JUSTIN PATTERSON

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EDUCATION

B.S. in Energy Engineering, GPA: 3.58, Northern Arizona University **Expected May 2026**

SKILLS

ANSYS Discovery + Fluent, MATLAB, Simscale, Onshape, SolidWorks, X-Ray Diffractometer Operation, SmartLab II Studio Powder XRD Software, SEM/TEM Microscopy Analysis, Microsoft Office Tools

EXPERIENCE

Research Assistant – Climate Solutions Engineering Lab **March 2025 – May 2026**

- Operated a high intensity reactor (185 °C, 1100 psi) to mineralize CO_2 using mafic/ultramafic rocks, producing Mg-Fe carbonates ($MgFeCO_3$) for permanent CO_2 storage
- Ran experiments spanning 48-96 hours, using monitoring software to hold setpoints, log process data, and ensure safety during the reaction
- Prepared samples and operated X-ray Diffractometer to collect sample composition data
- Calculated sample composition with uncertainty/error analyses in Excel based on Rigaku SmartLab Powder XRD software tolerances and machine measurement tolerances
- Analyzed SEM/TEM images + quantitative elemental analysis data to create presentations with findings
- Created and presented a research poster at the ASU CNCE Carbon Management Symposium 2025
- Developed publication-ready MATLAB figures that visualize sample reactivity and composition to compare Mg/Fe ratios, rock type, and CO_2 wt%; co-authored “An inventory of rock resources for carbon mineralization”: International Journal of Greenhouse Gas Control, Dec. 2025
- Currently using MATLAB to model reaction kinetics inside of a DAC reactor to calculate values such as CO_2 productivity, electricity used, and H_2O processed/lost to be optimized in the near future

PROJECTS

Capstone Project – Direct Air Capture (DAC) CO_2 Reactor **August 2025 – May 2026**

Project Website Link

- Leading a team of four in designing and constructing a vacuum moisture-swing CO_2 direct air capture reactor
- Managing a $50,000 budget given by Salt River Project for a wide range of DAC research possibilities
- Developed detailed system schematics and valve-state diagrams for process control and operational safety
- Calculated specifications for reactor subsystems, communicated with manufacturers, and assembled a BOM
- Integrating PLC-controlled sensors for temperature, pressure, and gas concentration monitoring
- 3D-printing and optimizing sorbent bed geometries for improved surface area and promote laminar flow
- Utilizing ANSYS simulations to model pressure-drops across the experimental charcoal-based geometries
- Selecting commercial vacuum fittings, piping and the ability to compress into canisters for future scalability
- Implementing water vapor condensation to recover liquid water; increasing reactor sustainability
- Coordinating system assembly, testing, and performance optimization to maximize CO_2 extraction