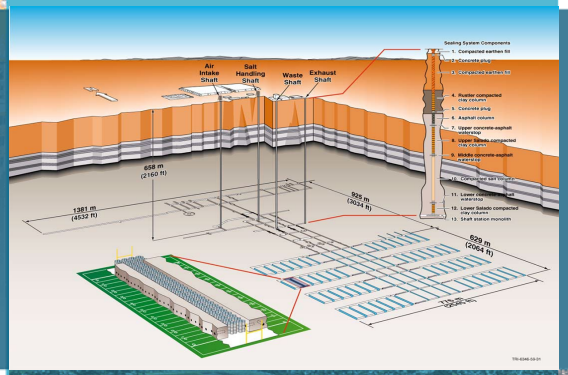
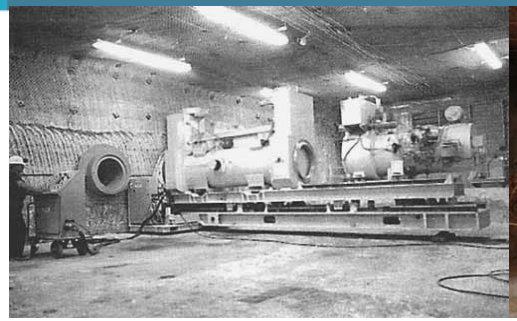
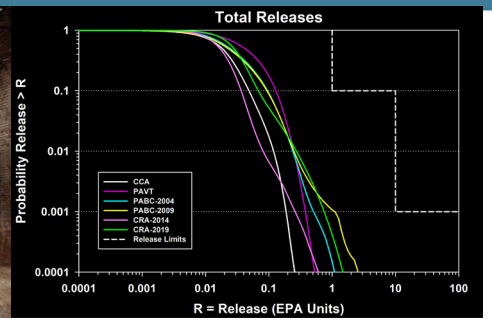
SAND2022-14727C

Sandia National Laboratories

Creep closure modeling in the WIPP PA







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Summary

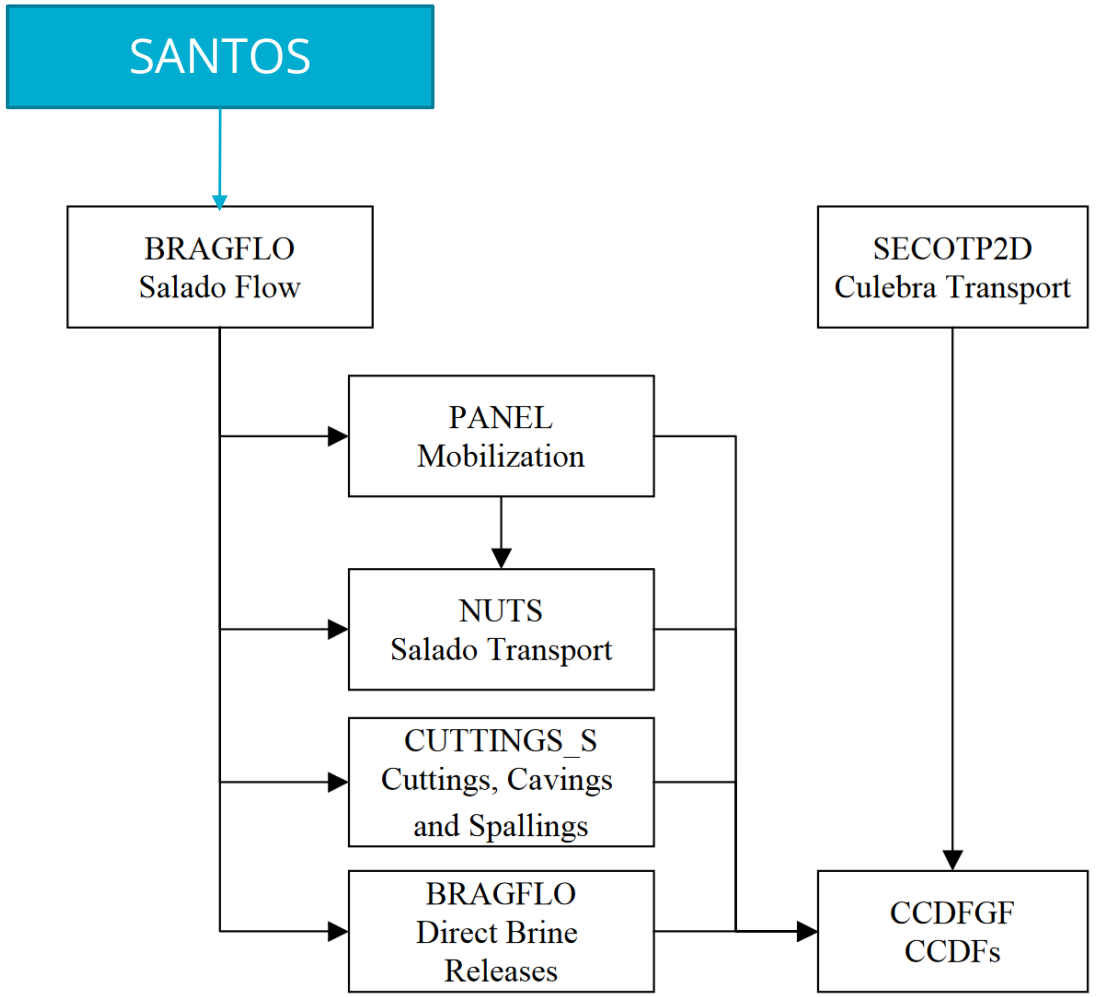
Creep closure of the repository is modeled in the WIPP PA

