SBGf19499

Multi-Disciplinary and Cross-Functional Geophysical Integration, Campos Basin, Brazil

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Abstract

Petrobras, anticipating the de-monopolization of the oil industry in Brazil, offered blocks for joint venture participation to international oil companies. This paper is a presentation of work done by one company and the approach to technical project management used in this evaluation. Specifically, the focus is on geophysical technologies, their integration and use in addressing petroleum systems elements and the associated risks.

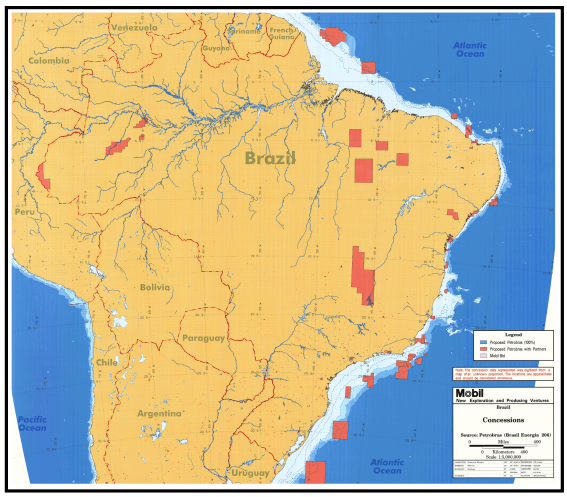
INTRODUCTION

In 1997 Petroleo Brasileiro S.A. (Petrobras), the national oil company of Brazil, offered fifty-seven exploration and ninety-two producing opportunities for joint venture projects to the international Oil and Gas Industry (Figure 1). The opening of acreage in a prolific basin to free market conditions created interest for companies possessing both functional and human resources needed to undertake projects of this magnitude. Petrobras allotted approximately two months for an initial evaluation and determination of prospectivity. If a company expressed interest on a block after the initial period, an additional two months were allotted for more detailed analysis. This paper is a result of the multi-disciplinary and cross-functional work done by Mobil Oil Corporation Inc., New E&P Ventures in evaluating several offerings in Brazil. The focus is on the geophysical aspects of the evaluation.

More importantly, this is also the story of how geoscientists work together in today's world of smaller upstream organizations. Business drivers, such as shortened exploration and development cycle times, are key success factors. Availability of in-house manpower resources, project management skills, financial capabilities, project visibility, and strategic direction were critical elements for pursuing this opportunity.

Seismic interpretation normally dominates an exploration evaluation. However, in today's world the integration of all disciplines must be incorporated into the evaluation including developing a depositional model, tying the geological data to the seismic, constructing seismic depth maps, delineating prospects leading to an economic evaluation. One of the key steps of a petroleum geophysicist's work in evaluating an exploration opportunity is the determination of the project's hydrocarbon potential. In addition, how it stacks up against the remainder of the companies' worldwide portfolio must also be assessed. And it all had to be done in four months!

Figure 1: **Location Map of Petrobras' Joint Venture Offerings**



METHOD

The methodology for completing such an intensive project as outlined above in the time period given, and to give the evaluation adequate scientific treatment, is through multi-disciplinary and cross-functional integration. The vision is a matrix structure with several multi-disciplinary teams working in tandem with several cross-functional teams. Project management is a key element that enables timely completion of all technical work required for a quality evaluation and works well in this team environment. This is in contrast to projects where individual contributors work in isolation, reuniting at the conclusion of their efforts. The team concept is a procedure utilized in some companies, where manpower resources must be fully utilized and time is of the essence.

Definitions of multi-disciplinary and cross-functional team concepts are given below for clarity. Webster defines "discipline" in this context, as a specific subject that is taught. The term "function" is defined as, one of a group of related actions contributing to a larger action. Therefore, my usage of the term "Multi-Disciplinary Team" is meant to denote a group of generalists or persons knowledgeable of several different subjects. This includes but is not limited to a geophysicist, a geologist, an engineer, a financial planner/economist, a lawyer/negotiator and a manager (Figure 2). My usage of the term "Cross-Functional Geophysical Team" is meant to denote a group of specialists. This includes, but also is not limited to the following geophysical functional specialties: amplitude variation with offset (AVO), attribute analysis, seismic reprocessing, rock physics, modeling, petrophysics, sequence stratigraphy, visualization, and interpretation

(Figure 3). The organization specifically used for this Brazilian evaluation was two multi-disciplinary teams working with one cross-functional geophysical team. This structure was a result of the project's focus being on different blocks, while the concentration was on the petroleum system elements that were common to both. Since almost all of the petroleum systems elements were similar, only small differences in technical applications were necessary.

