Digital Library for DOE Field Laboratories

Dustin Crandall & Kelly Rose

2022 Resource Sustainability Annual Project Review Meeting
Pittsburgh PA, 5:00 PM Tuesday October 25, 2022

U.S. DEPARTMENT OF ENERGY

Project Overview

NETL Research and Innovation Center – Remediation & Reuse of Onshore Resources Field Work Proposal

2021	2022	2023	2024	Total Project Value (2021 – 2024)
$590k	$130k	*$250k*	*$250k*	

- **Started in 2021; FWP Number: 1022415**
- **As DOE Funded field projects started winding down a need was recognized to ensure that the investment associated with these unique and valuable field laboratories was preserved and available.**
- **Each field project has a requirement associated with their efforts to make the data publicly available through the Energy Data eXchange.**
  - Familiarity with EDX system, focus on achieving science goals, and the plethora of other obligations on these massive projects resulted in less than fully accessible data sets being stored.
- **Need to create a more user accessible resource platform was apparent, and with the projects ending the timing associated with this was now.**

Overall Project Scope

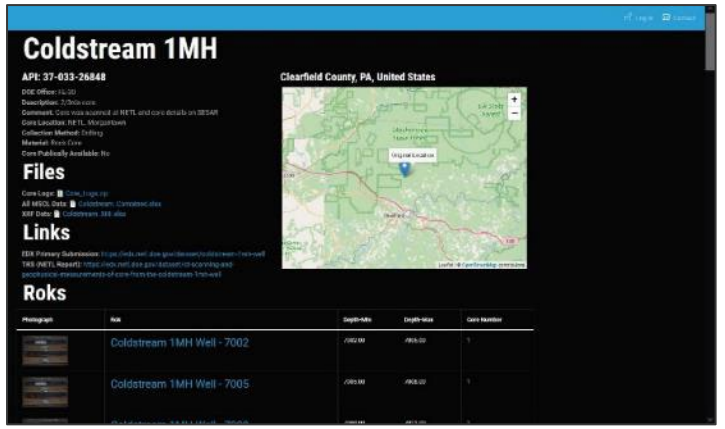
Overview: Obtain and scan core from field projects. Leverage EDX for data curation from field laboratories and develop data visualization capabilities to make data easy to find, query, download, and use.

Impact:

- Long-term preservation and publishing of data from studies offer critical and highly reusable insights into subsurface systems
- Data has reuse applications for carbon storage, well reuse, geothermal, energy-water, and other applications
- Information obtained from unconventional wells will be critical in future for shut ins, repurposing, etc.

End Products:

Collaboration between Montana State University and NETL to build visualization platform for fundamental rock property measurements from cores - **RokBase**



Collection of **core characterization data** in collaboration with FLs and publishing on EDX

Hosting of data from FL published to EDX within visualization platforms, including well logs, seismic, production, etc. (alongside other DOE funded project data)

Sustainable environmental and resource planning due to investment in field lab enables reuse of data for other applications:
Hydrogen, Carbon Storage, geothermal, basin modeling, reservoir modeling

Data ingestion from the field laboratories into private workspaces on EDX (data preservation)

Public publishing and curation of data into groups on EDX (data accessibility)

2021 → **2022+**

Task 22.0 Digital Library for DOE Field Laboratories

- The ~$150M DOE investment in field laboratories since 2014 has produced unprecedented data through partnerships.
- These 'learning-by-doing' labs are creating a public dataset of critical information that has never been as comprehensive for exploratory field efforts.
- Currently, this data is not easily accessible and curated in a form that allows widespread access. This project will develop the platform through which the DOE Oil and Gas Field Lab data are easily accessible, searchable, and downloadable per project, along with accompanying reports.

Task Team Members

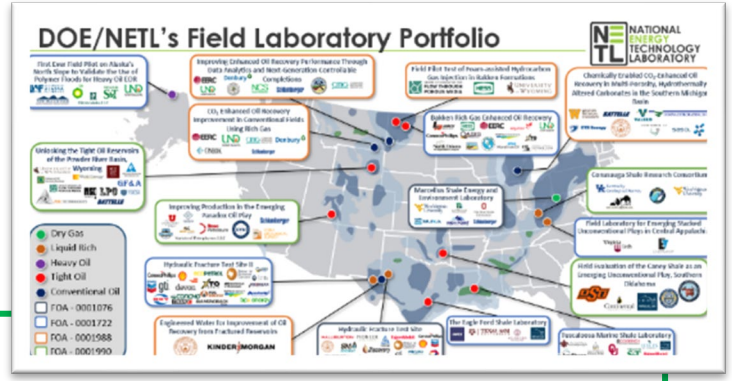
- **PIs:** Dustin Crandall, and Kelly Rose
- **Other Key Personnel:** Chad Rowan, Maneesh Sharma, Thomas Paronish, Bryan Tennant, Natalie Mitchell, Thomas Naberhaus (previously Andrew Bean, Paige Morkner, Rhiannon Schmitt, Johnathan Moore)

Task 22.0 Digital Library for DOE Field Laboratories

Need: Enable coordinated access to results from the ~$150M DOE investment in Field Laboratories + Industry Cost Share since 2014

- Access to basic rock property laboratory-collected data
- Access to field-generated results from the DOE Oil & Gas Field Laboratories
- A format where data are downloadable per project, along with accompanying reports (instead of dispersed through tech literature)
- Enables future R&D, sustainable resource planning, and environmental management associated with U.S. O&G basins

Example: HFTS I Basic Rock Property Data + Field Data = Enabling Insights as part of the Multilab HFTS Project



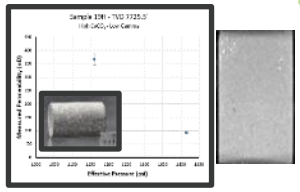
Fundamental Rock Property Measurements

Production and Other Data from the Field Laboratories

Sustainable Environmental and Resource Planning Due to Investment in Field Laboratories

Issue

- The unique and in-depth data associated with the field laboratory investments can be difficult to access, limiting the utilization beyond the original project scope.



End Product

- Digitized rock fundamental property data, organized along with field data generated by the O&G Field Laboratories, for up to eight UCR Field Laboratory sites.

Stakeholders: State and Federal EPA, DOI (USGS), Oil & Gas Operators & Service Companies, Water & Solid Waste Management Companies

Project Goals and Milestones

Original Milestones

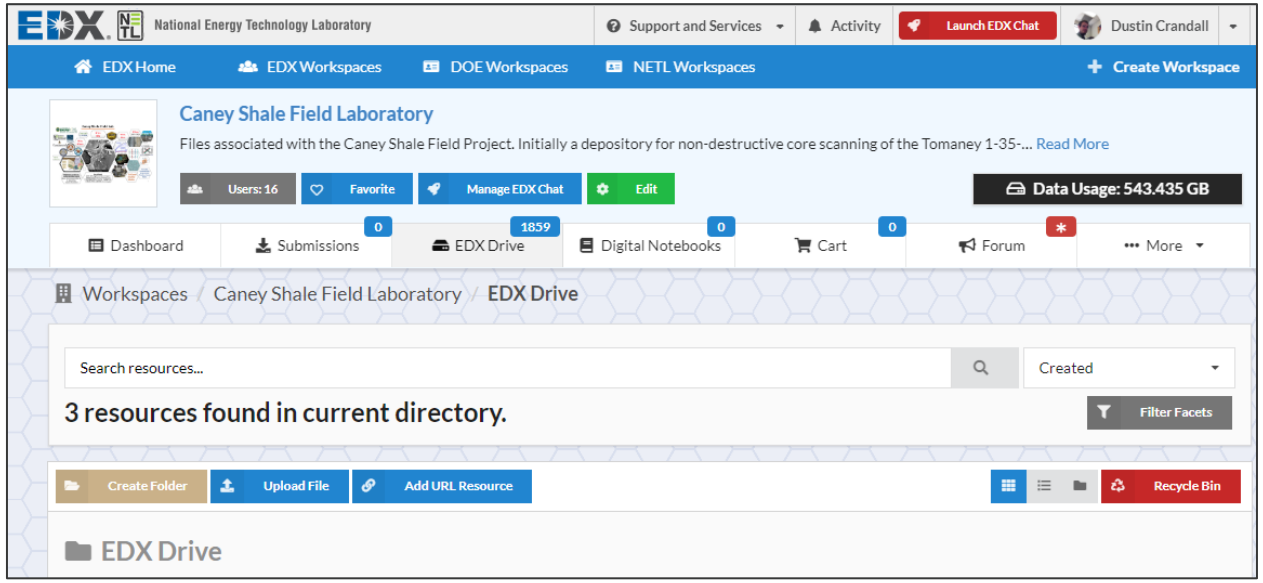
Identifier	Type[1]	Expected Completion Date	Description (What, How, Who, Where)
22.A	Project	06/2021	Work with NETL Project Managers to understand breadth and scope of data and knowledge products available from each FL project, focusing on FLs with earlier completion dates first.
22.B	Project	08/2021	Develop strategies for ingestion of FL data into EDX.
22.C	Project	11/2021	Initiate development of FL data exploration and visualization capabilities to enhance discovery and access to oil and gas data.
22.D	Project	02/2022	Beta version of FL data exploration and visualization on private EDX space for internal testing. Obtain feedback on the design from HQ and NETL Project Managers for OGFL projects.
22.E	Major	06/2022	Public facing beta version of FL capabilities on EDX platform.
22.F	Project	09/2022	Data from minimum four FLs uploaded to FL capabilities and available on EDX.
22.G	Project	03/2023	Data from minimum eight FLs uploaded to platform and available.
22.H	Major	06/2023	Process for dynamically updating data from ongoing projects codified and implemented on field projects on site.
22.I	Project	09/2023	Data from minimum 12 FLs uploaded to platform and available.
22.J	Major	02/2024	Data from all 17 FLs uploaded to platform and available.
22.K	Project	03/2024	Initial maintenance plan developed.
22.L	Major	09/2024	Dynamically updating of data from field projects shown to be functioning.
22.M	Project	12/2024	Maintenance plan and process presented to ensure stability.

