EVALUATION OF NATURALLY FRACTURED RESERVOIRS

Instructor : Dr. Djebbar Tiab
Professor, Mewbourne School of Petroleum and Geological Engineering, Mewbourne College of Earth and Energy, University of Oklahoma

27 November - 1 December 2017
Bandung

COURSE DESCRIPTION
This course stresses practical aspects of reservoir characterization for reservoir and production engineers, with a special emphasis on:

- Assessing recovery and reserves
- Petrophysical evaluation of Naturally Fractured Reservoirs (NFR)
- Interpretation of pressure tests of vertical and horizontal wells in NFR
- Reservoir management of NFR

BENEFITS OF THE COURSE:
At the end of this course, the participants will be able to do the following:

- Integrate rock data obtained from logs and cores
- Generate permeability-porosity relations unique to their reservoir
- Utilize data from formation evaluation tools to determine reservoir quality
- Analyze the variations in pore architecture and its effect on permeability
- Relate fracture density, aperture, and length to facies, lithology and diagenesis
- Determine fracture porosity and permeability in NFR
- Calculate Porosity partitioning coefficient of a naturally fractured reservoir
- Calculate storage capacity and inter-porosity flow factor
- Analyze well tests in naturally fractured reservoirs
- Assess reservoir performance of horizontal wells in NFR
- Use MBE to analyze impact of pressure Depletion on Recovery in NFR

Videos and Daily Excel-based class exercises will reinforce the concepts covered in class. Participants are required to bring a personal computer to work exercises.

WHO SHOULD ATTEND?
- Petroleum engineers, such as production engineers and reservoir engineers, geoscientists and other technical staff who are involved in the area of formation evaluation and field development.

COURSE CONTENT:

1 – EVALUATION OF CORE & LOG DATA IN NFR
   1. Evaluation of Naturally Fractured Reservoirs (VIDEO)
2. Indicators of Natural Fractures, Visual Identification of Fractures
3. Fracture Porosity Determination
4. Porosity Partitioning Coefficient, Fracture Intensity Index
5. Permeability-Porosity Relationships
6. Fracture Porosity and Aperture from Cores
7. Fracture Area, Fracture Storage Capacity, Fracture Conductivity
8. Cementation Factor in NFR
9. NMR Response Characteristics in NFR
10. Petrophysical Characteristics for Use in Dual-Porosity Simulators

11. EXERCISES

2 – RESERVOIR ZONING, NET-PAY CUT-OFF & FLOW UNITS
1. Reservoir Environments & their Characteristics (VIDEO)
2. Permeability-Porosity Models
3. Identification & Characterization of Flow Units in Clean Formations
4. Flow units in clean sands, flow zone index
5. Reservoir characterization by the J-function
6. Identification & Characterization of Flow Units in Shaly Formations
7. Log-derived evaluation of shaly sands
8. Flow units in shaly formations, shale zone index
9. Reservoir Quality Index for Fractured Systems
10. Permeability Averaging Techniques
11. Porosity Averaging Techniques
12. Net-Pay Cut-off Methods, Winland R35

13. EXERCISES

3 – INTEGRATING WELL TEST DATA IN NFR
1. Fundamentals of WTA & Test Design (VIDEO)
2. Pseudo-steady state Flow Model
3. Transient Matrix Flow Model
4. Composite NFR
5. Anisotropic reservoirs & Interference testing
6. Impact of Stress on Pressure Tests in NFR

7. EXERCISES

4 – PERFORMANCE OF HORIZONTAL WELLS IN NFR
1. Geological Aspects of Horizontal Wells (VIDEO)
2. Horizontal well applications
3. Overview of Horizontal Wells
4. Limitations of Horizontal Wells
5. Importance of Vertical Permeability of NFR to HW Performance
6. Objectives of HW in Naturally Fractured Reservoirs
7. Interpretation of HW Well Tests
8. Horizontal Wells in Anisotropic NFR

9. EXERCISES

5 – ASSESSING RESOURCES, RESERVES & RECOVERY OF NFR
1. R/P Ratio: DNA of a Company
2. Petroleum Reserves: Definitions
3. Estimating Oil in place
4. Recovery Efficiency and Reserves of Under-saturated Reservoirs
5. Recovery Efficiency and Reserves of Saturated Reservoirs
6. Estimating Reserves of a Water Drive Reservoir
7. Impact of Drive Mechanism on Recovery (VIDEO)
8. Estimating Gas Reserves
9. Recovery Efficiency, API Correlations
10. EXERCISES

