CEGA
Canadian Energy Geoscience Association

Short Course

Regional Geology of the Montney Resource Play: Western Canada Sedimentary Basin

Instructors: Thomas F. Moslow, PhD., P.Geol.
John-Paul Zonneveld, Professor

Location: AER Core Research Centre, 3545 Research Way, NW, Calgary, AB (3Days)
Field Trip- Kananaskis-Canmore, (1Day)

September 25-28, 2023, | 8:15am-4:30pm (MST)

COURSE OVERVIEW

This updated and revised four-day course utilizes a combination of lectures, core workshops and a one-day field trip to provide a regional overview of the reservoir characteristics, facies heterogeneity and stratigraphic framework of the Montney Formation from subcrop edge to outcrop with an emphasis on the geological attributes that make the Montney one of North America's leading resource plays. Emphasis is placed on the geologic parameters that drive reservoir performance, deliverability and EUR. Specific play types from west-central Alberta and northeastern British Columbia are reviewed in detail covering a broad geographic and geologic spectrum. Examples include:

- Siliciclastic sandstone and bioclastic (i.e. "coquina") shoreface facies in oil and liquid - rich gas pools along the Alberta –British Columbia subcrop edge;
- Sandstone and siltstone oil and gas reservoirs of turbidite, tempestite and deltaic facies deposited in proximal to distal shelf/ramp origin in the Alberta Deep Basin;
- Liquids – rich natural gas siltstone reservoirs of distal shoreface, offshore transition and shelf/ramp origin on the Peace River Arch; and
- Bituminous siltstones, "shales" and bioclastic reservoir facies of distal shelf/ramp and shoreface origin in northeastern B.C.

Lectures and core workshops include an examination of reservoir characteristics from the Lower (Griesbachian-Dienerian), Middle (Smithian), Upper (Spathian) Montney and Anisian Sunset Prairie Formations including an identification of the most commonly targeted intervals for long-length laterals. Emphasis is placed on the depositional origin, predictive geometry, lateral variability, heterogeneity, reservoir attributes of primary and secondary porosity/permeability and fabric related reservoir quality and anisotropy that provide the basis for making the Montney an excellent candidate for economic recoveries of hydrocarbons through horizontal drilling and multi- stage completions. Recent advances in sedimentology, ichnology, bio/sequence stratigraphy and tectonics are incorporated into lecture presentations. Additional topics include Montney paleogeography, depositional history, hydrodynamics, diagenesis and petrology placed into a regional and field specific context. The course has been significantly updated with observations from new plays and discoveries focusing on recent activity in west-central Alberta and Peace River Graben sub-basin of northeast BC. All lecture presentations are supplemented with detailed reviews of whole diameter core.

Course Itinerary

Day 1, Monday: AER Core Research Centre: Lecture Rm. 35, 3545 Research Way NW (Calgary)
Day 1: Regional Overview of the Montney and General Geology of the AB/BC Subcrop Region and West-Central, Alberta

AM Lectures:

1. 8:30 -8:45AM: Introduction to Course: Objectives, Itinerary, Format, Background of Montney Research Done Over Years at U of A and U of C by J-PZ and TFM and Industry Applications (10-15 minutes): (TM and J- PZ)
2. 8:45-9:15AM: Exploration and Development History of the Montney from 1950's to 2023: "From Tombstone to Gemstone": (TM)
   Break
3. 9:30-10:15AM: Paleogeographic, Paleo-oceanographic, Paleoclimatic/Ecologic setting of the Mid-Lower Triassic: (J-PZ)
   Break
4. 10:30-11:15AM: Litho-Chrono-Bio-Sequence Stratigraphic Framework of the Montney (from outcrop and subsurface analysis): (J-PZ)
5. 11:15-12 Noon: Siliciclastic and Bioclastic Facies: Reservoir Characteristics, Fabric Anisotropy and Core-Log Calibration of the Montney: (TM)

PM: Core Workshop: TM

1. La Glace turbidite reservoir facies; 8-28-74-7W6 (2135m -2145.5m); gas with liquids reservoir; slabbed; (Dinerian-Smithian)
2. Pouce Coupe 4-16-78-12W6, Core #1 (2069-2105.m); excellent display core for shoreface facies associations, marine flooding surfaces, sequence boundary and siliciclastic tempestites
3. Elmworth 13-6-69-8W6, (2742-2812m); Smithian siliciclastic facies and parasequence sets; facies include turbidites in D1, shoreface in D2 and deltaic in D3.