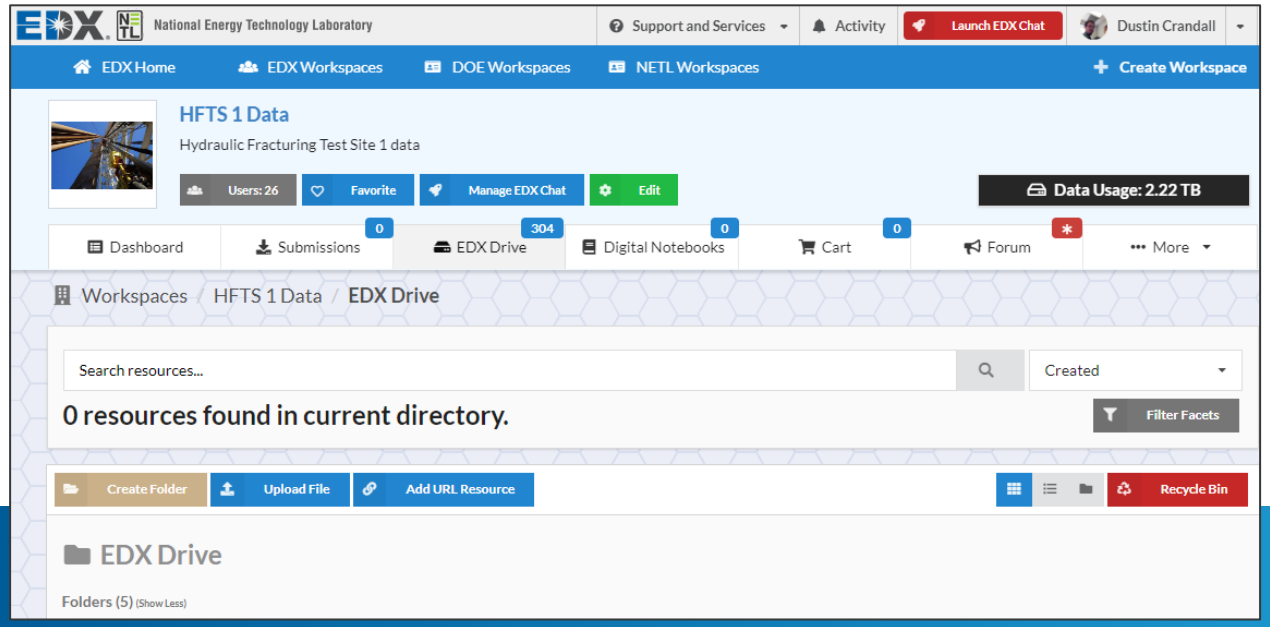
Accomplishments

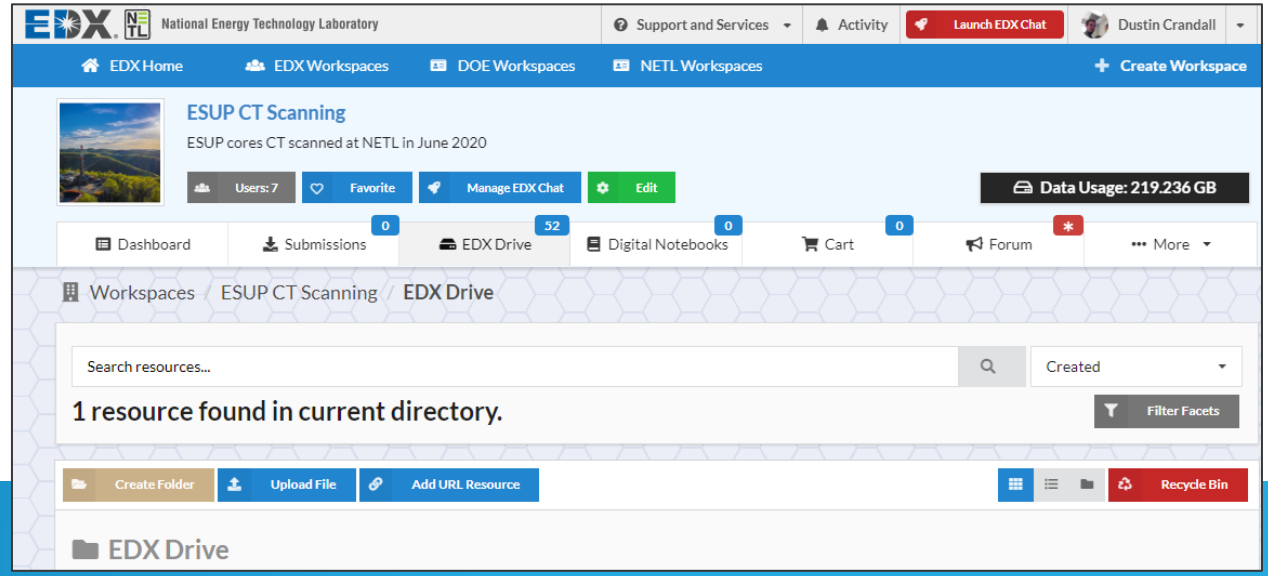
- **22.A and 22.B—Met with HFTS and MSEEL project managers in 2021 to establish workflow for data to EDX**
  - Integration of HFTS I Phase I & II data completed by HFTS project.
  - Integration of MSEEL data into EDX required aid by NETL researchers (1.8TB), with big dataset integration of seismic and wireline data ongoing (100+TB).
  - Continued along these lines with research contacts and collaborations
- **Work initiated by Montana State University to develop a database with access to core details, RokBase**
  - Met with EDX team to establish interoperability needs for RokBase development.
- **With reduction in funding toward this project in 2022, had to slow some of the efforts. But still making good progress. Slower push of some data public than initially envisioned.**

Data Integration from Field Projects

- **Ingest data to private workspaces for organization, development of metadata**
  - Different projects have different data streams and structures, resulting in need to handle appropriately.
  - From these three examples, 2.2 TB to 220 GB



