

KAOLINITE IDENTIFICATION IN ROCKS BY MEANS OF OPTICAL MICROSCOPE, SEM AND MICRO-CT-SCAN

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Physics of Earth and Complex Systems

Introduction:

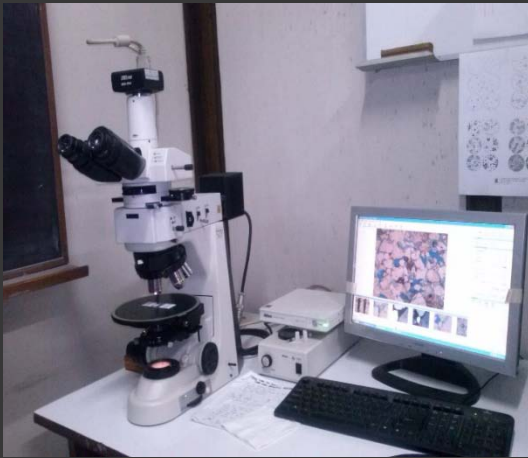
The presences of clay in reservoir rocks have significant influence in determining the physical properties of rocks.

Identification of clay such as kaolinite in rocks will be useful to understand influence of clay on rock permeability and to create suitable model of rock microstructures containing clays.

In this research:

Identification of kaolinite will be conducted by means image analysis techniques using image instruments, i.e.: optical microscope, Scanning Electron Microscope (SEM) and x-ray micro-CT-scan.

Equipments



Optical microscope

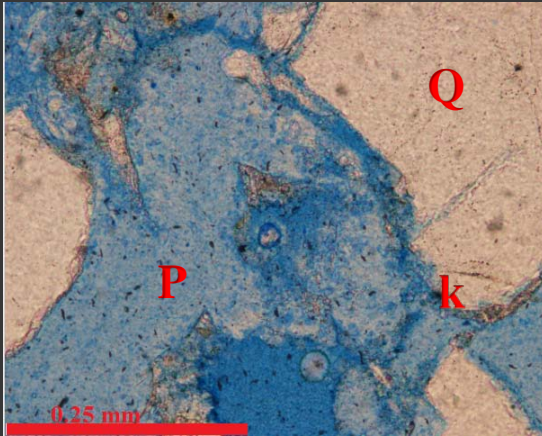


Scanning Electron Microscope (SEM)

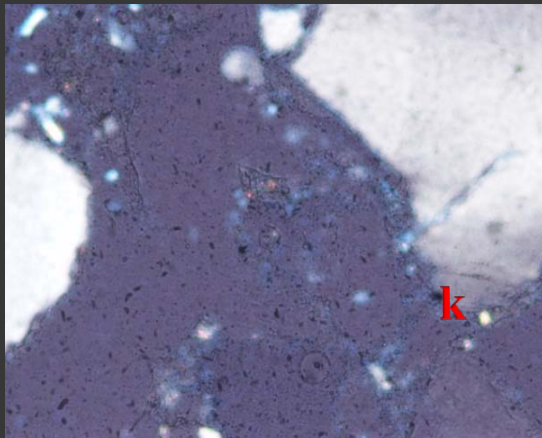


X-ray micro-CT scanner

OPTICAL MICROSCOPE IMAGES



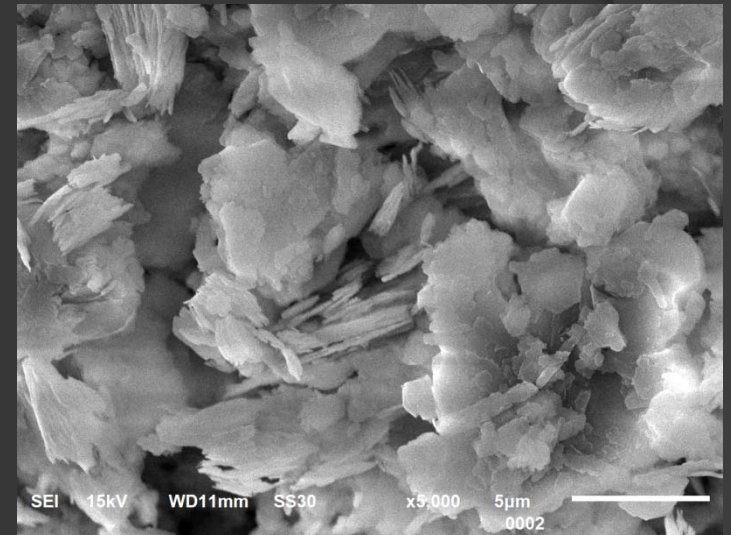
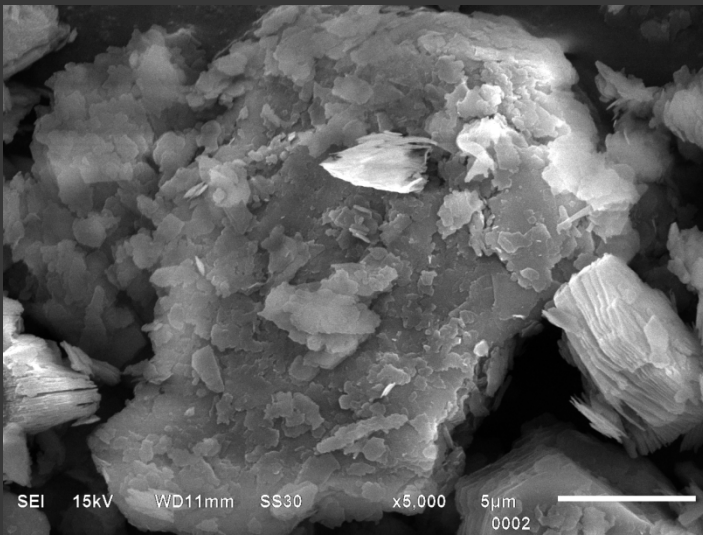
P: Pore space
k: Kaolinite
Q: Quartz