- Room closure is computed using SANTOS (SIERRA)
- SANTOS is run separately from the main PA computation sequence
- SANTOS produces a “porosity surface” that is input to BRAGFLO

Creep closure is incorporated into the Salado flow model

- At each time step in the two-phase flow solution, waste area porosity is updated as a function of **pressure** and **time**

CRA-2019 and all previous PAs use the porosity surface produced for the CCA



WIPP PA Computational Flow

Computation of the porosity surface

SANTOS simulates salt creep and waste material response

- Computes pore pressure over time during each simulation

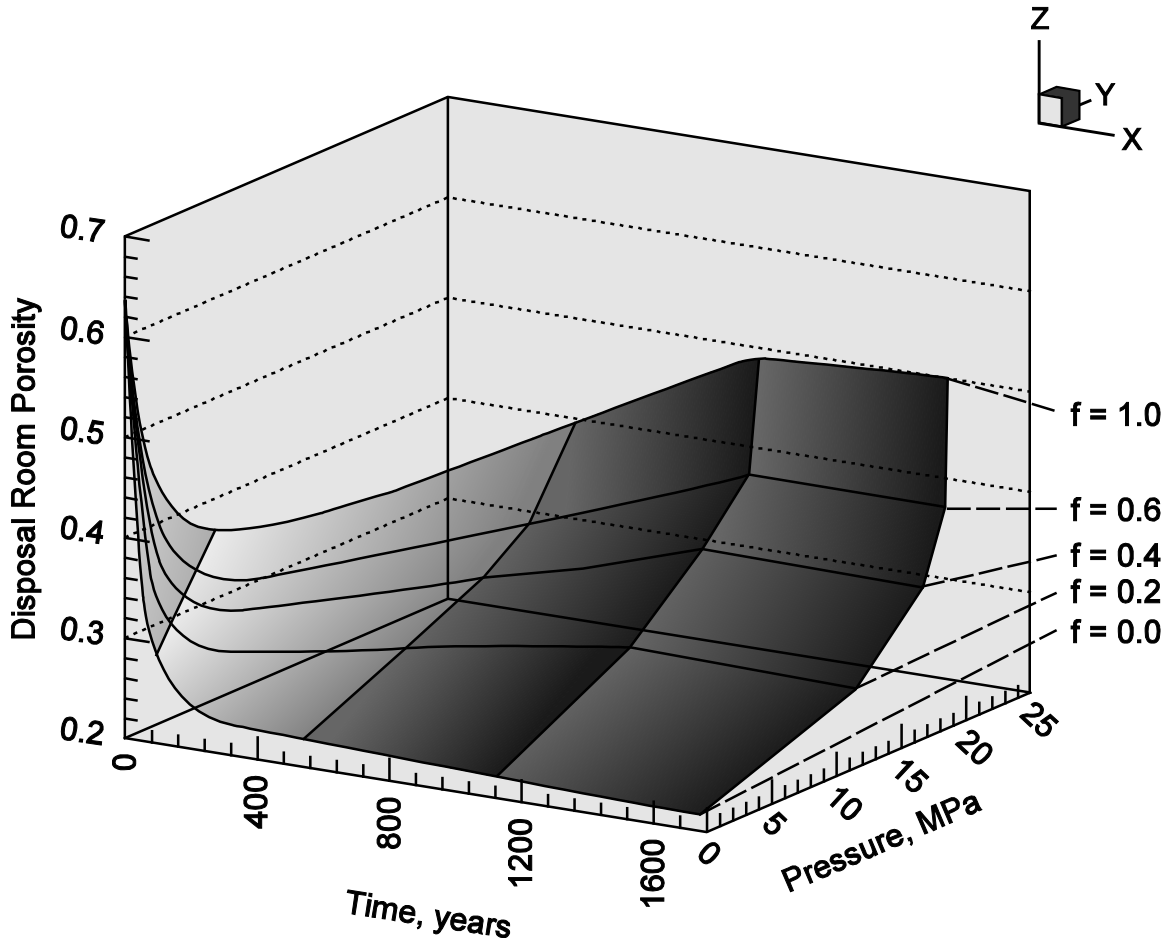
Gas generation is represented by a simple model: base rate r(t) x scaling factor (f)

