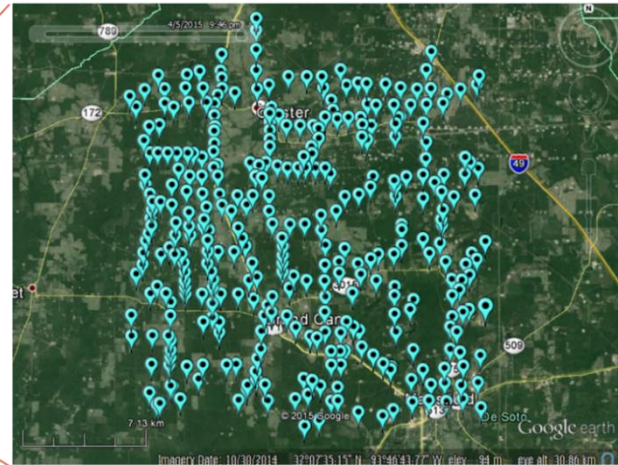
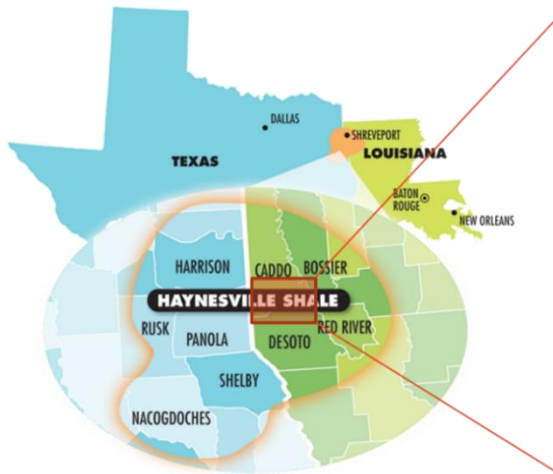


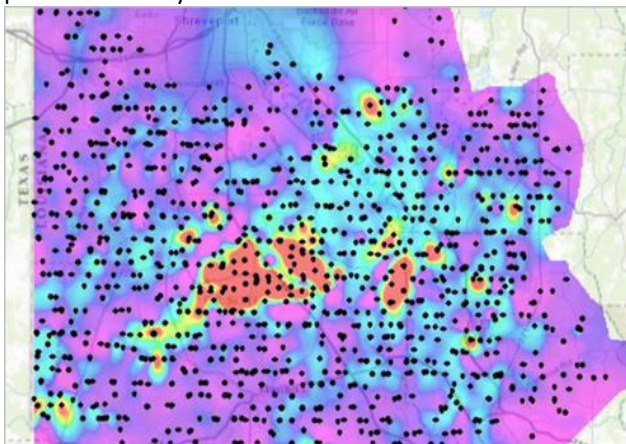
Maximizing returns on your shale asset - a Haynesville Case Study



Biodentify predicts sweet spots in shale plays with over 70% accuracy—prior to any wells being drilled. The following results show that Biodentify has successfully developed a cost-effective methodology that lets companies explore and develop a shale play using a highly prioritized drilling strategy.

Sweet spot prediction in the Haynesville Shale

Using a Haynesville Shale case study conducted for a midsize operator, Biodentify set out to validate our prediction ability.



- drilled wells
- contoured production rates

Contoured, production map based on well production data (average production rates over the first two years of production). The red areas are the top 10% performing wells

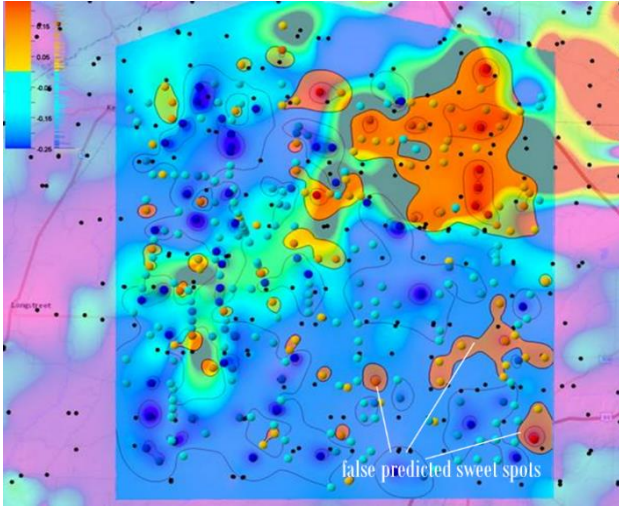
To do this, we selected an extensively drilled area having known production data. From here we took 348 shallow soil samples from a grid covering 16 miles square and then transported them to our Netherlands laboratories.