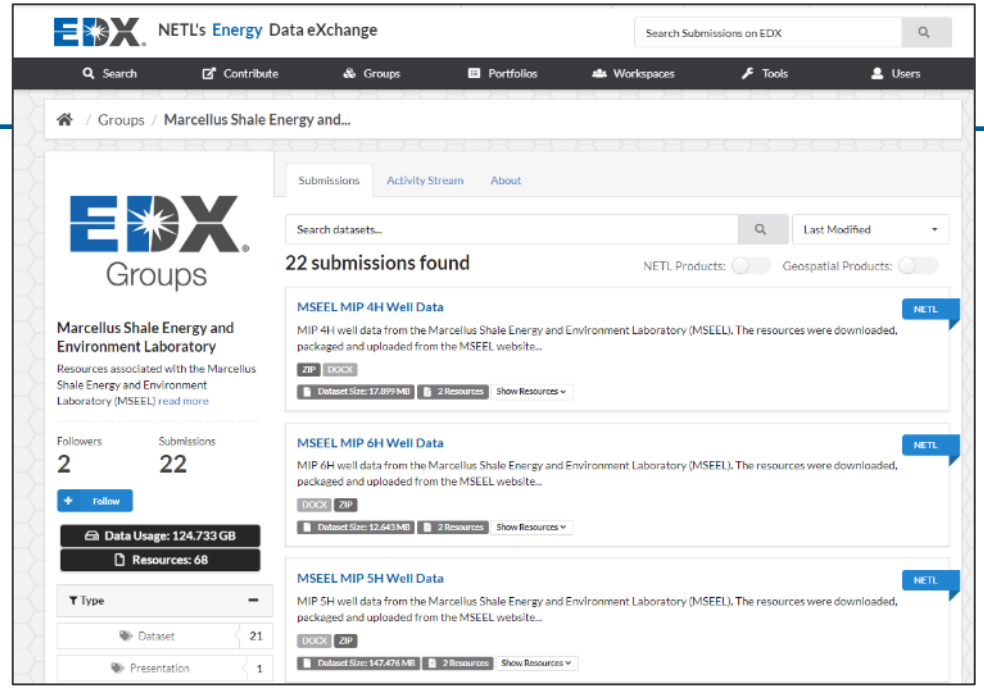


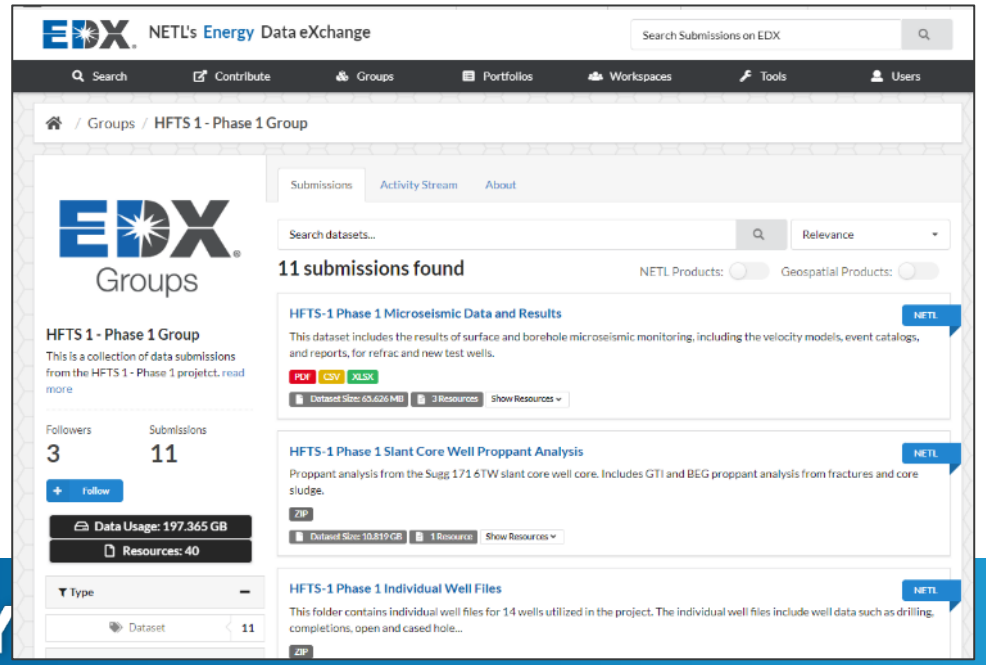


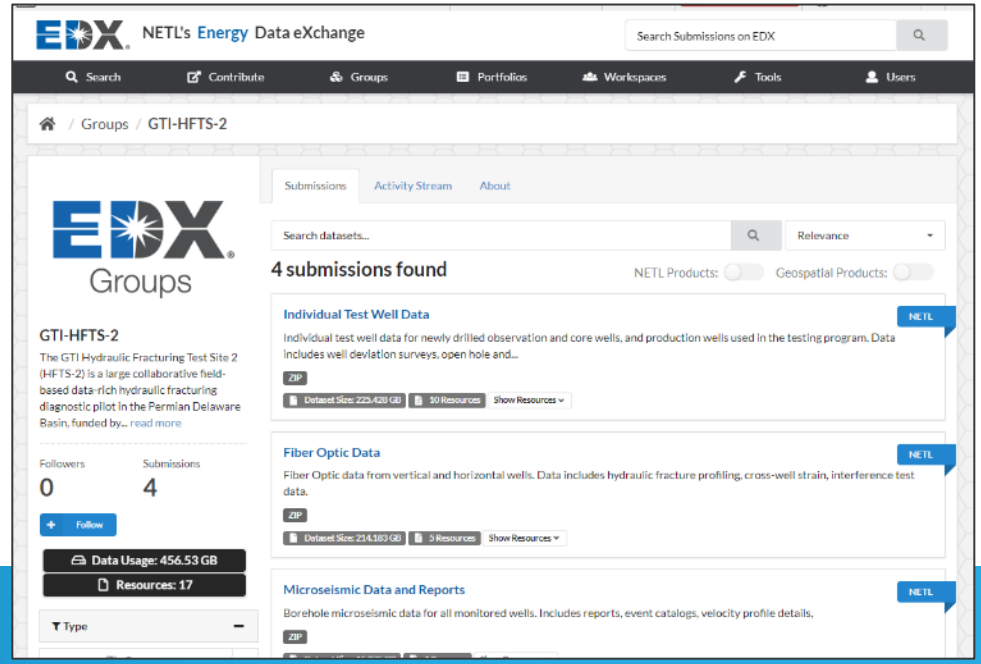
Public Data from Field Projects

MSEEL and MFTS Data Curated in EDX Groups

- https://edx.netl.doe.gov/group/marcellus-shale-energy-and-environment-laboratory
- https://edx.netl.doe.gov/group/hfts-1-phase-1-group
- https://edx.netl.doe.gov/group/gti-hfts-2S





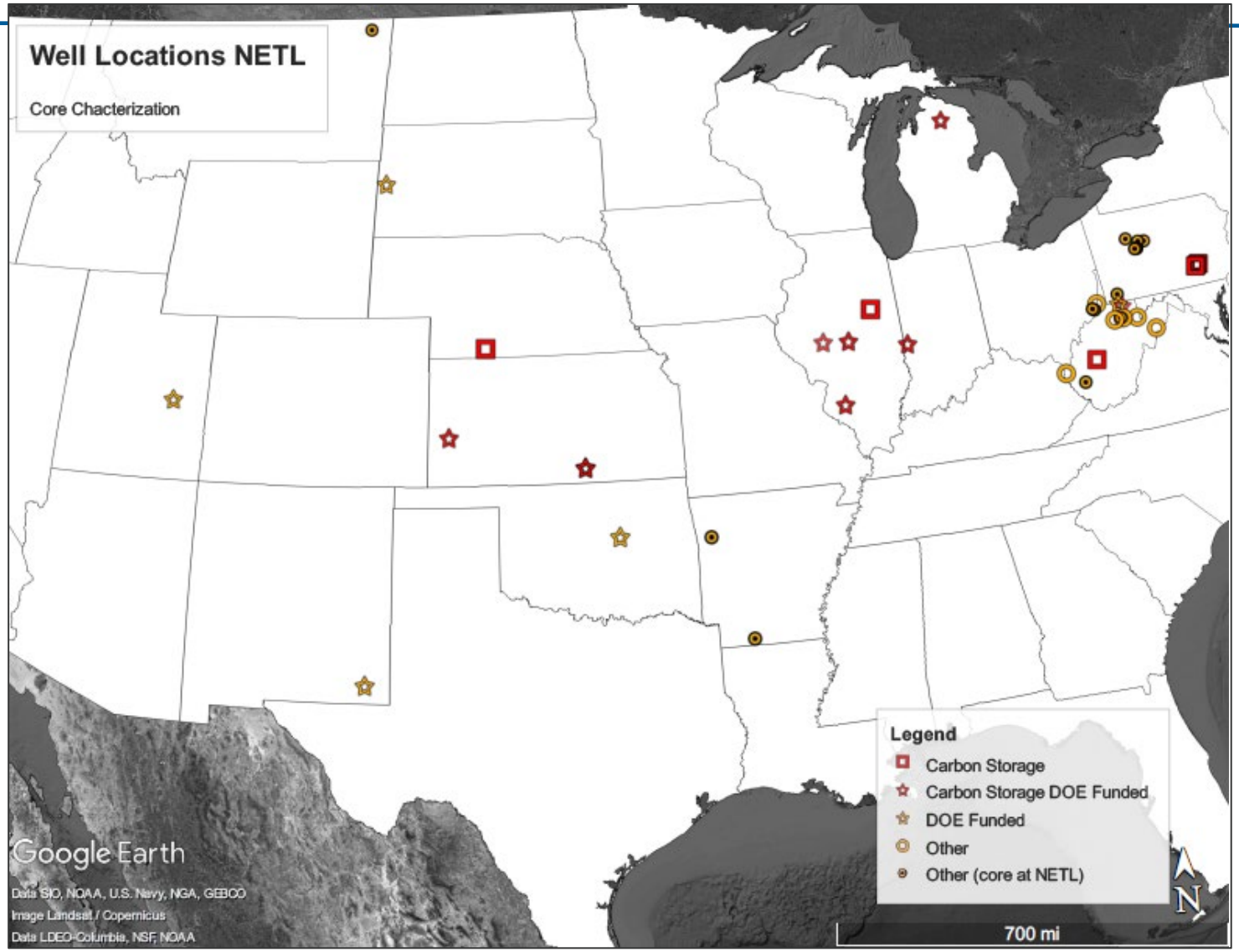


Core Characterization

29 Reports/Data Across FWPs

- **An underlying data stream that has made initial roll out of this information more consistent is the core characterization work that has been performed at NETL**
  - Ability to scan with multi-scale computed tomography and a high-resolution multi-sensor core logger
  - Pipeline to get the data out as public facing technical reports
  - Data pipeline to NETL EDX Group

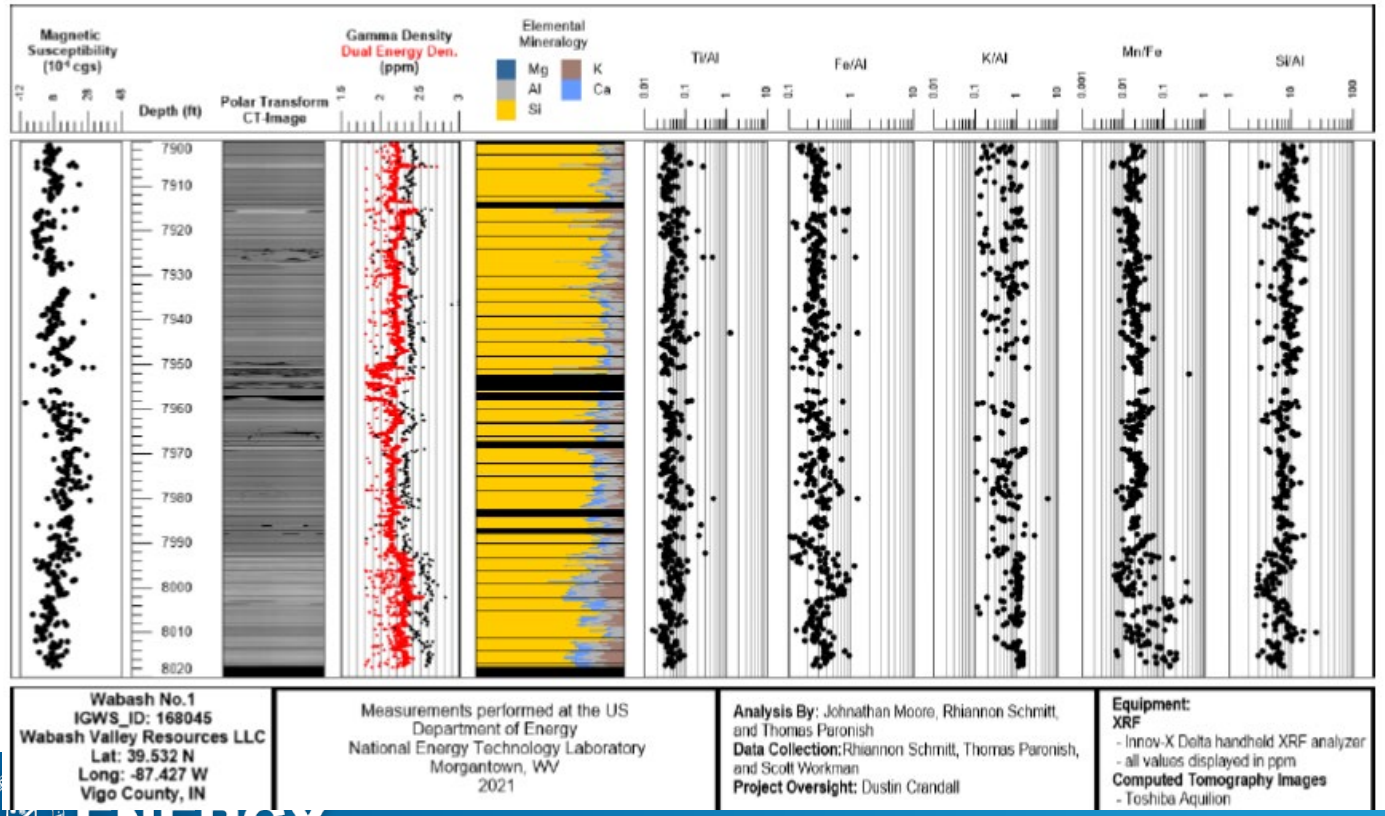
  https://edx.netl.doe.gov/group/core-characterization