- r(t) = 2 mol/drum/yr (t ≤ 550yr)
- r(t) = 1 mol/drum/yr (550yr < t ≤ 1050yr)
- r(t) = 0 mol/drum/yr (t > 1050yr)
- f ranges between 0.0 and 2.0 to create a sufficiently wide range of pressures

No anhydrite fracturing occurs in SANTOS; all gas remains in the repository

Porosity surface: φ = F(t, P)

Details in CRA-2014, Appendix PORSURF



Portion of porosity surface generated with SANTOS. structural mechanics code. (Figure 32 from Park and Hansen, 2003).

Park, B. and F. Hansen, 2003. Determination of the Porosity Surface of the Disposal Room Containing Various Waste Inventories. Sandia National Laboratories. Carlsbad, NM.

Implementation of the porosity surface

Time-dependent porosity applies to the waste-filled areas

Non-waste voids (Operations and Experimental area) are “pre-closed” to a fixed porosity

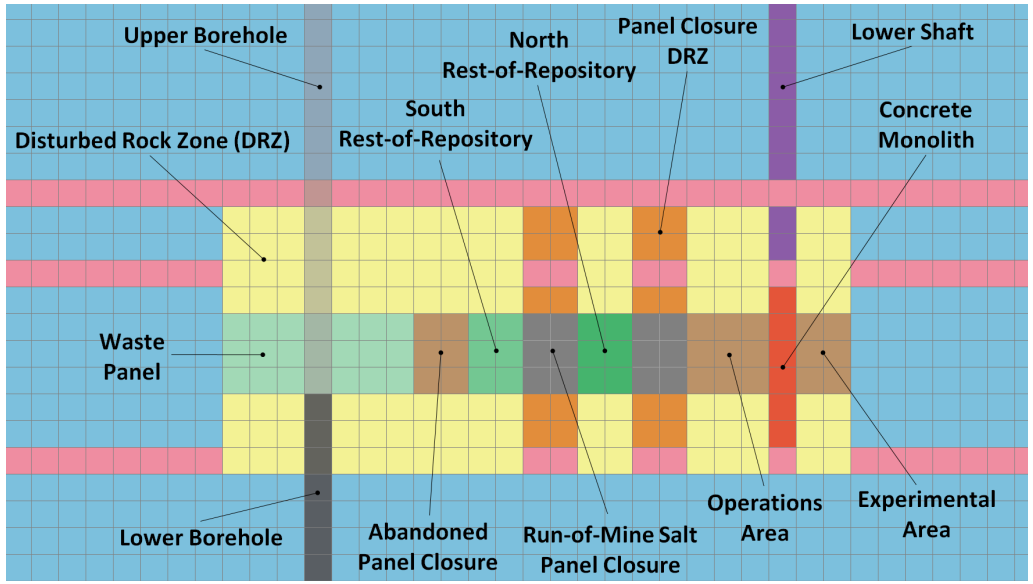
In SANTOS, room volume changes as salt creeps

