

**PTTC Workshop on “Fracture in Devonian Black Shale of the Appalachian Basin”
January 8-9, 2008
NRCCE Building, West Virginia University, Morgantown, WV**

**Co-Hosted by the Appalachian Geological Society and the
Research Partnership to Secure Energy for America
Sponsors: Natural Energy Development Corporation and
NGO Development Corporation**

Dr. Terry Engelder
Professor of Geosciences
The Pennsylvania State University
University Park, PA 16802

Premise of the PTTC workshop: The success of horizontal drilling for the enhanced recovery of natural gas is heavily dependent on the presence of systematic natural fractures. Because of the role that fractures play in draining matrix porosity, it behooves both geologists and petroleum engineers to develop the best possible understanding of natural fracturing in black shale of the Appalachian Basin.

Objective of the PTTC Workshop: This workshop is designed to provide as complete a technical understanding of fracture in Devonian rocks as is possible in a one day session. Fracture in any basin is a complex, multi-stage process that continues during the entire history of a basin. This PTTC workshop will provide a mechanical explanation for fracture generation during the burial, tectonic deformation, and exhumation of Devonian rocks.

Level of Instruction: The mechanics of the Appalachian basin will be boiled down into a simple language built around the laws of linear elasticity and fracture mechanics. Instruction will be designed for the consumption of professional geologists with just a rudimentary background in mechanics. Students may, however, expect an intense day of instruction.

Instructor: Dr. Terry Engelder, Professor of Geoscience, The Pennsylvania State University. At PSU, Terry, recipient of a college teaching award, has taught at all levels between general education classes for non-majors and equation-based graduate classes. Terry has given workshops on rock fracture in China, Saudi Arabia, Brazil, Italy, Austria, and the Czech Republic. Terry is one of the world's experts on fracture within petroleum geosystems.

Workshop schedule: The workshop will be divided into twelve (12) sessions with one hour's worth of information transmission followed by a half an hour for coffee and questions or lunch and questions.

Day #1 (January 8)

8:00 am: The Catskill Delta Complex and its black shale
Overview of Appalachian Geology

9:00 AM – Coffee and questions

9:30 am: The concepts associated with stress
Continuum mechanics applied to Appalachian Geology

10:30 AM – Coffee break with time for student exercise #1

11:00 am: Pore pressure, consolidation and compaction disequilibrium
The burial history of Devonian black shale

12:00 Noon – Lunch and questions

1:00 pm: Tectonics of the Appalachian Plateau
Tectonic stress and strain

2:00 PM – Coffee break with time for student exercise #2

2:30 pm: Elasticity versus rock strength
Analysis of faulting and folding on the Appalachian Plateau

3:30 AM – Coffee break with time for student exercise #3

4:00 pm: Elementary fracture mechanics
The source of fracture porosity in Devonian black shales

5:00 PM – Question and answer session as a means of wrapping up the day

Day #2 (January 9)

8:00 am: Joint growth in Devonian shale based on joint surface morphology
Rules for fracture development during the burial-exhumation cycle

9:00 AM – Coffee and questions

9:30 am: Mechanisms for generating abnormal pore pressure
The role of maturation during burial of the Catskill Delta Complex

10:30 AM – Coffee break with time for student exercise #4

11:00 am: Coupling of stress to pore pressure: Poroelasticity
Evidence for coupling in the Catskill Delta Complex

12:00 Noon – Lunch and questions

1:00 pm: Natural hydraulic fracturing: differences between black and gray shale
The mechanism for driving joints by high fluid pressure

2:00 PM – Coffee break with time for student exercise #5

2:30 pm: Fracture interconnectivity and its affect on reservoir permeability
Five types of fractures in outcrops of the Appalachian Plateau

3:30 PM – Coffee and questions

4:00 pm: Analysis of logs from the Devonian section of the Appalachian Basin
Prediction of rock properties in the Devonian Section

Closing session: Strategies for enhanced recovery from black shales
Comments on hydraulic fracture treatments and horizontal drilling

5:00 PM – Question and answer session as a means of wrapping up the day

DIRECTIONS:

The easiest access to NRCCE is from the Star City/WVU exit off I-79 north of the I-68 interchange. Turn right off the ramp if coming from the south, left if coming from the north. You will follow the signs for U.S. 19 south/ Rt. 7 East (Monongahela Blvd./Jerry West Blvd.). Go through 4 lights (the 4th is at the Coliseum). At the 5th light, turn left onto Evansdale Drive. The Creative Arts Center will be on your left. A map of WVU's Evansdale Campus is attached and should help you find your way to the NRCCE building once you turn into the campus.

HOTELS:

For workshop attendees who may wish to stay in Morgantown, the following is a list of hotels convenient to NRCCE. The first two are right off Monongahela Blvd./Jerry West Blvd. Directions to the hotels are given from the I-79 Star City exit:

Best Western – 800-528-1234 (turn left at the third traffic light from the Interstate, hotel is immediately on the right)
366 Boyers Ave.

Quality Inn - 599-1680 (hotel is just before the WVU Coliseum on the right after the third traffic light)
1400 Saratoga Ave.

Hampton Inn - 599-1200 (turn left at the 4th traffic light on Monongahela Blvd onto Patteson Drive; after the 3rd light when Patteson becomes Van Voorhis Rd., hotel is immediately on the left); 1053 VanVoorhis Rd.

Euro-Suites - 598-1000 (follow directions for Hampton Inn, but continue past Hampton Inn to the next light and turn right, the hotel is immediately on the left) 501 Chestnut Ridge Rd./Milan Puskar Blvd.

PARKING:

The following are suggestions for parking while attending the workshop:

Paid Parking is available in the short-term pay lot next to the WVU Greenhouse (see map; parking area #1). Rate is \$1.00 per hour and the machine does not give change. It accepts only \$1 bills and coins, so attendees need to arrive with at least 8 \$1 bills in their possession each day. Attendees should arrive early to use this option.

Free Parking is available in the WVU Coliseum parking lots (see map). Attendees may park at the Coliseum and ride the free university shuttle bus to the Mineral and Energy Resources Building and from there walk (5 minutes) over to NRCCE. Attendees also may choose to walk directly from the Coliseum parking lot to NRCCE. Attendees who choose one of these options should allow an extra 20 minutes to park, catch a bus/walk to NRCCE. Buses depart from the Coliseum Blue Gate every 10 minutes from 7:30 a.m. until 5:00 p.m., and every 15 minutes from 5:00 pm until 10:00 pm.

Access to the NRCCE Building is through the front (first floor) entrance for those who park at the Coliseum and take the short walk from the drop off point, or through the rear (ground floor) entrance for those who park in the pay lot next to the Greenhouse and walk to the NRCCE building. The workshop room will be immediately on the left as one enters the front entrance to the building.

NAME: _____

COMPANY: _____

ADDRESS: _____

CITY: _____ STATE: _____ ZIP CODE: _____

E-MAIL: _____

The registration fee for this 2-day workshop is \$175. This fee covers the entire workshop, continental breakfasts, morning and afternoon breaks and lunches. Please make checks payable to "West Virginia University" and return with this form by January 2, 2008 to: Douglas Patchen, P.O. Box 6064, Morgantown, WV 26506-6064.