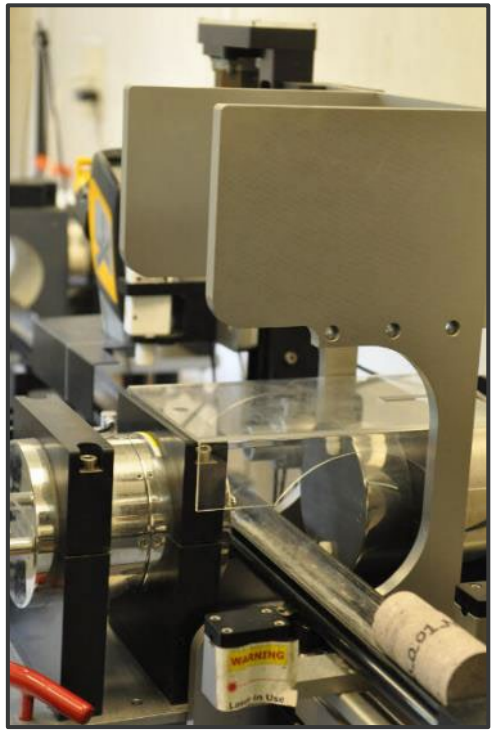


GeoTek Core Logger

POC: Thomas.Paronish@netl.doe.gov

- **The GeoTek Multi-Sensor Core Logger at NETL obtains high-resolution data including p-wave velocity, gamma density, natural gamma, resistivity, magnetic susceptibility, and handheld X-ray fluorescence spectrophotometry on whole or split-core samples.**



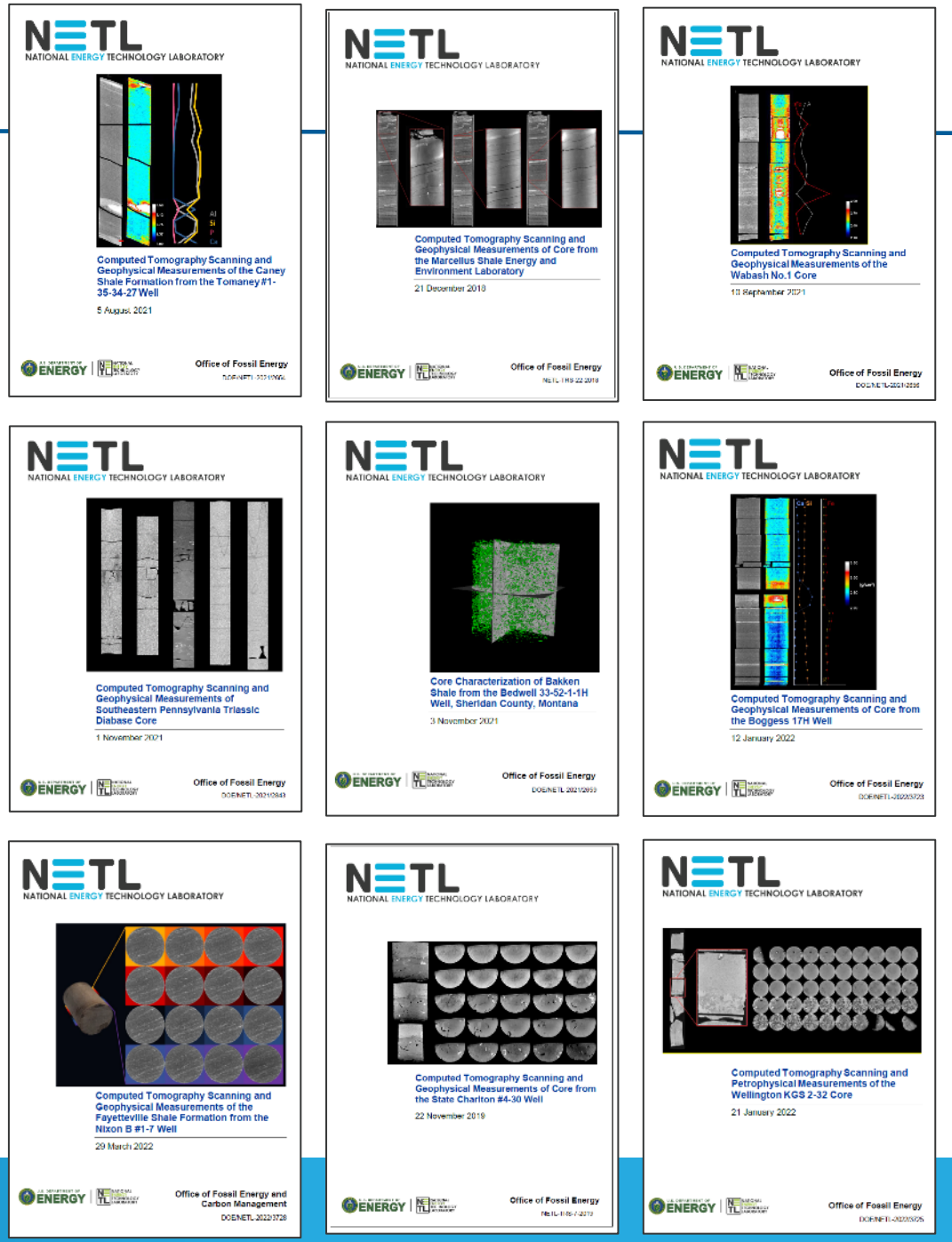


Medical CT Scanning + Core Logging

8 technical reports from past 18 months.

- **Non-destructive CT scanning and logging of core from energy relevant wells across the country**
- **Core from a range of energy applications**
  - oil/gas production wells, carbon storage reservoirs & seals, nuclear storage, geothermal production,.
- **Core from across the county**
  - Pennsylvania, West Virginia, Illinois, Oklahoma, South Dakota, Ohio, Indiana, Utah, Montana, Maryland, New Mexico, Nebraska …
- **Data is made publicly available for download via the Energy Data eXchange (EDX)**

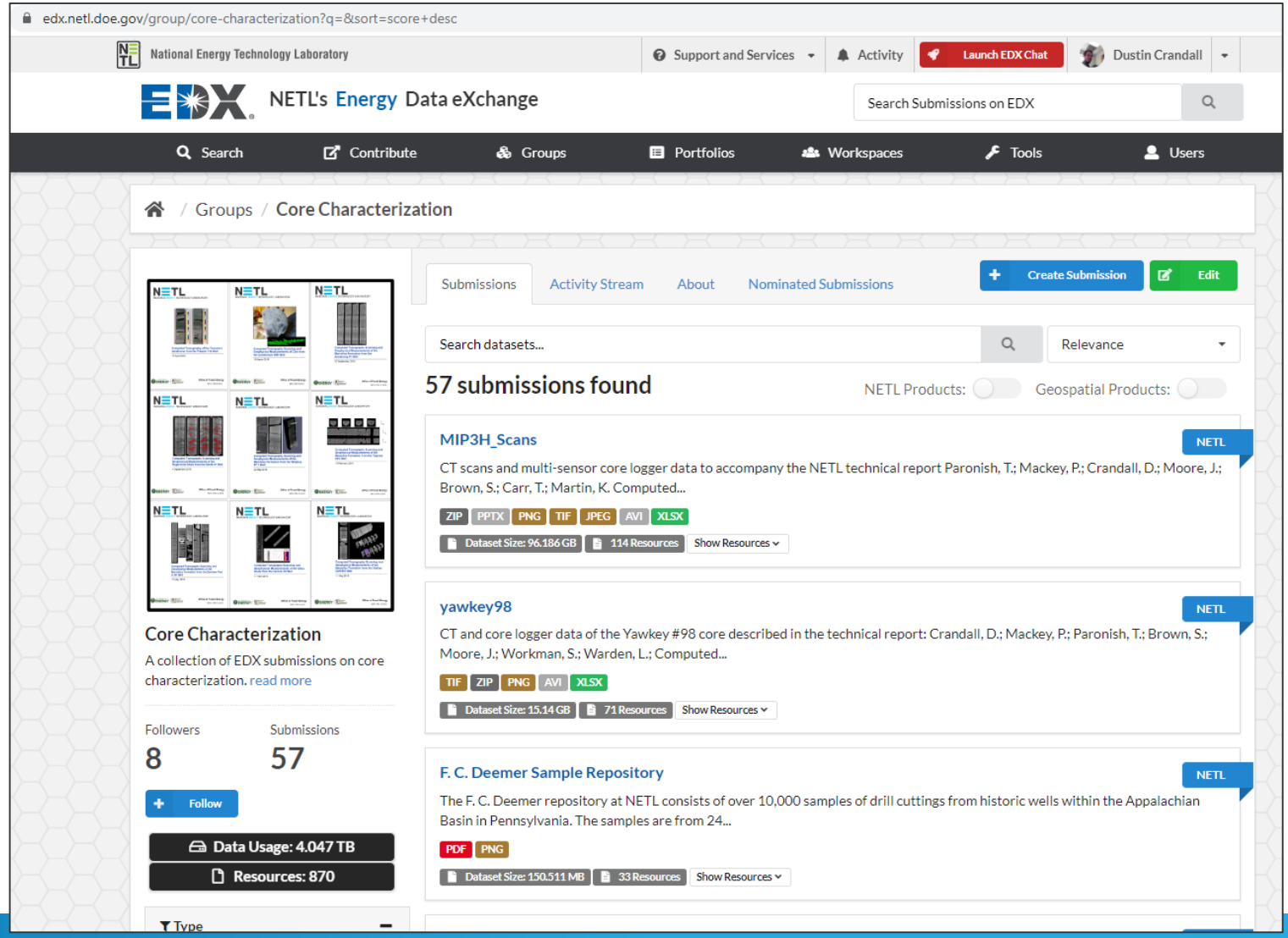
  https://edx.netl.doe.gov/group/core-characterization



