



**Joint Session with SPE**  
**Radisson Hotel – Greentree**  
**20 September 2007**

## **Rock Properties of the Marcellus Shale - A Regional Gas Resource in Southern New York, Pennsylvania, and West Virginia**

*presented by*

**Dr. Jack Ward**  
**PetroEdge Resources**

### **Abstract**

Recently reported production data from Marcellus Shale wells in West Virginia and Pennsylvania have high initial rates from wells treated with large water fracture stimulation methods. This is in contrast to results collected in the mid 80's from this formation from wells that were treated with foam fracture stimulation. These early results indicate that the play is potentially economic with modern technology and pricing. PetroEdge Resources began working on the Marcellus in West Virginia in 2005. The work included technical analysis of available core data, well logs, fracture pump in tests, and fracture stimulation pressure profiles. The goal of the work was to generate a model for shale exploitation that predicted future gas recovery. An additional requirement was that the method include old well log information so that it would be possible to gauge recoverability across the Appalachian Basin.

Development used the Devonian shale petrophysical model created by the Gas Research Institute in the early 1990's as a starting point. Using empirical correlations, the current model estimates the volume of kerogen in the Marcellus from well log data. Since the low density of the kerogen creates a false porosity signature on neutron and density logs, the derived kerogen volume is critical in creating corrected porosity logs devoid of the perturbation of low density kerogen. Once corrected neutron and density porosity are available standard multimineral simultaneous equations are employed to calculate the volume of clay, quartz, heavy minerals, and porosity. Kerogen not only distorts the porosity response, but exhibits spurious resistivity behavior. Knowing the volume of kerogen, the resistivity response is also corrected. With the input of the multimineral analysis, porosity, and corrected resistivity the amount of free gas in place is calculated using the traditional volumetric formula. Once free gas is known the kerogen volume is as an input to equations that derive total organic content. The amount of gas production from desorption is then estimated from the total organic

content. With this sequence the petrophysical model predicts the total gas productivity from free and desorbed gas.

The mineralogic output of the petrophysical model also is important in understanding the mechanical strength of the shale. This is expressed as dry rock moduli and converted to Young's modulus or Poisson's ratio. A layered sequence of rock strength is the starting point for pre and post fracture stimulation modeling. Subsequent to fracture stimulation of wells the moduli are again calculated from the pump in test data and compared to the first estimates from the log data. Comparison of independent computation of moduli from fracture pump in tests and petrophysical measurements provides a check and imposes limits on both methods of rock property calculation.

Petrophysical rock property models and fracture stimulation pressure analysis provide a view of the extent of the fracture artificially induced into the earth, in addition to confirming estimates of the strength of the rock. Microseismic monitoring of the fracture stimulation process is an alternate method of deriving the shape and extent of the artificial fracture system. Results of water fracture stimulation of the Marcellus Shale indicate that the fracture system is controlled in part by the rock strength and vertical layering, but has significant modification imparted by pre-existing fracture systems.

Borehole observations in logs, both modern and legacy, are suitable for estimation of gas available from both free and desorbed gas. The method is simple enough to include old logs and allow for basin wide mapping. The near borehole observations are extended away from the borehole by analysis of the pressure measurements from the fracture stimulation data. Lastly, microseismic observations provide a complete view of the total system. It is this last large scale observation that may have the overriding effect on gas production. The free gas and desorbed gas system are controlled by volumetric factors related to thickness and rock quality. The final delivery to the borehole and surface is controlled not only by in place hydrocarbon volume, but by fracture extension and efficiency of building an artificial fracture that crosses the Marcellus. It appears that this variable has large changes in the system leaving the final recovery of gas controlled by some factors that are not directly observed in the borehole measurements.

### **Author Biography**

Dr. John A. "Jack" Ward has over 30 years experience in the industry with extensive experience in implementing field development strategies. He developed many of the techniques employed for seismic reservoir mapping and is recognized as an expert in seismic inversion, seismic stratigraphy, AVO, and multi-component interpretation.

