Cheeseburger Field, a Case for Integration

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Difficult to find petroleum resources and expensive drilling costs dictate the need for improved exploration methods. While improvement can be made by technically advancing individual methods, greater improvement comes from integration. Integrating existing technology the right way can dramatically improve drilling results.

Sylvain Pirson published applying probability theory to exploration integration in 1941. The concept was largely ignored until 2002 when Saunders, et al , resurrected the technique in a successful integrated exploration program. Simple probability theory predicts the integration outcome when individual exploration standalone probabilities are known.

The concepts are simple. For exploration we are interested in the probability of a successful well from integration of several independent techniques with different probabilities for success. The probability of any one of n independent events is given by

P(E1 or E2 or … or En) = 1-(1-PE1)(1-PE2)…(1-PEn)

In the case of exploration integration

P = 1-(1-PW1)(1-PW2)…(1-PWn)

PW1 is the probability of a successful well using technique 1. Then (1-PW1) is the probability of W1 not occurring (a dry hole). Multiplying the terms (1-PW1)(1-PW2)…(1-PWn) gives the probability of drilling a dry hole using integrated techniques. Subtracting that quantity from 1 gives the probability of at least one successful well.

For example, if we have 2 independent exploration methods with each yielding a wildcat well 50% of the time, the probability of a well from integrating both methods is

P = 1-(1-0.5)(1-0.5) = 0.75 = 75%

That is the power of exploration integration.

A case study of Cheeseburger field, Eastern Shelf of the Midland Basin, Stonewall County, Texas, USA, illustrates integration of 3D seismic, subsurface geological, and surface geochemical data to improve drilling results beyond those of any method used alone. In Cheeseburger field, 3D seismic and subsurface geology resulted in 4/7 = 57% successful wells. After integrating surface geochemistry, results improved to 4/5 = 80%.

Modern petroleum exploration is a multi-tool, integrated information science. Probability theory provides a simple means for predicting outcome of integrating independent exploration methods. Surface geochemistry often is the independent and complementary exploration method needed to complete this integration process.