Core Characterization EDX Group Page

https://edx.netl.doe.gov/group/core-characterization

- **Over 4 TB of core scale data available**
  - 58 resources. 29 wells and 29 associated reports describing the data
    *as of 10/25/22 … more in progress!
  - Older data (pre ~2020) is poorly stored in some instances
    — Again, familiarity with EDX
  - Newer data more accessible



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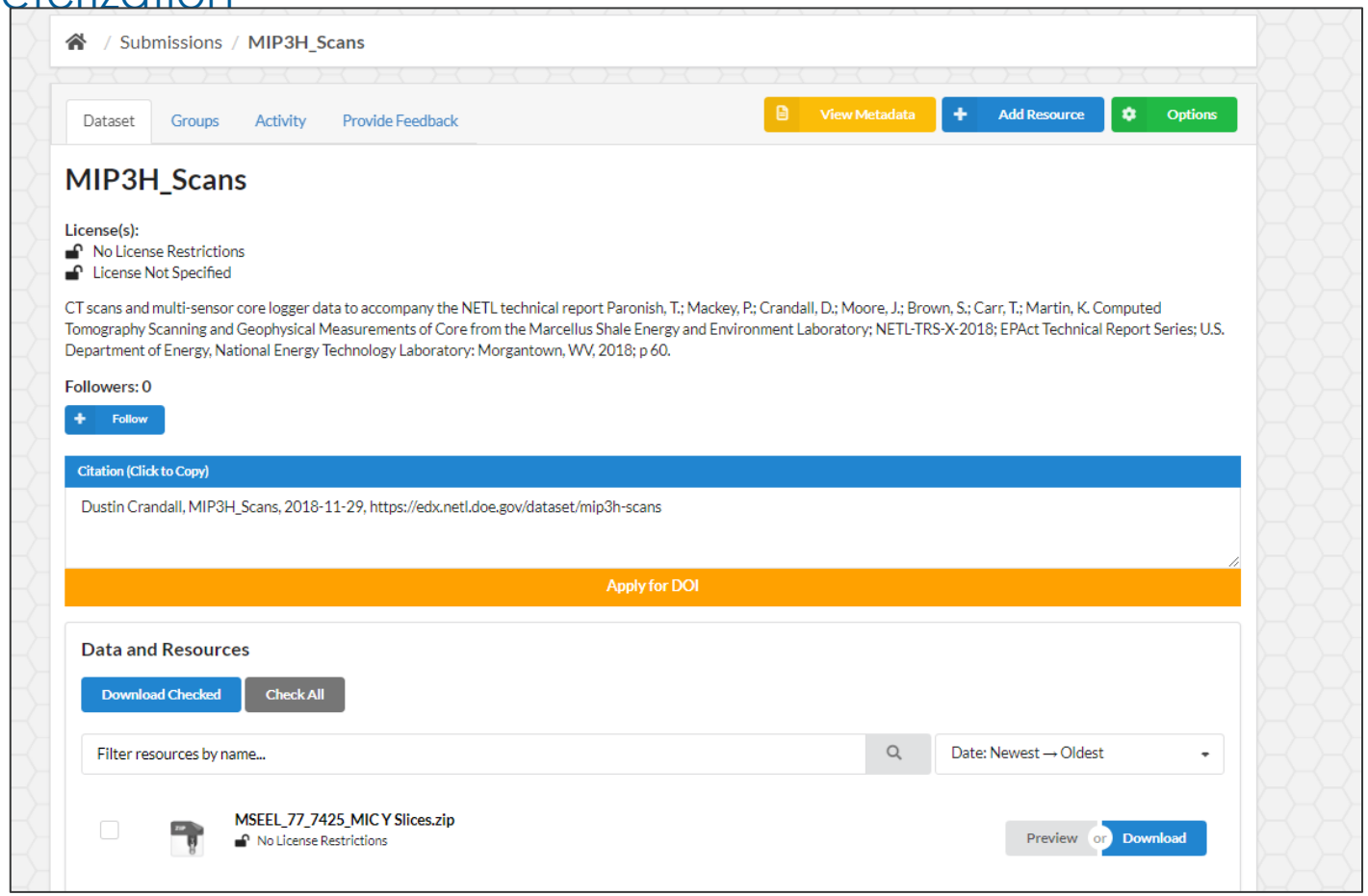

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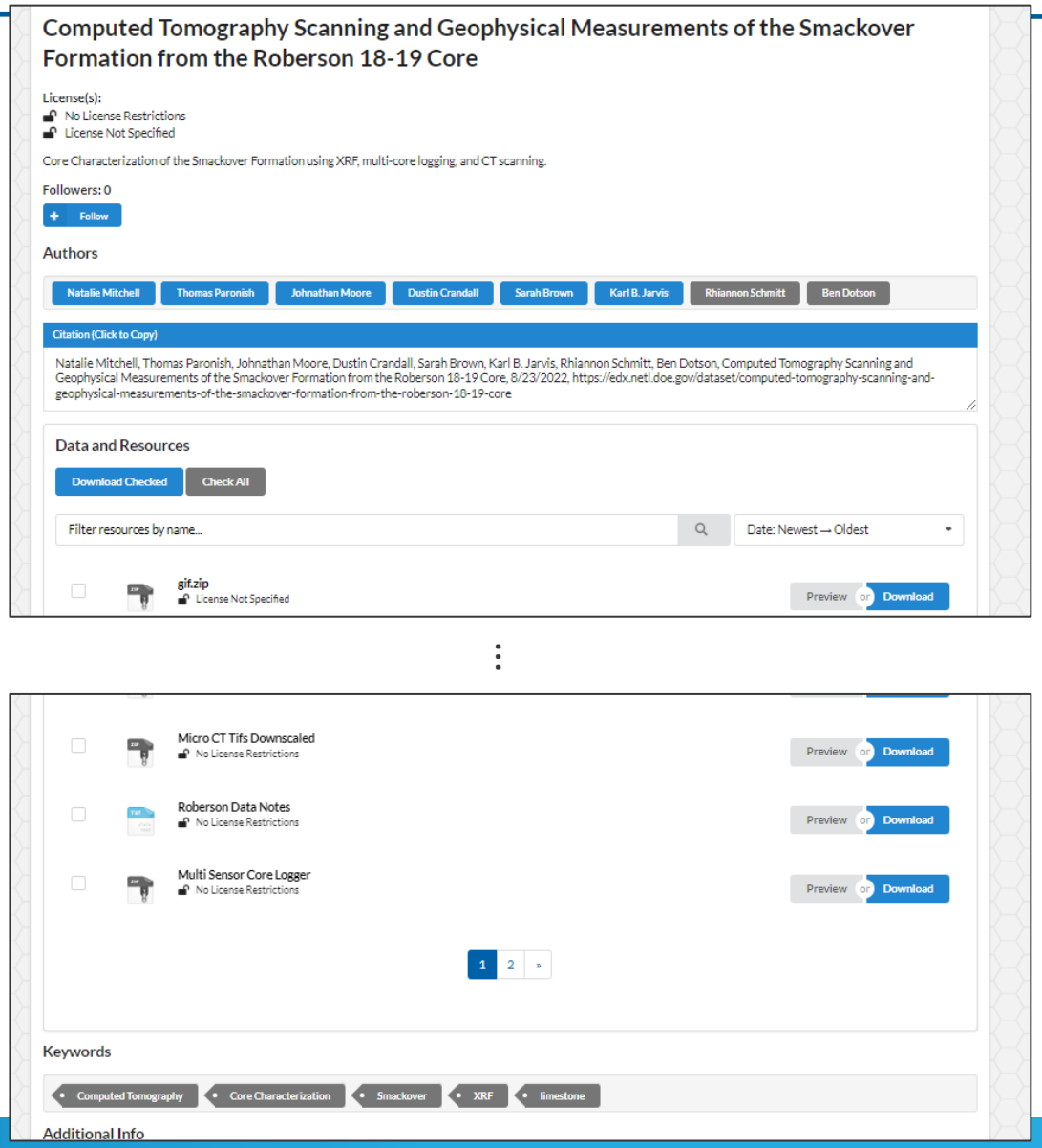