6 – RESERVOIR MANAGEMENT OF NFR
1. MBE for Dual-Porosity systems
2. Naturally Fractured Gas Reservoirs
3. Undersaturated NFR
4. Saturated NFR
5. Reservoir Management Of Mature Fields (VIDEO)
6. EXERCISES

*The Material in the following Appendices is very basic and is included for review purposes only.*

Appendix A – BASIC GEOLOGICAL EVALUATION & CORING
1. Introduction to Petroleum Geology
2. Objectives of Coring Programs
3. Conventional Coring
4. Core Alteration and Handling
5. Core Alteration During Recovery
6. Filtration Invasion
7. Core Preservation

ABOUT THE INSTRUCTOR

Prof. Djebbar TIAB:
- 1977-2014, Professor of Petroleum Engineering at the University of Oklahoma (OU);
- 2014 - ...: Emeritus Professor, University of Oklahoma,
- 2008 - : Visiting Professor of Petroleum Engineering at AUST. He retired from the University of Oklahoma in June 2014 to concentrate on consulting and training with his company UPTEC (United Petroleum Technology LLC), based in Norman, Oklahoma.

He received his B.Sc. (May 1974) and M.Sc. (May 1975) degrees from the New Mexico Institute of Mining and Technology, and Ph.D. degree (July 1976) from the University of Oklahoma - all in Petroleum Engineering. He served as the Director of the OU – Sonatrach “The University of Oklahoma Graduate Program in Petroleum Engineering in Algeria” from 1996 to 2004.
Before joining the University of Oklahoma in 1977, he worked as a research associate and as an assistant professor at the New Mexico Institute of Mining and Technology, where he taught drilling & well completion, production engineering, well logging and natural gas engineering. At the University of Oklahoma, Dr. Tiab taught various petroleum and general engineering courses including: well test analysis, advances in pressure transient analysis, petrophysics/reservoir rock properties, Core Analysis-lab, advanced petrophysics, oil reservoir engineering, natural gas engineering, reservoir mechanics lab, natural gas engineering lab, fluid mechanics, Production, Properties of reservoir fluids, Introduction to engineering, Advanced reservoir engineering, Fluid Flow Through Porous Media, Advanced natural gas engineering, Water flooding, Naturally Fractured Reservoirs, and Petroleum Geology for Non-Geologists.

He teaches Petroleum Engineering courses (MS and PhD level), as a visiting professor at the African University of Science and Technology (AUST) in Abuja, Nigeria, since 2008. He also supervises theses of several graduate students. In 2010, he taught at ESPRIT (Ecole Supérieure Privée d'Ingénierie et de Technologies) in Tunis, Tunisia.

Dr. Tiab has consulted for a number of oil companies and offered training programs in petroleum engineering in the U.S.A. and overseas. He worked for over two years in the oil fields of Algeria for Alcore, S.A., an association of Sonatrach and Core Laboratories. He has also worked and consulted for Core Laboratories and Western Atlas in Houston, Texas, for four years (1990-1993) as a Senior Reservoir Engineer Advisor. He is the manager of his consulting company, registered in Oklahoma, United Petroleum Technology, LLC (UPTEC).

He teaches several short courses for various organizations: Sonatrach (Algeria), OilProduction Inc. (Argentina), MAT (Iran), NExT (Schlumberger), PetroGroup (Colombia), Elite (Colombia), UPTEC (U.S.A.), HSG Consulting (Colombia), PetroSync (Singapore), BlackGold (India), GeoServices (Indonesia), Energex (Libya), Energy Institute of the Americas (USA), ... Provided training & consulting in several countries, including Algeria, Argentina, Colombia, Venezuela, India, Indonesia, Iran, Nigeria, Saudi Arabia, Tunisia, Turkey, UAE and USA. He typically teaches the following courses:

**Basic Courses:**
1. Properties of Reservoir Rocks (5 days)
2. Properties of Reservoir Fluids (5 days)
3. Oil Reservoir Engineering (5 days)
4. Gas Reservoir Engineering (5 days)

