



MGS Happy Hour



When? Thursday, March 23rd 5:00PM – 8:00PM
(dinner at 6pm, talk starts at 6:15PM)

Where? Bighorn Resort at the west end of Billings (1801 Majestic Lane)

What? Presentation, Buffet Style Dinner (dinner tickets are \$30 for members, \$40 for non-members (guests), and \$10 for students), Drinks (not included with ticket)

RSVP to montanageologicalsociety@gmail.com by latest Monday, March 20th

SPEAKER: TIM NESHEIM

NORTH DAKOTA GEOLOGICAL SURVEY

Timothy (Tim) Nesheim initially earned a B.S. degree in geosciences from the Minnesota State University of Moorhead (2007), and an M.S. in geosciences from the University of Iowa (2009). Tim started working for the NDGS in 2010 as a subsurface geologist and was promoted to Head of the Subsurface Section in 2017. Most recently (2022), he began serving as Acting Core Library Manager of the Wilson M. Laird Core and Sample Library located in Grand Forks, North Dakota. His early work at the NDGS focused on the preliminary identification and evaluation of



petroleum source beds within the North Dakota portion of the Williston Basin. More recently, his research focuses have shifted to core-based sedimentology and stratigraphy investigations of various formations within the Williston Basin.

Revisiting the Madison (Mississippian) Petroleum System(s) of the Williston Basin, western North Dakota

Madison Group reservoirs have combined to be the most productive conventional oil and gas interval of the Williston Basin. More than 32,000 vertical and horizontal Madison wells have produced a combined 4.1 billion barrels of oil and 2.6 trillion cubic feet of natural gas (~4.6 billion barrels of oil equivalent, BOE) across both the US and Canadian portions of the Williston Basin. Early geochemical studies proposed that Madison reservoirs were sourced by the underlying Bakken Formation while numerous later studies concluded that Madison reservoirs are largely self-sourced by petroleum source beds positioned somewhere within the Madison section. However, until the past several years, minimal published information existed regarding the hypothetical Madison source beds.

Examining several dozen cores and wireline logs across western North Dakota, two prevalent and prospective Madison source rock intervals have been identified. 1) An upper Lodgepole source rock interval that reaches up to 45 feet thick in core, TOC values of 2.7% to 5.5% (4.0% average), and Tmax values ranging from 436° to 442°C (440° average). 2) A lower Bluell source rock interval that reaches up to 14 feet thick in core, TOC values up to 5.2% (~2% average), and Tmax values of 447° to 454° (~451° average). The standard programmed pyrolysis (RockEval) data indicates both source rock interval contain primarily Type I/II oil-prone kerogen and have reached the peak to late mature stages of oil generation (pending vitrinite/bitumen reflectance and visual kerogen analysis data may be included in RMAG presentation). Subsurface mapping, combining core and wireline logs, demonstrate that both source rock intervals extend for at least 1-2 million acres each. Understanding the stratigraphic positioning, lateral extent, organic-richness and thermal maturity of Madison source beds may further unlock both the remaining conventional as well as the unconventional resource potential of the greater Madison petroleum system(s).

Recent exploration and development in the Midale-upper Rival play of northern Burke County of North Dakota may serve as an exploration model for re-examining Madison reservoirs for unconventional-style resources (horizontal drilling combined with multi-stage hydraulic fracturing). Initial vertical well exploration and development in northern Burke County began in the 1950's by targeting localized conventional reservoirs (peloidal-oolitic lime grainstone) in the upper Rival (≥ 10 feet thick with permeability values of 10's of millidarcies) and secondarily targeting fractured, low-permeability (sub-millidarcy) dolomite reservoirs of the Midale. Open-hole horizontal well drilling began during the 1990's that targeted relatively thin (<10 feet) and moderately permeable (1-5 millidarcies) upper Rival reservoir. Most recently, horizontal wells are being drilled in the upper Rival that are completed with multi-stage hydraulic-fracture stimulations which complete into the overlying Midale, and the composite reservoir section is sandwiched between two anhydrite beds. The evolution from vertical to horizontal, unconventional-style exploration and development of the Midale-upper Rival may be reproducible in other legacy Madison oil and gas fields across the Williston Basin.