Result:

- 2 Dimensional image
- Shape of clay is not well identified
- Fraction of clay can not be estimated easily

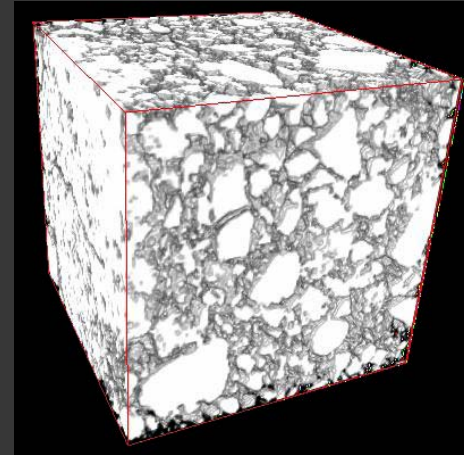
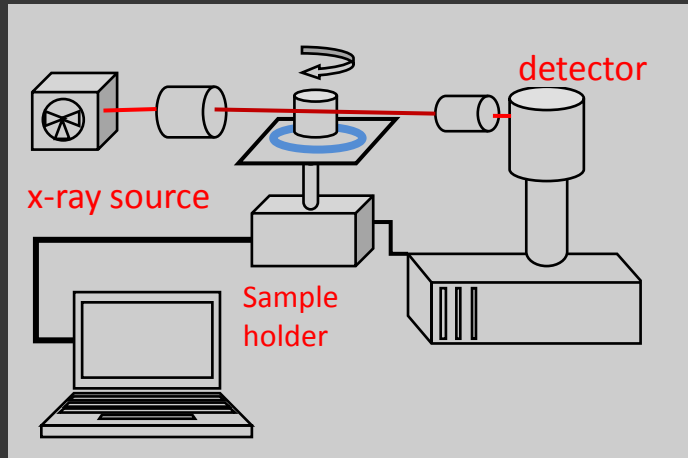
SEM



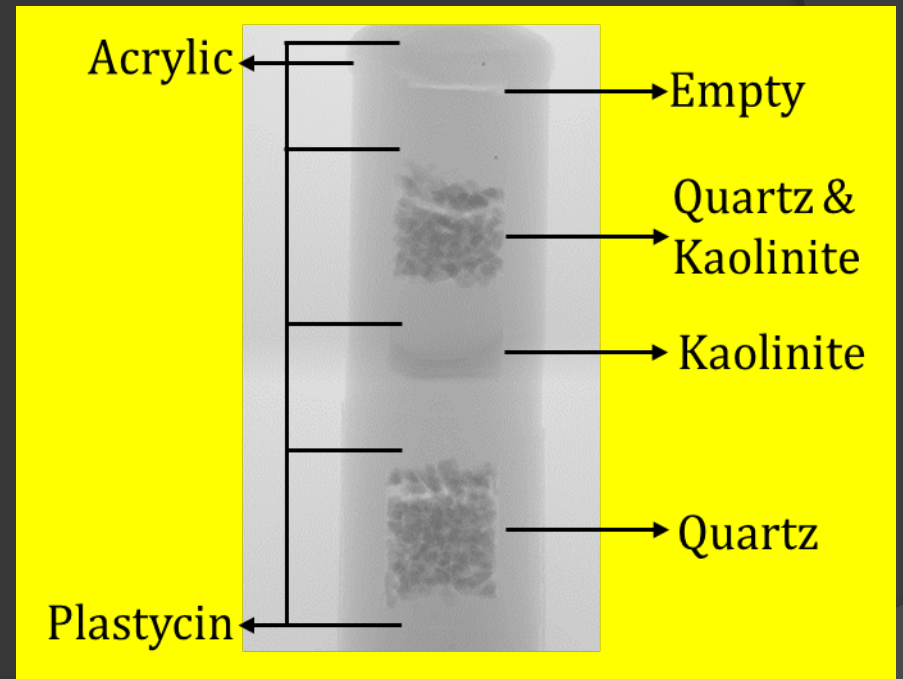
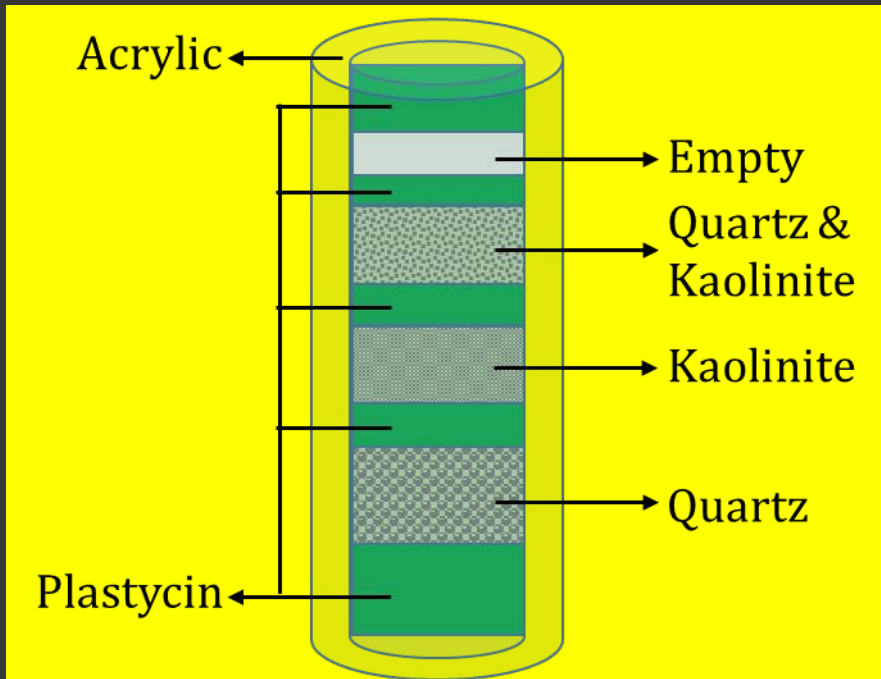
Result:

