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Update on Smectite-to-Illite Transformation: Laboratory Experiments

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Overview of Activity

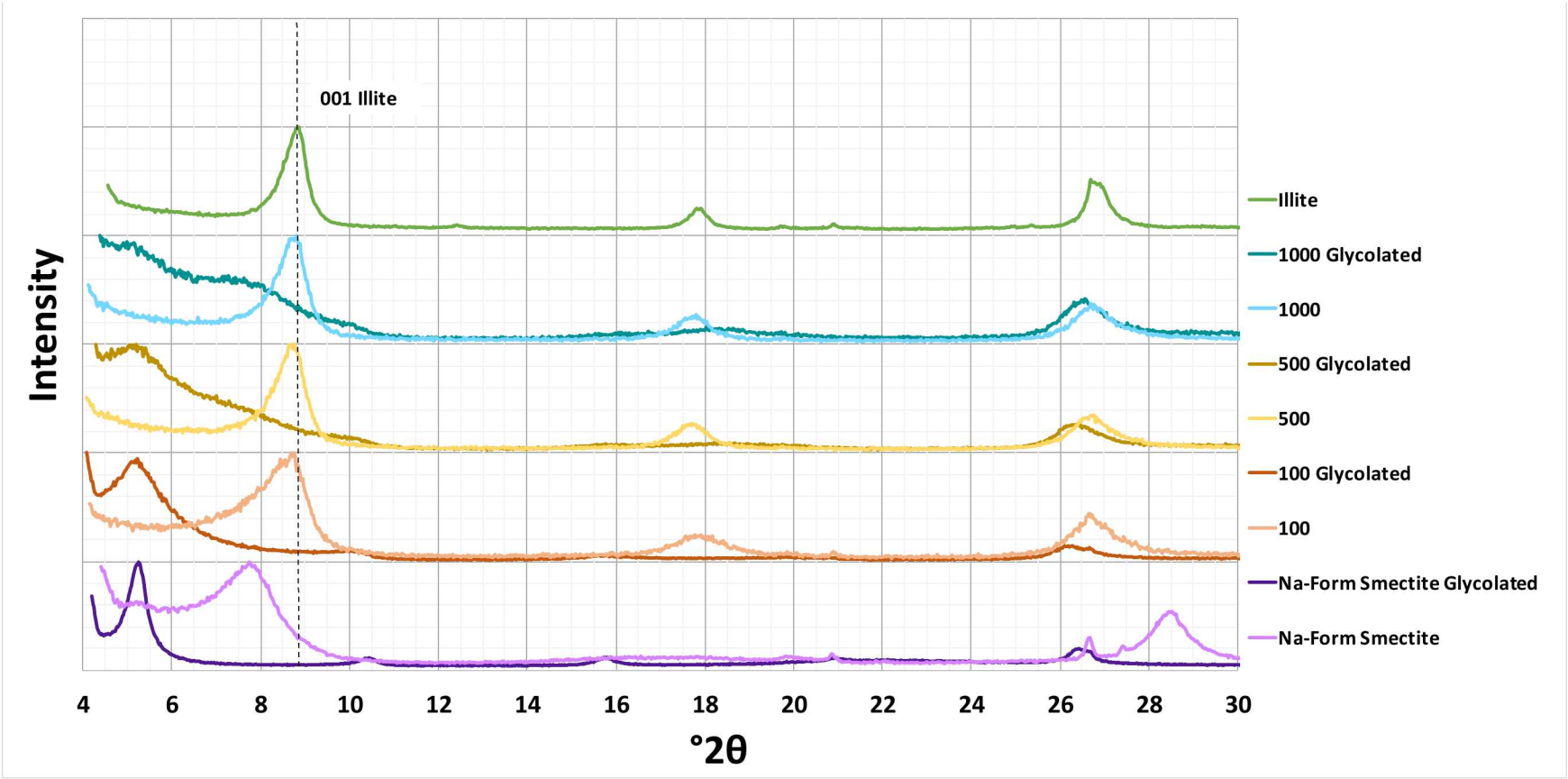
- **Hydrothermal reaction of smectite to illite important for bentonites as a barrier**
- **Understanding the thermal alteration effects is dependent on:**
  - Time
  - Temperature
  - Si and K^+ concentrations
  - Solid to liquid ratio
  - Possibly interlayer cations
- **Typically thought to take a long time for conversion**
- **Conducted laboratory experiments for diagenetic reactions in Parr Vessel reactors at 200°C for 1 week with variable loadings and exchanged cations (K, Cs, NH_4)**

