Overview of Activity

- Conduct brine analysis on multiple brine types and evaporation experiments at varying temperatures
  - Analyze liquid chemistry
  - Analyze precipitant composition
  - Perform EQ3/6 geochemical models
  - Compare to historical samples

- In support of the borehole heater field test
Laboratory brine experiments support the understanding and prediction of outcomes from the field test.

Brine availability is a major goal of the WIPP Field Test.

Impacts of brine availability on Performance Assessment:
- Waste package corrosion effects
- Limit closure of brine-filled cavities
- Transport of radionuclides to the far field

Relation to high-priority FEP’s
- 2.2.08.01 – Flow through salt host rock [7.73]
- 2.2.08.06 – Flow through the salt EDZ [7.73]
- 2.2.08.07 – Mineralogic dehydration of salt [6.49]

Compositional analysis of brine not a primary focus of international partners
- Will share results, get feedback, and discuss at US/German Workshop in Sept 2018
Three main types of fluid in salt:

- Intergranular water (between grains)
- Intragranular water (fluid inclusions inside grains)
- Hydrated minerals
  - Clays (5-18% H2O by weight)
  - Gypsum (21% H2O by weight)
  - Polyhalite (6% H2O by weight)

Water sources respond differently to heat

- Brine between grains flows first (ambient)
- Fluid inclusions move/break due to temperature
- Clays dehydrate at ≤100°C
- Gypsum dehydrates 75 – 175°C
- Polyhalite dehydrates ≥300°C
Observed WIPP Brine Chemistry

Fluid Inclusions

Seawater

MU-0 Target Interval

Salt R&D: Brine Evaporation Studies
Prepare brine solutions
- Type 1: Dissolve WIPP salt in water until saturated
- Type 2: Modified Synthetic Salado WIPP GWB brine

Heat brine in vacuum oven and sample periodically

Liquid Analysis
- Ion Chromatography (IC)
- Ion Coupled Plasma-Optical Emission Spectrometry (ICP-OES)

Precipitant Analysis
- X-ray Fluorescence (XRF)
- Scanning Electron Microscopy with Energy Dispersive X-Ray Spectroscopy (SEM-EDS)
- IC and ICP-OES of redissolved precipitated solids

Complexities
- High dilution required for liquids
- Need to cross section solids for internal composition on SEM-EDS
Brine from Dissolved WIPP Salt

- Dissolved WIPP salt is not the same as brine collected at WIPP:
  - $\text{SO}_4^{2-}$, $\text{K}^+$, $\text{Mg}^+$ & $\text{Br}^-$: too low
  - $\text{Na}^+$ & $\text{Cl}^-$: too high

**Point:** We can see differences in brine sources from analysis!
EQ3/6 Model: WIPP Synthetic Brine Evaporation at 100°C
In process of precipitant composition
  - XRF
  - SEM-EDS
  - Redissolved precipitated solids
    • Analyze on IC and ICP-OES

Additional evaporation experiments at varying temperatures
  - Attain repeatable results
  - More data points for model confirmation (or disagreements)

Validate EQ3/6 predictions for WIPP-relevant brines

Attain brine samples from field test and analyze
Questions?