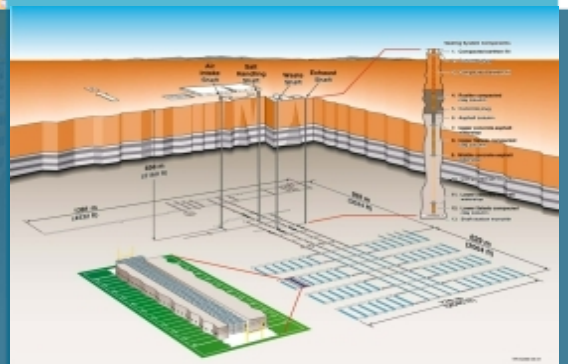
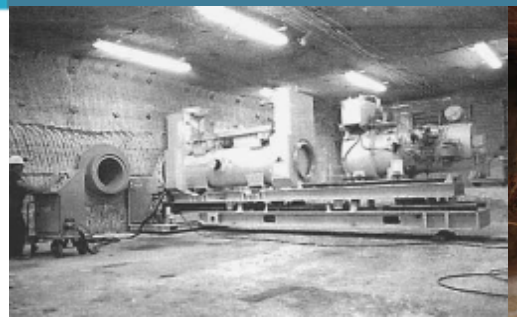
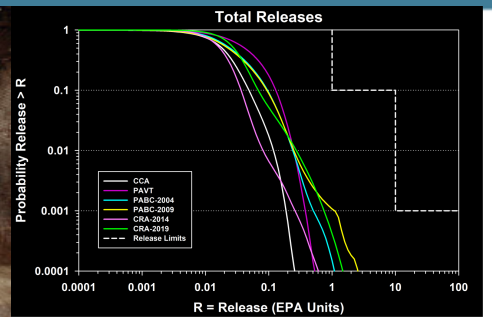
SAND2021-9171PE

Sandia National Laboratories

Porosity Surface and Fracture Model for the Salado Flow Model







Seth King and Clifford Hansen

July 2021

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Gas generation and pressure for Porosity Surface.

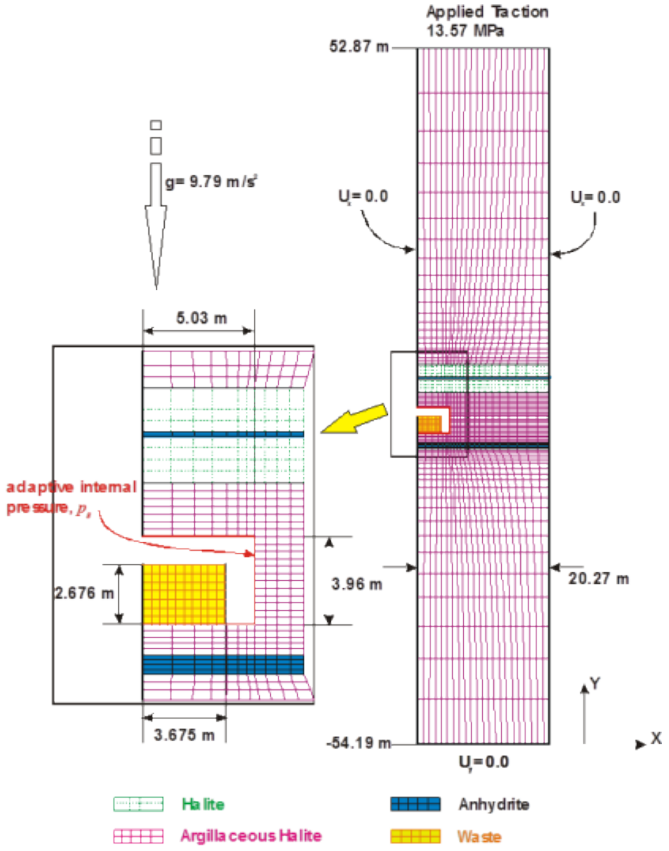


Figure PORSURF- 2. Mesh Discretization and Boundary Conditions Used for the Porosity Surface Calculations