Analysis Techniques

- XRD for basal spacing
- Cation exchange capacity (CEC)
- Recorded mass loss data and pH of reacted solutions
- Surface area by BET nitrogen adsorption
- Analysis of solutions after reaction by IC, ICP-MS, and ICP-OES
  - Determine dissolved ions
- Particle size by Malvern Zetasizer
- SEM-EDS for morphology and compositional mapping
- XRF for composition

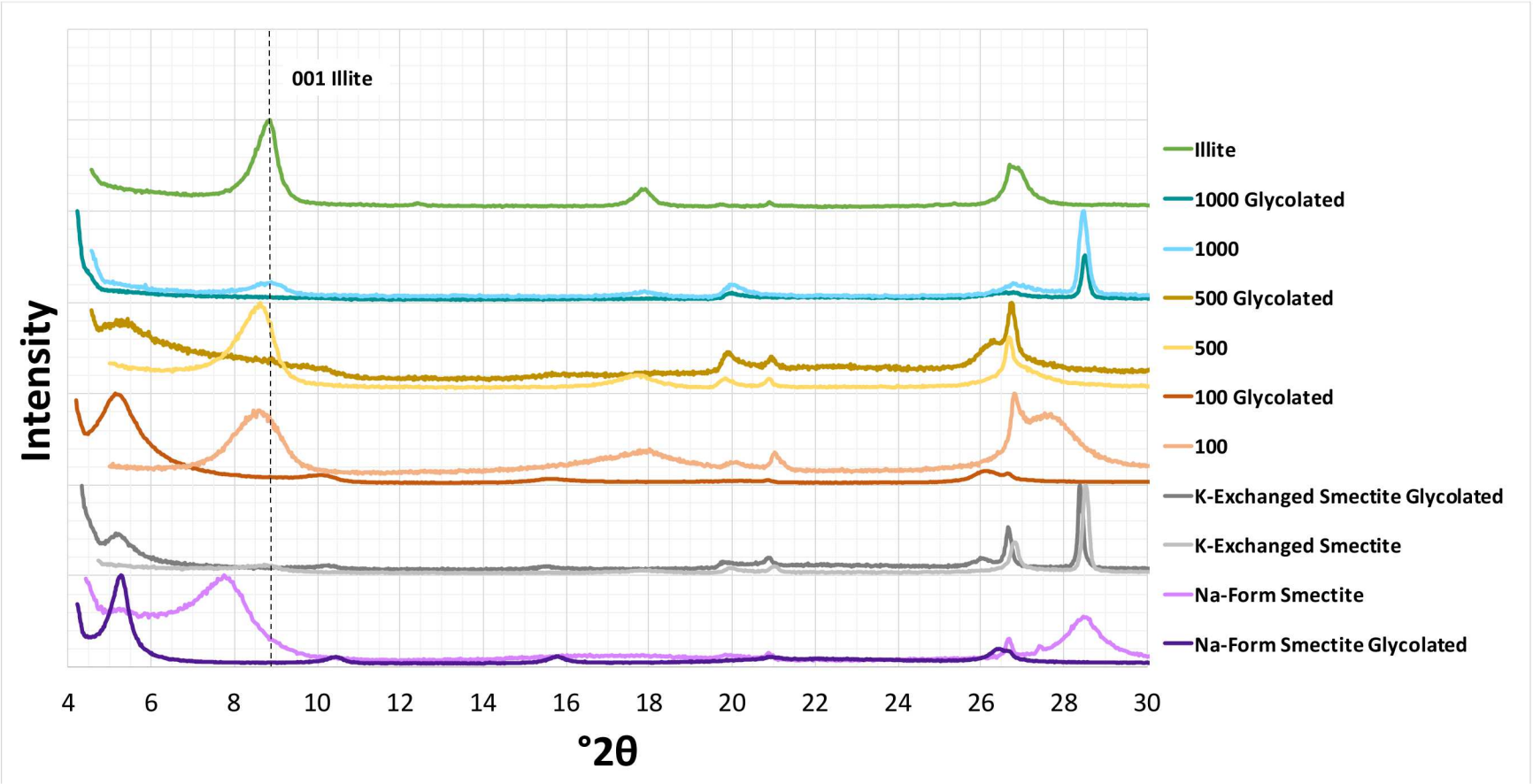
Results: XRD

Na-Form Smectite

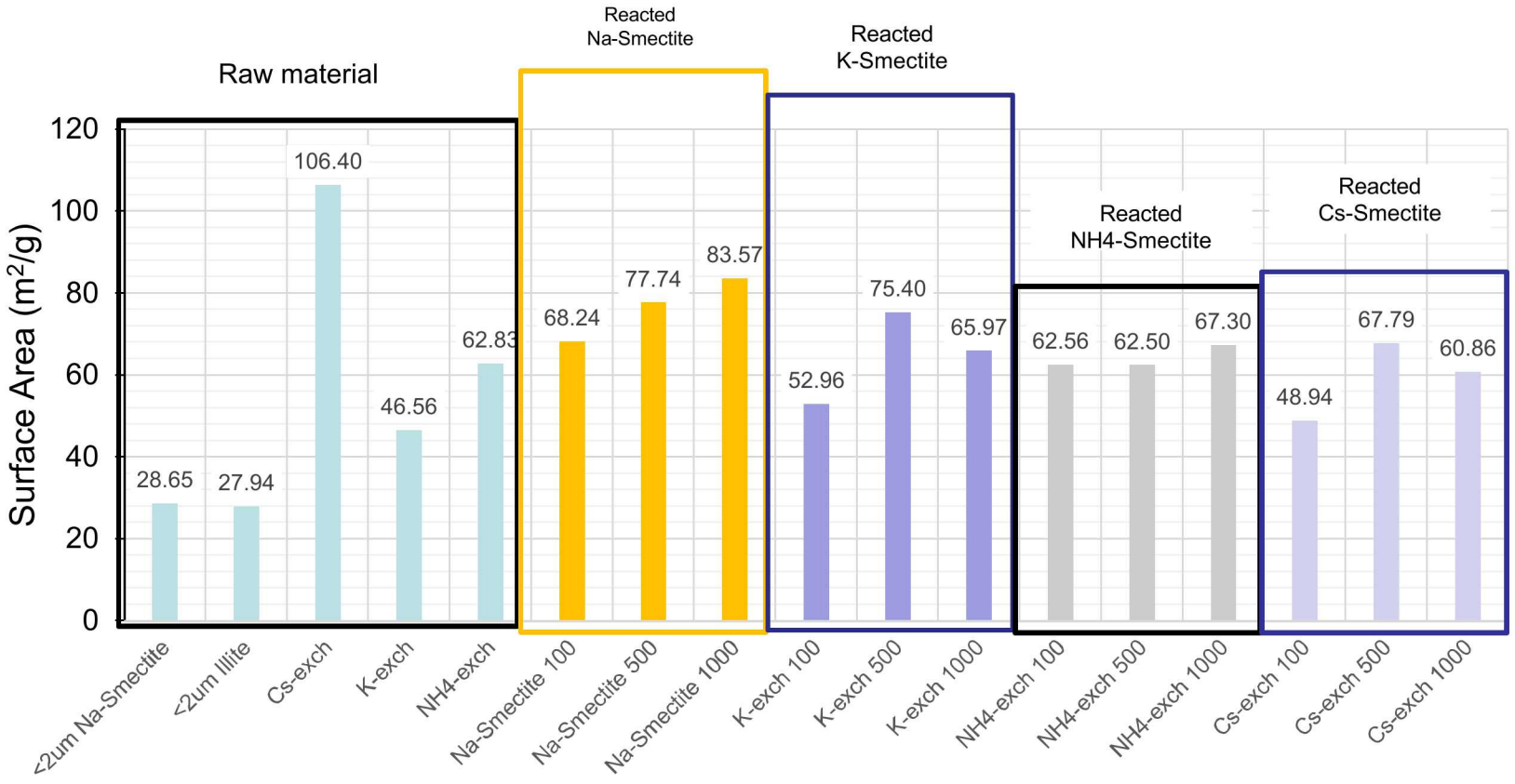


Results: XRD Continued

K-Form Smectite



Results: Surface Area