Figure 2: Multi-Disciplinary-Generalists Team

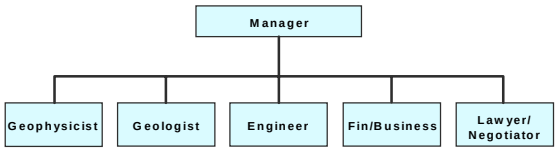
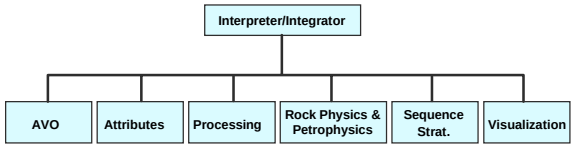


Figure 3: Cross-Functional Geophysical-Specialists Team



The first order of business was to establish a team of generalists to determine directionally how to handle the project. As the scope of the project became clearer, planning became more concrete. Initially, certain individuals played specific roles in the project planning, which over time and as the evaluation proceeded, these roles, responsibilities and associated time commitments fluctuated. As data was received, technical resources actively became involved in the project, while the managers' and planning roles decreased. Once the geophysical and geological reports were complete, the engineers, lawyers and negotiators went into high gear, with bid submittals, determination of terms, and familiarization with competitors for determining a strategy to win.

The following is a brief discussion of the different geophysical functions and technologies used in this evaluation, how they were integrated for reduction of exploration risk, and finally the bottom line impact on the exploration cycle. Elements of the petroleum system are discussed with the associated risks and the technical geophysical work done to either reduce risk or understand the risk. This paper is not meant to be an in-depth treatise on any one individual geophysical exploration tool, but a discussion on how these tools can be used in conjunction with other tools in assessing the exploration potential of an area.

DATABASE

Database issues directly impact the type and volume of work that can be done in an exploration effort. The availability of data in an exploration evaluation can be contrasted with exploitation or producing projects and the associated quantity and quality of data available for each. Two-dimensional versus 3D seismic data, a single composite log versus suites of logs for multiple wells, and no pressure information versus production profiles are all possible data variations.

The data set provided for analysis in this project included the following.
- 3 x 3 km to 10 x 10 km seismic grid
- Paper and digital copies of the seismic data (quality was fair to very good)
- Raw seismic field data on two seismic lines
- One dry well closest to the block with a check shot survey
- Composite log, including gamma ray, induction, and sonic logs
- Summary report on the regional geology and prospectivity of the block

Low exploration activity and resulting paucity of data placed these types of projects into the frontier portion of the Oil and Gas Industry's Lifecycle, automatically denoting higher associated risk.

