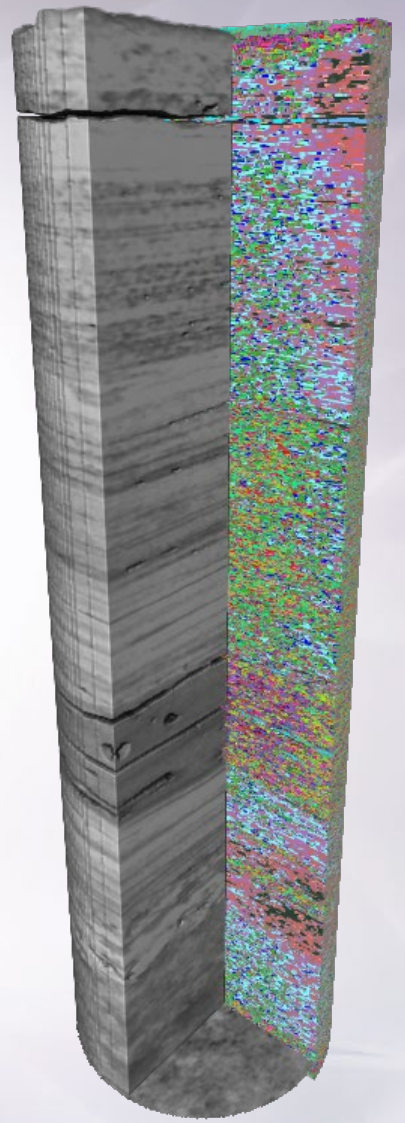
PerGeos Software

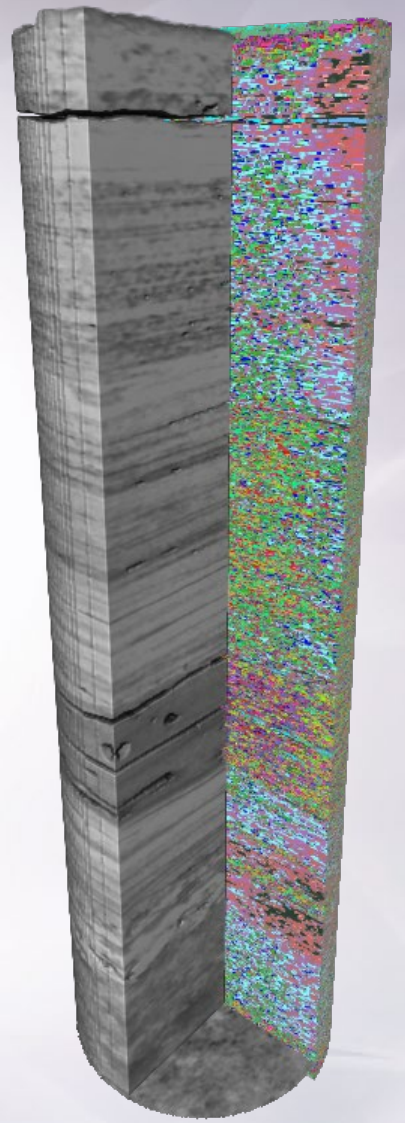
for Digital Rock Analysis

Dual Energy Computed Tomography (DECT)

