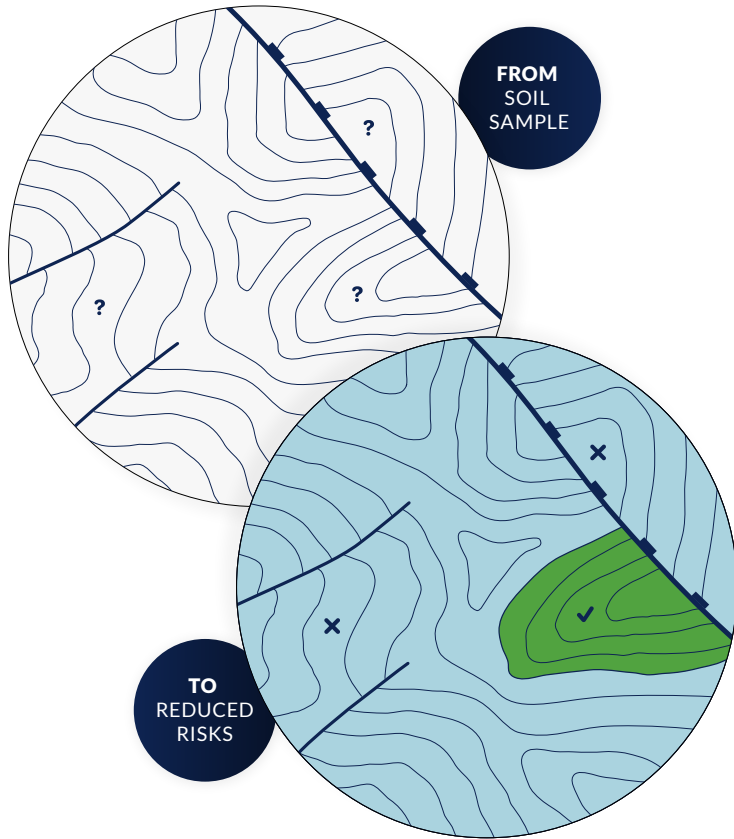


BIOIDENTIFY

DIRECT HYDROCARBON INDICATOR



MICROBIOME SURFACE EXPLORATION

**Minimize drilling risk,
Increase Probability Of Success**

Biodentify's patented technology uses the surface microbial ecosystem as a sensor to detect trace hydrocarbons, which are migrated from depth to surface through vertical microseepage, to predict the presence of hydrocarbon accumulations.

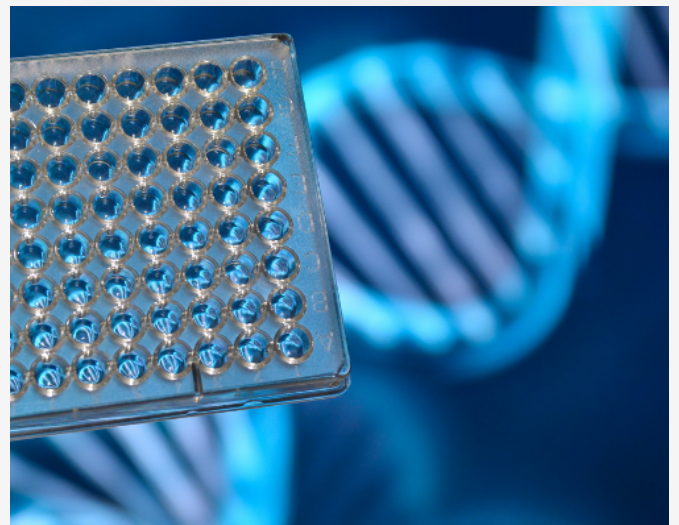
Geomicrobial exploration using DNA fingerprinting and machine learning

