

'Nano-Shales' and the Klareco Approach: A Crude Awakening?

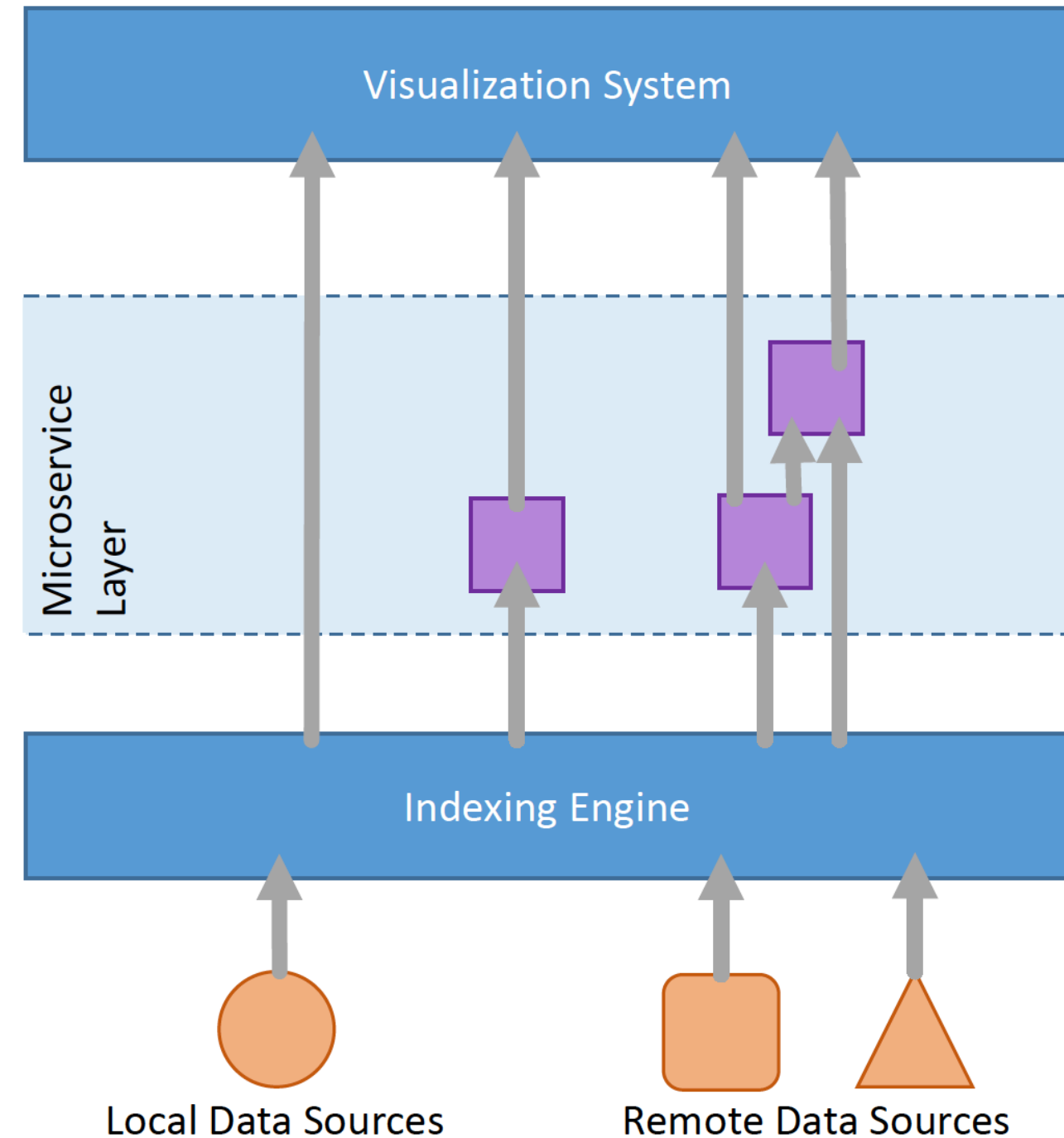
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NanoUtah 2015 | September 2015

