DISCOVERING THE HYDROCARBON POTENTIAL OF THE DOMINICAN REPUBLIC
INTRODUCTION

In 2015 the Ministry of Energy and Mines of the Dominican Republic launched a project aiming to identify the commercial potential of existing hydrocarbons in the country. To achieve this objective, the following activities were carried out:

1. Collection of existing technical data to prepare the data packets belonging to each oil basin. These data packets are available for consultation in a specialized database.

2. Creating the necessary geological models using specialized applications such as Petrel and TechLog.

3. Generation of the petroleum system model for Enriquillo, San Juan, Azua y Llanura Oriental basins using PetroMod as specialized application.

The project results will enable the government of the Dominican Republic define the petroleum hydrocarbons policy for the coming years.
### DATA PACKAGES

Data packages are composed mainly with geological, geophysical and cultural information. All data were prepared and treated with the highest quality control. The data packet inventory can be produced by well and / or basin. Also databases are available in specialized applications such as Petrel, TechLog and Petromod.

The following table shows for each data type its corresponding amount of records. Products generated in Petrel, TechLog and PetroMod are not included in the list.

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<th>Data Types</th>
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<td>Conventional core acquisition</td>
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WORKFLOW

The methodology followed for Petroleum Systems Modeling at each Dominican Republic basin required the integration of all available geological and geophysical information and it follows the next stages:

- **Tectonic-structural conceptualization.** From the integration of well data, electric logs, stratigraphic tops, seismic lines and existing bibliographic information, the data was consolidated in the Petrel© platform for further seismic interpretation and static modeling.

- **Structural Modeling.** With the seismic and well data available, the main geological events were identified in order to be interpreted depending of the quality and digital formats. In the case of wells with missing logs or no Petrophysical evaluation, these data were estimated in the Techlog© platform. The seismic interpretation was the basis for the structural model generation in Petrel© (Static Model).

- **Petroleum System Modeling.** Taking as input the Static Model from Petrel© and the well information for porosity and thermal calibration, a Petroleum System model is built on the platform PetroMod©.

- **Plays Analysis.** Having generated the petroleum system modeling, we proceeded to analyze their elements and their successful probability.

In terms of products generated at each stage and its integration into the petroleum system modeling, the process can be summarized as follows:
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PETROPHYSICS

In the case of Dominican Republic, this stage assumed even more significant importance as it allowed the estimation or completing of missing information. This data was crucial for the generation of synthetic seismograms and for the distribution of properties in the models.

The petrophysic phase includes 3 stages:

• **Gathering and integration of data**
  Each well report were reviewed and consolidated in a database within Techlog© with the information of geological tops, names, families and units of each variable and the logs were edited.

• **Homologation and estimated Tops**
  The homologation and estimation of regional stratigraphy was carried out using existing wells in the Enriquillo Basin and applying as criteria the electrical marks, analogies between wells, lithological descriptions and correlations between geological formations at different sedimentary basins.

• **Petrophysical Evaluation**
  The petrophysical evaluation of the wells were carried out in the platform Techlog©.
  For the support of other stages of the project, some information was estimated with the existing data available:
  
  • Spontaneous potential (SP) normalization
  • Calculation of Neutron (NPHI)
  • Calculation of synthetic curves of DT & RHOB to complete intervals and generate synthetic seismograms (Neural Networks and correlations were used)
  • Estimation of synthetic Neutron intervals (using neural networks)
The petrophysical parameters were estimated for each well using the Pickett chart. SP, GR and Resistivity: For the calculation of Volume of Shale, a sensitivity analysis was performed with different combinations of logs: SP, GR and Resistivity. For the calculation of Effective Porosity, a sensitivity analysis was performed between different logs: Density, Neutron and Sonic according to the information available at each well. For the Water Saturation estimation, the Simandoux model was applied.

At the end of the Petrophysical stage, a set of information with basic logs, lithological description, petrophysical evaluation and geological markers were generated for each well.

**STATIC MODELING**
The Static Model was built in the Petrel© platform following the stages and activities shown below:

- **Seismic Interpretation**
  - Loading and conditioning the data
  - Synthetic seismogram generation
  - Interpretation of faults and horizons

- **Velocity Modeling and Depth Conversion**
  - Velocity model construction
  - Depth conversion

- **Structural & Properties Modeling**
  - Structural Model
  - Facies Model
  - Properties Model
The results are presented by Basin.

**Enriquillo Basin**
The seismic interpretation of the Enriquillo basin allows the identification of some structures that could be of interest from a prospective point of view:
Potential structural traps generated by a transpressive phase and potential stratigraphic traps associated with conformable sequences and associated to unconformities.

The Static Model was generated for the entire basin and was populated with Petrophysical data previously generated for the wells available:
WORKFLOW

San Juan Basin
The information available in this basin allowed the generation of a Velocity Model to Depth convert the 2D transects.
In the seismic sections it was able to identify structures developed against reverse faults and that could be of interest from a prospective point of view.
WORKFLOW

Ocoa Bay Basin
In this basin, the interpretation of the main seismic events was done and allowed the identification of some anticlinal structures against reverse faults oriented NE-SW.