DNA FINGERPRINTING

Extract bacterial DNA from soil samples

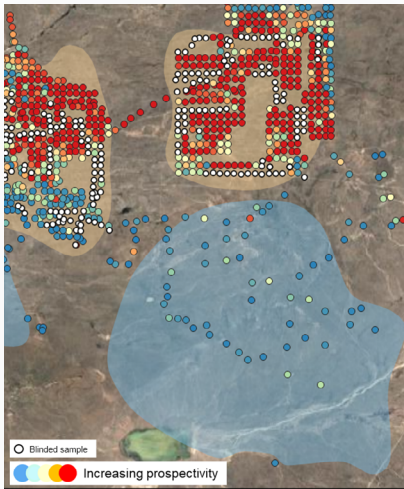
To study the microbiome, it is critical to get the highest possible quality DNA fingerprint of the microbial ecosystem. The extraction process of DNA from the soil is crucial. Biodentify's methods have been optimized during the processing of nearly 10,000 soil or seabed samples, a proprietary extraction protocol that minimizes contamination risk and maximizes the quality of the sequenced fingerprint has been developed. The 16S rRNA gene is used as a genetic marker for bacterial species, creating a full and all-inclusive DNA fingerprint.

Maximize DNA fingerprint quality



SOLUTIONS

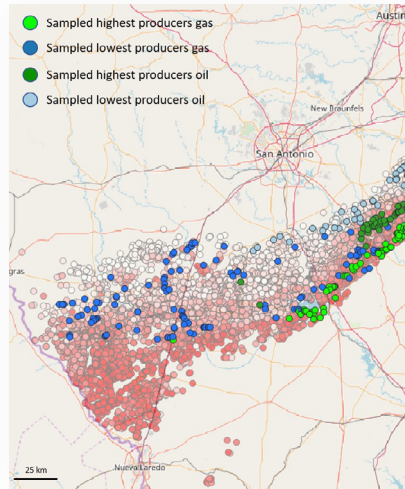
Conventional



Conventional targets in the Neuquén Basin

We de-risk conventional onshore prospects. This project was carried out for a European operator. 1100 surface samples were taken, spread over 1 active oil field, 1 active gas field, and 1 dry area. 300 samples were 'blinded'. A prediction model was trained based on the remaining 800 samples, 292 samples were correctly predicted.

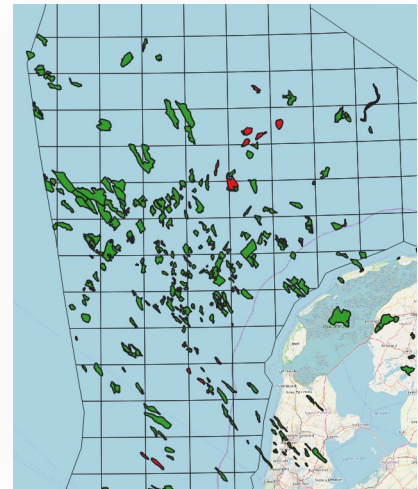
Unconventional



Unconventional targets in North Dakota and Texas

We pinpoint highly productive areas in shale plays. 540 surface samples were taken, in the Eagle Ford and Bakken shale, over wells that were either top or bottom 5% producers. 200 samples were 'blinded', from 340 samples a model was built. The blinded samples were predicted with 85% accuracy (high producer, or low producer).

Offshore



Predict dry/oil/gas based on North Sea cuttings samples

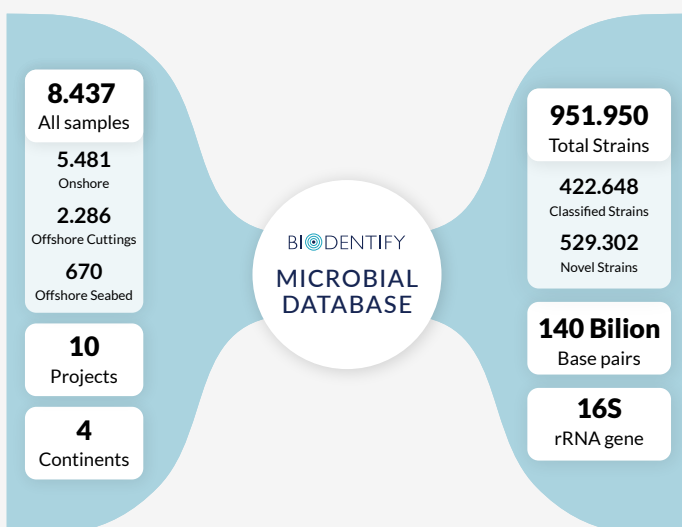
We rank offshore prospects based on POS. For this project, a database was built using samples taken from offshore cuttings. 1080 samples were analyzed for bacterial DNA, from either oil, gas, or dry wells. The model developed predicted with 82% accuracy whether the sample was from an oil or gas well, or a dry well.