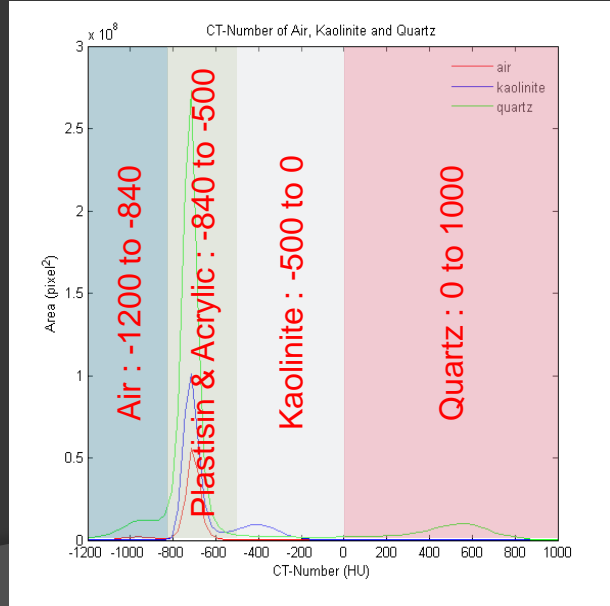
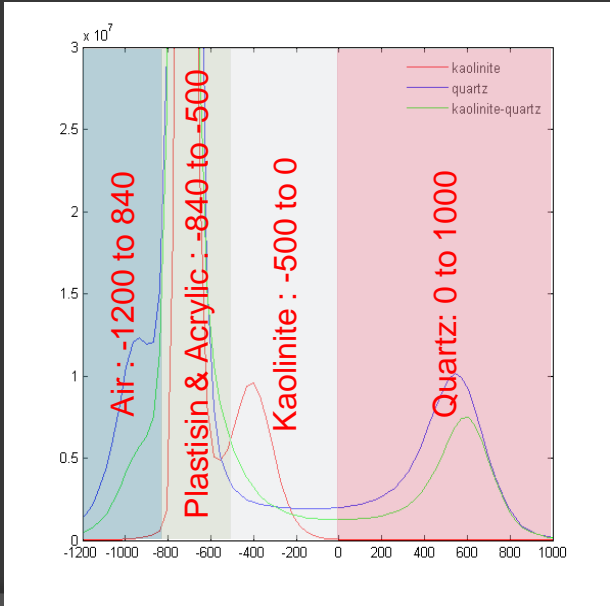
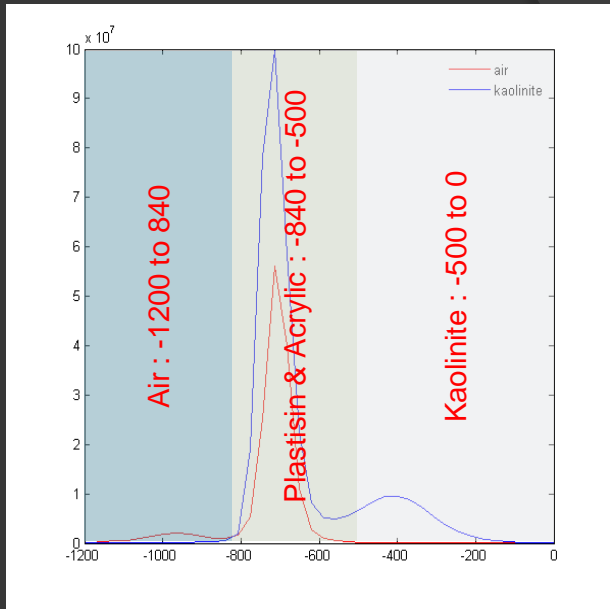
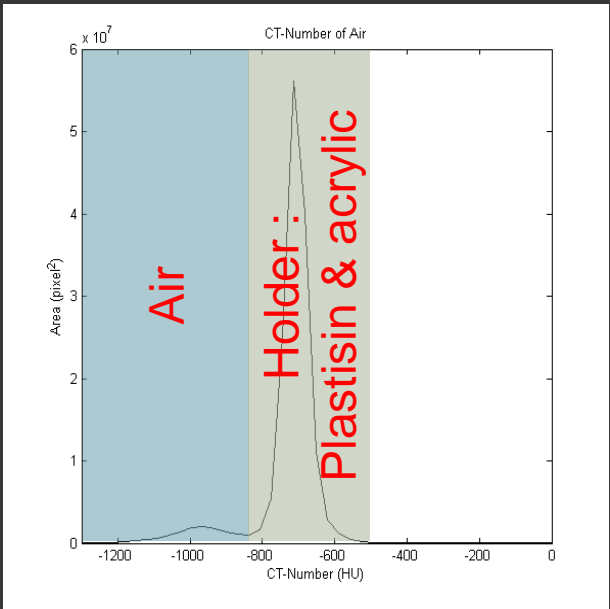
- 2 dimensional image
- shape of clay is well defined
- Fraction of clay can not be estimated easily

