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subject: Correlation between bulk compressibility and porosity in the Castile brine pocket as modeled in BRAGFLO.

1. INTRODUCTION

In preparation for the Technical Baseline Migration BRAGFLO calculations in March 2002, I requested a Limited-Scope Surveillance of the BRAGFLO input files in order to verify that I had set them up correctly (Chavez, 2002). In this surveillance, Mario Chavez and Scott James examined the input files and identified several errors that were corrected during the surveillance. In addition, an issue was raised concerning the method that was used in the PAVT for assigning a porosity value to the Castile brine pocket for the BRAGFLO calculations.

Following the CCA, the EPA ran a sensitivity study and provided guidance to DOE for a new set of PA calculations (PAVT) that included a number of changes to parameter values from the CCA (U.S. EPA, 1998). Included in these changes was the treatment of the volume, porosity, and bulk compressibility of the Castile brine pocket as modeled in the PA calculations. The EPA expressed concern that the way these parameters were implemented for the CCA may have underestimated the amount of brine available in the brine pocket. They provided revised distributions for the porosity and bulk compressibility that, combined with a constant volume of the brine pocket modeled in the BRAGFLO grid, results in a range of available brine that is consistent with data from the WIPP 12 borehole (U.S. EPA, 1998).

In the PAVT, the bulk compressibility of the brine pocket (*COMP_RCK*) was sampled by LHS from the range listed in table 1 and used to calculate the brine pocket porosity, *POR_BPKT*. This calculation was done in the ALGEBRA step as:

$$POR\_BPKT = \frac{1.848\times10^{-11}}{COMP\_RCK}, \qquad (1)$$

The constant numerator (1.848×10^{-11}) equals:

WIPP: 1.3.5.1.2.1 : PA : QA-L : 526660

$$MAX(POR\_BPKT) \times MIN(COMP\_RCK) = MIN(POR\_BPKT) \times MAX(COMP\_RCK) \tag{2}$$

This approach results in a range of porosity values that matches the range required by the EPA and listed in table 1. However, this relationship assumes that porosity and bulk compressibility are inversely correlated. The surveillance questioned whether the correlation should be positive rather than negative. This memorandum addresses this issue by suggesting a more representative way to define brine pocket porosity for the Compliance Recertification (CRA) calculations.

2. NEW METHOD FOR ASSIGNING BRINE POCKET POROSITY

Table 1 lists the PAVT ranges over which porosity and bulk compressibility vary for the Castile brine pocket (Material: CASTILER). The triangular distributions are geometrically "similar", meaning that they are linearly proportional.

Table 1.

Parameter	**Distribution**	**Min**	**Max**	**Mode**
COMP_RCK	Triangular	2.00E-11	1.00E-10	4.00E-11
POR_BPKT	Triangular	0.1848	0.9240	0.3696

In a porous media, bulk compressibility is a combination of the compressibility of the fluid, the compressibility of the rock matrix, and the porosity. In general, the compressibility of the rock matrix is considerably lower than the fluid compressibility. Therefore, bulk compressibility tends to increase as the proportion of fluid in the rock (porosity) increases. For this reason, the correlation between porosity and bulk compressibility should be positive (i.e. high porosity material has high bulk compressibility).

To implement a positive correlation between these properties, we define the porosity as:

$$POR\_BPKT = \frac{COMP\_RCK}{1.0823 \times 10^{-10}}, \tag{3}$$

where the constant denominator (1.0823×10^{-10}) equals:

$$\frac{MODE(COMP\_RCK)}{MODE(POR\_BPKT)} = \frac{MIN(COMP\_RCK)}{MIN(POR\_BPKT)} = \frac{MAX(COMP\_RCK)}{MAX(POR\_BPKT)} \tag{4}$$

For the CRA, we will use equation (3) in the ALGEBRA step to assign the porosity for the Castile brine pocket.

Changing this correlation is not expected to result in significant changes to the performance assessment results. It is possible that changing this correlation may affect the amount of brine that enters the repository following a brine pocket intrusion, however such brine inflows are more dependant upon other parameters, such as borehole permeability, which are sampled independently of bulk compressibility. Figure 1A shows a scatter plot of total brine flow up the borehole at the bottom of the lower DRZ against brine pocket bulk compressibility for the TBM S3 scenario. There is little correlation between these variables. In contrast, figure 1B shows the highly correlated relationship between brine flow up the borehole and sampled borehole permeability.

The analysis of the CRA BRAGFLO calculations will include an evaluation of the effect on BRAGFLO results of changing the correlation between bulk compressibility and porosity for the CRA.

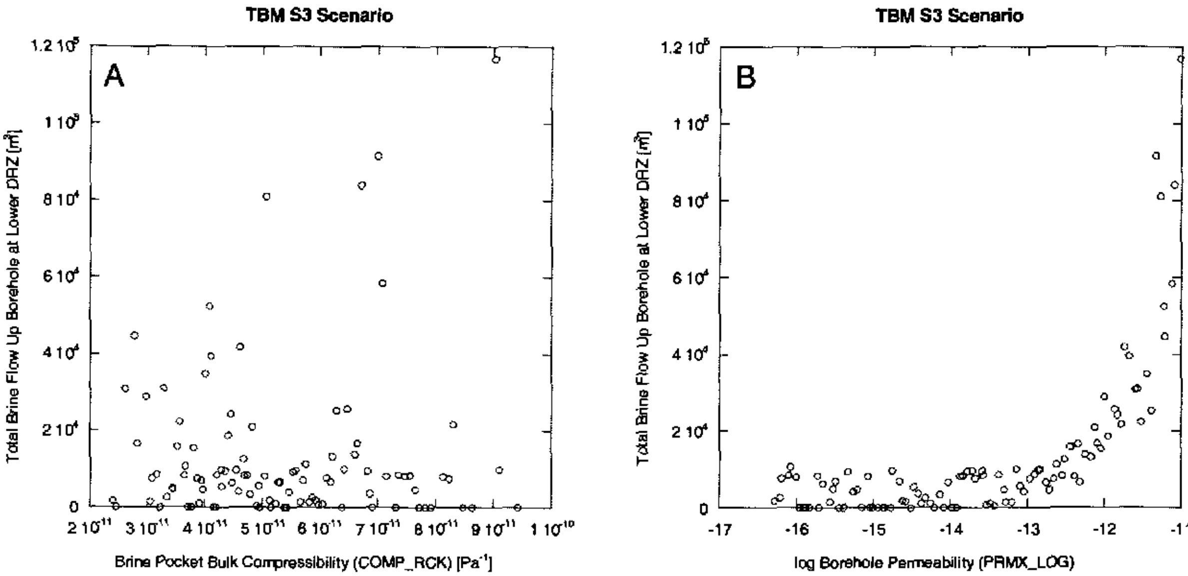

Figure 1. Plots from the TBM S3 scenario. **A**. Scatter plot of brine pocket bulk compressibility vs. total brine flow up the borehole from the brine pocket at the lower DRZ. **B**. Scatter plot of log borehole permeability vs. total brine flow up the borehole from the brine pocket at the lower DRZ.

3. REFERENCES

Chavez, Mario. 2002. Limited-Scope Surveillance Report. ISR 02-01, ERMS # 522737.

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