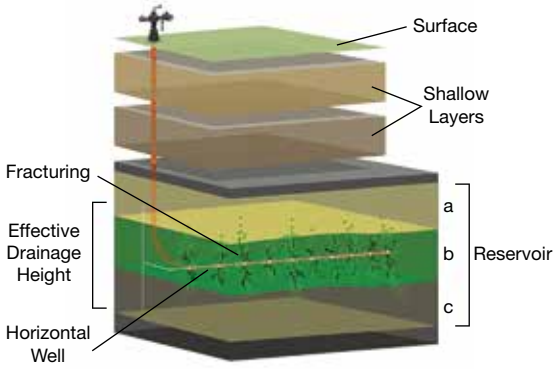
DNA Sequencing: A New Diagnostic Tool for the Oil Industry

The U.S. oil industry is trying to do more with less, as operators seek to maximize reservoir production during a period of low oil prices. Producers are looking for cost-effective technology advances that can give them a competitive advantage to maintain profitability. One such technology may come from an unlikely source: the Human Genome Project. The application of DNA sequencing in the oil industry provides operators with a unique perspective of subsurface reservoirs to help maximize production and minimize environmental impact.

The technology, a combination of DNA sequencing and advanced analytical software, is being developed for the oil and gas industry by genomics startup Biota Technology. DNA from microbial communities residing in hydrocarbon reservoirs can serve as natural tracers to track the flow of oil within a well and across a field. Modeling DNA sequencing data obtained from these microbes can provide novel insights about the oil reservoir. These insights provide information that helps operators place wells more effectively, with the ultimate goal of placing a maximum number of wells across a lateral and vertical horizon in a given acreage while preventing drainage overlap between neighboring wells.

The new technology would replace or complement diagnostic tools currently used to determine the best location to place a well, such as microseismic surveys, petrophysical logs, oil geochemistry data, and chemical tracers. While useful, these techniques were designed for conventional and offshore oil exploration, and are not ideal for low-permeability reservoirs such as those found in shale rock. The density of the data provided by these techniques alone is not adequate to explain the multivariate and heterogeneous nature of shale rock and accurately identify shifts in the flow of oil over an extended time. The resulting limited subsurface data is one of the main factors contributing to primary recovery rates of less than 10% of the original oil in place.

Called Subsurface DNA Diagnostics, the analysis technique developed by Biota involves first collecting well cuttings (rock shavings produced during drilling) directly from the drilling rig without disrupting operations. Oil samples are obtained from the wellhead, and then the microbes are extracted from the samples and their DNA sequenced using a next-generation sequencing (NGS) method.



▶ A diagnostic tool developed by Biota Technology uses DNA data obtained from microbes residing in the subsurface of oil reservoirs to track the flow of oil. Subsurface DNA Diagnostics creates a DNA baseline along a wellbore with cutting samples (red line in layers a and b). Data from the oil samples provides information on the vertical drainage height in the target oil layer (b) and shows whether the oil layers above (a) and below (c) the target layer are also being drained.

Data about the sequenced DNA provides information on the type and abundance of microbes within each sample. The data are analyzed with advanced machine-learning models to create statistical models that correlate the DNA data to subsurface depth and oil flow. The analysis characterizes different layers of the reservoir and also sections of the wellbore. Ultimately, the analysis reveals the movement of oil with accuracy and precision that enable better placement of subsequent wells in the field.

With support from the National Science Foundation's Small Business Innovation Research program, Biota has developed a robust oilfield workflow procedure and transformed this technology from an academic lab tool to a commercial service.

"We've applied this technique with several paying customers in 70-plus operating wells and various shale plays to help producers improve their well spacing and fracture designs," says Ajay Kshatriya, CEO and co-founder of Biota. "The early risk capital from the NSF, in conjunction with venture capital investors, has enabled our substantial technology progress to date."

"Biota is introducing the first new data source to the oil and gas industry in two decades," says Vik Rao, former Chief Technology Officer for Halliburton and now the Chief Technology Officer of Biota. "In a short time, the team has demonstrated a broad portfolio of high-impact applications."

According to J. C. Wan, geophysical advisor at EP Energy, "The DNA Diagnostics tool is being used to address real unmet challenges in our Permian Basin fields. The early results are promising, and if DNA sequencing can be proven to work, it would be a game changer for our company and the industry." CEP

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