Natural and anthropogenic methane fluxes in a non-exploited shale gas area in Québec, Canada

D.L. PINTI[1*], Y. GÉLINAS[2], A. MORITZ[2,3], M. LAROCQUE[1], Y. SANO[4]

[1]GEOTOP, Université du Québec à Montréal, QC, Canada
(correspondence: pinti.daniele@uqam.ca)
[2]GEOTOP, Concordia University, QC, Canada
[3]Isospark, Dorval, QC, H9P 1K2, Canada
[4]AORI, The University of Tokyo, Kashiwa, Chiba, Japan

The increasing number of studies on the determination of natural methane in groundwater from shale gas areas offers a unique opportunity for refining the quantification of natural and anthropogenic methane emissions on land. Here we report methane fluxes computed from four potential sources in the St. Lawrence Lowlands, Québec (Canada), where the Utica shales are a potential target for the industry. Methane emissions can be caused by 1) groundwater degassing by human abstraction; 2) groundwater discharge along springs or rivers; 3) migration to the surface by microseepage. In areas where shale gas is extracted by hydraulic fracturing, methane emissions can also be related to 4) the degassing of flowback waters during recovery. A methane survey in 130 private and municipal wells tapping groundwater from the regional fractured Ordovivian aquifer showed concentrations from 0.6 to 45.9 x 10^3 μg L^{-1}, with a regional median value of 86 μg L^{-1}. This is the most methanogenic aquifer among those studied for methane emissions in North America (0.76-9 μg L^{-1}; internal bibliographic review), except for the exploited areas of the Marcellus (700 μg L^{-1}) and Bartnett (5996 μg L^{-1}) shales.

Methane fluxes related to groundwater discharge in the St. Lawrence Lowlands (2.5 x 10^{-4} to 9.5 x 10^{-3} Tg yr^{-1}) surpass those of microseepage (4.1 x 10^{-6} to 7.1 x 10^{-5} Tg yr^{-1}) and human abstraction (6.6 x 10^{-6} to 2.5 x 10^{-4} Tg yr^{-1}). Yet, methane emitted by human abstraction in the St. Lawrence Lowlands is up to 300% higher than that emitted by the six major aquifers of the United Kingdom [1] where methane concentrations are ca. 60 times lower.

Exploitation of the Utica shales over a 10- to 20-year horizon would emit from 2.55 x 10-3 to 1.62 x 10-2 Tg yr^{-1}, an estimate that amounts to one third to 45 times the methane flux emitted from groundwater discharge.

[1] Gooddy & Darling (2005) *Sci. Total Environ.* **339**, 117-126.