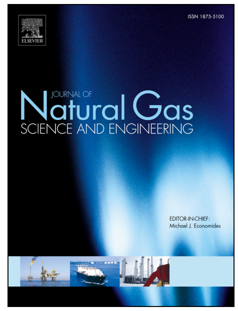

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Molecular Investigation of the Interactions of Carbon Dioxide and Methane with Kerogen: Application in Enhanced Shale Gas Recovery

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1. INTRODUCTION

The overall rate of gas production in the US has increased significantly in recent years due to increased gas production from shale gas plays. In year 2016, the total shale gas production rate in the US was over 40 billion cubic feet per day (Figure 1). However, the overall recovery factor from these shale gas plays is still only about 20% (U.S. Energy Information, 2013). The gas bearing shale rocks are sites of continuous gas accumulation rather than conventional reservoirs, and different approaches (other than hydraulic fracturing) are need to increase recovery. One of the main reason for low recovery factors and increased complexity in shale gas reservoirs is the presence of solid organic matter, known as kerogen (Vandenbroucke and Largeau, 2007). The kerogen is believed to be the precursor of oil and gas deposits found in the subsurface around the world. However, residual kerogen present in these rocks change the dynamics of gas storage and production. According to simple scaling laws, the surface area per unit volume is inversely proportional to the scale of the porosity in geometrically similar porous materials, and because of the nanoscale porosity of gas rich kerogen, the surface area per unit volume is very high, and hence adsorption on kerogen surfaces may play an important role in gas retention. The net attractive interactions between gas molecules and kerogen surfaces may lead to adsorption of