COMPARATIVE GEOCHEMICAL AND PYROLYTIC STUDY OF COALS, ASSOCIATED KEROGENS, AND ISOLATED MACERALS

Laura ZIEGER[1], Ralf LITTKE[1] and Christoph HARTKOPF-FRÖDER[2]

[1] *EMR, RWTH Aachen University, Lochnerstr. 4-20, 52056 Aachen, Germany; laura.zieger@emr.rwth-aachen.de*
[2] *Geological Survey North Rhine-Westphalia, De-Greiff-Straße 195, 47803 Krefeld, Germany*

Introduction

Not only type but also content of organic matter take influence on maturity parameters (Goodarzi et al., 1993; Huc et al., 1985; Jasper et al., 2009; Scheidt and Littke, 1989). In the study presented, we compare the chemical and structural constitution of kerogen, concentrated and isolated from sedimentary rocks with that of coals and single macerals (vitrinite, sporinite, and cutinite) from the same depth intervals based on elemental, pyrolytic, and optical analyses. With the analyses of several coal seam intervals within a narrow maturity range (high volatile bituminous stage) we aim to detect differences in chemical and optical properties such as the composition of pyrolysis products and functional groups as well as vitrinite reflectance in order to elucidate if and how the amount of organic matter in a source rock influences maturation/timing of the formation of hydrocarbons.

Samples and methods

For this purpose, 10 Bolsovian (Westphalian C) coal seams with maturities ranging from high volatile bituminous A to C and rocks from the same depth intervals (mostly fine-grained siltstones) with high amounts of organic matter were sampled from a core drilled in the Ruhr Basin (Germany). Kerogen was concentrated from sediments overlying the coal seams by dissolving carbonates and silicates with hydrochloric and fluoric acid, respectively. Vitrinite, megaspores, and cuticles have been isolated from these concentrates to study the effect of the surrounding mineral matrix on these particular macerals upon maturation as compared to the same macerals surrounded by organic matter. Vitrains were hand-picked from the coal seams. Coal powders, sediments and kerogen concentrates were analysed for TOC and sulphur contents and vitrinite reflectance (VR_r) and maceral composition of kerogen and coals were analysed microscopically. The chemical signature of bulk kerogen concentrates, coals and vitrinites was further compared by using Rock-Eval pyrolysis and Curie Point (CP) pyrolysis GC/MS at two different temperatures (590 °C, 764 °C) as well as attenuated total reflectance (ATR) FTIR. Variations in aromaticity and the relative abundance of functional groups of isolated megaspores and cuticles from the kerogen concentrates will be accessed using microscopic FTIR techniques (transmission and reflectance). The same techniques will be applied on megasporinite and cutinite in polished coal blocks.

Results

First results show that coals are dominated by vitrinite with varying amounts of liptinite and inertinite, while maceral composition of the kerogen concentrates from clastic rocks varies strongly between the different seam levels. VR_r values differ in some cases (up to 0.15%; Fig 1) with those of the kerogens being lower in most cases as compared to the coals of same thermal maturity. While T_{max} values are consistently higher for the organic rich sediments compared to the adjacent coals, temperatures of maximum hydrocarbon generation of the concentrated kerogens are in the same range and only differ slightly from those measured for the coals. HI values are in most cases lower and OI values higher for the kerogens compared to the coals sampled in the same depth interval (Fig. 1). Pyrolysates and FTIR spectra of the bulk isolated kerogens show increases in the aromatic fraction with maturity.

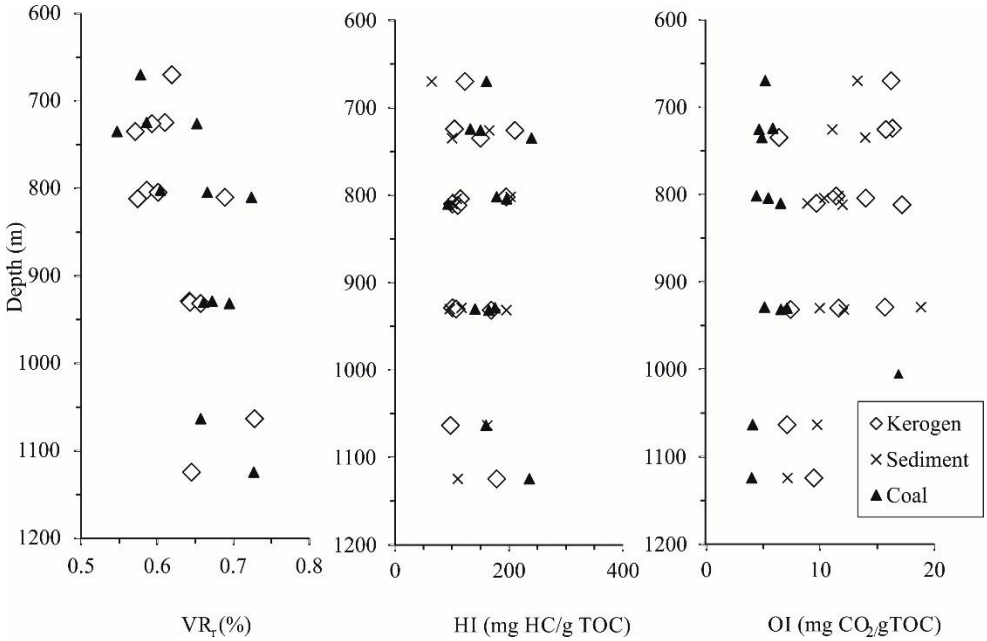

Figure 1. *Vitrinite reflectance, HI and OI of bulk coals, sediments, and concentrated kerogens from different seam levels.*

References

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