The Biodentify procedure of DNA extraction and sequencing delivered highly detailed DNA “fingerprints” for each of the many thousands of microorganisms per sample, creating terabytes of data.

Predictive analytics – Training the model to predict new locations

Biodentify has built an extensive database of soil DNA data from six shale plays across the US. First we match DNA fingerprints from comparable shale areas with those of the target; this is the training set.

The first iteration of our predictive analytics used only DNA fingerprints of the soil samples in the target area. Biodentify’s machine learning algorithm constructed a predictive model from the training DNA set in our database. For every soil sample in the target area the DNA fingerprint was then used to make a prediction whether it was a sweet spot. The results were contoured from existing wells on a map and overlaid on the actual production data. The accompanying visuals should make it clear that our predictive analytics have done a very good job in identifying existing sweet spots (see the large northeast sweet spot area that was predicted well). A few smaller sweet spots were incorrectly predicted in the southeast.



Bright colors: Predictive, contoured, sweet spot map based on soil samples only—no well data included.
Underlying: Main sweet spot correlates well with actual production data. Two small spots were incorrectly identified.

Improve predictions with targeted drilling

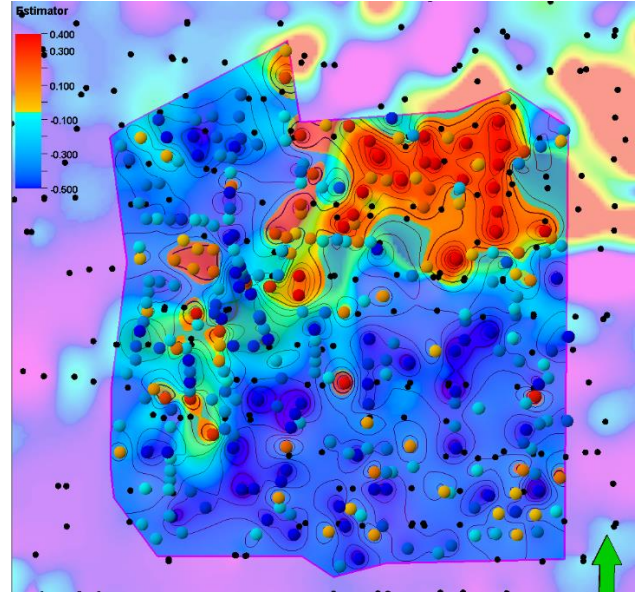
Our next step was to further improve the prediction map. Based on presumptive sweet spots identified from our initial results, we added production data from fifteen additional wells—all from the sweet spot areas identified by our initial map—to our machine learning algorithm. This step further trains the model. A greatly improved map is the result, now accurately predicting nearly all sweet spots.

Saves development costs of a play

In areas where Biodentify predicted no sweet spots prior to drilling, well production rates proved to either be low or indicated non-producing sites. Looking ahead, this means that using the company's patented process can save operators from spending wastefully on non-producers.

Used iteratively, this outcome demonstrates that Biodentify's DNA sampling technology—incorporating deep machine learning—greatly improves the efficiency of shale development, as summarized below.

- Without Biodentify – Of 97 wells drilled, only 27 were high producers (28% success rate).
- With Biodentify (using shallow soil DNA samples and machine learning) – 46 wells were “drilled,” of which 31 were top producers (67% success rate).



Highly accurate (86%), predictive sweet spot map derived from >300 locations where DNA analysis was carried out.
Underlying: Main sweet spot correlates well with actual production data.

We'll think you'll find these results to be extremely exciting, as they demonstrate the significant potential Biodentify technology brings to shale exploration. Subsequent studies and modeling efforts have shown that these results are reproducible. The prediction maps generated from DNA fingerprints of shallow soil samples form a very informative, additional information source (in addition to TOC, maturity, seismic, porosity and pressure maps) for exploration/production teams of operators.

Biodentify was founded as a spin out from Dutch R&D group TNO, in December 2014. TNO is a 3000+ R&D organization, hosting the largest Microbiological research group in the Netherlands. It is owned and managed by JOA Ventures, 3 partners with extensive entrepreneurial experience bringing innovative technologies to market in the Oil & Gas industry.

11111 Katy Freeway Suite 910 Houston,
77079 TX, United States of America
+1 (713) 444 9442

Delftechpark 25
2628 XJ Delft, the Netherlands
+31 (0) 15 2572796

info@biodentify.ai
www.biodentify.ai