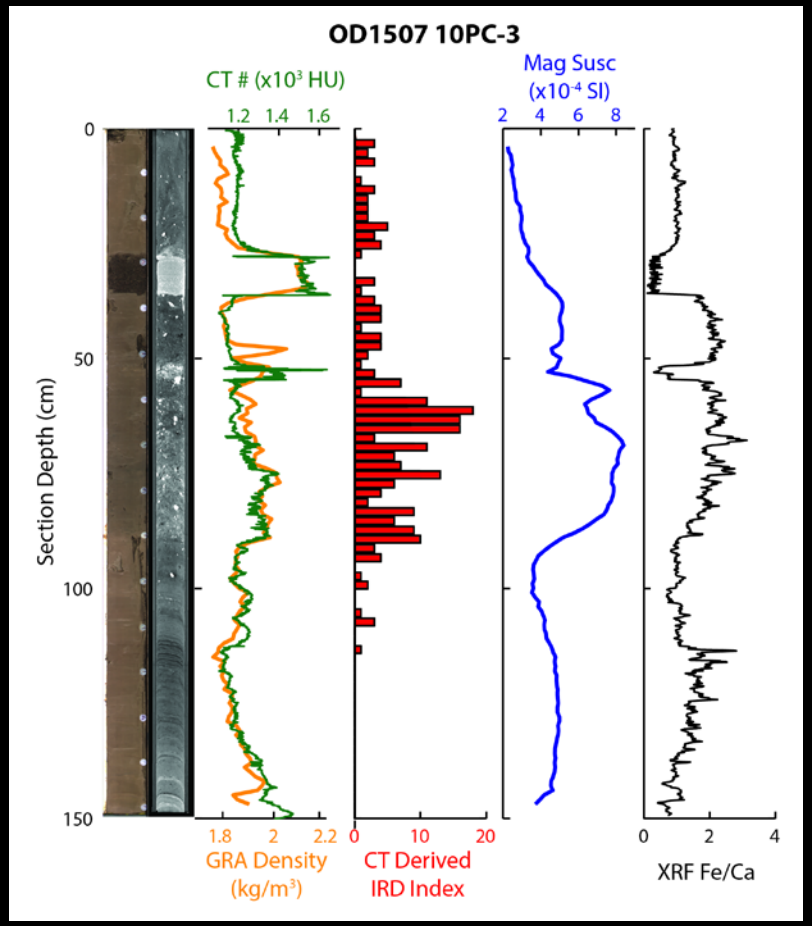
Christensen 2011

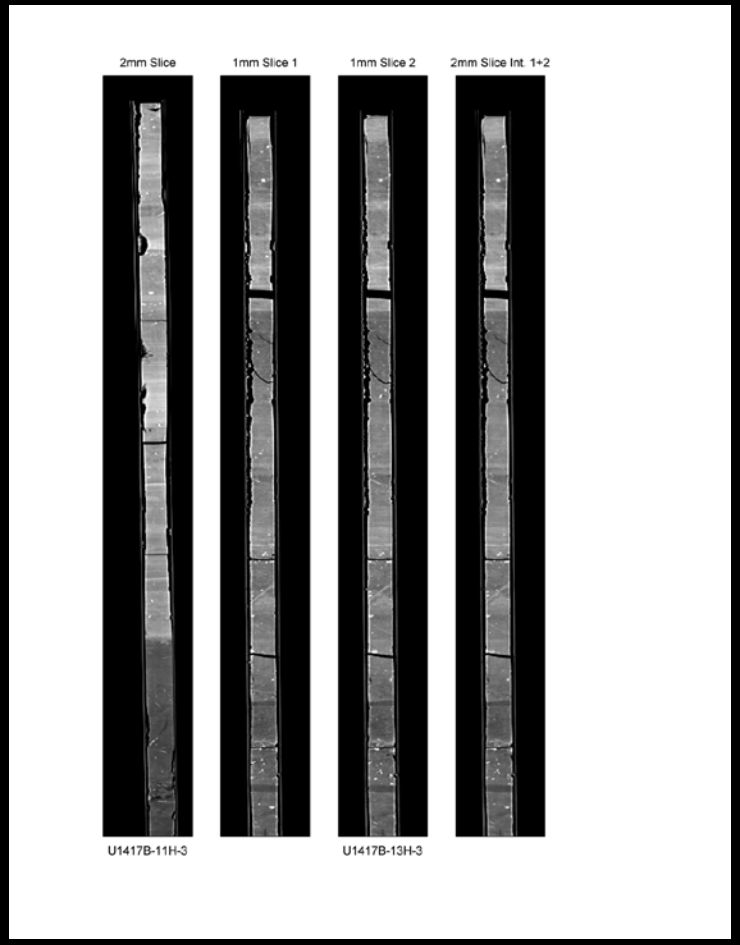
Sawtooth Lake, Ellesemere Island



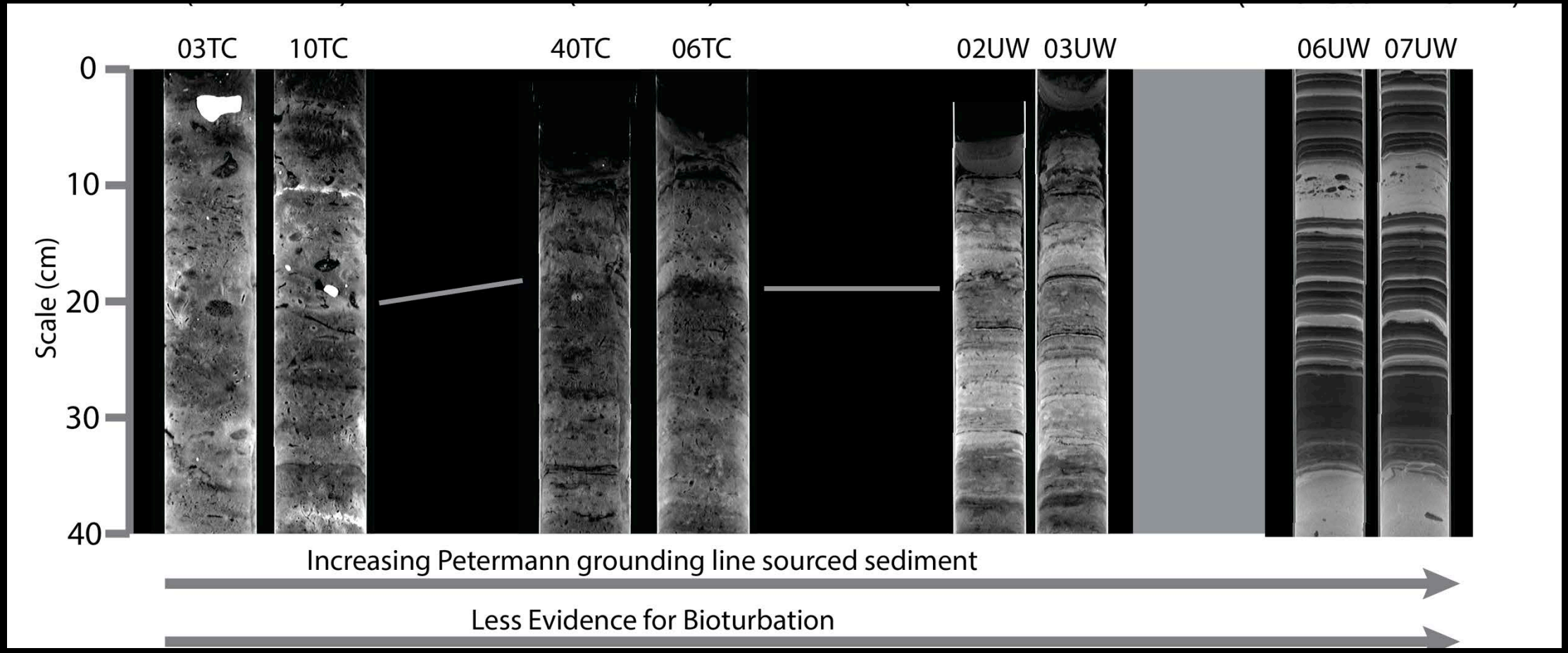


Other Capabilities, IRD counts, scans of multiple u-channels





Comparison of cores with distance from grounding line of the Petermann Glacier, Greenland



User friendly processing of sediment CT data:

Software and application in high resolution non-destructive sediment core data sets

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