Applying Probabilistic Well-Performance Parameters to Assessments of Shale-Gas Resources

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In assessing continuous oil and gas resources, such as shale gas, it is important to characterize not only the ultimately producible volumes, but also the expected well performance. This is critical to any cost analysis or production scheduling. A probabilistic approach facilitates (1) the incorporation of variability in well performance within a continuous accumulation, and (2) the use of data from developed accumulations as analogs for the assessment of undeveloped accumulations.

In assessing continuous oil and gas resources of the United States, the U.S. Geological Survey analyzed production data from many shale-gas accumulations. Analyses of four of these accumulations (the Barnett, Woodford, Fayetteville, and Haynesville shales) are presented here as examples of the variability of well performance. For example, the distribution of initial monthly production rates for Barnett vertical wells shows a noticeable change with time, first increasing because of improved completion practices, then decreasing from a combination of decreased reservoir pressure (in infill wells) and drilling in less productive areas.

Within a partially developed accumulation, historical production data from that accumulation can be used to estimate production characteristics of undrilled areas. An understanding of the probabilistic relationships between variables, such as between initial production and decline rates, can improve estimates of ultimate production. Time trends or spatial trends in production data can be clarified by plots and maps. The data can also be divided into subsets depending on well-drilling or well-completion techniques, such as vertical versus horizontal wells.

For hypothetical or lightly developed accumulations, one can either make comparisons to a specific well-developed accumulation or to the entire range of available developed accumulations. Comparison of the distributions of initial monthly production rates of the four shale-gas accumulations that were studied shows substantial overlap. However, because of differences in decline rates among them, the resulting estimated ultimate recovery (EUR) distributions are considerably different.