GFZ

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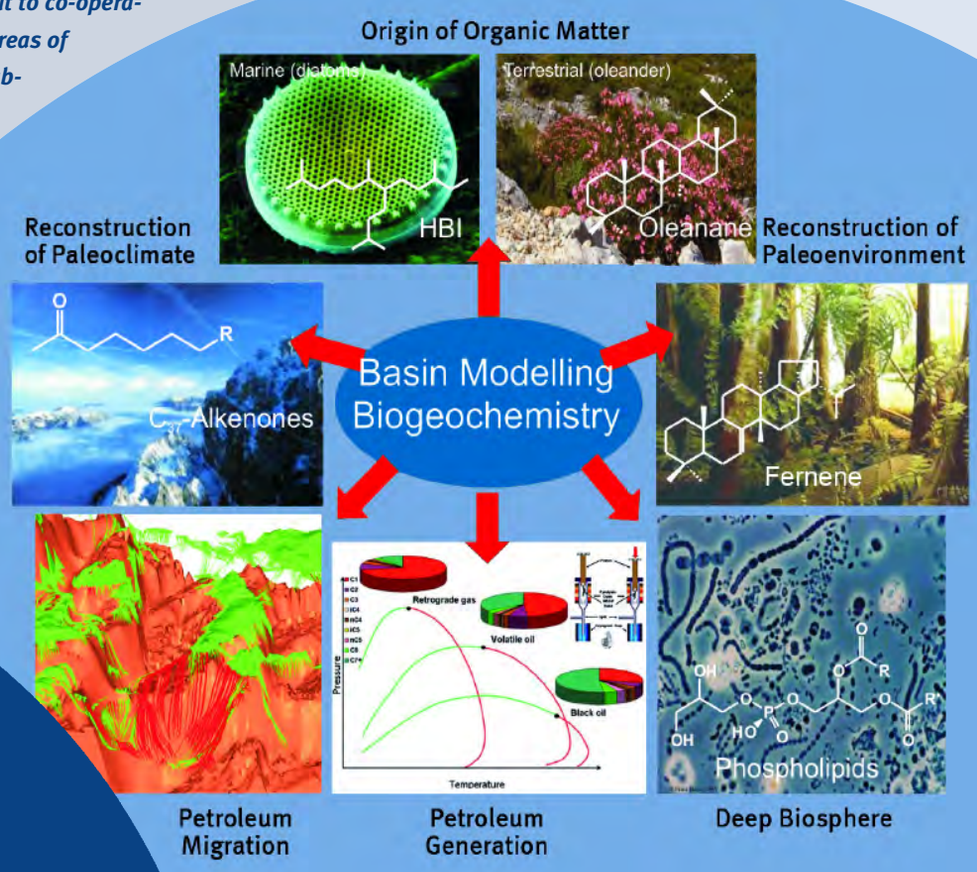
**GFZ GERMAN RESEARCH CENTRE FOR GEOSCIENCES**

# Upstream Petroleum Systems Research
## Industry Partnership Programme (GFZ-IPP)

- *Improving petroleum exploration efficiency and recovery rates are of critical importance in ensuring the future supply of fossil fuels. Additionally, growing environmental concerns and energy saving policies require a focus on clean energy sources.*
- *The Industry Partnership Programme (IPP) at GFZ offers the petroleum industry the possibility to work towards achieving these goals by actively participating in our research programme. The main principle here is not to offer research on demand, but to co-operatively define areas of scientific collaboration. Our IPP projects focus on the processes controlling the generation, distribution and degradation of petroleum and are, hence, of direct relevance for the main goals of petroleum exploration.*
- *Presently, 17 companies are taking part in one or more projects.*
- *Participation in our IPP programme allows the petroleum industry to be actively involved in the forefront of research.*





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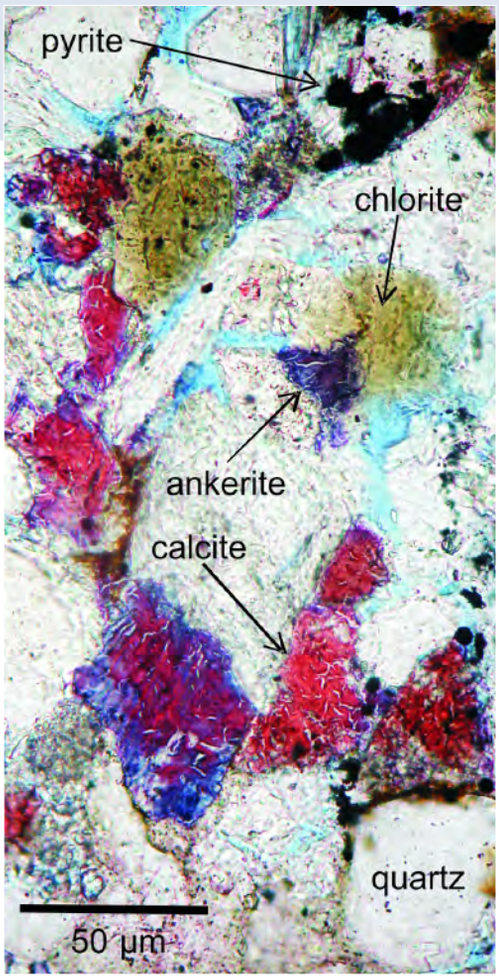


