High temperature methane as an unconventional gas source

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Late gas potential evaluation

In this study we consider in detail which source rocks possess a late gas potential in general. Late dry gas generation can be expected for organic matter with $R_0 > 2.0\%$ and for geologic temperatures in excess of 200°C [1, 2]. This may, in addition to the cracking of unexpelled oil, contribute significantly to the accumulation of thermogenic gas in gas shales and coal seams.

Figure 1: Late gas potentials of analysed source rocks, based upon $C_{1\text{-}5}$ and C_{6+} MSSV-pyrolysis yields at 560°C and 700°C (see equation 1 and 2 for the late gas ratios definition).

Equations: Late gas ratios (MSSV-pyrolysis)

(1)

(2)

Discussion of Results

High late gas potentials (LGR1 > 0.55) are mainly seen for terrestrial influenced type III to type II/III shales and coals. The late gas yield cannot be attributed to secondary cracking of C_{6+} compounds alone (LGR2 > 1) but is related to the decomposition of a neoformed recombination residue generated at lower maturation levels [1, 2].

$$LGR1 = \frac{C_{1-5}^{700°C}}{C_{1-5}^{560°C} + C_{1-5}^{700°C}}$$

$$LGR2 = \frac{C_{1-5}^{700°C}}{C_{1-5}^{560°C} + (C_{6+}^{560°C} - C_{6+}^{700°C}) \times 0.7}$$

[1] Erdmann & Horsfield (2006), *Geochim. Cosmochim. Acta* **70**, 3943-3956. [2] Dieckmann *et al.* (2006), *Mar. Pet. Geol.* **23**, 183-199.

Climate impacts on annual-average airborne particle source contributions in California

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California has one of the worst particulate air pollution problems in the United States with some estimates predicting more than 5000 premature deaths each year attributed to air pollution. Climate change will modify weather patterns in California with unknown consequences for airborne particulate matter (PM). Previous down-scaling exercises carried out for the entire United States have typically not resolved the details associated with California's mountain-valley topography and mixture of urban-rural emissions characteristics. Those detailed studies specifically carried out for California have identified strong effects on PM acting in opposite directions making the net prediction for climate effects on PM somewhat uncertain. More research is needed to reduce this uncertainty so that we can truly understand climate impacts on PM and public health.

The objective of this research is to predict climate change effects on annual average concentrations of particulate matter (PM) in California with sufficient resolution to capture the details of California's air basins. Particular emphasis will be placed on trends in source contributions to PM in the presence of climate change. Business-as-usual scenarios generated by the Parallel Climate Model (PCM) will be downscaled to 4km meteorology using the Weather Research Forecast (WRF) model. The CIT/UCD source-oriented photochemical air quality model will be employed to predict PM source contributions throughout the entire state of California. The modeled annual average total and speciated PM concentrations for the future (2047-2049) and the present-day (2004-2006) periods will be compared to determine climate change effects. The results from this study will improve our understanding of global climate change effects on PM source contributions in California.