Powder River Basin

Petrophysical Database

A Relational Database of Petrophysical Properties
from the Powder River Basin of Wyoming-Montana

GEOMARK RESEARCH, LTD.

GEOMARK

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INTRODUCTION

GeoMark is initiating a petrophysical database for the Powder River Basin of Wyoming-Montana. This new database holds both organic and inorganic laboratory measurements (Figure 1), allowing subscribers to calibrate evaluations and calculations derived from a modern suite of wireline logs. It is unique because it holds both subsurface and outcrop samples, enabling all subsurface disciplines to link their geological context into the subsurface environment. Virtually all the samples analyzed for petrophysical parameters were previously analyzed for geochemistry, permitting a full integration of all log calibrations.

The Powder River Basin Petrophysical Database is a new module in GeoMark's RFDbase Database. It is constructed using the Microsoft SQL Server data platform and displayed via the ArcView™ Geographic Information System (GIS). This online database allows full mapping, graphing, and on-screen interpretation of all the available data. Participants can integrate these modules with other types of data [e.g. source-rock total organic carbon (TOC), programmed pyrolysis, gas isotopes, produced oil properties, formation water composition, and pressure-volume-temperature (PVT) results]. Users may also combine in-house proprietary data with the GeoMark-supplied data.

Measured Results in the Petrophysical Database	
Organic Analyses	**Inorganic Analyses**
Total Organic Carbon (TOC)	Elemental Analyses (XRF)
Programmed Pyrolysis (S1, S2, HI)	Mineralogical Analyses (FTIR)
Thermal Maturity (Tmax, VRE)	Mineralogical Analyses (XRD)
Water Chemistry	Density Analyses (RHOB & PHI)

Figure 1. *Data included in GeoMark's Powder River Basin Petrophysical Database.*

The initial price of the Powder River Basin Petrophysical Database is $35,000 per year, with a three-year minimum commitment. Companies may elect to remain in the database after year three, but this is not an obligation.

More pricing information is explained in the Terms and Conditions section. A more detailed description of the Powder River Basin Petrophysical Database is contained in Appendix A of this proposal.

DATABASE CONTENTS

The Powder River Basin Database currently holds the results for source rock, oil, gas, and PVT analyses. To these data, we now are adding XRF, XRD, FTIR, and density (RHOB & Phi) measurements (Figure 2). This unique database allows log analysts to calibrate interval-by-interval log responses and wireline algorithms.

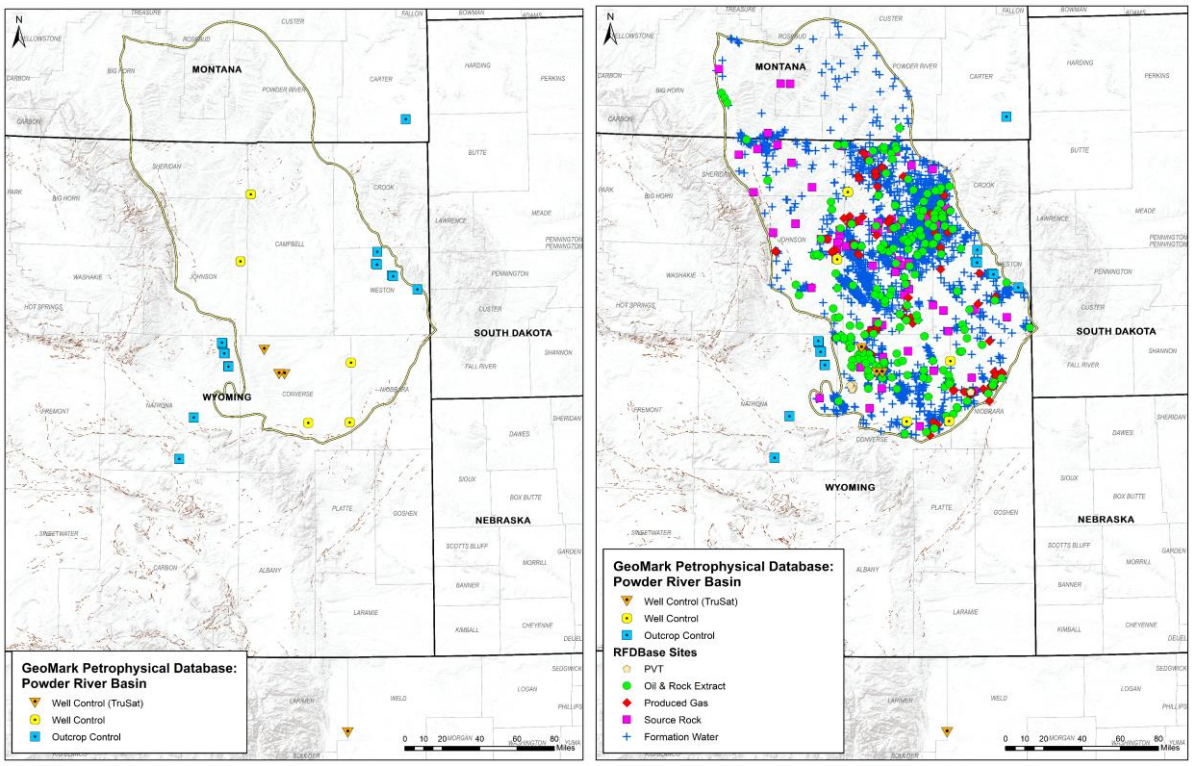

Figure 2. *Left: Wells currently in the Powder River Basin Petrophysical Database (yellow=subsurface control, blue=outcrop control). Right: Powder River Basin RFDbase coverage, including all data types. Note: GeoMark has the ability to expand the subsurface data set upon request.*

