Oil & Natural Gas Technology

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Quarterly Research Performance Progress Report (January - March 2014)

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

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SUMMARY

Task 1.0 Project Management and Planning
Done

Task 2.0 Pore Network Generation
Done

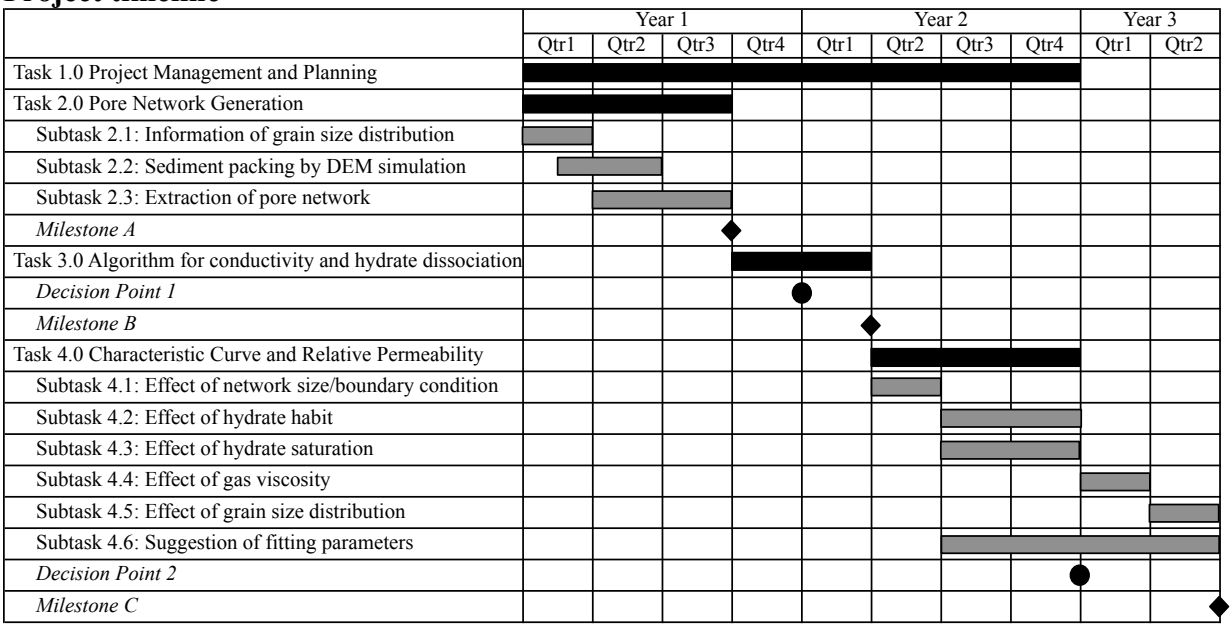
Task 3.0 Algorithm for conductivity and hydrate dissociation
Done

Task 4.0 Characteristic Curve and Relative Permeability
In progress

Subtask 4.1 Effect of network size/boundary condition
Done

Subtask 4.2 Effect of hydrate habit
In progress

Project timeline



Evaluation of the effect of pore-network model size

During the quarter from January 2014 to March 2014, the effect of pore-network model size on relative permeability data is studied by running simulations using several pore-network with different sizes.

Four different sizes of the pore-network models are generated: 1mm×1mm×1mm, 2mm×2mm×2mm, 3mm×3mm×3mm, and 4mm×4mm×4mm.

The below table and figures show the detailed information of four pore-network models and the distribution of pore radius of each pore-network model.

Table 1. Information of generated pore-network model

Network	Pores	Throats	max R (mm)	min R (mm)	average R (mm)	min Z	max Z	ave Z
1x1x1 mm	75	242	0.1958	0.0232	0.0865	2	18	5.71
2x2x2 mm	539	1794	0.2280	0.0237	0.0852	1	18	6.29
3x3x3 mm	1878	6269	0.2282	0.0210	0.0835	1	23	6.43
4x4x4 mm	4526	15282	0.2282	0.0219	0.0827	2	26	6.57