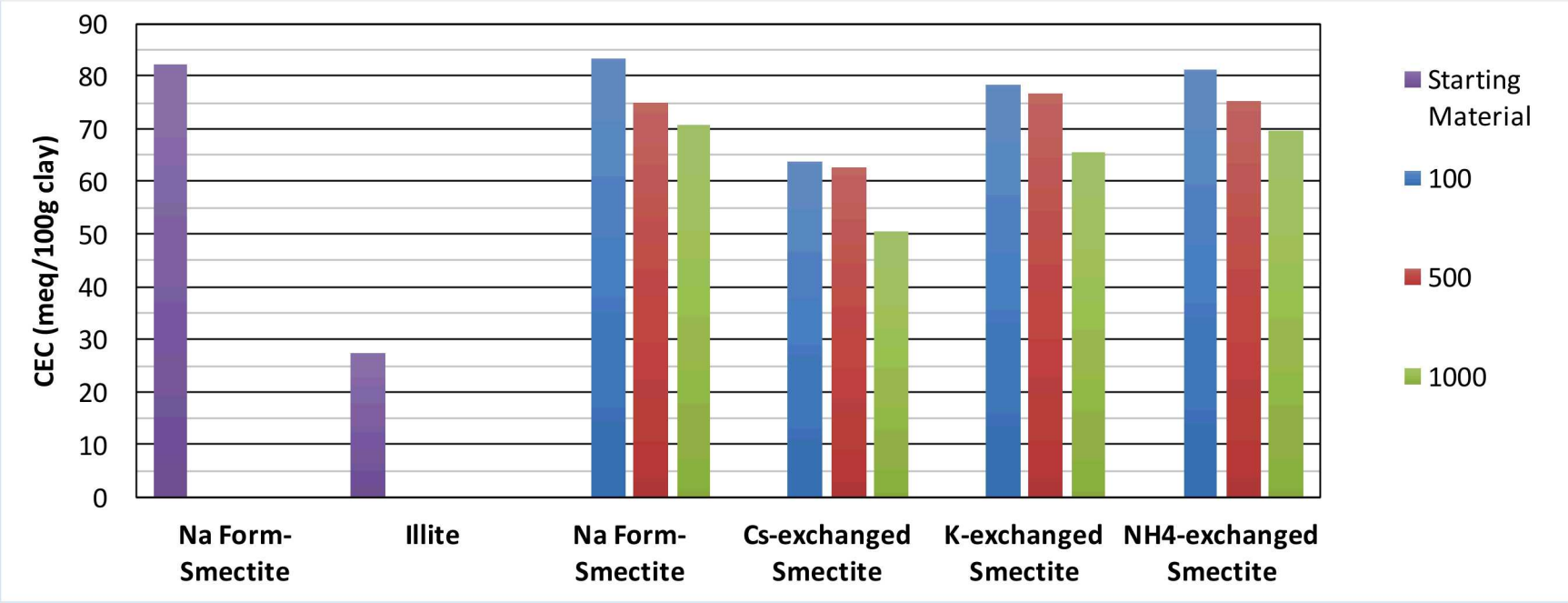


Future R&D

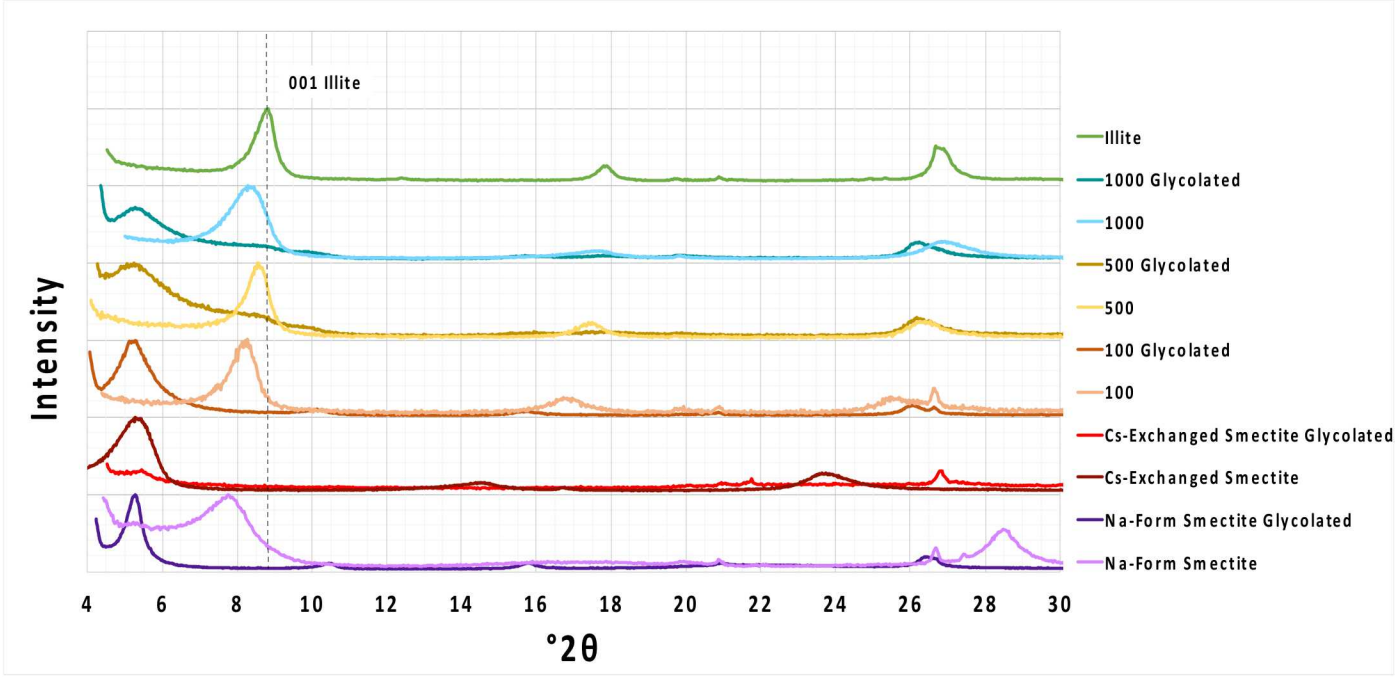
- Perform additional characterization techniques
- Investigate behavior of iron in reaction
- Addition of mica to possibly escalate conversion
- Addition of quartz to inhibit conversion