During the second year and beyond, GeoMark will add new wells and measurements to the database [(e.g. crushed rock and plug-based laboratory measurements, including total porosity, grain densities, oil and water saturations, permeability, mercury injection capillary pressure (MICP), and nuclear magnetic resonance (NMR)]. The number of new wells added will depend on the popularity of the database.

What makes this database unique is the large collection of organic and inorganic rock measurements collected in every section of very deep wells distributed throughout the Powder River Basin. Since all the data are housed in a single database, it will be easy to compare and contrast multiple exploration opportunities. Additionally, since most of the organic and inorganic measurements were performed on identical samples, this extends the benefits of integrated, log-based interpretations.

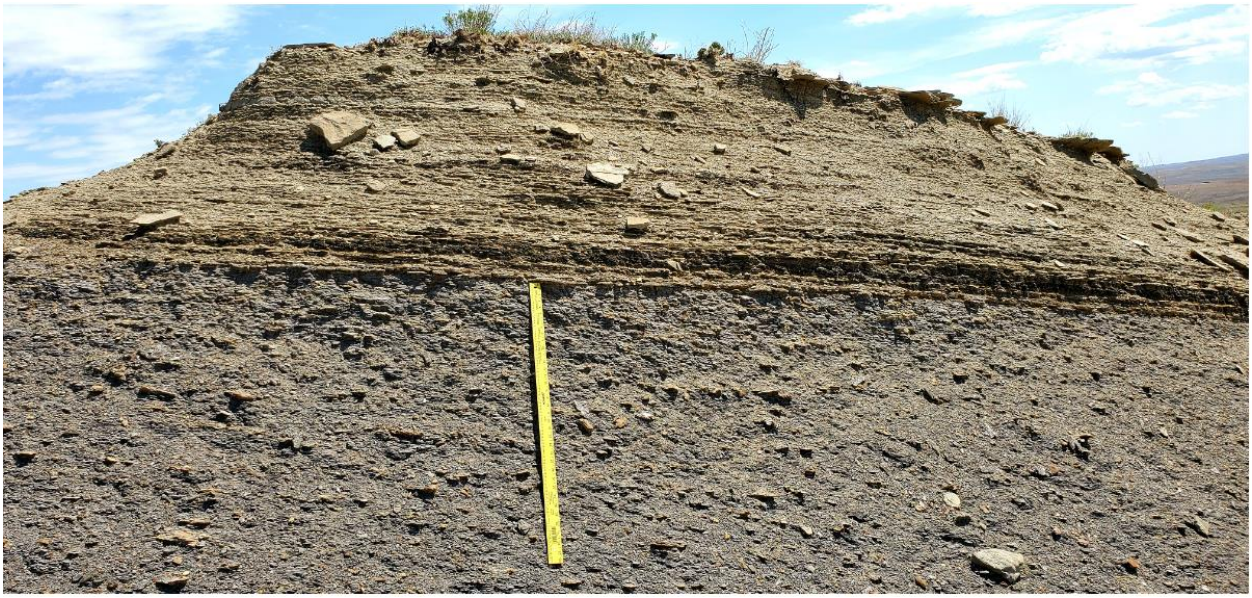

Figure 3. *Turner Sandstone outcrop photograph, where samples were collected in a transect across the Powder River Basin stratigraphic column. Outcrop samples span the Parkman Sandstone through the Muddy formations. These samples, as well as subsurface locations, are available in the Powder River Basin Petrophysical Database.*