**For reservations to this informative and entertaining evening, please complete the attached reservation form.**

## WHAT IS THE PAPG?

PAPG is a non-profit organization founded in 1984 to provide a forum for Petroleum Geologists in the Pittsburgh Area to meet socially and discuss technical topics relative to the exploration and development of reserves in the Northern and Central Appalachian Basin. PAPG is an affiliated association with AAPG (American Association of Petroleum Geologists) and has representation in the House of Delegates. Educational opportunities are provided via field trips, seminars and AAPG Sectional meetings, sponsored solely by PAPG or in conjunction with the PTTC (Petroleum Technology Transfer Council), PGS (Pittsburgh Geologic Society) and SPE (Society of Petroleum Engineers).

Although PAPG is predominately a geologic organization, numerous industry professionals including geophysicists, engineers, lawyers and landmen are among PAPG's members and find the interaction at meetings and educational opportunities beneficial to their professions. PAPG also encourages student membership and participation.

Meetings are typically held monthly from September through May in locations within 50 miles of downtown Pittsburgh. From time to time, meetings are held in conjunction with SPE and PGS.

## NEWS AND EVENTS

### **Message from the President:**

Several advances and changes have been made in the PAPG recently:

- Advisory Board - We formed an Advisory Board of interested members that met with the current officers in June for the first time and is structured to provide support, advice and planning assistance as the organization goes forward in the coming years. If you desire to be part of this group, please contact me and we can add you to the list.
- Logo - You will note that we have a new PAPG logo that was designed by Eric Ober and modeled loosely after the AAPG logo.
- Website! - Importantly, this organization has moved into the 21<sup>st</sup> Century in a big way with its own website, papgrocks.org. The website was designed by Dave Boyer and we plan to include a calendar of events and future meeting details among other things. Dave tells me that this website is still a work in progress, so be patient.

The PAPG has another strong year of talks planned in conjunction with the SPE and we are currently in the midst of planning for the BIG upcoming joint SPE/AAPG Eastern Regional 2008 meeting to be held here in Pittsburgh. We hope to see you at our kick-off meeting September 20<sup>th</sup>.

**- Gregory Wrightstone**

### ***Mark your calendar now for these upcoming events:***

**September 16<sup>th</sup>-18<sup>th</sup> 2007 - Hyatt Regency, Lexington, KY**

**AAPG Eastern Section Annual Meeting**

*"Winning the Energy Trifecta: Explore, Develop, Sustain"*

**October 8<sup>th</sup> 2007 - 5:00pm Radisson, Green Tree**

**PAPG/SPE Joint Meeting**

*"Acadian-Alleghanian Orogenesis as Revealed by Fracturing Within the Appalachian Foreland"*

Terry Engelder - AAPG Distinguished Lecturer

**October 30<sup>th</sup>- 31<sup>st</sup> 2007 - Lake View Conference Center, near Morgantown, WV**

**The North American Coalbed Methane Forum, Inc. - Fall Session**

- For more information please contact:

Ihor Havryluk - (412)445-5803

or

Dr. Kashi Aminian - (304)293-7682 ext 3406

**2008 AAPG Eastern Regional Meeting**

- Scheduled for Pittsburgh - Planning under way

**Have information you want to share with the organization?**

**Please contact the secretary to add the information to the next newsletter.**

## **PAPG 2007-2008 DUES**

### **PAPG dues for the 2007-2008 season are now DUE!**

*The membership form is attached to this newsletter. Please fill the form out **completely** so that we can ensure that we have your latest contact information. We are planning to publish a membership directory this year and your updated information is crucial.*

## **SPONSORS**

***PAPG is looking for companies to sponsor the 2007-2008 season.***

### **Sponsor Information**

***If you or your company would like to sponsor the PAPG and help support the continuation of our Meetings, Field Trips, and other events, we ask that you send a donation to the PAPG. Any contribution of \$100.00 or more by any group or individual will be recognized on our website, in the monthly newsletter, and at scheduled monthly meetings.***

***We ask that you show your support for the PAPG by a contribution and your continuing attendance at the monthly meetings.***

