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Integration, Probability, and Surface Geochemistry

Modern petroleum exploration is a multi-tool, integrated information science. While integrating disparate complementary exploration methods to predict reservoir properties remains a complex task, probability theory provides a simple means for integrating independent exploration methods. Surface geochemistry often is the complementary and independent exploration method needed to complete this integration process.

Simple probability theory predicts the integration outcome when individual exploration stand-alone probabilities are known. A case study of Cheeseburger field, Eastern Shelf of the Midland Basin, Stonewall County, Texas, illustrates integration of 3D seismic, subsurface geological, and surface geochemical data to improve drilling results beyond those of any method used alone. In this small field, 3D seismic and subsurface geology resulted in 4/7=57% successful wells. After integrating surface geochemistry, results were 4/5=80%.

Additional examples illustrate simple probability calculations provide other useful information. For example, we can calculate the number of wells needed for a 95% chance of making a well using a method, or integrated methods. Given a 40% chance of success on any single well, six wells have to be drilled.

Data shows US wildcat drilling success in the US are less than 20%. With increasing demands on precious few resources, these numbers must improve. Exploration integration uses existing technology, put together the right way, to dramatically improve drilling success. Surface geochemistry plays a key role in that integration process by supplying independent and complementary information about the petroleum system.