SANTOS computes Eulerian porosity φ:

$$\varphi = \frac{v_v}{v} = \frac{\text{void volume}}{\text{room volume}}$$

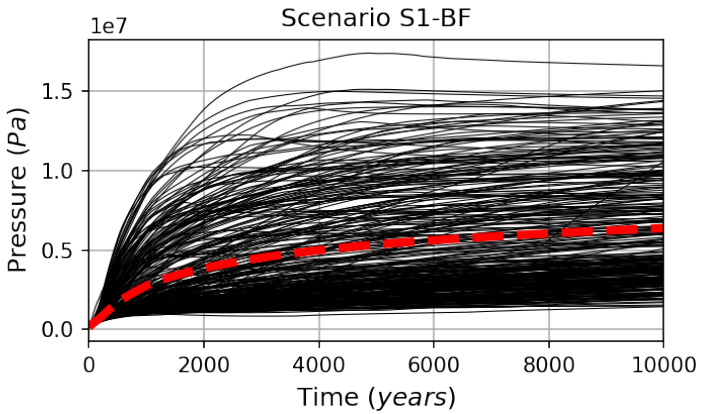
BRAGFLO requires Lagrangian porosity φ_B:

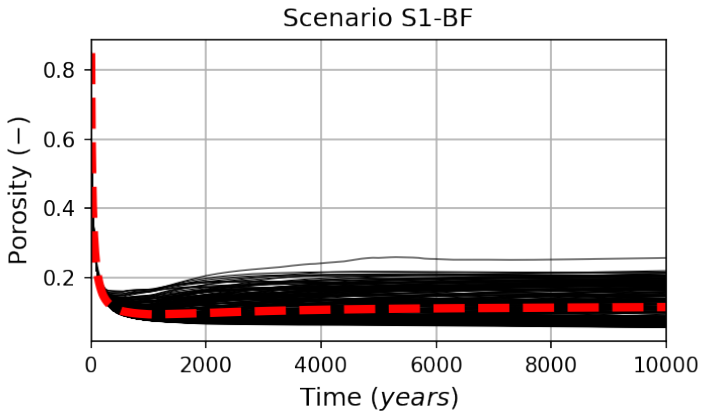
$$\varphi_B = \frac{v_v}{v_0} = \frac{\text{void volume}}{\text{initial volume}} = \frac{1-\varphi_0}{1-\varphi}\varphi$$