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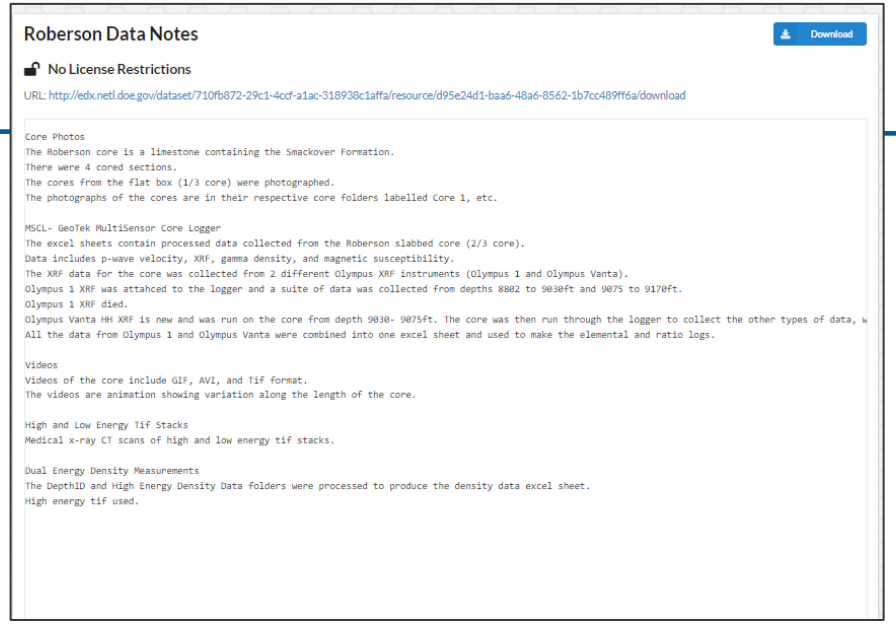
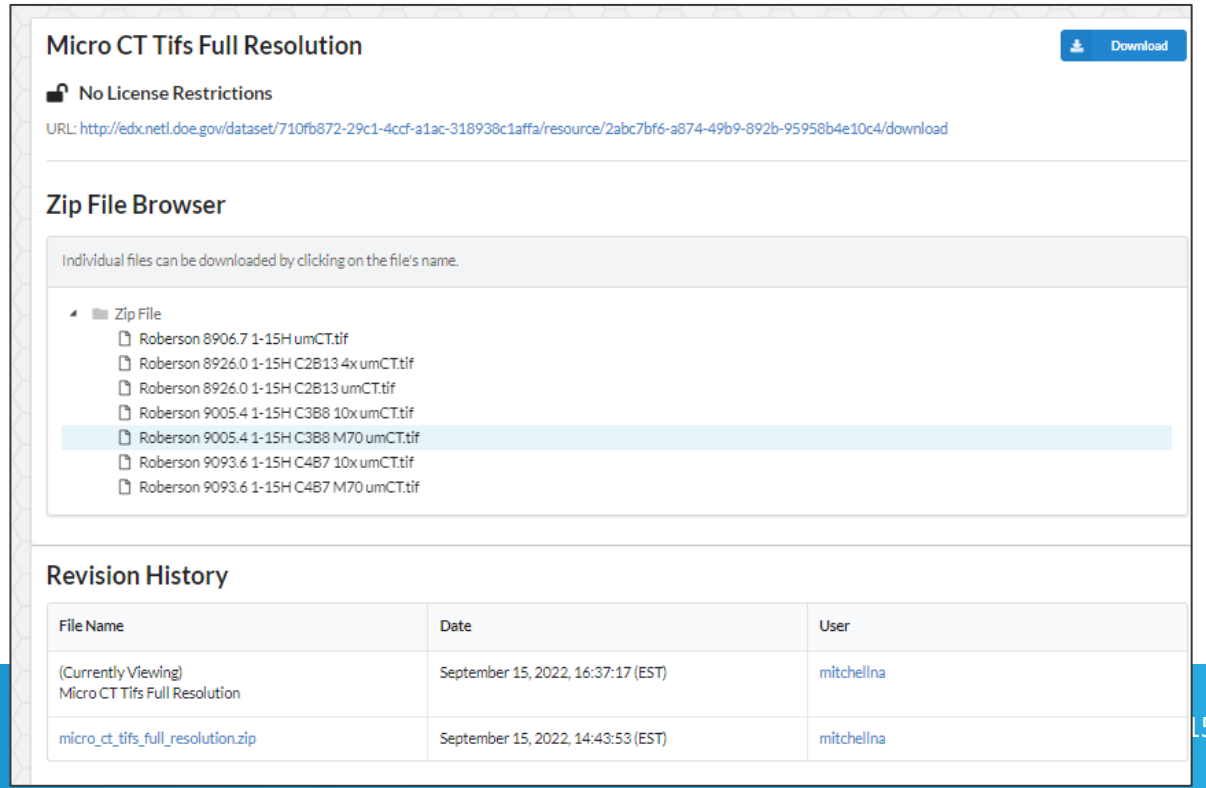
  - **Newer** data more accessible
    — Use of zipped folders to combine data subsets
    — Use of notes files

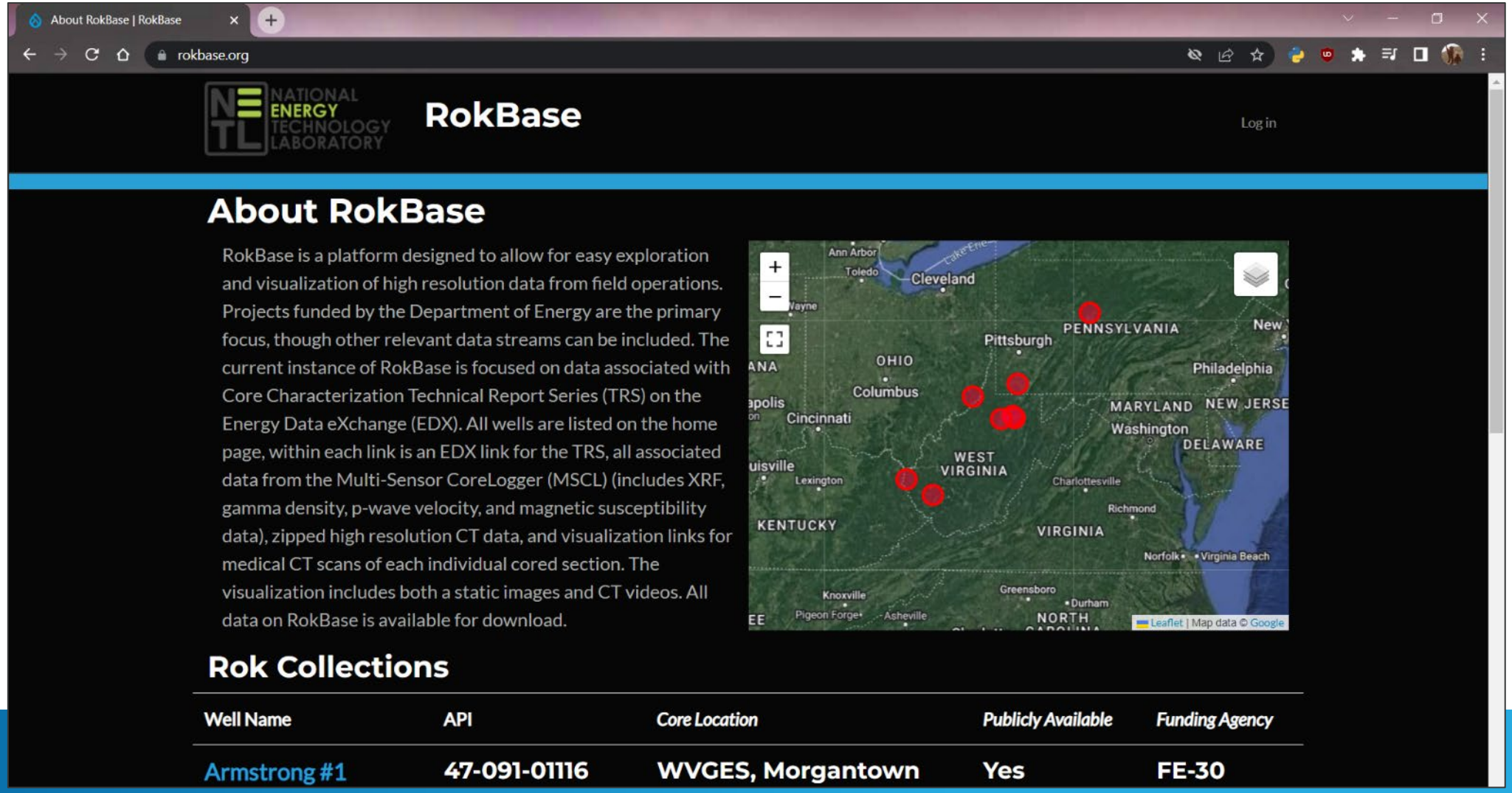




Moving Beyond the Core Characterization EDX Group

Beta Viewing and Feedback Session at Tools Demo!

- **Organization is improved, but still not as human accessible as desired**
- **RokBase**



RokBase Homepage

- Integrating geospatial information with well data

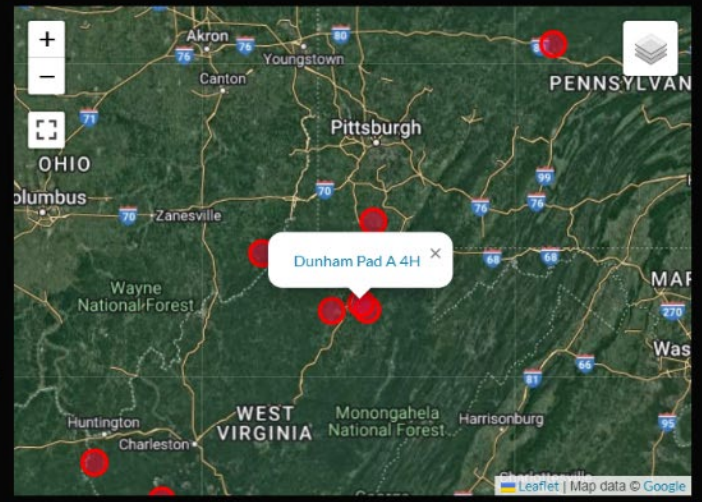
NATIONAL ENERGY TECHNOLOGY LABORATORY

RokBase

Log in

About RokBase

RokBase is a platform designed to allow for easy exploration and visualization of high resolution data from field operations. Projects funded by the Department of Energy are the primary focus, though other relevant data streams can be included. The current instance of RokBase is focused on data associated with Core Characterization Technical Report Series (TRS) on the Energy Data eXchange (EDX). All wells are listed on the home page, within each link is an EDX link for the TRS, all associated data from the Multi-Sensor CoreLogger (MSCL) (includes XRF, gamma density, p-wave velocity, and magnetic susceptibility