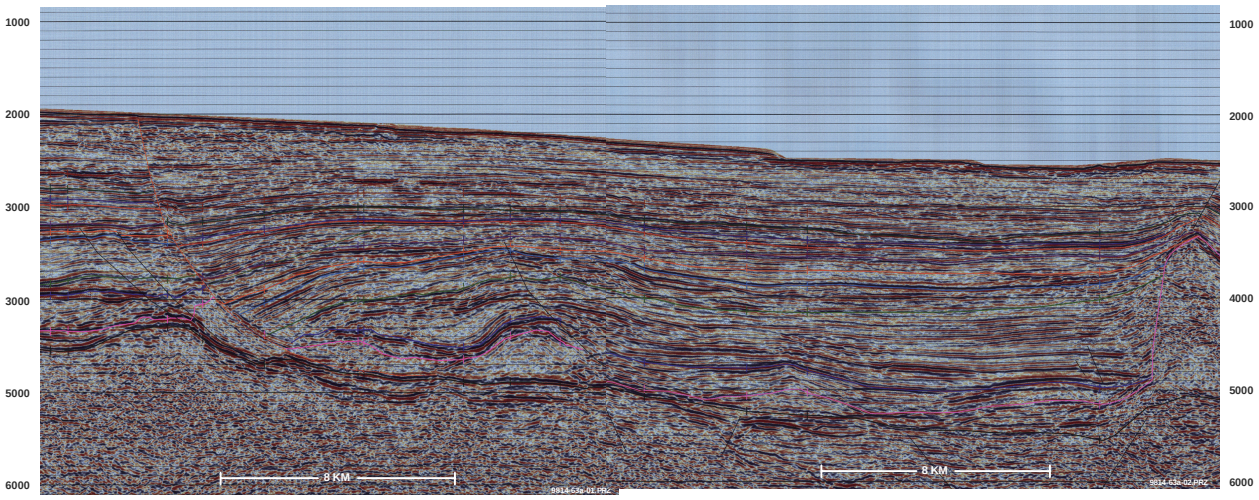
INTERPRETATION AND INTEGRATION

Interpretation and integration is a continuous, evolutionary process. Concepts and ideas form, change, dissipate, evolve, and come together incrementally as more work is done. Therefore, communication throughout the process between the cross-functional specialists and multi-disciplinary generalists is paramount to a successful evaluation. Communications on a weekly, daily, hourly, or even working on a side-by-side basis can benefit the team. Flexibility is a critical success factor in making this process work. This is the role of the generalist, to bring together all of the elements of the cross-functional team into the sphere of the multi-disciplinary team (other generalists), to piece together a coherent report of the potential of an area. Addressing specific elements of the petroleum system scientifically, and placing the work into a "Play Framework" greatly facilitated the multi-disciplinary and cross-functional communications.

In the past, the interpretation of seismic data and map making were the most labor-intensive portions of an interpreter's job. The basic posting of values, contouring, and understanding the significance of a map was the basics of the job. Today however, with workstation technology, this function can be accelerated allowing more time for integration of the other geophysical tools into a cohesive evaluation. The interpreter now has time available to work more with the other specialized geophysicists and geologists, passing on information and observations that are valuable for the others' work.

Figure 4 shows a representative seismic line from the area.

Figure 4: **Representative Seismic Line**



CONCLUSIONS

In four months, a thorough evaluation was completed, risks ascertained, economics determined, and managerial support gained. Success had been achieved through the combined efforts of both generalists and the specialists. The synergies created through the establishment of the multi-disciplinary and cross-functional teams grew as the project progressed.

In conclusion, the following statements summarize the key points determined from our involvement in this exploration project. Some are given, some are common sense and others are learned through application.

-Multi-disciplinary and Cross-functional teams are critical for a quality evaluation of the petroleum risks.
-Project planning is key to all projects with short time frames.
-When there are numerous unknowns, additional tools can be used to assist in understanding risk.
-Rewards for the risk takers can be large.
-The value of an exploration project is directly related to the assessment of risk.
-Our job as exploration geophysicists is to identify the technical risks and the rewards, to enable managers to decide if an opportunity merits expenditure of risk capital.
-The time value of money as related to shortening of the exploration cycle time can be significant.
-Every technologists' trade off is how to achieve the right amount of speed while paying enough attention to details.
-Pushing the technology envelope has its pluses and minuses.
-Fully communicating the facts, identifying and understanding the risks and allowing the project to stand on its own merit, is critical to all technical evaluations.
-An effective organizational structure with Multi-disciplinary and Cross-functional Teams can have a bottom line impact.

ACKNOWLEDGMENTS

Thanks to my professional co-workers, specifically John Armentrout, Paul Hunt, Christopher Reaves, Jim Schuelke, Bob Keys, Bill Soroka, Mo Sabih, George Kerns, John Quirein, Gregg Zelewski and Richard Theiss, who participated on the cross-functional and multi-disciplinary teams. Also, thanks to the technical and administrative support, specifically Roxanne Clary, Dorsaline Allen, Gaye Proza, Karin Bourland and Chuck Holmes. Finally, thanks to Mobil for allowing me to present this work and to Petrobras for allowing me to show their data in this study.

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