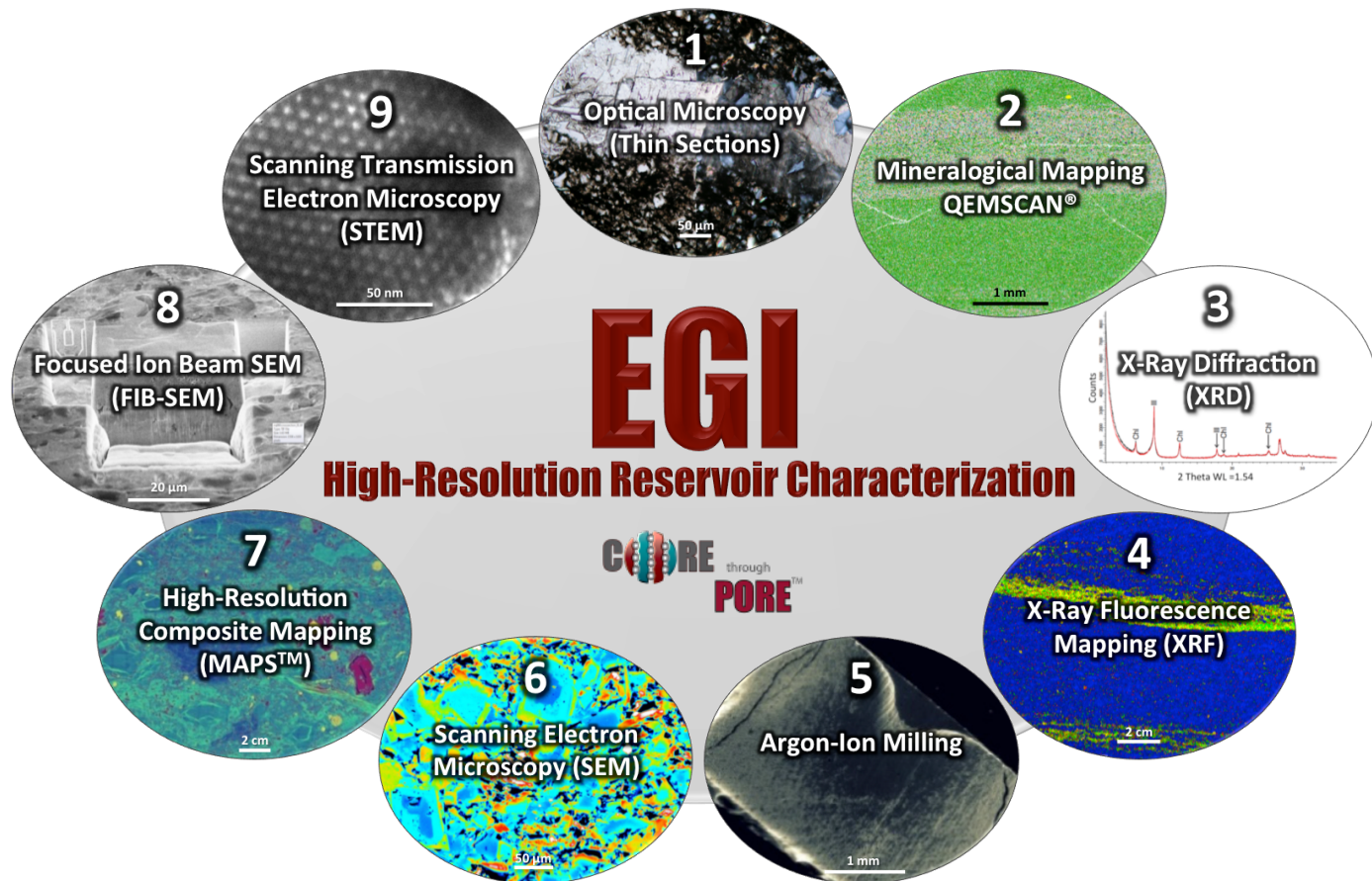
Indexing Contextual Data

- ◆ Klareco and associated software: EGI, SCI, Utah Nanofab collaborative effort
- ◆ Seeks to bridge the gap in visualization of large datasets allowing users to contextually analyze information
 - ◆ *Correlation of nano-imaging with larger scales to allow contextual elucidation of results*
- ◆ Klareco's indexing-based architecture allows the user to interactively visualize data from contextually linked, large datasets. It is therefore applicable across many disciplines; i.e. biology, geology, material science etc.