PM: Core Workshop: JPZ

1. Ring Border/ Pedigree subcrop edge: 11-12-99-11W6 (1037-1070m) wave-modified deltaic succession (one table).
2. Anten Coquina type core: 10-36-67-24W5 (1839-1852 m). Bioclastic shoreface succession (one table).
3. Amoco Giroux: 07-14-65-22W5 (6285'-6344') incised valley and shoreface reservoir facies (one table).
4. CNRL Graham c-033-C/94-B-09 (2180-2233m) Sunset Prairie Formation (one table)

Day 2 Tuesday: AER Core Research Centre: Lecture Rm. 35, 3545 Research Way NW (Calgary)
Day 2: Deep Basin and Peace River Arch Reservoirs /Resource Plays

AM Lectures:

1. 8:30-9:15AM: Regional Tectonic and Structural Overview of the Mid- Lower Triassic and Hydrographic Regimes of the Montney in Alberta and NEBC: (TM)
   Break
2. 9:30-10:15AM: Bioclastic Reservoir Facies of the Montney in NEBC: Dienerian-Smithian Aged Reservoirs of the Montney "Northern Shelf" ™
   Break
3. 10:30-11:15AM: Ichnology and Paleoecology of the Montney (shelf, shoreface, deltaic facies): (J-PZ)
4. 11:15-12 Noon: Primary Depositional Controls on Reservoir Quality in the Montney Formation: (J-PZ)

PM: Core Workshop: TM

1. Pouce Coupe 6-3-79-13W6; Box 46 (approx. 1999.m) to Box 90 (approx. 2065.m); 66m core length; 2 tables; mid-upper Smithian Altares Member; Montney D3, D4, D5 interbedded bioclastic/siliciclastic facies.
2. Town d-B95-H/94-B-16; 1/3 slabs; 2030.-2060m; Lower Montney (Upper Dienerian) Pocketknife Member/ "Claraia Zone" and overlying base of basal Smithian MmA.

PM: Core Workshop: J-PZ

1. Shell Gold Creek 5-24-68-5W6: 2235-2402m (2 tables) (starting bottom up).
2. Conwest Pouce Coupe (15-31-77-10W6) Cores 1 (1989-2007m), 2 (2032-2050m) and 4 (2215-2235m). (two tables, starting bottom up).

Day 3, Wednesday: AER Core Research Centre: Lecture Rm. 35, 3545 Research Way NW (Calgary)
Day 3: Peace River Arch and NEBC Reservoirs and Resource Plays

AM Lectures:

1. NEBC Reservoir Facies and General Geology from Core and Outcrop: (J-PZ)
2. Break
3. 9:30-10:15: Sequence Stratigraphic Architecture and Depositional Models of the Montney Formation, NEBC. (TM)
4. Break
5. 10:30-11:15: Summary: Geologic Controls on Montney Formation "Resource Plays" and Reservoirs: Summary (TM and J-PZ)
6. 11:15-12Noon: Field Trip Overview and Logistics (J-PZ)

PM: Core Workshop: TM

1. Birch a-94-J/94-A-13: 1619.-1672.m; 1/3 slabs; SB/FS at Smith/Spath Bndy; majority of Spathian interval; aggradational to retrogradational parasequence set at base of Spathian;
2. LaPrise a-82-I/94-G-1; Core #1; 1670-1705m; 35m of 4" (10cm) core; 1/3 slabs; Good core to demonstrate sequence strat of the Spathian interval in NEBC; entire Spathian (Um1, Um2, UmA) and thin Sunset Prairie Fm.

3. LaPrise a-82-I/94-G-1; Core #2; 1770-1810m; 4 1/3 slabs; Siliciclastic facies equivalent of Pocketknife Member on Stoddart High; uppermost Dienerian (LmC/LmD). Example of influence of tectonics on sedimentation and lateral facies variability in the Montney.