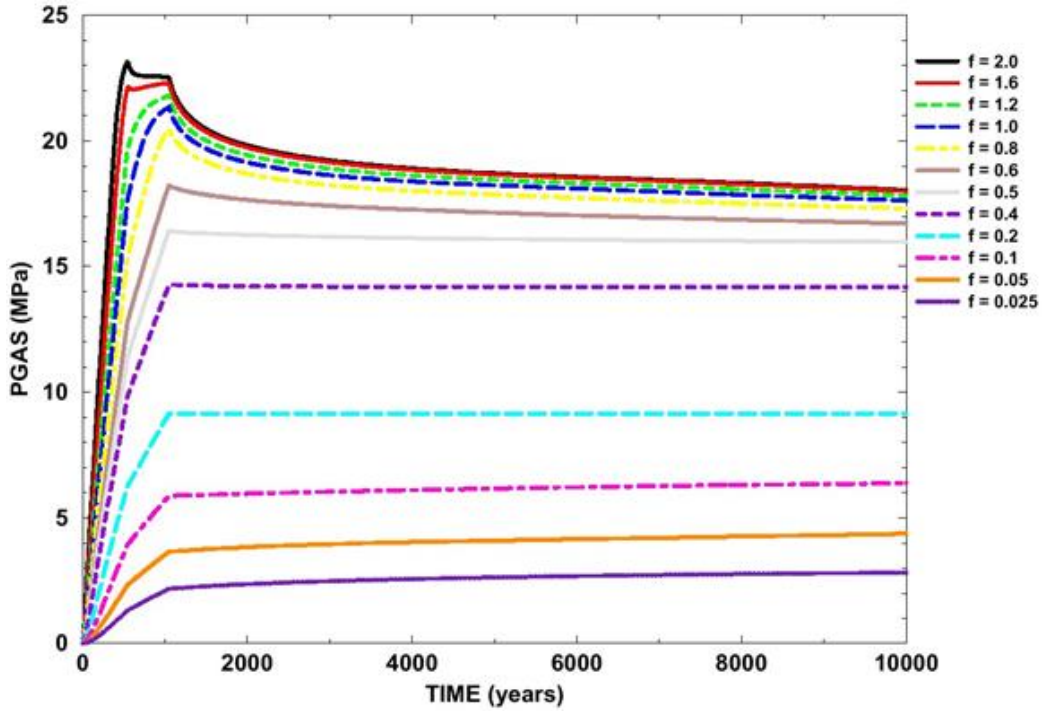


Figure PORSURF- 4. Disposal Room Pressure for Various Values of the Scaling Factor *f*

DOE(2014) CRA-2014 Appendix-PORSURF - https://wipp.energy.gov/library/CRA/CRA-2014/CRA/Appendix_PORSURF/Appendix_PORSURF.htm

