# Geochemical and isotope geochemical investigations on Palaeozoic sedimentary rocks

ANKE JURISCH[1], BERNHARD M. KROOSS[1] AND BIRGIT PLESSEN[2]

[1]Institute of Geology and Geochemistry of Petroleum and Coal, RWTH Aachen University, Lochnerstr. 4-20, 52056 Aachen, Germany (jurisch@lek.rwth-aachen.de)
[2]GeoForschungs Zentrum Potsdam, Telegrafenberg, 14473 Potsdam, Germany (birgit@gfz-potsdam.de)

Palaeozoic natural gas reservoirs in the Central European Basin (CEB) regionally contain high percentages of molecular nitrogen ($N_2$). The highest nitrogen contents are found within Rotliegend reservoirs of the North East German Basin (NEGB) where thick, highly mature Palaeozoic sedimentary sequences are present.

The release of molecular nitrogen from coals and sedimentary rocks with low contents of dispersed organic matter was investigated by means of non-isothermal open system pyrolysis, elemental analysis and stable isotope mass spectrometry. The principal goal was to explore the contents, isotopic composition ($\delta^{15}N$) and the speciation of nitrogen in organic and inorganic constituents of these sequences.

Total nitrogen contents of Namurian shales from four deep wells (4400 - 7000 m) in NE Germany ranged from ~500 to ~2700 ppm. Between 50 and 100 % of this nitrogen is inorganic and fixed as ammonium. Although there is a clear facies trend from marine sediments in the lower part to paralic and terrestrial sediments in the upper part of the Carboniferous sequence, the corresponding $\delta^{15}N_{fix}$ values are within a narrow range (+1 to +3.5‰) along the entire profile while the isotopic composition of the thermally liberated nitrogen was consistently lighter (by 3-5‰). Low nitrogen contents (as low as 460 ppm) and high $\delta^{15}N$ values (up to +5.6‰) in one well in the basin centre suggest a significant release of nitrogen (as $NH_3$ and/or $N_2$) associated with $^{15}N$ enrichment in the residual nitrogen.

Open-system non-isothermal pyrolysis has revealed the presence of inorganic nitrogen species with relatively low thermal stability in marine Namurian A shales. Inorganic nitrogen components in the paralic Namurian B facies show a higher thermal stability range while nitrogen in kerogen and coals is fixed in very refractory compounds decomposing in the 700 – 1200°C temperature range. The presence of significant amounts of inorganic nitrogen is also reflected in the high $N/C_{org}$ (atomic) ratios (up to 0.108) of the Palaeozoic shales. Thus the on-line isotope analysis indicates the presence of precursor pools with different thermal stability and nitrogen isotopic composition.

The combination of laboratory data, field data and numerical simulations is expected to further constrain the time, temperature and fluid flow conditions and result in an improved understanding of this complex issue.

# Pit lakes in Kemerovo region, Russia: Geochemical composition and ecological risk

N.V. JURKEVICH AND S.B. BORTNIKOVA

Trofimuk Institute of Petroleum Geology and Geophysics SB RAS

The open pit mining and processing of polymetallic ores in XVIII-XX centuries resulted in rise of pits with high-sulfides wastes in all over the world and Russia particularly. The pit lakes arise after pits flooding with atmospheric and underground water and are characterized by low pH, high metal and $SO_4^{2-}$ concentrations. Unfortunately investigations on pit lakes composition, development and transformation haven't been carried out adequately in our country. The several pit lakes situated in the Salair ore field (Kemerovo region) are examined in this paper.

Results of the field researches in 2005-2006 and following analytical works allowed to ascertain the composition of water and bottom sediments in pit lakes situated in three ore deposits: Aleksandrovskoe, II Mine, III Mine. Slow interaction between water and oxidized ore bodies in the pit walls resulted in formation of acid solutions (pH=3-5) with high mineralization (5-8 g/l) and metals (Fe-up to 350 mg/l, Zn - to 100 mg/l, Cu, Cd and Pb - to 10 mg/l) and metalloids (concentration of arsenic is up to 0.3 mg/l). The concentrations of concerned elements considerably exceed the background and maximum allowable values with the greatest portion of Cu, Zn, Cd species is most toxic free ion.

The geochemical anomalies of various elements (Ti, Mn, V, Cu, Zn, Cd, Pb, As, Sb, Ag, Te) appear in the pit lake bottom sediments which are mainly in very soluble forms and of high mobility.

The data obtained point out not only an ecological risk but also indicate it is possible to extract the ore elements from these objects for the second time. But currently superficial lakes with transparent water and bottom sediments lacking in vegetation are very popular pleasure resorts for Salair's natives. The detailed research of circulation of toxic elements will be conducted in the system «pit wall – bottom sediments – water – biota» which is essential to forecast the subsequent changes in pit lakes and find the methods of improvement of these objects.