Klareco Application: Shale Petroleum Systems

- ◆ Petroleum system data ranges from regional (km) scale to nano-scale
 - ◆ Data is often fragmented, large and complex (multiple sources)
 - ◆ Data reflects the incredible complexity of rocks (mineralogically/chemical and mechanically), capable of generating and storing large quantities of hydrocarbons (oil and/or gas)
- ◆ Our ability to effectively trace and extract hydrocarbons is directly linked to our ability to understand data

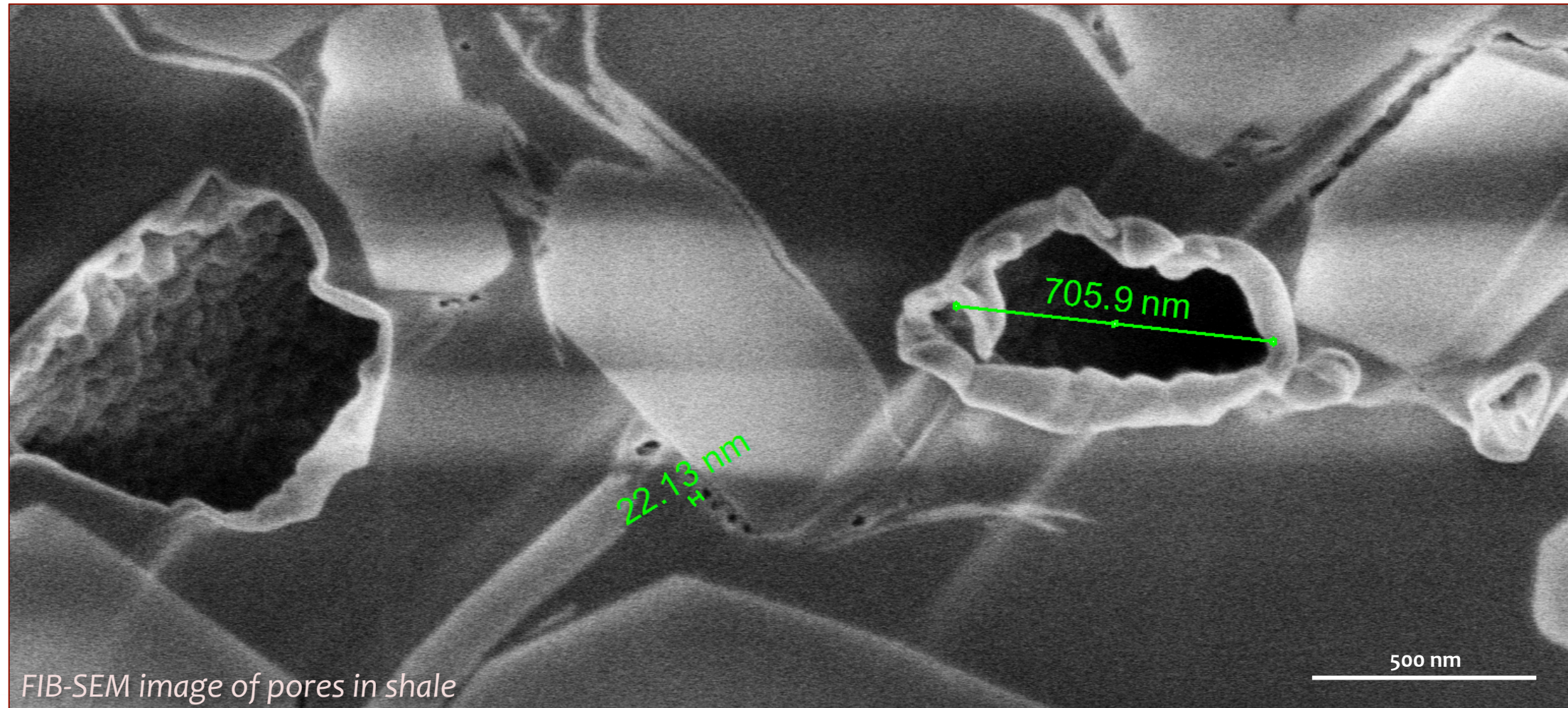


- ◆ Rocks are characterized using a large variety of imaging, chemical and mechanical techniques

- ◆ Results however are interpreted across multiple platforms, with no integrated method to interpret analysis
- ◆ Multiple nano-imaging techniques that need to be correlated with corresponding images and with contextually larger scales

Klareco Application: Shale Petroleum Systems

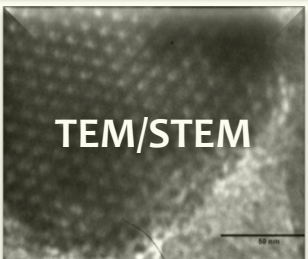
- The inherent nano-scale mineralogical heterogeneity of unconventional reservoir rocks complicates every level of their understanding.
- Including the understanding of their pore systems through which hydrocarbons are stored and transported...