Porosity Surface

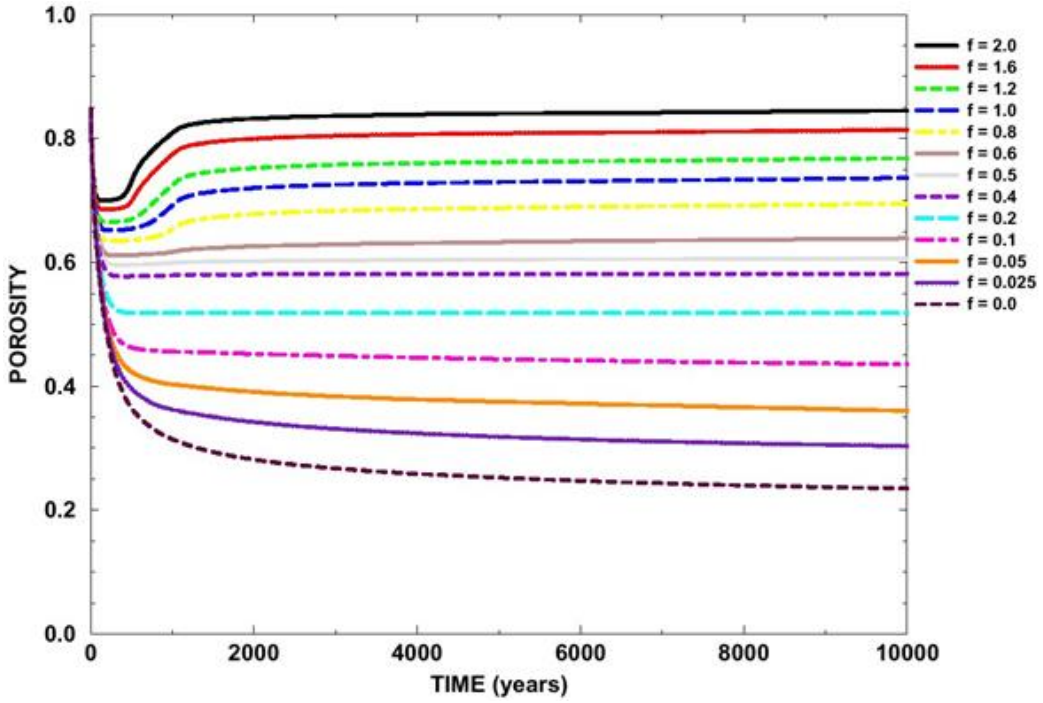
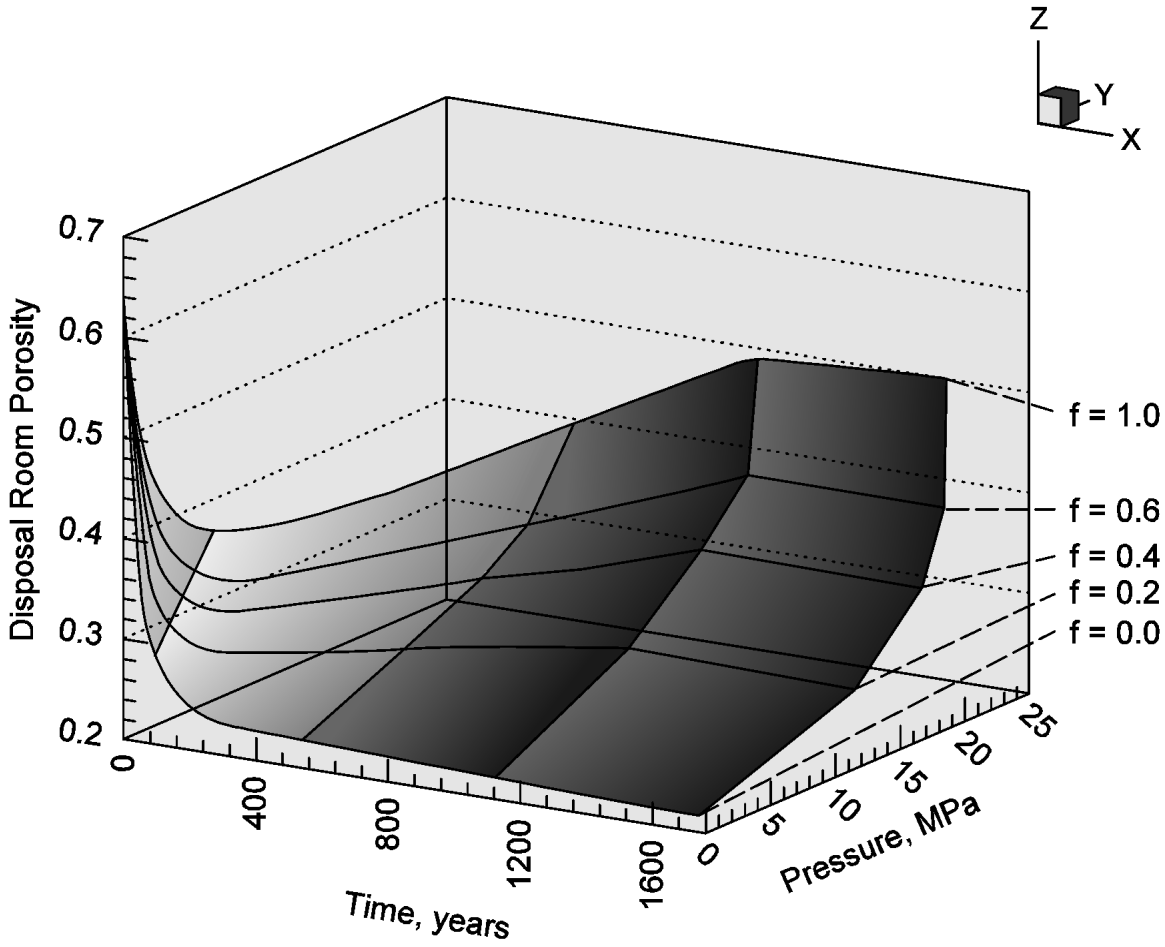


Figure PORSURF- 3. Disposal Room Porosity for Various Values of the Scaling Factor *f*

DOE(2014) CRA-2014 Appendix-PORSURF - https://wipp.energy.gov/library/CRA/CRA-2014/CRA/Appendix_PORSURF/Appendix_PORSURF.htm