Additional Slides

Results: CEC

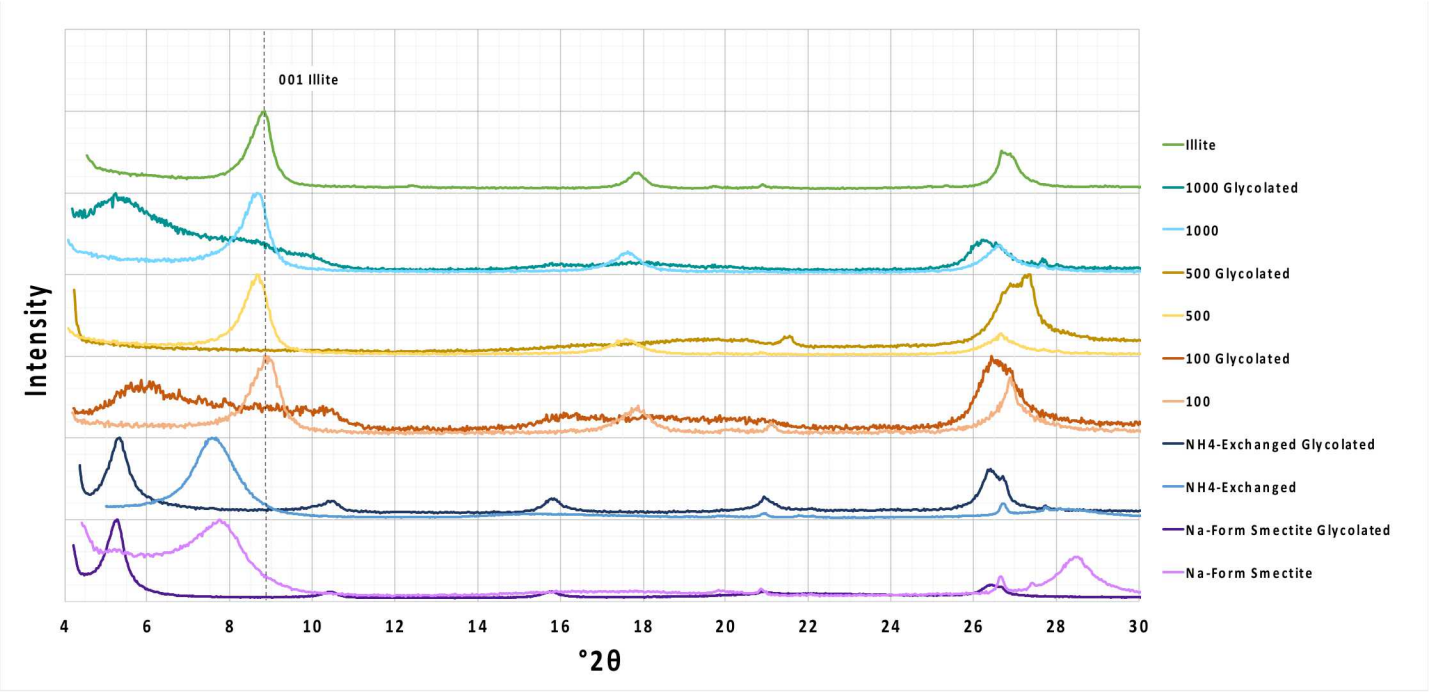

CEC (meq/100g clay)
90
80
70
60
50
40
30
20
10
0
Na Form-Smectite
Illite
Na Form-Smectite
Cs-exchanged Smectite
K-exchanged Smectite
NH4-exchanged Smectite
Starting Material
100
500
1000

