

Exceptional service in the national interest



X-Ray Diffraction Analysis of Hydrothermally Altered Montmorillonite Clay

Clay Payne

University of New Mexico

Anticipated Degree: Chemical Engineering

Supervised by

Yifeng Wang

Org 6222: Nuclear Waste Research and Disposal

6220/6230 summer student mini-symposium
August, 16th 2016, Sandia Nat'l Labs, Albuquerque NM

Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.



Outline

- Introduction and Motivation
- Methodology
- Results and Discussion
- Conclusion and Future Work

- **Experimental Interests:**

- Evaluating possible interaction between cesium and montmorillonite will provide fundamental understanding of cesium uptake and/or retention in montmorillonite backfill if a release is to occur
- Understanding the solution chemistry properties pertaining to illitization and other mineral reactions will provide reaction dynamics that can potentially provide kinetic data for important reactions

- **Applications:**

- Radioactive Cesium in waste forms proposed for deep borehole disposal
- Reaction Kinetics for Cs-illitization could provide information on long-term predictions of Cs waste isolation

• Hydrothermal Preparation:

- Cationic exchanges were performed on size separated montmorillonite using 1M CsCl and 1M KCl
- Suspensions (10:1 water:solid ratio) in teflon-lined parr reaction vessels were heated up to $\sim 175^{\circ}\text{C}$ under hydrostatic pressures.
- The reaction vessels were sampled 3 times (0 day, 2 week, 2 month)

