H51J-1624 - Subsurface Gas Mobility and Its Associated Poro-Elastic Deformation of a Heterogenous Geologic Medium under Near-Water Saturated Conditions using Combined Brooks-Corey-Burdine (BCB) and van Genuchten-Mualem (vGM) Capillary Pressure-Saturation-Relative Permeability (p-S-k) Relationships

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- *Moscone South - Poster Hall*

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Abstract

Mobility of pore fluids in a heterogenous geologic medium is important for understanding various subsurface processes such as geological sequestration of CO_2 deep in saline aquifers, hydrocarbon migration in basin modeling studies, heat transport by pore fluids in geothermal energy production, groundwater recharge and contaminant transport in vadose zone for groundwater sustainability, etc. Most software packages for simulating multi-phase flow in a geologic medium have used Brooks-Corey-Burdine (BCB) or van Genuchten-Mualem (vGM) capillary pressure-saturation-relative permeability (p-S-k) relationships. Previous researches showed BCB p-S-k relationship more closely represented by coarse-grained medium with a "J"-shaped capillary pressure-saturation curve in comparison to vGM relationship that fitted more closely to fine-grained medium with a "S"-shaped curve. In addition, capillary entry pressure plays a crucial role in mobilizing non-wetting fluid in a Brooks-Corey model whereas it is ignored in van Genuchten model. Therefore, these separate models may represent end-member rock properties predicting different flow behavior. The main purpose of present research was to determine pore fluid mobility and its effect on poro-elastic deformation of a heterogenous medium using a combined BCB and vGM p-S-k relationships considering parameter equivalency between two models. One-dimensional equations of mass balance and the Darcy's flow mechanics for pore water and methane were solved over a ~130 m thick vertically graded sequence from coarse sandstone at the bottom to siltstone/mudstone at the top. Vertical heterogeneity in a rock sequence was modeled by variation in porosity, permeability and capillary entry pressure which depended on sediment size and clay content in the rock. Simulation

results showed methane propagation rates predicted with a p–S–k relationship close to vGM model were greater than that with a relationship close to BCB model by two orders of magnitude, and this difference also affected poro–elastic deformation. Moreover, model results also agreed with previous findings that overprediction of methane flow velocity could occur if one ignored entry pressure heterogeneity indicating the importance of combined BCB & vGM model as suggested by Valiantzas (2011).