PM: Core Workshop: JPZ

1. Polarstar Conroy b-066-D/94-H-12 – (1399-1495m; 1560-1617m) Middle to Upper Montney; 4 tables.

Day 4, Thursday: Field Trip: 8:30AM, Depart from AER –CRC parking lot.
Day 4 Field Trip: Montney Sedimentary Facies and Reservoir Characteristics in Outcrop

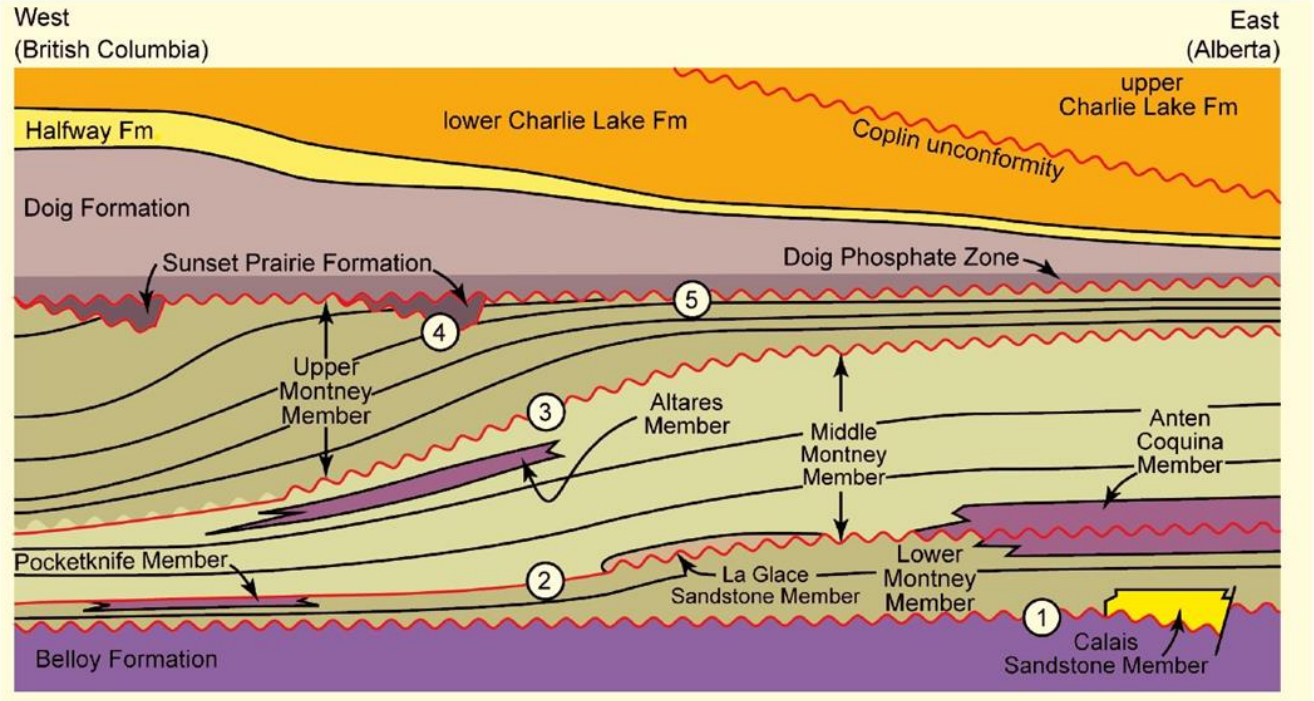
STOP 1: Kananaskis:

- 10:00AM: Hood Creek Traverse and Hwy 40 Road Cut (bedding plane surfaces and vertical section: sedimentary structures, fractures; burrowed horizons; stratal surfaces)
- 12:30PM: Lunch and overview/ discussion

STOP 2: Canmore "Spillway

- 2:30 PM: outcrop traverse
- 4:15 PM: return to Calgary.
- 5:30PM: Return to AER – CRC parking lot.

