

## Hydrogen Sulfide in the Montney – Investigating a Complex Issue

In collaboration with Natural Resources Canada (NRCan), the Geological Survey of Canada (GSC), and the University of Calgary (UofC), CSUR hosted a full day technical workshop on the topic of “Hydrogen Sulfide in the Montney: Investigating a Complex Issue”. Given the importance of this play for Canada and the difficulty surrounding the source, distribution, generation, and production of this product from the wells into this formation, a significant amount of research has been undertaken and continues to be the focus of ongoing work at various institutions and organizations, including at those noted above. Several speakers were on hand to elaborate on their specific research and work in this area.

To set the stage for this technical workshop, opening comments were provided by Dr. Ted Little, Head – Energy Geoscience Subdivision at GSC & Manager for GSC’s National Program on Geoscience for New Energy Supply, and Dr. Omid Haeri Ardakani, Research Scientist at NRCan. The main objectives of the workshop were to highlight the latest research & corresponding findings, to continue to promote dialogue amongst all stakeholders, and to identify any gaps in the work that is currently underway or that need to be addressed.

The morning sessions were moderated by Dr. Ardakani and resulted in discussions around the existence of micro-organisms in extreme conditions such as those in the Montney formation or the unintended introduction of micro-organisms via injection fluids during drilling and completion operations that may have contributed to the onset of H<sub>2</sub>S formation. Discussions also delved into the diagenetic processes, the effects of geochemical controls, and migration paths that may have taken place since initial deposition to spur or initiate H<sub>2</sub>S formation in the Montney. In order to determine the potential original source(s) of this toxic compound, specialized work using gene sequencing (DNA) and fingerprinting (isotopic) analyses have also been incorporated into some of the research work. In addition, modeling of the subsurface phenomena and incorporating all of the processes mentioned above have been undertaken in order to be able to predict the distribution in and the production of H<sub>2</sub>S from the Montney in the Western Canadian Sedimentary Basin (WCSB). Planned future work includes studying sulfurized organic matter and integrating into the modeling work the study of the Namibian coast, which is considered a modern-day depositional analog for the Montney.

Dr. Per Kent Pedersen, Associate Professor – Department of Geoscience at UofC, took over the moderator duties for the afternoon sessions. Discussions continued around identifying the sources of sulfur via fingerprinting methods and possible migration patterns. Other tools / methods used to map and identify distinct signatures consisted of basin modeling and x-ray diffraction work. There was significant discussion throughout the day around the two main methods of H<sub>2</sub>S formation: thermochemical sulfate reduction (TSR) and microbial sulfate reduction (MSR) to ascertain the dominant subsurface process in the formation of H<sub>2</sub>S. The effects of structural distribution within the Montney geological setting were also highlighted to identify structural corridors and study the correlation (or anti-correlation) with seismicity and prevalence of H<sub>2</sub>S in the area. Detailed Montney stratigraphic analysis was then presented to provide the distribution of the H<sub>2</sub>S in the various subsets of the Montney zone. The structure of this stratigraphic analysis was based on the work by Dr. Carolyn Furlong for her thesis work while at University of Alberta, which was also presented at a CSUR event in April 2020.

To finish off the workshop, a poster slide deck was presented, which was an aggregation of all the different types of analyses and models that were discussed throughout the day. In addition to the significant amount of data quality and QA/QC work that was necessary in order to generate information that was representative of reservoir data, the presentation was discretized to identify H<sub>2</sub>S is gas, liquid and aqueous phases.

During the open discussion period, additional elements were discussed as part of possible future work to further characterize the occurrence / prevalence of H<sub>2</sub>S in the Montney:

- Variability of H<sub>2</sub>S with respect to time
- Map the distribution of H<sub>2</sub>S in the Montney sub-members
- Map the distribution of H<sub>2</sub>S in under and overlying formations (Elk Point, Woodbend, Belloy, Charlie Lake, etc.)

