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A Review of My Work in High Temperature Engineered Barrier Systems and the Importance of Mentoring Female Scientists in the Geosciences

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Retired

The US Department of Energy (DOE) manages nuclear waste created by civilian nuclear power. Since 2012 our research group at Los Alamos has conducted systematic long term research program using rocking autoclaves to investigate evolution of the mineralogy and geochemistry of EBS bentonite clay at predicted repository temperatures and pressures (300-250-200°C, 150 bar). In 2018, the Spent Fuel and Waste Disposition (SWFD) campaign, which emphasized dual purpose canisters (DPC**)** and high temperature studies related to these larger waste packages began. This included interaction with repository wall rocks, simulated groundwater, canister outer skins and cement liners. Wyoming bentonite has been used in all experiments as the buffer material. We chose Grimsel granodiorite for a crystalline wall rock, and Opalinus Clay as the argillite wall rock, both for the availability of material and long term research by the Swiss repository agency (NAGRA). Canister materials investigated included stainless and carbon steels, along with copper overcoats. Recently, cements such as ordinary Portland cement and low pH cured cements have been added to the reactant mix.

A summary of the experimental results will be discussed. Observations of note include 1) lack of illite generation in the majority of experiments due to bulk system chemistry, 2) transformation of precursor clinoptilolite to analcime at the highest temperatures, 3) creation of abundant analcime and CASH minerals in the presence of cement reactants, and 4) growth of Fe smectite / chlorite at the steel bentonite interface. The results were used to inform modeling efforts on the long-term function of deep geological repositories for nuclear waste.

From 2015-2024 I had the opportunity to hire both students and post docs to work in my experimental lab in various capacities. With only one exception, the top couple candidates were always females. Therefore, over time I hired two post docs and four students, all women. Further, everyone on the team had a voice at the table, whether designing experiments, upgrading SOPs, or deriving conclusions for reports. Each one came on board knowing that they were changing disciplines, yet all of them excelled in both the laboratory and research on heated clay diagenesis.