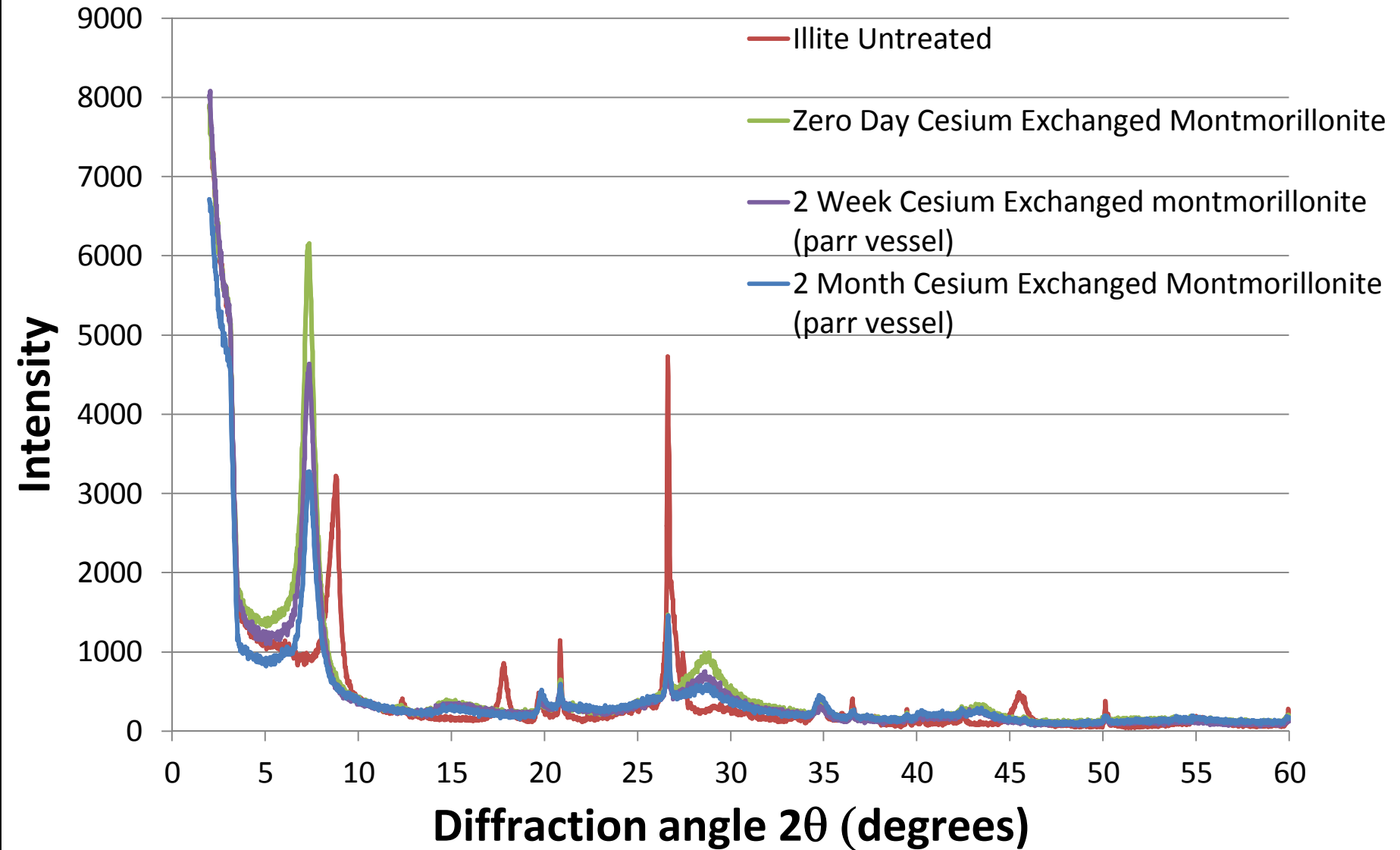


• X-Ray Diffraction Analyses:

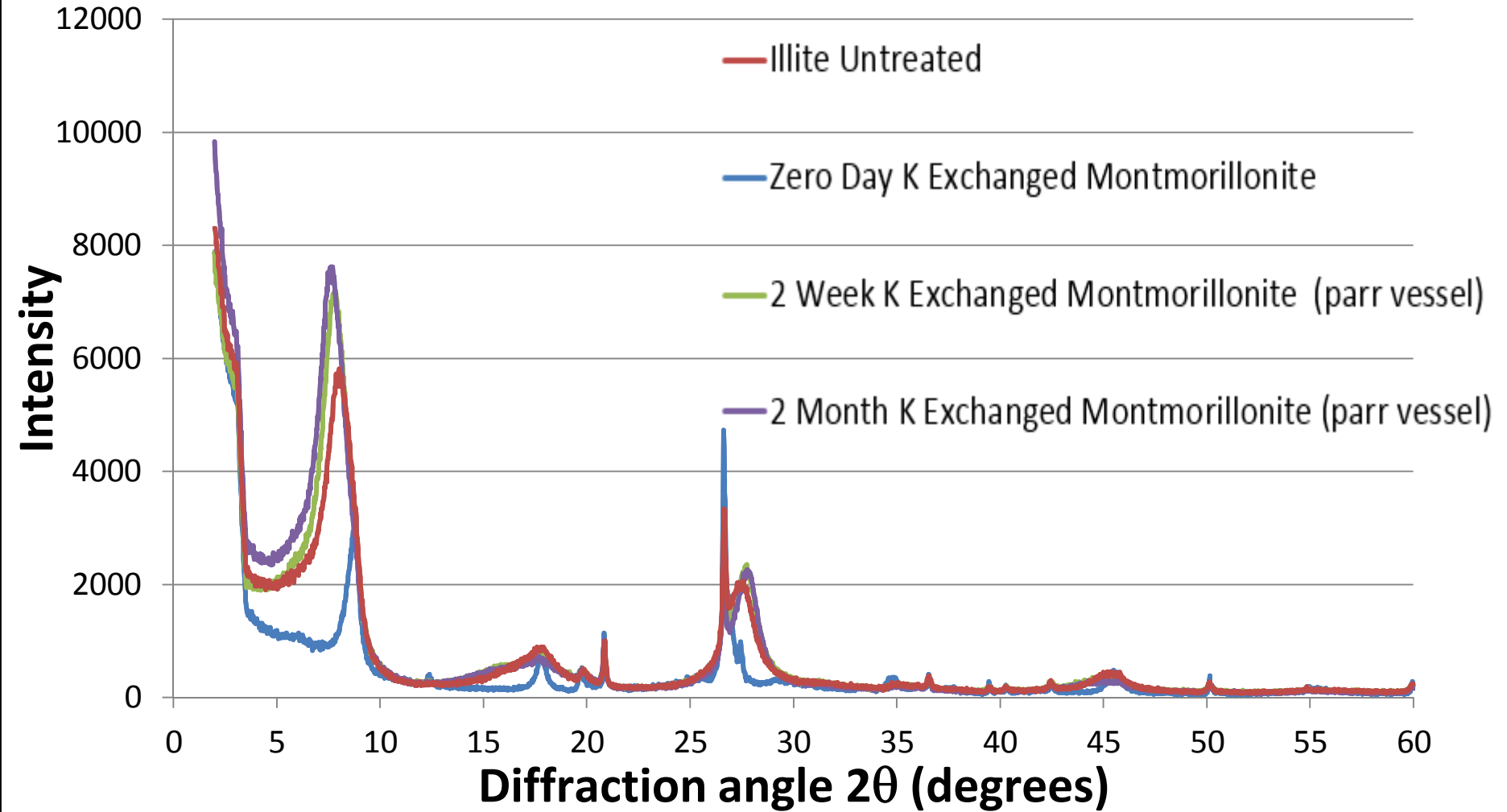
- Solids were then deposited onto a zero-background substrate for XRD analyses
- Oriented mounts were analyzed under air dried and ethylene glycol saturated conditions using X-Ray Diffraction



