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# Gas Shales: Advances in Production Analysis

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**Summary**

Increasingly, rate-transient (production data) analysis methods are being used to evaluate shale gas production in order to extract hydraulic fracture and reservoir information. Some of the complex reservoir behaviors that may affect the analysis procedure include:

- Low matrix permeability, which causes transient flow periods to be extensive
- Dual porosity or dual permeability behavior, due to existence of natural fractures or induced hydraulic fractures (or both)
- Other reservoir heterogeneities, such as multi-layers (interbedded sand/silt/shale) and lateral heterogeneity
- Stress-dependent permeability, due to a highly compressible fracture pore volume
- Desorption of gas from the organic matrix
- Multi-mechanistic (non-Darcy) flow - in shale matrix, caused by gas-slippage along pore wall boundaries and diffusion, or in the hydraulic fractures due to inertial flow

Additional factors affecting production data analysis from shale gas wells include the wellbore architecture used (vertical, deviated, horizontal, multi-lateral), and stimulation treatment chosen. Horizontal wells, completed in multiple stages, often using high volumes of low-viscosity fluid during the hydraulic fracturing treatment, are the development method of choice in shale gas plays today. The objective is often to create a complex fracture network (or "stimulated reservoir volume") that maximizes contact with the low permeability shale matrix. The complexity of the induced hydraulic fracture network will depend upon a variety of factors including in-situ stress orientation and magnitude, mechanical properties of the shale, shale fabric, existence of heterogeneities within the shale (healed natural fractures, or other planes of weakness) and of course the stimulation treatment itself.

The potential complexity in created hydraulic fracture network, combined with the aforementioned unique shale gas attributes, means that production data from shale plays are often difficult to interpret quantitatively. Further, additional data, such as microseismic and other surveillance methods (ex. production logs) are often required to constrain model choices and assist with data interpretation.

The purpose of this presentation is to review the state-of-the-art in rate-transient and production data analysis methods, as they pertain to shale gas reservoirs. An emphasis will be placed on the integration of data, and the geologic/reservoir/hydraulic fracture causes of the rate transient signatures observed.