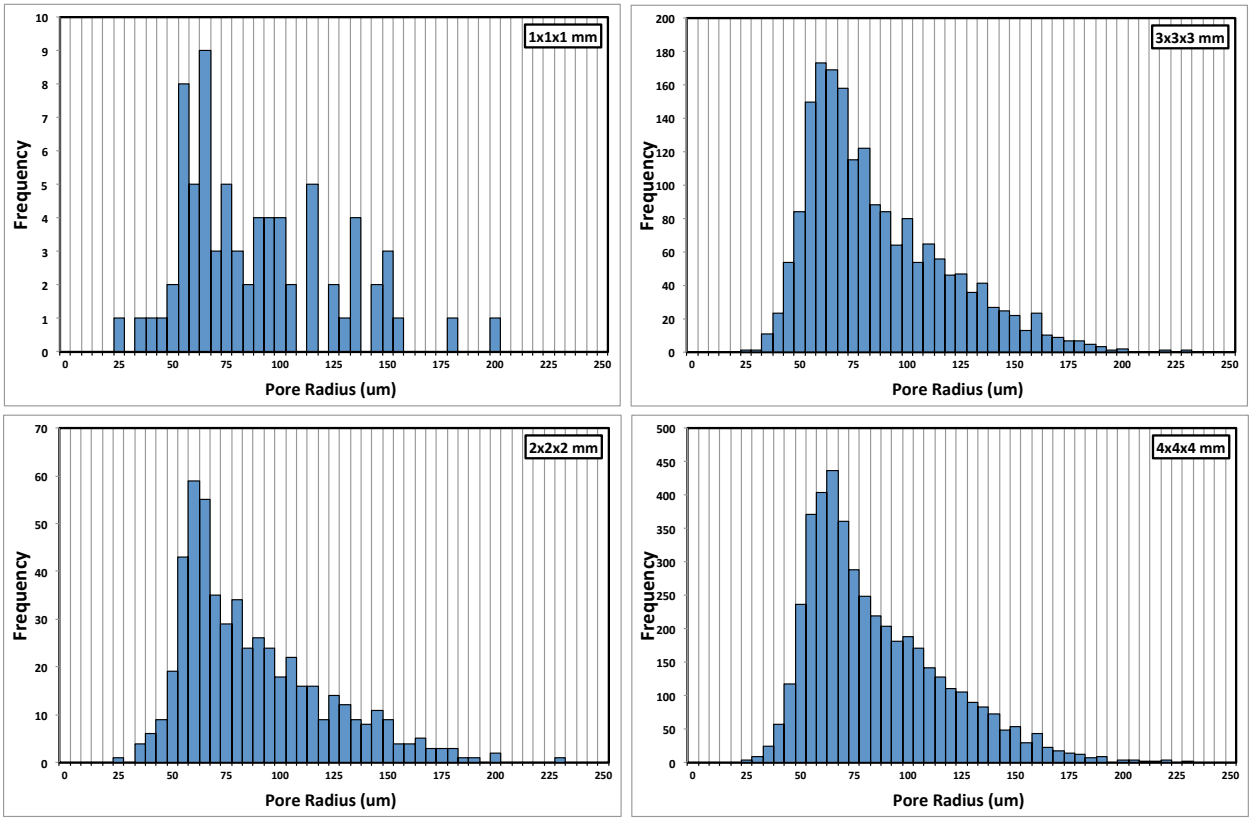


Figure 1. Histogram of pore radii of pore-network models

Ten simulations are performed for each pore-network model. Initial hydrate distribution is S_h=20%. Hydrates are assigned randomly to fill pores. Every simulation run starts with different location of hydrate pores. Pores are filled with either hydrate or water.

Figure 2, 3, 4, and 5 show the results of relative permeability simulation during gas expansion from hydrate dissociation. The pore-network models that have the size of 1mm×1mm×1mm and 2mm×2mm×2mm show very dispersed data points.

The subtasks under Task 4.0 will be performed using the pore-network model whose size is 4mm×4mm×4mm.