X-RAY MICRO - CT SCANNER

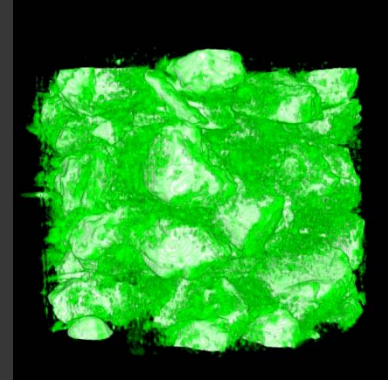
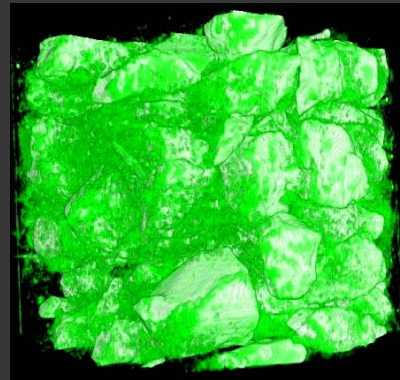
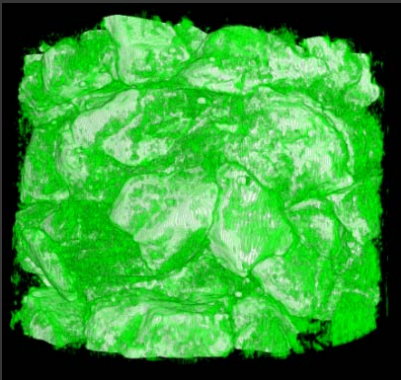
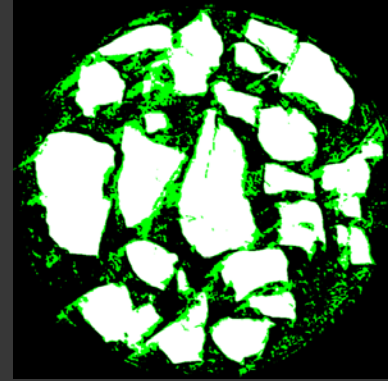
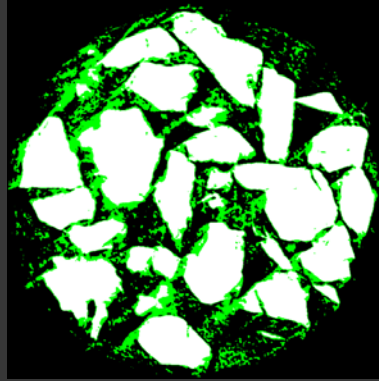
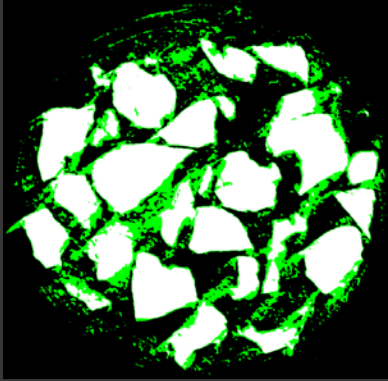