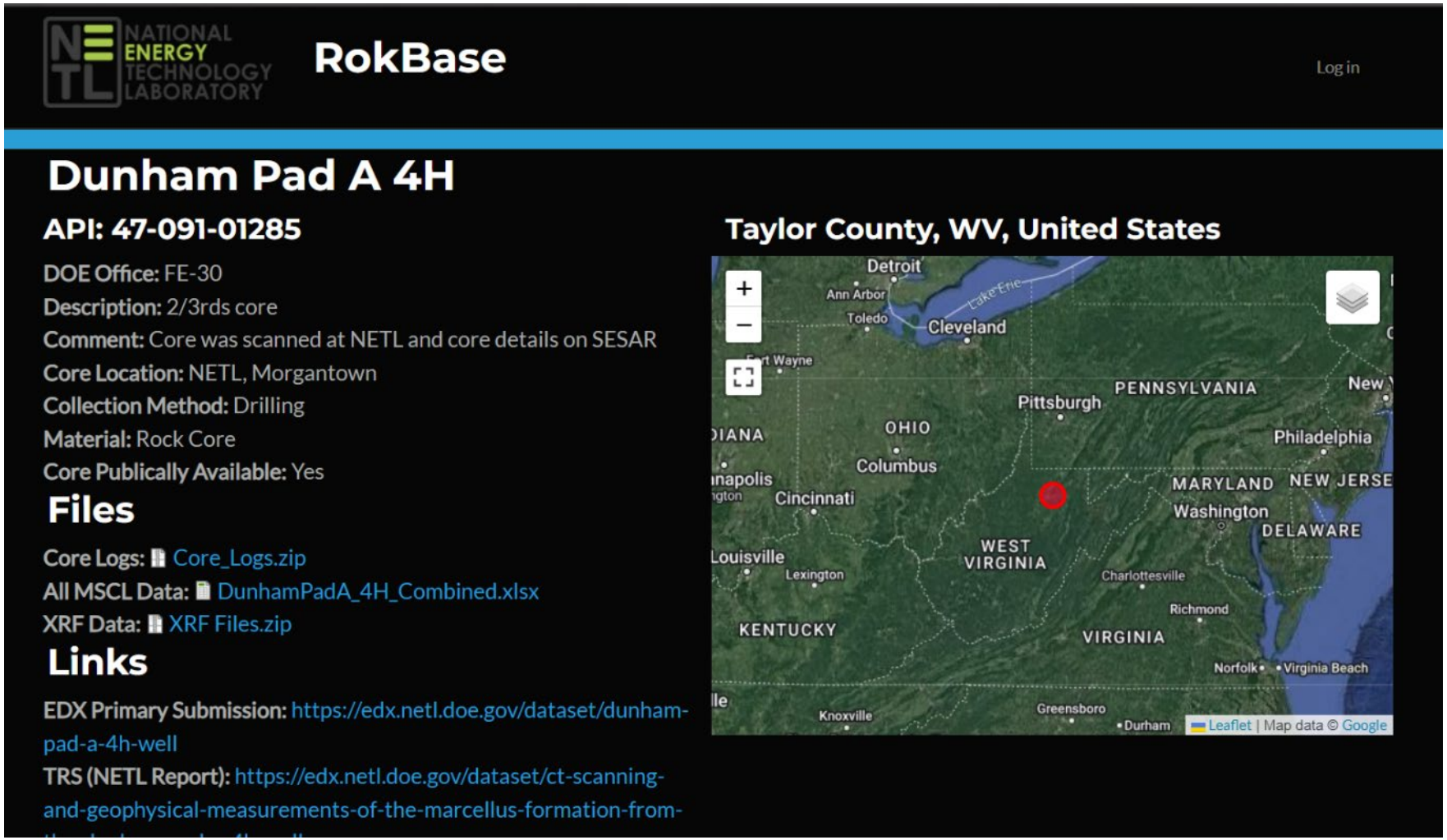


Rok Collections

Well Name	API	Core Location	Publicly Available	Funding Agency
Armstrong #1	47-091-01116	WVGES, Morgantown	Yes	FE-30
Coldstream 1MH	37-033-26848	NETL, Morgantown	Yes	FE-30
Dunham Pad A 4H	47-091-01285	NETL, Morgantown	Yes	FE-30
Jay P Smith #1	47-099-01572	WVGES, Morgantown	Yes	FE-30
Nathan Goff #55	47-033-05106	WVGES, Morgantown	Yes	FE-30
Tippens 6H	34-111-24358	SWN, Fayetteville, AK	No	FE-30
Whipkey ST 1	37-059-24715	NETL, Morgantown	Yes	FE-30
Yawkey #98	47-045-01815	NETL, Morgantown	No	FE-30

RokBase Beta Capabilities

- Detailed Well Info
- Links to full well data downloads and links to EDX Group info



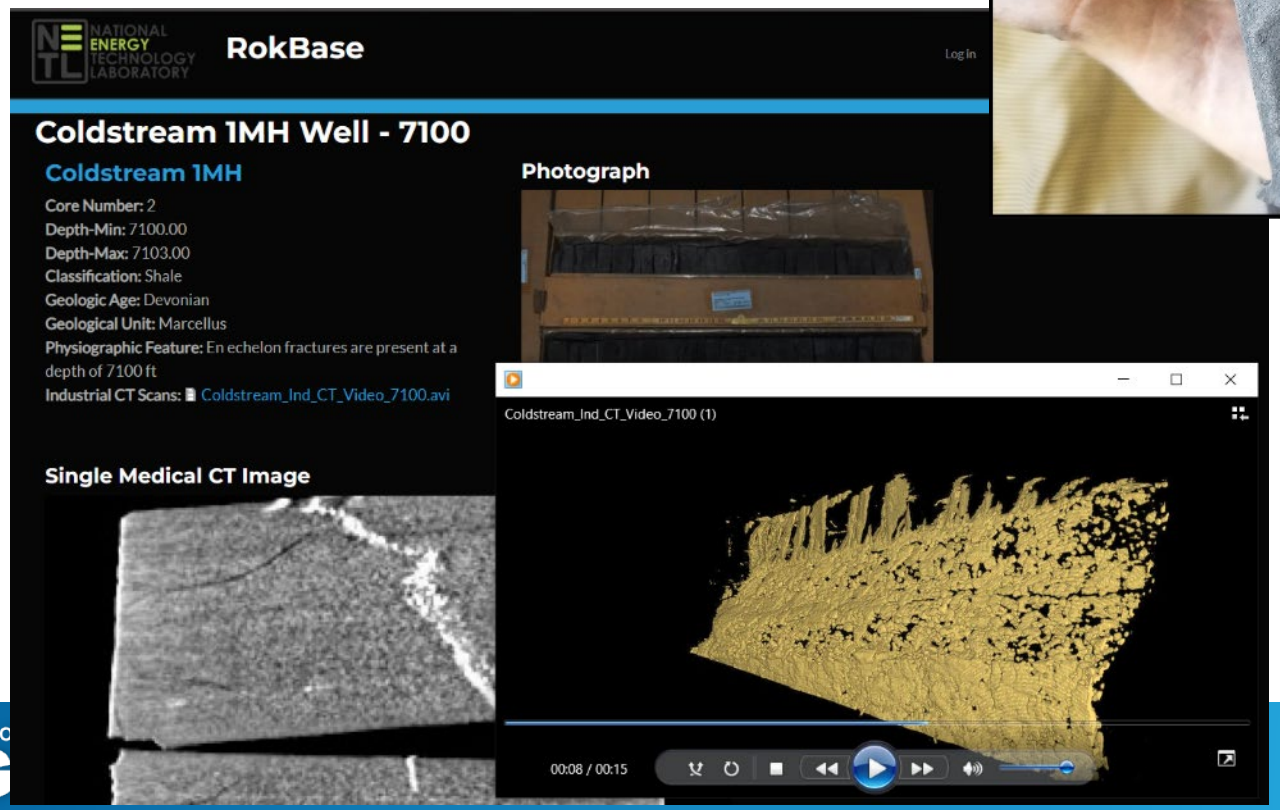
RokBase Beta Capabilities

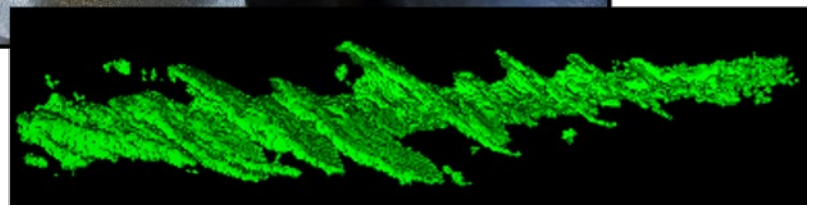
- Individual Core Box & CT Scan Data Visualization

Dunham Pad A 4H - 7502	7502.00	7505.00	1
Dunham Pad A 4H - 7505	7505.00	7508.00	1
Dunham Pad A 4H - 7508	7508.00	7511.00	1
Dunham Pad A 4H - 7511	7511.00	7514.00	1
Dunham Pad A 4H - 7514	7514.00	7517.00	1
Dunham Pad A 4H - 7517	7517.00	7520.00	1
Dunham Pad A 4H - 7520	7520.00	7523.00	1
Dunham Pad A 4H - 7523	7523.00	7526.00	1
Dunham Pad A 4H - 7526	7526.00	7529.00	1
Dunham Pad A 4H - 7529	7529.00	7532.00	1
Dunham Pad A 4H - 7532	7532.00	7535.00	1
Dunham Pad A 4H - 7535	7535.00	7538.00	1
Dunham Pad A 4H - 7538	7538.00	7541.00	1
Dunham Pad A 4H - 7541	7541.00	7544.00	1
Dunham Pad A 4H - 7544	7544.00	7547.00	1

Linking Additional Data Streams in RokBase

- **Structured data ingestion process to be flexible for other data streams**
  - Coldstream en echelon fracture
  - TRS 2018 > Geosphere 2020 > RokBase 2022



