



Joint Session with SPE
Radisson Hotel – Greentree
8 October 2007

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

presented by

Dr. Terry Engelder
Pennsylvania State University
AAPG Distinguished Lecturer

Abstract

Assets within the Appalachian Basin range from conventional clastic and carbonate reservoirs to source rocks of Devonian black shale and Pennsylvanian coal, all of which are fractured. These fractures range from coal cleat and cracks around kerogen flakes to natural hydraulic fractures, tensile joints in stiff beds, and late-stage cross joints.

With some exceptions this broad range of fracture types propagated with the help of pressure generation accompanying the positive ΔV reaction during maturation of hydrocarbons.

Before and during maturation fracture orientation in the Appalachian foreland was controlled by an evolving tectonic stress that reflects three important details of Acadian-Alleghanian orogenesis in the Appalachian hinterland.

First, pre-maturation, forebulge-related tensile joints in distal portions of the Acadian Catskill Delta complex reflect initial loading of Laurentia (i.e., North America) by Gondwana (i.e., Africa) at the New York promontory. The earliest syn-maturation fractures are microcracks around kerogen flakes in black shale. Maturation-related pressure was enhanced by compaction disequilibrium.

Maturation continued to elevate pressure within Devonian black shales to the point that macroscopic natural hydraulic fractures (NHF) developed within the source rocks. The orientation of NHF in black shale and early coal cleat in the foreland reflects a basin-wide stress field arising from the oblique convergence of Gondwana and Laurentia, the second detail of Acadian-Alleghanian orogenesis.

This basin-wide joint system supports the emerging view that dextral transpression controlled the kinematics in the mountain belt to a greater extent than previously recognized. Further burial led to the development of a complete fracture network in siltstones and gray shale of the basin. This later system of fracturing evolved in Alleghanian stress

fields arising when transpressional tectonics within crystalline basement, the third detail, drove the classic detachment sheets of the Valley and Ridge and Appalachian Plateau.

Author Biography

Education:

1968 B.S. in Geology
Pennsylvania State University
1972 M.S. in Geology
Yale University
1973 Ph.D. in Geology
Texas A&M University



Experience:

1985-Present Pennsylvania State University
1973-85 Lamont-Doherty Geological
Observatory of Columbia University
1968-73 Texaco, Inc.
1966-67 U. S. Geological Survey

Publications and Awards:

Fulbright Senior Fellowship,
Macquarie University, Sydney, Australia, 1984

French-American Foundation Fellowship,
France, 2001-2002

Guest Professorships at Erherzog Johann Technical
University, Graz, Austria, 1999 and
Università di Perugia, Perugia, Italy, 2004

Visiting Scholar at TotalFinaElf,
CSTJF Pau, France, 2001-2002

Written over 130 research papers.

Engelder, T., 1993, Stress Regimes in the Lithosphere:
Princeton Press, Princeton, New Jersey, 451 p.

The Hancock Volume: Cosgrove, J.W. and Engelder,
T., eds, 2004, The Initiation, Propagation, and Arrest of
Joints and Other Fractures: Geological Society,
London, Special Publications, 231.

Professional Interests:

- Frictional properties of fault gouge.
- Strain relaxation and hydraulic fracture in situ stress measurements.
- Fracture analysis with focus on development of natural hydraulic fractures.
- Strain Analysis in foreland fold and thrust belts.
- Analysis of coupling between pore pressure and stress in basins

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

[PAPG Website:](#)

The PAPG Website is now up and running. Visit the site at <http://www.PAPGrocks.org>.

Mark your calendar now for these upcoming events:

October 11th 2007 - Chestnut Ridge Golf Club, Tom's Run Course, Blairsville, PA

SPE-PAPG Annual Golf Outing

Shotgun Start @ 10:00am; dinner @4:30pm

Download Registration Form from PAPG website: <http://www.papgrocks.org/golf.pdf>

October 30th - 31st 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.

SPONSORS

PAPG wishes to thank the companies who have contributed to the PAPG 2007-08 season

Billman Geologic Consultants Inc.

P.O. Box 567
Mars PA 16046
724-625-3461

NATURAL ENERGY DEVELOPMENT CORP.
37 McMURRAY RD. SUITE 3100 PITTSBURGH PA, 15241



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 OCTOBER 2007 MEETING PITTSBURGH ASSOCIATION OF PETROLEUM GEOLOGISTS

DATE: Monday 8, October 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: “Acadian-Alleghanian Orogenesis as Revealed by Fracturing Within the Appalachian Foreland”

SPEAKER: Dr. Terry Engelder

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

DINNER OPTIONS: Almond Encrusted Orange Roughy
or
Roast Pork Loin

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

NAME(S) _____

COMPANY

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CONTACT THE PAPG

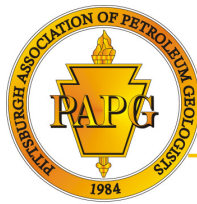
PAPG Officers:

- President:** **Greg Wrightstone** -- Texas Keystone, Inc..
Phone: 412-434-5616
Email: gwrightstone@texaskeystone.com
- Vice President:** **Jim Pancake** --Equitable Production Co.
Phone: 412-395-3912
Email: jpancake@eqt.com
- Secretary:** **Dave Boyer** -- Texas Keystone, Inc.
Phone: 412-434-5616
Email: dboyer@texaskeystone.com
- Treasurer:** **Eric Ober** -- Texas Keystone, Inc.
Phone: 412-388-0917
Email: eober@texaskeystone.com
- AAPG Delegate:** **Doug Patchen** – Petroleum Technology Transfer Council
Phone: 304-293-2867 ext 5443
Email: doug.patchen@mail.wvu.edu

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.*



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 _____

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

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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 _____