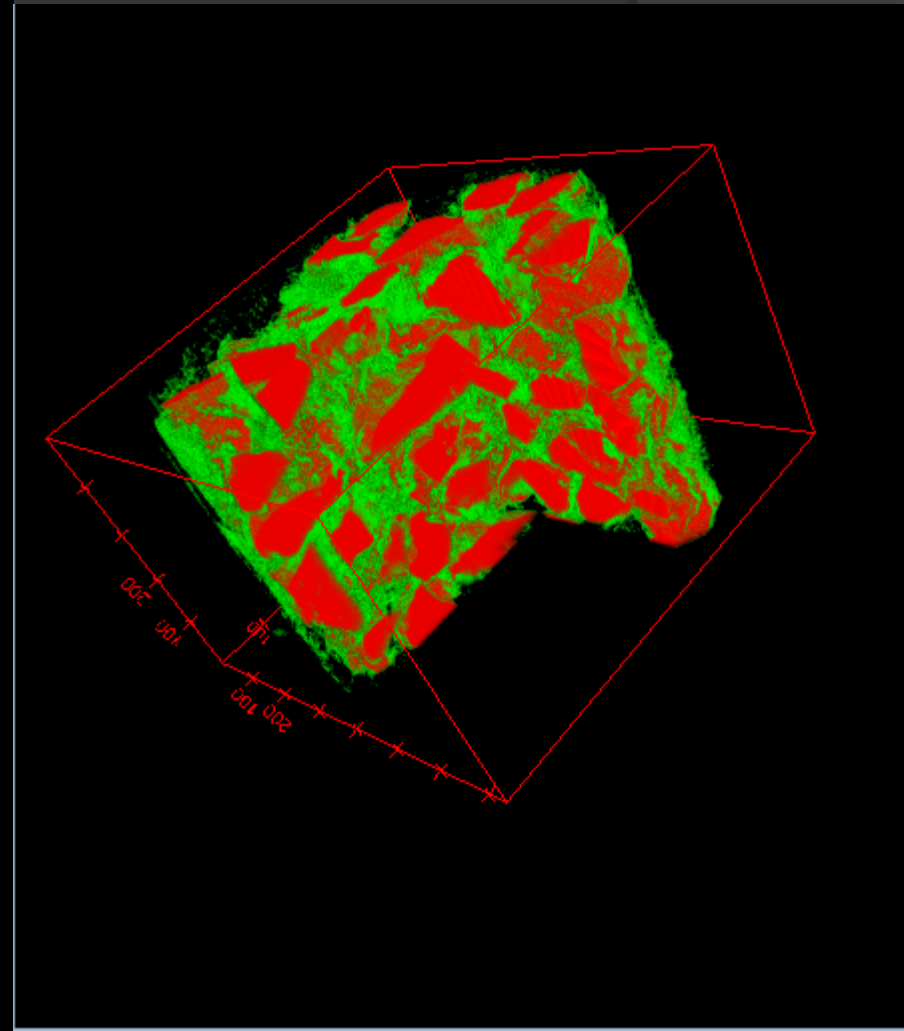
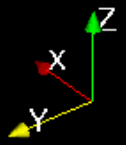
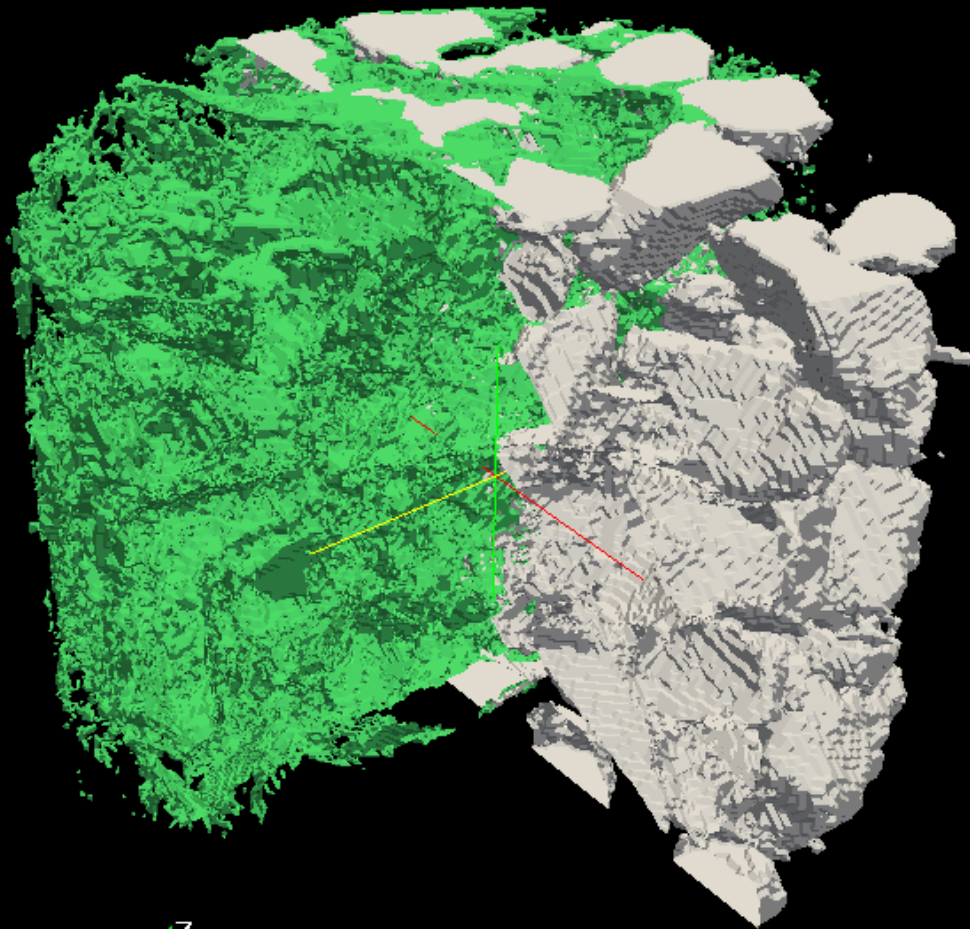
Sample for Micro-CT scan





