Supporting Information

Insights on Foam Transport from a Texture-Implicit Local-Equilibrium Model with an Improved Parameter Estimation Algorithm

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Table S1: Relative permeability data of Bentheimer sandstone[41,46]

Parameter	Bentheimer sandstone
k_{rw}^{o}	0.22
k_{rg}^{o}	0.94
S_{wc}	0.10
S_{gr}	0.05
n_w	4.00
n_g	1.80

Derivation for Equation 13 and Equation 14:

According to Darcy's law, the superficial velocity for gas and liquid phases can be expressed as:

Equation S1

$$u_g = -\frac{k_{rock} \cdot k_{rg}^{f}}{\mu_g} \nabla p = -\frac{k_{rock} \cdot k_{rg}^{nf} \cdot FM}{\mu_g} \nabla p$$

Equation S2

$$u_w = -\frac{k_{rock} \cdot k_{rw}}{\mu_w} \nabla p$$

According to the definition of apparent viscosity of foam in Equation 1, the $-k_{rock} \nabla p$ term can be expressed as:

$$-k_{rock} \nabla p = \mu_{app} \times (u_g + u_w)$$ Equation S3

Substitute Equation S3 into Equation S2, the relative permeability to aqueous phase can be solved as:

$$k_{rw} = \frac{\mu_w \times u_w(1 - f_g)}{\mu_{app} \times (u_w + u_g)} = \frac{\mu_w \times (1 - f_g)}{\mu_{app}} \quad \text{Equation S4}$$

Further substitute Equation S4 into Equation 11 and water saturation S_w can be solved for as in Equation 13.

In addition, k_{rg}^{nf} can be calculated from Equation 11 as:

$$k_{rg}^{nf} = k_{rg}^{o} \times \left(\frac{S_g - S_{gr}}{1 - S_{wc} - S_{gr}}\right)^{n_g} = k_{rg}^{o} \times \left(\frac{1 - S_w - S_{gr}}{1 - S_{wc} - S_{gr}}\right)^{n_g} \quad \text{Equation S5}$$

Plug Equation S3 and Equation S5 into Equation S1, FM can be solved for accordingly as shown in Equation 14.