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## **SUMMARY AND AGENDA**

The origin and distribution of hydrogen sulfide (H<sub>2</sub>S) — a highly toxic and corrosive gas in conventional and unconventional resources of the Western Canada Sedimentary Basin — was subject of many studies. The Early Triassic Montney Formation, one the major North American unconventional gas resources, contains significant amount of H<sub>2</sub>S in some areas. Several research teams in western Canada including the Geological Survey of Canada, University of Calgary, and University of British Columbia are investigating this complex issue. This workshop will provide a venue to discuss the latest scientific advancements on this topic in order to reach a better understanding on the distribution, origin, and mitigation strategies to overcome the associated economic and environmental issues.

(MST)

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| 09:00 – 09:20        | Welcome and Agenda   |
| 09:20 – 09:40        | <b>Microorganisms from the Montney Formation: where are they coming from and what can they do?</b><br>presented by Gabrielle Scheffer - UofC.  |
| 09:40 – 10:00        | <b>Diagenetic and geochemical controls on H<sub>2</sub>S distribution in the Montney Formation, Peace River Region, Western Canada</b><br>presented by Mastaneh Liseroudi - UofC.                      |
| 10:00 – 10:20        | Q&A - <u>Moderated by Dr. Omid Haeri Ardakani, Ph.D., P.Geo.,</u><br>Research Scientist - NRCan  |
| 10:20 – 10:40        | <b>Organic geochemistry of the Montney Formation. New insights on the source of hydrocarbons, their accumulation history and post accumulation processes</b><br>presented by Jaime Cesar - NRCan, GSCC |
| 10:40 – 11:00        | <b>Tracing the subsurface sulfur cycle using isotopic and elemental fingerprinting: from the micro to the macro scale</b><br>presented by Andrew Kingston - NRCan, GSCC                                |
| 11:00 – 11:30        | Q&A - <u>Moderated by Dr. Omid Haeri Ardakani, Ph.D., P.Geo.,</u><br>Research Scientist - NRCan  |
| <b>11:30 - 12:20</b> | <b>LUNCH BREAK</b>   |

- 12:20 – 12:40      **Controls on the distribution and composition of gas and condensate in the Montney resource play**  
presented by Andy Mort - NRCan, GSCC
- 12:40 – 13:00      **Gas Geochemistry and the Origins of H<sub>2</sub>S in the Montney Formation**  
presented by Pablo Lacerda Silva - MTI Energy and Marc Bustin - UBC.
- 13:00 – 13:20      Q&A - Moderated by Dr. Per Kent Pedersen, Ph.D., P.Geol.  
Associate Professor, Department of Geoscience - UofC
- 13:20 – 13:40      **Identification of regional structural corridors in the Montney play using trend surface analysis combined with geophysical imaging**  
presented by Paulina Wozniakowska - UofC
- 13:40 – 14:00      **Stratigraphy and facies heterogeneities in the Montney Formation of Northeastern British Columbia: relation to H<sub>2</sub>S distribution**  
presented by Samantha Mackie - UofC
- 14:00 – 14:30      Q&A - Moderated by Dr. Per Kent Pedersen, Ph.D., P.Geol.  
Associate Professor, Department of Geoscience - UofC
- 14:30 – 15:00      **Hydrogen sulfide (H<sub>2</sub>S) distribution in the Triassic Montney Formation of the Western Canadian Sedimentary Basin**  
presented by Andrew Kingston - NRCan, GSCC
- 15:00 – 16:00      Open Discussion

# H<sub>2</sub>S in the Montney

## Investigating a Complex Issue

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Wednesday, February 9th, 2022 | 09:00 - 16:00 MT | Virtual Workshop

**A Joint Collaboration between:**



**UNIVERSITY OF CALGARY**



Natural Resources Canada • Geological Survey of Canada  
Ressources naturelles Canada • Commission géologique du Canada



**CSUR**  
Canadian Society for Unconventional Resources

**\*\*Pre-registration mandatory\*\***

**For More Information and Registration , visit [www.csur.com/events](http://www.csur.com/events)**