CT Scan images





Result:

- 3 Dimensional image
- Shape of kaolinite is not too clear, but can be recognized
- Fraction may be estimated quite easily
- Influence of clay on fluid flow may be analyzed

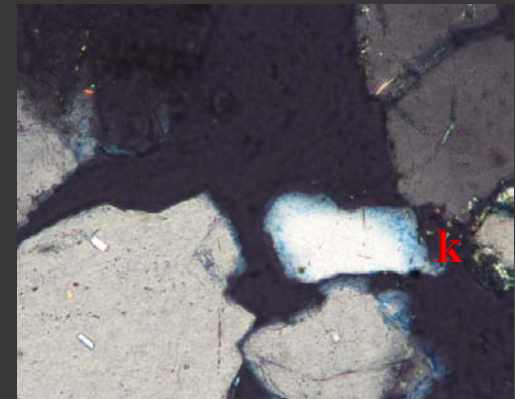
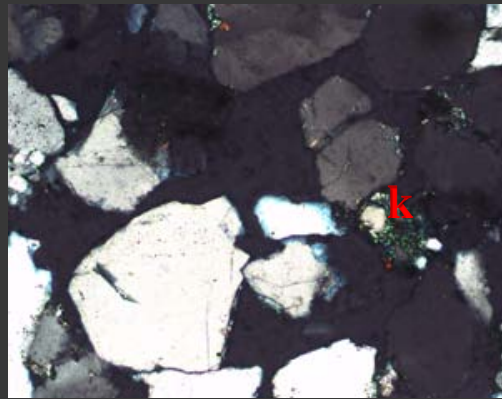
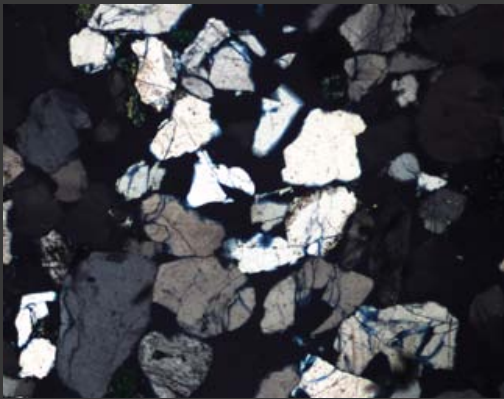
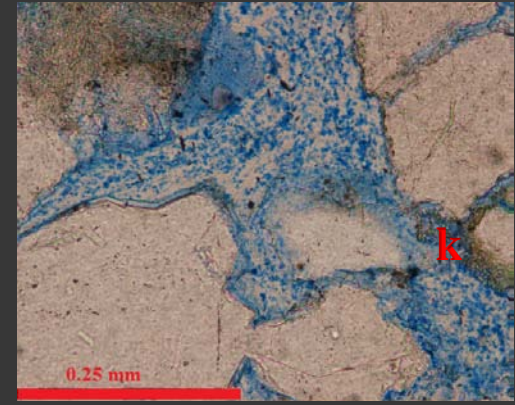
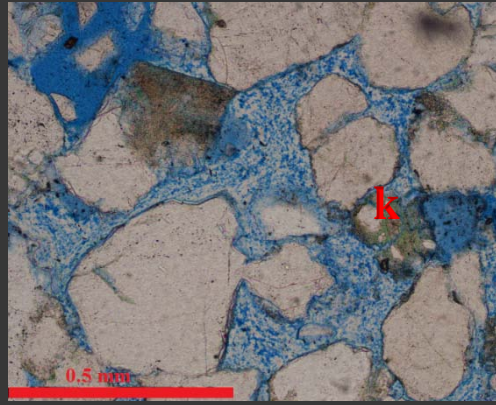
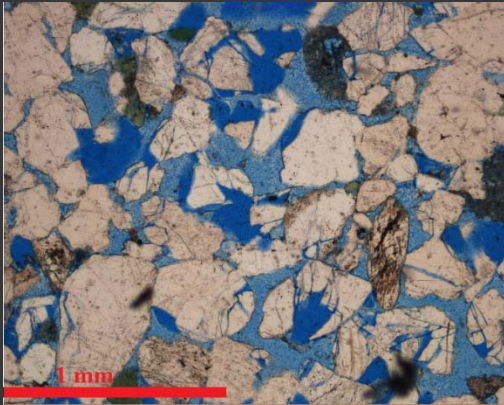
	Quartz	%	Quartz & kaolinite	%
Dimension	1200 x 1200 x 960		1200 x 1200 x 790	
Kaolinite	34.625.758	3.21	37.221.542	4.20
Quartz	135.981.962	12.60	92.855.467	10.45
Others (pore, acrylic, plasticyn)	908.647.855	84.19	758.081.022	85.35
Matrix Volume	1.079.255.575		888.158.031	
Total Volume	1.382.400.000		1.137.600.000	