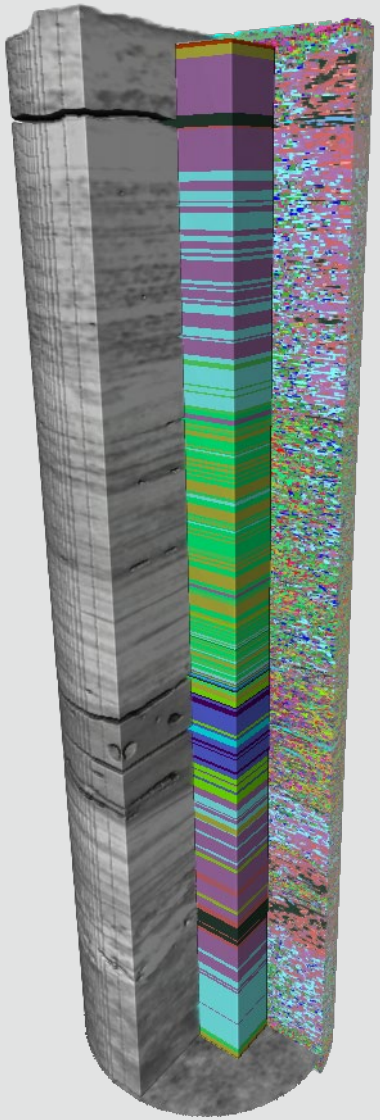


Dual Energy Computed Tomography (DECT) - Outline

- Introduction
- Calibration
- Analysis
- Results
- Batch Processing



Dual Energy Computed Tomography (DECT)



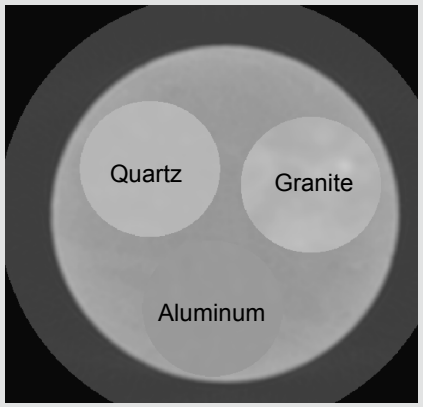
By acquiring X-ray CT data at two different energy levels and using the DECT tools in PerGeos Software, you can calculate **density** and **effective atomic number** for the sample on a voxel-by-voxel basis.

A characterized materials image that can be considered a **rock-typed image** is created based on a list of reference materials.

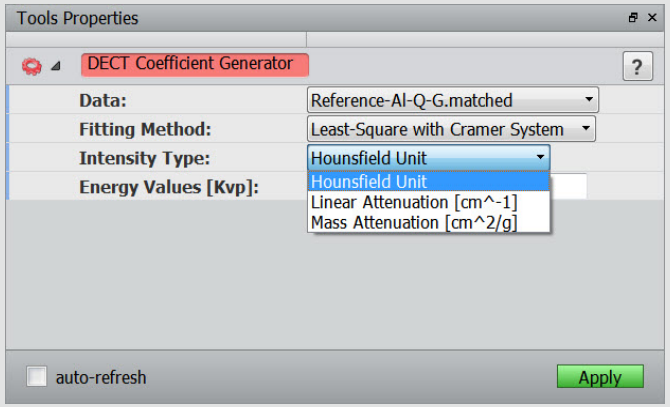
This technology adds value to whole-core CT analysis workflows, by providing you with actual density information that can be compared with density logs and used for further characterization of rock formations. This enables comparison of whole-core CT images across multiple formations and wells.

- Calculate density and atomic number of your samples.
- Detect rock types and minerals in your whole-core CT data.
- Assist with plug selection for further analysis (e.g. SCAL or DRP).
- Enhanced contrast for segmentation of features with similar X-ray intensities.

