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# Stimulation of Tight Gas Reservoirs Worldwide

Stephen A. Holditch, Texas A&M University



## Introduction

Tight gas is the term commonly used to refer to low permeability reservoirs that produce mainly dry natural gas. Tight gas reservoirs have one thing in common—a vertical well drilled and completed in the tight gas reservoir must be successfully stimulated to produce at commercial gas flow rates and produce commercial gas volumes. Normally, a large hydraulic fracture treatment is required to produce gas economically. In some naturally- fractured tight gas reservoirs, horizontal wells and/or multilateral wells can be used to provide the stimulation required for commerciality.

The best way to define tight gas is that "the reservoir cannot be produced at economic flow rates nor recover economic volumes of natural gas unless a special technique is used to stimulate production" (Holditch, 2006). Specifically, large hydraulic fracture treatments, a horizontal well bore, or multilateral wellbores must be used to stimulate flow rates and increase the recovery efficiency in the reservoir.

The optimum drilling, completion and stimulation methods for each well are a function of the reservoir characteristics and the economic situation. Some tight gas reservoirs are in south Texas, while others are in the deserts of Egypt. The costs to drill, complete and stimulate the wells, plus the gas price and the gas market affect how tight gas reservoirs are developed. As with all engineering problems, the technology used is a function of the economic conditions surrounding the project.

In this paper, I have chosen to focus on a few new areas of technology development that have come from research at Texas A&M University in the past several years. As one might expect, there is a lot of technical literature involving the two subjects addressed in this paper, which are stimulation and tight gas reservoirs. In fact, if you go to the SPE eLibrary and search on these key words, you will find there are over 1000 papers dealing with hydraulic fracturing and tight gas reservoirs. If would be impossible for me to attempt to deal with all aspects of these two subjects in this paper. However, there are two chapters in the SPE Petroleum Engineering Handbook (Holditch 2007a and Holditch 2007b) that can provide an interested party with a reasonably recent review of the technical material.

## Unconventional Gas Reservoirs Worldwide

Even though most of the production from tight gas and most of the technology used to develop tight gas reservoirs has been developed in North America, it is clear that the technology will be applied globally. In coming decades, the production of natural gas from low permeability gas reservoirs, coal bed methane reservoirs and shale gas reservoirs will be occurring in virtually every major oil and gas basin in the world.

### The Resource Triangle

The concept of the resource triangle was used by Masters to find a large gas field and build a company in the 1970s (Masters, 1979). The concept is that all natural resources are distributed log-normally in nature. If you are prospecting for gold, silver, iron, zinc, oil, natural gas, or any resource, you will find that the best or highest-grade deposits are small and, once found, are easy to extract. The hard part is finding these pure veins of gold or high-permeability oil and gas fields. Once you find the high-grade deposit, producing the resource is rather easy and straightforward. **Fig. 1** illustrates the principle of the resource triangle.

As you go deeper into the resource triangle, the reservoirs are lower grade, which usually means the reservoir permeability is decreasing or the hydrocarbon viscosity is increasing or both. As with other natural resources, low quality deposits of oil and gas require improved technology and adequate product prices before they can be developed and produced economically. However, the size of the deposits can be very large, when compared to conventional or high-quality reservoirs. The concept of the resource triangle applies to every hydrocarbon-producing basin in the world. One can estimate the