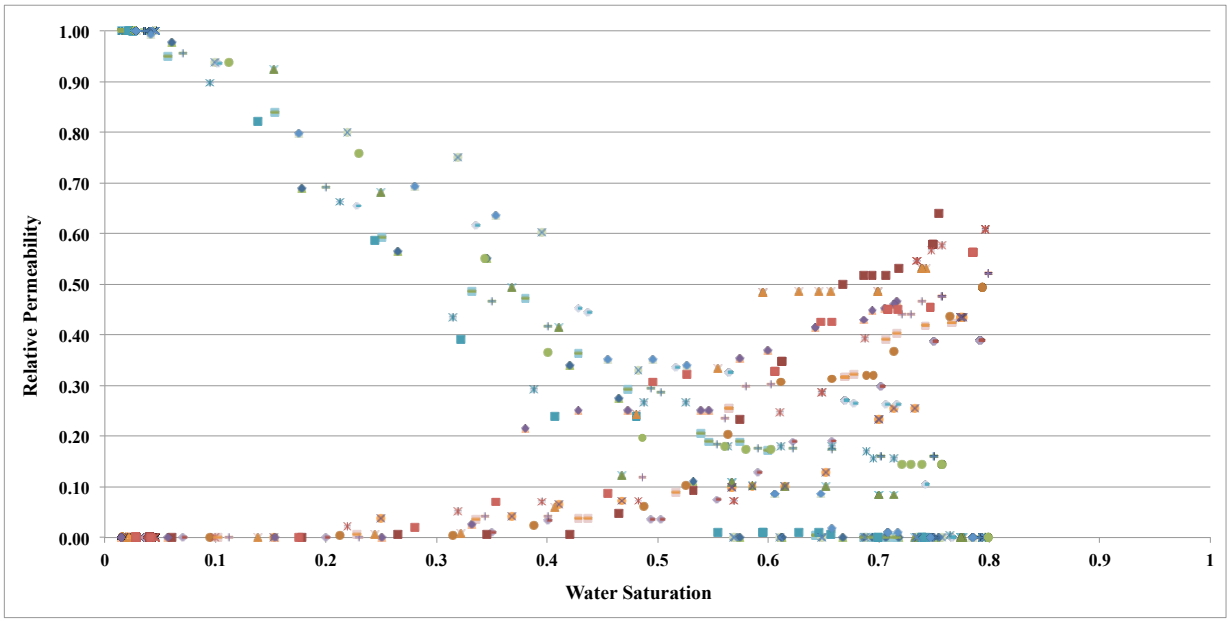


Figure 2. Relative permeability data obtained by using 1mm×1mm×1mm pore-network model.

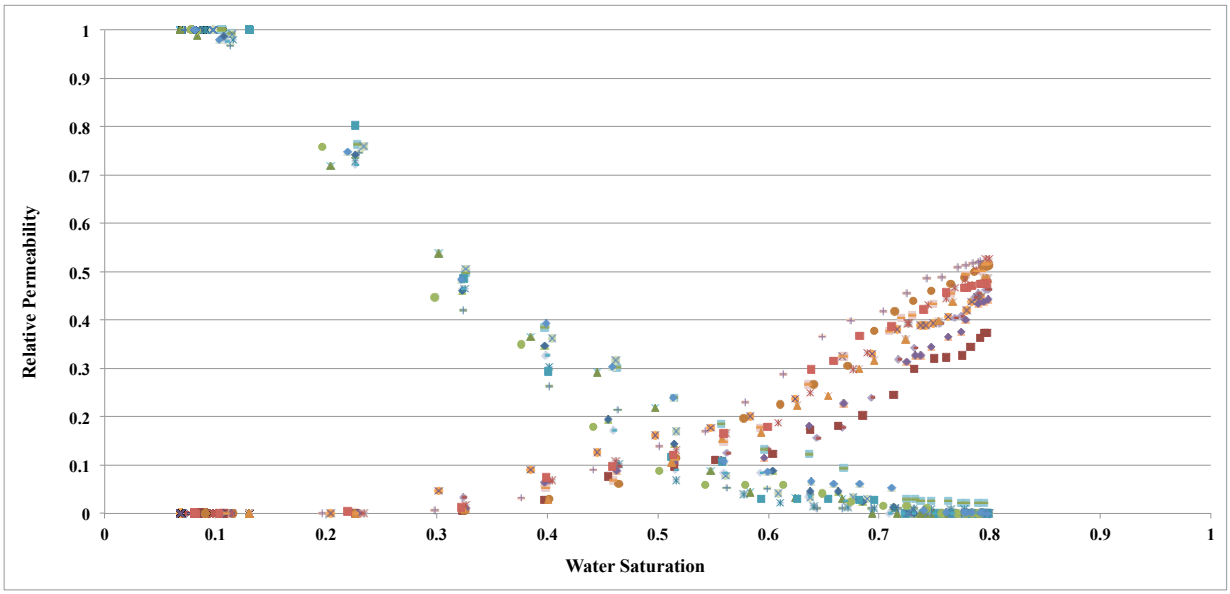


Figure 3. Relative permeability data obtained by using 2mm×2mm×2mm pore-network model.

