

## **Sourcing Dissolved Methane From the Tablelands, Gros Morne National Park, NL, CAN: a Terrestrial Site of Serpentinization**

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The Tablelands massif in Western Newfoundland, Canada is part of a Phanerozoic ophiolite sequence and is a terrestrial site of serpentinization. The Tablelands possess characteristics that are conducive to all three established pathways of methanogenesis: abiogenic, microbial, and thermogenic, or a combination thereof. Sourcing methane (CH<sub>4</sub>) from the Tablelands has thus far been limited because the CH<sub>4</sub> concentrations were below the requirements for stable hydrogen isotope analysis. In this study, we tested dissolved gas extraction methods (vacuum extraction and gas stripping). We found that neither method caused significant isotope fractionation in the stable carbon or hydrogen isotope ratios of the dissolved CH<sub>4</sub>. Using these methods, we measured the stable carbon and hydrogen isotope values of the Tablelands' CH<sub>4</sub> in 2016 and 2017 ( $-27.8 \pm 0.2$  ‰, and  $-173 \pm 2.8$  ‰, respectively). On a carbon-deuterium CH<sub>4</sub> provenience graph, the Tablelands CH<sub>4</sub> plotted in an overlapping section of the thermogenic and abiogenic fields. If the CH<sub>4</sub> originated from the sedimentary organic matter in the underlying unit as thermogenic gas, then it is expected that the gas would be dry and formed under high temperatures (i.e. >150°C). However, the methane clumped isotope analysis yielded an apparent temperature of ca. 80°C, leaving open the possibility of low-temperature (<100 °C) abiogenic methane formation. While the apparent temperature estimate is within the temperature limits of life (up to 122 °C for hyperthermophilic methanogens), previous studies of the springs have discounted the likelihood of microbial origin of CH<sub>4</sub> in the Tablelands. However, oil and gas producing units to the south of the Tablelands are 80°C. The data from this study suggest an abiogenic origin, however other sources of CH<sub>4</sub> from more distal locations should be investigated.