

## Petrobras Management of National Geophysical Data

Raul Damasceno, Petrobras, Brazil  
 Livio Marques, Petrobras, Brazil  
 João Francisco Fernandes, Petrobras, Brazil  
 Maria Auxiliadora, Petrobras, Brazil  
 André Steklain, Petrobras, Brazil

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### Abstract

In this paper we present the state of the art of Petrobras data management in national area. We start with a short historical retrospective of Petrobras experience with data management. We then present the main features of geological and geophysical data in Brazil and the implications of the production of a large amount of data in the huge territory that comprises Petrobras exploration area. Finally, we discuss the recent Petrobras data management approaches in order to organize legacy and incoming data.

### Petrobras Experience in Data Management

In October 1953, Petrobras was founded as a national oil company to undertake oil sector activities in Brazil. The oil exploration and production operations, as well as the remaining activities connected to the oil, natural gas, and derivative sector, except for wholesale distribution and retail via service stations, were a Petrobras monopoly held from 1954 to 1997.

The company always took care of its data in an organized way. During this period, however, the data was spread all over the country in the different Business Units (BUs) that compose Petrobras exploration structure. Only from 1995 Petrobras started a project of gathering all pre-stack data of the entire country. Tapes, documents and coordinate files were put together in a single deposit, organized and cataloged with a unique seismic line nomenclature. The success of this project was the impulse for a second project for post-stack data.

In 1997 the Petrobras monopoly was broken, and the National Oil Agency (ANP) was created by the government in order to control the oil sector. According to the new legislation the Petrobras data also belong to ANP, and the project of gathering the seismic lines was migrated to the Oil Agency.

From the year of 2000, Petrobras begins internally to evolve its concept of database and started to design the current Petrobras Integrated Database. This database deal not only in the seismic area, but also with other areas of geological knowledge

Nowadays, Petrobras has been carrying intense exploratory work out and discovering new reservoirs in the blocks granted by ANP concessions for in nearly all of the Brazilian sedimentary basins. Several new oil fields were discovered after the monopoly was broken, both in onshore basins, already in advanced exploratory conditions, and in the continental platform. All this exploratory effort generates a huge volume of data that must be organized and stored in a competitive way. This situation represents a challenge for Petrobras Data Management sector.

### Brazil's Geological and Geophysical data features

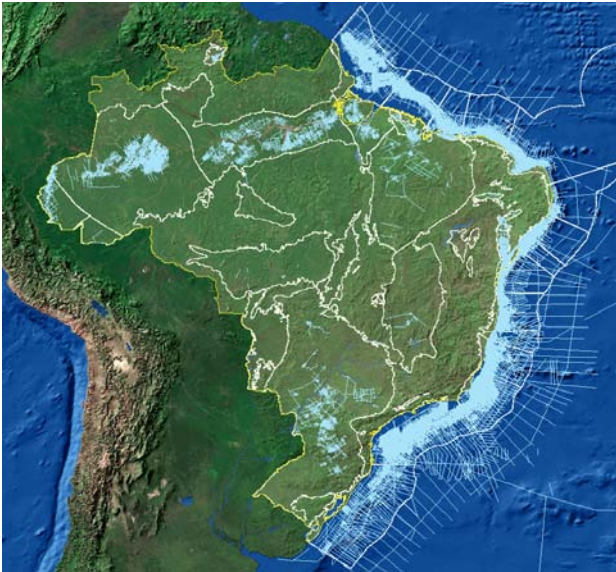
Exploring and handling all the information in a competitive way requires from Petrobras good organization and efficient policies from its contingent of 928 geologists and 537 geophysicists.

The Figure 1 shows the Petrobras concessions in Brazil at 1996. The total of exploratory area comprises 304.2 thousand km<sup>2</sup>, in which Petrobras operate (sep. 2007) 137.6 thousand km<sup>2</sup>. Operating in such huge area brings many challenges, like different cartographic projections and a large amount and variety of data (2D and 3D seismic, well data, all the seismic derivative data). Since Petrobras was the only company operating in the country for a long period of time, one of the main current problems is dealing with the company's great amount of data, mainly legacy data which is still stored in old formats and media. Nowadays these data must be recovered and sent to ANP, according to the current legislation.



Figure 1. Overview of Petrobras E&P in Brazil.