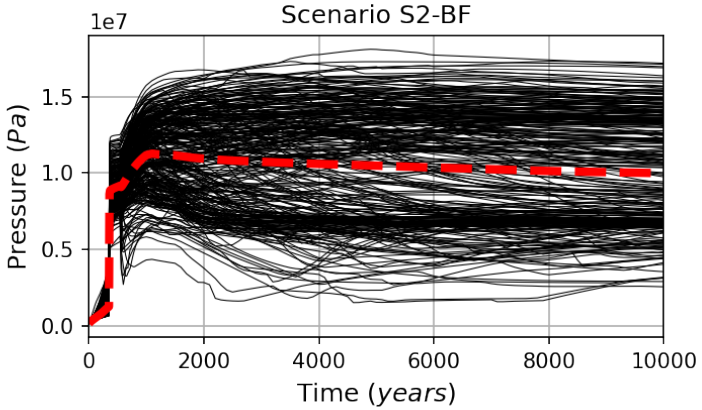


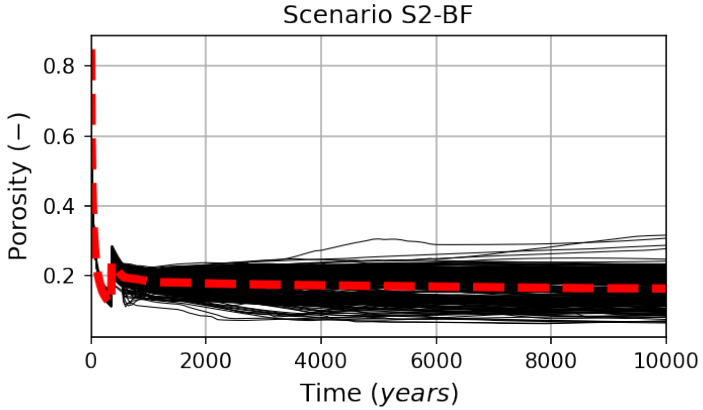
CRA 2019 Results

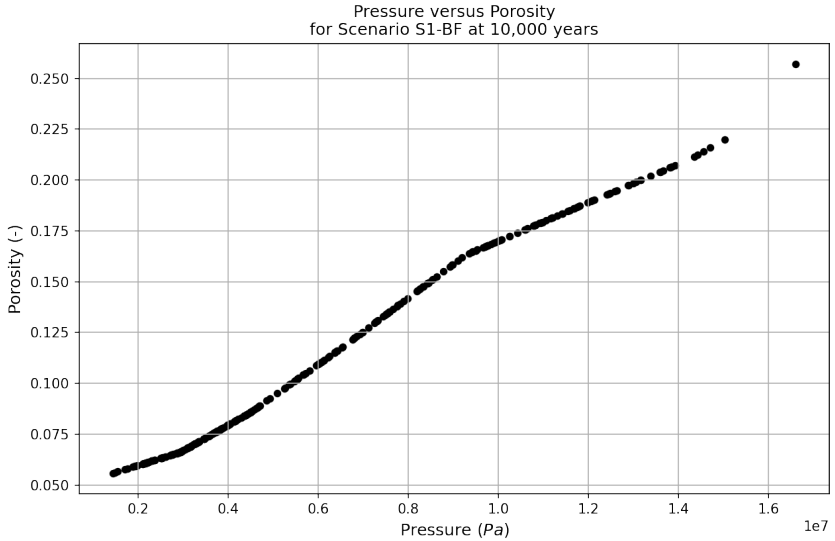
Long-term porosity correlates directly with brine pressure

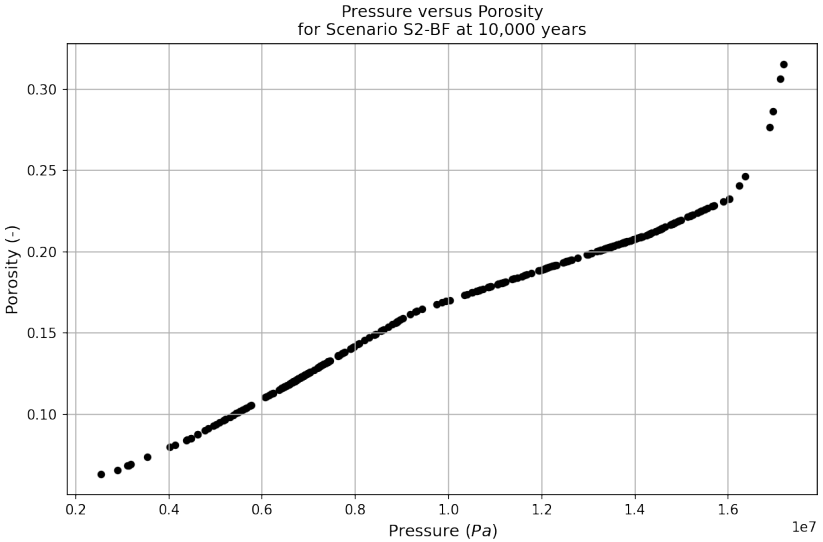












Volume-averaged pressure and porosity for WAS_AREA