Reservoir characterization, sedimentology, facies, sequence stratigraphy, petrophysics, fractures, and geochemistry of shale-gas/oil bearing tight carbonate rocks in classroom and core workshop

Length: 5 days

Instructor

Dr. Ursula Hammes obtained her Diploma in Geology from the University of Erlangen in Germany in 1987 and her PhD from the University of Colorado at Boulder in 1992. She spent ten years working as a consultant, performing postdoctoral research at the Bureau of Economic Geology, and as exploration geologist in industry. Dr. Hammes worked at the Bureau of Economic Geology and the University of Potsdam, Germany, as a Research Scientist and currently teaches at Texas A&M University as Halbouty Visiting Chair. Since January 2017, she has been consulting for a variety of oil and gas companies as well as teaching classes in evaluation of shale oil/gas plays. Her main research focus is in shale-gas/oil systems specializing in basin to nano-scale characterization of shale basins. Other research interests and specialities include clastic and carbonate sequence stratigraphy, analyses of depositional systems, and carbonate and clastic diagenesis. She has published more than 200 papers, 400 abstracts, and served as AAPG Bulletin Editor, AAPG session chair, GCSSEPM President, and lecturer.

COURSE DESCRIPTION

During this 5-day hands-on core workshop the participant will learn techniques to interpret mudrocks (shales and mudstones) and tight carbonates from basin to nano-scale. The workshop focuses on rock-based interpretation using core, geochemical, and petrophysical data to characterize tight reservoirs. Upon completion of this workshop the participants will be able to apply depositional, sedimentological, sequence stratigraphic, geochemical and petrophysical principles to exploration areas and production assets of tight basin. Participants will learn to understand the variety of shale and tight carbonate systems from basin to nanoscale, classify mudrock and tight carbonate facies, identify sequences (in cores and well logs) and be able to
tie those to well-log character, learn to interpret geochemical data critical to understanding tight systems, and understand controls on source-rock deposition, reservoir heterogeneities, and discern fracable intervals.

**COURSE CONTENT**

**Course Overview – Day 1, am (at Conference Center, Austin)**

Approaches to understanding the geology of shale-gas/oil plays

- Overview of organic-rich mudrock systems
  - Carbonate-dominated systems
  - Clastic-dominated systems
  - Mud-dominated systems
- Factors determining organic-rich deposits
  - Paleogeography
  - Ocean chemistry
  - Climate
- Modern examples (Cariaco Basin)

**Course Overview – Day 1, pm (Conference Center, Austin)**

Techniques for characterization of mudrocks (overview)

- Paleogeographic and tectonic setting
- Sedimentology
- Sequence Stratigraphy
- Geochemistry
- Petrophysics
- Seismic and Geomechanics
- Fractures

Examples from different North American resource plays

- Inter- and intrabasinal variations – examples from different shale and tight carbonate formations (Haynesville, Barnett, Eagle Ford, Bakken, Wolfcamp, Buda, Austin Chalk)

**Course Overview – Day 2, am (at Conference Center, Austin)**

Interpretation of depositional environments in shale and carbonate basins

- Facies interpretations
- Calcareous shales (Haynesville, Eagle Ford examples)
- Siliceous shales (Barnett, Wolfcamp examples)
- Clay-rich shales (Tuscaloosa Marine Shale; Tertiary Shale)
- Tight carbonates (Buda, Austin Chalk)
- Mudrock and carbonate sedimentology
- Sedimentary structures and depositional processes
- Exercise

**Course Overview – Day 2, pm (at Conference Center and BEG core facility, Austin)**

Stratigraphic framework

- Regional correlations and variations
- Sequence stratigraphy (shelf to basin correlations)
- Hands-on exercise for shelf to basin correlations

Introduction to cores (at BEG core facility, Austin)

- Core interpretation guidelines
- Core viewing: Introduction to cores at the BEG-CRC
- Eagle Ford, Haynesville, Bossier, Bakken, Barnett, Wolfcamp, Buda and Austin Chalk

**Course Overview – Day 3, am (at Conference Center, Austin)**

Geochemical Tools and Geochemistry Review

- Overview of definitions in source rock evaluation
- Lithology
  - XRD
  - XRF
- Organic-matter type and richness
  - Kerogen/TOC
- Maturity
  - Rock-eval
- Interpretation of geochemical results – incorporating data
- Exercise (Van Krevelen plot, chemostratigraphy)

**Course Overview – Day 3, pm (at Conference Center and BEG core facility, Austin)**

Mudrock and carbonate diagenesis

- Type of cements
- Timing of paragenesis
- Influence of diagenesis on production
Core exercise: Relating geochemistry to facies and mineralogy

Course Overview – Day 4, am (at Conference Center, Austin)

Reservoir characterization and reservoir quality of mudrocks and tight carbonates:

- Porosity
  - Porosity from wire line logs
  - Porosity from core measurements
  - Porosity from SEM pictures
- Permeability
  - Permeability measurements and pitfalls
- Wireline log interpretation and petrophysics
- Methods for calculating TOC from wireline logs
  - ΔLogR and Multimin methods
- Lithology, porosity, and permeability modeling from wireline logs
- Exercise identifying TOC-rich zones on logs

Course Overview – Day 4, pm (at Conference Center and BEG core facility, Austin)

Seismic tools and Fractures

- Faults, fractures, TOC, acoustic impedance, Q-factor, attribute maps, pore pressure, effective stress
- Geocellular modeling
- Fractures in mudrocks and tight carbonates
  - Types of fractures
  - Control of fractures on fracs
- Microseismic monitoring

Core viewing and descriptions

Course Overview – Day 5 am (at BEG core facility, Austin)

Course summary (in core viewing room)

- Integration: Evaluating and finding best shale and tight carbonate reservoirs using learned skills

Course Overview – Day 5 pm (at BEG core facility, Austin)

- Course Summary and take-home lessons