D-16 TUNISIA OFFSHORE A BASIN MODELLING ASSISTED EXPLORATION HISTORY

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INTRODUCTION

During mid 90's a basin modelling application was performed on the Tunisian Offshore in order to evaluate the residual potential, by using a 3D code applied in 2D along some regional depth converted sections. The lack of a full and proper regional seismic coverage did not permit a complete regional mapping of the whole sedimentary record necessary for a 3D application

PREVIOUS EXPLORATION HISTORY

The Tunisian offshore can be considered a quite mature area with a long exploration history dated from 19XX and the discovery of several fields Oil and Gas bearing. In the early 90's the drilling of two dry wells demonstrate the problems relating in developing the residual HC potential of the basin. The relevant post-mortem analysis outlined the problems related to HC charging and the necessity of a proper reconstruction of the petroleum system of the area.

SIMULATION PIPELINE

The simulation was performed by a multidisciplinary task force organised in the Exploration and R&D department in order to validate and upgrade the company's advanced 3D basin modelling code **SEBE3** (**SE**dimentary **B**asin **E**valuation in **3** **D**imension).

This code has been developed with the aim to provide explorationists with an effective tool to evaluate the petroleum system of a sedimentary basin, with the final goal to reconstruct the charging history of each prospect, and the hydrocarbon phase definition.

The reconstruction of the geological processes that characterise the basin evolution requires a multidisciplinary approach; several models must be developed to discretise a sedimentary basin and its evolution through time: a **geological model**, a **hydrodynamic model**, a **thermal model** and a **geochemical model**. Those models have to be integrated and quantified, developing the **numerical model** of the subsurface necessary to perform a basin modelling evaluation.

Once the burial history of the basin was reconstructed the temperature and pressure histories and the final source rocks maturity was computed.

The objective of the code is to integrate the physical and chemical laws for hydrocarbon generation with the geological basin dynamics in a three-dimensional time dependent simulation.

This is obtained in three steps each one corresponding to a particular software of the company basin modelling pipeline, devoted to the simulation of particular geological process.

A backstripping module used for the definition of basin burial history coming from a structural interpretation and restoring with a **Backstripping by Scenarios (BBS)** approach.

A pressure and temperature module where water flow evolution in time and space is computed permitting to take into consideration the **3D Conductive and Advective** effects.

A geochemical module that considers the hydrocarbon generation processes happening in an **Open System** with the computation of the hydrocarbon volumes expelled by the source rock.

A migration module capable to reconstruct the migration pathways and the drainage areas of each prospect permitting the definition of the **Charging History**.

SIMULATION RESULTS

The simulation exercise permitted to define that the main source of the Fahdene fm is the main source of the area and is in the gas generation phase in the kitchens located along the main Plio-Quaternary graben . A gap seems to exist between generation and expulsion processes and only one expulsion pulse involving both oil and gas was recognised.

One of the main geological features affecting hydrocarbon distribution within the petroleum system are the Plio-Quaternary half graben distribution which can determine seal juxtaposition on its steep side. A second important aspect is the Upper Miocene structuration phase that can be considered a good trapping mechanism being before the main hydrocarbon production phase.

The last Plio-Quaternary structuration phase can provide a risky trapping mechanism determining dismigration of previous trapped hydrocarbon or lack of closure when the hydrocarbon reaches the prospect area.

This kind of consideration was used to select the most perspective sectors of the Tunisian offshore were the condition for hydrocarbon entrapment were contemporaneously satisfied . those conditions area vicinity to the expulsion area, timing of structuration and absence of major hydrodynamic constrains.

The above condition was also verified numerically with a secondary migration test on the main carrier beds of the area, with the reconstruction of the charging history.

The results were used to plan the future exploration activity in the Tunisian offshore.

EXPLORATION RESULTS

The results of the basin modelling simulation permitted to evaluate the residual petroleum potential of the area in order to give some guidelines for the proceeding of the company's exploration activity in this sector of the Tunisian Offshore.

The sectors of the basin showing a good time relationship between structuration and HC production phases and with an reliable charging mechanisms were outlined and kept for further exploration activities. In the early phases two prospect were drilled resulting both HC bearing, and encouraging the further development of the area. The HC phases reservoir was in agreement with those resulting from the basin modelling simulation, supporting the reliability of the methodology applied.