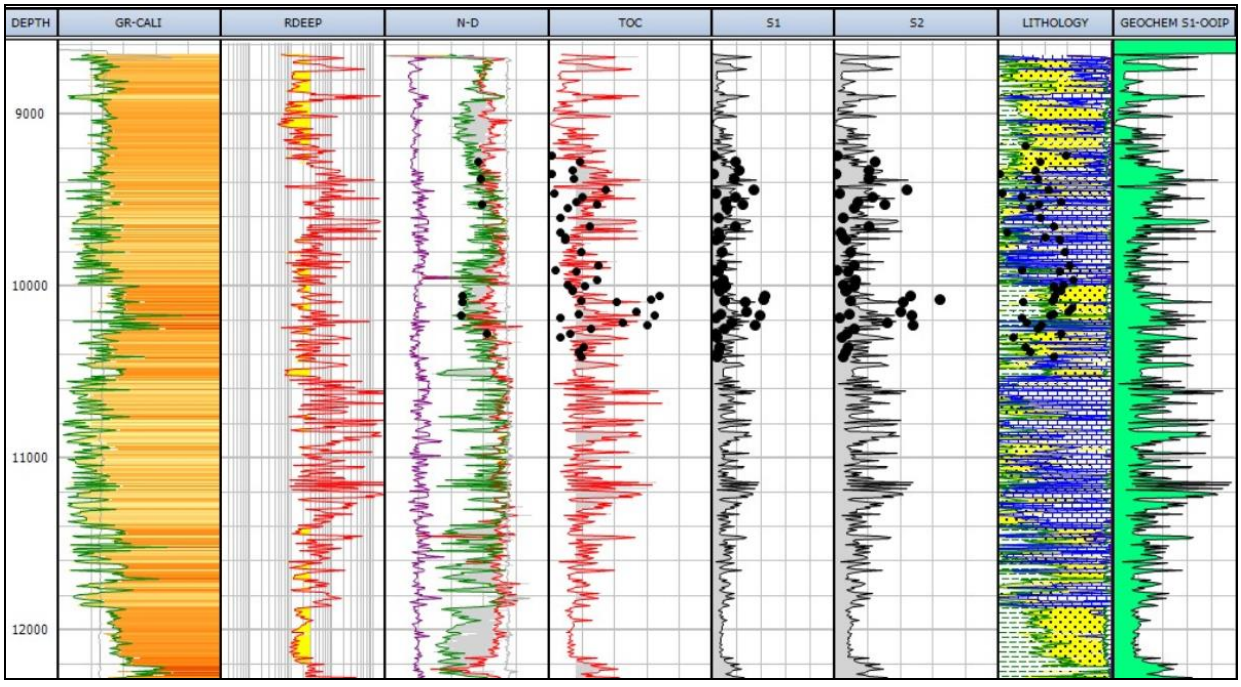

Figure 4. *Example log showing how data from the Powder River Basin Petrophysical Database can be integrated with wireline log analysis.*

TERMS AND CONDITIONS

Pricing Schedule
The cost of joining the consortium varies depending on the time of entry. The price of the database increases over time as more subscribers (and data) are added.

As more companies join, and the database increases, the subscription price will escalate according to the table below.

Number of Subscribers	Study Price
1 - 3	**$35,000.00 / yr**
4 - 6	**$45,000.00 / yr**
6+	**$55,000.00 / yr**

Companies may elect to remain in the database after the third year.

For additional information, contact:

GEOMARK RESEARCH, LTD.
9748 Whithorn Drive
Houston, Texas 77095

Tel: 281/856-9333
Fax: 281/856-2987
e-mail: info@geomarkresearch.com

APPENDIX A

Overview
The Powder River Basin Petrophysical Database is an Internet-enabled database for the storage, review, and manipulation of key petrophysical calibration measurements. This integrated database consists of key organic and inorganic geochemical analyses selected to support exploration and exploitation functions. Additionally, all modules within the database structure are fully exportable to databases holding other types of data (including geochemical data, rock properties, production data, etc.).

Database Features
The Powder River Basin Petrophysical Database has a number of functions in addition to the ability to store and maintain all geochemical reports. The mapping interface can be used to search for specific studies or to locate similar samples (based on petrophysical and bulk characteristic classifications) in different geographic regions. These "similar" samples may be further utilized in estimating fluid properties or parameters, and in linking to commercial or in-house simulation programs.

Some of the specific functions of the Powder River Basin Petrophysical Database are listed below.

- Electronic or hardcopy reports generated directly from the database, and can be exported into standard Excel or Access file formats
- Extensive data search function by rock properties, field information, etc.
- Web-enabled Geographical Information System (GIS) mapping for location-specific data searching and comparative analyses of multiple rocks or fluids in a more visual environment
- Real-time plotting of selected data or data sets
- Data easily exported to Excel for development of rock or fluid property correlations and mathematical relationships

Database Design
The Powder River Basin Database has been developed as an interactive, web interface overlaying a Microsoft SQL Server database populated with rock data. The database applications are hosted off-site, offering electronic and physical security, as well as broadband access for member companies.

Database Security
All data/reports are protected with cascading levels of user access, based on established permissions. Levels include Open access, Corporate access, and Proprietary access for tight-hole wells.

Not only are proprietary data protected from unauthorized access by other participants, but the existence of such data is not available, or even indicated, during GIS mapping or numerical searches. If a company wishes to "share" data with another participating company, a password adjustment allows only the specific data to be exchanged, while maintaining overall confidentiality.

Downloading Data
Users have a number of options for printing and/or downloading data. GeoMark's standard Geochemical Summary Sheet GSS may be viewed on-screen or printed. Data tables can be downloaded in several format types, including Microsoft Excel and Microsoft Access. Graphical data can be viewed on screen, or downloaded in report format. Raw GC and GC/MS data are also downloadable from the website.