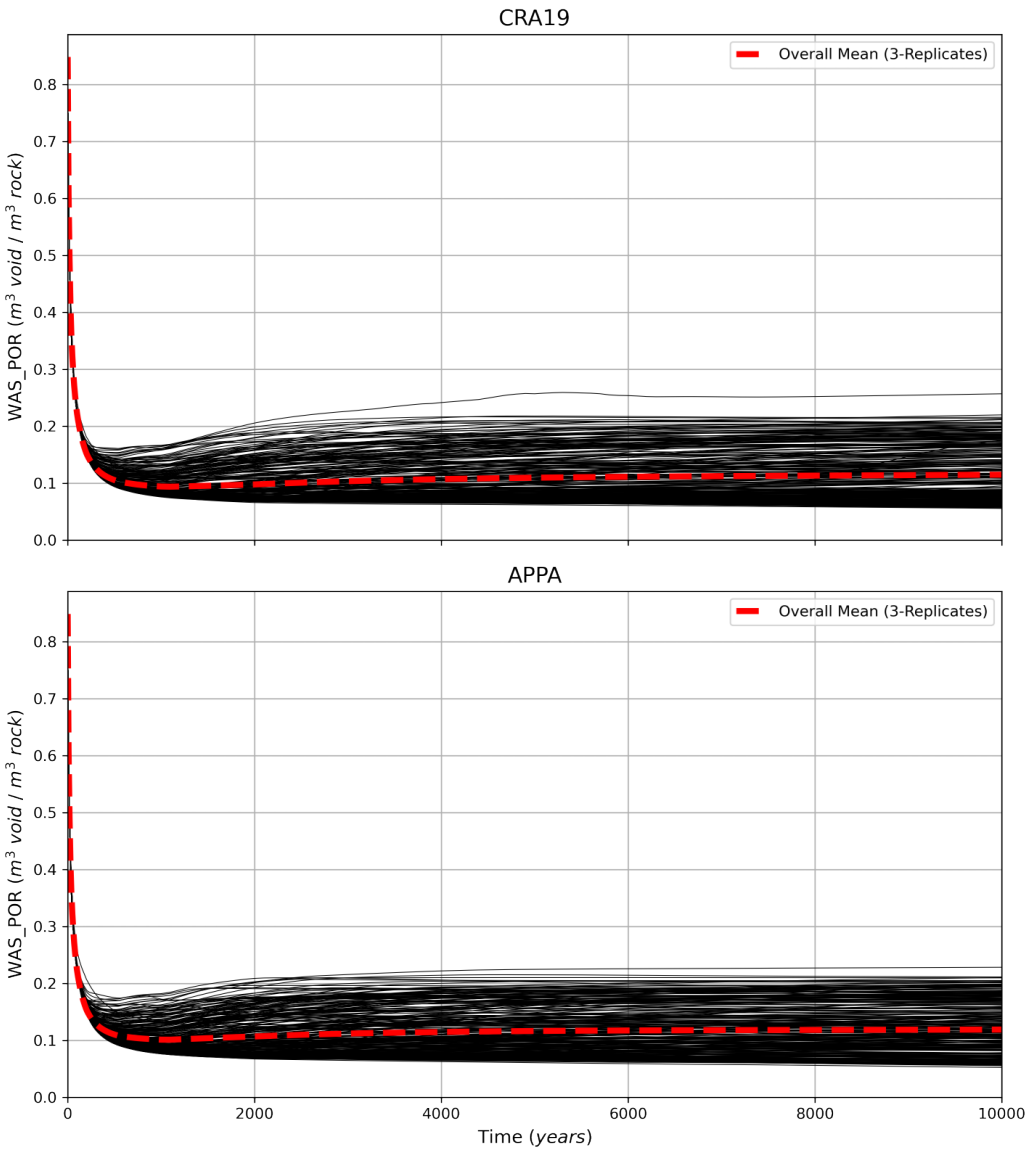


Pressure driven porosity function generated from SANTOS structural mechanics code. (Park and Hansen, 2003).