Dual Energy Computed Tomography (DECT) - Calibration

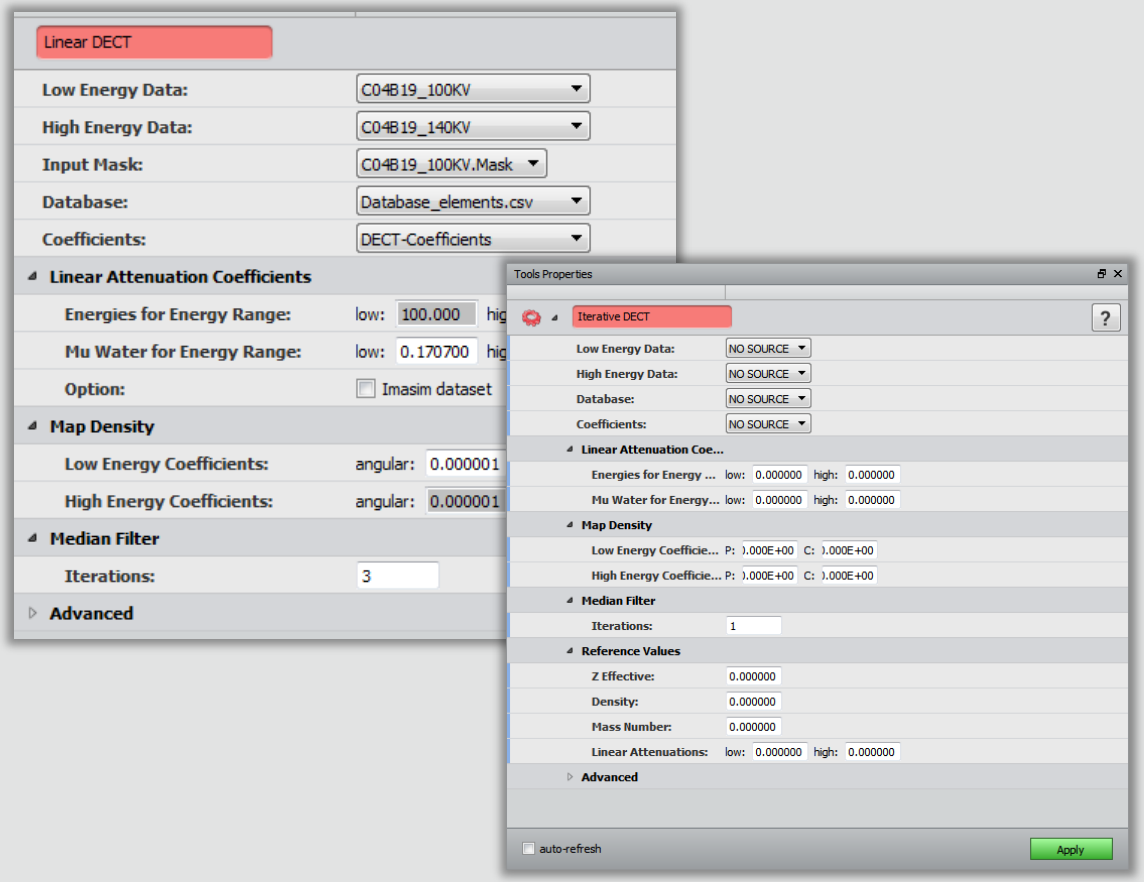


DECT Mean Intensity → DECT Merge and Match → DECT Coefficient Generator



- A DECT system must be calibrated using reference standards with known density and composition.
- PerGeos Software provides a set of tools that enable calibration of a DECT system through calculation of linear (α) and angular (β) coefficients based on the information obtained from the DECT data of reference materials.
- A DECT calibration recipe is also provided.
- Hounsfield unit, linear attenuation (1/cm) and mass attenuation (cm^2/g) intensity types are supported in the calibration workflow.

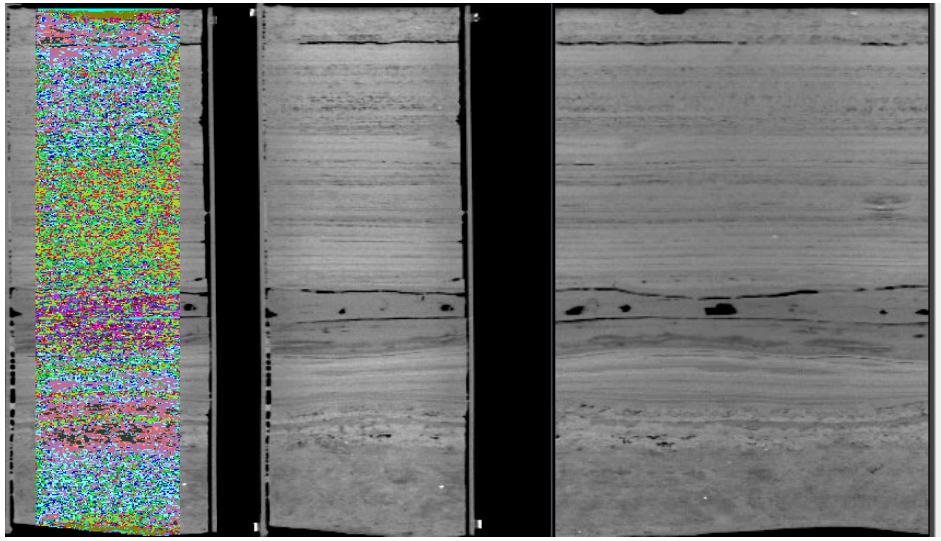
Dual Energy Computed Tomography (DECT) - Analysis



