Digital Core Characterization

Dustin Crandall¹, Sarah Brown¹, Johnathan Moore^{1,2}, Thomas Paronish^{1,2}, Natalie Mitchell^{1,2}, Megan Rich^{1,3}, Devanshi Patel^{1,3} ¹National Energy Technology Laboratory, Morgantown, WV; ² National Energy Technology Laboratory, LRST, Morgantown, WV; ⁴National Energy Technology Laboratory, MLEF, Morgantown, WV;

Abstract

The Computed Tomography (CT) and Multi-Sensor Core Logger (MSCL) facilities at the NETL in Morgantown, West Virginia rapidly characterize large volumes of core for public dissemination. The CT analysis and measurements of magnetic susceptibility, P-wave velocity, and XRF provide a unique look into the internal structure of core and macroscopic changes in lithology. The primary impetus of this work is a collaboration between universities, state surveys and NETL to characterize core from multiple wells to better understand the structure and variation of key formations and provide access to this data for further research and analysis. As part of this effort, bulk medical CT scans and MSCL data sets are obtained for multiple cores relevant to energy production and carbon storage. The resultant datasets are presented in a series of reports and can be accessed from NETL's EDX online system. All equipment and techniques used were non-destructive, enabling a detailed digital record of the core, before any destructive testing or further degradation, that is accessible and can be referenced for future studies. Qualitative analysis of the medical CT images, coupled with measurements from the MSCL are useful in identifying zones of interest for more detailed analysis, experimentation, and quantification. The combination of methods used provides a multiscale analysis of this core and provides both macro and micro description of the core that is relevant for many subsurface energy related examinations that have traditionally been performed at NETL.

Multi-scale CT Flow and Imaging Facility

- Real rocks at real conditions
- Visualizing pore networks and trapped fluids
- Comparison with well logs
- Micro CT Scanner, sub-micron to micron scale
- Dynatom CT Scanner, microns scale
- Industrial CT Scanner, micron to sub-millimeter scale
- Medical CT Scanner, sub-millimeter scale



Sample Data Flow System for Earth Joining our repository (SESAR) Scanned in Multi-Sensor Core New cores arrives Logger (MSCL) On loan Scanned in Medical CT





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- SESAR: <u>https://www.geosamples.org/</u>
- Over 1500 NETL samples, more than 4.3 million samples registered
- EDX: https://edx.netl.doe.gov/
- Provide data in multiple formats: avi, jpg, tiff, excel, png, rtf
- Digital Rocks Portal: https://www.digitalrocksportal.org/



Data Collection

NETL's Toshiba[®] Aquilion RXL[™] Multislice Helical Computed Tomography Scanner





Voxel resolution of 0.43 x 0.43 mm in the XY plane and 0.50 mm along the core axis. Dual energy scans obtained



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



Our Goal: to rapidly characterize and standardize large volumes of core data for public dissemination • We'll continue to add samples and more data to SESAR

Acknowledgements and Disclaimer

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Geophysical Logging MSCL

Continuously run petrophysical measurements on whole core: fractional porosity values, portable X-ray XRF spectrometer (www.geotek.co.uk).



Dual energy scans - different x-ray energies, to approximate the density. 2 in diameter core, Rogersville shale.

Example data logs from combined CT and MSCL core logging

		NETL NATIONAL ENERGY TECHNOLOGY LABORATORY	NETL NATIONAL ENERGY TECHNOLOGY LABORATORY	NATIONAL ENERGY TECHNOLOGY LABORATORY
Computed Tomography Scanning and Geophysical Measurements of the FutureGen FGA-1 Core	Computed Tomography Scanning and Geophysical Measurements of Core from the Coldstream 1MH Well 15 March 2018	Image: Second	Computed Tomography Scanning and Geophysical Measurements of the Marcelius Formation from the Trippens BHS Well	Computed Tomography Scanning and Geophysical Measurements of the Marcellus Formation from the Nathan Coff #50 Well
Office of Fossil Energy NETL-TRS-6-2019	Office of Fossil Energy NETL-TRS6-2018	Office of Fossil Energy NETL-TRS-16-2018	Office of Fossil Energy NETL-TRS-3-2019	Office of Fossil Energy NETL-TRS-10-2018
NTIONAL ENERGY TECHNOLOGY LABORATORY	<image/> <figure></figure>	Displayed in the rest of the rest o	<image/>	Image: State Stat
1 November 2021	Office of Fossil Energy DOE/NETL-20229723	GENERGY Contractions Office of Fossil Energy NETL-TRS-21-2018	Office of Fossil Energy NETL-TR3-1-2019	Office of Fossil Energy NETL-TRS-4-2020
DOE/NETL-2021/2843				

Numerous Other Cores Analyzed from Different Formations

• As new core becomes available (via major demonstrations, active CCS sites and academia/industry) \rightarrow CT and MSCL scan • Provide data in multiple forms – EDX, Digital Rocks Portal and Technical Report Series – to allow others to use the data

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