Results: XRD



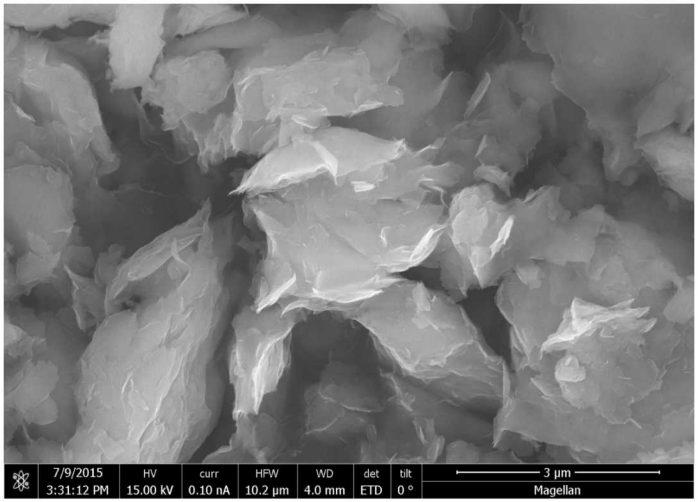
Cs-Exchanged Smectite

Results: XRD

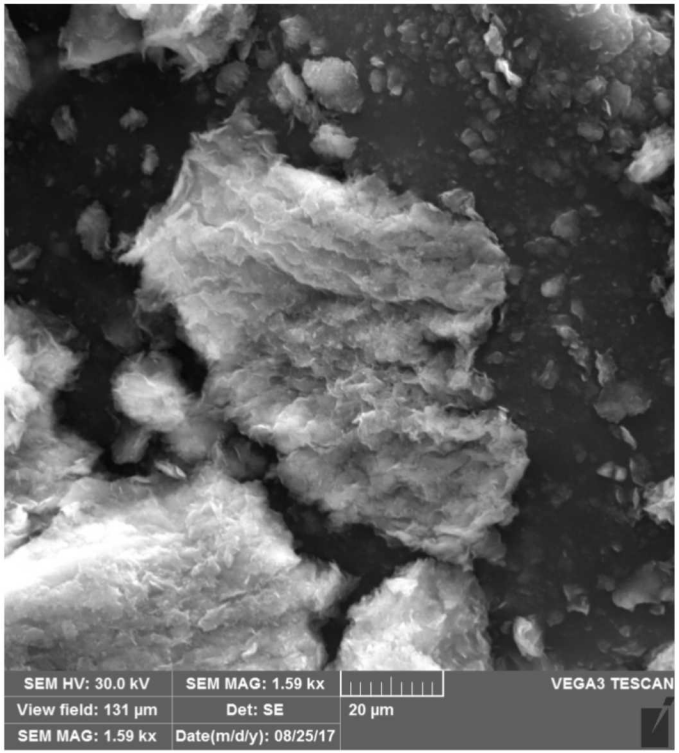


NH_4-Exchanged Smectite

Results: SEM



Cs-Exchanged Smectite



Cs-Exchanged Smectite:
1000 liquid/solid ratio

Results: Mass Loss and pH