MACHINE LEARNING

Use of our database to construct a model with AI

Analyzing the complete microbiome is a Sparse Data challenge that can only be solved with large compute power and advanced machine learning tools. Tens of millions of sequencing strings are to be filtered and denoised. Biodentify uses a SLURM powered high-performance GPU/CPU cluster and a highly automated and modular workflow with deep learning algorithms, tuned to solve our specific problem. Our methods are optimized to maximize predictability and minimize overfitting. A large, proprietary database with microbiome data is used to calibrate and train to achieve highly predictive models.

Construct a predictive database

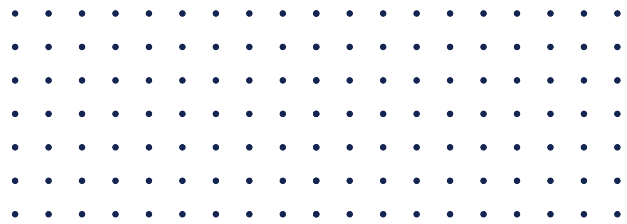


APPLICATIONS

1 Wildcat / Near Field Exploration

Explore prospectivity in a new area for future data acquisition or prioritized shale development. Sample area with a regular grid, pre (3D) seismic. Spacing dictated by expected field size (1-2km apart).

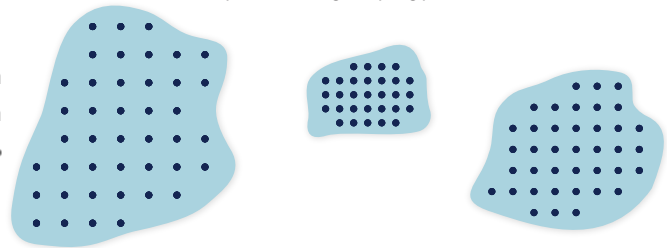
Wildcat / Near Field Exploration sampling pattern



2 Prospect de-risking

To de-risk prospects, high-grade portfolio, for exploration well decisions. Prospects have been mapped; limited data available. Sample prospects (min 30 per prospect, 250 to 350m apart).

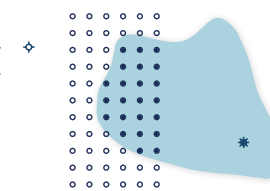
Prospect derisking sampling pattern



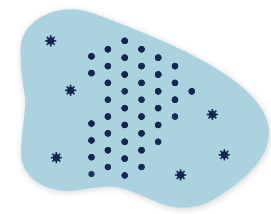
3 Delineation / Infill drilling

Delineate field or find target location for infill drilling. Existing discovery, prospect proven and mapped. Regular sampling pattern across expected boundary or Infill locations, high-resolution grid.