Petrobras seismic data base comprises more than 1 million km of 2D seismic (see Figure 2) and more than 550 millions km<sup>2</sup> of 3D seismic (see Figure 3). The total amount of data is about 2.9 Pbytes. The interpretation data sums up to 50 Tbytes. The data formats covers from modern SegY formats to old IBM code 4 (legacy data), considering only the national area. Interpretation data are generated in different softwares, and include several data types, like horizons, attributes volumes, faults, modeling, etc. These data are produced on a daily basis by hundreds of interpreters. Except for Campos Basin, the most prolific oil basin, the majority of seismic data is composed by 2D seismic data. Due to the vast sea coast, there are many lines of hundreds of kilometers long which bring an additional difficulty.



**Figure 2.** 2D seismic data network. There are more than 1 million linear Km, spread into 46 land and 18 marine basins.

### Petrobras data management solutions

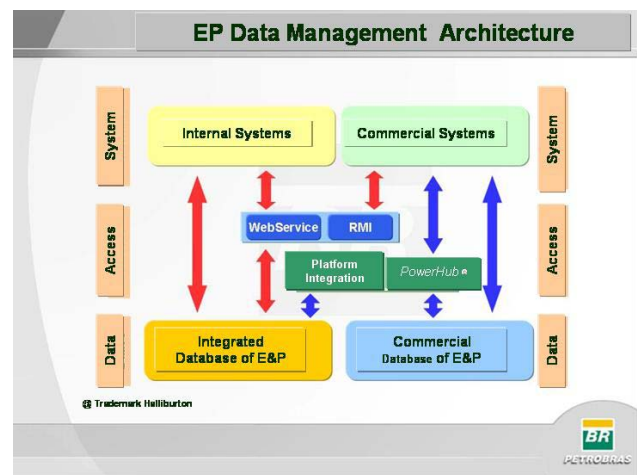
As said before, is a big challenge to organize, classify, store and provide such large quantity of data in order to satisfy Exploration necessities and keep ANP updated. This necessity comes with all the modern technology evolution, after which the interconnectivity and information velocity multiply the data variety and the need to obtain and keep the accurate data.

Since the year of 1997 when a project of organization has started, more than 450,000 tapes were remastered and changed from different old formats (SegA, code4, etc.) to SegY. This process has been going on until today when we are changing from tapes of 20 and 40 Gbytes to tapes of 700 Gbytes. Another task is digitalize seismic data in paper such as sections, velocity functions and all the documentation related to them.



**Figure 3.** 3D seismic data network. It comprises an area of more than 550 millions km<sup>2</sup>.

In order to centralize and coordinate the data management, an integrated data base was created as the single repository for the different company units spread over the country named Integrated E&P data base (Figure 3). The objective is to create a data repository independent from applications and suppliers, assuring a secure, unified and efficient access to both the internal and external applications, by adopting open or market technologies. Specific data bases were created to manage the different kinds of data such as seismic, interpretation, wells, production, etc. As a consequence there was the necessity and the effort made to classifying and standardizing the data and training the users.



**Figure 4.** Data Architecture of Petrobras E&P.

Concerning data interpretation, prior to the year of 2000 we had a situation of local disks and oracle servers, duplication of *OpenWorks* and *Seisworks*\* projects in different workstations, data interpretation lacking

\* *OpenWorks* and *SeisWorks* are Halliburton trademarks.

standards, no procedures for backups and restoration and the data loading was made without any control. In 2004, a group was formed to manage the data base interpretation with the mission to create an integrated company vision of the data aiming to preserve and guaranty their quality. An intensive job has begun and is still in progress but it has already resulted in

- A single *OpenWorks* project for each sedimentary Basin with an equally single oracle instance for each one of them;
- Filer provided and managed by Petrobras IT;
- Backups and restore using snapshot;
- The implementation of a standard to name the different kinds of data interpretation (horizons, seismic volumes, lines, etc);
- Adoption of CMP files instead of 3DV files resulting in 90% of disk space saving;
- Discarding redundant horizons, which eliminate about 60% of this kind of data.

It's important to point out that all the work has been done with the interpreters partnership. Each interpretation project incorporated geophysical and geological data improvements like misties corrections, amplitude equalization, standard stratigraphic marks, etc.

The work done to standardize the data allows their interpretation to be controlled, easily found and read and makes the interpreter's job more trustworthy.

### **Conclusions**

The policy of integrating the data and the investment in technology and training people has brought to Petrobras' data management the tools to handle the large amount of data, and the instruments to control and standardize the data. This initiative has resulted in better access, improvement in the data confidence as well as a real gain in the employees' time. Nevertheless the company's work is still in progress due to the number of people involved, the legacy data and the great amount of data acquired so far.

### **Acknowledgments**

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