

# **PS Quantitative Assessment of Shale Gas Potential Based on Its Special Generation and Accumulation Processes\***

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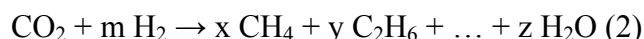
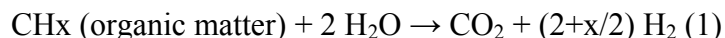
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## **Abstract**

In our recent work a new mechanism of shale gas generation was recognized, that is a Fischer-Tropsch-type synthesis of hydrocarbon from CO<sub>2</sub> and H<sub>2</sub> resulting from the water-reforming of residual organic matter in shale.



This mechanism, which brings about an abnormal carbon isotope distribution of ethane, propane, CO<sub>2</sub> against maturity, are found to be universal in some shale gas basins as well as some conventional gas reservoirs from worldwide overmature source rocks.

This mechanism contributes both generation and accumulation of shale gas. Conventional mechanisms of shale gas accumulation are the unexpelled primary and secondary gas produced from kerogen and oil cracking. Carbon isotope composition indicates that the above new mechanism may account for 50% up to over 80% of gas in shale, especially in the high-producing wells. We developed the kinetics for its hydrocarbon potential under different organic facies and thermal history, in order to evaluate its significances to the original gas in place (OGIP) of shale plays.

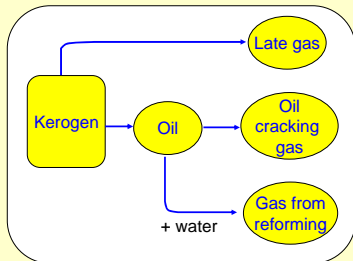
Meanwhile, this mechanism increases the porosity and permeability of both the organic and inorganic part in the shales. We evaluated that porosity and specific surface area of the organic and inorganic matter increase due to water-reforming process and reaction of generated CO<sub>2</sub> with minerals, respectively.

The extent of the above mechanism along with its influence on gas saturation and reservoir property is reflected through the carbon isotope composition of shale gas. We investigated the isotope fractionation kinetics and revealed the quantitative relationship between the gas isotope variation and OGIP as well as productivity.

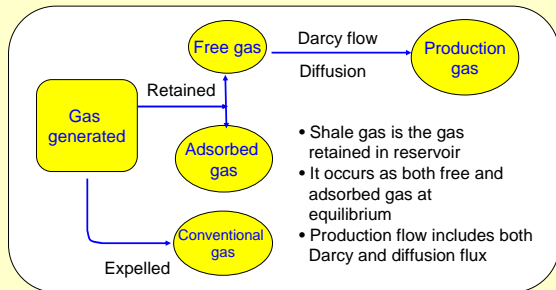
These results not only deepen the understanding the petroleum system of shale gas, but also provide new insight to assess the resource distribution of deep-basin gas and conventional gas from overmature source rocks.

## The special processes

- Special generation processes at high maturity



- Special accumulation processes



Evidences:

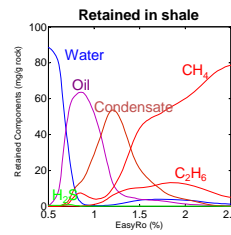
- Carbon/hydrogen Isotope fractionation
- Chemical simulation of model compounds

## Significance to shale oil/gas appraisal

- OGIP, OOIP, condensates and wetness prediction considering
  - Late gas potential
  - Oil expulsion efficiency
  - Water saturation
- Sweet spot screening considering
  - Well-logging response to water saturation, mineral conversion and organic matter maturation
  - Isotope as indicator to productivity

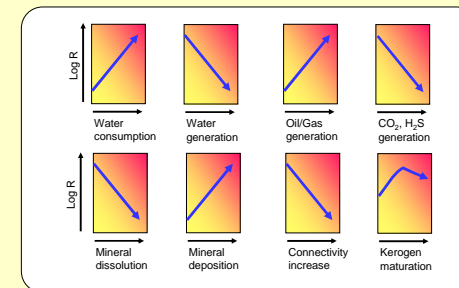
## Shale fluid prediction

- Our model integrates the significant processes, such as kerogen cracking, oil cracking, water-reforming of organic matter, gas adsorption and fluid expulsion
- We derive oil/gas/water retained in shale of different maturity



## Well-logging interpretation

Unlike in conventional gas reservoirs, well-log signals are closely affected to the chemical processes in shale. Based on the variation of fluid and solid in different maturity stage, we provide better interpretation to well-logging data.



## Production Prediction

Residual oil determines the source quantity of shale gas, therefore the productivity is largely related to the contribution of gas from oil, thus it can be predicted by isotope composition.

