CO_2 and Hydrocarbon Gases Generated from Opalinus Clay at Elevated Temperatures and Pressure

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Diagenesis leads to the generation of hydrocarbon gases and CO_2 through thermal degradation of complex organic matter (OM), e.g. kerogen. The decarboxylation of low-molecular-weight organic acids (LMWOA) and the dissolution of carbonate minerals might add additional sources for CO_2.

In natural environments where OM, water, and minerals are subjected to elevated temperatures, e.g. during subsidence of sedimentary basins, chemical reactions accelerate. As basin burial takes place on geological timescales, investigating gas generation from sedimentary rocks *in-situ* to determine the amount of gas that had been released under elevated temperature and pressure conditions is difficult. One way to simulate this in the laboratory is by the use of heated high-pressure autoclaves[1] equipped with flexible Au-TiO_2 reaction cells[2].

In the present study, water and ground claystone (1.8:1 w/w) were brought together in such a reaction cell, heated to 80, 120 and 160 °C, respectively, for a duration of 504 to 906 hours. The sample material initially contained 0.6 wt.% organic carbon and 4.1 wt.% inorganic carbon. Fluid samples were taken from the Au-TiO_2 cells in intervals and were subsequently measured to quantify dissolved gases and to obtain their stable carbon isotopic composition ($\delta^{13}C$).

Gases were generated early on and accumulated until near-equilibrium conditions were attained. Between 1 and 4 µmol/kg CH_4 and 8 and 38 mmol/kg CO_2 were formed at 80 °C and 160 °C, respectively. Stable carbon isotope data for OM, carbonates and dissolved CO_2 indicated that with increasing temperature a higher percentage of CO_2 was generated from OM relative to carbonate dissolution. LMWOA may have contributed to measured CO_2 and possibly CH_4 at the higher temperatures. In total, there is a very small generation potential for CH_4 from the Opalinus Clay. In Comparison, CO_2, predominantly sourced from carbonates, contributes three oders of magnitude more to the dissolved gases.

[1] Dickson et al. (1963), *American Journal of Sciences* 261(1), 61-78 [2] Seyfried et al. (1987), *Hydrothermal experimental techniques* 23.