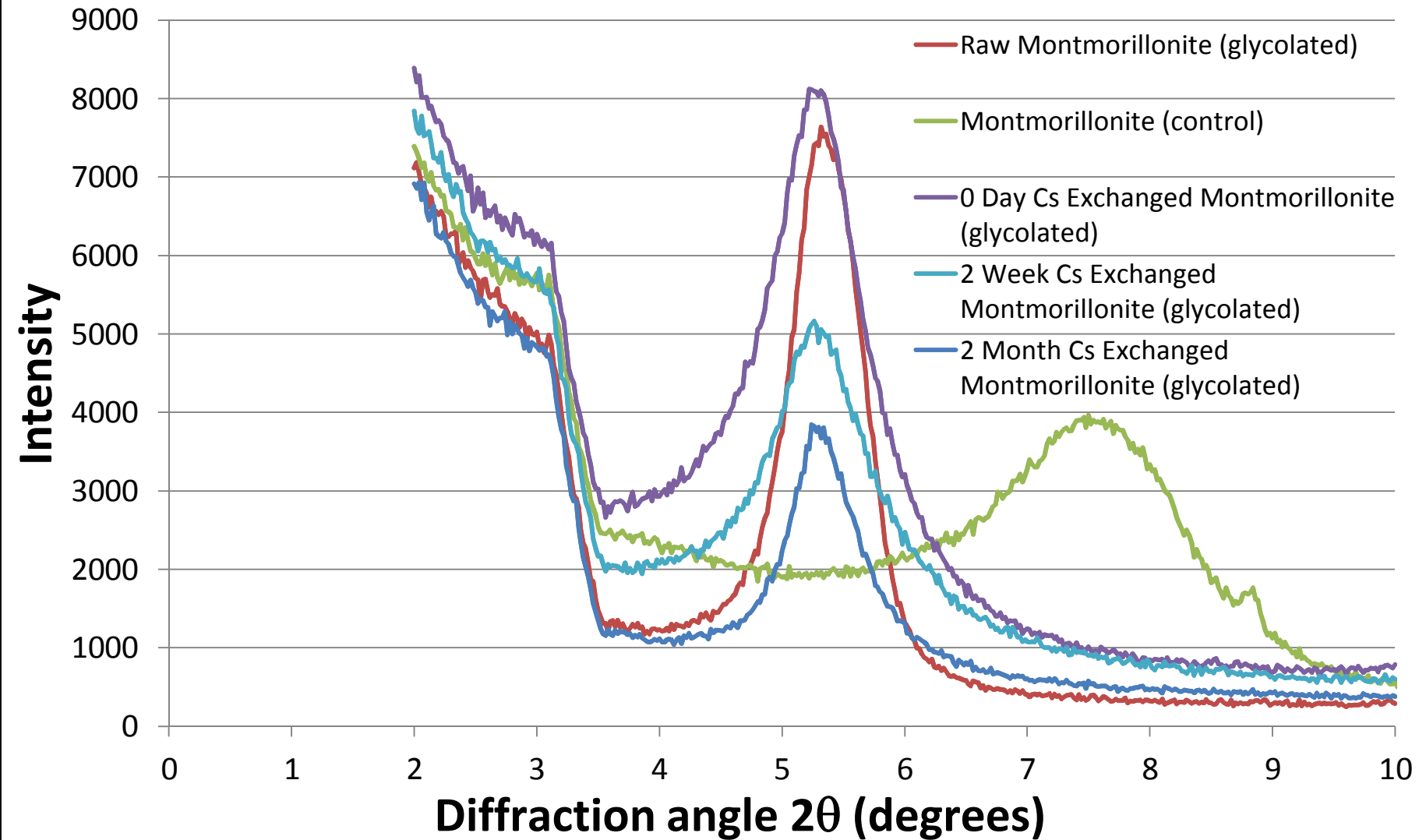
Results and discussion



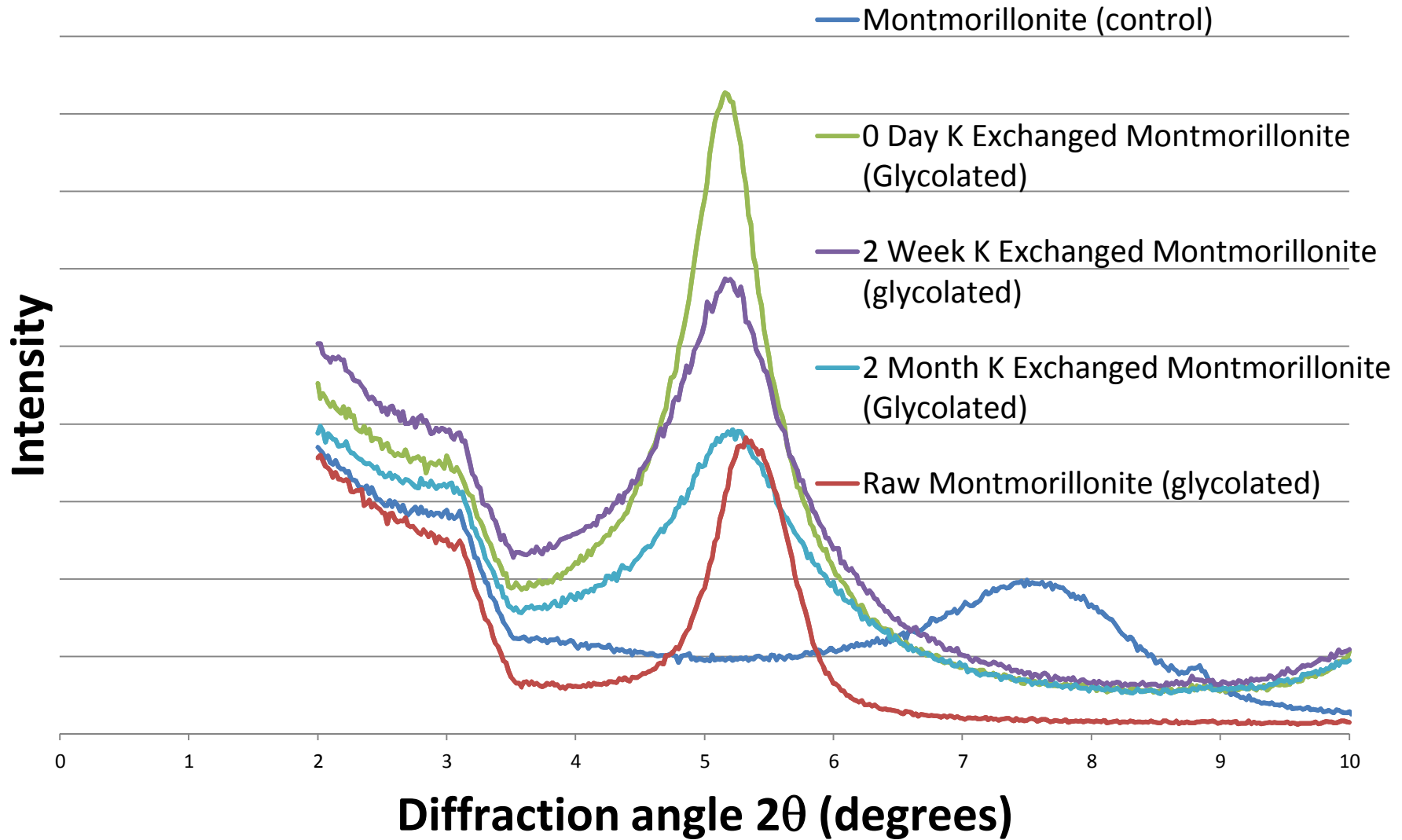
Results and discussion



Results and discussion



Results and discussion



- **Findings-**

- Hydrothermally altered montmorillonite demonstrated incomplete illitization during the Glycolation experiments

- **Future Work-**

- Illite-smectite composition and ordering will be determined via $\Delta^{\circ} 2\Theta$ methods (Środoń 1980; Eberl et al. 1993; Moore and Reynolds 1997).
- Cation exchange capacity (CEC) determinations will follow methods described by Busenberg and Clemency (1973). Using an ammonia ion selective electrode.

Personal: Clay Payne

- Declared Major: Chemical Process Engineer
- Interned with org 6222 for two years
- Career/School Plans:
 - Graduate from UNM in the fall
 - Attend UNM for graduate school as a part of the dual credit program
 - Start a research career in alternative energy