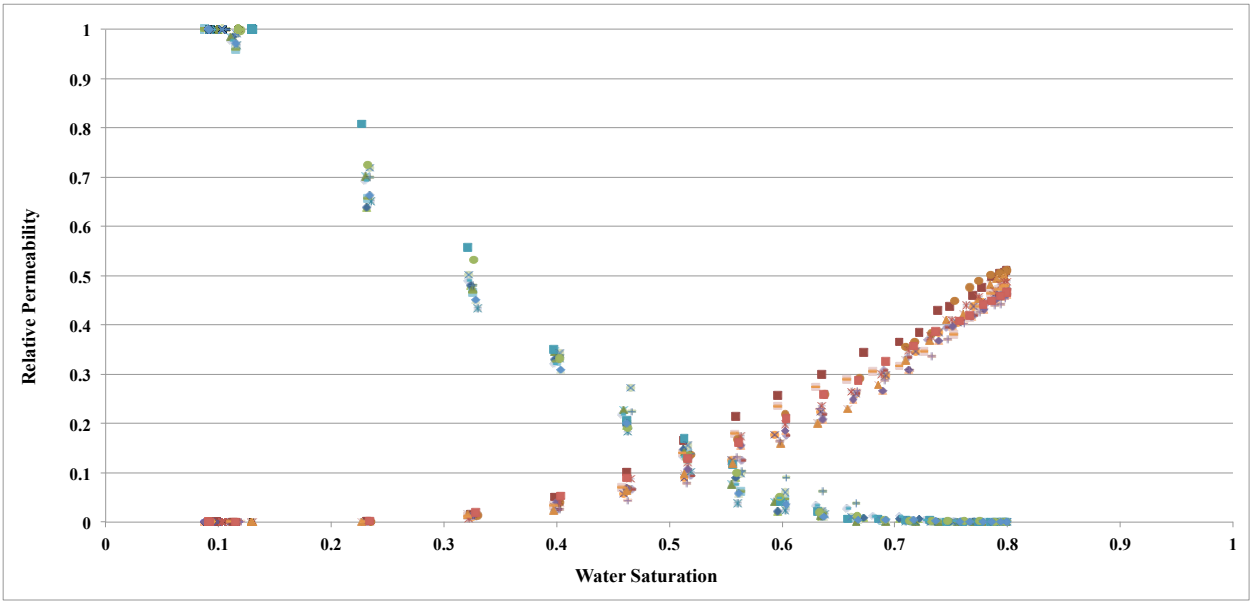


Figure 4. Relative permeability data obtained by using 3mm×3mm×3mm pore-network model.

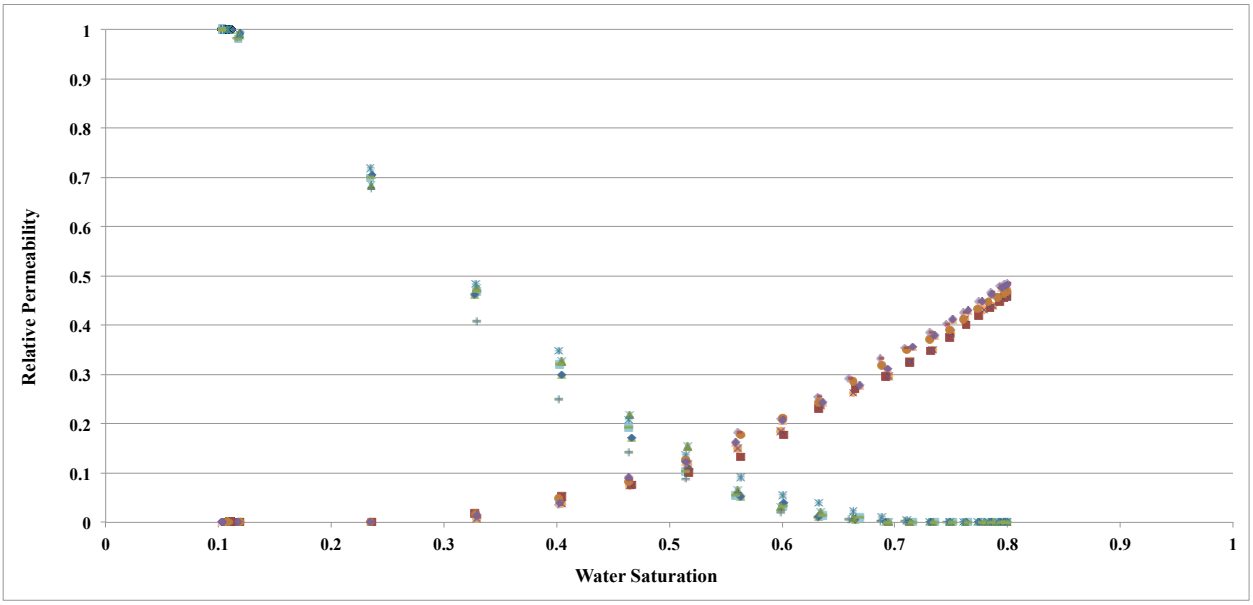


Figure 5. Relative permeability data obtained by using 4mm×4mm×4mm pore-network model.

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