X-ray CT data in Hounsfield unit and linear attenuation (1/cm) are supported.

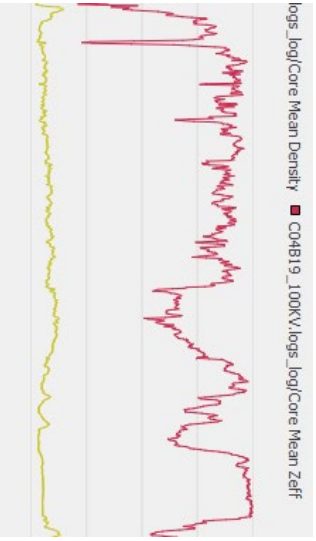
- DECT Analysis is the process of calculating densities and Z_{eff} values and identifying different materials in a sample through use of X-ray CT images acquired at two energy levels.
- PerGeos Software provides a set of tools to enable DECT analysis using two different algorithms.
  - Linear DECT
    - **Methodology for attainment of density and effective atomic number through dual energy technique using microtomographic images**, H. Alves, I. Lima, R.T. Lopes, *Applied Radiation and Isotopes*, Volume 89, Pages 6-12, 2014
  - Iterative DECT
    - **Application of a dual-energy monochromatic X-ray CT algorithm to polychromatic X-ray: A feasibility study**, S. Chang, H.K. Lee, G. Cho, *Nuclear Engineering and technology*, Volume 44, Pages 61-70, 2012