Contextual Shale Analyses

Nano-scale

Ultra-High Resolution Microscopy



- Mineralogical analysis
- Textural/fabric analysis
- Porosity/fracture analysis

High-Resolution Microscopy



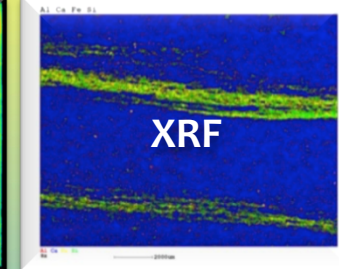
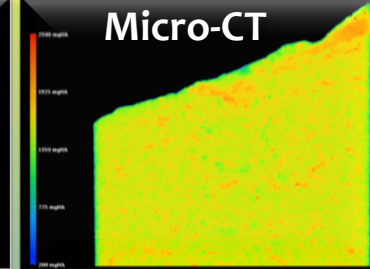
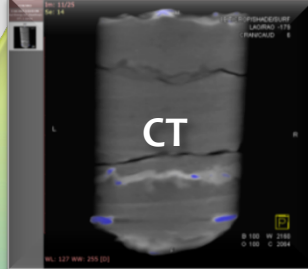
- High-resolution imaging
- Pore studies
- Fracture studies
- Microdepositional environment studies

High-Resolution Sample Preparation



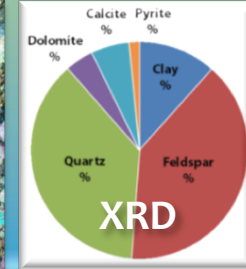
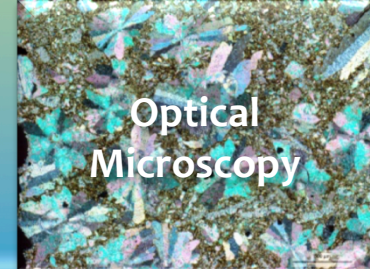
- Removal of artifacts
- 'True' rock surface exposed
- Ideal for high-resolution imaging

Elemental Topography



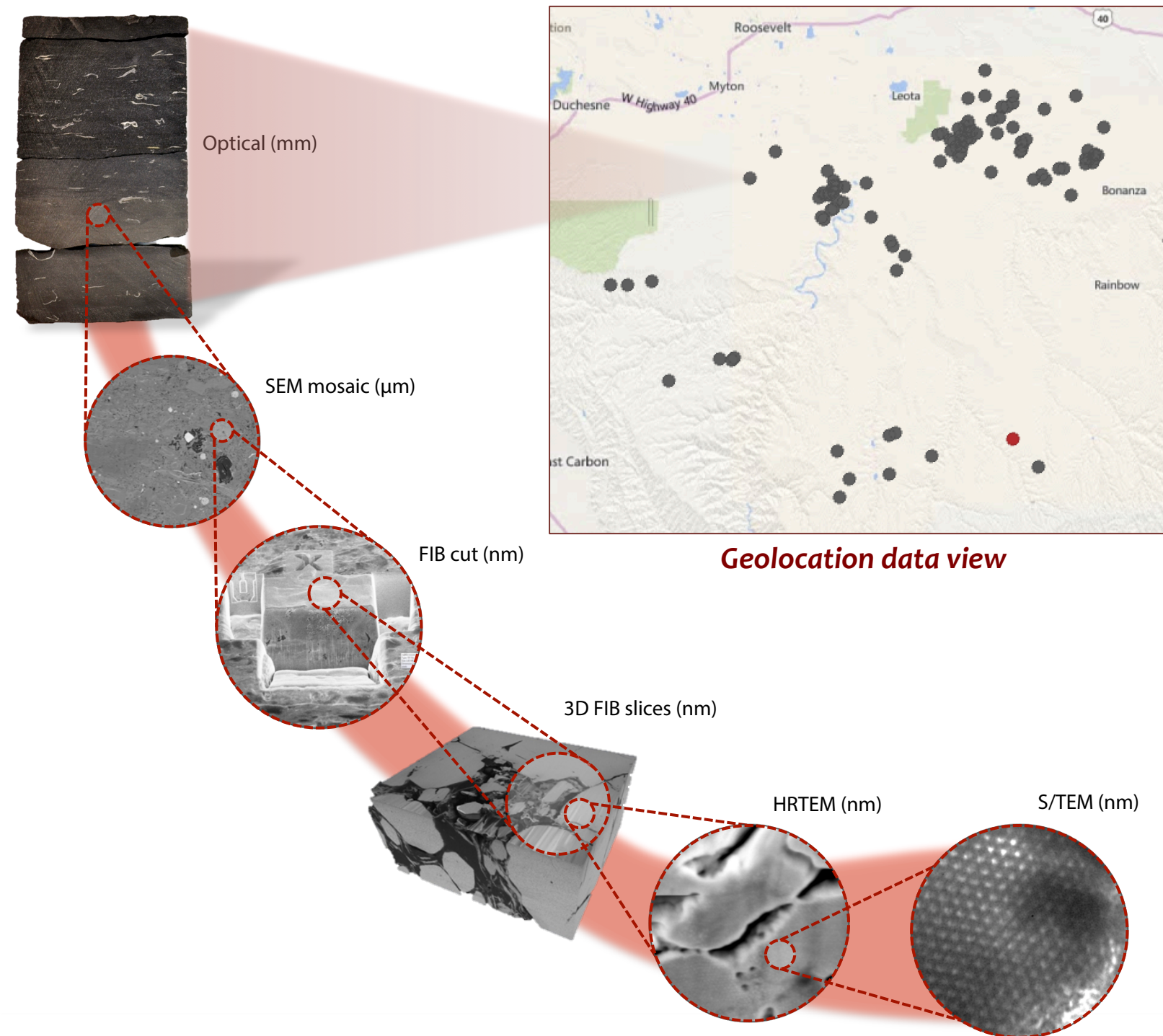
- Textural/fabric analysis
- Porosity analysis
- Microdepositional environment studies