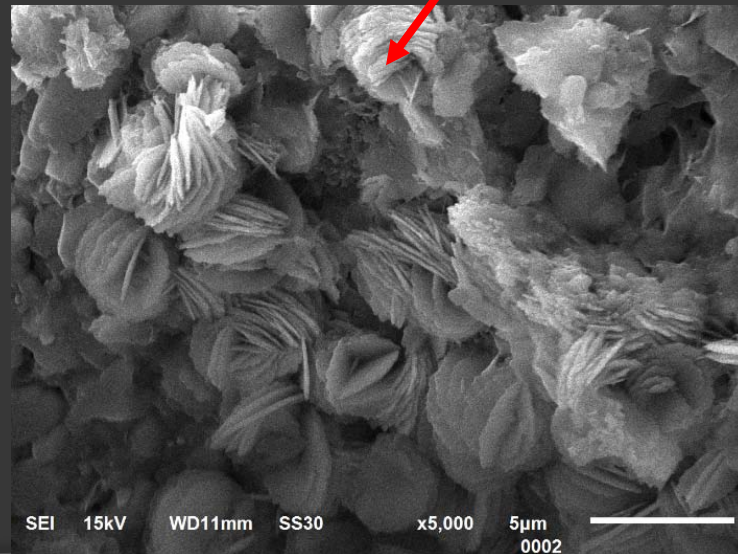
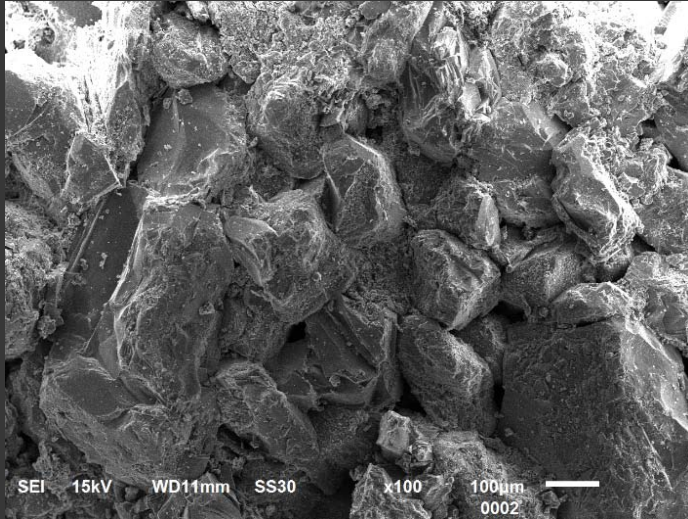
CLAY IDENTIFICATION ON REAL ROCKS

Sumatra sandstone

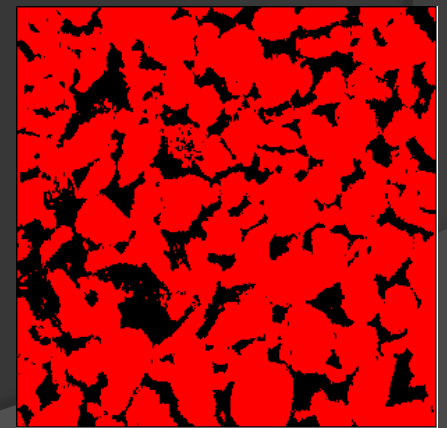
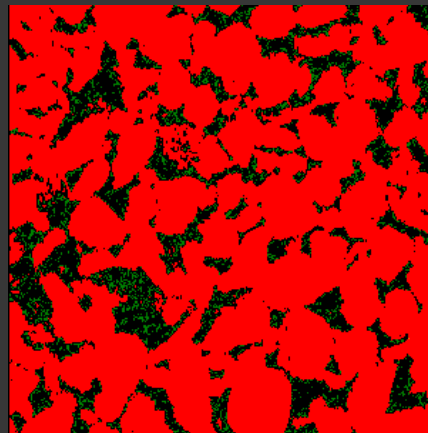
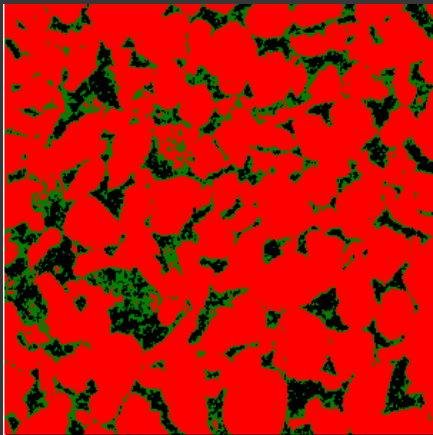
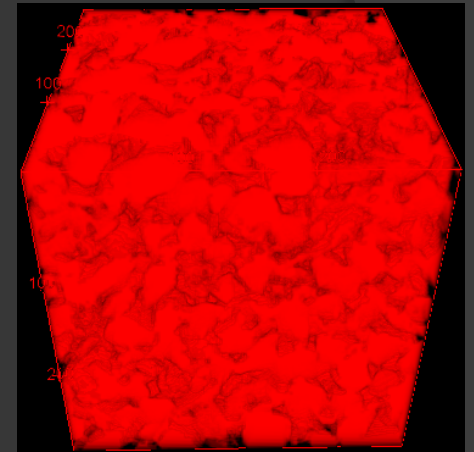
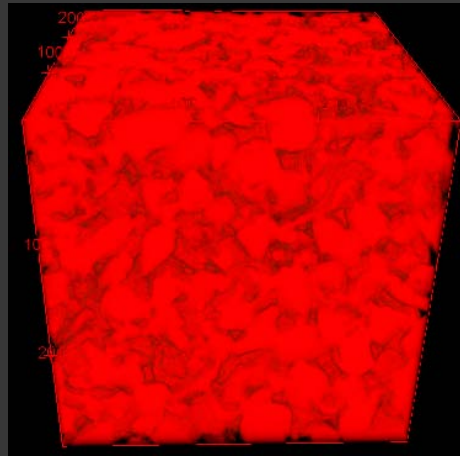
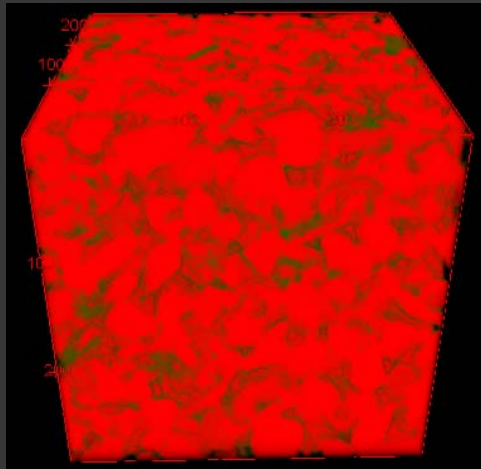
Optical Microscope



