Used Fuel Disposition Campaign

THM processes in Salt (PFLOTRAN-Sierra/Solid Mechanics)

Heeho Park, Ayman Alzraiee, Glenn Hammond

Sandia National Laboratories

2016 UFDC Annual Working Group Meeting

Integration Session, June 8, 2016

Las Vegas, NV

WIPP Creep Closure

- **The excavation of the WIPP will result in a plastic deformation of the salt material (creep) and resultant closure of excavated areas.**

- **The creep closure causes the reduction of void volume. It increases repository pressure over time with gas generation from waste decomposition and microbial activity.**

- **Values of porosity are calculated as a function of time and gas pressure from a look-up table**
  - It was obtained by modeling deformation of a waste-filled room using a finite element structural mechanics code, SANTOS.

- **The waste-filled room in PFLOTRAN is modeled as homogeneous high porosity media.**

Creep Closure in PFLOTRAN

Effective porosity (red) of the waste area decreases significantly due to creep closure in the first 800 years

Wetting (blue) of the unsaturated waste area
Wetting (blue) of the unsaturated DRZ and then drying of the DRZ due to gas generation from wastes

Continuous rise in gas pressure (green) in the DRZ and the waste area

PFLOTRAN-Sierra/Solid Mechanics (SM)
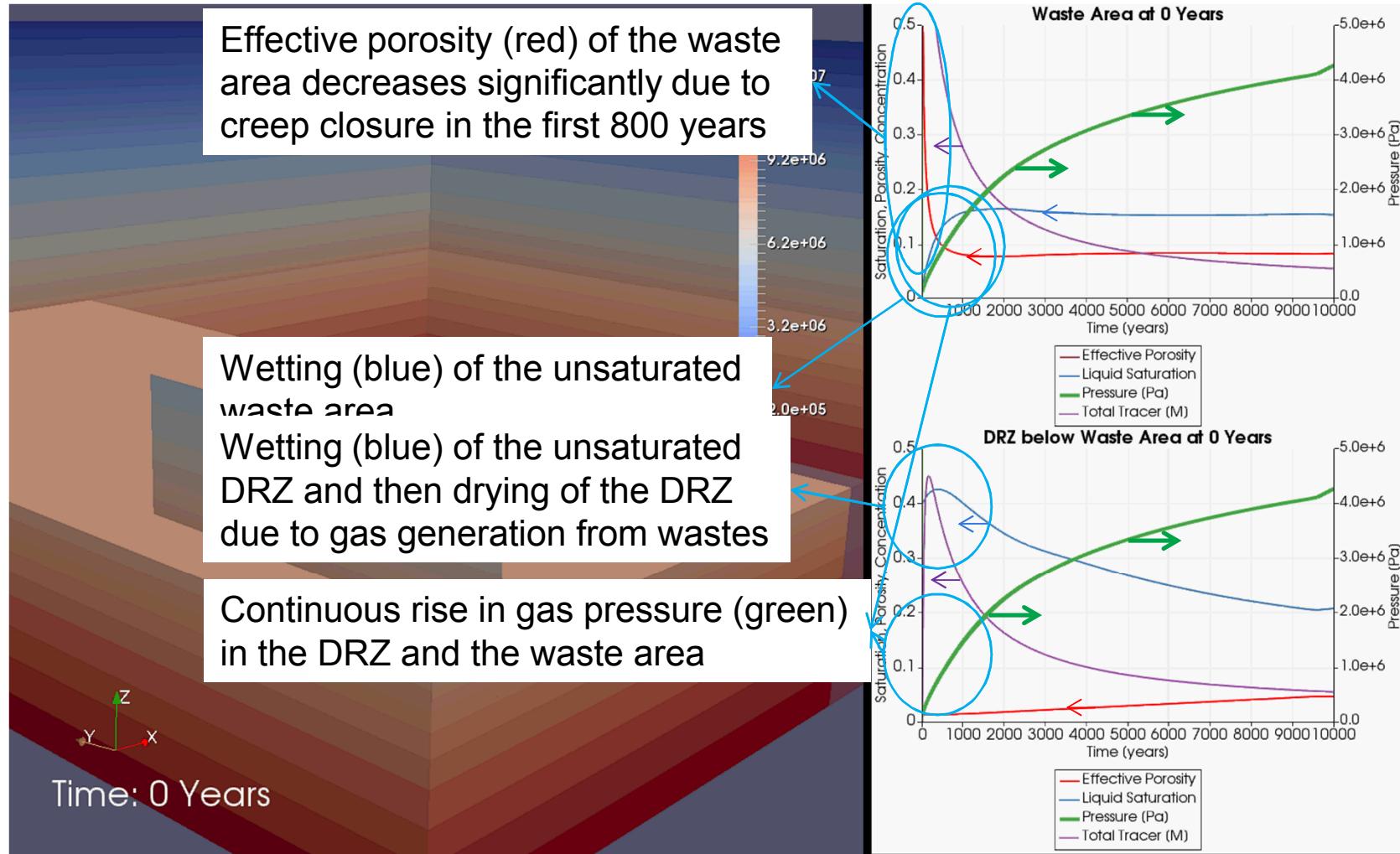
- **Increasingly mechanistic representations of salt creep closure are needed.**