***We appreciate your continued support.***

**Contributions may be sent to:**

**PAPG**

**PO BOX 16352**

**GREENTREE PA 15242-0352**

# NOTICE OF SEPTEMBER 2007 MEETING PITTSBURGH ASSOCIATION OF PETROLEUM GEOLOGISTS

**DATE:** Thursday 20, September 2007

**PLACE:** Radisson Hotel - Greentree  
101 Radisson Drive  
Pittsburgh, PA 15220  
(412) 922-8400

**TIME:** 5:00 PM – Social Hour (w/ Cash Bar)  
6:00 PM – Dinner  
7:00 PM – Speaker

**TOPIC:** “Rock Properties of the Marcellus Shale - A Regional Gas Resource in Southern New York, Pennsylvania, and West Virginia”

**SPEAKER:** Dr. Jack Ward

**COST:** \$25.00  
\$10.00 students  
(Checks payable to PAPG)

**DINNER OPTIONS:** Chicken Maurice  
or  
Sliced Roast Sirloin of Beef

**RESERVATIONS:** Call, email, fax, or mail this reservation form to:

**Barbara A. Purks**  
412-787-5403 (phone)  
412-787-2906 (fax)  
bpurks@pittsburgh.oilfield.slb.com

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NAME(S) \_\_\_\_\_

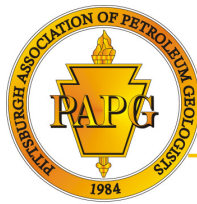
COMPANY \_\_\_\_\_

DINNER CHOICE(S) \_\_\_\_\_

# CONTACT THE PAPG

## PAPG Officers:

- President:** **Greg Wrightstone** -- Texas Keystone, Inc..  
Phone: 412-434-5616  
Email: [gwrightstone@texaskeystone.com](mailto:gwrightstone@texaskeystone.com)
- Vice President:** **Jim Pancake** --Equitable Production Co.  
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**P·A·P·G**

Pittsburgh Association of  
Petroleum Geologists

An AAPG Affiliated Society

www.papgrocks.org

## **APPLICATION FOR MEMBERSHIP AND MEMBERSHIP RENEWAL**

PLEASE INDICATE YOUR MEMBERSHIP STATUS BY CHECKING THE APPROPRIATE BOX:

PROFESSIONAL - RENEWAL

STUDENT - RENEWAL

PROFESSIONAL – NEW MEMBERSHIP

STUDENT - NEW MEMBERSHIP

The **PITTSBURGH ASSOCIATION OF PETROLEUM GEOLOGISTS** membership year runs from JUNE 1 through MAY 31. Monthly meetings are usually held the second Thursday of the month from September through May.

**Professional Dues are \$25.00 per year**

**Student Dues are \$10.00 per year**

**NEW APPLICATION:** If you have never been a member of PAPG, please fill out the remainder of the form, obtain the signatures of two members to sponsor you, and mail check, payable to PAPG, to the address below.

**RENEWAL:** Please fill out the mailing address/directory information below if your contact information has changed and submit dues, payable to PAPG, to the address below.

**Mail completed form and dues payment (checks only - Payable to PAPG) to:**

Dave Boyer  
Texas Keystone, Inc.  
560 Epsilon Drive  
Pittsburgh, PA 15238

### **MAILING ADDRESS / DIRECTORY INFORMATION – PLEASE COMPLETE ALL INFORMATION**

NAME \_\_\_\_\_ DATE \_\_\_\_\_

COMPANY / UNIVERSITY \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY \_\_\_\_\_ STATE \_\_\_\_\_ ZIP \_\_\_\_\_

JOB TITLE: \_\_\_\_\_

EMAIL: \_\_\_\_\_ **Please fill this in – help us save those mailing costs!**

PHONE: (        ) \_\_\_\_\_ - \_\_\_\_\_

FAX: (        ) \_\_\_\_\_ - \_\_\_\_\_

**WOULD YOU BE INTERESTED IN PAPG PARTICIPATION?:**                      Officer                      Speaker

**WOULD YOU LIKE YOUR CONTACT INFORMATION PLACED  
IN THE MEMBERSHIP DIRECTORY (available to members only?)**                      Yes                      No

### **TWO SPONSORS REQUIRED for NEW MEMBERS**

Name \_\_\_\_\_ Date \_\_\_\_\_

Name \_\_\_\_\_ Date \_\_\_\_\_