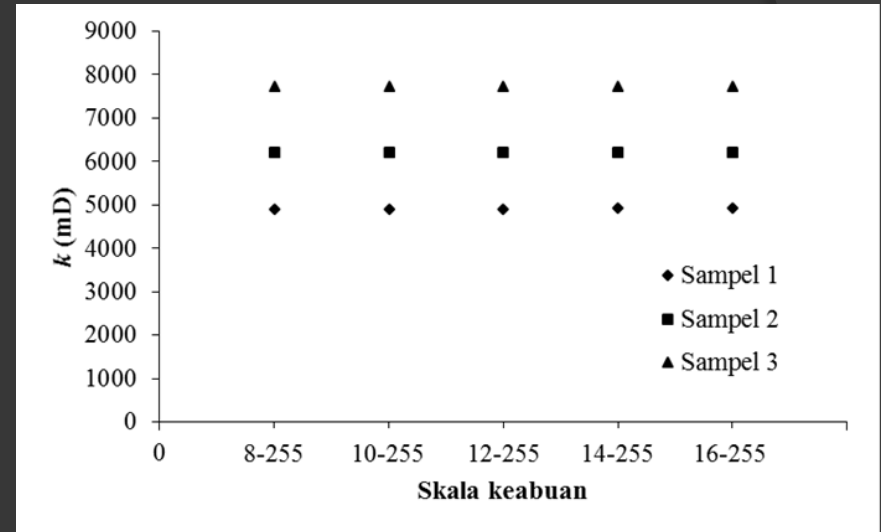
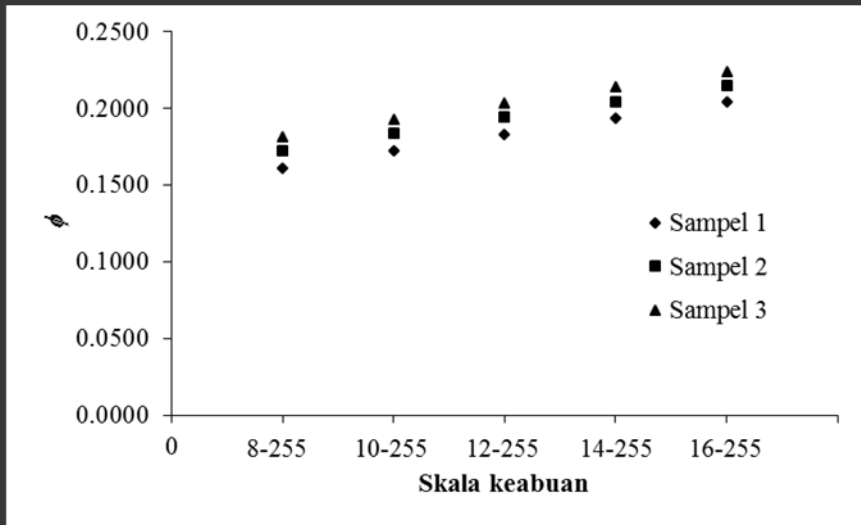
SEM



Micro-CT



Physical Properties



NO	Grey-scale	Porosity		
		1	2	3
1	8-255	16.13%	17.22%	18.13%
2	10-255	17.26%	18.38%	19.30%
3	12-255	18.35%	19.45%	20.38%
4	14-255	19.39%	20.47%	21.41%
5	16-255	20.44%	21.48%	22.42%

NO	Grey-scale	Permeability (mD)		
		1	2	3
1	8-255	4914.79	6206.96	7723.78
2	10-255	4914.80	6206.96	7723.83
3	12-255	4915.12	6207.36	7724.12
4	14-255	4916.38	6209.64	7725.89
5	16-255	4919.27	6213.29	7729.99

Summary and Discussion:

- Shape of kaolinite may be extracted from SEM
- Study influence of kaolinite on permeability may be gained from micro-CT scan