- **TOUGH-FLAC simulations of THM processes have shown promise.**
  - Rutqvist, 2011
  - Blanco-Martin et al., 2016

- **For massively-parallel simulation of THM within the GDSA PA framework, we propose coupling:**
  - PFLOTRAN - reactive multiphase flow
  - Sierra/SM - solid mechanics

- **PFLOTRAN-Sierra/SM will be benchmarked against TOUGH-FLAC.**

Converting Finite Element Grid to Finite Volume Grid

- **Finite element nodes are treated as centers of finite volume cells**

- **Interfaces are generated to be perpendicular to flowlines.**
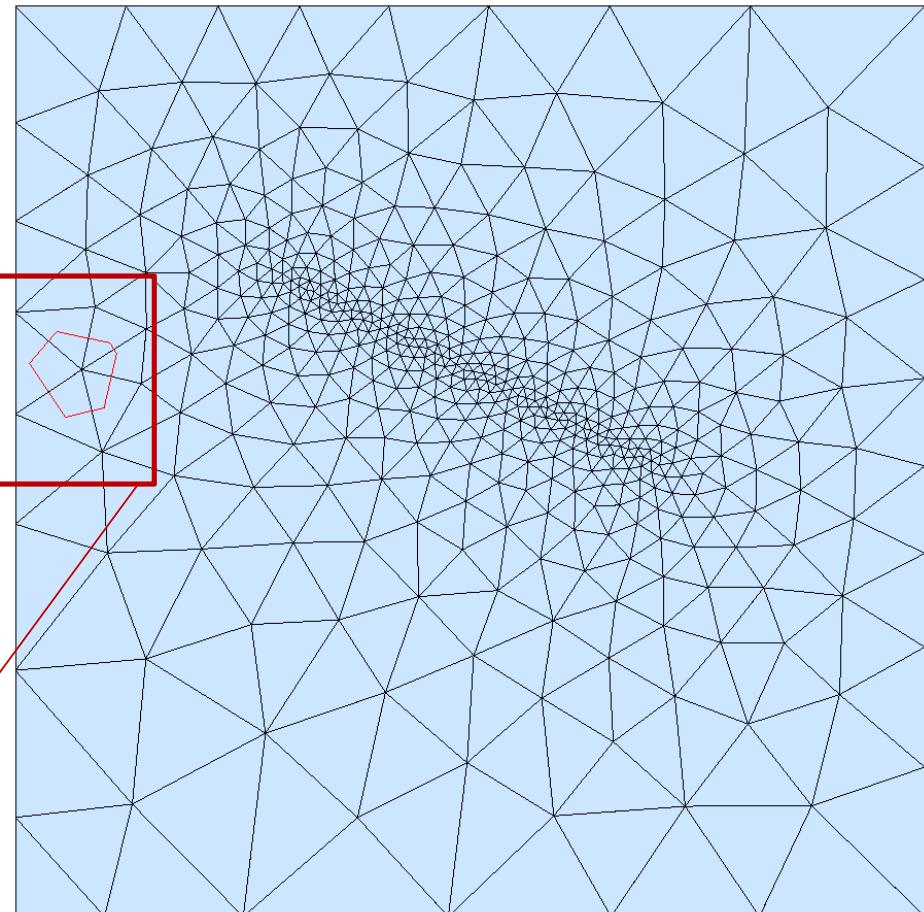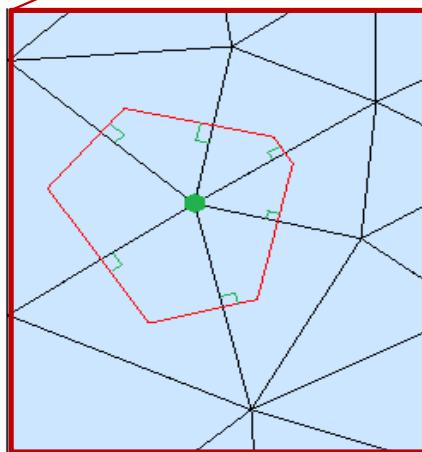
Discussion/Questions

- **This procedure can be automated within PFLOTRAN to allow PFLOTRAN to read either FE or FV grids**