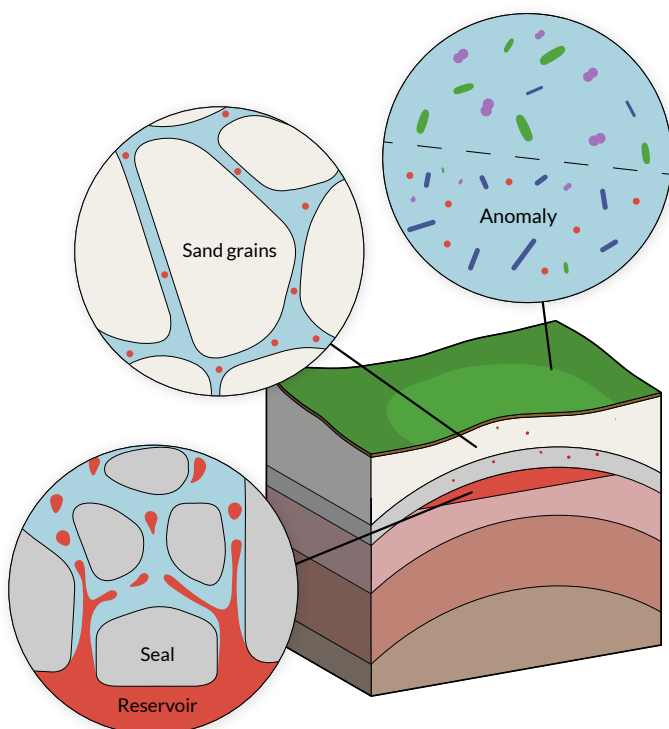
Delineation sampling pattern



Infill drilling sampling pattern



MICROSEEPAGE



Microseepage relates to charged reservoirs

Microseepage consists of colloidal size gas bubbles that move upwards vertically, due to buoyancy, with a speed that is $> 100-1000\text{m/year}$. The bubbles are generated in the transition zone of gas to water when the buoyancy pressure exerted by the gas is greater than the capillary forces in the water, allowing the gas to migrate into the water. Because this process takes place from nano- to micro-scale, the migrated volumes are negligible and therefore not always directly measurable, but they will affect the microbial communities in the soil. Some bacteria flourish as they metabolize the gas, while others find the new environment toxic and die out. These subtle differences, in the abundance distribution of some hundreds of species within the microbiome, form the signal used for Biodentify's predictions.

The microbiome as Direct Hydrocarbon Indicator

WORKFLOW

From a teaspoon of soil to predicting hydrocarbon accumulations

From sampling -1 ft below the surface - to the final report typically takes 2 to 4 months, depending on the size of the project - # of samples required and the area of interest. For onshore projects terrain type affects timing; offshore depends on access to appropriate vessels as samples are taken by drop coring for shallow to medium water depth, and ROV/AUV for deep water. The final report provides prospectivity predictions for all samples, and/or ranked prospects. Contoured maps are created for the area of interest.

Patented 4-step workflow delivers predictive map

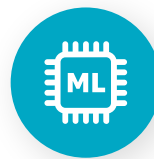
Patent EU/USA: 16713618.3



Soil Sampling



DNA Fingerprinting



Machine Learning



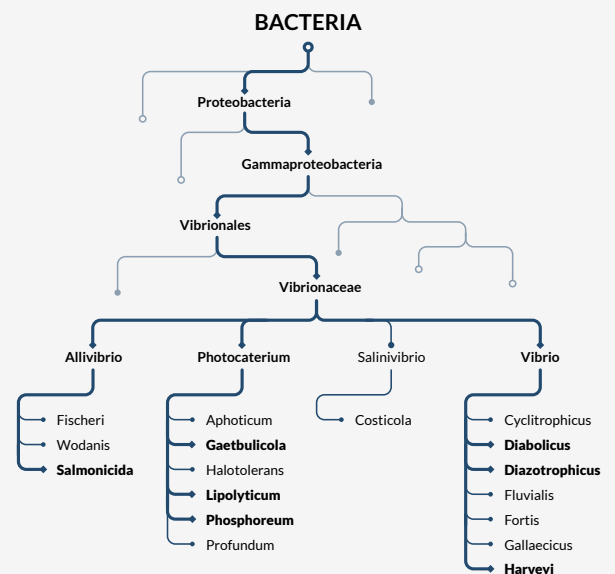
Prospect Mapping

NLP BASED LITERATURE MINING

Improve Data model with TAXONOMY

Natural Language Processing technology is used for the automatic mining of knowledge in scientific publications on the relationships of hydrocarbon gases and bacteria. This information is fed back into our models where clear hydrocarbon phobic microorganisms are identified. The methodology can also be used 'standalone', to identify relationships of bacteria and hydrocarbon gases, as pollutants, and use machine learning and taxonomy to monitor and predict outcomes. This is a vast area to explore and is currently actively being developed.

>80,000 scientific articles



ABOUT

Founded in 2015 as a spin-out from Dutch R&D group TNO, a 3000+ R&D organization with the largest microbiological research group in the Netherlands. In 2018 the company received the EU H2020 research and innovation - SME instrument programme grant, and was named the #58 most innovative company in 2019 by the KvK (Dutch Chamber of Commerce).

LEARN MORE

www.biodentify.ai/publications/

info@biodentify.ai
+31 (0) 15-2572796

Delftechpark 25
2628 XJ Delft,
The Netherlands

11111 Katy Freeway Suite 910
Houston, 77079 TX,
United States