Petrology



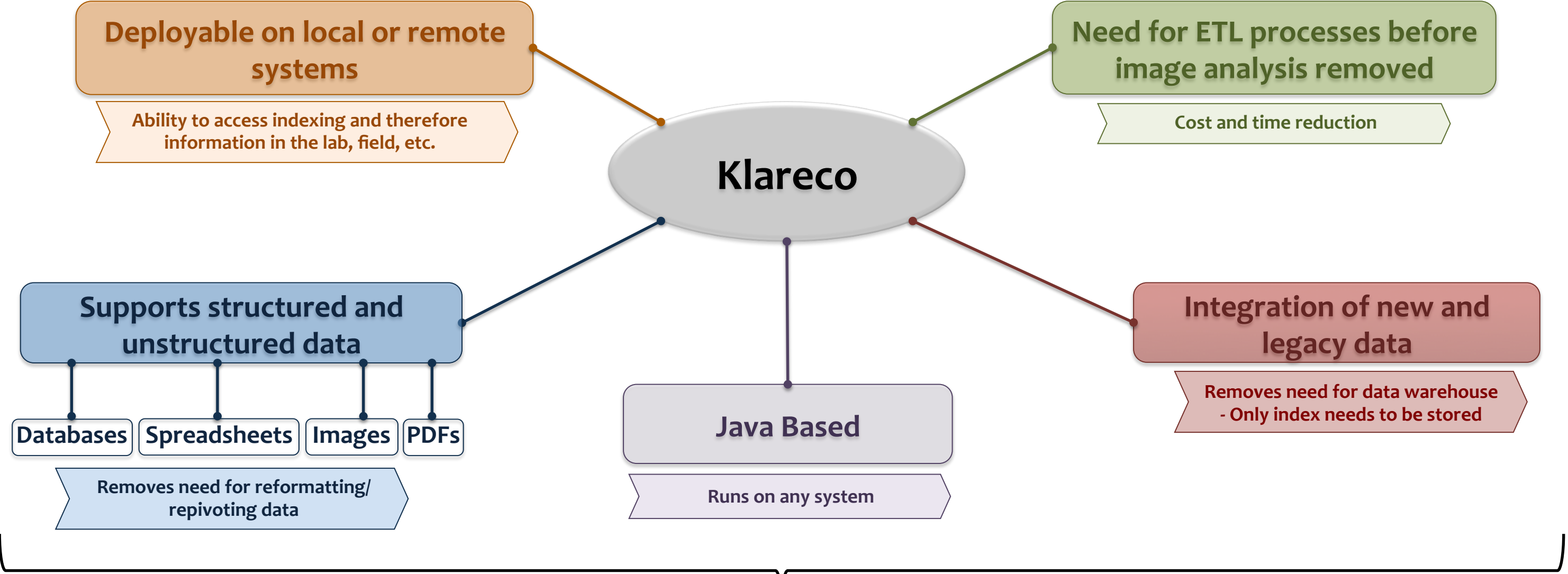
- Mineralogical analysis
- Textural/fabric analysis
- Basic porosity/fracture analysis

Visualization System



- ◆ **Coupled architecture for accessing multiple sources:**
 - ◆ *Legacy and new data integration*
- ◆ **Nano-imaging and metadata is visualized in context with other data sources**

Key Features



Contextual reconciliation of data from nano- to regional- scale data