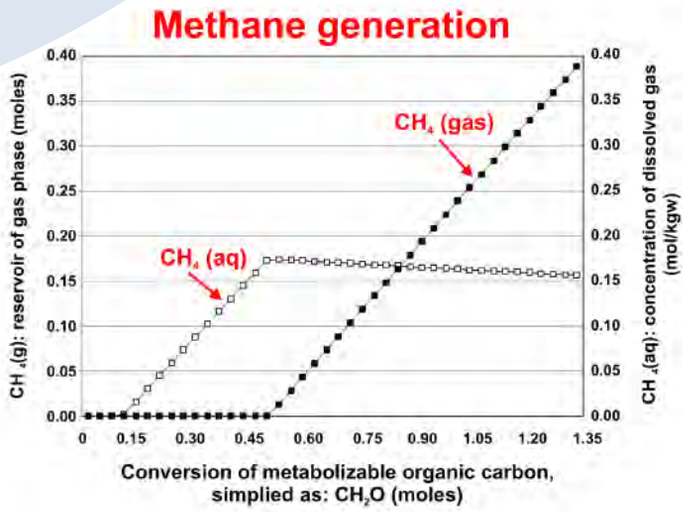


*Input parameters for the hydrogeochemical model are mineralogy and geochemical composition of cements which are due to methanogenic processes. These key signals will be quantitatively retraced to resolve the diagenetic pathways.*
*The outcome is a model of methane generation in dependence on the conversion of metabolizable organic matter CH2O. In this example, early methane generation leads to dissolution (CH4(aq)) until saturation at about 0.18 moles. After saturation methane is progressively exsolved as gas phase (CH4(gas)).*

## Biogenic Methane Potential (BioMeP)

- **Goals**

- to predict biogenic methane potential based on chemical thermodynamics by analysis of diagenetic cement as a quantitative indicator for different marine depositional environments
- to predict interaction between porosity development and reservoir charging by methane
- to compile a catalogue of physicochemical conditions in different marine settings capable for methane generation

- **Approach**

- Hydrogeochemical, predictive models to retrace the conversion of metabolizable organic carbon into diagenetic cements in immature source and reservoir rocks due to methanogenic processes
- Main features include hydrogeochemical reaction- and equilibrium-calculations of cement recipitation/dissolution, and mass balancing of metabolizable organic carbon and inorganic carbon – all based on chemical thermodynamics

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*Current IPP Participants*

## Nitrogen risk in natural gas reservoirs (Ngen)

- **Goals**

The main objective of this proposal aims to assess the nitrogen risk in sedimentary basins by

- evaluation of nitrogen potential of source rocks
- determination of release mechanism
- nitrogen isotope fractionation during migration and accumulation

- **Approach**

- Worldwide database of nitrogen occurrences
- Database of nitrogen ($N_2$, $NH_4^+$) content and isotopic composition of source possible source rocks
- Experimental proof of cation exchange processes between $NH_4^+$ and $K^+$ in minerals and brines
- Nitrogen isotope fractionation processes
- Enhanced models of cation exchange, migration and oxidation processes
- Quantification of nitrogen potential

- **Contact**

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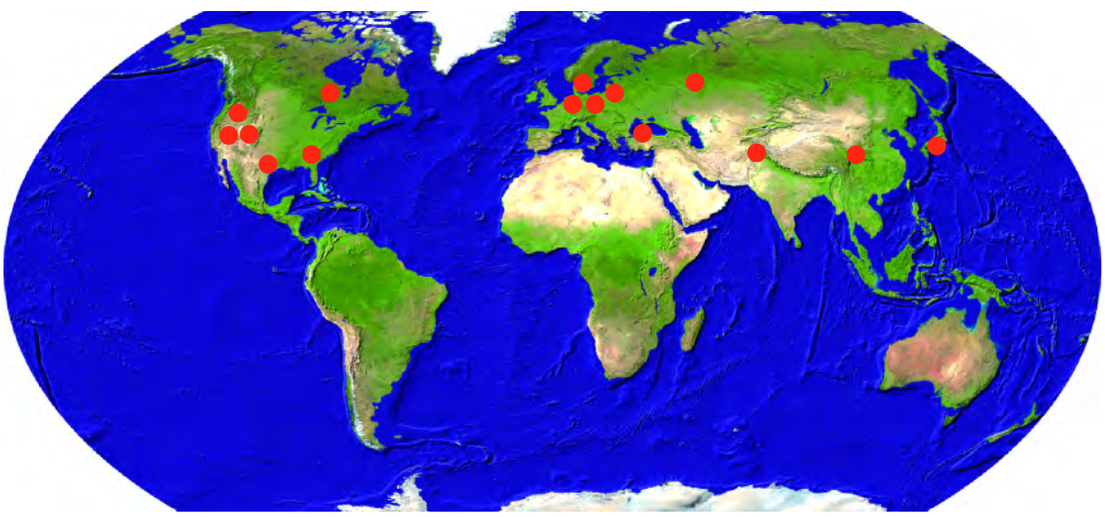
### Nitrogen sources