Dual Energy Computed Tomography (DECT) - Results



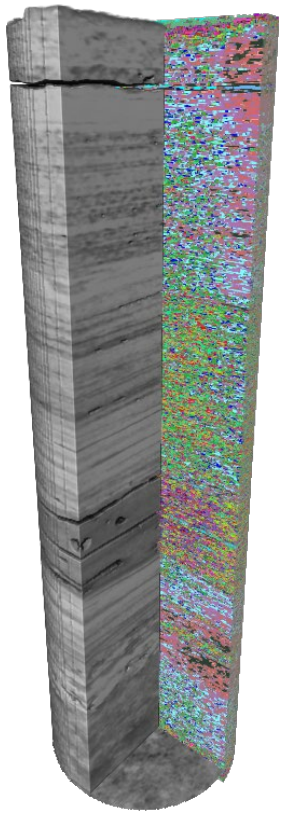
Predicted materials

100KV data

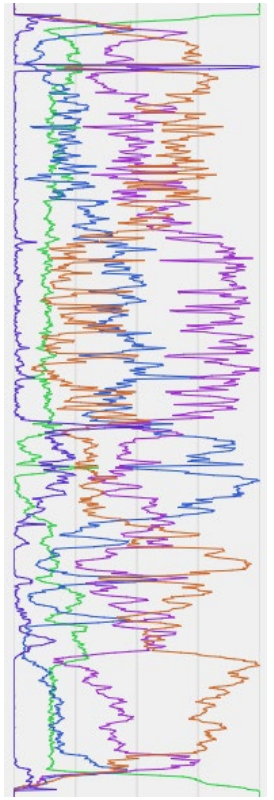


Unwrapped slice

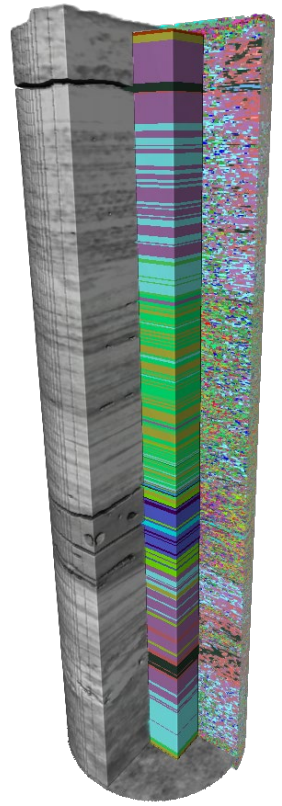
Mean & Zeff log



Grayscale and Materials



Heterogeneity Material logs



Majority Material Rock typing

- 3D Density map
- 3D Effective Atomic Number (Z_{eff}) map
- 3D predicted materials → Rock Typing

- Z_{eff} / Density logs
- Map of Z_{eff} errors

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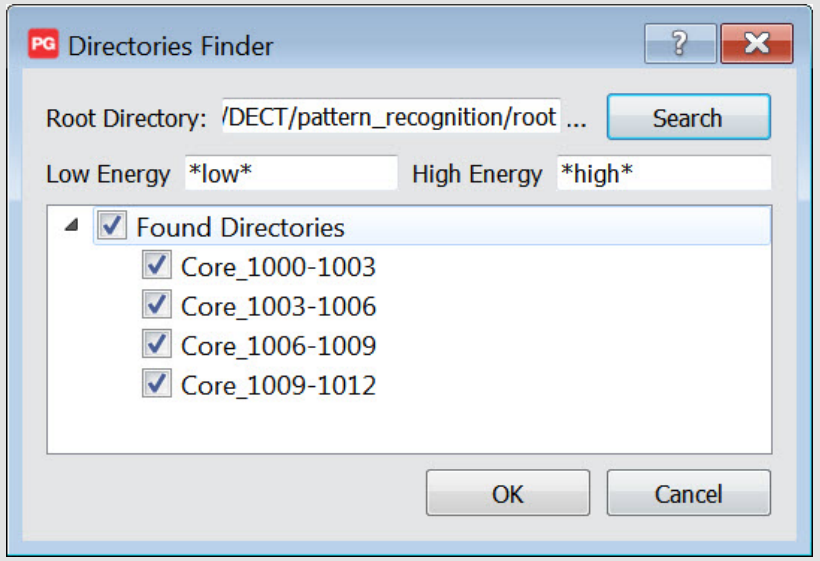
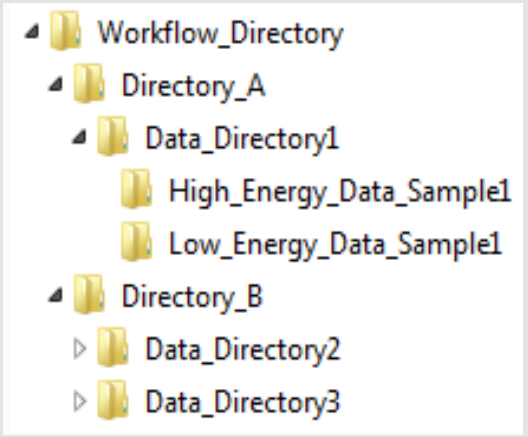
Dual Energy Computed Tomography (DECT) – Batch Processing





- DECT Batch Processing tool performs DECT analysis on a select list of folders found in a root directory.
- A pattern recognition mechanism finds all sub-folders that contain low energy and high energy patterns specified by the user.
- Results are automatically saved to disk by preserving the same folder structure as input data.
- DICOM and AM formats are supported.