

## CAVEATS FOR BIOMARKER MATURITY PARAMETER KINETICS AS DEDUCED FROM HYDROUS PYROLYSIS EXPERIMENTS: MINERALOGY RULES

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Early on biomarkers in oils have been used for oil-source rock correlation by comparing their abundances in oils and source rock extracts. Shortly thereafter it was discovered, that the relative abundance of isomers of biomarkers might vary in a systematic way with the thermal maturity of the oil or the source rock. Hence biomarker maturity parameters were defined and employed in maturity assessments.

In one of the early studies of the changes in biomarker maturity parameters in artificial maturation experiments, Lewan et al. (1986) used high temperatures, liquid water and water vapour pressure in high pressure reactors to simulate petroleum generation of the Phosphoria Retort Shale by hydrous pyrolysis. The authors noted that the observed changes in parts corroborated the findings in natural maturity series, in parts exhibited different trends. Despite that, the authors derived kinetic parameters for one reaction of aromatic biomarkers.

Eglinton & Douglas (1988) investigated in a pioneering work the relative contribution of bitumen and kerogen to biomarkers in oil by artificial thermal maturation of four different immature source rocks and kerogens in hydrous pyrolysis experiments. The authors concluded that the importance of kerogen as contributor of biomarkers in oils varies significantly from subordinate to major source. And they mentioned that hydrous pyrolysis does not accurately reflect processes of natural petroleum generation, “but rather produces pyrolyzates that bear some resemblance to crude oils.”

Nevertheless, several authors attempted to improve the calibration of biomarker maturity parameters by artificial maturation of source rocks, kerogens, extracts or oils – even attempting to derive kinetic data for changes in biomarker parameters (e.g. Marzi et al., 1990). But in addition to the caveats mentioned by Eglinton & Douglas (1988), in an investigation of source rock samples of the Phosphatic and the Siliceous members of the Monterey formation Peters et al. (1990) concluded, that apparently rock mineralogy was responsible for different rates of isomerization and differential destruction of biomarker isomers in hydrous pyrolysis experiments.

There were some follow up studies on the influence of mineralogy on the kinetics of petroleum formation in general or the kinetics of biomarker maturity parameters or individual isomerization reactions – but all with a clear focus on the molecular organic geochemical findings.

Here we present findings on changes in biomarker maturity parameters in isothermal hydrous pyrolysis experiments of different source rocks and kerogen types – together with data on the concomitant changes in the mineralogy during the experiment.

There is a significant influence of initial source rock mineralogy on individual isomerization and aromatization reactions of biomarkers. This is mediated by either control of the redox system by mineral buffering of the hydrogen and hydrogen sulphide fugacity in the system or by catalytic activity of exposed mineral surfaces. One finding of significant transformation of clay minerals and quartz into zeolite-type minerals during the hydrous pyrolysis experiment raises an additional caveat of production of new, artificial (?) highly active mineral surfaces during hydrous pyrolysis at the hydrothermal temperatures (250-350°C) not encountered in most natural petroleum systems.

## References

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