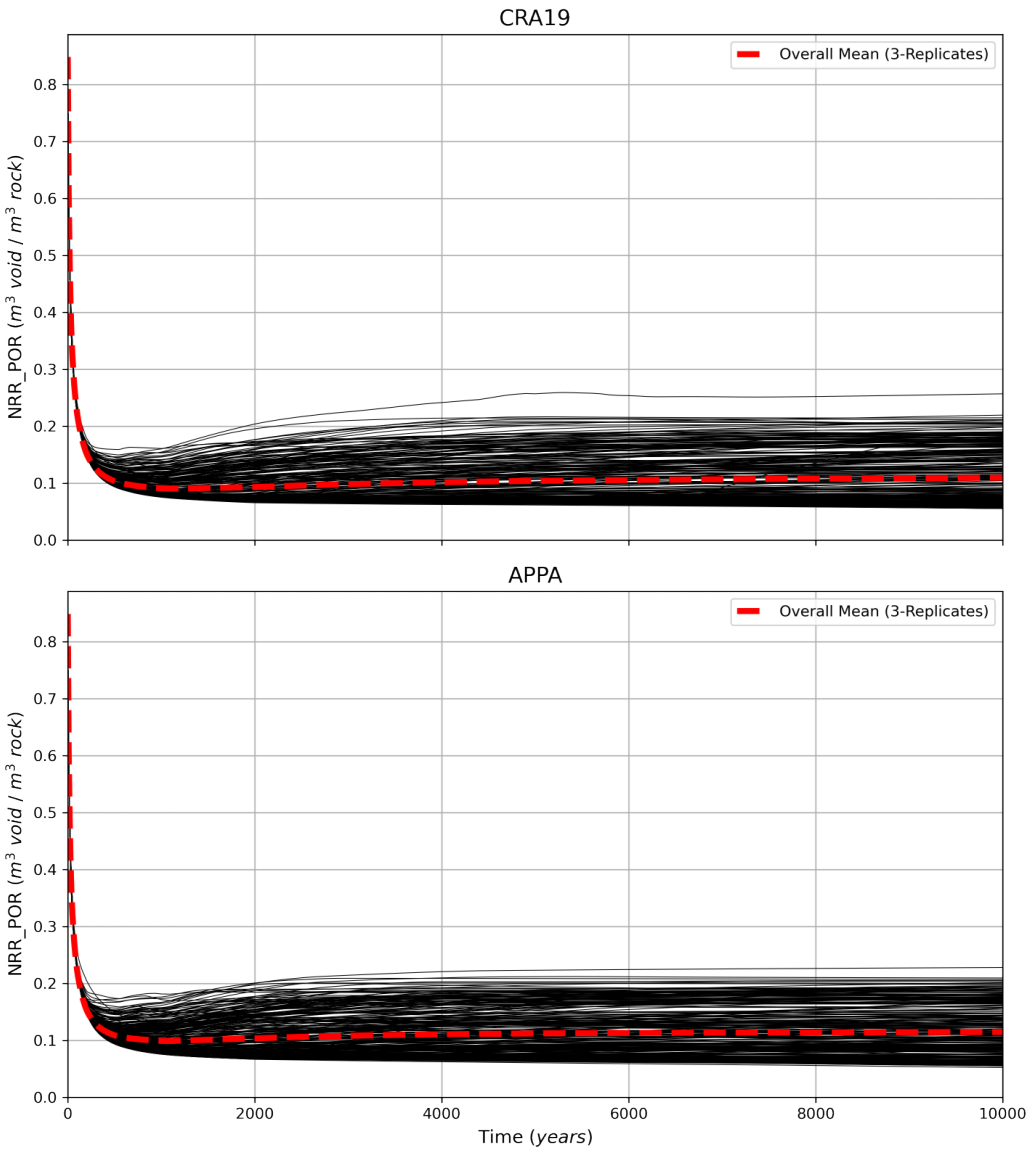
Park, B. and F. Hansen, 2003. Determination of the Porosity Surface of the Disposal Room Containing Various Waste Inventories. Sandia National Laboratories. Carlsbad, NM. https://wipp.energy.gov/library/CRA/CRA-2019/N%20-%20S/Park%20and%20Hansen%20%202003%20%20ERMS%20533216.pdf