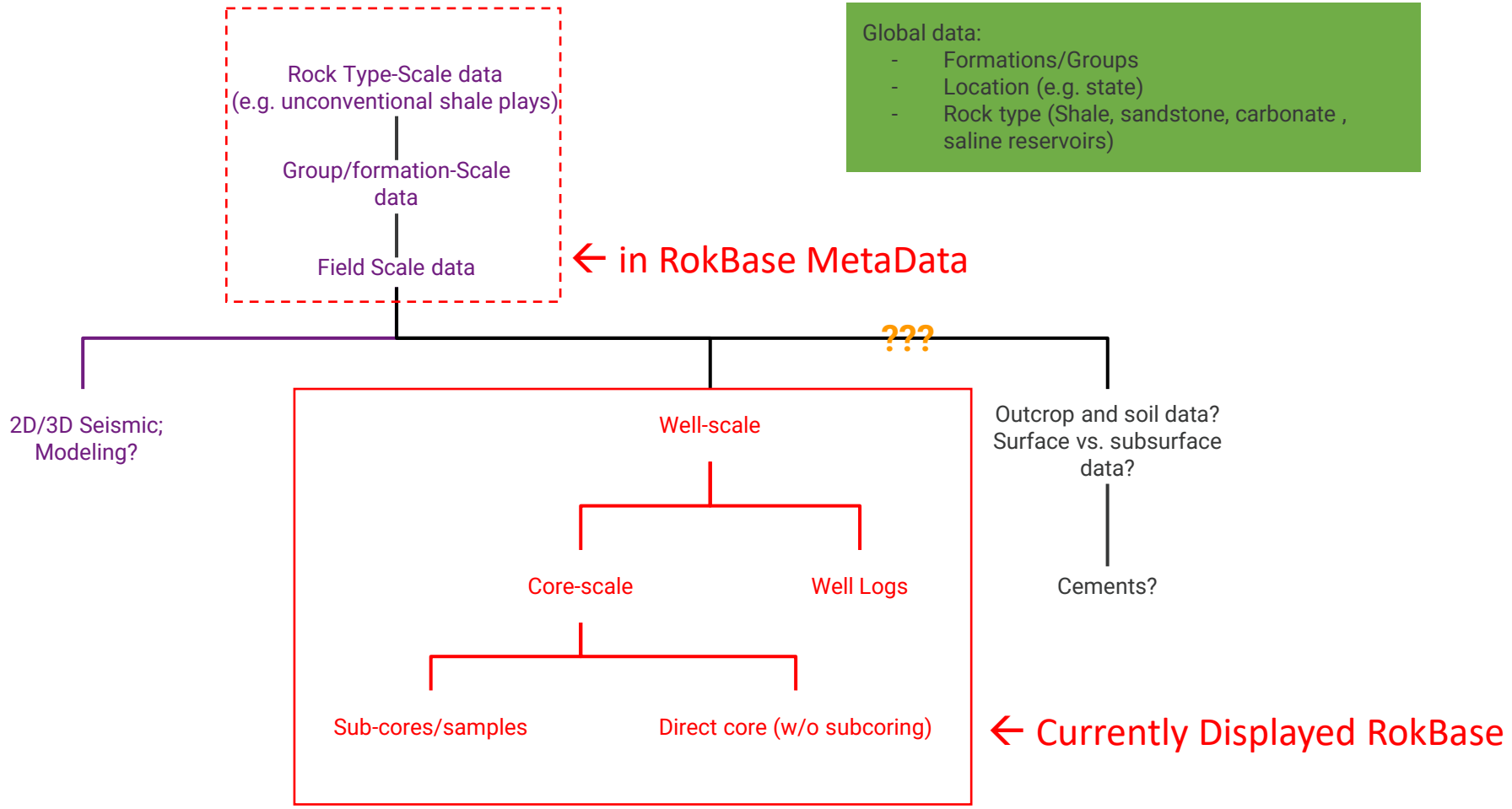


Andrews, G.D.M., Brown, S.R., Moore, J., Crandall, D., Mackey, P. (2020) **Computed Tomography X-Ray Scanning Reveals the Transition from Planar to Sigmoidal En Énchelon Morphology in a Single Vein**, Geosphere https://doi.org/10.1130/GES02191.1

RokBase Data Structure

Parent/Child Structure Allows for Wide Range of Data to be Co-Collected

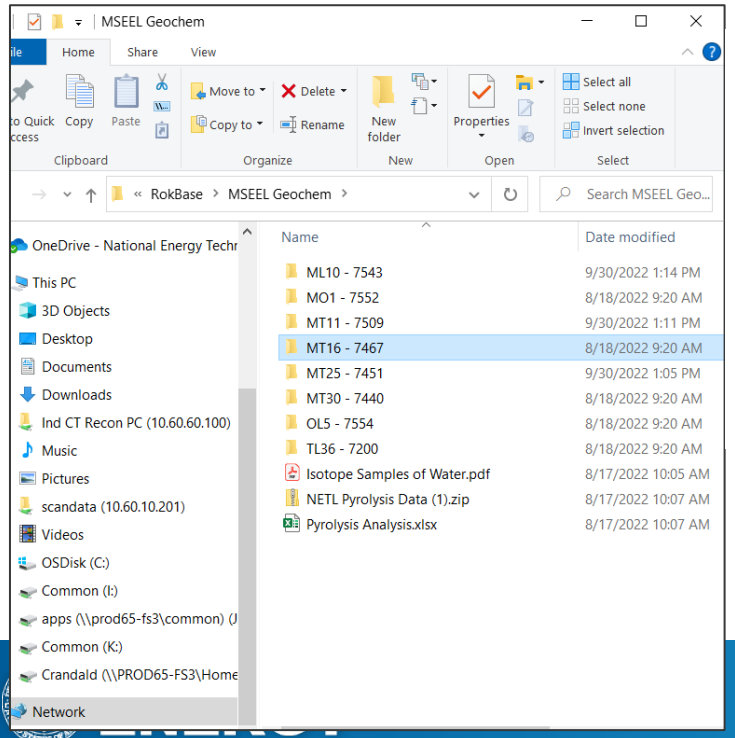
- **Using the core characterization data stream to build the architecture, beta test, and refine whilst keeping an open backend for multiple data streams and visualizations**

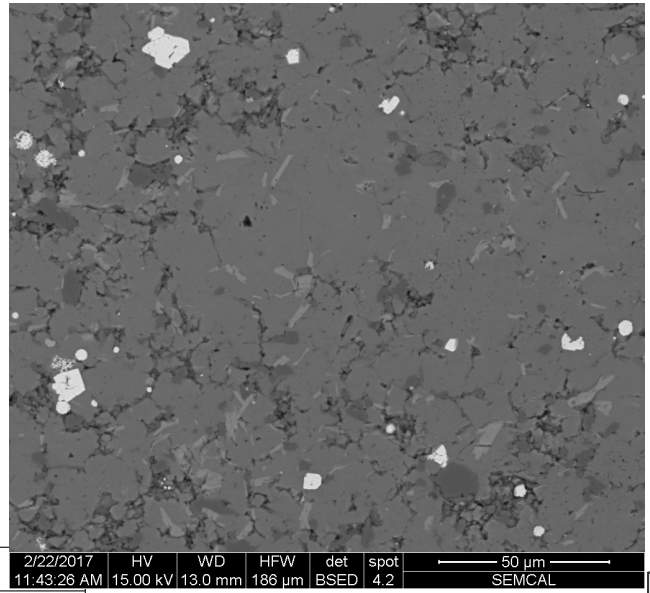


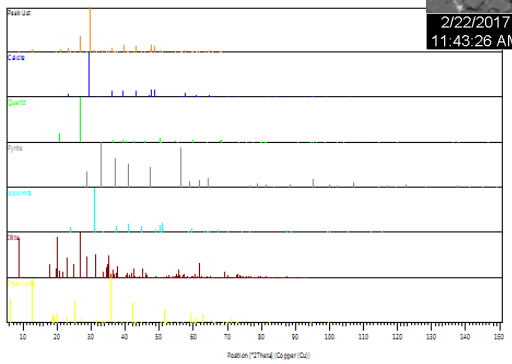
Using MSEEL Geochemistry Data as an expanded Trial Case

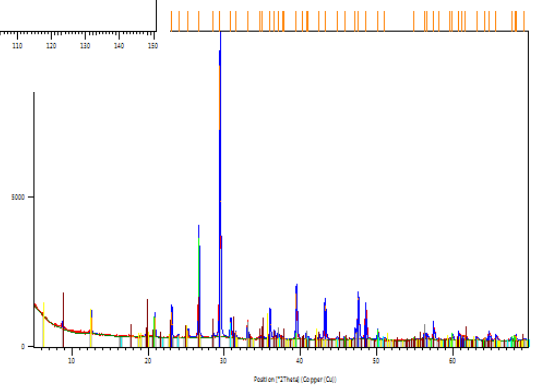
Work in progress, over the next weeks

- **Familiarity with MSEEL MIP3H Well Geochemistry, so using this as broader test case**
  - SEM, water isotopes, pyrolysis, sorption data.









Drilled

Whole well
(Ternary representation: XRD; XRF; ICP-MS, etc.)(chemostratigraphic data types)

Core
(chemostratigraphic data types)

Sub-cores/samples (ICP-MS)

Raw data (direct w/o subcoring)

Integration with Field Laboratory Data Streams

- **And that brings it back to the discussion of field lab data. The richness of these data sets is incredible and the investment from the DOE is laudable.**
  - Acquisition, uploading, and curation takes time and effort
  - Individual resources from these sets can have profound impacts
    - HFTS Fracture spacing data use in the multiple national lab fundamentals of shale effort
  - Individual resources can diverge into a wide array of insights
    - Coldstream en echelon fracture
    - Z. Karpyn fracture scan in 2008 … (PhDs > multiphase insights > Digital Rocks Portal)
- **The true utility and outcomes from these field efforts may not be known for decades, but only if they are accessible**

Summary and Work in Progress

- **Data ingestion from field laboratories underway**
  - Data in private workspaces
- **Data curation from field laboratories underway**
  - Data is being collected into public EDX Groups
- **Beta version of more user-friendly integrated platform (RokBase) complete**
  - Tools demo after this talk
  - Geochemistry data streams incorporation underway
- **Expansion of RokBase utility and incorporation with Cloud Based EDX++ platform underway**

Acknowledgements, contacts, and links

Thank you to all the field labs and their DOE sponsors for making such a rich field to play in.

Thank you to the NETL collaborators, past and present, for the work shown here today.

Any questions?

Dustin.Crandall@netl.doe.gov or Kelly.Rose@netl.doe.gov

https://edx.netl.doe.gov/group