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Monitoring and Repair of Damaged Cement-Geomaterial Interfaces in High Pressure, High Temperature Repository and Borehole Scenarios (17-0814)

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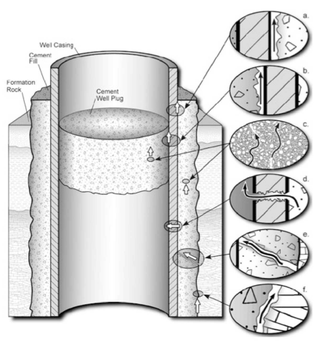
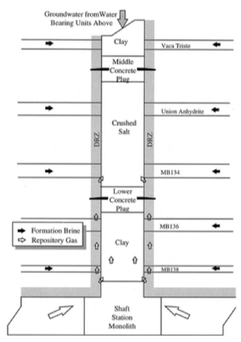
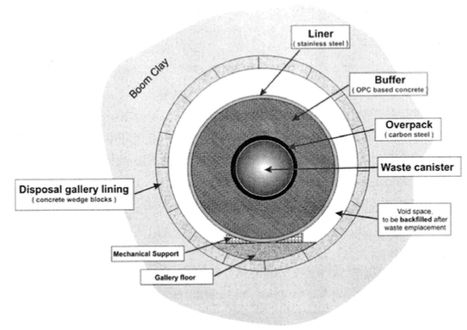
Problem: Seals are guardians of conduits that pass through stratigraphy. When a seal fails there is potential for direct communication between the subsurface, hydrogeologic units, and the surface.



Wellbore Seals



Shaft and Drift Seals



Engineered Barrier System Components

Goals and Technical Approach:

The overarching technical goal for this project is to develop fundamental understanding of cement-geomaterial interfaces via an experimental and modeling study that incorporates chemo-mechanical coupling at high-temperature, high-pressure conditions.

Objectives:

1) Characterize the chemistry and physics of a cement-geomaterial interface
2) Develop modeling capability for coupled chemo-mechanics
3) Develop and evaluate next-generation seal repair materials suitable for the expected shaft/wellbore environments

Multi-scale Characterization
-micro-CT, velocimetry of interfaces
-post-mortem analysis (SEM, TEM, EDS, AFM)
-PFLOTRAN-Sierra Mechanics modeling

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Interface failure
-Rate dependencies
-predominant failure modes
-stresses/strains

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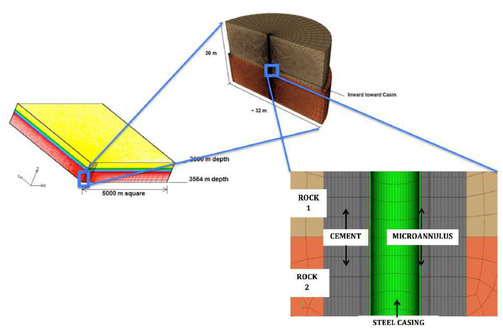
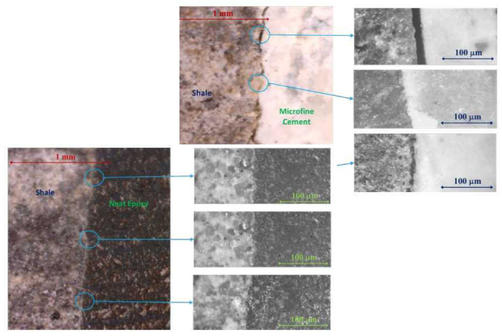
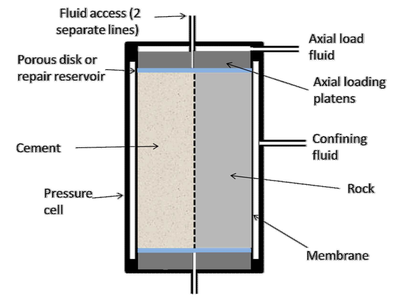
Seal Repair Material
-robust at *in situ* conditions
-ductility
-penetration into flaws
-self-healing







Significance of Results:

- Greatly advance our fundamental understanding of interface failure, rate dependencies of these processes, and coupled chemo-mechanics at *in situ* subsurface conditions
- Experimentally validated, model-based predictive capability applicable to large domains and long time scales
- Fit-for-purpose seal materials with IP potential and high-utility for subsurface environments

Built on LDRD Laboratory Directed Research and Development

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