

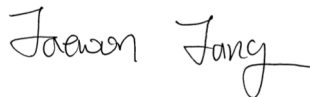
Oil & Natural Gas Technology

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Quarterly Research Performance Progress Report (October - December 2012)

Verification of capillary pressure functions and relative permeability equations for gas production

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SUMMARY (for Quarter 1 of Year 1):

- Task 1.0 Project Management and Planning
Done (submitted)
- Task 2.0 Pore Network Generation
In progress
- Subtask 2.1 Information of relevant information of in-situ hydrate-bearing sediments
Done
- Subtask 2.2 Generation of sediment packing using Discrete Element Model (DEM)
In progress
- Subtask 2.3 Extraction of pore-network from sediment packing
Initiated

Project timeline

	Year 1				Year 2			
	Qtr1	Qtr2	Qtr3	Qtr4	Qtr1	Qtr2	Qtr3	Qtr4
Task 1.0 Project Management and Planning								
Task 2.0 Pore Network Generation								
Subtask 2.1: Information of grain size distribution								
Subtask 2.2: Sediment packing by DEM simulation								
Subtask 2.3: Extraction of pore network								
<i>Milestone A</i>			◆					
Task 3.0 Algorithm for conductivity and hydrate dissociation								
<i>Decision Point 1</i>				●				
<i>Milestone B</i>					◆			
Task 4.0 Characteristic Curve and Relative Permeability								
Subtask 4.1: Effect of hydrate habit								
Subtask 4.2: Effect of hydrate saturation								
Subtask 4.3: Effect of gas viscosity								
Subtask 4.4: Suggestion of fitting parameters								
<i>Milestone C</i>								◆

Subtask 2.1 Compilation of relevant information of in-situ hydrate bearing sediment

Information of hydrate-bearing sediments relevant to generate three-dimensional sediment packing using DEM simulation is compiled. Grain size distributions of several reservoirs are shown in Figure 1. This information is used as input parameters to generate numerical three-dimensional sediment packing in Subtask 2.2.

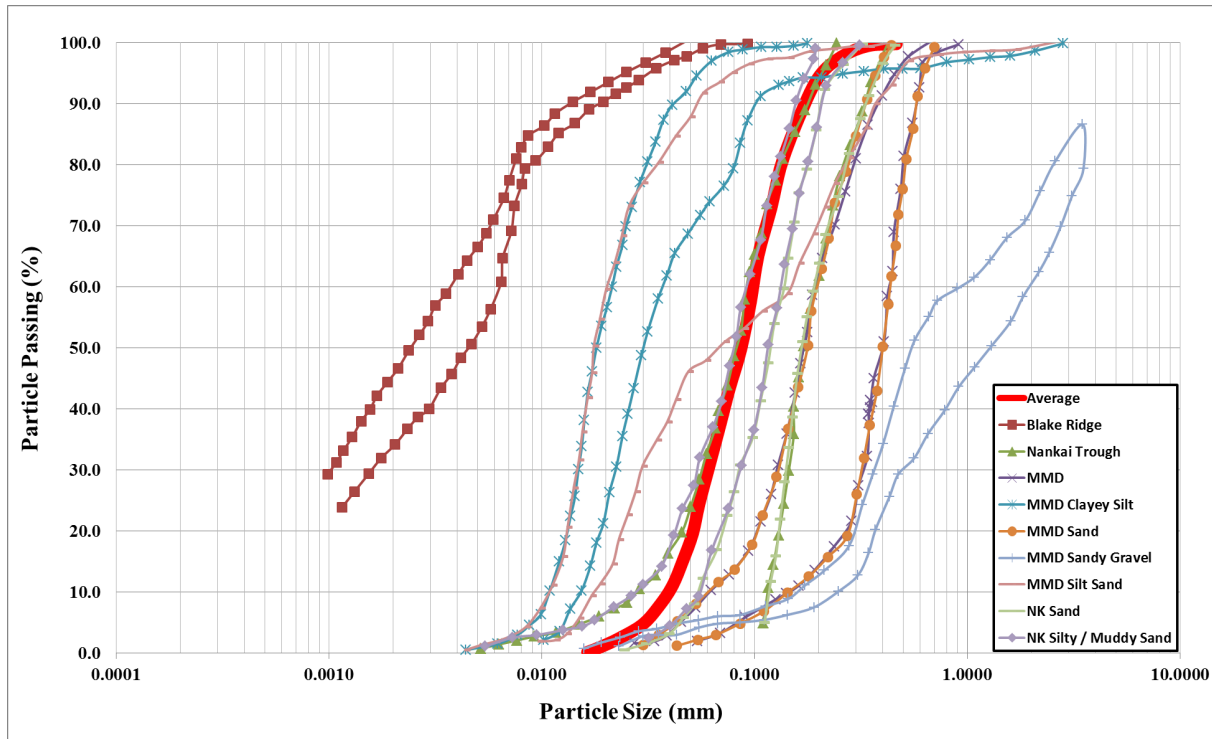


Figure 1. Compilation of grain size distribution curves in hydrate-bearing sediment (e.g., Black Ridge, Nankai Trough, Mallik-Mackenzie Delta, and Hydrate Ridge).

Subtask 2.2 Generation of sediment packing using Discrete Element Model (DEM)

Commercial software (*PFC 3D*, ITASCA) is purchased and installed in the PI's group. The information of grain size distribution is used to generate sediment packing under different conditions (left in Figure 2). Pore space is also extracted from the sediment packing (right in Figure 2). The extracted pore image will be used for pore-network extraction in Subtask 2.3. The verification of the generated sediment packing will be done by next quarter as planned in project timeline. Porosity, lateral earth pressure, and effective stress will be checked.

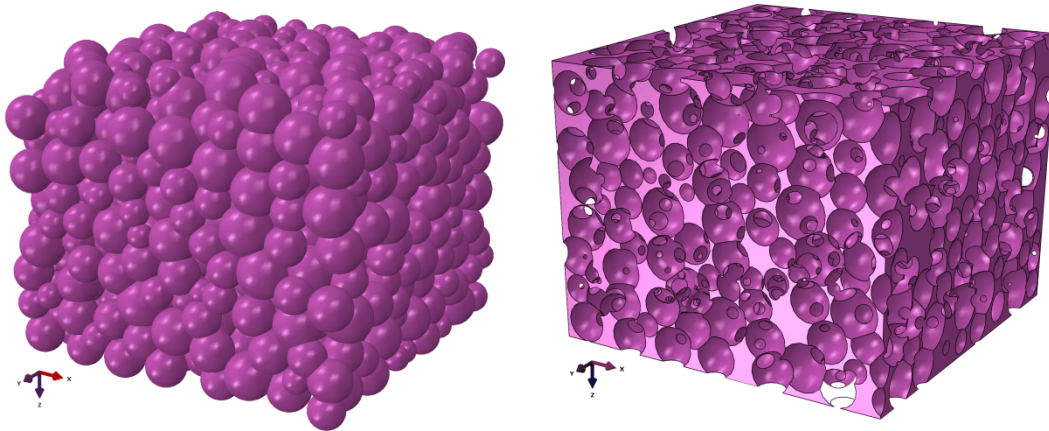


Figure 2. Sediment packing generated by discrete element model (*PFC 3D*) using in-situ data of grain size distribution and effective stress (left). Pore space of the sediment packing (right).

Subtask 2.3 Extraction of pore-network from sediment packing

The algorithm development for pore-network model extraction is initiated ahead of schedule.

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