**Advanced courses:**
1. Advanced Well Test Analysis (5 or 10 days)
2. Advanced Petrophysics: Reservoir Characterization (5 days)
3. Advanced Reservoir Engineering (5 days)
4. Evaluation of Naturally Fractured Reservoirs & Carbonates (5 days)
5. Reservoir Performance of Horizontal Wells (5 days)
6. Basic & Advanced Reservoir Engineering (10 days)

As a researcher at the University of Oklahoma, Dr. Tiab received several research grants and contracts from the National Science Foundation (NSF), United States Department of Energy, U.S. Department of HEW, Sonatrach, KOC, Oklahoma Mining and Mineral Resources Institute, EPSCoR and the Energy Resources Institute. He is a member of the U.S. Research Council,
Dr. Tiab is the author/co-author of over two hundred forty (240) conference and journal technical papers in the area of pressure transient analysis, dynamic flow analysis, Petrophysics, natural gas engineering, reservoir characterization, reservoir engineering and injection processes. In 1975 (M.S. thesis) and 1976 (Ph.D. dissertation) Tiab introduced the pressure derivative technique, which revolutionized the interpretation of pressure transient tests. He developed patents for CORE LAB in the area of reservoir characterization (identification of flow units).


Dr. Tiab supervised one hundred forty research projects at the University of Oklahoma and several at Core Laboratories. These research projects formed the basis of 154 theses (M.Sc. and Ph.D.). The research projects covered all aspects of Petroleum Engineering including reservoir engineering, formation evaluation/well test analysis, reservoir characterization, enhanced oil recovery and production. Most of his Ph.D. students are now consultants and/or professors at universities in the U.S.A., South America, Africa, Asia and the Middle East.

He received the Outstanding Young Men of America Award (1983), the SUN Award for Education Achievement (1984), Kerr-McGee Distinguished Lecturer Award (1985), the College of Engineering Faculty Fellowship of Excellence (1986), the Halliburton Lectureship Award (1987-89), the UNOCAL Centennial Professorship (1995-98), and the P&GE Distinguished Professor (1999 – 2000). The UNOCAL Professorship was created to honor the one-hundredth anniversary of the University of Oklahoma. He received the 2007 USCO Recognition Award for Outstanding Technical Achievements.

He received the prestigious 1995 SPE Distinguished Achievement Award for Petroleum Engineering Faculty. The citation read, “He is recognized for his role in student development and his excellence in classroom instruction. He pioneered the pressure derivative technique of well testing and has contributed considerable understanding to petrophysics and reservoir engineering through his research and writing.”

Dr. Tiab has been elected in October 2002 to the Russian Academy of Natural Sciences as a member because of “His outstanding work in petroleum Engineering”, and was awarded the Kapista gold Medal of Honor for “His outstanding contributions to the field of engineering.”
He received the technical 2003 SPE Formation Evaluation Award for “Outstanding achievements in petrophysics and reservoir engineering.”

Dr. Tiab receives (November 2013) the Africa Education Leadership Best Professor in Petroleum Engineering Award. The AEL Awards are presented to “Individuals who have surpassed several levels of excellence and set an example of being a role model and Exemplary Leadership. Individuals behind the Institution who are building their Institutions through Leadership, Innovation, Academic and Industry Interface and a supreme objective of Building future leaders.”

ENROLLMENT
In order to allow sufficient time for arranging travel plans, early enrollment is recommended. Registration will be closed on 20 October 2017. Late enrollment may result in course cancellation.

CANCELLATION, SUBSTITUTION & REFUND
The tuition fee will be refunded (less US$ 100 registration fee) only if notification of cancellation is received at least 10 days prior to the commencement.

Non payment of tuition fee does not constitute automatic cancellation of participation. Substitution may be made at any time for those enrolled.

CERTIFICATE
A certificate of participation will be awarded to each person completing the course.

TUITION FEE
Tuition fee at Rp. 39,500,000 + VAT per delegate (the tuition fee will be adjusted based on the prevailing rate) is due and payable upon confirmation of enrollment. The fee is excluded accommodation. Payment should be settled at the latest on 20 October 2017. Any bank charges connected with payment in Rupiah must be added to tuition fee payment. Tuition fee includes admittance to the course, course materials, daily refreshments and full lunch.

Payment can be made to PT. Geoservices
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