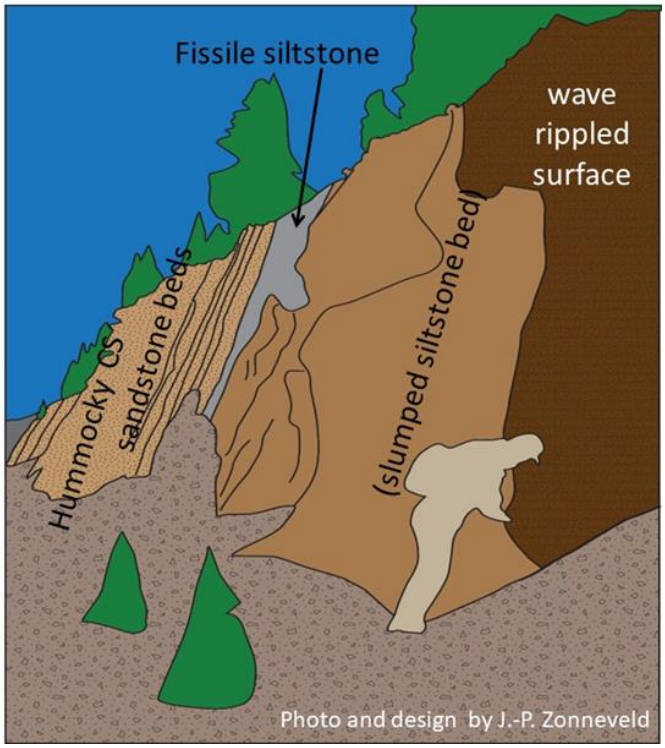
End of Trip



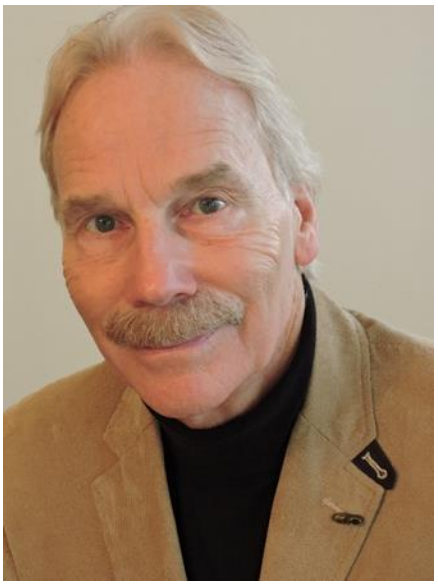
(form Zonneveld and Moslow, 2018)

Sulphur Mountain Fm. (Montney equivalent) outcrop: Hood Creek, Kananaskis

photo by T. F. Moslow



Biographies



Dr. Tom Moslow is President of Moslow Geoscience Consulting Ltd. and an Adjunct Professor in the Department of Geoscience at the University of Calgary. He was a former Professor (1987–1994) at the University of Alberta Department of Erath and Atmospheric Sciences and Louisiana State University Department of Geology and Geophysics (1983-87). Tom was employed by Canadian Hunter Exploration Ltd. (1995-1970) and Ulster Petroleum (1997-2000). In 2000, he became a co-founder of Midnight Oil & Gas Ltd., which led to the creation of Daylight Energy Trust. He held executive positions in subsequent affiliated companies. He is the author or co-author of over 100 publications and has won numerous awards and honours for his work and research including the 2021 Stanley Slipper gold medal from the CSPG. His current consulting work is focused on the Triassic and Lower Cretaceous of Western Canada and resource play geology in general including both domestic and international ventures.

John-Paul Zonneveld (JP) is a Professor in the Department of Earth and Atmospheric Sciences and curator of the University of Alberta Core Collection. He has been with the University of Alberta since 2008 prior to which he was a research scientist with the Geological Survey of Canada. John-Paul is a sedimentary geologist and palaeoecologist with a focus on Mesozoic and Cenozoic mixed siliciclastic-carbonate depositional systems. John-Paul has served as editor of Palaios and the SEPM Special Publication series and remains associate editor of several ichnological and sedimentological scientific journals.

John-Paul's research projects are typically multidisciplinary and commonly focus on problems involving the interface between geological and biological system. Current projects include: mixed siliciclastic-carbonate depositional systems and reservoir controls in the Triassic of western Canada (Montney, Doig, Halfway, Charlie Lake Baldonnel, Pardonet and Bocock formations and their outcrop equivalents); reservoir controls in shoreface and deltaic successions in the Fernie, Spirit River, Cardium and Dunvegan formations of Alberta and British Columbia; the sedimentology, biostratigraphy and paleoecology of Early to Middle Eocene successions in southwestern Wyoming; and the Paleogene to Quaternary paleontology and sedimentology of Island Southeast Asia (focusing on Sumatra, Kalimantan, Sumba, Bali and Timor).