Cibao Basin
In this basin, the Arroyo Blanco, Angostura, Trinchera and Sombrerito top formations were interpreted. The interpretation of faults and horizons was carried out in time domain and some anticlinal structures that could be of prospective interest were identified.
WORKFLOW

San Pedro Basin
The interpretation of the sections was supported by previous studies in the basin and existing publications. The sedimentary fill of the San Pedro basin can be grouped in different sections. The top of the seismic section is interpreted as a “Sheet-like” system consisting of well-defined levels. Below this first filling level, we interpreted a deep turbidity system, consisting of alternating shale and sand deposits. Finally, the deepest section could be interpreted as a possible submarine turbidity fan system. All the horizons and faults were originally interpreted in the time domain.

PETROLEUM SYSTEM MODELING
In terms of the elements that constitute it and the technologies used, the petroleum system modeling is summarized as follows:
The petrophysical parameters were estimated for each well using the Pickett chart. SP, GR and Resistivity: For the calculation of Volume of Shale, a sensitivity analysis was performed with different combinations of logs: SP, GR and Resistivity. For the calculation of Effective Porosity, a sensitivity analysis was performed between different logs: Density, Neutron and Sonic according to the information available at each well. For the Water Saturation estimation, the Simandoux model was applied. At the end of the Petrophysical stage, a set of information with basic logs, lithological description, petrophysical evaluation and geological markers were generated for each well.

**Azua Basin**

During the Petroleum System modeling of this basin, two Plays (reported in multiple public references) were identified and a new, deeper, Play is proposed within the Oil generation window.

Analysis of petroleum system elements:

- **Source Rock.** The quality and maturity of source rocks of Trinchera and Ocoa are low, but the models suggest the potential of source rocks at deeper depths that should be confirmed with new wells.

- **Reservoir Rock.** Good quality, represented by sands and conglomerates.

- **Seal Rock.** Good quality of Sombrerito formation, constituted by loams. Arroyo Blanco shales may be less compact. The presence of active faults to the top of the structures affects the quality of the seals.

- **Trap.** Despite of the existing seismic lines were acquired in the mid-80’s, we can observe some anticline structures generated against inverse faults that could act as traps if the closure of the structure is confirmed with new data.

- **Sync.** There is synchrony in the geological processes but there is some uncertainty in the level of generation, which could be confirmed with the acquisition of new data.
WORKFLOW

San Juan Basin
This model is based on the technical information of the well Candelón -1. During the Petroleum System modeling of this basin, two Plays (reported in multiple public references) were identified and a new, deeper, Play is proposed within the Oil generation window (Eocene).

Analysis of petroleum system elements:

• Source Rock. The quality and maturity of source rocks of shallow Formations Trinchera and Neiba present uncertainty due to the limited data; however, there is a potential at deeper depths as suggested by our models

• Reservoir Rock. Along the column of Candelón-1, small layers of good quality rocks are present; however it requires a detailed definition in the lateral facies distribution. With the scenario evaluated, limited accumulations in the Neogene levels are observed but is not excluded the existence of stratigraphic traps between the existing wells, especially considering the geological history of the basin

• Seal Rock. Good quality of Sombrerito formation. Arroyo Blanco shales may be less compact

• Trap. Despite of the existing seismic lines were acquired in the mid-80’s, we can observe some synclinal structures that could act as traps if the closure of the structure is confirmed with new data. As indicated before, there are good possibilities exploring for stratigraphic traps

• Sync. There is synchrony in the geological processes but there is some uncertainty in the level of generation, which could be confirmed with the acquisition of new data
**WORKFLOW**

**Enriquillo Basin**

Trinchera, Sombrerito and Plaisance were defined as source rocks for Enriquillo basin petroleum system

The source rock of the Trinchera formation is between the stage of immaturity and the oil early generation toward the central portion of the study area.

The source rock of Sombrerito formation is among the early and middle stages of hydrocarbon generation. The source rock of Plaisance formation is among midle and late maturity stage of the oil generation and early generation of gas

Accumulations in the three source rocks indicate that the systems behave as closed.
In order to perform sensitivity analysis, various scenarios were simulated by modifying the properties of the source rock and the geological faults and doing some change to the facies.

The traps might consist in some structures identification in the seismic available. There are also some potential stratigraphic traps associated with conformable sequences and associated to unconformities.

Temperature and maturity of Source Rock are low, but deeper source rocks could be present and need to be confirmed by deeper wells.

Llanura Basin (San Pedro-1)

According to the results of the 1D model it is inferred that the Oligocene source rock must be at a depth between 3,500 and 4,000 meters to reach the maturity of oil generation stage.

The well San Pedro-1 showed manifestations of Hydrocarbons, suggesting that the petroleum system works in this area.

**Source Rock Maturity**
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SUMMARY

Although the 2D seismic information available was acquired in the mid-80s, it allowed the identification of some structures and stratigraphic features that could be of interest from a prospective viewpoint, especially in those basins that have proven the existence of an active petroleum system. New seismic acquisition would be advisable in order to define more precisely those structures.

Because existing wells are shallow, it is not possible to check the lithologic, stratigraphic, temperature, and pressure information. Acquisition of this information would enable:

a. Identification of the deepest Play generators.

b. Conducting new geochemical analysis to identify the quality of source rocks.

c. Specialized laboratory tests to generate transformation kinetics “organically hydrocarbons matter.”

d. Finally, it will be possible to upgrade existing petroleum system models and therefore decrease the uncertainty in some basins.

The new vision of the Ministry of Energy and Mines is the consolidation of the oil industry in the Dominican Republic, considering the beginning of exploration activities in the medium term, sustained in bidding processes.