Waste Area Porosity Evolution

Scenario S1-BF
Porosity in Waste Panel

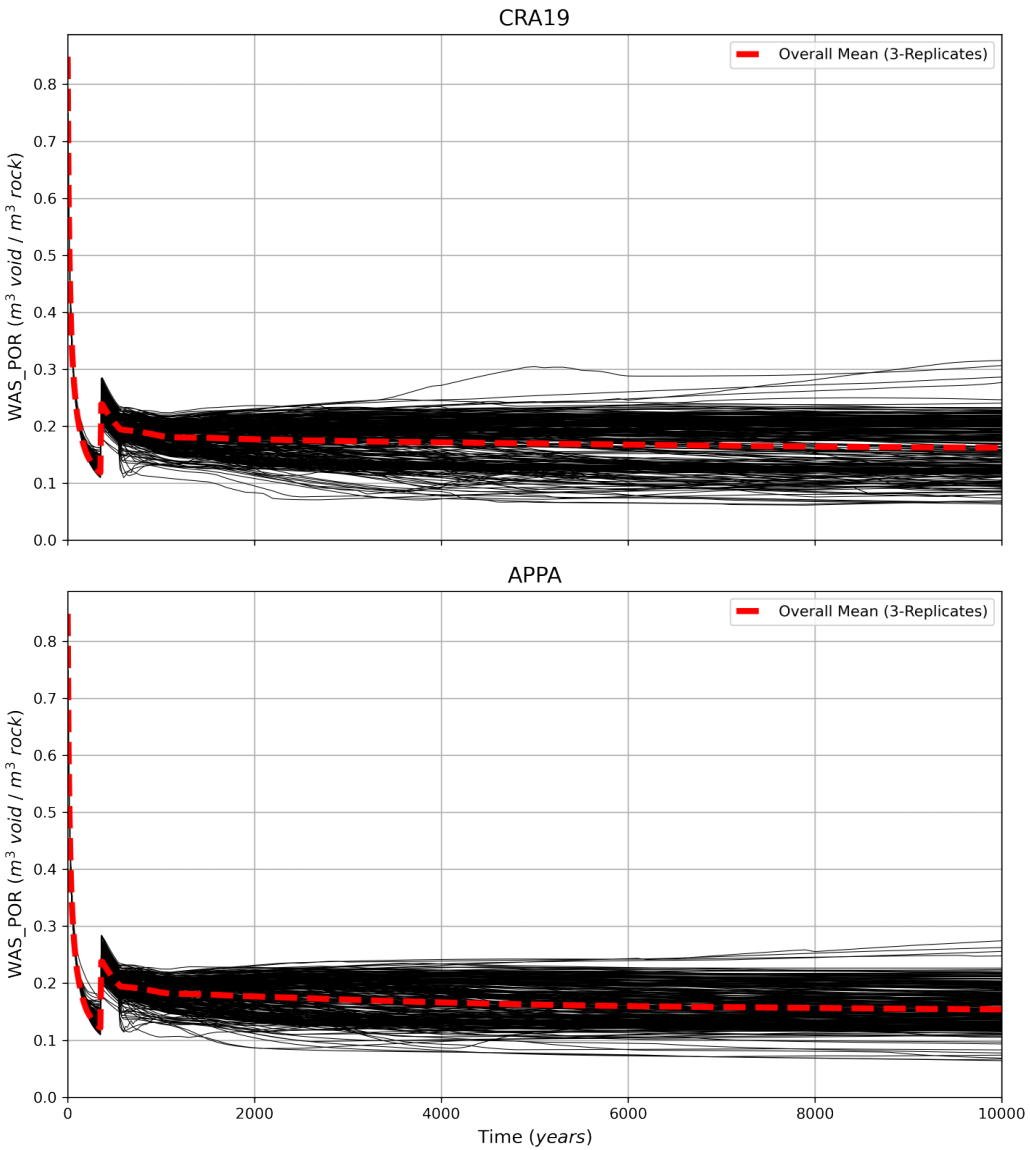


Scenario S1-BF
Porosity in North Rest-of-Repository

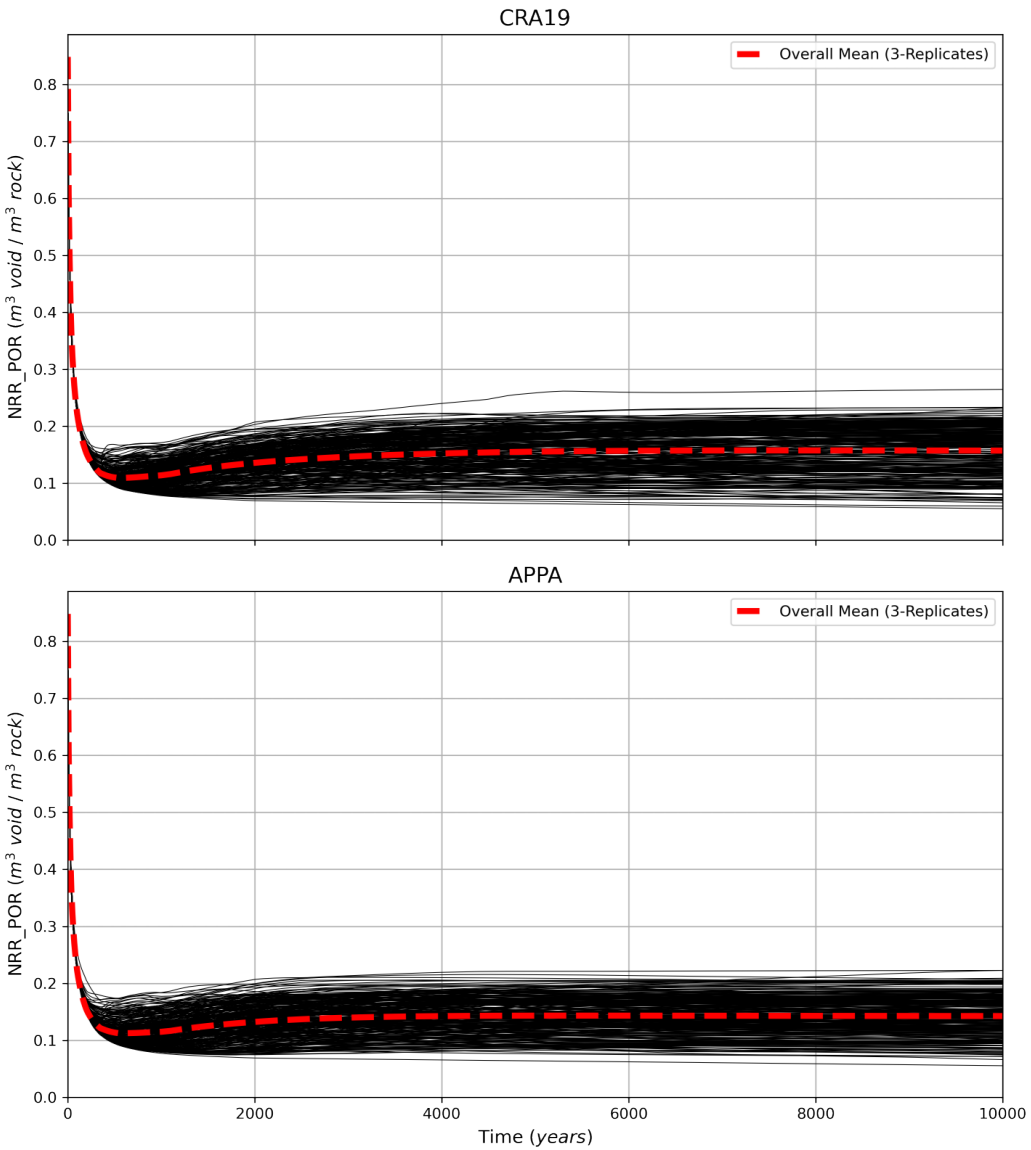


Waste Area Porosity Evolution

Scenario S2-BF
Porosity in Waste Panel



Scenario S2-BF
Porosity in North Rest-of-Repository



Fracturing model

Pressure-driven fracturing applies to DRZ and anhydrite interbeds (above and below DRZ)

Conceptualized as dilating natural or excavation-caused fractures that are assumed to not fully heal with creep closure

Initiate at p_{bi}=12.7MPa, fully dilate at p_{ba}=15.5Mpa

Before fracturing:

- Porosity 0.6 – 1.7% (interbeds), 0.04 – 3.3% (DRZ)
- Permeability 10^{-21} – 7.9×10^{-18} m^2 (interbeds), 3.98×10^{-20} – 3.16×10^{-13} m^2 (DRZ)

Reference: DOE (2004) CRA 2004, Appendix PA, Section 6.4.5.2 and 6.4.5.3

- Linear change in porosity (up to +4% for MB138, MB139, +24% for A/B)
- Power law change in permeability

$$k_f(p_b) = \left[\frac{\phi(p_b)}{\phi(p_{bi})}\right]^n k \,,$$

  - k – non-fractured permeability
  - Φ – porosity (function of pressure)
  - n – empirical exponent so that

$k_f(p_{ba})=1 \times 10^{-9}$ m^2 at full dilation

CRA-2019 DBR simulation of upper intrusion animation