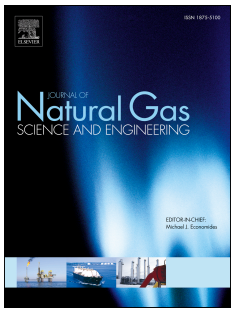
Accepted Manuscript



Parameter Determination for A Numerical Approach to Undeveloped Shale Gas Production Estimation: The UK Bowland Shale Region Application

Ukadike Nwaobi, Gabrial Anandarajah

PII: S1875-5100(18)30335-4

DOI: 10.1016/j.jngse.2018.07.024

Reference: JNGSE 2669

To appear in: *Journal of Natural Gas Science and Engineering*

Received Date: 5 September 2017

Revised Date: 24 June 2018

Accepted Date: 24 July 2018

Please cite this article as: Nwaobi, U., Anandarajah, G., Parameter Determination for A Numerical Approach to Undeveloped Shale Gas Production Estimation: The UK Bowland Shale Region Application, *Journal of Natural Gas Science & Engineering* (2018), doi: 10.1016/j.jngse.2018.07.024.

Parameter Determination for A Numerical Approach to Undeveloped Shale Gas Production Estimation: The UK Bowland Shale Region Application

Ukadike Nwaobi* and Gabrial Anandarajah[1]*

Abstract

The estimation of production potential provides the foundation for commercial viability appraisal of natural resources. Due to uncertainty around production assessment approaches in the unconventional petroleum production field, an appropriate production estimation methodology which address the requisite uncertainty at the planning stage is required to guide energy policy and planning. This study proposes applying the numerical unconventional production estimation method which relies on geological parameters, (pressure, porosity, permeability, compressibility, viscosity and the formation volume factor) as well as the rock extractive index (a measure of technical efficiency). This paper develops a model that estimates the appropriate values for four of these parameters based on a depth correlation matrix while a stochastic process guides two based on known data range. The developed model is integrated with a numerical model to estimate gas production potential. The developed framework is eventually applied to undeveloped shale gas wells located in the Bowland shale, central Britain. The results account for below ground uncertainty and heterogeneity of wells. A sensitivity analysis is applied to consider the relative impacts of individual parameters on production potential. The estimated daily initial gas production rate ranges from 15,000scf to 319,000scf while estimated recovery over 12 years is approximately 1.1bscf in the reference case for wells analyzed.

Key words: Unconventional Gas, Production Analysis, Production Forecast, Estimated Ultimate Recovery, Parameter Determination

1. Introduction

Well evaluation and its decline characteristics are fundamental to decision making in the petroleum industry; estimating recoverable cost-effective hydrocarbon reserves is of utmost importance to engineers, investors and policy makers (Statton, 2012). However, the recoverable reserve uncertainty creates a challenge for both policymakers and investors appraising the commercial viability of shale gas plays. The estimated ultimate recovery (EUR) is among the most contested topic amongst petroleum industry experts (Baihly *et al.*, 2010). HoL (2014) concludes that the economic benefits of unconventional gas development cannot be quantified without knowledge of the EUR. The early phase of shale gas development is uncertain and risky due to limited knowledge of the EUR (Weijermars 2013). Zou *et al.*, (2016) highlights shale gas resource assessment challenges to be typified by large uncertainties as well as complex geological, petrophysical and geochemical factors. Yuan *et al.*, (2015), based on statistics and analyses, states that there only few studies available that address input

*UCL Energy Institute, University College London, Central House, 14 Upper Woburn Place London; [1]Corresponding author, Email: g.anandarajah@ucl.ac.uk