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Date: 10 April 2007
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Re: Revised porosity estimates for the DRZ

In preparation for the upcoming Performance Assessment (PA) runs in association with Analysis Plan AP-132 (Vugrin and Nemer, 2007), we discovered a problem in the determination of the maximum of the porosity variable S_HALITE:POROSITY, which was reported in Parameter Problem Report 2007-02 (Ismail, 2007). Porosity measurements should be reported as a volume fraction; however, the maximum of the range now used is taken from data reported as weight percents without the conversion to volume fraction having been performed. As reported in Skokan *et al.* (1987): "From all of the data obtained the bulk water content is between 1 and 3% by weight." Since 3.0% is used as the maximum value of S_HALITE:POROSITY, this indicates that no conversion was made.

Since the PA model assumes complete saturation of the pores, using a brine density of 1232 kg/m³, and a halite density of 2180 kg/m³ (Brush *et al.*, 2006) leads to a maximum for S_HALITE:POROSITY of (Dullien, 1992)

$$\phi_{\max} = \frac{y_w / \rho_w}{y_w / \rho_w + y_h / \rho_h} = \frac{0.03/1232}{0.03/1232 + 0.97/2180} = 0.0519,$$

or 5.19 percent.

With the other points defining the distribution (0.001 as the minimum porosity, and 0.01 as the median porosity) remaining the same, the mean of the distribution will therefore be (Billingsley, 1985)

$$\langle \phi \rangle = \int_{0.001}^{0.01} \frac{x dx}{2(0.010 - 0.001)} + \int_{0.0100}^{0.0519} \frac{x dx}{2(0.0519 - 0.010)} = 0.0182,$$

or 1.82 percent. The second moment will be

$$\langle \phi^2 \rangle = \int_{0.001}^{0.01} \frac{x^2 dx}{2(0.010 - 0.001)} + \int_{0.0100}^{0.0519} \frac{x^2 dx}{2(0.0519 - 0.010)} = 0.0005706,$$

and therefore the standard deviation will be

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$$\sigma = \sqrt{\langle \phi^2 \rangle - \langle \phi \rangle^2} = \sqrt{0.0005706 - 0.0182^2} = 0.0154.$$

Consequently, the distributions for the S_HALITE and DRZ porosities should be as listed below. Following current WIPP PA practice, the ranges for the DRZ porosity distributions are found by increasing S_HALITE:POROSITY values by 0.0029 and repeating the above calculations.

The median value of 0.01 for S_HALITE:POROSITY is based on an additional density measurement independent of the resistivity measurements used by Skokan *et al.* (1987); we have therefore maintained that value as the median.

Table 1. Revised Porosity Distributions

Material	S_HALITE:POROSITY	DRZ_0:POROSITY DRZ_1:POROSITY DRZ_2:POROSITY
Description	Effective porosity	Effective porosity
Analysis	AP-132	AP-132
Parameter Type	Conceptual	Conceptual
Distribution	Cumulative	Cumulative
Units	None	None
Mean	0.0182	0.0211
Median	0.0100	0.0129
Deviation	0.0154	0.0154
Minimum	0.0010	0.0039
Maximum	0.0519	0.0548

Table 2. Associated Values for Revised Porosity Distributions

Probability	S_HALITE:POROSITY	DRZ_0:POROSITY DRZ_1:POROSITY DRZ_2:POROSITY
0.000	0.0010	0.0039
0.500	0.0100	0.0129
1.000	0.0519	0.0548

References

Billingsley, P. (1995) *Probability and Measure*. New York: John Wiley and Sons.

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