*Salt, atmospheric nitrogen, radiogenic sources, deep crust, mantle origin, volkanic rocks*

*organic matter*
*$NH_4^+$ fixed in minerals*



*Distribution of nitrogen-rich natural gas accumulations worldwide*

## IPP Projects

Completed:

- Asphaltenes as Geochemical Markers
- Predicting Petroleum Phase and Composition
- Shallow Gas in Time and Space
- Mechanisms and Effects of Petroleum Biodegradation
- Bioactivity in Petroleum Systems (BioPetS) RISK

Running:

- Predicting Petroleum Quality
- Bioactivity in Petroleum Systems (BioPetS) FLUX :
  - Petroleum Asphaltenes in Reservoir Compartments (PARC) *running with*
  - In Reservoir Alteration Dynamics (INRAD)

Open for Participation:

- Biogenic Methane Potential (BioMeP)
- High Temperature Methane (HiTMe)
- Nitrogen in natural gas reservoirs (Ngen)
- Shale gas (GASH)

## High Temperature Methane (HiTMe)

- **Goals**

- to assess timing and amount of dry gas generation at high geologic maturity levels in relation to SR organofacies and organic matter evolution
- to document the kinetic parameters and stable isotope characteristics for gas generation within systems under study

- **Approach**

- Examination of a worldwide series of immature source rocks
- Combined open and closed system pyrolysis to monitor primary and secondary product evolution and to build a kinetic model for primary and secondary gas generation
- Characterisation of the ensuing residues using pyrolysis, isotopic and spectroscopic methods
- Calibration using field example

- **Contact**

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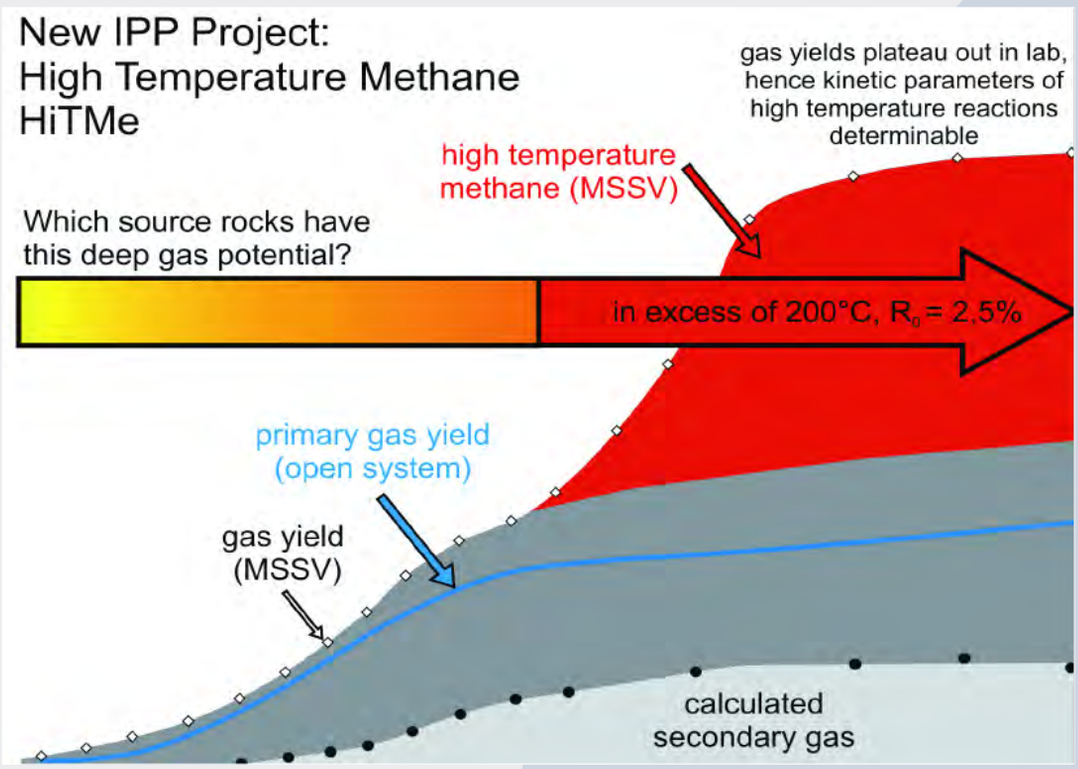
*Duvernay Formation, Posidonia Shale* late gas begins Ro = 1.2%:

Yields dependent on original oil expulsion efficiency (Dieckmann et al., 1998)

*Heather Formation, Taglu Formation* late gas begins at Ro > 2.5%:

Yields *high* in mixed OM facies (Erdmann and Horsfield, 2006, Dieckmann et al., 2006)



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